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INTRODUCTION

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Sustainable Cities, Cultures & Crafts

Every region of the world has its particular cultural, social and artistic heritage. In urban centres this is at its most pronounced, with the places we live in being the result history – a history of artistic visions, social and cultural forces, planning initiatives, and engineering projects. As UNESCO points out, in thinking about the future of any given place, we are obliged to build on its past and its present. A city and its cultural life then, are living questions – past, present and future.

This means that when discussing the history and future of specific sites we must think broadly. We have to understand the local and the global context in we live: the transnational forces of globalization, the growing importance of culture and tourism, the worldwide trends of heritage and consumerism, the universal concern for sustainability etc. In this regard too, a city, a region or a site are all complex entities – questions of specific responses to global issues. The host city of this event, Barcelona, and by extension the whole region of Catalonia, is a perfect example of this and in addressing the questions and issues typical of the Catalonia region, the conference from which these proceedings come, sought debates relevant to Barcelona but also cities the world over.

Across the Mediterranean issues of sustainable futures are paramount. In Europe more widely, the gentrification of traditional neighborhoods is endemic. In North America and Australasia the respect for Indigenous cultures and crafts is urgently needed. In Africa and Asia, how to sustainably design for growth in existing contexts is a pressing problem. In Latin America and the Middle-East, development that avoids the homogenizing forces of globalization is vital. In these contexts the papers included in this publication will all explore how such interchangeable global issues are key to our pasts, but also to our sustainable futures.

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GOVERNING ACCESS TO SUN AND SHADE: URBAN MICROCLIMATES AS COMMONS IN VIENNA AND BERLIN

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INTRODUCTION

The urgent need to adapt cities to global warming gives new emphasis to the urban thermal landscape. This paper suggests that the consideration of urban microclimates as urban commons may contribute to a more just form of urban climate adaptation. Although urban microclimates are frequently addressed by public initiatives, it remains unclear to which extent they can be considered a common good. If they are, their collective governance is necessary to avoid their demise.[1]

We investigate and compare two case studies of thermal governance in two European cities and enquire about the role microclimatic commoning can have in urban climate adaptation. The structure of our paper is as follows. We begin by discussing two case studies, the first focusing on access to indoor thermal infrastructure in Berlin, and the second on governing sun and shade access in Vienna. We then compare the two cases and draw our conclusions.

The term "thermal governance" has been defined by Roesler, Kobi, and Stieger as "The synergetic operation of thermal regimes, thermal structures and thermal practices." Thermal governance, then, is the governing of thermal conditions, through regimes (norms, standards, zoning), structures (infrastructure, building envelopes, building services) and practices (moving around, clothing, relocation of objects) – in an urban context.[2] In other words, it is the management of thermal conditions such as temperature or wind through means that range from building codes to sunshades and urban climate migration.

In contrast to climate control, which is premised on the idea that the climate can, and should, be controlled privately, thermal governance is conceived as the management of thermal conditions on a collective level, for example, on the level of a district or city, and therefore involves an inherently political dimension.[3] Moreover, while climate control usually describes the control of indoor conditions only, thermal governance applies to both indoor and outdoor conditions.

The agreement on collective goals and coherent ways to reach them are a central aim of governance.[4] Negotiating disparate goals of involved stakeholders is also a core element of design processes.[5] It is therefore of particular interest how collective agreements on thermal governance are currently found, who is involved in the deliberation process and which methods are employed in the construction of urban microclimates.

"Microclimatic commons" is a concept that seeks to define microclimates as "urban commons". Urban commons have been defined by David Harvey as shared, accessible elements that are crucial to the life and livelihood of a group of people and that are shaped and governed, to an extent, by this

group.[6] Following Brigitte Kratzwald, we view the commons not as established against the state, but rather, commoning can mean demanding the governance of cities by citizens. We view the urban commons as co-designed by the municipality and the residents.[7]

The following analysis maps two examples of municipal-led projects in Berlin and Vienna where we document how thermal structures, regimes, and practices are employed in the design of urban microclimates and assess if this process can be understood as a form of commoning. By interviewing relevant stakeholders, we seek to highlight the underlying individual values, the agreed collective goals, as well as the employed design and governance methods. We ask whether the actors involved view and interpret these projects as thermal governance, and to what extent they consist of microclimatic commons. In this paper, we focus on semi-structured interviews conducted with actors and stakeholders in order to answer these questions.

CASE STUDY 1: INDOOR THERMAL INFRASTRUCTURE IN BERLIN

This case study examines the *Netzwerk der Wärme* (NdW), or Network of Warmth, a municipal initiative for public warm spaces in Berlin, as a thermal infrastructure. The Network was launched during the energy crisis in November 2022. During this period, Russia curbed its natural gas supply to Europe. Research conducted since has shown that overall energy costs in Germany surged by 31% in 2022.[8]

This was the context for the foundation of the network, which provided warm public spaces for residents who were struggling to heat their homes. The project was founded by the Berlin senator for work and social affairs from the democratic socialist party *Die Linke*, it was funded by a 1.6-billion-euro Berlin relief package and set up by the NGO *Karuna Family*. As the founding senator mentioned in an interview I conducted with her, "The network of warmth played with the double concept from the beginning: physical warmth and interpersonal warmth."

The network operated fully from November 2022 until the Berlin government was replaced and the new government terminated the project in February 2023. At its peak, it included over 400 facilities such as libraries, community centres, NGO's, museums, churches and mosques, that offered warm spaces open to the public, along with free warm drinks or snacks, and sometimes activities, counselling or cultural programs. The institutions were listed on a website that includes a map and a chatbot that offers assistance with energy saving.

The network comprises a unique experiment in creating a novel thermal infrastructure using existing and newly established facilities to provide wider access to microclimatic conditions. It assumed a demand for heated indoor spaces based on the predicted rise in energy prices. To what extent can we say that the NdW involved city residents in the process of thermal governance? This question will be investigated through a closer look at three facilities in which the network operated.

A. Bucher Bürgerhaus: Selbsthilfe in Buch

Selbsthilfe in Buch is first and foremost a self-help centre. The two main projects opened and funded by the NdW were the "Bibliothek der Dinge" and the "Repair café", both of which are still running today, even after the funding from the Network has stopped. The "thing library" offers an array of appliances on loan. The repair café meets once a week to repair home appliances together. Both projects rely on volunteers and directly involve community members.

The thermal aspect was not viewed as significant by the director of *Selbsthilfe in Buch* and one of the volunteers with whom I spoke. They interpreted the "warmth" in the NdW as interpersonal warmth, solidarity and community-building in the neighbourhood. Volunteers played a large role in designing and carrying out the project, yet it is difficult to describe them as involved in thermal governance per se, since this was not interpreted as central to the operation of NdW in this facility.

B. Ort der Wärme, Humboldt Forum

The “Ort der Wärme” (OdW) was operated by the charitable organisation Johanniter-Unfall-Hilfe. The space in which the OdW operates was offered to Johanniter for free by the Museum shop MUSON and the Humboldt Forum, a Prussian Palace controversially reconstructed for 680m Euro and designated to house several of the city's museums.

The OdW was intended for unhoused people, but also for people who struggle with their energy bills, and those who are lonely. It is designed like a large, high-ceilinged café, and is a welcoming space offering free coffee and snacks. In this facility, the physical warmth plays a significant role, as evident by the number of visitors going up on colder days: between 120-160 on colder days (180 at the peak) and around 100 when the weather is warmer. Many of the visitors I spoke to come here daily. I spoke to several who said they prefer this facility over others because it’s not oriented only towards unhoused people, but open to all, which makes them feel less marginalised.

In this facility, the thermal aspect was significant. This was one of the facilities that catered more directly to unhoused people, who are more exposed to cold temperatures, even if its director highlighted that this is not the only public they strive to serve. In this case, in which heat was most significant, the participants were least involved in the design. They were constructed as vulnerable and to some extent, helpless, or passive.

C. Stadtbibliothek Pankow

Funding from the NdW enabled libraries across Berlin to extend their opening hours on evenings, and on weekends, when they were open without the presence of library staff. The funding was primarily used for security and cleaning services during these extended hours.

During the extended opening hours, the libraries offered cultural activities for different ages like readings and puppet theatre performances, and counselling services, such as counselling refugees in multiple languages on rights of residence, as well as counselling on energy saving. The director of the libraries consortium told me in an interview how these offerings attracted new publics to the library, and how the needs of various communities were determined through the library’s connections in the communities.

Summary

To conclude, The NdW is to some extent, but not fully, a microclimatic commons, mainly because the level of the participation of the residents in the project’s design is very low, since it was set up very rapidly as a crisis measure. Although the project was initiated by the municipality it was interpreted and implemented by the facilities in varying ways, so in this sense, there were some bottom-up initiatives that were incorporated into the top-down structure. Some of the facilities interpreted the “warmth” as thermal and some as only interpersonal. Karuna is currently collaborating with the municipality on a new project which will use a similar network structure to provide cooling centres across the city. This testifies to the potential indoor infrastructure networks can have for tackling the effects of urban climate change.

CASE STUDY 2: GOVERNING SUN AND SHADE ACCESS IN VIENNA

The second case study investigates how sun and shade access is governed by urban design in a development area of the city of Vienna. Solar radiation is one of the most influential parameters of human thermal perception[9] and therefore a decisive component of urban microclimates. The arrangement and form of buildings is the primary element affecting sun and shade distribution in urban areas and also the most effective source of shade in reducing mean radiant and surface

temperature during daytime.[10] Understanding how and if planning processes consider sun and shade distribution is therefore of considerable interest.
Seestadt Aspern is one of the main contemporary urban development sites in the city of Vienna and was described in its design as a return to inner city density ideals. Nevertheless, the urban design follows a distinct contemporary approach, with differentiated building heights and fragmented perimeter blocks that allow for semi-public access. The development has taken place in sequential steps since 2013 and is still underway.
In order to understand to which extent the microclimatic commons of sun and shade access are considered in the planning deliberations, a series of semi-structured interviews with relevant stakeholders are carried out. For the purpose of this paper, the responses of a senior manager of the development agency are analysed in depth. The semi structured interview followed the topics of sun and shade valuation, design governance, and stakeholder identification. This was done in order to understand, first the individual and collective interests, second the employed design methods, and third the accounted stakeholders in the process of urban microclimate governance. The conclusion assesses to which degree this form of governance can be considered a participatory process of commoning.

Valuation of sun and shade as microclimatic elements

In his responses, the interviewed manager of the Aspern Seestadt development agency describes urban heat to be a central topic in the governance of the new district. It has been important both for planners and inhabitants for a few years, however not yet in the initial phases of the planning of the district. Nevertheless, he remarks that in his perception of the public opinion, solar incidence is recently rendered as something merely negative, without taking into consideration that it is welcome and necessary for human wellbeing during “two to three quarters of the year”.
He therefore asserts the necessity of a more strategic provision of shade depending on usage patterns and seasons. Mentioned examples include bus stops, kindergartens, essential path networks as well as summer and winter squares in close proximity to each other. At the same time he is critical towards existing technical norms that still allow for buildings without external solar protection. This is especially true for housing projects, since he asserts that there is “less self-interest” by developers involved compared to office constructions.
Despite this criticality towards a one-sided valuation of solar radiation, he identifies problematic areas of the development as those where no shade can be provided during hot hours due to car traffic requirements, street orientation and proportion. A heavily sealed public square was the source for a particularly strong disagreement between urban design and the public opinion.

Urban Design Governance

Microclimatic considerations have so far influenced the position of building block openings, trees, façade greening and functional programming. The “Physiological Equivalent Temperature” index, is the governing parameter for these decisions. This index also incorporates radiant and surface temperature and therefore sun and shade. Nevertheless, building shade is not an actively governed parameter, whereas ventilation and green infrastructure is.
The development process of the Seestadt is described as an iterative process with multiple feedback loops of expert inputs and learnings from previous steps. For each partial development invited architects design a rule-set that incorporates these inputs and defines the main urban building properties for private developments. On top of this design-framework, private developers have to achieve a number of “Key Performance Indicators” such as a minimum green area ratio.

The interview partner identifies certain problematic aspects in the design of contemporary buildings. The lack of outdoor window shades and loggias with high thermal inertia that re-radiate the daytime heat during nights are rendered as especially problematic. Positive examples include building core activation technology and night time ventilation.

Identified Stakeholders

It was a public outrage caused by the perceived excessive surface sealing of a public square that led to its quick adaptation shortly after the opening. For the re-design a user survey on thermal perception was carried out in addition to the typical microclimatic measurements and simulations. It was, however, admitted that the final adaptation project was not of a truly participatory nature.
The stakeholders who were most prominently mentioned by the planning representative during the interview are the Aspern development agency, its planning expert advisory board, the meteorological consultants, and the general "public opinion". A crucial role is given to the meteorological consultations which are fundamental in the re-shaping of built form and building arrangements based on the "PET" microclimatic indicator. In addition, there is also a survey of inhabitant's satisfaction carried out by the University of Vienna every three years. University research projects are in general a frequently mentioned influence for the evaluation process of the development.

Summary

To conclude, the construction of microclimates is a relevant factor in the design of new urban form in the Seestadt Aspern. The microclimatic goals and valuations are largely defined by meteorological consultants for the urban outdoors but are still missing a generally accepted consensus. The difficulty to define collective goals was expressed especially regarding the seasonal differences and the different desirability of solar radiation.
The inadequate integration of microclimatic concerns became visible in the public outcry over a newly designed square accredited by the interviewee as too little "green on the eye level". Although some urban microclimate criteria, such as a "minimum green area ratio", have now been implemented in the quality evaluation, sun and shade access are not actively steered.
Overall, the interviewed planning representative expresses a slight distrust in the opinions of the public, that he perceives as overemphasising certain climatic issues (surface sealing, solar radiation) while disregarding others (stormwater, winter sun). Although there is a genuine care for the microclimatic environment, a truly participatory practice of commoning cannot be observed.

CASE STUDY COMPARISON

The case study in Berlin examined the governance of active thermal conditions and in Vienna the case study focused on the governance of passive thermal conditions. Despite this significant difference, there are many similarities between the two. In terms of **Practices**, we saw low levels of resident participation: In both cases residents are not involved in the design of the project. The municipalities tried to take into account the needs of the inhabitants, yet with little participatory elements. In terms of **Structures**, in both cases established institutions and frameworks (libraries / urban development) received a new thermal function, thereby becoming thermal infrastructure. In terms of **Regimes**, although some clear aims were provided by the project designers and managers, the precise execution showed different priorities in each location. The diversity of outcomes contributed to an incremental learning process, resulting in new aims and methods of thermal governance.

CONCLUSION

In this paper, we showed that the concept of urban commons can play an important role in thermal governance and urban climate adaptation. This was done by examining, comparing and assessing two municipal thermal projects. We found that in these projects' microclimates were constructed as commons only to a partial extent, because of the low participation of citizens in both project's design. In Vienna, a demand of citizens for better thermal governance became visible in public outcries on urban design qualities and is mirrored by high sensitivity for the perceived "public opinion" by planning actors. In Berlin, there was no similar public outcry because the examined project was viewed as an emergency measure, but citizens were not empowered by the design of the project and were conceived in most of the facilities as beneficiaries rather than active participants. The concepts of thermal governance and thermal infrastructure, which include political and social dimensions, allowed us to go beyond the concept of climate control and theorise microclimatic governance on a collective level. By using these concepts, our research concluded that the complex nature of urban microclimates requires a continuous deliberation of collective goals, for which processes of commoning are a potential procedure.

NOTES

[1] Sheila R Foster and Christian Iaione, “The City as a Commons,” *Yale Law & Policy Review*, no. 281 (2016): 69, https://dx.doi.org/10.2139/ssrn.2653084.
[2] Sascha Roesler, Madlen Kobi, and Lorenzo Stieger, eds., *Coping with Urban Climates: Comparative Perspectives on Architecture and Thermal Governance* (De Gruyter, 2022), 147, https://doi.org/10.1515/9783035624243.
[3] See Sascha Roesler, *City, Climate, and Architecture: A Theory of Collective Practice*, KLIMA POLIS, vol. 1 (Basel: Birkhäuser, 2022).
[4] Jon Pierre and B. Guy Peters, *Governing Complex Societies* (London: Palgrave Macmillan UK, 2005), https://doi.org/10.1057/9780230512641.
[5] Jesko Fezer, “Horst Rittels vernünftige Argumente für eine Politik des Designs,” in *Umstrittene Methoden: Architekturdiskurse der Verwissenschaftlichung, Politisierung und Partizipation im Umfeld des Design Methods Movement der 1960er Jahre*, 1. Auflage (Hamburg: Adocs Produktion und Verlag, 2022), 113–42.
[6] David Harvey. *Rebel Cities: From the Right to the City to the Urban Revolution*. Paperback ed. London: Verso, 2013.
[7] Brigitte Kratzwald. "Urban Commons – Dissident Practices in Emancipatory Spaces". *Urban Commons: Moving Beyond State and Market*, Berlin, München, Boston: Birkhäuser, 2022.
[8] Best, Aaron, Flora Dicke and Nora Kögel. “Who took the burden of the energy crisis? Country report: Germany”. Berlin: Ecologic Institute, 2023.
[9] Or Aleksandrowicz and David Pearlmutter, “The Significance of Shade Provision in Reducing Street-Level Summer Heat Stress in a Hot Mediterranean Climate,” *Landscape and Urban Planning* 229 (January 2023): 104588, https://doi.org/10.1016/j.landurbplan.2022.104588.
[10] Ariane Middel et al., “50 Grades of Shade,” *Bulletin of the American Meteorological Society* 102, no. 9 (September 2021): E1805–20, https://doi.org/10.1175/BAMS-D-20-0193.1.

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BREAKING WITH THE PAST TO DELIVER A DECARBONIZED FUTURE: THE ROLE OF URBAN BUILDING PERFORMANCE STANDARDS

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INTRODUCTION

Cities are increasingly developing building emission performance standards (BEPS) to reduce urban greenhouse gas emissions.[1] These mandatory urban policies regulating operational building emissions have the potential to be more effective than voluntary programs – due to low uptake – and building codes that do not apply to existing buildings.[2] Some view BEPS as transformative policies capable of breaking past cycles of fossil fuel dependence to deliver the decarbonized built environments of the future.[3] Despite the high cost of BEPS implementation and cities' limited resources,[4] the transformative capacity of BEPS has yet to be assessed.

This study takes a socio-technical approach to building sector decarbonization. This means we understand the building sector as a system whose negative impacts on climate cannot be resolved through incremental improvements.[5] System-wide transformations are needed to unravel the dynamics that reinforce the ongoing use of fossil fuel.[6] These dynamics are often called carbon lock-ins.[7] Carbon lock-ins associated with long-lived infrastructures, like buildings, have a greater impact on global emissions over time. Yet, the literature on carbon lock-ins has focused mainly on the energy sector at global and national scales.[8] By investigating how urban BEPS address building sector carbon lock-ins, this paper aims to answer the question: To what extent do urban BEPS help overcome (or reinforce) buildings' dependence on fossil fuels?

BUILDING SECTOR CARBON LOCK-INS

To answer this question, we first identify which carbon lock-ins stand in the way of building sector decarbonization. Carbon lock-ins may be material, institutional, behavioral, or discursive. Material carbon lock-ins reinforce fossil fuel infrastructure and technology use through economic mechanisms such as economies of scale or increasing returns on investment.[9] Institutional lock-ins reinforce fossil fuel use through rules, learning patterns, information flows, and power structures that are difficult to change once established.[10] Behavioral carbon lock-ins refer to individual habits or social norms that reinforce fossil fuel use.[11] Discursive lock-ins occur when unchallenged assumptions or narrative manipulation reinforce the status quo.[12] While discursive lock-ins merit attention, they tend to be context specific and are best analyzed through in-depth case studies. Thus, discursive lock-ins fall beyond the scope of this study. Table 1 provides an overview of carbon lock-ins, their underlying mechanisms, and how they manifest themselves in the building sector.

Carbon lock-in mechanisms	Carbon lock-in mechanism descriptions	Building sector carbon lock-ins
Material		
Economies of scale	Existing infrastructure investments seem more attractive because unit costs decrease as output increases	**Existing infrastructure** decreases the cost of fossil fuels and makes investments in existing infrastructure seem less costly
Technological interrelatedness	Favors the development of compatible or complementary technologies and infrastructures	**Biofuels as drop-in fuels** benefit from existing fossil fuel infrastructure.
Technological learning effects	Knowledge about incumbent technologies leads to quality improvements, incremental innovations, and cost reductions	**Fossil fuel system knowledge** results in increased efficiencies, greater reliability, and lower maintenance costs. Limited familiarity with alternatives limits their adoption
Return on investment	Long-lived physical assets are difficult and costly to change	**High upfront costs**, limited financing, and tenant disruption minimization reduce the perceived feasibility of deep retrofits
		Buildings suffering from **historical underinvestment** face greater difficulties accessing low-cost financing
		Municipal investment in fossil fuels is in tension with decarbonization objectives
		Municipal biofuel production can support the promotion of biofuel use
Institutional		
Collective action	Without collective action, institutions are hard to change	**Individualization of climate risks and responsibilities** limits communitywide solutions
High density of institutions	Interacting institutions whose rules incentivize the same behavior limit institutional change	**Economic importance** of fossil fuels can lead to less ambitious decarbonization targets and investments in low emission alternatives
		Retrofits may **trigger other regulatory requirements** increasing the overall cost
		Net metering and **zoning rules** can limit investment in on-site energy generation
		Utility incentive programs can encourage incremental savings and continued fuel use
Institutional learning effects	Enhanced coordination and complementarity of formal and informal institutions enhances their efficiency and increases interdependencies	Municipal **climate policy learning and leadership** increases policy certainty
		Municipal regulatory authority may be **preempted** by higher levels of government
		Industry fragmentation supports suboptimal retrofits
Power asymmetries	Agents with power can impose rules on others that enhance their power or protect vested interests	**Data** privacy and aggregation costs limit the ability of utilities to share building-level data
Behavioral		

Habituation	Unconscious behaviors that favor existing choices or practices	**Wasteful uses** of energy and space
Risk avoidance	Unclear outcomes of behavioral change limit new practices	**Lack of control over grid emission intensity** and **tenant behaviors** favors biofuels
Cognitive costs of switching	Adopting new practices requires an investment in acquiring new skills	**Fear of underperformance** supports the improvement of exiting fuel systems
Informational increasing returns	Consumer awareness supports adoption	**Acceptance of biofuels** supports fuel use
Social structure	Social practices produce and reproduce social structures and practices	**Social status** is associated with large spaces and multiple amenities
		Convenience lifestyles rely on energy intensive appliances

Table 1. Carbon lock-in mechanisms and building sector manifestations.

While useful, this classification overlooks interactions between carbon lock-ins. Simoens, Leipold, et al. argue that mapping interacting carbon lock-in clusters reveals the complex dynamics of resistance and helps identify opportunities for change. We propose that the analysis of how policies address carbon lock-in clusters acts as an assessment of their transformative decarbonization capacity. This type of assessment highlights how transformative policies avoid mutually reinforcing "carbon fractal traps" and "spark cascading transformation towards decarbonization".[13] Our documentary review revealed five building sector carbon lock-in clusters centered around the following themes: limited municipal authority and capacity, suboptimal retrofits, fuel dependence, emission displacement, and individualization. Figure 1 maps these clusters and their interactions. These clusters are described in the section on BEPS impacts on carbon lock-in clusters.

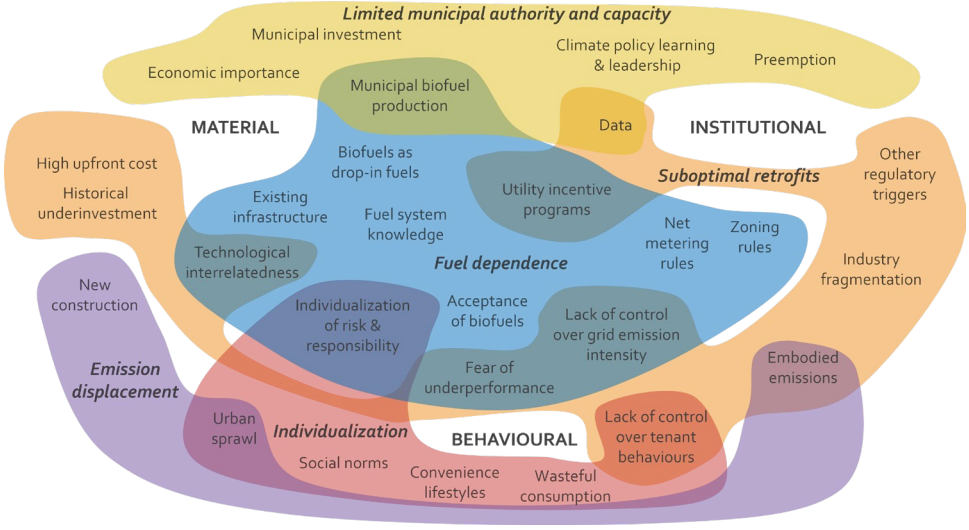

Figure 1. Building sector carbon lock-in clusters and interactions

METHODS: DOCUMENTARY ANALYSIS AND EXPERT INTERVIEWS

This study is based on the review of policy documents, industry reports, and academic literature on urban BEPS. Documentary review served three main purposes. First, a theoretical review of the literature on building decarbonization helped identify the sector-specific carbon lock-ins and their

interactions. Second, a review of academic and grey literature helped identify cases of whole-building urban BEPS. Urban standards focused on specific building elements (lighting upgrades energy audits, retrofit, tune-ups, and recommissioning) or using energy as their main metric were excluded. Five cities adopted BEPS that met these criteria prior to January 1st, 2024: Boston (BOS), New York City (NYC), Seattle (SEA), Tokyo (TOK), and Vancouver (VAN). Key case-specific documents were analyzed to understand the carbon lock-ins at play and how BEPS respond to them. Documents were coded using QDAMiner® software. Deductive coding was based on the material, institutional, and behavioral carbon lock-ins initially identified. Results were triangulated with data from 3 semi-structured interviews with BEPS experts in Canada, the US, and Japan and validated through internal reviews. Table 2 provides an overview of the documents reviewed.

Actor type	**General**	**BOS**	**NYC**	**SEA**	**TOK**	**VAN**
Government	1 (39)	2 (82)	3 (78)	4 (107)	3 (100)	3 (91)
Industry associations	2 (125)	4 (144)	0 (0)	0 (0)	0 (0)	0 (0)
Nongovernmental orgs	11 (534)	0 (0)	1 (169)	1 (39)	2 (16)	2 (8)
Academic	5 (61)	2 (100)	2 (85)	1 (19)	4 (66)	1 (16)
Total	**18 (762)**	**10 (326)**	**5 (332)**	**6 (165)**	**9 (182)**	**6 (115)**

Table 2. Number of documents (pages) analyzed by actor type and case.

Tables 3 and 4 summarize the characteristics of the BEPS selected for this study.

Case	**BEPS enacted**	**City/regional benchmarking enacted**	**Performance targets enacted**	**Building types covered**	**Min. building size covered (SF)**	**Metric**
Boston	2021	2013/2023	2026	C, MF	20,000	CO_2eq/sf
New York City	2019	2010/-	2024	C, MF	25,000	CO_2eq/sf
Seattle	2023	2015/2026	2031	C, MF	20,000	CO_2eq/sf
Tokyo	2010	2002/-	2015	C, I	1,500kL oil eq.	Total CO_2eq emissions
Vancouver	2022	2024/-	2026	C, MF	100,000	CO_2eq/sf & heat energy/sf

Building types: C, Commercial; I, Industrial; MF, Multifamily residential

Table 3. BEPS characteristics

Case	**Emissions trading**	**Exemptions**	**PPAs**	**RECs**	**Fees and fines**
Boston	N	Vacant buildings	Y	Y	$234/MT CO2e > limit

		Municipal buildings			$300-1000/day over limit $150-300/day not reporting $1000-5000 for inaccuracy
New York City	N	Electric generation facilities Municipal buildings NYC housing authority and rent controlled housing Places of worship	N	Y max 10%	$268/MT CO2e > limit $0.5/sf not reporting $500 000 OR prison for inaccuracy
Seattle	N	Buildings occupied < 3 years High vacancy, low income, low-rent housing	N	N	Greater of $1250-2500 OR $190/MT CO2e > limit/year $2,50-10/sf for residential $7500-15000 for inaccuracy
Tokyo	Y	N/A	Y	Y	Based on credit price
Vancouver	N	Demolition permit	Y	Y	$500 +$350/MT CO2e > limit

PPA – Power Purchase Agreements; REC – Renewable Energy Certificates

Table 4. BEPS compliance paths, fees, and fines.

BEPS IMPACTS ON CARBON LOCK-IN CLUSTERS

The following sections analyze how the five urban BEPS address each of the carbon lock-in clusters. Table 5-9 summarize the impacts of the BEPS on each lock-in cluster.

Limited municipal authority and capacity

The municipal authority and capacity lock-in cluster challenges urban regulation of building emissions in five main ways. First, the importance of the fossil fuel industry for local jobs can make decarbonization policies unpopular. The fossil fuel industry is not a major contributor to the local economy in any of the cities under study. Second, reliance on fossil fuel investments to fund municipal activities contradicts urban decarbonization objectives. This tension, made more apparent by BEPS, has resulted in fossil fuel divestment in all five cities, gradually dismantling this material lock-in. Third, uncertainty with respect to jurisdictional powers can result in higher levels of government preempting municipal rights to regulate building emissions. Reframing emissions as carbon pollution has allowed municipalities to regulate building emissions based on their responsibility for urban environments and citizen wellbeing. This new understanding of municipal authority also justifies investing in municipal climate policy development and enforcement capacity challenging the fourth lock-in mechanism. Finally, data privacy laws and data aggregation costs limit the ability of utilities to share data with building owners and municipal authorities. The lack of reliable data delays target setting and building owner action. BEPS have motivated many municipalities to establish closer relationships with utilities to simplify the data collection process or have found ways to work limited or low-quality data. Overall, the limited municipal authority and capacity cluster is less present in Tokyo which has greater authority over climate policy than North American cities. Tokyo provides a glimpse into how this lock-in might be dismantled by providing municipalities with the regulatory authority needed to invest in climate policy capacities and relationships to ensure higher quality data collection.

Limited municipal authority and capacity	BOS	NYC	SEA	TOK	VAN
Economic importance of fossil fuels	-	-	-	-	-
Municipal fossil fuel investments	C	C	C	C	C
Policy preemption	C	C	C	-	C
Limited climate policy leadership and learning	C	C	C	-	C
Data privacy and aggregation (SR)	C	C	C	-	C

For Tables 5-9: N, negligeable impact; R, reinforces; C, challenges; R/C, reinforces and challenges; -, lock-in not present. Abbreviations in parentheses indicate interactions with other lock-in clusters.

Table 5. BEPS impacts on the limited municipal authority and capacity carbon lock-in cluster.

Suboptimal retrofits

Suboptimal retrofits lock-in future building emissions by reducing the maximum emissions reductions that can be achieved. While BEPS fees/fines make retrofits more financially attractive than inaction, they do not explicitly prevent suboptimal retrofits. Thus, building owners are incentivized to choose the lowest cost measure that meet interim targets, regardless of whether these measures make compliance with future targets physically or financially unfeasible. Many respondents indicated that the administrative cost of demonstrating compliance reduces the funds available and therefore the scope of retrofits. The desire to avoid triggering additional fire and life safety requirements also favors small scale, punctual interventions. In Seattle, recent investment in major upgrades can justify BEPS exemption. In Tokyo, however, mandatory seismic upgrades are viewed as opportune moments to undertake deep emission reducing retrofits.

Cost concerns are exacerbated with respect to buildings suffering from historical underinvestment. BEPS compliance is an additional burden for these buildings. Managers of underinvested buildings have a harder time accessing financing and pay higher rates, in part because of their lack of retrofit experience. Moreover, meeting targets based on average building performance means that underinvested buildings must do more to comply than buildings that have been upgraded over time. Most BEPS exempt buildings under financial distress, further perpetuating the problem. Boston and Seattle address this issue by using alternate compliance payments to support emission reduction projects in underfunded buildings. Tokyo's BEPS has a negligeable impact on underinvested buildings because it requires percentage improvements based on each building's past performance.

BEPS have limited impact on industry fragmentation, utility incentive programs that incentivize fuel use, and fears about decarbonized building system performance.

Perceived lack of control can also result in suboptimal retrofits. The lack of control over tenant behaviors incentivizes the use of low-emission power purchase agreements or biofuels rather than on building envelope or mechanical system improvements or energy conservation measures. Tokyo's BEPS challenges split incentives by requiring that tenants help building managers meet their emission reduction targets. In all other BEPS, tenants are only required to provide the data needed to demonstrate compliance. Embedding in BEPS requirements that hold tenants accountable for building performance is a missed opportunity to address split incentives and encourage energy conservation.

Decarbonization implies switching to low-emission electricity or biofuels. Where the grid is not already low-emissions, grid decarbonization adds uncertainty with respect to grid emission intensity

and thus BEPS compliance. To reduce compliance uncertainty, NYC set fixed electricity emission intensities based on grid decarbonization projections. However, nuclear plant decommissioning resulted in electricity emission intensities that rise before they fall in response to new renewable energy generation and procurement. While these values accurately reflect projected emissions, they delay electrification locking-in future emissions. Boston responded differently. Because the Massachusetts' grid decarbonization plan does not allow Boston to meet its municipal targets, Boston plans to procure sufficient renewable electricity to meet all urban demands by 2030. The Boston Community Choice Electricity program ensures that building owners will be able to comply with BEPS by purchasing low- or zero-emission electricity. Contrary to NYC, grid emission uncertainty in Boston will drive rapid electrification.

Suboptimal retrofits (SR)	**BOS**	**NYC**	**SEA**	**TOK**	**VAN**
High upfront cost	R	R	R	R	R
Other regulatory triggers	R	R	R	R/C	R
Historical underinvestment	R/C	R	R/C	N	R
Utility incentive programs (FD)	N	N	N	N	N
Industry fragmentation	N	N	N	N	N
Lack of control over grid emission intensity (FD)	C	R	-	N	-
Lack of control over tenant behaviours (FD, I)	N	N	N	C	N
Fear of underperformance (FD)	N	N	N	N	N

Table 6. BEPS impacts on the suboptimal retrofits carbon lock-in cluster.

Fuel dependence

Fuel dependence locks-in emissions through economies of scale and knowledge associated with existing fuel systems and infrastructures. Biofuels (i.e. renewable natural gas, hydrogen), which use fuel infrastructures and serve fuel systems, also benefit from these lock-in mechanisms. Moreover, since biofuels are a small percentage of the fuel mix, biofuel use implies the continued use of fossil fuels. Thus, the fuel dependence lock-in includes increased dependence on biofuels.

BEPS have a negligeable impact on the economics of fuel infrastructures and systems. Together, fuel system knowledge, the lack of knowledge about low emission alternatives, and municipal biofuel generation contribute to consumer acceptance of biofuels. BEPS largely reinforce these mechanisms by allowing biofuels as an acceptable solution. Boston and Seattle provide marginal exceptions. Boston encourages electrification through its clean energy procurement program. In Seattle, electrification is incentivized through prescriptive compliance options whereby 100% electric buildings and residential buildings that replace fuel heating with electric heat pumps are deemed to comply. These prescriptive measures are powerful because they reduce the administrative burden and

data challenges faced by building managers and municipal staff while explicitly driving decarbonization.
Zoning and net metering rules are cited as barriers to on-site electricity generation and storage. While BEPS do not directly address these issues, they can help highlight these policy contradictions. Finally, the individualization of risk and responsibility encourages building owners to prioritize individual building resilience over community resilience measures. This favors the installation of fuel or hybrid systems that are perceived as capable of providing heating/cooling during electric power outages. Unfortunately, these systems nearly always need electricity to run.

Fuel dependence (FD)	**BOS**	**NYC**	**SEA**	**TOK**	**VAN**
Existing fuel infrastructure	N	N	N	N	N
Biofuels as drop-in fuels	R	R	R	R	R
Fossil fuel system knowledge	N	N	N	N	N
Limited familiarity with low-emission systems	N	N	N	N	N
Municipal biofuel generation (MAC)	R	R	R	R	R
Consumer acceptance of biofuels	R/C	R	R/C	R	R
Net metering rules	N	N	N	N	N
Zoning rules	N	N	N	N	N
Individualization of risk and responsibility (I)	R	R	R	R	R

Table 7. BEPS impacts on the fuel dependence carbon lock-in cluster.

Emission displacement

Emission displacement is the consequence of the narrow focus on urban building emissions. Emission accounting rules incentivize transferring emissions beyond city limits or to other streams (industry, waste, transportation). Focused on operational emissions, urban building emission accounting does not consider embodied emissions associated with new construction or retrofits. Some documents indicated that poorly set BEPS targets could encourage demolition and new construction over retrofits, resulting in must higher industrial and waste emissions. Some documents raised concerns that BEPS costs might incentivize urban sprawl and increase transportation emissions. Industry experts, however, did not feel that the impact of BEPS on urban sprawl was significant.

Emissions displacement (ED)	**BOS**	**NYC**	**SEA**	**TOK**	**VAN**
New construction	N	N	N	N	N
Embodied emissions (SR)	R	R	R	R	R

Urban sprawl (I)	N	N	N	N	N

Table 8. BEPS impacts on the emission displacement carbon lock-in cluster.

Individualization

Individualization locks-in emissions by reinforcing individual practices that are more emission-intensive than collective alternatives. Most BEPS make individual buildings responsible for meeting emission targets and only apply to a few building types. This limits collective action and community scale solutions, including thermal energy networks. Seattle allows portfolio compliance and Boston is considering similar provisions. But portfolio compliance favors large building owners and can result in high-end buildings being retrofitted to superior standards while others continue to underperform . These equity issues resulted in NYC abandoning portfolio compliance and emissions trading. Because Tokyo's BEPS does not apply to residential buildings, environmental justice issues were not often raised. However, NYC's experience suggests that Tokyo's BEPS could mean that citizens living in industrial areas may not benefit from the air quality improvements if retrofits concentrated in commercial buildings allow industrial buildings to maintain the status quo.

The three US BEPS reinforce wasteful uses of energy and space through the carbon intensity metric. Per unit area emission targets can be met by using more space for a given function. Total emission reductions, as required in Tokyo, are more difficult to manipulate in this way. Vancouver's heat energy intensity limit helps limit the wasteful use of energy. However, the ability to set such limits hinges on municipal authority. Even in Vancouver, which is somewhat shielded from preemption, carbon and energy limits do not apply to electricity. Finally, BEPS have little impact on social norms and lifestyle choices.

Individualization (I)	**BOS**	**NYC**	**SEA**	**TOK**	**VAN**
Individualization of risk and responsibility (FD)	R	R	R	R	R
Wasteful use of energy and space	R	R	R	N	C
Social norms	N	N	N	N	N
Convenience lifestyles	N	N	N	N	N

Table 9. BEPS impacts on the individualization carbon lock-in cluster.

TRANSFORMATIVE AND EQUITABLE BUILDING DECARBONIZATION

This paper argues that the analysis of how policies address carbon lock-in clusters can be used to assess their potential to deliver decarbonization. This complements ex-post policy assessment approaches by anticipating how new policies might reinforce the status quo, encourage incremental improvements, drive decarbonization, or create new carbon lock-ins. We identified five building sector carbon lock-in clusters focused on the following themes: limited municipal authority and capacity, suboptimal retrofits, fuel dependence, emission displacement, and individualization.

Our analysis of five urban BEPS shows that BEPS reinforce suboptimal retrofits, fuel dependence, emission displacement, and individualization. However, we also see opportunities for urban BEPS to drive decarbonization and challenge split incentives. While the BEPS studied emerged in cities with

significant regulatory authority, their reframing of greenhouse gas emissions as urban pollution is enhancing municipal authority and capacity in other cities. As found by Tozer (2020), reframing greenhouse gas emissions as urban pollution broadens the discussion to include environmental justice issues. These debates, in turn, justify the development of prescriptive compliance options and support programs that ensure that buildings move away from fuels. As optional compliance paths, these measures have faced less direct opposition but have the potential to deliver significant emission reductions. Such positive outcomes would support ongoing municipal authority and capacity investments. Our analysis also highlights the environmental justice implications of BEPS emissions trading, portfolio compliance, alternative compliance payments, and exemptions that do not feed into this virtuous cycle. While alternative compliance paths help increase policy acceptance for BEPS, they also increase policy complexity, administrative burdens, and compliance uncertainty. These paths tend to favor large commercial building owners but provide little relief for residential building owners, particularly in environmental justice communities. Figure 1 illustrates the decarbonization lock-in mechanism described.

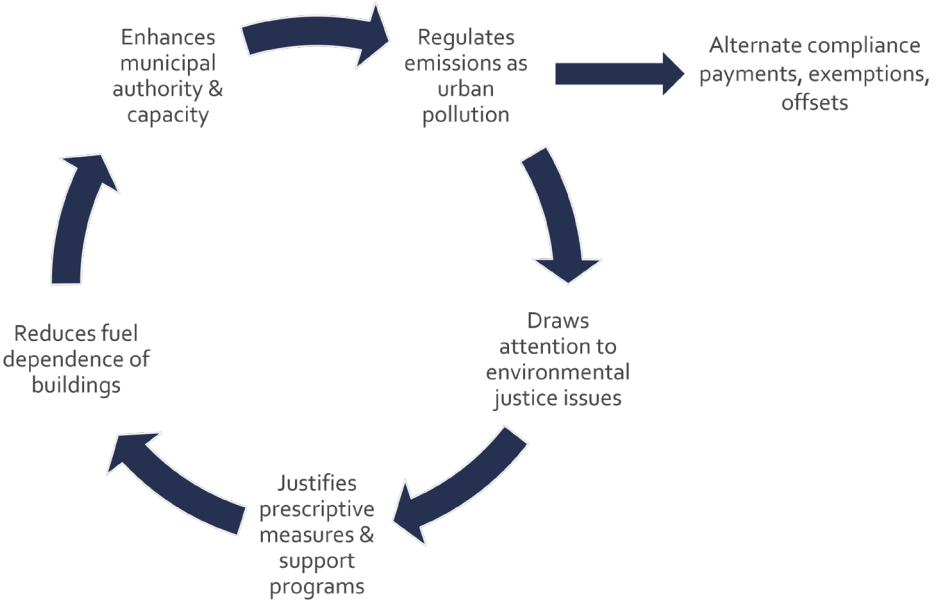

Figure 2. Mechanism locking-in decarbonization through urban BEPS

CONCLUSION

Urban building emission performance standards (BEPS) are often viewed as capable of delivering building sector decarbonization. But this capacity has yet to be assessed. This paper investigates how BEPS address carbon lock-ins to evaluate to what extent they can break the sectors' dependence on fossil fuels. We find that BEPS propose a wide variety of compliance pathways that do not require optimal retrofits or changes in tenant behaviors. In many cases, they reinforce fuel dependence and historical injustices. However, BEPS have succeeded in reframing greenhouse gas emissions in terms of urban pollution, allowing cities to regulate building emissions under their responsibility for urban environmental quality and citizen wellbeing. This perspective stresses the importance of retrofits enhancing the quality of life of people living in existing buildings. This is a significant shift from voluntary programs, adopted primarily by high-end building owners. This newfound focus on environmental justice has led to the development of prescriptive compliance measures that require that buildings reduce their reliance on fuels, improve their air quality, and thermal performance. As

optional paths, these requirements are less subject to resistance from building owners and fuel providers. Prescriptive measures increase policy acceptance by reducing compliance uncertainty and the administrative burden associated with compliance demonstration and enforcement. Our results suggest that attempts to regulate buildings' measured performance has paved the way for prescriptive requirements that are more likely to deliver the equitable decarbonization of buildings we seek.

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POURABLE CLAY: POTENTIALS FOR SUSTAINABLE AND CLIMATE-APPROPRIATE CONSTRUCTION USING SOLID CLAY

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INTRODUCTION

The construction sector is currently at a crossroads, facing both immense challenges and promising opportunities. In Germany, over 50% of waste is generated by construction and demolition activities, highlighting the industry's substantial environmental footprint.[1] Moreover, the buildings and construction sector is responsible for approximately 21% of global greenhouse gas emissions.[2] These values not only underscore the significant contribution of this sector to climate change but also emphasize its critical role as a potential catalyst for sustainable transformation.

Minimizing the negative environmental impact of construction requires innovative approaches and materials that reduce waste and emissions while maintaining structural integrity and performance, leading to the aim of this study. This paper explores potential strategies, with a focus on the integration of sustainable practices and advanced materials in construction.

Clay, as a building material, provides several environmental benefits. It consists solely of natural components like sand, silt, and clay, which can be sourced regionally with minimal environmental impact. Furthermore, the processing is energy-efficient, making it a more sustainable option compared to conventional building materials. Moreover, it can be readily recycled or disposed of in an eco-friendly manner. Its ability to absorb moisture additionally allows it to regulate humidity and capture pollutants, promoting healthier indoor conditions. Despite its benefits, clay is not yet fully optimized as a building material, and extensive research is needed to make it cost-competitive with conventional materials.

By developing pourable clay, the construction industry can transition to a more sustainable and environmentally friendly paradigm, thereby significantly contributing to climate change mitigation.

The following investigations were based on the hypothesis that clay can become flowable by integrating appropriate additives, without the need for additional water. Special emphasis was placed on preserving the material's positive attributes, including its beneficial CO_2 footprint and recyclability.

BACKGROUND

Clay and concrete share similarities in both, composition and material behavior, allowing for an effective adaption of concrete building standards and test setups for use in clay constructions. However, there is a notable difference in their developmental progress over time (see Figure 1). While

	ADVANCEMENTS IN CONCRETE CONSTRUCTION	ADVANCEMENTS IN CLAY CONSTRUCTION
5000 – 8000 B.C.	*Earliest evidence* of concrete use in Syria dates back to circa 6500 B.C.[3]	*Earliest evidence* of adobe construction in Central Asia dates back to circa 8000 B.C., while the earliest evidence of rammed earth construction in Egypt dates back to circa 5000 B.C.[4]
18th century	In 1796, *'Roman cement'* was patented by J. Parker. [5]	
19th century	In 1824, *'Portland cement'* was patented by J. Aspdin.[6] In 1845, *modern Portland cement* was discovered by I. Johnson.[7] J. Moniers patetent of *reinforced concrete*.[8]	
20th century	In 1917, E. Freyssinet discovered a new method of *compacting* concrete using mechanical vibration.[9] *Prestressed concrete* was developed.[10] *Precast concrete* elements where developed.[11]	*Clay, once largely displaced as a building material, gained renewed importance during and after the World Wars as a cost-effective and readily available emergency solution.*[12] In 1993 *cast earth* was invented by H. Lowenhaupt.[13]
21th century	In 2003, *fibre reinforced concrete* was patented.[14] In 2011, *translucent concrete* elements were patented.[15] In 2012, selfcompacting concrete was patented.[16]	From 2019 to 2022, research was conducted on the *robotic fabrication* of rammed earth components.[17] From 2021 to 2024, research was conducted on the *prefabricated clay* panel construction.[18]

Figure 1. Comparison of selected highlights in the development of concrete and clay from 8000 B.C. to the present.

concrete construction technology has seen continuous advancements over the past centuries, clay construction techniques have remained largely unchanged for almost 10,000 years. As shown major advancements, such as prefabricated elements, were already realized in the concrete industry during the 20th century, while similar progress in clay construction remains limited.[19] Furthermore, it is evident that research and further development in earth building materials experienced severe stagnation due to the displacement of earth building techniques by modern building materials, such as concrete, prior to the two World Wars. Although there are a few pioneering projects involving prefabricated earth components, large-scale economic application of these techniques were not realized to date.

Consequently, the objective is to leverage the established infrastructure of the concrete industry to accelerate advancements in clay construction. This study specifically aims to explore adjustments in processing consistency to facilitate this transition.

State of the Art

The concept of pourable clay is not entirely new, as demonstrated by previous studies that achieved a pourable consistency for clay. There have been scientific efforts to render clay into a pourable consistency. However, many of these products are stabilized through the addition of additives such as gypsum or cement, consequently disqualifying them as earth building materials under the earth building regulations defined by Volhard and Röhlen. According to these regulations, earth building materials must be solely clay-bound, with their strength achieved only by drying.[20]

As early as the beginning of the 1990s, Lowenhaupt and Frerking developed a mixture of clay (80-85 wt%), gypsum (15-20 wt%), and a retarder (N/A), called 'Cast Earth'. In the context of a test building, Cast Earth was mixed in a ready-mix truck, similar to concrete, and subsequently pumped into forms using a grout pump. Although compressive strengths of nearly 7.00 N/mm² can be achieved with this mixture, many of the beneficial properties, such as clay's good recyclability, are lost.[21]

Within the last two decades the number of studies focusing on cement- and gypsum-free pourable clay has increased. One study, performed by Oxara Corporation, uses various mineral powders, including a dispersant and a coagulant to increase fluidity. However, their integration parallelly affects both, vapor permeability and recyclability, in an adverse manner.[22]

Other research focuses on the use of primarily organic additives, such as the combined use of molasses, vinegar essence, and metakaolin.[23]

The comprehensive research described above highlights the potential of pourable clay and the need for further investigation. A careful selection of admixtures could further expand this potential of clay, thereby sustainably strengthening earth building practices. Figure 2 representatively illustrates the surface structure of pourable clay. Liquefaction opens up a variety of design options, while additionally enabling innovations on a larger scale.

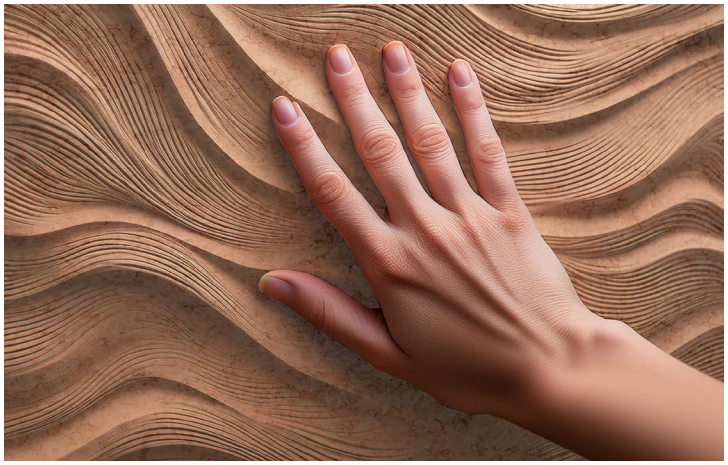

Figure 2. Representative illustration of complex and accurate shaping possibilities.

Selection of Additives

The selection of additives was guided by more advanced mineral systems, such as gypsum or cement. With the aim to enhance the workability of clay, the flowability needs to be modified through the use of additives such as retarders, plasticizers, dispersants, and coagulants.

Retarders (R) extend the setting or hardening time of a material, providing more time for processing, transporting, and pouring the mixture.

Plasticizers (P) enhance the workability of material mixtures by increasing their flowability without the need for additional water, thereby optimizing the consistency while additionally preserving and potentially even improving the strength and durability of the material.

Dispersants (D) keep particles evenly distributed within a material mixture, by preventing the formation of agglomerates. They improve the mixture's homogeneity resulting in a more homogeneous texture and enhanced mechanical properties of the final product.

Coagulants (C) function by aggregating fine particles within a material mixture, effectively binding them into a solid mass. This process enhances the material's consolidation and stabilization, especially in applications that demand rapid curing or increased strength.

Tannin has previously been described as functioning as an organic and natural dispersant.[24] The additional inclusion of the coagulant magnesium oxide is intended to counteract the liquefying effect, allowing the solidification of pourable clay.[25]

According to the manufacturer, the addition of soda to gypsum extends the setting time by acting as a retarder.[26] In the ceramics industry, sodium carbonate is widely used as a plasticizer.[27] Experimental investigations will determine whether clay construction can also benefit from the effects.

To that end, sodium carbonate (R, P) and tannin (D) combined with magnesium oxide (C) were selected as suitable additives.

METHODS

The field of clay construction currently lacks a solid foundation of standardized testing methods. Consequently, established practices from the more developed concrete industry have been adapted and modified.

In this context, this study will assessed the flowability of clay using DIN EN 12350-5, a standard originally designed for evaluating the consistency of fresh concrete.

The prepared clay is poured into a mold positioned on a spreading table. After removing the mold, the table is raised and dropped 15 times to its full extent. The spread ratio can then be numerically

represented as the average maximum spread in the x- and y-directions, and ideally ranges from 340 mm to 620 mm.[28]

To ensure sustainability, the recyclability of the clay must not be compromised by integrating additives. The experimental setup of this study included simplified recyclability tests and should be complemented by more profound, prospective studies. At this stage, recyclability is assessed solely based on the material's behavior when exposed to water, particularly by determining the sample's solubility in water.

Given the construction sector's substantial contribution to climate change, the carbon footprint of individual building materials is a critical factor in evaluating their environmental impact, as materials with a high carbon footprint can further accelerate global warming. For its assessment, the Global Warming Potential (GWP) is a key metric measuring a material's contribution to the greenhouse effect. The GWP-value represents the impact of various greenhouse gases relative to the damage caused by one kilogram of CO_2, indicated as a measurable CO_2 equivalent ($kgCO_2e$). In the following analysis, the GWP of used additives was determined within the system boundary (A1-A3), encompassing raw material procurement through production.

To qualify as a load-bearing building material, pourable clay must meet the minimum standards defined by the earth building regulations, which require a compressive strength of at least 2.00 N/mm² for structural viability.[29] In this study, tests were conducted on cubic specimens with a 10 cm edge length, differing from standard procedures. Thereby a pre-load of 250 N was applied, with a testing speed of 400 N/s.

RESULTS AND DISCUSSION

To better contextualize the results of the conducted investigations, reference values from a specimen made of pure rammed earth were used.[30] Ideally, the pourable specimens should demonstrate comparable compressive strength and recyclability while exhibiting significantly enhanced flowability.

	Reference value
Flowability	230 mm
Water solubility	excellent
GWP-total/m³ (A1-A3)	9.62 $kgCO_2e$
Compressive strength	3.75 N/mm²

Table 8. Reference values for pure rammed earth specimens.[31]

The following experiments were conducted by Isabel Kirst as part of her master's thesis at Bauhaus-Universität Weimar in 2024.

Tannin & Magnesium Oxide

The addition of tannin (0.25 wt%) and magnesium oxide (0.25 wt%) resulted in a slight liquefaction of the mass, with the flow table test revealing a flowability of 270 mm. The mixture was compacted using a vibrating table without the need for manual recompaction, finally resulting in a homogeneous test specimen (see Figure 3). Although the flow spread of 270 mm is considered stiff in consistency, the mixture was easy to compact and alowed in a clean surface finish.

Figure 3. Specimen containing tannin (D) and magnesium oxide (C) in a dried state [Photo: Kirst, I.].

While tannin is highly water-soluble, magnesium oxide is not. The potential impact of its insolubility on the material's recyclability requires further evaluation.

Furthermore, it is noteworthy that there is no available data on the environmental impact of oak tannin. Magnesium oxide, in contrast, has previously been shown to contribute approximately 2.24 $kgCO_2e/kg$, significantly deteriorating the overall balance (↑ 126%).[32] Despite the significant GWP-impact of magnesium oxide, the total environmental footprint remains lower than that of conventional mineral building materials.

Compressive strength tests yielded a maximum compressive strength of 1.90 N/mm^2 for the described mixture, narrowly missing the threshold value for load-bearing applications, which is 2.00 N/mm^2. Overall, the compressive strength is about 50% lower compared to the reference specimen (see Figure 4).

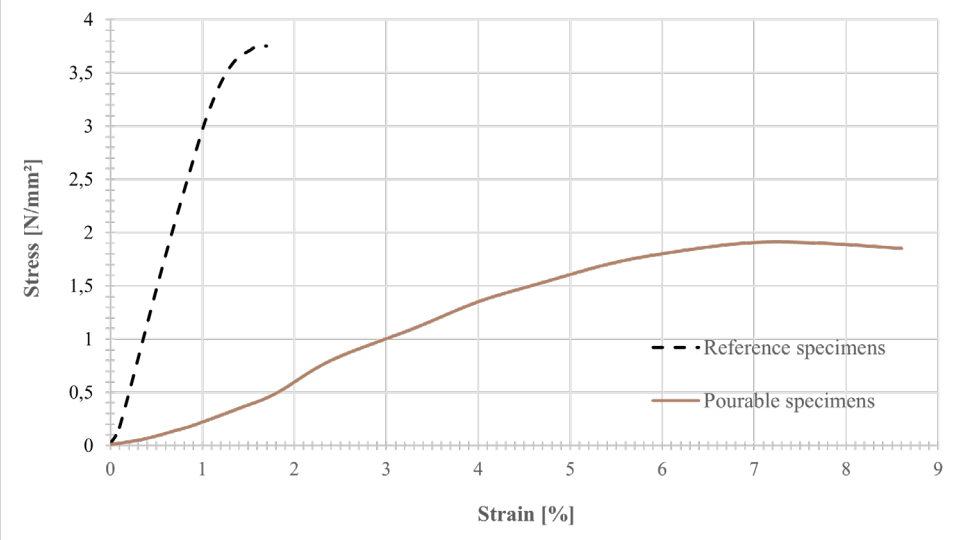

Figure 4. Stress-strain diagram comparing specimens containing tannin (0.25 wt%) combined with magnesium oxide (0.25 wt%) to a solid rammed earth reference mixture.

During the compaction process, the mixture showed promising results. However, recyclability and environmental impact have not yet been conclusively assessed. Therefore, alternative material

mixtures should be preferred, especially considering the need for optimization regarding load-bearing capacity. Table 2 summarizes all the material values.

	Test value
Flowability	270 mm
Water solubility	Potentially limited
GWP-total/m³ (A1-A3)	Min. 21,82 $kgCO_2e$
Compressive strength	1.90 N/mm²

Table 9. Material properties of the mixture containing tannin (D) and magnesium oxide (C).

Sodium Carbonate

The addition of 0.125 wt% sodium carbonate resulted in measurable liquefaction, as indicated by a flow spread of 345 mm, confirming the effectiveness of sodium carbonate as both a retarder and plasticizer in clay-based materials. The liquefied mixture was molded into a test specimen using a vibrating table without the need for manual recompaction.

Figure 5. Specimen containing sodium carbonate (R, P) in a dried state [Photo: Kirst, I.].

However, the surface is not as homogeneous as intended (see Figure 5). As a potential countermeasure, pore formation could be minimized in subsequent steps, for example, by using internal vibrating systems.

Sodium carbonate is soluble in water, suggesting that unrestricted recyclability is achievable. It has a carbon footprint of only 1.84 $kgCO_2e/kg$.[33] Despite its minimal quantity of 0.125 wt%, sodium carbonate still significantly impacts the overall GWP (↑ 47%). However, the GWP remains significantly reduced compared to that of conventional mineral building materials.

Compressive strength tests documented a maximum compressive strength of 2.20 N/mm² for the described mixture, meeting the requirements for load-bearing applications; however, the compressive strength is still about 40% lower compared to the pure rammed earth mixture (see Figure 6).

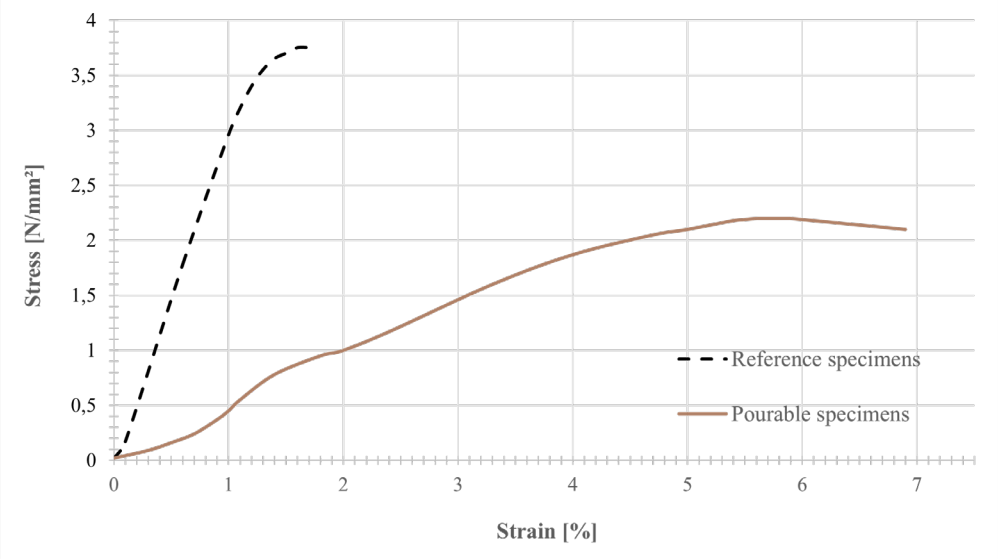

Figure 6. Stress-strain diagram comparing specimens containing sodium carbonate (0.125 wt%) to a solid rammed earth reference mixture.

In summary, sodium carbonate proves to be a promising and effective retarder and plasticizer. Table 2 summarizes the assessed property values.

	Test value
Flowability	345 mm
Water solubility	Not limited
GWP-total/m³ (A1-A3)	14.22 kgCO_2e
Compressive strength	2.20 N/mm²

Table 10. Material properties of the mixture containing sodium carbonate (R, P).

CONCLUSION

This study assessed the potential of pourable clay as a sustainable building material by examining the specific effects of various additives on its properties. The evaluation focused on both the environmental impact and the practical performance of pourable clay compared to conventional materials like concrete.

Due to its natural composition, low energy processing, and excellent recyclability, clay seems to be a promising, eco-friendly alternative for conventional building materials. In contrast to clay construction, which has been used for thousands of years with limited enhancement, modern concrete technology has advanced rapidly since its establishment in the 18th century, highlighting the slower progress in clay-based construction.

The results indicate that pourable clay can achieve desirable flowability while retaining all inherent advantages of clay. Specifically, the addition of sodium carbonate improved flowability and resulted in a compressive strength of 2.20 N/mm², meeting the minimum standards for load-bearing applications. However, even the integration of sodium carbonate led to a 40% decrease in compressive strength compared to pure rammed earth. Despite its increased environmental impact compared to pure clay, sodium carbonate's overall footprint remains significantly lower than that of traditional building materials, such as concrete.

In contrast, the mixtures with tannin and magnesium oxide demonstrated promising workability but fell short of meeting load-bearing capacity requirements. The environmental impact was notably higher due to the substantial carbon footprint of magnesium oxide. While the flowability of these mixtures reached 270 mm, their compressive strength of 1.90 N/mm² did not meet the required 2.00 N/mm² for load-bearing use.

In conclusion, the research conducted demonstrates the potential of pourable clay to advance sustainable construction practices. However, several open questions and opportunities for refinement remain, warranting further investigation:

Optimizing additive ratios is crucial to achieving the ideal balance between consistency, load-bearing capacity, and minimal environmental impact. Future research should explore additional eco-friendly additives and examine their combined effects to enhance performance while maintaining sustainability.

Beyond material composition, practical investigations into the pumpability of pourable clay are essential. Specifically, studies should assess its suitability for transportation and processing using existing concrete infrastructure (e.g., truck mixers, pumps, formwork, vibrating systems, etc.). Additionally, producing large-scale components would allow for testing compaction and drying behavior in real-world applications, providing vital data for industrial-scale adoption.

A key area for exploration is the preservation of the inherent properties of clay, such as its water vapor permeability. Focused research should ensure the material's ability to quickly absorb and efficiently release water vapor, maximizing its natural regulatory capabilities for healthier indoor climates.

In summary, pourable clay holds significant promise for advancing sustainable construction practices. While its potential is yet to be fully realized, comprehensive and interdisciplinary research is needed to refine its performance and establish it as a viable, eco-friendly alternative in the building industry.

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MAKING HERITAGE MATTER: AT THE BOUNDARIES BETWEEN ECOSYSTEM-BASED PLANNING AND CONSERVATION OF THE BUILT ENVIRONMENT

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INTRODUCTION

In Swedish urban planning, evaluating ecosystem services and the historic built environment is now standard practice. However, achieving effective integration of these elements remains a critical but challenging objective for fostering diverse and resilient urban landscapes.

The ecosystem services approach, introduced by the United Nations and integrated into international policies around 2005, originates from natural sciences but adopts an anthropocentric perspective.[1] Its principle is that nature provides numerous services often overlooked, leading to significant environmental consequences. By recognizing and valuing these natural services, the approach aims to raise awareness, mitigate interests, and support better decision-making. In planning, this approach emphasizes "green and blue" structures, focusing on the natural aspects of urban and rural landscapes, such as parks, rivers or forests.[2]

Ecosystem services are typically categorized into four main types: supporting, regulating, provisioning, and cultural services. Supporting services include ecological processes such as nutrient cycling and soil formation. Regulating services encompass functions like climate regulation, flood control, and water purification. Provisioning services refer to tangible products obtained from ecosystems, including food, water and fiber. Cultural services include non-material benefits such as tourism, recreation, and heritage.[3]

In Sweden, built environment conservation predominantly focuses on "grey" structures—such as buildings, street grids, monuments, and archaeological sites—that are integral to the historical and architectural fabric of cities. These elements are often considered heritage assets due to their historical significance.[4] Based on the legal principles of *consideration, carefulness*, and *protection* of historical buildings, municipalities typically commission a built heritage expert to assess the historic characteristics of a place. The integration of these physical elements into urban development efforts are crucial for maintaining the historical and architectural integrity of urban environments.[5]

While ecosystem services planning and built environment conservation both aim to enhance urban spaces, these practices often remain separate, with administrative and disciplinary divisions hindering effective collaboration and creating gaps in current practices.[6] This paper analyzes a workshop with professionals to explore these gaps, focusing on how they interpret their roles and the landscapes they work within. It examines the processes involved in assessing and managing both natural and historic

built elements, with particular attention to how boundary work—whether competitive, collaborative, or configurative—shapes these practices. The study aims to identify shared approaches, concepts, and tools that could enhance collaborative planning, offering insights into opportunities for a more integrated approach to urban planning.

METHODOLOGY AND THEORETICAL FRAMEWORK

Seven professionals with expertise in the historic built environment (2), landscape architecture and planning (4), and environmental planning (1) participated in a 3-hour workshop. These experienced planners, often working with municipalities or major contractors, engaged in discussions and activities focused on integrating the historic built environment with ecosystem services and vice versa. Using the Ecosystem Cascade Model and areal photographs, they explored current practices and future ambitions. The workshop results provide a detailed account of the shared insights and approaches.

Given the focus on interdisciplinary practices, the workshop discussions were analyzed through the lens of the analytic concept of boundary work. Boundary work, as initially conceptualized by Gieryn[7] in 1983, pertains to the dynamic interactions that occur both between and within professional groups. Langley and colleagues[8] elaborate on this notion by framing organizational design as a fluid and continuously evolving process, emphasizing its inherently open-ended nature. They categorize boundary work into three distinct types: competitive, collaborative, and configurative. Competitive boundary work leverages boundaries to gain advantages over others, while collaborative boundary work seeks to align boundaries to foster cooperation. Configurative boundary work, on the other hand, involves the strategic adjustment of differentiation and integration patterns between groups to coordinate activities and manage areas of competition and collaboration effectively.

This theoretical framework deepens our understanding of how professionals from diverse fields effectively collaborate and communicate by leveraging shared tools and concepts, even when their goals, expertise, and methods differ. Additionally, it provides valuable insights into recognizing critical boundaries and opportunities when integrating ecosystem services (green/blue infrastructure) with the built environment (grey infrastructure) in urban planning.

THE WORKSHOP DISCUSSIONS

The Cascade Model

Initially, the professionals were introduced to the Cascade Model (Figure 1) to elucidate the logic of ecosystem services analysis and to familiarize experts in built environment with this practice.

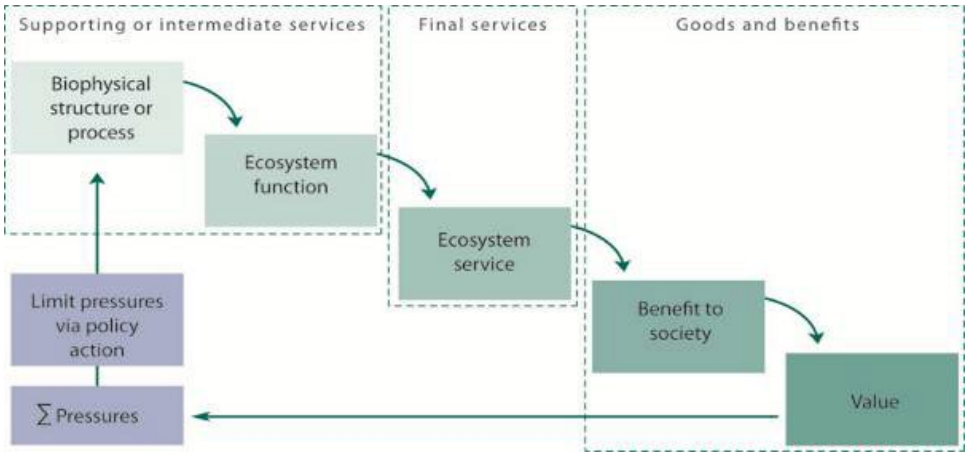

Figure 1. The Ecosystem Services Cascade Model, based on Potschin and Haines-Young.[9]

When asked about their starting points for analysis, most participants begin by assessing landscape attributes, similar to "supporting or intermediate services" in the cascade model. Landscape architects focus on landscape forms, while historic environment experts examine the built environment's history. In contrast, the environmental specialist starts by identifying values through stakeholder engagement, akin to "Goods and Services" in the cascade model, exploring how stakeholders use and value landscape elements. This specialist stressed the importance of involving the right stakeholders and ensuring clear objectives for meaningful assessments.
Furthermore, there was a consensus that clear distinctions between service, benefit, and value, as portrayed in the Cascade model, are seldom made. For example, one historic environment expert acknowledged that she does not typically specify the precise value and significance of historical environments for different stakeholders, often assuming that the historical characteristics of a place are inherently valuable. Despite some self-criticism—acknowledging that while the built environment may be distinctive and "readable" to her, it might not be to the general public—she argued that assessing community values is not typically be the responsibility of built environment experts.

Aerial photograph of a traditional landscape

In the second part of the workshop, the professionals were shown an aerial photograph of Äskhult (Figure 2), with cluster village characteristics reminiscent of Sweden's landscape from 200 years ago. The photograph, highlighting the clear relationship between nature and culture, was chosen to facilitate an accessible discussion of current practices among the various professionals.

Figure 2. This aerial photograph showcases the hamlet of Äskhult, a cultural reserve since 2006, located in southwest Sweden. Source: Google maps.

The built environment expert explained that such landscapes are considered "cultural landscapes," highly sensitive and usually protected from development. When faced with similar landscapes, but also more everyday landscapes, her work involves analyzing historical maps and conducting field visits to trace the continuity of elements like buildings, open spaces, roads, and trees. The main narrative that emerges focuses on the combined histories of the buildings and the landscape, emphasizing the authenticity and readability of the agricultural story.
A landscape architect noted that when conducting a *green corridor analysis,*[10] she focuses on opportunities for ecological connectivity from a broad perspective, making groups of buildings like the ones in the aerial photograph irrelevant, since they do not hinder such connectivity. Another landscape architect noted that on a very detailed scale, buildings would be included in the *green area factor analysis*[11] if they had green roofs or climbing plants along facades; otherwise, they are

excluded. It was also added that considering buildings as habitats for bats, birds and insects, is an essential part of any ecosystem services analysis.
From the perspective of the environmental specialist, the value-centered approach underscores the significance of buildings not merely as physical structures but as functional elements integral to their occupants' interaction with the landscape. Here, the primary task is to understand how ecosystem services can enhance the functionality and attractiveness of the location, thereby supporting its users and contributing to their well-being.
In summary, the workshop participants illustrated that current landscape analysis practices are multifaceted: built environment experts evaluate the historical continuity and authenticity of cultural landscapes, landscape architects assess the impact of structures on ecological connectivity and green area factors, and environmental specialists focus on leveraging ecosystem services to improve functionality and user well-being.

Aerial photograph of a common Swedish neighborhood

In the third part of the workshop, professionals were shown an aerial photograph of northwestern Linköping, featuring villas, gardens, and apartment buildings within park-like surroundings framed by a forest. This photograph was chosen for its complexity, offering a richer context for discussing contemporary challenges in landscape analysis.

Figure 3. Aerial photograph of the northwestern part of Linköping, southeastern Sweden. Source: Google Maps.

While examining the photograph, one built environment expert envisioned a scenario: “If someone wanted to develop here, they would probably seek to exploit this park,” she remarked, pointing to the central area of the map. To address this, she emphasized the need to demonstrate the interconnections between green spaces and built environments, noting that the park has been an integral part of the residential area since the 1940s. She began to contemplate whether understanding the current use of these spaces, and whether they have evolved over time, could yield valuable insights into their functionality. However, she pointed out that such people-centered questions are rarely addressed in her assessments, which focus exclusively on the physical characteristics of the place and its overall heritage significance from aesthetic and pedagogical perspectives, without engaging with the community. She also noted that green and blue structures are typically considered only if they support the built environment, despite regulations in the Swedish Plan and Building Act, requiring the integration of natural and cultural values, which are often analyzed separately.

The environmental expert emphasized the value of preserving historical architectural layouts for their benefits to both heritage and ecosystem services, including shade, recreation, and cultural values. However, he stressed the need to address current and future needs, not just existing attributes. He proposed incorporating the concept of "system identity" from environmental science to better understand a place's functions and the services it requires based on human interactions. For instance, the rise in remote work may create a demand for new community amenities, such as lunch spots or coffee spaces. Integrating system identity into planning could thus foster urban environments that are both historically rich and adaptable to modern needs. While others agreed on the importance of considering residents' needs, they noted that this aspect is often missing from their analyses. The discussion then turned to who should guide this planning approach and take responsibility for community desires, particularly given the constraints of tight budgets and the dominance of current rational planning ideals.

Shifting focus, one landscape architect explained that in green corridor analysis, buildings are classified as either supporting biodiversity, such as villa gardens, or impeding it, such as large parking lots, which are viewed as opportunities for enhancing ecosystem services. To advance proposals for improving built-up areas, all landscape architects reported using Municipal Heritage Conservation Plans and Geographical Information Systems (GIS) to identify potential “hotspots” for ecosystem services. They noted that environments like those in Äskhult and Linköping are likely to be featured in these plans, presenting opportunities to integrate natural and cultural values in a mutually beneficial manner.

Overall, it was concluded that while the landscapes depicted in the aerial photographs do not reveal significant conflicts between practices and the professionals generally understand each other's perspectives, collaboration between these practices remains rare, and valuable information is seldom shared. In considering future improvements for collaboration, they suggested that Landscape Character Assessments offer a broader and more inclusive approach compared to ecosystem services analyses.

Coming to the end of the workshop, the participants compared the “everyday landscapes” of Linköping with another type of urban environment—large quaysides (figure 4), which are frequently subject to development plans. In these settings, collaboration might be even more crucial, yet conflicts often arise.

Figure 4. An aerial photograph of Lindholmen, Gothenburg Harbour, Southwest Sweden. Although this image was not presented at the workshop, the landscape type it represents was discussed as being contentious among professional approaches and values. Source: Google Maps.

These types of places often present significant conflicts regarding which "story" should be prioritized, protected, and developed. From an ecosystem services perspective, it would be possible to highlight the 19th-century landscapes rich in flora and fauna to underscore the historical motivations for integrating greater biodiversity. However, the landscape architects claimed they rarely conduct historical analyses. Conversely, the built environment sector often emphasizes the industrial narrative of the 20th-century landscape, which does not support the enhancement of biodiversity. Consequently, in these types of landscapes, the two practices frequently clash in their discourses and objectives.

BOUNDARY WORK AT PLAY

The workshop provided insights into how boundary work manifests within and between the practices assessing ecosystem services and the historic built environment. This analysis is framed through the three types of boundary work: competitive, collaborative, and configurative.

Competitive Boundary Work

Competitive boundary work involves leveraging disciplinary boundaries to gain advantages and assert specific goals. During the workshop, it was evident that current practices often showcase this dynamic, with different disciplines presenting their methodologies to advance their respective agendas. For example, professionals in the built environment emphasized heritage aspects to secure preservation priorities, while those focused on ecosystem services highlighted ecological benefits to influence planning decisions. This competitive dynamic was particularly pronounced in contexts where heritage and ecological objectives conflicted, such as in industrial quaysides. Here, the goals of preserving historical elements and enhancing ecological functions frequently clashed, revealing the tension inherent in competitive boundary work. Despite the Swedish Plan and Building Act advocating for a synergetic approach—requiring that buildings and structures be designed with consideration for urban and landscape characteristics as well as natural and cultural values—siloed working practices remain prevalent due to entrenched traditions, budget constraints, and project scope limitations.

Collaborative Boundary Work

Collaborative boundary work aims to align different practices to foster cooperation and improve planning outcomes. During the workshop, current practices were highlighted, showcasing efforts to integrate ecosystem services with built environment considerations. Discussions focused on traditional cultural landscapes, such as Äskhult, and mid-20th century residential areas like those in Linköping, demonstrating how both perspectives can enhance planning outcomes when aligned. These areas, identified as "hotspots," illustrate how historic structures and ecosystem services can synergistically benefit each other. Tools such as GIS and Municipal Heritage Conservation Plans are pivotal in analyzing these hotspots, revealing how historical structures and their settings contribute to ecological connectivity, habitat provision, and cultural authenticity, thereby integrating both natural and cultural values.

Configurative Boundary Work

Configurative boundary work involves adjusting the patterns of differentiation and integration between groups to manage specific activities and direct areas of competition and collaboration. During the workshop, participants identified three key areas they hope to address for better integration of ecosystem services and the built environment in the future.

First, there is a need to tailor the scale of analysis to ensure that both ecosystem services and heritage considerations are addressed in a way that fits the specific context and demands of each area. By

strategically adjusting analytical boundaries, different perspectives can be integrated, and efforts can be better coordinated, balancing natural and cultural values within planning processes.

Second, participants emphasized the importance of enhancing the integration of historic map analysis into the development of new ecosystem services. Improving this integration would better inform the creation of ecosystem services and foster greater collaboration between experts in the built and natural environments. A landscape character assessment that incorporates historic analysis is seen as a more effective platform for bridging disciplines and addressing the complexities of integrating ecosystem services with cultural and historical values, leading to a more cohesive planning framework.

Third, the workshop highlighted a significant gap in methods for incorporating a values-centered approach into planning. Heritage, as a cultural ecosystem service, has the potential to bridge the material and immaterial aspects of urban spaces. It provides historical and cultural value, fosters community connections, and links people to their past.[12] However, consistent with previous research[13], the workshop revealed that the full spectrum of heritage is often underutilized, with a predominant focus on tangible elements like historic buildings, while intangible aspects such as cultural practices and community values are frequently overlooked.

To address this imbalance, participants advocated for less siloed reports, more collaborative workshops, and the collection of community narratives. They emphasized that these narratives can help reconcile different perspectives, enriching the planning process. Participants suggested that future efforts should integrate heritage more centrally, supporting a values-based approach that includes both cultural values and community stories. This strategy aligns with configurative boundary work principles, aiming for a more balanced and heritage-enriched urban planning approach.

CONCLUSION

The following table provides an overview of how the tree types of boundary work operate within the context of ecosystem services and historic built environment practices. It highlights current integrations and outlines future prospects for incorporating heritage more effectively into planning processes. Based on the workshop, an overview of the practices and future prospects can be illustrated.

Boundary Work Type	Approach	Illustrative Examples	Tools and methods	Current Integration and Prospects for Heritage
Competitive Boundary Work	Leveraging disciplinary boundaries to assert specific goals.	Conflicts between heritage preservation and ecological functions.	- Traditional methodologies of each discipline. - Swedish Plan and Building Act guidelines.	The focus is primarily on tangible heritage elements, understood as either green/blue or grey (bio)physical elements/attributes.
Collaborative Boundary Work	Aligning different practices for improved planning outcomes.	Integration of ecosystem services with built environment considerations.	- GIS: Mapping and analysis of both built environment and natural landscape elements. - Municipal Heritage Conservation Plans: Understanding historical context.	Heritage is integrated in efforts to combine historical context with ecological benefits.
Configurative Boundary Work	Adjusting differentiation and integration patterns to manage activities.	Tailoring scales of analysis, integrating historic maps, and incorporating values-centered approaches.	- Landscape Character Assessment: Bridging ecological and cultural values. - Historic Map Analysis. - Narrative collection methods.	Heritage could play a more central role, bridging material and immaterial aspects. Future efforts should integrate community narratives to develop inclusive, culturally enriched frameworks.

Table 1. Boundry work of Ecosystem Services and Built Environment Practices, and the Current and Future Role of Heritage.

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THE CIRCULAR JOURNEY OF JOINERY: A VALUE NETWORK EXPLORATION FOR POST-CONSUMER METAL WINDOWS BEYOND RECYCLING

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INTRODUCTION

In Belgium, the implementation of the circular construction economy is currently an important focus area of both practitioners and researchers. Research projects as FCRBE or renovation projects as U-Square are examples of this circular momentum. Although the importance of their efforts and results shouldn't be underestimated, these projects mainly concern reuse of construction products with relatively limited technical and organisational challenges. As the literature review of Ding et al noted, insights are missing on the interface between the forward and reverse supply chains of "more complex sectors that supply construction products, such as the steel/timber structure and the aluminum/glass facade supply chains."[1] Therefore, the aim of this research is to explore the organisational opportunities to facilitate reuse processes of aluminium and steel windows. To unravel their complex 'ecosystems', value network mapping is used as a method in a co-learning approach.[2] By organizing interviews and workshops with different actors from the façade value chain, data could be gathered while simultaneously triggering new questions and ideas in the industry towards more value retention of post-consumer metal windows.

The efficiency paradox in window renewal

When façades are renewed, building owners aim to increase the energy performance, repair damage and often also to obtain a new look.[3] Unfortunately, "current energy focused optimization might lead to a sub optimization of actual environmental impact."[4] While striving for an increase of the energy efficiency of the building, today building owners, architects and contractors are often renewing the existing façade products with a tabula rasa approach, resulting in a low material efficiency. Therefore, this wasteful renovation practice includes an efficiency paradox. Moreover, it indicates a discrepancy between the high theoretical reuse potential and the low perceived reuse potential of façade products such as metal windows.

High theoretical reuse potential

The reclamation or reuse potential of an existing construction product can be estimated based on a set of factors.[5] When applying these to aluminium and steel joinery, we observe that several characteristics could contribute to a high theoretical reuse potential, among which:

- slim profiles due to high strength (especially steel): aesthetic value;
- robustness, long technical lifespan;
- removable from a façade without (large) defects on window;
- manageable due to low weight (especially aluminium);
- high cost of new joinery;
- high embodied carbon.

Low perceived reuse potential

In practice, however, several aspects are contributing to the current catch 22 where there is both a low demand and low offer of post-consumer metal joinery. Today, only 3 Belgian dealers can be found on Opalis, offering reclaimed aluminium exterior windows.[6] In a previous paper the authors discussed several challenges to the reuse of façade products, as perceived by Belgian pioneering stakeholders.[7] When projecting these in specific to metal windows, the following aspects might contribute to their low perceived reuse potential:

- technical restrictions: e.g. presence of asbestos in mastic, corrosion, …;
- outdated thermal performance, e.g. absence or first generation thermal breaks;
- decreased airtightness, e.g. wear of the gaskets;
- design limitations, e.g. fixed dimensions and colours;
- technical uncertainties, e.g. unknown thermal performance;
- procedural uncertainties, e.g. lack of experience with reuse processes of windows;
- financial uncertainties, e.g. unknown cost during design phase.

Losing embodied values through recycling

The low perceived reuse potential of metal windows is reflected in the way aluminium windows are currently treated at the end of their first use. 90% of them are shredded and remelted, or in other words ‘recycled’.[8] Of course, recycling allows the construction sector to reduce its need for new aluminium. As a result, it reduces the negative social and environmental impacts and risks of mining and refinery at the beginning of the aluminium value chain, of which the Brumadinho dam disaster is a well-known example.[9] Although recycling is a resource preserving strategy, it does not seem to be capable of valorising the financial, environmental and technical values embedded in the existing products.

First, through recycling 99% of the financial value of the joinery is lost, showcasing the principle of the Value Hill.[10] A considerable share of this lost value might be related to the manual labour of assembling and installing the window, which can be referred to as ‘embodied craft’.[11]

As an example:

- fixed Al window without glazing: e.g. 600 €/m² (based on interviews)
- scrap value Al window: e.g. 1100 €/ton[12] * 4,95 kg aluminium / m² window[13] = 5,45 €/m²

Second, the embodied carbon from the aluminium is partially ‘lost’ as it has to be remelted. Although this consumes only 5-10% of the energy needed to produce new aluminium[14], the reduction of the overall embodied carbon has its limits, related to the availability of post-consumer scrap. According to the following calculation, an aluminium window with a recycled content of 36% (i.e. the European average availability) has a reduction of 33% in embodied carbon of the smelting process, in comparison to a product made with 100% virgin aluminium:

- Recycled post-consumer Al: 0,5 kg CO_2/kg Al
- New Al: 6,7 kg CO_2/kg Al[15]
- 36% recycled content: 4,5 kg CO_2/kg Al

• Avoided carbon: 2,2 kg CO_2/kg Al = 33%

Third, as aluminium is applied in façade systems together with other products and finishes, the original Al-Si-Mg-Fe-alloy might become polluted through the recycling process, resulting in lower quality.[16]

Alternatives for enlarged value retention

As aluminium and steel window frames are multi-component products, reuse and recycling are not the only circular options at the end of their first functional lifespan. Different strategies exist to retain the embodied values of the window or its parts, such as remanufacturing and refurbishing. While these strategies have been implemented for years in other industries, only recently, researchers and practitioners started exploring their potential for metal façade systems, such as the research of Teeuwen in collaboration with Scheldebouw.[17] To scale the value retention processes from the scale of pilot projects to an industrial scale an increased collaboration will be necessary throughout the value chain.[18] Therefore, this research aims to contribute to a better understanding of the organisation of value retention options for post-consumer metal joinery, from a value network perspective. As a sector wide research project in the Netherlands, PerpetuAL contributed significantly to this. Nonetheless, with a main focus on recycling practices of aluminium façade systems, the other value retention options (and different roles involved in these processes) remain relatively underexplored.

First, this paper will look at the existing forward and reverse value chains of metal window frames installed in Belgium. Second, it will explore the alternative circular trajectories for the post-consumer products, beyond recycling. The third section initiates a discussion on the questions concerning the feasibility of these circular options. Finally, this paper will zoom in on the organisational opportunities within the value chain to facilitate these circular trajectories.

THE EXISTING VALUE CHAIN

Today, construction processes (forward logistics) and demolition processes (reverse logistics) are two separated domains. This segregation is noticed in practice as several architects mention they do not have a good view on where end-of-use materials are going to and how they are processed. Also in academic research the knowledge between both domains is still segregated, as emphasized by the literature review of Ding et al.[19] To provide an integrated overview on the value chain, this research adds information from interviews and workshops to descriptions from literature[20] and manufacturers[21]. Underneath, an example is given of a value chain of aluminium windows from the Belgian system developer Reynaers, describing both the forward and reverse supply chain. In annex A, you can find a graphical representation of this combined value network.

Construction chain

The linear supply chain starts with the extraction of bauxite, for example in Australia or Brazil. Nearby, this is refined to create alumina (i.e. aluminium oxide), creating a voluminous toxic by-product called ‘red mud’. Next, the alumina is transported to Belgium where aluminium is extracted through an energy-intensive process of electrolysis, creating CO_2 as a by-product. Next, this is melted into billets of aluminium alloys. The aluminium billets are then extruded into profiles, according to the design of a system developer. Next to these extruded profiles, the system developer also buys fittings, seals, PA thermal breaks (produced in Germany or Belgium) and accessories from different manufacturers. The system developer first assembles the thermal break between the inner and outer profile, through a semi-automated mechanical process of knurling, strip insertion and rolling (crimping). These insulated profiles are transported to a coater to be coated or anodised and sent back. Then, the system developer creates ‘packages’ of different components and sells these to assemblers,

representing 20-33% of the total cost of the window. In addition to the guarantees on the products, their services include training, calculation software and sales. As the main coordinator of the supply-chain, the system developer is also in direct contact with architects, providing technical advisory while reassuring the specific prescription of their profiles. The assembler cuts the coated insulated profiles which are delivered at 5 and 7 meter length, manually assembles them into window frames and sells them to an installer. In most large-scale projects these two roles are taken up by the same company with a revenue model based on selling the window, not the installation (which represents 10-15% of the total cost). The installer also buys insulated glazing (approx. 10% of the total cost), which has an elaborate value chain on its own.[22] They might work under the coordination of a general contractor, or directly for a client.

Deconstruction chain

At a certain moment, often before the end of the technical lifespan of the window, it is removed from a building by a demolition contractor (or façade contractor). Conventionally, they throw the windows in a container of a scrap dealer who shreds the windows and separates the different fractions. Besides the post-consumer aluminium they also collect the cut-offs from the assemblers, representing about 10-15% of the volume they purchase from the system developers. Finally, this scrap is sold to the melter to be remelted into aluminium billets. As more than 90% of the post-consumer aluminium from buildings is recycled today, it can be argued that applying a recycled content above the average availability (i.e. 36%) does not directly reduce the total use of virgin aluminium, but only shifts this from one product to another.[23]

CIRCULAR TRAJECTORIES

In the current value chain, aluminium is preserved as a raw material. This recycling process, as explained before, only allows to retain parts of the embodied financial, environmental and technical values of the existing window. Nonetheless, this is what the industry of aluminium joinery is mainly focusing on today. It seems as if it is stuck in the recycling paradigm. As an example, the guidelines of FAC, the Belgian federation of aluminium assemblers only mentions recycling as a circular practice.[24] However, 5 other strategies exist to retain more value from post-consumer products.[25] Through workshops with architects, system developers, an assembler, a general contractor and a demolition expert, these R-strategies were discussed for metal joinery, including the question which existing roles are equipped to execute these processes. As the participants emphasized that post-consumer window frames will (almost) always need some cleaning or repair, the option of ‘repair’ is included in ‘reuse’.

Reuse by the installer

The first option is reuse, i.e. the reapplication of post-consumer windows without changes to the product itself, besides cleaning or minor repairs. The process of dismantling, transporting, cleaning / repairing, storing, transporting and reinstalling could be executed by an installer or façade contractor. Although they are not post-consumer products, windows which are refused on the construction site have the highest potential for this, given their up-to-date characteristics. To compensate for the lower energy performance of older reclaimed windows, they can be applied in two layers, as in the example of K118 in Winterthur, Switzerland.[26]

Refurbishing by the assembler

The second option is refurbishing, i.e. to restore a product and bring it up-to-date. This can be achieved through renewal of components, for example through renewing the rubber seals, fittings or coating of a window. For these processes the assembler would be suited, whether or not through a subcontracted coater. In fact, today in-situ refurbishing is already occurring as part of maintenance works, but when a window is removed from a building, this rarely seems to happen.

Remanufacturing by the system developer

The third option is remanufacturing, i.e. to use parts of a discarded product in a new product with the same function. For insulated glazing this is already being applied in practice, reapplying one reclaimed glass pane with a new coated glass pane, as described by Geboes et al.[27] For metal windows this could for example mean the windows are dismantled back into profiles to change their dimensions or to separate the inner and outer profile to renew the thermal break. At first sight, the system developer seems most suited for these processes, as they have the machinery to insert a thermal break and the network to sell remanufactured profiles, together with new ones.

Repurposing outside of the façade value chain

The final option is to repurpose, i.e. to use a discarded product or its components for a new function. This would mean the windows are removed from the façade value chain to be used by artists and designers to create other objects such as chairs, insect hotels or art installations. By imaging other material cultures, these practices have the potential to raise awareness on issues related to current linear practices. Nonetheless, it could be questioned what material use the new application avoids, as repurposing removes much-demanded aluminium and steel from the construction sector.

PILOT OPERATIONS AS FEASIBILTY STUDIES

As these four practices are different from current common practice, some questions arise from practice on their feasibility. Pilot operations in collaboration between different actors could provide answers to these questions, as suggested in the PerpetuAL project.[28] Making different mock-ups of refurbished and remanufactured post-consumer windows could not only provide more insights into the technical, financial and logistical feasibility of these processes, but also create a basis for new organizational set-ups to integrate the forward and reverse supply chains, verifying the need and viability of new intermediate roles.

Technically feasible?

As new ideas are emerging on upgrading existing window frames, new remanufacturing processes need to be developed and tested. To achieve this, a consortium involving academic researchers and industry experts could combine ideas from value retention processes from other products (such as insulated glazing) with specific knowledge on the manufacturing processes of window frames. In particular remanufacturing processes seem to provide interesting technical challenges to the industry. For example, how to reconnect metal profiles in the longitudinal direction, creating an esthetical satisfactory joint? Would connector elements (cfr. corners) create sufficient stiffness for aluminium profiles? Or to increase the thermal performance, would it be possible to renew the thermal break? As a start, could the thermal break be removed completely through a reverse mechanical process or would it be feasible to melt the polyamide break (which is a thermoplastic) out of the profiles? Just as Hegla developed a disassembly machine for insulated glazing, who will be the first to develop a disassembly machine for aluminium profiles?[29] Depending on the result of this separation process, can a new thermal break be installed in a similar way as in the regular manufacturing process or

would it be necessary to develop a new thermal separator? Or as an alternative, would it be more feasible to add insulation, without removing the existing thermal break?

Financially feasible?

As the individual components have a share of 20-33% in the total financial value of a metal window, remanufacturing has the potential to valorise this share by reapplying the profiles, fittings or accessories. Although this would be a significant improvement compared to the 0,9% value retention of recycling, the financial feasibility of specific value retention processes should be investigated. As these are typically labour intensive,[30] they might include relatively high labour costs in comparison to (automated) linear manufacturing processes. During interviews, certain actors are referring to ideas of exporting products for reprocessing in low-wage countries as an answer to this financial challenge. The authors wish to emphasize that both the increased environmental impact of transportation and the social risks of exploitation should be studied and discussed transparently before deciding on such industry developments. Moreover, such an evolution seems to contradict the creation of local jobs, which is one of the main goals of the transition to a circular economy in the Brussels Capital Region.[31] Therefore, instead of outsourcing labour, the financial feasibility of remanufacturing could increase by combining process innovations with legal changes. More specific, the amount of non-desirable manual labour (e.g. including risks for the workers' health) might be reduced through developing new reprocessing machines, while the cost of local labour should be reduced without negative effects on the workers' wages. Founded in the Netherlands, the Ex'tax Project Foundation is studying the practical implementation of tax shifts that could enable this change.

Logistically preferable?

Moreover, questions emerge about which option would be logistically preferable from a societal point of view. In general, assemblers are smaller companies which are operating locally, while system developers are often operating on an international scale, with a centralized location to assemble the profiles. As a consequence, based on the existing supply chain, bringing the profiles back to a system developer might require more transportation in comparison to direct refurbishing by a local assembler. It should be emphasized that the geographical distribution of the assembling activities might not only differ between different brands, but also between different façade systems (i.e. windows, post and beam curtain wall systems, and unitized systems).

OPPORTUNITIES WITHIN A CIRCULAR VALUE CHAIN

Finally, the question rises how to organize these circular material trajectories. As mentioned before, in Belgium there are a very limited number of established networks connecting the reverse and the forward supply chains, beyond recycling. Today, direct reuse of metal windows is facilitated by a handful of small-scale reclamation dealers, while recycling is integrated into the value chain, supported by networks such as A | U | F in Germany. To also include the other value retention options in the façade value chain, the following questions should be investigated: "How to integrate the key logistics operations that connect supply channels from deconstruction planning in reverse logistics back to the new distribution channels in forward logistics? … Who are the logistics intermediaries?"[32]

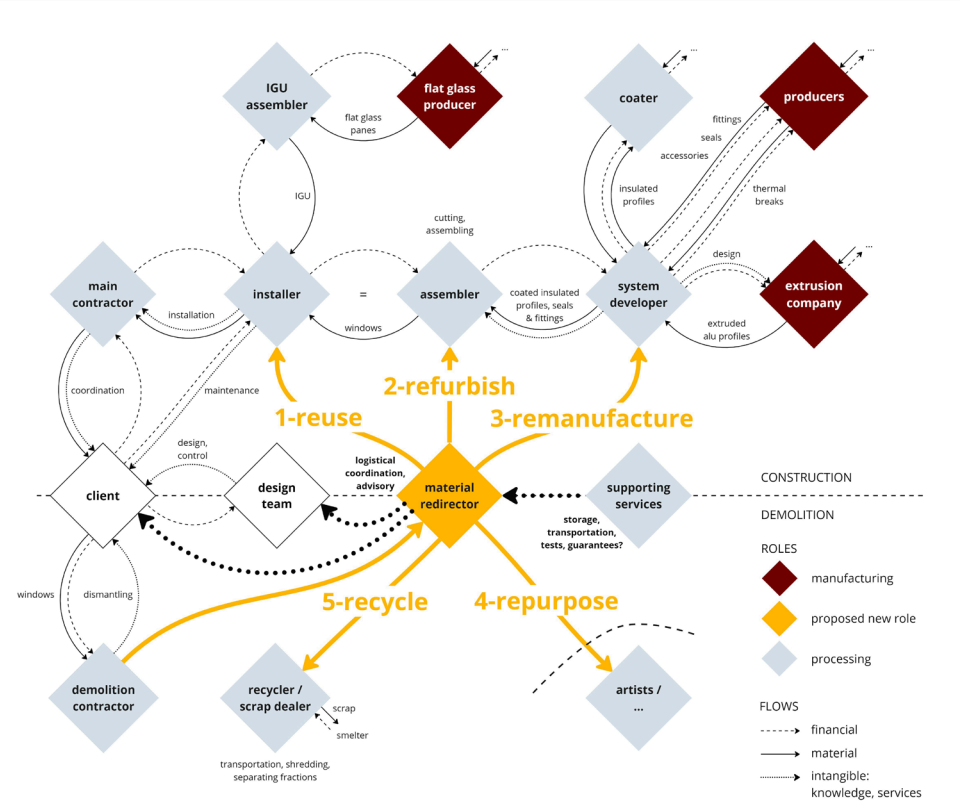

Figure 1. Hypothesis of a new role of material redirector, facilitating the different value retention options for metal windows

The material redirector

Through the workshops with practitioners an opportunity was detected at the intersection of the construction and demolition side of the façade ecosystem. This resulted in the hypothesis of a new role, a 'material redirector', as the new generalist connecting the reverse and the forward supply chain. Their main task would include the coordination of the different flows of post-consumer joinery, estimating the feasibility of the different options through a cascade system, based on the hierarchy of R-strategies. Therefore, their two crucial assets would be their knowledge on existing products and value retention processes, and their network including all different stakeholders from the façade value chain. In addition to this material flow coordination, they could provide advisory to clients, design teams and façade contractors. Through feasibility studies on the technical, financial, environmental and logistical aspects the material redirector could facilitate their decision-making on including post-consumer joinery in their projects.

Dealer or broker?

One of the recurring challenges for reusing (façade) products is the intermediate storage. More specific, clients, contractors, assemblers or system developers are rather hesitant to take the financial risk of storing reclaimed products without having a new destination for it yet. In the existing reclamation market, this is of course one of the important added values of a reclamation dealer who creates a stock. In analogy to finance, the material redirector could also choose to act as a broker. In both cases, intermediate storage will be necessary, but as a broker the material redirector would not anticipate a future demand as a stockist, but instead try to find a match between the offer of (soon-to-

be-available) windows and the product demands from new projects. If no match can be found, the windows would not be stored and disposed of for recycling. Indeed, this time limitation might result in a significant reduction of the windows that could be reused, but as the scope of the forward supply could be broadened by also including refurbishing and remanufacturing options, could it reduce the use of new components more effectively? Next to the intermediate storage, the material redirector could also organize transportation, tests and guarantees.

If the cap fits, wear it

With the technical knowledge and network as the main assets of the material redirector, existing system developers might be suited to take up this role. This would be an example of vertical integration (i.e. actors taking up different roles), as suggested by Smeets et al in order to distribute costs and gains of structural steel reuse among less actors.[33] To the authors' knowledge, currently already one system developer is investigating the specific possibilities of taking up this role, as shown in the process map by Batalla Garcia[34], and two other system developers are experimenting with remanufacturing processes through mock-ups. Instead of one organisation taking up the coordinating role in value retention processes, also a new organisation could be created as a consortium between different stakeholders. Although the Dutch sector agreement 'Circulaire Geveleconomie' might provide a breeding ground for such an initiative, it also shows the difficulty of making the industry look beyond recycling practices.

CONCLUSION

By investigating the value retention options for post-consumer aluminium and steel joinery from a value network perspective, this research showed the existing value chain of metal windows is stuck in a recycling paradigm. The possible alternatives of circular trajectories are to reuse, refurbish, remanufacture or repurpose the windows. To facilitate this, a material redirector could become a new central role connecting the reverse and forward supply chain of metal windows. Its added value would include material flow coordination, advisory and intermediate storage (as a dealer) or matchmaking (as a broker). To investigate the technical, financial and logistical feasibility of these processes and to refine the added values of this new role, the authors suggest to organize pilot projects, ranging from mock-up settings to actual projects.

ANNEX A. EXISTING VALUE NETWORK ALUMINIUM JOINERY

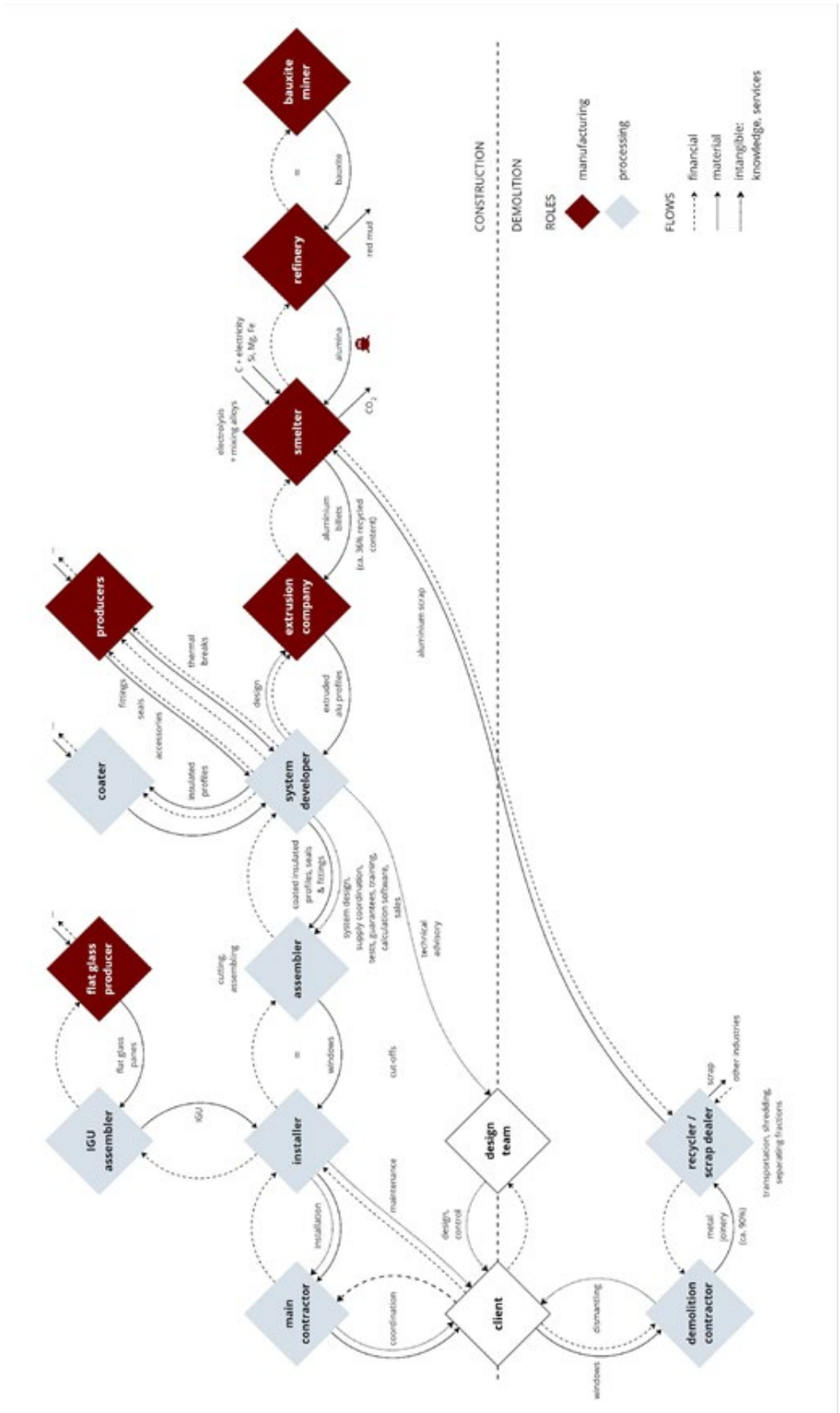

Figure 2. Value network map of aluminium windows from the Belgian system developer Reynaers

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WHAT CONDITIONS HAVE LED TO DESIGN FOR DECONSTRUCTION IN TEMPORARY INTERVENTIONS? A QUALITATIVE COMPARATIVE ANALYSIS.

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INTRODUCTION

As awareness of the value of temporary use (TU) for reactivating unused buildings grows, its implementation is increasingly more embraced by society. However, these reactivations often prioritize short-term impact, leading to inefficiencies in design interventions and material losses afterwards. The limited time available for making thoughtful, sustainable choices (is a condition that) seems to reinforce that pattern.

To address these challenges, this article explores the conditions that enable the implementation of Design for Deconstruction (DfD) in spatial interventions within temporary use projects in Brussels. DfD is an emerging circular strategy for sustainable design interventions that promotes material-conscious practices. Therefore, we question:

Which conditions result in Design for Deconstruction in temporary interventions?

Spatial Interventions and Material Usage in Temporary Use projects

Temporary use (TU) emerged through to the immense number of vacant buildings, which in the Brussels Region is estimated to account for 6.5 million square meters.[1] Originating from the squatter's movement, temporary use is now increasingly more often being implemented by public institutions and private developers to stimulate urban regeneration,[2] and intentionally, or not, gentrification.[3]

The recognition of the benefits of TU for preventing the negative effects of vacancy, like vandalism and urban decay, and the positive effects on social life allowed its implementation to boom in the last ten years in European cities like Brussels. In Brussels, this growth is particularly notable, with TU projects increasing from just one in 2014 to twelve int 2023. This expansion has not only diversified the types of temporary activities[4] but also transformed the nature of contracts and initiatives. Whereas TU was once organized mainly through open project calls involving non-profits and vacancy management companies, Brussels now sees public design competitions where architectural and urban planning offices are actively proposing TU projects.[5]

Understanding and exploring this shift and rise of TU is especially interesting in the context of a sustainable built environment. The construction sector is known to be a significant contributor to greenhouse gas emissions. With construction and demolition waste accounting for more than one third

of all waste generated in the European Union, the construction sector also is the main contributor to waste generation.[6]

Since raw resources are becoming increasingly scares, construction materials need to be recovered at their end-of-life and reused in closed cycles. In fact, material reuse is being promoted more and more in large scale construction projects.[7] In smaller adaptive reuse projects, like TU projects, reuse already seems to be a common practice as is observed.[8] TU, in fact, has a history that can be linked to sustainable practices, like reusing and transforming existing buildings for new initiatives and activities as well as various materials, products and elements.[9]

Yet, this reuse is primarily driven by economic necessity, coupled with the urgency inherent in temporary settings.[10] Temporary use managers in particular, face the challenge of quickly establishing their activities with limited financial resources. This often results in inefficient design interventions and material damage, which limits the potential for future reuse. The lack of adequate preparation time and budget further hampers the ability to make material-and design-conscious choices.

Circular Design Strategies

In our previous research, we explored common material and design choices in TU. That research - based on nine TU projects in and around Brussels - highlighted several critical considerations and action points, that must be considered when designing material-wise TU. A framework was proposed to design and analyze TU, that offers a holistic approach going beyond the standardization of TU, by putting forward perspectives and guidelines for the materialization, design and actors. [11]

This research confirmed that implementing circular design strategies in construction projects can be essential to shift to a sustainable built environment and construction sector, where resources are valorized and recovered. Specific design choices, such as extending the service lives of buildings and closing material loops by reuse and recycling are key strategies in the transition to a circular construction sector that can easily fit TU.[12]

In TU, material reuse manifests through an interplay among onsite, network-based, and external recovery and reassembly practices. In addition to material reuse, two additional strategies were observed within the TU context: Design for Deconstruction (DfD) and modularity. Both lever the potential for future reuse and resource savings; however, they are not consistently implemented.[13]

In fact, DfD is a key design principle that must be followed from the design stage onwards.[14] It is one of the key aspects of circular design, as it aims to extend the service life of components and materials by allowing easy disassembly, without damage, and ensuring a high reuse potential.

To understand which conditions support or encourage DfD in temporary interventions, this article employs a Qualitative Comparative Analysis (QCA) to provide a transparent, yet explorative view of the conditions under which the circular strategy DfD was followed in the past. QCA proves particularly advantageous for probing such complex relationships and combinations of conditions that contribute to specific outcomes.[15]

METHODOLOGY

The reach the objective of identifying patterns of conditions under which DfD was applied, a Qualitative Comparative Analysis (QCA) is conducted. The following section provide insight in method for the collection of the case studies, and the preparation of the QCA.

Collecting case studies

To address the research question, twenty-eight distinct temporary design interventions were identified, across ten temporary use projects (TUPs) in and around the Brussels Capital Region. Each case was thus embedded within broader TUPs. The selection of cases was driven by two main criteria: either

the reuse of existing building materials or the use of new materials in the temporary interventions. This dual focus enabled a comparison of different approaches within TU.
Data collection involved a triangulation of methods to ensure robustness. Data was collected through semi-structured interviews, literature, and site visits. The semi-structured interviews with temporary project managers and architectural offices were conducted in Dutch or English, depending on the interviewee's preference, and they were transcribed. **Figure 1** gives an overview of the cases of temporary interventions selected per temporary use project (TUP).

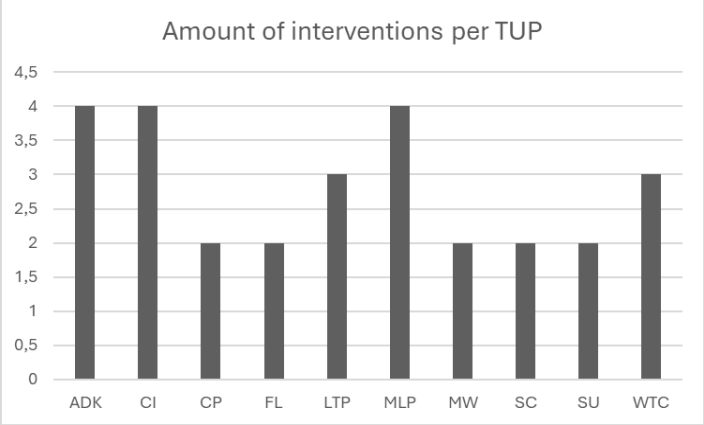

Figure 6. Overview of cases (design interventions) per TUP

Setting up the QCA

A Qualitative Comparative Analysis (QCA) was applied to offer a comprehensive, case-wide overview of the diverse conditions under which Design for Deconstruction (DfD) has been effectively implemented. This study utilized the fuzzy set QCA (fsQCA) approach, as detailed by Schneider and Wagemann,[16] which allows for a more refined analysis by accommodating the gradations in how conditions are present or absent in each case. The fsQCA software is a specialized tool designed for QCA's, enabling researcher to systematically explore complex causal relationships across cases. Details on how our fuzzy sets were defined can be found in the 'Defining Data Sets' section.
In QCA, consistency and raw coverage are two key metrics used to evaluate the strength and relevance of the data. The consistency (cons) measures how consistently a combination of conditions leads to a specific outcome. It is a measure of reliability. To ensure thus reliable solutions and reduce the impact of contradictory cases, a consistency threshold of 0.8 should be applied in the software.[17] Raw coverage (rcov) indicates the proportion of cases with the outcome that are explained by a specific combination of conditions. It is a measure of relevance. As such, a raw coverage limit of 0.25 should be set to guarantee that each solution's frequency of occurrence is significant.[18]
The conditions analyzed were determined through a two-step process. An initial exploration of the data highlighted key distinctions between different temporary use projects, particularly in areas related to the lenses of the framework for designing TU: Actors, Design and Materialization.[19] The 'Actors' category further includes distinctions related to governance models, financial structures and stakeholder engagement. Additional conditions were sourced from existing literature and recurring themes from interviews, reflecting the real-world complexities of temporary use projects.

Categorization of Conditions

A fuzzy data set was formulated for iteratively defined conditions. These conditions encompass key characteristics of temporary use projects, and key characteristics for the materialization and design of interventions. **Table 1** shows the conditions considered to build up the fuzzy data sets.

Condition	Explanation
Financially Driven Manager: FDM	Was the manager financially driven? Financially driven managers include those from vacancy management firms, transitional real estate companies, and smaller profit-oriented businesses.
Financial Support: FS	Was there financial support for the temporary project and its spatial interventions? For example, property owners might support the project by maintaining their building but not the spatial interventions, while government agencies might provide financial support through grants and subsidies.
Difficult Design Intervention: DDI	Was the design intervention challenging? Did the existing building and its constraints limit certain design possibilities? Designing enclosed spaces or partition walls typically presents greater complexity that creating public space furniture.
Designers: D	Was the spatial intervention designed by experts, such as technical advisors, architectural firms, or scenography designers? They have expertise and experience in the design development and supervise the execution.
Materials Value: MV	Were the materials used in the spatial intervention valuable for deconstruction? For instance, wooden beams and elements, Cross Laminated Timber (CLT), steel, and glass are noted for their high reuse potential. Whereas cardboard, fiber boards and concrete are typically discarded.
Do-It-Yourself: DIY	Were the users involved in designing and constructing the spatial intervention? For example, managers and users might adopt a DIY approach, learning by doing rather than relying solely on professional design.

Table 1. Definition of the different conditions

Defining Data Sets

For making **table 1** practical, a fuzzy data set was drawn up to assess the extent to which specific conditions were present in each case, with values ranging from 0 (completely absent) to 1 (fully present), including intermediate values of 0.4, 0.6, and 0.8 to capture partial membership.

The Financially Driven Manager (FDM) condition was binary, with 1 indicating the presence of a financially driven manager and 0 indicating their absence.

For Financial Support (FS), a value of 1 was given when funding was used for the intervention and its design, 0.6 when it was for the project's operational functioning but not the intervention, and 0 when no support was received.

The Difficulty of Design Intervention (DDI) condition assessed design complexity, with 1 for highly complex interventions, 0.6 for moderate ones, and 0 for simple interventions.

Designer Background (D) values ranged from 1 for professional architects, 0.8 for scenography designers, to 0.4 for temporary use managers acting as designers.

Material Value (MV) measured the reuse potential of materials: 1 for commonly reused materials like wood, steel, glass or aluminium, 0.6 for moderate reuse materials, like wooden building components

and products, 0.4 for 'waste' materials like plastic crates and fiber boards, and 0 for concrete and the like.
Lastly, the Do It Yourself (DIY) condition evaluated construction responsibility, with 1 if users constructed the intervention, 0.6 if individuals with some construction knowledge were involved, and 0 if contractors or professionals did the work.
These values are a first attempt to implement the fuzzy approach ... and can be discussed. Also, their robustness should be evaluated in further analysis, for example with sensitivity analyses, to verify if changes in these values would change the conclusions or not.

Defining outcome: Design for Deconstruction

Considering the objective developed above, the data set was tested for the outcome Design for Deconstruction (DfD). This outcome is defined here as the initial intention to design and implement the materials and elements in such a way that deconstructing them would be easy and without damage. Table 2 shows the resulting data sets.

CASES	FDM	FS	DDI	D	MV	DIY	D4D
ADK_Yellow Atelier	0	0,8	0,6	0,4	1	1	1
ADK_Kitchen Wall	0	0,8	0,6	0,4	1	1	1
ADK_Skate ramps	0	0,8	0,6	0	0	1	0
ADK_OutdoorStructure	0	0,8	1	1	1	0	1
LTP_Atelier Boxes	0	0,6	0,6	0,4	1	1	1
LTP_Expo Structures	0	0,6	0,8	0,4	1	1	0
LTP_Bar	0	0,6	0,8	0,4	0,4	1	1
WTC_Replika Expo box	0	1	1	1	1	0	1
WTC_coworking	0	1	0	1	0,6	1	0
WTC_Curtains	0	1	0	1	0,6	1	0
SU_kinograph	1	0	0,8	0	1	1	0
SU_Velodrome	1	0	1	1	1	0	1
SC_B-Modules	1	0	1	1	1	0	1
SC_Atelier	1	0	0,6	0,4	1	0	0
CI_Users'offices	1	0	1	1	1	0,6	1
CI_Communal KitchenWall	1	0	1	1	1	0,6	1
CI_fences	1	0	0,2	0,4	1	0	0
CI_Scaffolding structure	1	0	1	1	1	0	1
CP_dj booth	1	1	0,6	0,4	0,8	1	1
CP_Containers	1	1	0,4	0,4	1	0	0
FL_Scenographies	0	1	1	0,8	1	0,6	1
FL_containers	0	1	0,4	0,8	1	0	0
MW_Containers	0	1	0,4	1	1	0	0
MW_ArchCanopy	0	1	1	1	1	0	1
MLP_Scaffolding	0	1	1	1	1	0	1
MPL_Crates wall	0	1	0,6	1	0,4	0	0
MPL_Circular' Façade	0	1	1	1	1	0	1
MPL_Containers	0	1	0,4	1	1	0	0

Table 2. Defining sets (input)

DISCUSSION OF THE RESULTS

When performing the Qualitative Comparative Analysis (QCA), the fsQCA software produced the results that will be explored in this section.

First, we discuss the results from the Analysis of Necessary Conditions. This analysis identifies conditions that must be present for the outcome DfD to occur. This insight is crucial for understanding the fundamental requirements of an outcome.

Second, we present the results of our QCA truth table, which includes the complex, parsimonious and intermediate solutions.

Last, we provide an in-depth discussion of the intermediate solution, focusing of the specific combination of conditions that it reveals.

Analysis of Necessary Conditions

The fsQCA software facilitates a quick analysis of the necessary conditions, as detailed in Table 3. For a condition to be necessary, its consistency must reach 1.[20] When we tested our conditions (FDM, FS, DDI, D, MV, DIY) against the outcome (DfD), no condition met the threshold for necessity. However, Material Value (MV) (cons 0,95; cov 0,61), Difficulty of Design Intervention (DDI) (cons:0,88; cov: 0,73) and Designer (D) (cons:0,80; cov: 0,63) were identified as important due to their high consistency, though they fell short of being necessary. This underscores the complexity and project-specific nature of temporary use (TU) projects and their associated design interventions.

	Consistency	**Coverage**
FDM	0.375000	0.600000
DDI	0.887500	0.731959
FS	0.600000	0.533333
D	0.800000	0.633663
MV	0.950000	0.612903
DIY	0.425000	0.576271

Table 3. Analysis of Necessary Conditions (output)

QCA Solutions: Under which conditions was Design for Deconstruction applied in temporary interventions?

In a QCA, so-called solutions are derived through the construction and simplification of a truth table by the software, as detailed in Table 4. The truth table lists all possible combinations of conditions across the cases, indicating whether the outcome occurs in each case. The table is then simplified by grouping similar configuration, which reduces complexity and highlights key patterns. From this QCA generates three types of solutions:

The **complex solution**, which includes all conditions and combinations, offering detailed insights but may include overly specific patterns. From our QCA, three combinations of conditions were generated:

FDM*DDI *~FS*D*MV (rcov: 0,31, cons: 0,89)

~FDM*DDI*FS*D*MV (rcov: 0,45, cons: 0,79)

DDI*FS*~D*MV*DIY (rcov: 0,18, cons: 0,83)

The **parsimonious solution**, which is simplified by including only essential conditions, focusing on core factors but potentially losing nuance. From our QCA, two combinations of conditions were generated:

DDI*FS*MV (rcov: 0,54, cons: 0,77)
DDI*D*MV (rcov: 0,8, cons: 0,81)
The **intermediate solution**, which strikes a balance between the two, retaining important conditions while simplifying others for practical insights. From our QCA, three combinations of conditions were generated:
FDM*DDI *~FS*D*MV (rcov: 0,31, cons: 0,89)
~FDM*DDI*FS*D*MV (rcov: 0,45, cons: 0,78)
DDI*FS*~D*MV*DIY (rcov: 0,18, cons: 0,83)
With * meaning 'and' (also this condition was fulfilled) and ~ meaning 'not' (the opposite of condition was fulfilled). With rcov meaning 'raw coverage' (measure of relevance) and cons meaning 'consistency' (measure of reliability).

FDM	DDI	FS	D	MV	DIY	number	D4D	cases	raw consist.	PRI consist.	SYM consist
1	1	0	1	1	1	2	1		1	1	1
1	1	1	0	1	1	1	1		1	1	1
1	1	0	1	1	0	3	1		0.863636	0.863636	0.863636
0	1	1	1	1	1	1	1		0.846154	0.846154	0.846154
0	1	1	0	1	1	4	1		0.8	0.8	0.8
0	1	1	1	1	0	5	1		0.764706	0.764706	0.764706
0	1	1	0	0	1	2	0		0.5	0.5	0.5
0	0	1	1	1	1	2	0		0.5	0.5	0.5
0	0	1	1	1	0	3	0		0	0	0
0	1	1	1	0	0	1	0		0	0	0
1	0	0	0	1	0	1	0		0	0	0
1	1	0	0	1	0	1	0		0	0	0
1	0	1	0	1	0	1	0		0	0	0
1	1	0	0	1	1	1	0		0	0	0

Table 4. QCA's truth table (output)

Discussion of the Intermediate Solutions

Even though the generated solutions did not have a consistency (cons) of 1, meaning that not all conditions were always present when Design for Deconstruction (DfD) was applied, they provide valuable interpretations of the results. In particular, they might serve as a starting point for an in-dept analysis of each case, or as a starting point for discussion with actors involved in past, current and future TU projects. Each of the Intermediate Solutions is expressed in words below.

Financially driven manager, but no financial support

The solution FDM*DDI*~FS*D*MV indicates that DfD seems to be implemented in scenarios where a financially driven manager is involved, the design intervention is complex and challenging, valuable materials are used, a professional designer is engaged, and there is no external financial support.

This pattern suggests that financially driven managers are motivated to ensure a return on their investment. This could be achieved by reselling the building materials and components in the future or by reusing them in other projects. Moreover, the analysis outcomes and a review of the cases fitting this solution reveals that temporary interventions were typically designed by architects and other professionals with construction expertise. Their interventions often involved high-value construction materials, such as wood, cross-laminated timber (CLT), steel, and glass, as well as elements like scaffolding. These materials represent a significant investment for temporary use projects, making it advantageous for the investor if they can be deconstructed and repurposed in future endeavours. **Figure 2** represents the cases of temporary interventions that correspond to this first solution.

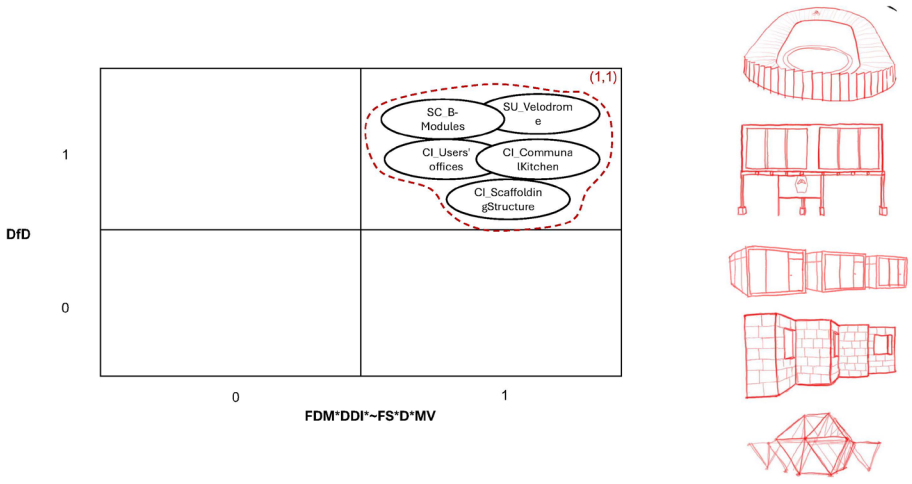

Figure 7. Cases presenting the combination of conditions

No financially driven manager, but financial support

The solution ~FDM*DDI*FS*D*MV reveals that DfD tends to be applied in situations where there is no financially driven manager, but a challenging design intervention is undertaken with valuable materials by a professional designer, supported by external financial funding.

Analysis of the cases fitting this solution highlights that temporary interventions have been often arising from design competitions, where the briefs specifically emphasize circular strategies such as DfD and reuse. Additionally, two more cases partially align with this solution. They have been featuring temporary interventions with external funding, such as research grants or subsidies. These cases further illustrate how external financial backing, in the absence of an aim to have a return of

investment, can drive the adoption of sustainable design practices in temporary projects. **Figure 3** illustrates the cases of temporary interventions that correspond to this second solution.

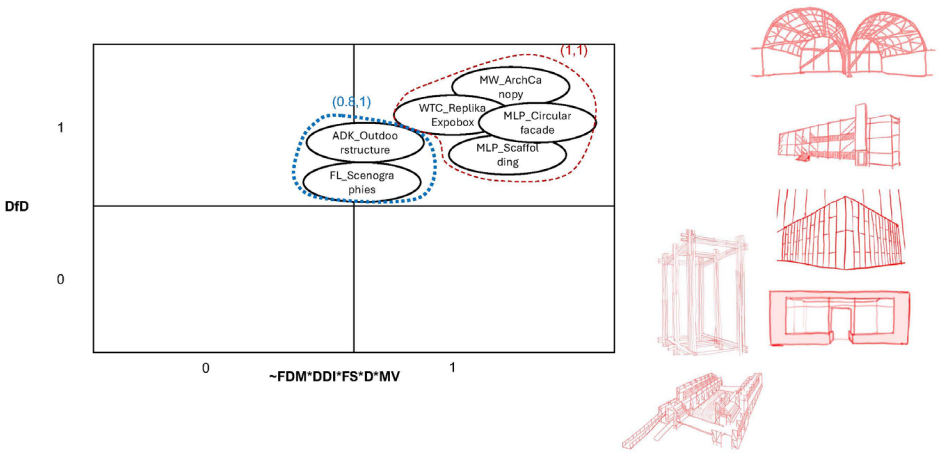

Figure 8. Cases presenting the combination of conditions

No designer, but do-it-yourself

The solution DDI*FS*~D*MV*DIY indicates that DfD seems to be more likely applied in cases involving a moderately challenging design intervention, where materials with some reuse value are used, and both the design and construction are carried out by the space's users with some form of financial support, but without the involvement of a professional designer or architect.

The cases fitting this solution show that no formal design process was undertaken beforehand. Instead, users approached the design in a do-it-yourself manner, as highlighted during stakeholder interviews. These interventions predominantly utilized reclaimed materials, often repurposed for their third or even fourth life. The DfD in these cases appears to follow a practical method, where materials are assembled in a way that allows them to be easily unscrewed and reused elsewhere. However, interviews revealed that after deconstruction, these some materials were cut into smaller parts by future reusers, highlighting that DfD does not guarantee future reuse. **Figure 4** illustrates the cases of temporary interventions that correspond to the solution.

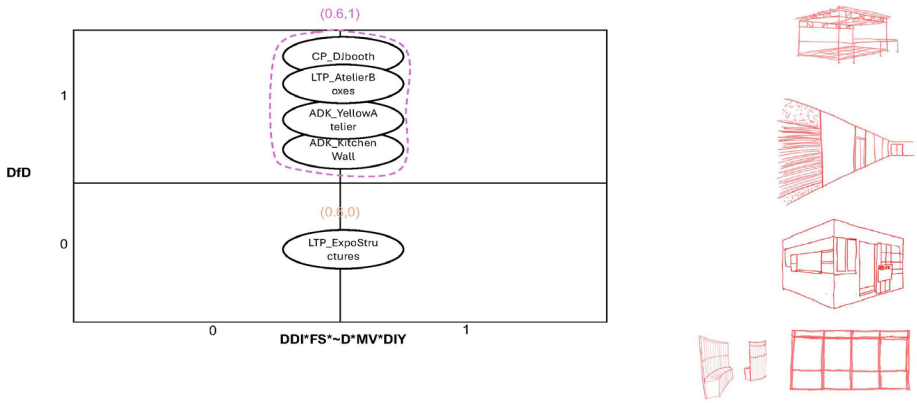

Figure 9. Cases presenting the combination of conditions

CONCLUSIONS AND CRITICAL REFLECTION

The application of QCA to study circular design strategies, like Design for Deconstruction (DfD), in temporary interventions has yielded insightful patterns but also revealed critical limitations. The results indicate that the predefined thresholds for consistency and coverage, presented by Schneider and Wagemann,[21] were not met, suggesting that the findings are not robust enough to draw definitive conclusions about the necessary conditions or combinations thereof for implementing DfD. This highlights the need for careful consideration of these thresholds and the possible need for adjustments based on empirical findings.

The analysis did however reveal preliminary patterns, such as the potential impact of complex interventions involving valuable materials, the involvement of designers and professionals with construction knowledge, and external financial support. QCA proved to be a valuable method for uncovering patterns and relationships in complex cases involving multiple conditions. Its strength seems to lie in its ability to handle qualitative data and identify combinations of conditions that lead to specific outcomes.

A potential avenue for further research could involve investigating the influence of varying types of financial support and managerial involvement in more detail, in addition to reviewing the conditions and including the ones that might have been missed in this study.

Altogether, with this explorative study it is illustrated how QCA can offer added value. It can enable researchers to explore complex causality and identify patterns that are not easily discernible through quantitative methods alone. In the context of DfD, QCA can elucidate the interplay of various conditions and provide a framework for understanding how different conditions collectively influence the adoption of sustainable practices.

In addition, the QCA's outcomes can be the starting point in reflexive discussions with stakeholders and in informing decision-making processes. Fin, QCA's findings can guide policymakers, building owners and practitioners in crafting targeted policies. For example, understanding that certain configurations of financial support and architectural complexity might influence the implementation of circular practices can encourage more effective support mechanisms for temporary use projects.

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RESILIENCE BY RECYCLING ANALYSIS OF THE POTENTIAL OF USING RECYCLED MATERIALS AND PRODUCTS IN ARCHITECTURE AND DESIGN

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INTRODUCTION

The base of this collaborative research was to find ways to introduce more recycled and sustainable materials to architectural design. Our discipline generates much environmental pollution; construction, demolitions, maintenance, and just the everyday life of a building require considerable energy and produce even more waste. As a UK study points out: "*around 420 million tons of materials are used each year in the construction industry* (only!) *in the UK; however, only 360 million tons are incorporated into products. Additionally, construction and demolition activities in the UK generated more than 150 million tons of waste in 1998, comprising 40% from the manufacture of products and 60% from site-based activities, including an estimated 13 million t of unused material"*.[1] These rates have only gone higher in recent years, even though we have gained more and more information on the damage caused by pollution on Earth. The same research showed no clear relationship between companies with ISO 14001 certification and implementing actual waste minimization activities. According to a 2004 estimation, 33% of wasted materials arise because architects fail to design out waste.[2]

As global concerns regarding climate change and resource depletion intensify, architects must seek innovative solutions that minimize environmental impact while fostering aesthetic and functional excellence. One of the potential solutions could be investigating the pivotal role of renewable materials in advancing sustainable architecture, particularly exploring their effective integration into architectural design projects. This study identifies and evaluates a variety of renewable materials, such as recycled plastic, reclaimed wood, natural insulation, and biodegradable composites, emphasizing their potential to reduce carbon footprint.

Taking plastic as an example, according to an OECD study, we humans have produced one ton of plastics per person every year since 2019, and this consists of mostly packaging and single-use objects which, over time, find their place in rubbish bins and then be mismanaged 22%, or landfilled at about a 50% ratio while only 9% of it gets recycled.[3] According to their more recent research,[4] even though 2020 caused a 2.2% decrease in plastic production, from 2021, the plastic industry returned to its "normal" upward trajectory of plastics production, and waste generation resumed.

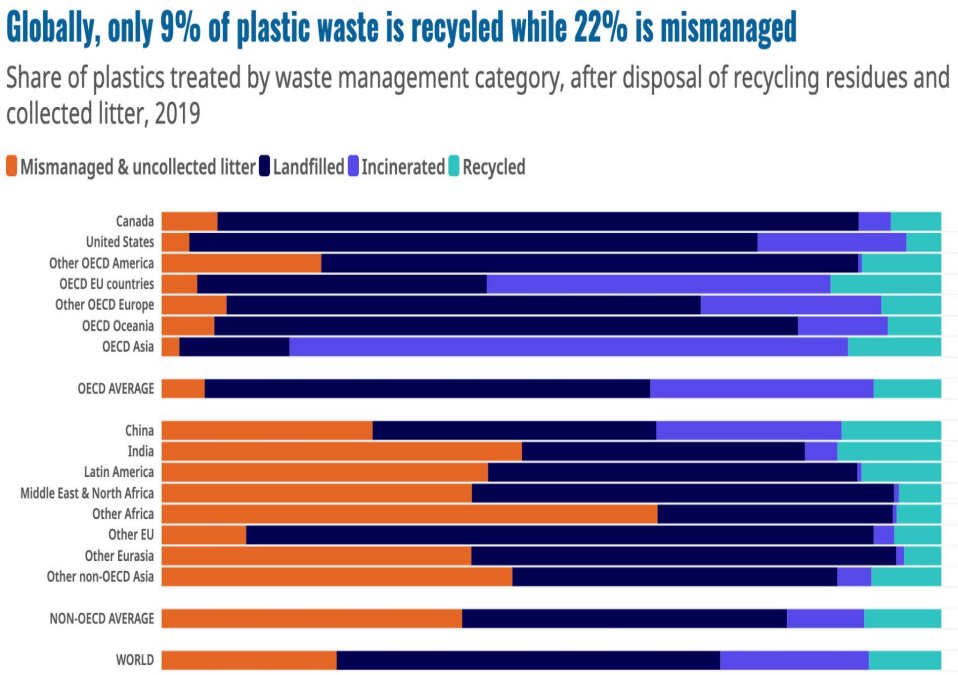

Figure 1. Global plastic recycling rates.[5]

To tackle this issue, academia is focused on different fields related to circularity and accountable sustainability by creating a multidisciplinary scene to gather information and give solutions to current and upcoming problems. In a UK study at Kingston University,[6] the survey explicitly targeted architects and designers to understand their use of "recycled." However, the current study opened the demographic window to all disciplines and people of all age ranges to see a broader picture of the approach toward these materials and products.

In many international surveys on sustainable building design practices, research and authors focused more on the design practice itself and life cycle analysis, such as Bunz, Henze, and Tiller,[7] giving detailed insight into the strategies used in Europe, Asia, and North America. However, these studies did not monitor the approach, knowledge, and willingness of architects and people towards the matter, which is vital when deciding on a more sustainable solution. The research often shows that "green solutions" are not embedded in architectural practice enough, as a 2016 study by Ajah Ekpeni Obia & Isaiah Dickson Obot points out, due to the lack of knowledge on this matter.[8] Their research used a questionnaire to examine the understanding of sustainable architecture and raise awareness in South Nigeria. However, they still didn't survey the disposition to include such techniques in practice. Their study pointed out that the concern is more about the lack of knowledge of materials and the availability of such products in many cases, which also became part of the current study.

In addition to that, architects and customers are not the only ones deciding on a greener possibility. Governmental building rules and regulations often limit choices such as recycled or natural materials. This topic appears in the research mentioned above developed at Loughborough University on the attitude of architects and contractors to waste minimization,[9] and in conclusion, pointed out a few critical stages where the problem could be tackled: *the design process itself, better waste management practices by sub-contractors, a change of culture to improve company and individual attitudes,* and such rules and regulations which would benefit reducing waste during all stages of building constructions. However, their investigations did not monitor the attitude of clients, even though they

pointed out their lack of interest, which will be a main obstacle when it comes to building sustainably and reducing a building's environmental impact.
The current study incorporates questions regarding local and governmental regulations as designers and customers see them. It also aims to fill the gap between knowledge, preparedness, and disposition to "building greener" by determining whether recycling and sustainable resources are well received among the respondents. By contributing to collecting information about the popularity of recycled products, this work aims to guide architects, policymakers, and stakeholders in making informed decisions that prioritize using renewable materials, fostering a more sustainable and resilient built environment for future generations.

METHODOLOGY

The questionnaire consists of qualitative and quantitative measurements, mostly using a five-point Likert scale to analyze data, implemented through an online platform (Qualtrics) to assess the practical implications of incorporating renewable materials in everyday architectural and design projects, monitor the level of satisfaction related to rules and regulations on waste management and recycling, and lastly to inquire after the amount of available information and education. Moreover, this study also explores the challenges and barriers architects face in adopting renewable materials, considering cost, availability, and regulatory constraints. The opinions of consumers and designers have been assessed to find out their willingness to use innovative techniques and if they have any negative preconceptions regarding circular design.

Data collection

The questionnaire was prepared and written in English, then spread online via email, social media, and university contact lists. Data collection took place from March until May of 2024.
The online platform we used allowed us to collect responses internationally, so we could also reach respondents from Europe, Asia, and North America.

Questionnaire structure

The questionnaire covered forty-two questions and included four sections: demographics; knowledge of waste management, waste recycling, and related regulations; customer and designer attitudes towards recycled materials and products; and lastly, general education on recycling and sustainability. Demographics were assessed through four main variables: gender, age, country of residence, and occupational status. The core started with five questions regarding solid waste and recycling knowledge, followed by five regarding local and governmental rules and regulations. The attitude section consisted of twenty questions regarding companies' and customers' approaches to recycled materials and products and the availability of such techniques and artifacts. Finally, the education section had four questions regarding elementary and higher education on recycling and sustainability.

Analysis of specific research questions

The 196 responses received were analyzed using Qualtrics. Below are ten selected diagrams demonstrating the overall image of the concluded work. Diagrams from group number one, related to demographics, show that the questionnaire reached a wide range of people considering age. Though most answers came from university students and young adults, we also had a few responses from middle-aged and retired respondents. Two-thirds of the respondents were female, and internationally, we reached three continents by gaining responses from the United States, many European countries, Turkey, and Jordan. The current paper focuses more on the second and fourth groups of questions regarding general knowledge, regulations, and education received on recycling.

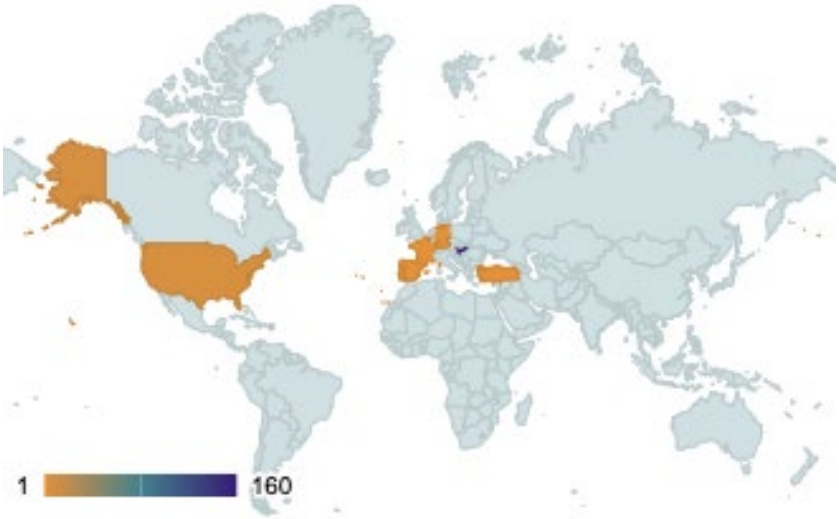

Figure 2. Nationality chart

The diagrams of group number two revealed a more comprehensive range of information related to knowledge on recycling and regulations concerning waste management.
One of the first questions was: *Have you ever heard about the process of local material recycling?*

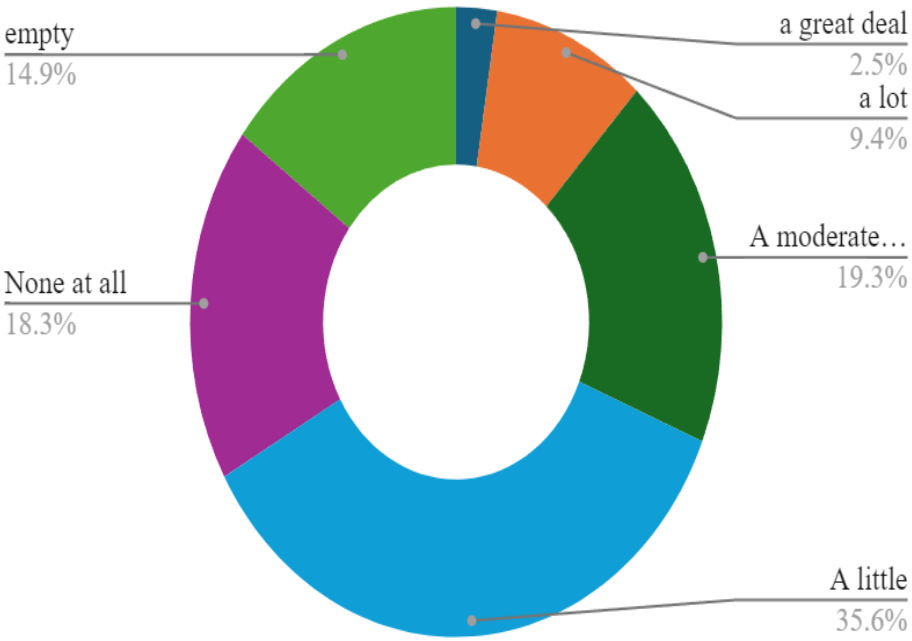

Figure 3. Knowledge of Local Recycling.

At this point, we learned there is a huge gap between academic research and general knowledge. Even though local recycling has been a well-known process since Precious Plastic started its global movement[10] in 2013, only 11% of respondents answered they knew some of the process. 55% of respondents confirmed they had some knowledge but mostly vague ideas, and almost 20% confirmed they knew nothing about local recycling techniques. In this group of questions, we asked after regulations, as an example, the following:

Are you satisfied with the governmental or local regulations and public roles concerning waste management and recycling (for example, are there any rules against local initiatives or waste use? Does waste collection go efficiently and sustainably? Do you see strikes or mistreated waste management? etc.)?

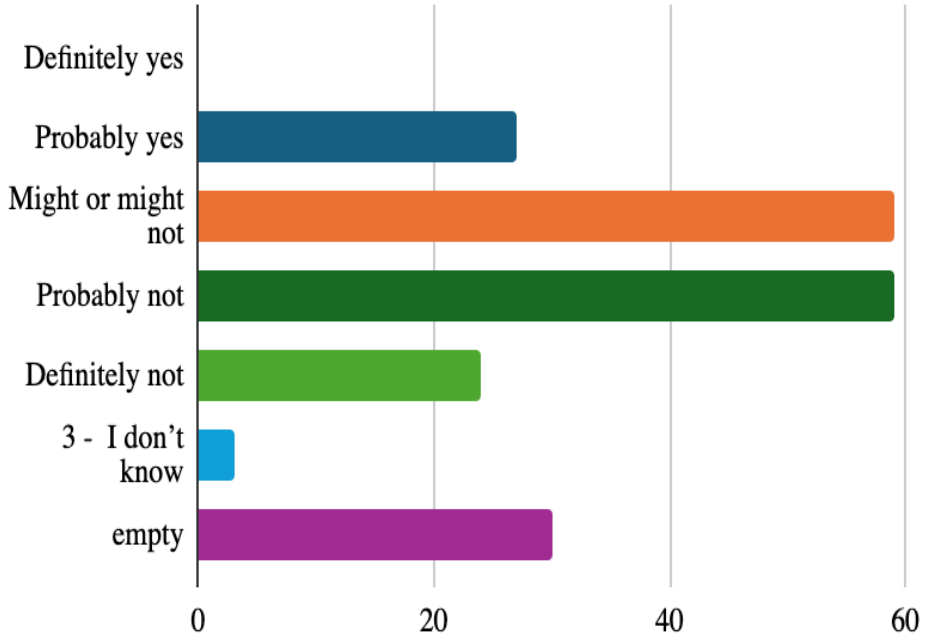

Figure 4. Governmental regulations satisfaction chart.

We were interested in the economic points of view individually, thus listed several questions regarding the willingness of people to invest in such products, such as:
If a recycled product is more expensive, would you be willing to choose it over a less sustainable option?

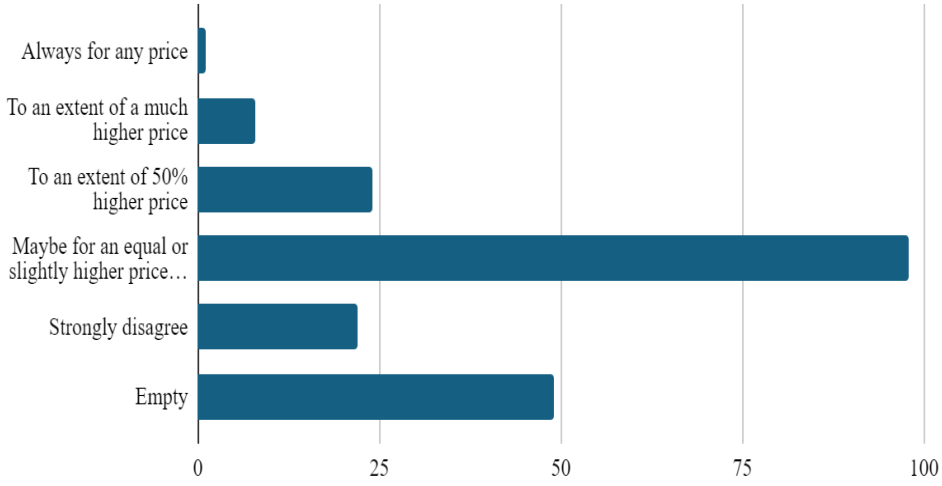

Figure 5. Investment in Recycled Products.

Also, we wanted to collect some information on the general availability of these products and materials like in the following question:
Do you think there is sufficient choice in the building material market for recycled products?

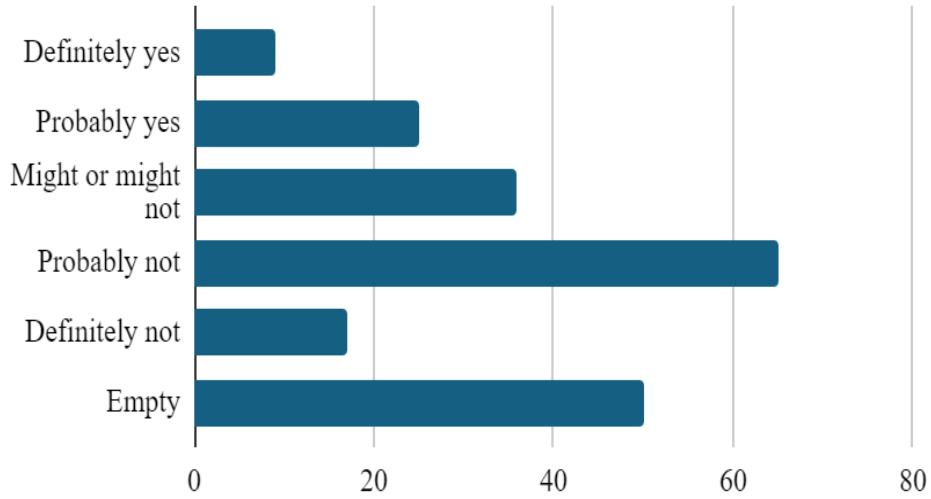

Figure 6. Availability of Recycled Building Materials.

Finally, we asked some questions in section number two about the presumptions about recycled materials and product quality, such as the following:
How do you think the quality of recycled products compares to non-recycled products?

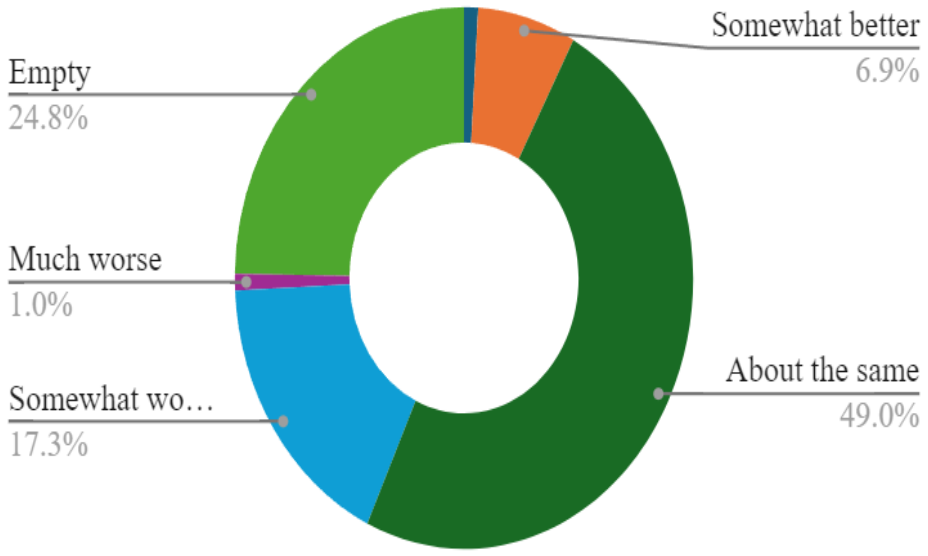

Figure 7. Quality of Recycled Products.

In question group number four, we inquired about the education respondents received on sustainability and recycling:
How important do you consider recycling as part of the curricula in primary and secondary education (for example, workshops and classes dedicated to recycling materials and products)?

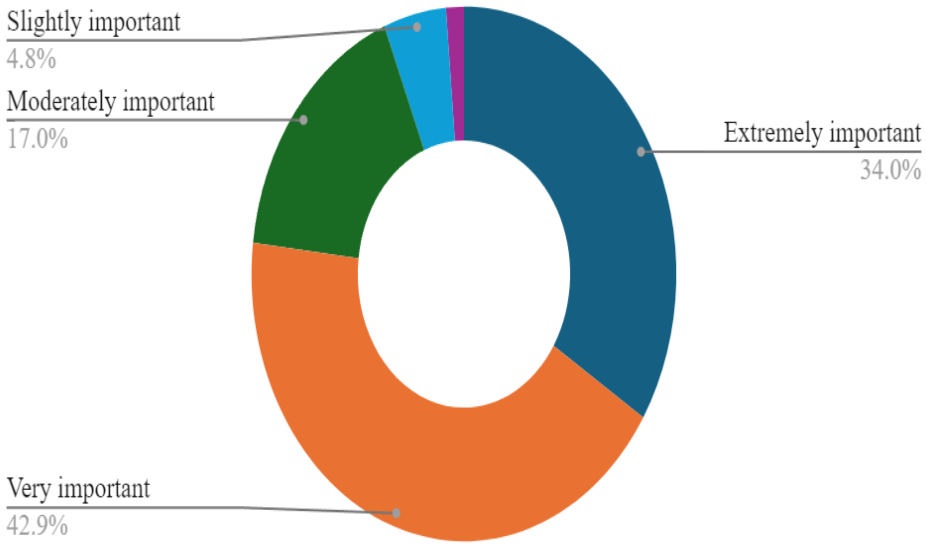

Figure 8. Importance of Education about Recycling and Sustainability.

As a follow-up, we asked how sufficient their education was on this matter:
How much have you learned about recycling in elementary, high school, or college education?

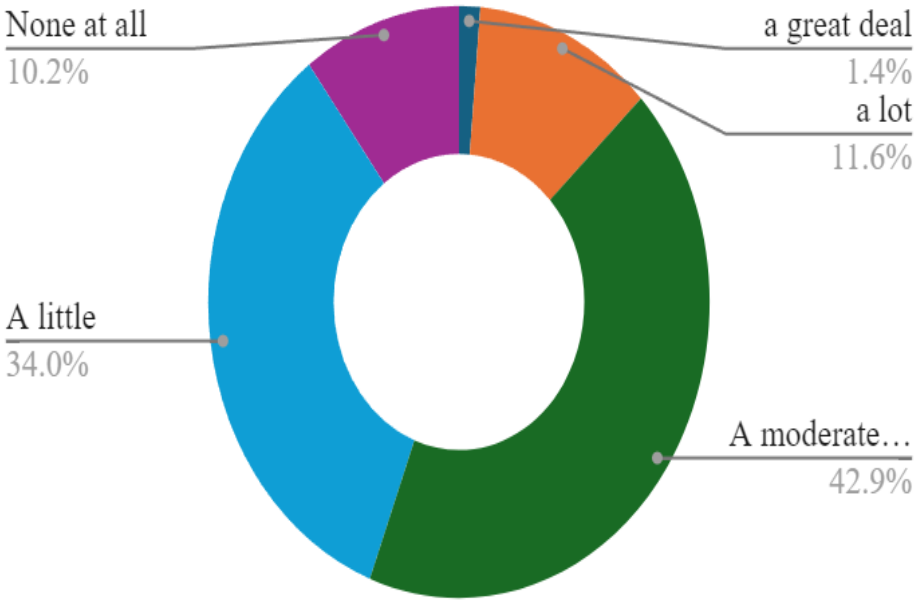

Figure 9. The Sufficiency of Education Present in Current Education Curricula.

In this last group of questions, we involved the respondents in the topic of building industry and environmental awareness to see if they find it essential to keep environmental awareness in mind during a building project.[11]

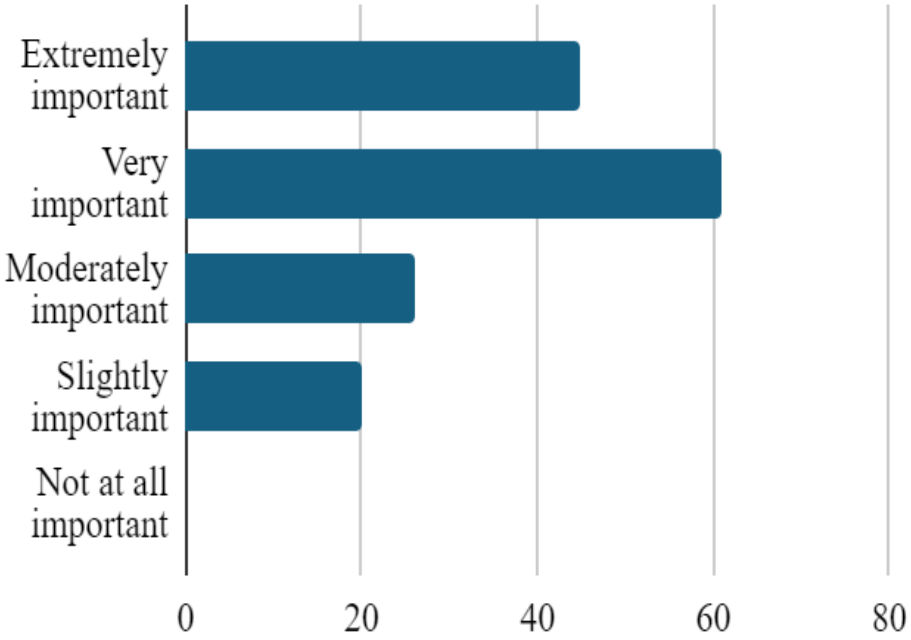

Figure 10. The importance of sustainability during a building project.

CONCLUSION

The research outcomes underscore the need for an approach that considers the general public's thinking—students, employees, and employers, who all are possible clients—when creating a strategy for sustainability's success and defining preferences in architecture and design. To achieve a more balanced building and design industry, we should incorporate environmental, social, and economic aspects into general education and construction marketing. Most of our respondents stated they find it essential to receive more information on this matter, yet there is no sufficient platform for this in current curricula. Furthermore, the received answers show that people trust the quality and design of recycled products and materials and are willing to spend more to support sustainable building and design. On the other hand, they find the market and availability of such techniques, materials, and products scarce, which is a more difficult barrier to cross. In many cases, the responders find governmental regulations on recycling and waste management favoring sustainable designs less, which might also be a restricting factor in achieving true sustainability.

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DEVELOPMENT OF A NEW BIODEGRADABLE BRICK MADE FROM STRAW AND NATURAL BINDERS

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INTRODUCTION

This research is primarily motivated by the immense CO2 emissions, resource consumption and waste in the construction sector of which exterior walls make up a significant proportion. In apartment buildings the proportion of grey energy is around 30%.[1] To reduce the negative environmental impact, more renewable and recyclable building materials should be developed and used. Straw, a by-product of agriculture, could be used for this purpose. Each year about 20% to 30% of the produced straw in Germany is not used.[2] Therefore straw presents an affordable, regionally available, and previously unexploited material resource which, if used, would neither take up any additional land nor cause any food resource competition.

This research project aims to develop a new load-bearing building material for walls based on straw. The biggest challenge here is to achieve a load-bearing capacity that allows a construction of three to four-story buildings with standard wall thicknesses of approx. 40 to 50cm constructed with “StrawBricks”. To this end, the straw is processed, supplemented with additives, heated and pressed to produce biodegradable blocks. The investigations focus on two binder-based approaches. The chosen binders, lignin and starch, are also renewable and biodegradable raw materials. The influence of the various formulation parameters on the load-bearing capacity of the new building material is being investigated with the help of compressive strength determinations. The measured results suggest that the main objective can be achieved.

Ultimately, the vision of the new straw building material is to be able to build monolithic exterior walls with traditional and well-known means such as masonry work in the future (Figure 1), which ideally guarantees thermal insulation as well as load transfer. It will not only be used for new buildings, but also for urban densification projects such as building extensions.

Figure 1. StrawBrick masonry – a vision

BACKGROUND

To provide a good basis for understanding, a rough overview of the structural uses of straw is given below and the aspects relevant to this research are explained. In this context, used binders are also roughly outlined with a focus on lignin and starch.

Straw as building material

Straw building materials are used in various forms in building construction (Table 1). A new load-bearing straw building material can be seen as a further development of this product range.

	Load-bearing	**Non-load-bearing**	
Main function	*Load transfer*	*Insulation*	*Interior construction*
Form	Small/big bales (Straw bale masonry)	Small bales (infill, external insulation), blow-in straw insulation, straw insulation boards	Straw boards/panels

Table 1. Structural applications of straw

Load-bearing

Building load-bearing structures with straw currently means creating a masonry structure from straw bales. As even high-density straw bales have a bulk density of max. 240kg/m³ and a low stiffness, load-bearing straw bale walls have high wall thicknesses (up to 1.2m for two stories) and a high degree of settlement. The latter can be up to 14% for walls that are not pre-compressed.[3]

Non-load-bearing

In addition to straw bales and blow-in straw as insulation, there are various types of straw boards/panels that are mainly used for interior construction. The latter are usually pressed under heat and pressure using mechanically processed straw and binding agents. Common binders in this context are pMDI, a formaldehyde-free binder, lime-protein binders, but also the activation of the straw's own lignin in combination with glued recycled cardboard on the surface of the board.[4]

Lignin and starch as binders

This research explores the suitability of the bio-polymers lignin and starch as additional binders for the development of a load-bearing straw building material. Both binders are bio-based and biodegradable materials which are obtained from plants.

Lignin

In wheat straw and other plants, lignin is responsible for the lignification and thus the stability of the cells and tissue. Furthermore, it is hydrophobic and helps to protect the plant.[5] The chemical composition of lignin is biomass-specific,[6] which means that its properties differ depending on which plant it comes from. In extracted form, lignin is mainly produced as a by-product in the pulp and paper industry. It can be used as a mean to increase mold resistance of products such as plasters[7] as well as a binding agent in wood-based materials, among other things.[8] So far, however, it is mainly burned for energy production.[9]

When exposed to heat, natural lignin becomes viscous and capable of forming adhesive or liquid bridges, which turn back into solid bridges on cooling. The melting point of lignin depends on its composition and the water content of the mixture. The formation of the bridges is furthermore influenced by the contact pressure.[10]

Starch

Plants produce carbohydrates in the form of starch to store energy. It serves as a source of energy for humans and animals as well, which is why starch is primarily used as a foodstuff. However, it is also used, for example, in the production of paper[11] or biodegradable plastics.[12]

One way to use it as a binding agent is to add water and then heat the mixture, which leads to gelatinization of the hydrophilic starch and the ability to form liquid bridges. When cooled, the viscous solution solidifies to a gel and is followed by a crystallization process, resulting in the formation of solid bridges.[13]

MATERIALS AND METHODS

To achieve a suitable compressive strength and rigidity, two approaches were prioritized. Firstly, a higher density compared to straw bales was to be achieved. Although a higher density is feasible, an approximate density of 300 kg/m³ was chosen to ensure that the thermal insulation properties are not compromised too much to enable monolithic construction.

Secondly, the aim was to create adhesive bridges between the individual culm parts, fibers, and particles to ensure material cohesion of the previously loose components. The effectiveness of lignin and starch is being tested for this purpose.

Derivation of the parameters to be analyzed

The type of binder is decisive for the dimensional stability and compressive strength. In this case, the activation of the straw's own lignin is tested on the one hand. On the other hand, five different binders are added in the same quantity. This includes starch and four different types of lignin. As the formation of adhesive bridges for lignin and starch depends on the water content and the heating temperature, different temperatures and moisture contents are tested. Table 2 provides an overview of the test parameters.

Natural binders	Straw's own lignin, four different types of lignin (lignin 1- 4), corn starch
Heating temperatures	120°C, 150°C, 180°C, 210°C
Moisture contents	6-7%, 11%, 15%, 20%, 30%, 40%

Table 2. Parameters to be analyzed

Sample Preparation

To produce a homogeneous material according to the intended concept, a process was developed that follows the steps listed in Table 3 and is explained in more detail below.

1. Culm processing	2. Additives	3. Pressing	4. Heating + finishing
Fine shredding (not required later on, as blow-in straw is used)	Water/ water + starch/ water + lignin	Fill in, compress, close formwork	Heat, cool off, remove formwork

Table 3. Manufacturing steps

1. Culm processing

Initially, the straws were processed manually using a chopper to shorten them and a mixer to shred them. The manually processed straw was then substituted by industrially produced blow-in straw insulation. This material has comparable properties but is in addition mechanically dedusted.

2. Additives

Firstly, the gravimetric moisture content of the straw was determined using a formula based on Krick for determining the moisture content of straw bales.[14] After adding starch or lignin in form of powder, water was supplemented to reach a certain moisture content.

3. Pressing process

The first step is to determine how much of the mixture is required to achieve a certain density. This quantity is then pressed into a cubic steel form with an inner edge length of 15 cm and with the aid of a mounted magazine (Figure 2). The formwork is then closed while the straw is compressed.

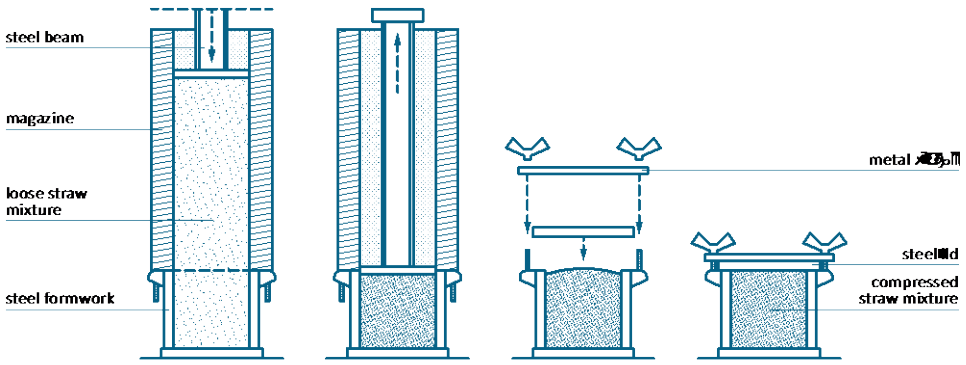

Figure 2. Pressing process

4. Heat and finish

The straw mixture is heated in the steel form in a compressed state for two hours. It is then necessary to let it cool down to room temperature before removing the finished test specimen (Figure 3) from the formwork.

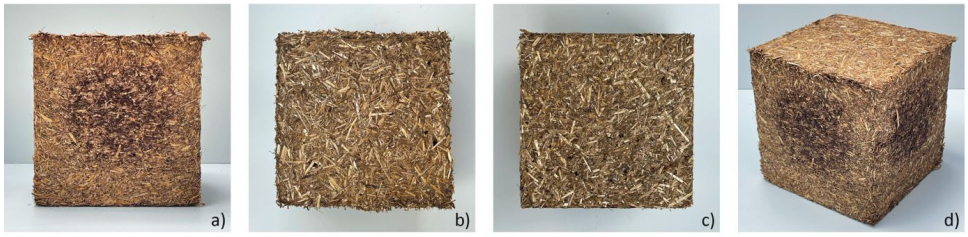

Figure 3. Exemplary finished test specimen; a) front, b) top, c) bottom, d) side

Scope of research

The influence of the above-mentioned parameters on the load-bearing capacity was investigated using compressive strength tests. In the following chapter, the measured compressive strengths of the various formulations at a compression of 6% are presented and analyzed. Each measured value represents the compressive strength of one formulation, which is the mean value of a series of three test specimens of the same type (deviations are labelled with "n=x"). The fixed parameters of the test specimens and the test settings are shown in Table 4. Percentage quantities of additives refer to the dry mass of the straw.

Test specimen		**Compressive strength test**	
Straw type:	wheat (shredded)	Pre-load:	90N
Measurements:	15 x 15 x 15cm	Loading velocity:	15mm/min
Density:	approx. 300kg/m³	Max. compression:	15%
Thermal treatment:	2h	Measured values:	at 6% compression

Table 4. Fixed parameters

RESULTS AND REFLECTION

The following subchapter explains the production-specific observations and findings. The subsequent subchapter then examines how various parameters influence the compressive strength and compares the different formulations.

Sample preparation related findings

The process described above is suitable for producing dimensionally stable test specimens from straw mixtures. During the process development, knowledge was gained that is important for the successful production of test specimens and the understanding of the material behavior.

Culm processing

As the initial straw processing was done manually, the ratios of culm/fiber lengths to small particles fluctuated. Observations suggested that the variations in culm processing also have a significant effect on the compressive strength of the test specimens, which in turn affects the accuracy of the test results. To avoid this, a change was made to use industrially shredded straw with similar but more consistent properties.

Additives

To determine the amount of water that needs to be added to the straw mixture, the moisture content of the straw itself has to be measured first. It became apparent that, unlike straw bales, the moisture content of loose straw fluctuates greatly due to its much greater surface area for moisture exchange with the unstable room air humidity during processing. Consequently, the mass-specific moisture was measured in sealed plastic containers to avoid fluctuations.
When adding a binder in the next step, an even distribution of the selected binding agents in solid state is only possible if they are a fine powder, as the powder adhere on to the surface of the straw. If the degree of grinding is insufficient, the binder trickles down within the straw mixture, resulting in inhomogeneous concentrations.

Pressing process

Since the formwork is closed while the straw is compressed the straw mixture holds a big tension. When the lid is opened at this state, the straw decompresses and swells out of the form, as there is no dimensional stability at this stage. It was found that the internal tension decreases significantly after merely a few minutes. In addition, the tension also depends on the moisture content of the mixture. The decompression is noticeably slower with wetter mixtures.
As a result of the vertical pressing process, the straw fibers and culms are given a predominantly horizontal alignment. The vertical surfaces are an exception, where the fibers tend to align diagonally upwards due to friction on the formwork wall. The horizontal alignment of the fibers and culms leads to anisotropic properties of the material.

Heat and finish

By heating the compressed straw mixture, the binders are activated and form liquid adhesive bridges. It then has to cool down before removing the formwork, so that the liquid bridges can completely transform into solid ones and guarantee the specimens' dimensional stability.

Influence of different parameters on the compressive strength

In contrast to starch, it is not possible to find enough information on the properties of the straw's own lignin in the literature. For this reason, investigations were necessary to determine its melting temperature and the influence of the moisture content on the compressive strength. Only after investigating the reactions of the straw's own lignin the tests were further continued with added lignin. For the approach with the starch, however, only the water content was varied. Parameters such as temperature and binder content were adjusted to those of the lignin formulations for comparability. The experiments relating to the starch formulations were carried out by the student Julian Johannes Pracht as part of his master's thesis at the Bauhaus-Universität Weimar.

Heating temperature

Four different treatment temperatures were tested without the addition of binders to activate the straw's own lignin (Figure 4). The compressive strengths performed best at 150°C and a moisture content of 11%. The compressive strengths fell slightly with increasing temperature but fell sharply with decreasing temperature.
Although the best values were measured at 150°C, it was decided to continue the research at 180°C because these specimens had firmer surfaces and trickled less during handling. The reason for the better surface is still unclear. It should also be mentioned that the melting temperature can be reduced by selecting an appropriate moisture content. This dependency is yet to be researched.

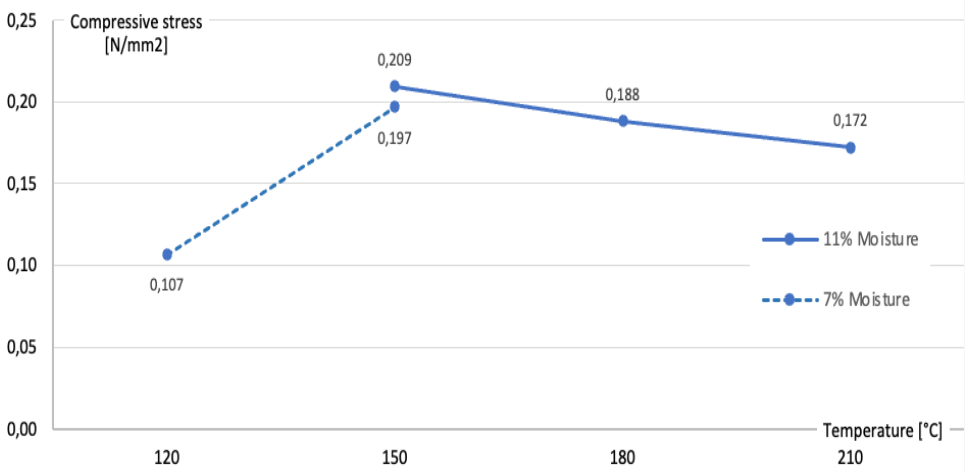

Figure 4. Compressive strengths of pure straw specimens depending on heating temperature

Water

Six different moisture contents were tested to determine the optimum for the compressive strength when activating the lignin contained in the straw. The highest strengths were achieved at 11% and 15% (Figure 5). The compressive strength decreased progressively with an increasing moisture content. Containing 40% moisture, the compressive strength decreased by around 76% compared to the highest measured value without additional binders. Adding 8% of lignin type 1 at 20% moisture content proved to be the best amount (Figure 5).

The formation of lignin bridges appears to be excessively suppressed when the optimal moisture content is exceeded, whereas a moisture below the optimum has a weaker influence.

Adding 8% of starch instead of lignin, a lower compressive strength is achieved at 15% moisture content than with the formulation without additives (Figure 5). The compressive strength exceeds those of the straw's lignin by around 25% from a moisture content of 20%. A further increase to 30% moisture did not result in better values. Test specimens with a water content of 30% exhibited occasional, partly severe cracks.

The strengths of the starch and lignin formulations run in opposite directions with increasing moisture content in the measured range. It appears that the potential of lignin cannot be utilized at the same time when starch is used effectively.

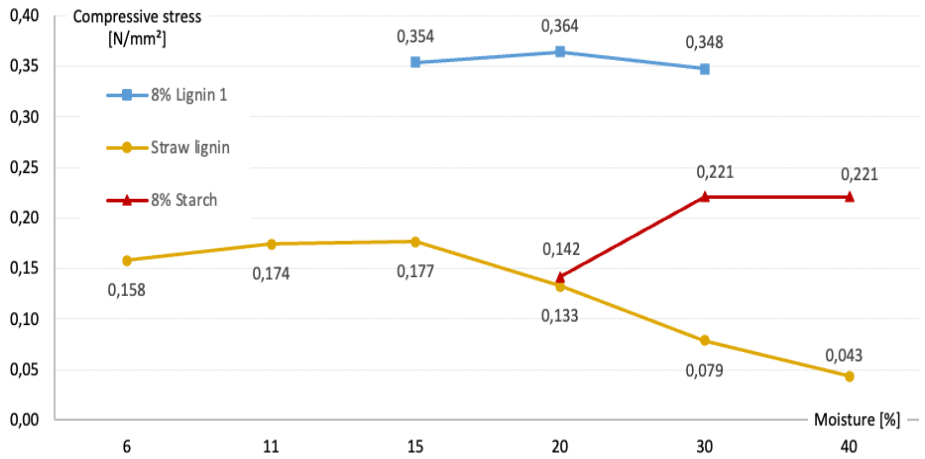

Figure 5. Compressive strengths of different formulations depending on moisture content; heated at 180°C

Added binders

To enhance the effect of adhesive bridges, the addition of corn starch and four different types of lignin was tested. All five binders achieved significantly higher compressive strengths at an addition rate of 8 % compared to the reference straw bale, despite great differences in the measured values (Figure 6). Here, lignin types 3 and 4 lead to the highest compressive strengths.

Assuming a natural straw lignin content of approx. 15%,[15] a test specimen would contain about 137g of lignin. Although only 73g of lignin was added, the compressive strengths increased by an average of 125%. This suggests that merely a small proportion of the straw's own lignin is available for binding, as it is mostly enclosed in cells, while the added lignin is distributed exclusively on the surfaces of the straw and can therefore develop its effect much more effectively.

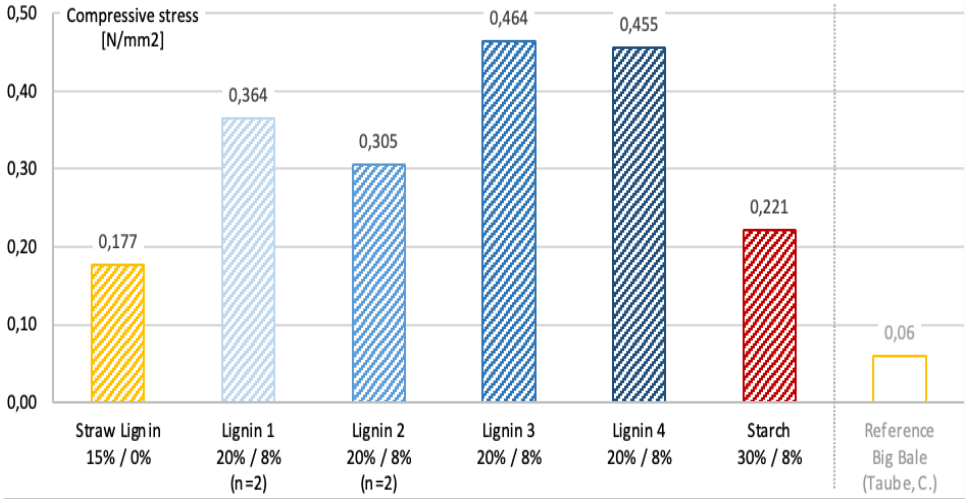

Figure 6. Compressive strengths of selected formulations with their moisture (15% - 30%) and binder content of 8%; heated at 180°C; reference big bale[16]

CONCLUSION

The manufacturing process used is suitable for producing stable test specimens/"StrawBricks" with defined edges and even surfaces. All process steps can be assumed to be easily transferred to an industrial scale. The load tests show that lignin and starch can be used to produce straw specimens with 3,5 to 9 times the compressive strength of straw bales (Figure 6). Heating temperatures of ≤ 180°C are sufficient to develop the adhesive effects with the chosen binders. The addition of water contents <20% poses a problem, which applies in specific to the starch formulations. Due to the swelling behavior of the straw, the water strongly promotes the formation of cracks and further makes a heated and controlled drying process necessary to avoid mold. A water content of ≤ 18% is categorized as uncritical according to ETA-17/0247.[17] With the favorable moisture content of the lignin formulations of about 20%, the drying process is therefore expected to be low in energy consumption or even unnecessary. Higher compressive strengths are achieved with lignin than with starch formulations, maintaining the same addition quantities of water and binder. Furthermore, the use of starch in the construction sector could lead to a competition with foodstuffs. For these reasons, the utilization of starch in its current form and against the background of the research objective is classified as less suitable. The lignin approach, on the other hand, appears promising and will be explored more deeply. Overall, the research project has great potential to expand the range of applications of load-bearing construction with straw, particularly through slimmer wall constructions and simpler handling options, and thus to promote straw as a building material. Compared to big bales with a density of

approx. 200kg/m³, significantly higher compressive strengths, dimensional accuracy and surface qualities can be achieved, which offer the potential to simplify and improve the construction process. In addition to the enhanced load-bearing capacity, the higher density can also be expected to improve the physical building properties in terms of fire resistance and sound insulation especially in comparison to small straw bale constructions.

ACKNOWLEDGMENTS

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FOUNDERSKEEPERS: MATERIAL CIRCULARITY WITHIN EDUCATIONAL FRAMEWORKS

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INTRODUCTION

This paper aims to question how educational institutions could develop, implement and analyse their materials flows for a more circular and sustainable practice through student initiatives taking upon a ground up approach. This approach works in tandem with the existing educational model rather than redefining it. The benefits include the encouragement of a collaborative and interdisciplinary way of working within the different systems of the institution, while the result is a more sustainable and efficient utilisation of materials/resources. The paper's case study is a project we led 2023-2024 in the *Bartlett School of Architecture* (*BSA*) called *FoundersKeepers*, a circular material hub that became a platform for sustainable advocacy and a teaching resource that activated the change in behaviour surrounding material use.[1] We believe that the project showcases a micro/ macro cosmos relating the educational institutions to the new movements towards more circular projects within the wider industry.

In 2018 within the UK, 62% of total waste generated was from the construction industry, with similar numbers the following years.[2] The circular economy has emerged as an increasingly important approach, offering solutions to some of the world's most pressing and interconnected sustainable development challenges.[3] The concept was frequently highlighted as a crucial solution during the *UN Expert Group Meeting* and the in-depth review of SDG 12 on Sustainable Consumption and Production (SCP) at the *2018 High-Level Political Forum*:

The circular economy holds particular promise for achieving multiple SDGs, including SDGs 6 on energy, 8 on economic growth, 11 on sustainable cities, 12 on sustainable consumption and production, 13 on climate change, 14 on oceans, and 15 on life on land.[4]

Of all the materials flowing through the UK, at the moment, only 7.5% are reused.[5] With regards to architectural education during the climate and ecological emergency, architectural commentator Sofie Pelsmaker writes that the profession must re-evaluate a "holistic sustainable architecture" which "takes into account the interconnections" of systems requiring "a culture shift and a new ethical position."[6] Architectural practices in the UK like *Jan Kattein Architects*,[7] *Baker Brown studios*[8] showcase the obvious yet beautiful solution of reusing materials, while organisations like *ACAN*[9] and the *Design Museum*[10] recently released design toolkits for circular economies. Many other initiatives are paving the way for the embedding of circular thinking into practice, which emphasises the growing need for this new ground to be mirrored in education.

With regards to reuse, our project showcased how critical it is for schools of architecture to challenge how waste is perceived, and how to adapt its current linear material flows into a circular economy model as an educational resource for students and staff to explore within a low-stake, high-reward environment. If the current linear process of the wider industry can be challenged early and freely within education, it could immensely benefit future decision-making.

METHODOLOGY

Mapping existing processes

The genesis of the project began by mapping the current material flows and existing practices of reuse. This revealed the need for a service which could process the distribution of reuse materials with greater transparency and efficiency for the university. The method was never critiquing current systems, rather opening the conversation about student material culture and the school's management of it. Discards are continually being circulated and transformed, making the identification of waste an ongoing challenge.[11]

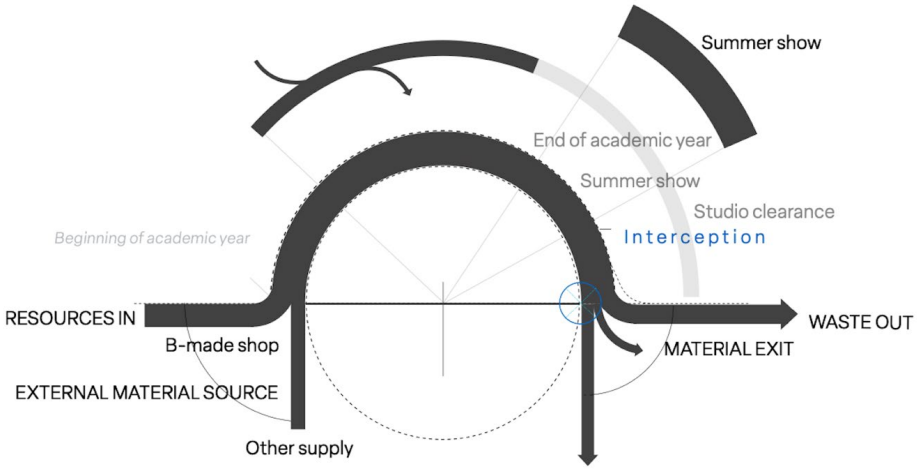

Figure 1. Material flow through the BSA producing an open cycle, resulting in large resource demand and "waste" output. Existing material flow mapped.[12]

Filling gaps

In response to this need, *FoundersKeepers* was initiated in 2022 as a connecting agent for all reuse processes and to fill existing gaps within the material flow. The objective was not to overhaul the entire system, but to identify specific gaps with which the initiative could help with. It operates as a student-led free circular material "shop" which collects discards from the school's waste stream and brings them to the forefront of the design process.

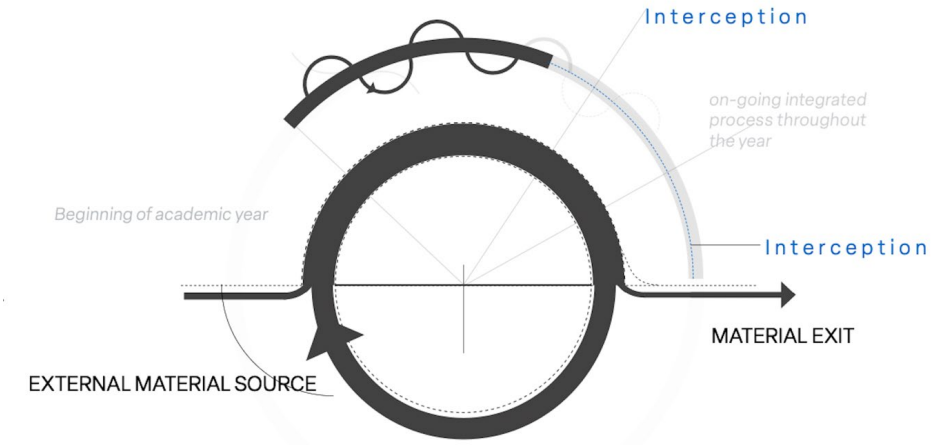

Figure 2. Material cycles through the BSA producing a primarily closed loop that keeps "waste" within the school feeding it back for new uses. FoundersKeepers proposed cycle.[13]

Our methodology was designed to reflect the principles of the circular economy, emphasising iteration and constant redesign. Contextual practical learning is as important as theorising beforehand. We knew early on that introducing a system like *FoundersKeepers* will have multiple benefits regarding resource management, material affordability and creative advocacy. However, we were willing to prototype the idea practically before collecting concrete evidence of the effects, which we eventually did in retrospect. This allowed for faster turnover and reaction. Operating within an educational environment has afforded us a degree of freedom to explore these concepts.

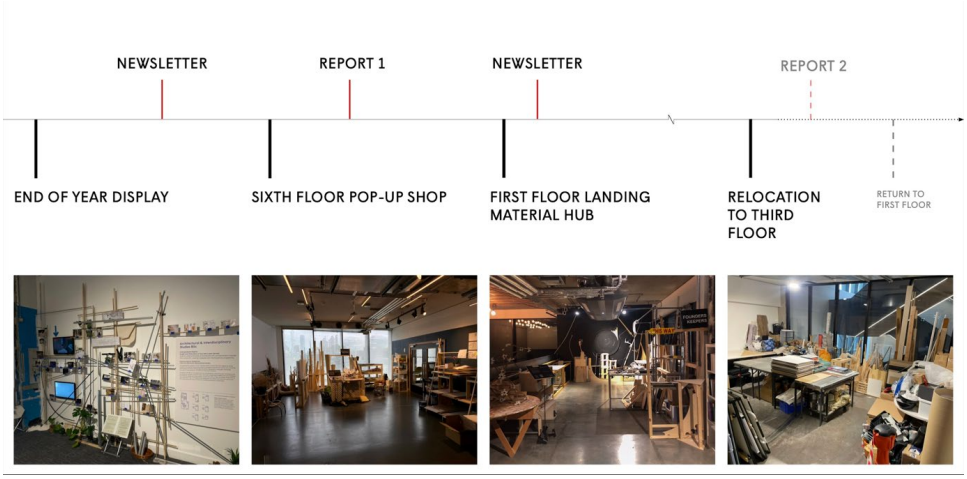

Figure 3. FoundersKeepers timeline 2023-2024.

Changing the vocabulary around waste

One key insight was the ambiguous nature of waste itself—a term that often conjures images of discarded, untouchable items. This perception can make waste seem overwhelming or hazardous. To counter this, our methodology focused on simplifying the process and reconsidering the language and

definitions we use. For example, by taking a yellow skip filled with mixed waste materials, we found that, by separating and analysing each material individually, we could uncover a wealth of useful resources hidden within what was once considered useless.

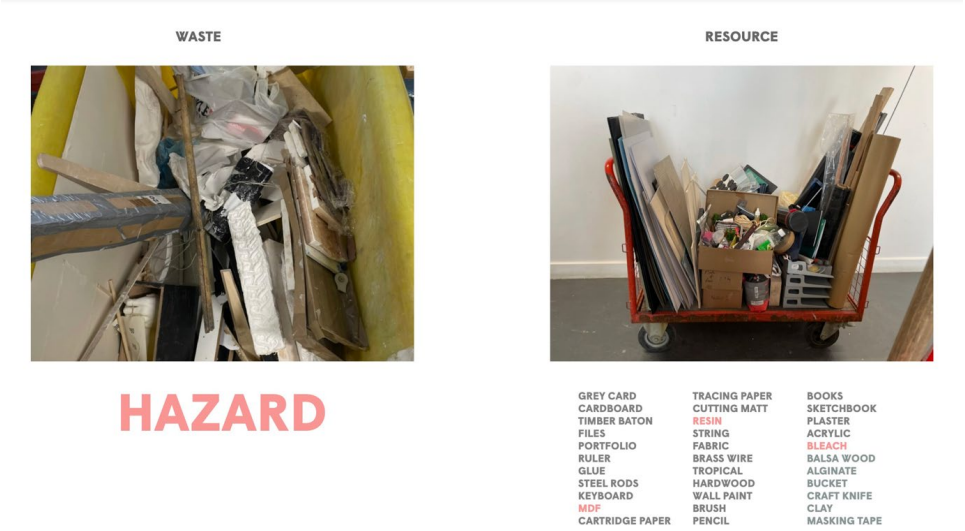

Figure 4. Example of "waste" analysis.

The word "waste" has connotations which influence the way people think and interact with it. As a generalisation, the term inherently calls materials "no longer useful." It takes the individual materiality out of people's minds and hides the useful resources that were available for students.

Making a platform for discussions

Our working method relies on interdisciplinary participation from various members who use the building. Our motivation was to create a platform for these discussions, facilitating a rich exchange of ideas and, most importantly, sparking a dialogue within the school about our material culture.

Figure 5. FoundersKeepers as it looked for most of the year.

FINDINGS

University College London (*UCL*) reports that 0% of its waste is sent to landfill,[14] yet it is clear that the amount of waste produced yearly is substantial. Most materials (56%) end up being "recycled" by energy recovery from incineration.[15] Within the institution, the internal facilities team manages the flow of materials throughout the academic year. Some clearly new materials were saved by their initiatives. However, it is important to note that this activity is beyond the requirements of their official role and was unknown to the larger student body. Other schemes that implement reuse ranged from students dedicating cupboards in their studios for leftover materials, to the exhibition show team using modular and reusable plinths.

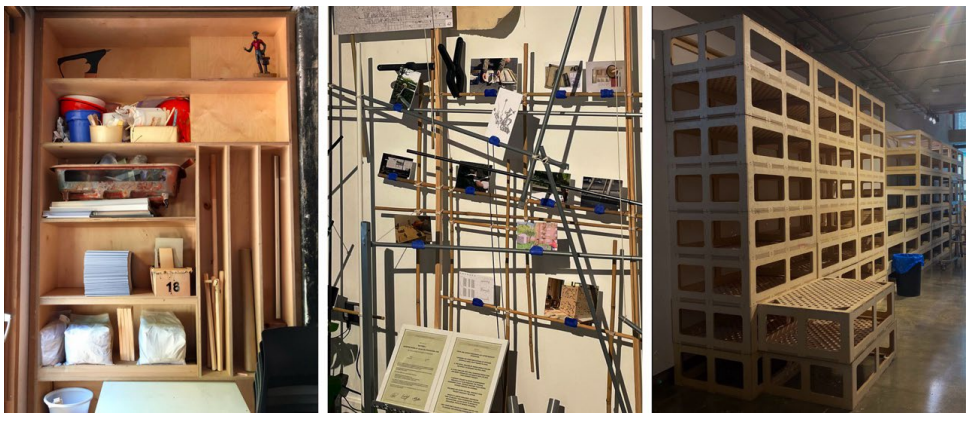

Figure 6. Student cabinet for leftover materials. Exhibition display made from reused materials. Modular reusable plinths used by the show teams.

The prevalence of skips throughout the building illustrates a material journey where most waste ends up in energy recovery through incineration. However, within an educational environment, this linear

process, reflective of global practices, presents an opportunity to challenge the status quo. The process we are talking about is the “design, test, iterate, final outcome, repeat.” In every step of this system materials are introduced and are a means to an end, after which they are discarded. The current linear approach to teaching, where projects are short-term and conclude with the materials losing their perceived value, is clearly unsustainable. Students occupy a unique position within the school, as their time here is limited to the duration of their studies. Once they graduate, they often lack the time or mental bandwidth to manage leftover materials or projects.

The students, who create the culture and practice, were the driving force of the project. It was essential that they promote and enforce these values to instil a sustainable mentality surrounding material use. We maintained close contact with students through emails and in-person interactions to analyse the materials that were frequently sourced by students. The positive feedback for the initiative, along with the extensive use of sign-in and sign-out sheets, provided clear evidence that students were open to the idea, wanted to actively participate in it, and responded to the needs of the school.

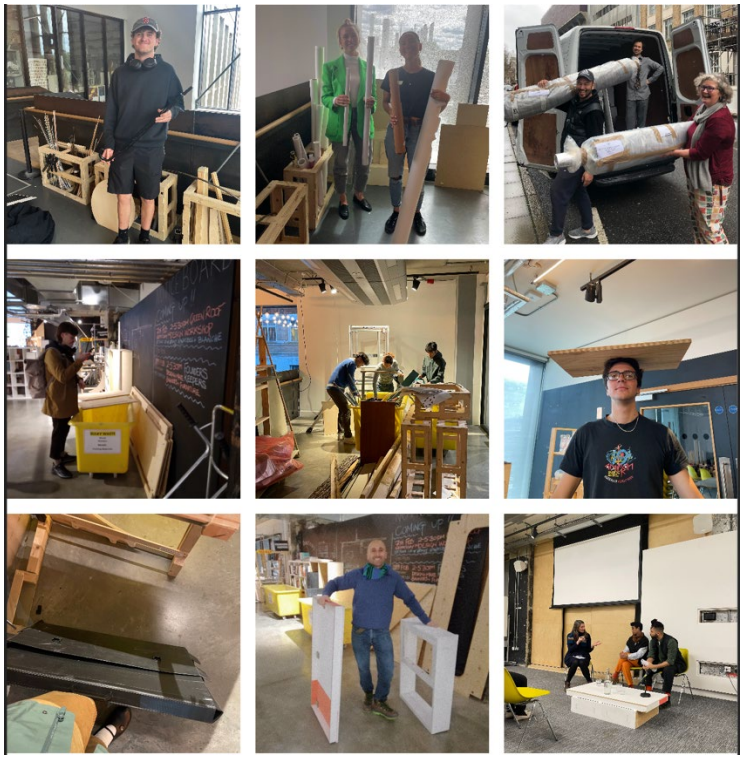

Figure 7. Photos from emails and in-person encounters.

Within a month and a half the register recorded a 278 interactions with students. Although several materials were taken without recording them, the data was valuable for tracking the lifecycle of materials, student feedback and qualitative data showcasing the value of the project.

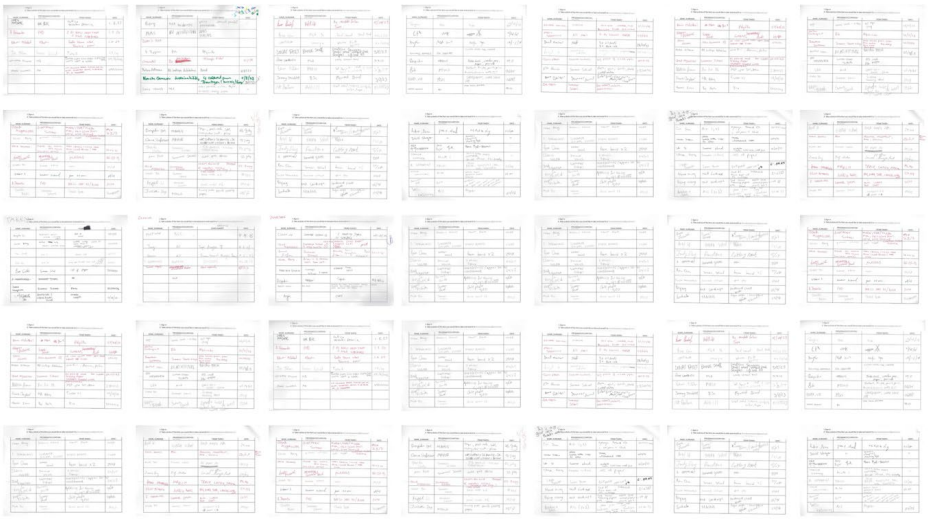

Figure 8. Sign-in sheets from the first month operating FoundersKeepers. Each containing 8 people specifying their program, which material they took and when.

Despite our efforts to minimise hazardous materials like MDF, resin and bleach, these substances still present challenges. Decisions often involve asking ourselves “this can be reused, but should it?” or “this looks un-reusable, but could it?”

Most of the “waste” were unused materials, which likely have been overbought or left after the projects have ended. A parallel could be made to the surplus materials most construction projects have, whether due to change of designs, overestimation, or miscalculation. Given that university is where most architects and designers first develop their work practices, it is not a surprise that the university mirrors the industry incredibly closely.

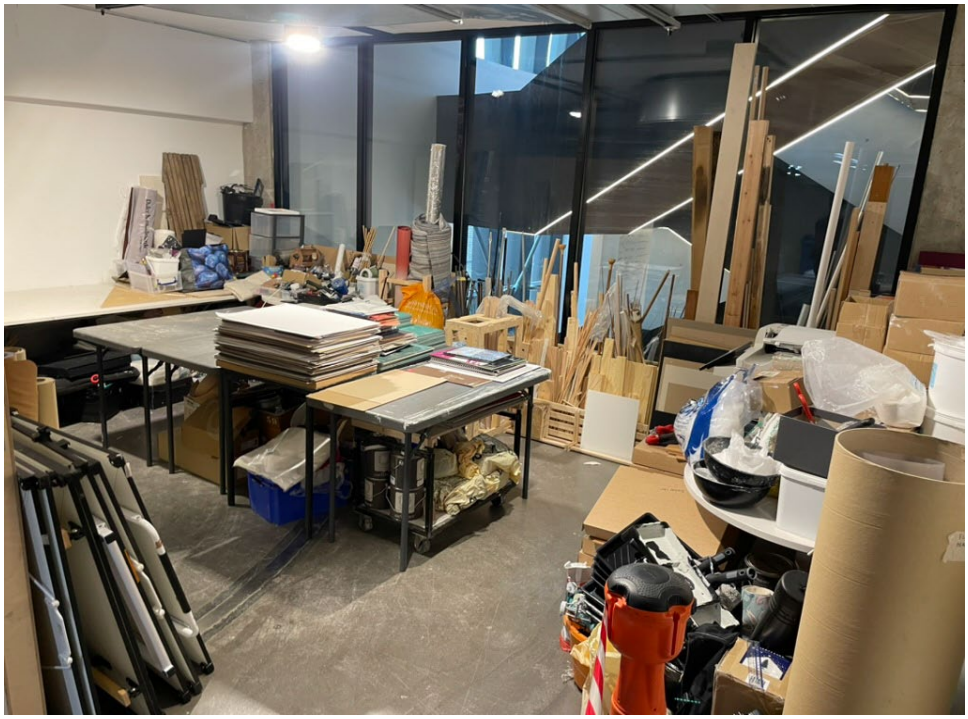

Figure 9. Half of the saved materials alongside the facilities team from studio clearances 2024.

We found that *FoundersKeepers* was relevant not only to students who use the shop but also to internal staff and organisations outside of the Bartlett. As the initiative expanded its reach, *FoundersKeepers* evolved into a platform for ideas, inspiring similar initiatives to take shape. Students from other Bartlett facilities, lacking their own *FoundersKeepers*, expressed a desire to create similar environments on their campuses. This led to the emergence of ideas like a natural materials library, drawing us into a broader network of initiatives. We realised that this increased exposure not only enhanced the culture surrounding material use but also empowered individuals to take agency over their own environments. This was achieved through talks, workshops, and active communication across the school. Educational institutions are particularly conducive to such collaboration, as they are filled with experts who, once engaged, offer a wealth of knowledge and perspectives.

External relations

During our time at the school, we had opportunities to engage with external practices. We offered to transfer and store their surplus or leftover materials within our institution, leveraging our available space and students always needing materials. However, our goal extended beyond mere data storage; we aimed to educate them on the importance of viewing waste management as a circular rather than a linear process. Through ongoing dialogue and interaction, we emphasised that waste is not simply about offloading materials. Instead, it involves understanding the holistic cycles of waste, considering all vectors and data factors within the system. As mentioned before, the challenge often lies in transparency. When waste is simply offloaded, it becomes easy to lose track of its final destination and impact.

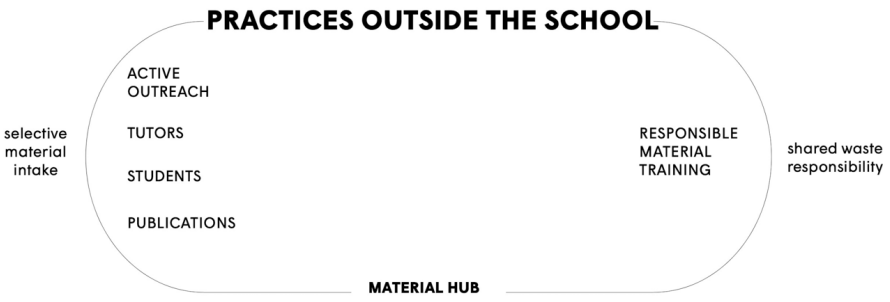

Figure 10. Relationship diagram of architecture schools and practices within the industry.

Our project, symbolic in nature, confronts the political implications of space within an architecture school, where waste, often invisible due to the opaque nature of its management, occupies a significant portion of it. Through our intervention, we have occupied spaces to collect, sort, and subsequently analyse waste, thus bringing the issue to the forefront for further examination and action.

ANALYSIS

The effectiveness of the *FounderKeepers* waste management system questioned why similar initiatives were not adopted within the university beforehand. It was found that existing political hierarchies, which govern access to space and have authority within the decision-making process,

complicate who is responsible for occupying space within the institution. Understanding waste flows throughout the university involved navigating these hierarchies to determine the benefactors and who should be accountable.

The concept of a student circular materials hub is not a novel idea. It was being tested by both *Renee Materials*[16] and the *AA Material Arcade*[17] during the development of *FoundersKeepers.* Questions of how the space is used, who benefits and who should be held responsible are often discussed on a higher level that supersedes students. However, the authorities who make policy cannot realise a project which aims to reduce students' waste. The student-led staff supported approach to university initiatives was found to be effective in developing the agency of students for their design implications. The curriculum should teach sustainable education around reuse as an integral part of the process, giving power to the educators who play an integral role in teaching students to use the opportunities that have been offered. Collaboration was essential in bringing all the stakeholders together in implementing a circular materials culture within the *BSA*.

Where *FoundersKeepers* supersedes its materialistic benefits to the *BSA* is when the students and staff are able to diplomatically collaborate through the educational infrastructure to execute projects efficiently. Identifying and engaging with the appropriate individuals enabled the quick integration of our project with the existing system and its stakeholders. Our approach represents a unifying platform that integrates with the *B-MADE* workshop facilities, the waste stream of student projects, and the existing *BSA* material management process. This was to take accountability for the waste produced. It was crucial to translate this mentality to outside practices to foster a collaborative dialogue between bigger institutional systems, ensuring services that are mutually supportive. Global change for a net-zero industry must eventually take place, but it is often difficult to apply behavioural change into practice. It is within educational institutions where *FoundersKeepers* has the greatest opportunity in implementing circular thinking into the practice of students, who will shape the future for the industry.

The project took a bottom-up approach which highlighted the boundaries that existed within the *BSA* institution. During *FoundersKeeper's* initial inception, the design and layout of the shop was informed by the practical restrictions that were in place to minimise fire risks, potential accidents or toxic substance distribution. Similarly, acceptable aesthetics and regular management of the shop's presentation played an important role in ensuring its operation as this would maintain the favour of both staff and students.

FoundersKeepers implemented a simple solution to manage waste materials within the *BSA* by designating a specific area for storage, clearly labelling the waste, creatively representing waste and making it freely available to the community. This communicated that simple changes were enough to shift how the concept of waste was perceived, from a hazardous element to being recognised as a valuable resource. Whether or not the idea of resources never becoming waste was challenged, or the understanding of what constitutes "resource" was expanded, it was important that this approach enabled students with quick and easy access to necessary resources, reducing the need for material purchases.

By questioning the quick uptake for this new resource, it is clear that the concept of a circular economy is becoming widely acknowledged within the education sector. Although sustainable practices are frequently discussed in design work, it is harder to implement them into practice. As the project became more integrated into the *BSA*, it developed from being a component of the system to becoming a platform on which to reconsider the material flow of the entire institution.

This shift in materials culture has transformed waste that could be easily discarded into a teaching resource the institution must scrutinise. This benefits not only the models, exhibitions and summer courses for the school but can also be used to challenge the broader complex material flows within

educational institutions. Designers should question why materials lose their perceived value to become waste. Much of the construction industry creates waste from its current linear processes that are backed by legislations, building codes, insurance and the supply chain. The materials being used could have significantly longer lifespans if there were space to experiment and reimagine the waste stream.

FoundersKeepers serves as a valuable educational tool to promote the principles of a circular economy and foster a sustainable approach to material use in the low-stakes, high-reward environments within education.

The project has shown that the transparent and creative management of waste opens opportunities to further question the existing systems that facilitate it. From outside and within the institution, practices that revert to the linear, less transparent methods of waste disposal was observed.

Collaboration is not an inherent practice; Students and staff need to be taught and nurtured to engage together with an ongoing dialogue. Introducing circularity into our waste management is crucial because it integrates with the existing systems it operates within. This was done with careful analysis and adjustments, such as revising policies or the reallocation of resources, to the existing systems. The stakeholders of the circular economy require time and effort for the change in behaviour to take place.

The issue of waste production within educational institutions becomes manageable with small but practical changes. It isn't about rewriting entire policies but about making strategic tweaks that start with allowing students to take ownership of their waste.

CONCLUSION

The broader lesson here is that waste management is not just about dealing with physical materials—it is about rethinking the educational processes themselves. To effectively teach others about waste, we must first learn to manage it ourselves. Without this internal understanding and space to experiment freely, our external outreach efforts will struggle to gain traction out in practice. This project highlights the importance of embedding circularity not only in waste management but across all aspects of school and educational systems, encouraging greater involvement from both students and staff in this ongoing transformation.

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BALANCING TRANSFORMATION: DESIGN INSIGHTS FOR NAVIGATING PERI-URBAN ECOLOGIES

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INTRODUCTION

Freshwater ecosystems are declining at an alarming rate, faster than their land and marine counterparts, due to greater human physical pressures.[1] These habitats are vital systems, supporting around 10% of all known species, with less than 1% of Earth's surface,[2] providing essential services for human and non-human survival. The Citarum River, infamously called the "world's dirtiest river,"[3] stands as a prime example of a degraded ecosystem. As the largest river in West Java, it flows between two of the largest cities in Indonesia: Bandung and Jakarta, providing water, energy, and sustaining agriculture for 25 million people. This population pressure has turned the river into the destination of at least 35.5 tonnes of daily human waste.[4] While this might be the most visible problem and the reason the river has gained so much notoriety, it is not the only issue. The degradation of the watershed includes deforestation, erosion, loss of habitats, increased flooding events.[5]

The upstream section of the river, known as the Upper Citarum, covers a 2,330 km^2 sub-watershed.[6] It comprises a multitude of tributary basins feeding into the Citarum, which meanders in the flat central area where most of the population and agricultural activities concentrate. A large portion of the catchment, north of the river, is occupied by the city of Bandung, extending to the hillsides of the northern mountain ranges. This upper catchment is characterised by a vast peri-urban region that sprawls from the urban centre. The growing metropolis of Bandung exerts pressure on the watershed, with symptoms felt throughout, either by the effects of an extended urbanisation or by the environmental externalities carried downstream by the river. And while rural areas rely on ecosystem services for water provision and waste disposal, peri-urban areas experience degradation of these services, with little benefit from urban infrastructure.[7] On the other hand, the level of development in these areas still allow for meaningful interventions.

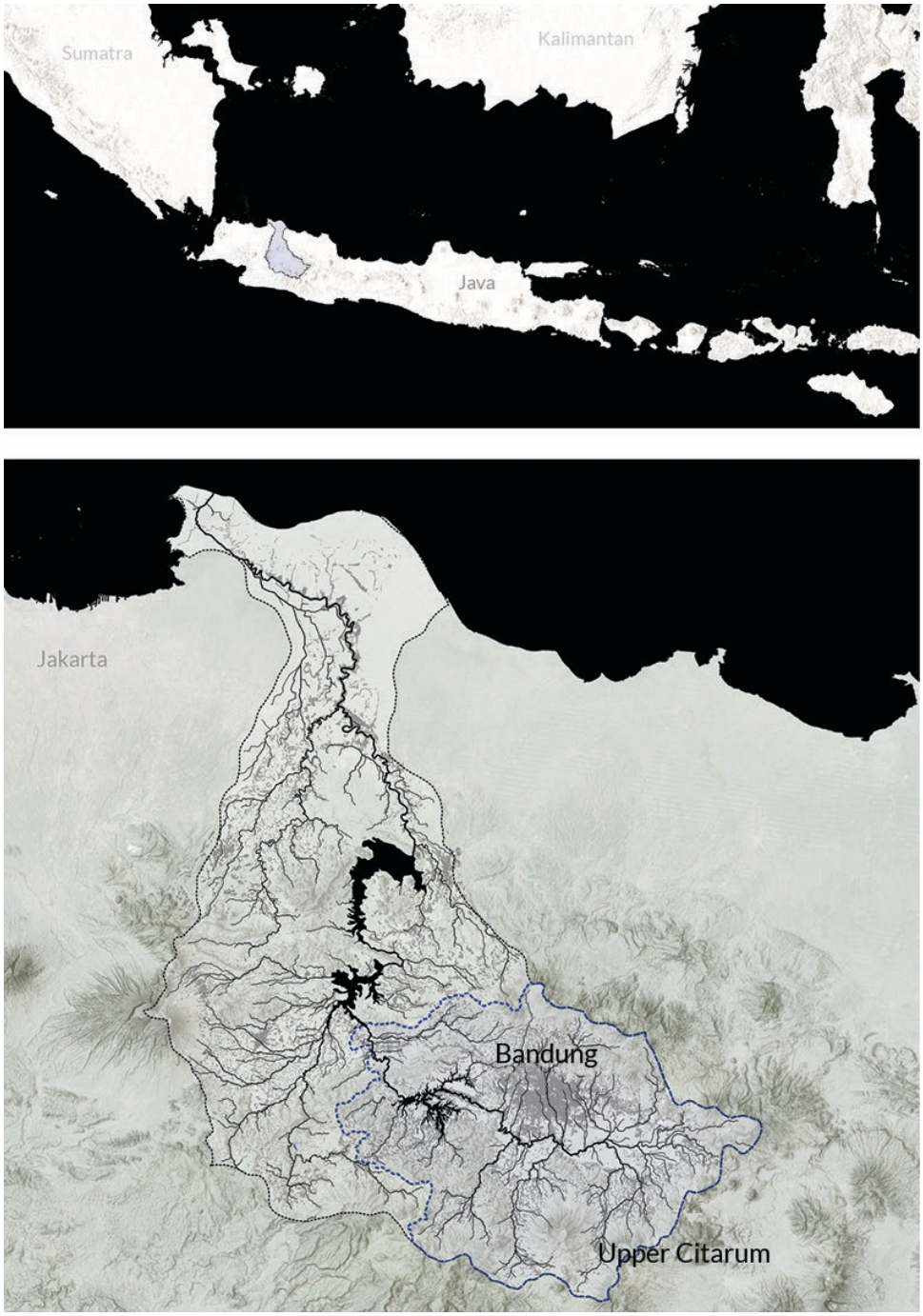

Figure 1. Location of Citarum watershed and the upper catchment

The international notoriety that the Citarum gained due to its pollution problem pushed the government to implement several programs to address this issue. However, all of these have failed to achieve their main goals. Programs of this scale often encounter the problems of Indonesian governance: institutional fragmentation, corruption, sectoral and local lack of cooperation,[8] and in the case of the Citarum, a politically and ecologically diverse watershed.[9] The sheer scale of the watershed also complicates the interventions along an heterogenous and unequally degraded river. In this context, a transformation project of the Citarum River ought to consider the pressures of urbanisation on water systems, particularly on peri-urban regions, as these landscapes are often neglected and bear much of the degradation. Moreover, an effective transformation of the river calls

for a more focused approach targeting hotspots of degradation creating opportunities for cost-effective interventions, while balancing catchment-scaled operations. This research aims to understand the urban pressures that impact the Upper Citarum and propose a cost-effective way to address them. With these aims in mind, this study is framed under the following research questions:

1. How do peri-urban processes take part in the degradation of the river?
2. How can degradation hotspots along the Upper Citarum River serve as leverage areas for transformation?

The failure of previous restoration programs has proven that large cleaning operations of the river will not be enough to change the degradation of the river. Understanding the problem of urbanisation and its pressures over water systems may provide valuable for future and more comprehensive transformation programs. By understanding pollution as a symptom of a broader challenge in peri-urban areas, the study hopes to bridge the gap between restoration programs and the degradation system currently at play, proposing a framework for transforming the Citarum both spatially and institutionally.

A RIVER UNDER (URBAN) PRESSURE

Rapid urbanisation is likely to continue for decades in Southeast Asia, increasing the demand for services and infrastructure,[10] and putting pressure on natural systems. In the case of Indonesian cities, especially in Java, urban expansion is not slowing down. This urbanisation places pressures on the urban peripheries as physical expansion takes over fertile agricultural lands and other habitats vital for sustaining ecosystem services. Urban growth increases the demand for water and land, while land speculation creates social displacement and dispossession.[11] Freshwater systems are usually degraded by five types of threats: overexploitation, invasion by exotic species, destruction of habitat, water pollution, and flow modification.[12] However, from an urbanisation-driven perspective, the Citarum is mainly faced by challenges of land use change, pollution and river morphology change. The next section examines each of these challenges.

Land use change

Urban growth in Bandung, unlike Jakarta, is expressed mainly as horizontal expansion.[13] However, urbanisation-driven land use change is not exclusive to the city's outskirts, as the process of regional peri-urbanisation also takes place in the upstream areas of the basin. Despite the agricultural performance of Bandung's 'rice bowl' basin, city-based activities greatly exceed their productivity,[14] leading to massive land use changes, primarily from rice agriculture to urban and industrial developments. While this is happening in the urban periphery, deforestation in the mountains for new dry-agricultural land is creating significant problems with runoff,[15] erosion and sedimentation,[16] and pollution.[17] Land use change is the main driver for changes in the Upper Citarum, directly or indirectly pressuring the river.

In recent years, the proliferation of planned neighbourhoods, locally known as *perumahan*, has radically changed the landscape around the city of Bandung. These developments are not comprehensively planned, leading to scattered pockets of residential areas throughout the basin, often violating land-use plans.[18] Most of the land converted to *perumahan* development consists of rice paddies in the flat central areas,[19] which are cheaper to develop than hillsides and are closer to the city of Bandung, but these developments are slowly encroaching the upstream areas of the catchment, potentially impacting its headwaters. For example, an increase in population around waterways dramatically decreases the water quality, particularly in the form of human and solid waste.[20] Additionally, as Bandung sits on the bed of a prehistoric lake, the area is prone to flood events.[21] The risks of inundation and flood are increasing, favoured by the drastic changes in land-use. The loss of

vegetation by urbanisation and deforestation in the mountains has led to a decrease of evapotranspiration, increasing the water yield and runoff due to a decrease of groundwater infiltration.[22]

Deforestation

The loss of forest cover is not new in Bandung. The island of Java is the most deforested island in the Indonesian archipelago.[23] Presently, primary and secondary forest cover in the Upper Citarum stand at about 19.6% of the catchment's surface.[24] Most of the deforestation in the area is a result of land conversion on the mountainous slopes from forest to dry-agriculture, which is largely driven by the increasing food requirements of a growing population.[25] Atharinafi and Wijaya[26] argue that displaced, landless farmers have resorted to deforestation to cultivate in these areas. However, the link between *perumahan* development downstream and deforestation require further study.

Deforestation is the single most challenging environmental pressure in terms of runoff, groundwater recharge, evapotranspiration, erosion, and biodiversity loss.[27] However, the literature on the subject is not conclusive. Some authors claim forested areas have increased,[28] while others argue that the loss of forested areas has been significant over the years.[29] Regardless, it is clear that the rate of deforestation has slowed down.[30] Most importantly, sedimentation along the Citarum and the Saguling Reservoir is worsening,[31] reducing the lifespan of the reservoir and favouring more flooding events. The difference in observed deforestation and sedimentation rates can be attributed to the lag between the loss of forest cover and the time it takes the sediment-rich lateral flows to reach a water source.[32] In the case of the Citarum, erosion and sedimentation are crucial components to assess the river's health.

Pollution

The pollution of the Citarum River is likely to be its most visible and well-known problem. Multiple cleaning programs have been implemented since the year 2000 to address the issue, but they have mostly failed to achieve their objectives.[33] Although half of the river's waste was reduced by 2017,[34] solid residues are not the only form of pollution in the river. Pollutants in the river originate from two main sources: 70% come from domestic residues, while the remaining 30% comes from industrial uses, agriculture and animal husbandry.[35] Plastic and other solid residues, however harmful, can be collected; it is the invisible pollutants that cause most of the damage to the population dependent on these waters. Industrial chemicals and *E. coli* bacteria are especially prevalent in densely populated areas next to waterways; while agrochemicals are often found upstream, where dry-agriculture practices take place.[36]

Pollution in the Citarum is both a spatial problem and a governance one. As mentioned before, urban (mainly residential and industrial) and agricultural land uses put considerable pressure on the water quality. Simultaneously, the Citarum's chemical contamination is mostly a consequence of negligent governmental control: industrial waste poured illegally onto the river is mainly a failure from local Indonesian authorities.[37] While pollution is usually addressed at a policy level, understanding the problem as a symptom of urbanisation and approaching it indirectly, may provide an alternative solution to this issue.

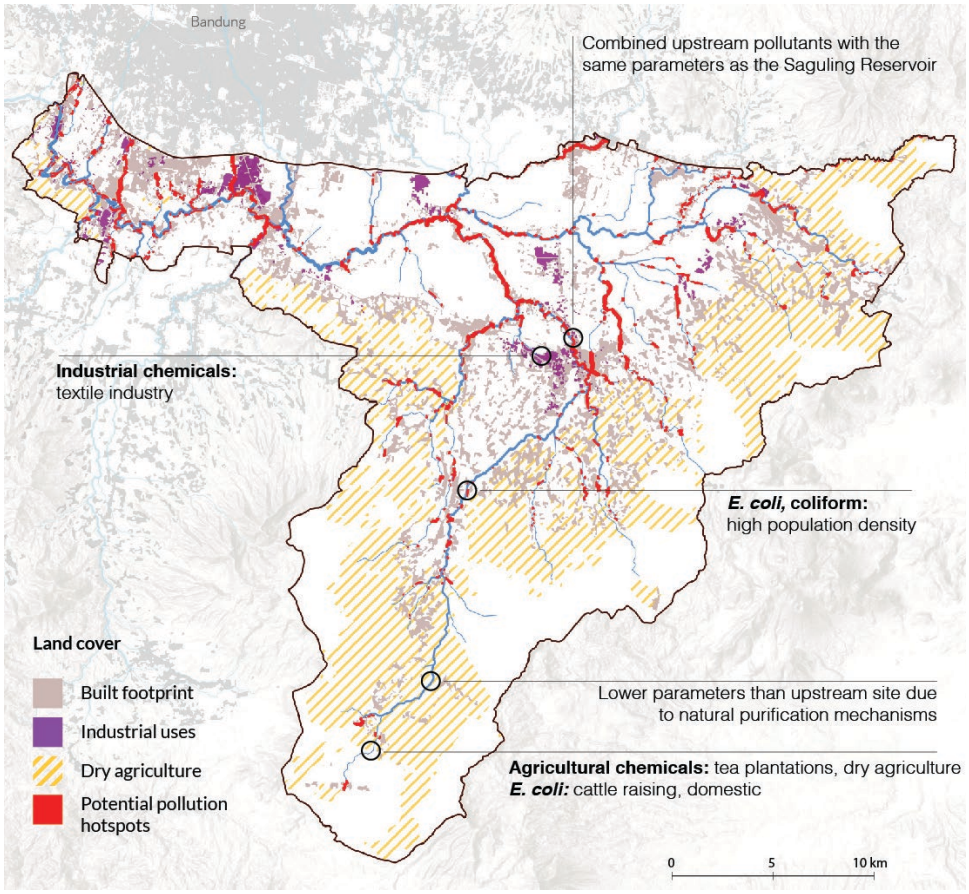

Figure 2. In red, areas in the proximity of the river that intersect with urban land uses. Pollution samples along the Citarum based on Parikesit et al. (2005).

River morphology and riparian ecology

The physical conditions required for rice agriculture have transformed the rural landscape of Southeast Asia into a highly engineered one. At the centrepiece of this transformation lies the centuries-old tradition of diverting and containing waterways.[38] It is no different in the Citarum's context, as authorities have slowly channelized its main course, primarily to control flooding. Rivers can be segmented by reaches that range from completely natural (usually in their headwaters) to completely artificial.[39] The sequence in Figure 3 illustrates how in a relatively short period of time, a tributary in the Citarik sub-watershed was channelized. This abruptly modified its morphology and profile to conform to the standard used throughout the Bandung basin. The degree of morphological transformation varies, as more rural areas have fewer physical constraints (or less developed land) than highly dense urban areas. In other words, more development around the Citarum forces authorities to partially maintain the original course of the river, while the opposite is true for more rural contexts.

Figure 3. Channelization of a minor tributary. Years 2015 (up) and 2018 (down).

However, the implications of this transformation in the Citarum are not yet studied. Potentially, the impacts of over-engineering can increase erosion, flooding, loss of habitat and river species.[40] Straightening the channel increases the slope by reducing the distance travelled by water, rising the speed of water. Usually channelization projects have a concrete profile to manage erosion caused by the increased water speed, but the Citarum, in most areas, does not have this type of measure. The erosion of the river banks causes an increase of sedimentation, which in the long term can cause flooding downstream.

Another impact of channelization is the loss of the riparian ecology. The leftover oxbows serve as a testament of the river's past, struggling to sustain whatever vegetation remains. The loss of this vegetation has severe implications not just for the quality of the water but also for the entire infrastructure project, including the Saguling Reservoir. Riparian vegetation controls water temperature, and acts as a filter, capturing a significant percentage of runoff that contain sediments or pollutants.[41] The transitional zones between land and water play an important function integrating multi-directional processes in both ecosystems.[42] The loss of these zones effectively transforms the river channel in an open pipe that accelerates the river's environmental problems.

Figure 4. Vegetation loss between 2005 (up) and 2023 (down).

FOCUSING TRANSFORMATION

Implementing large-scale policies and programs is challenging, often resulting in years of budget misuse and limited impact, as the more than 20 years of programs focusing the Citarum have attested. These programs encounter the inherent complexities of watershed management, where large-scale interventions require greater need for external mediation,[43] adding layers of institutional complexity. The challenges of territorial interventions—both technically and politically—and the scale of the operation, makes up for a difficult implementation. With this context in mind, a simpler approach would be to identify hotspots, or the areas responsible for a disproportionate share of the river's

degradation[44] and develop localised strategies to mitigate this. In the case of erosion, these hotspots can usually be found in gullies, river banks, unpaved roads, footpaths, forest margins and steep slope cultivation.[45] Focused solutions through this perspective supposes separating the scale of the phenomenon (hillside deforestation and erosion) from that of the solution (adding filters to stop soil-rich lateral flows). Applying localised solutions might prove an easier strategy to an increasingly larger problem in the Citarum watershed.

Hotspots can vary depending on the type of impact, which can be erosion, vegetation loss, pollution or changes in the river morphology. From a systems perspective, the Citarum degradation hotspots can be traced to the urbanisation pressures on the landscape. This means that a hotspot is not merely a degraded area or a place that severely impacts the river, but rather, it is a spatial manifestation of pressure drivers intersected by environmental conditions within a larger system. For this reason, looking at hotspots can point out areas where to intervene and what points within that system can be leveraged for change.[46]

Spatial hotspots

In water-sensitive projects, international experiences have shown that people are more interest in working with their neighbours at a local level.[47] And while the watershed may be the ideal hydro-ecological management unit—especially when compared with 'arbitrary' administrative boundaries—in practice, water decisions are seldom separable from political and socioeconomic considerations.[48] This is not to say that 'catchment thinking' does not work. On the contrary, watershed-scaled management suits policy-level actions. However, the Citarum programs failed, in part, due to the inherent difficulties of navigating the Indonesian institutional structures and making organisations to cooperate. Conversely, the smallest Indonesian administrative units in non-urban areas are the villages, or *desas*. These *desas* hold greater autonomy compared to urban municipalities and have stronger roles and responsibilities to manage projects in their territory.[49] With this in mind, inserting interventions within the administrative framework of the *desa* could help make projects more feasible where many other watershed-scale programs have failed.

A hotspot-focused strategy could be applied to target specific areas that particularly threaten the river, and interventions in riparian zones seem to be the most fitting to address the aforementioned challenges. From a regional perspective, the entire river corridor can be considered a hotpot and a place for intervention, where the most cost-effective actions can be localised in areas of particular degradation within the water system. From a local perspective—using the *desa* framework—by locating the areas that threaten riparian zones the most, we can design strategies to slow down or stop river degradation with localised blue/green infrastructure that links the community to the river. However, interventions along the river have the challenge to respond not only to their particular local hotspot but to the entire regional system. Spatial interventions are necessary to address land-use challenges, but a multi-scale approach is needed to touch on a regional level.

Regional adaptation

The highly localised nature of the hotspots facilitates intervention, as large-scale measures have proven costly and inefficient. This approach not only conserves resources but also leverages local knowledge to address problems effectively. However, as each transformation project differs from the other, answering to its localised issues, in large catchments individual transformations need to work as a system. A regional design project bounded to the river corridor, with a multi-scale and multi-level approach, could have the capacity to coordinate otherwise independent local hotspot projects, creating multidirectional flows of information to local and regional authorities. This way, a regional design approach has the potential to create institutional capacity[50] and work as a hypothesis,[51] providing the

groundwork to inform and design better contextualised solutions. Focusing on river-urban hotspots can provide the ideal location for interventions, while the design of the intervention may leverage for changes in future restoration programs.

CONCLUSION

The challenges of a sustainable transformation of the Citarum are multiple. Driven by urbanisation pressures, the direct and indirect impacts on the river create a complex landscape that restoration projects have failed to respond to. Moreover, the scale at which these projects operate further complicates an already difficult scenario. But even if we assume policies and large-scale projects work as intended, the watershed will continue to degrade due to a misalignment between the government's objectives and the source of the degradation in the river. Future transformation programs need to recognise the pressures and drivers of degradation along the river, understanding the role urbanisation plays in the larger hydro-ecological system.

The Citarum's challenges are regional. However, solutions should be addressed locally, through the identification of degradation hotspots along its course. Mapping the degradation system from an urban development perspective should help determine appropriate hotspots for interventions. In other words, a multi-scale strategy that looks at a watershed/systems level to solutions in hotspots for easier implementation in key areas to provide the most cost-effective actions. Addressing these hotspots can not only slow the degradation in such locations but also inform the change needed for a systemic transformation of the landscape. Consequently, this research proposes that a design-led approach to the restoration of the river can act as a catalyst for new institutional arrangements while transforming ecological and social environments along the river's course.

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BORDER ECOLOGIES

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INTRODUCTION

An ecology represents the balance between humans and nature.[1] At the US–México coastal border, urban, political, and economic forces have rapidly reshaped the physical landscape and challenged the geographic and natural ecosystems, which lie invisible and often in conflict with growth premises. This paper investigates the border ecology of Yogurt Canyon (Figure 1), a unique unoccupied open space in Tijuana situated at the convergence of the ocean and the international border, addressing the site's adaptations and multidisciplinary challenges for preservation and integration. By examining our interdependent existence within these divided landscapes, where water, people, and environmental challenges intersect, this study aims to foreground the physical landscape to reframe boundaries and civic values in architecture and city-making. Additionally, this study highlights actions of design reciprocity explored with students at the University of San Diego, examining the potential for co-production with the environment and the dissemination of preservation, ecosystem maintenance, and social integration.

Figure 1. Parque de los Sauces North (Yogurt Canyon) and the US–México border wall. Photo by Adriana Cuéllar.

RIVER, OCEAN, BORDERS

Tijuana and San Diego share a history of an environment in constant exchange. A main protagonist of this condition is the Tijuana River. At a regional scale, the river is part of the Tijuana River Watershed, a vast area of approximately 5300 square kilometers ranging from sea level to hills and mountain regions in the east. Seventy-three percent of this watershed is in Mexico.[2] The water flows from east to west, and all channels pass through Tijuana, the densest urban area in the Baja California region, before reaching the Pacific Ocean on the United States side.

The exponential growth of Tijuana's population, from 300 in 1919 [3] to over 2 million in 2020,[4] has appropriated land resources without discrimination. This expansion, spanning informal settlements, infrastructure projects, and private development, has often disregarded the intrinsic value of geography, transforming it into a series of fragmented abandoned landscapes for human survival or economic gain.[5] Amidst the acceleration of urban growth and practices of human boundaries, can border citizens reconcile with its broken and divided landscape?

Geography of divided landscapes

Throughout history, landscape has been a complex synthesis of viewer and environment. It is a reflection of our mediating mindsets toward territories, from colonialist thought to de-centered human processes. The history of landscape in the border region has gone through imbalanced transformations, from displacing indigenous semi-nomadic communities of the Kumeyaay to the subsequent urban reconfigurations driven by binational and local development. In the late 19th century, Kate Sessions—a botanist, horticulturist, and gardener—redefined San Diego's landscape by fostering a horticultural identity. She introduced and transplanted massive quantities of eucalyptus, oak, pepper, and other trees that thrived in the city's climate, shaping the present botanical diversity of public parks and influencing domestic gardening practices in communities and suburbs.

Conversely, the landscape of the southern border differs from those of single figures and public visionaries. Tijuana has consumed less land than San Diego and has a denser urban fabric with sliced hills, filled canyons, and concrete surfaces to control erosion. Residual landscapes populates the city as overlooked systems that absorb the imbalanced management of trash, sewer, and water flows. The resulting urban voids render the city in its most native dry conditions, and communities affectionately attach to small patches of trees for shade and nostalgic scenery. One example is the interstitial *Quinceañera Park*, an adopted public space located at a highway entry, appropriating 40-year-old trees planted during the construction of the Tijuana River Canal. In other instances, independent community initiatives intervene with the landscape for protection and social integration, as in the case of the binational garden on the Mexican side of the border wall at Friendship Park. Apart from the modern river canal and roads from the 1970s and the binational water treaty in 1944,[6] no other major comprehensive collaboration for landscape infrastructure has been implemented.

Figure 2. US–México coastal border map. Image by Border Design Lab.

Border coast

The Tijuana River crosses into the United States and reaches the Tijuana Estuary on the Pacific coast, the largest remaining coastal wetland in Southern California. This extraordinary river-ocean exchange is marked by the first monument established to demarcate the international boundary after the *Treaty of Guadalupe* in 1849. Over the past 175 years, the river, estuary, and distributary streams have undergone unrecognizable transformations.[7] A 2017 historical survey by the *Tijuana River Valley Historical Ecology Investigation* revealed that gradual narrowing of the Tijuana River Valley and Estuary occurred before human settlements. A cross-border coastal map in Figure 2 illustrates the current state of transformation from the open landscape field of the north versus the dense urban field of the south.

Beginning at the northern edge, the *Naval Outlying Landing Field Imperial Beach*—a US military training camp established in 1917[8]—marks the boundary where the dynamic river landscape unfolds. Here, the Tijuana River Estuary forms a series of floodplains and wetlands that exchange both river and salt water. The rhythmic ebb and flow of tides redistribute sediment, which has led to the emergence of new and diverse life. The landscape is continually changing with long periods of dry weather contrasted with sporadic heavy rain seasons, causing the river to flood the valley, sweep

through vegetation, and reshape the ground surface.[9] This constant flux of soil, water, and air transforms the area into a living sponge of algae, grasses, damp patches, and a thick border surface that is continuously mutating, cleaning, and absorbing various forms of waste.
Toxic contaminants from the south settle and contribute to the emergence of new plant species and ecological conditions. As one approaches the border, surveillance roads become increasingly evident, emptying the landscape with open panoramic fields for trucks and motorcycles to patrol. Roads end at the sand, where erosion and deposition caused by tides and waves sculpt arch-shaped dunes, transitioning enforced silence into nature contemplation. Ultimately, the landscape converges at the border wall and the encroaching city of Playas de Tijuana, where the dichotomy of urban development and natural resilience reaches its most intense expression of co-dependency.

A LANDSCAPE OF FERTILE RUINS

Figure 3. Parque de los Sauces Norte-Sur, transformation from 2000 to 2024. Image by Border Design Lab

Stretching from the transborder river to the ocean, Parque de los Sauces Norte (Yogurt Canyon) occupies a unique position at the confluence of the estuary, ocean, and military border. Over the past twenty-four years, this landscape has undergone a profound transformation, with its footprint shrinking by 30% and its once-rich native ecosystem now reduced to sediment, debris, and sewer runoff (Figure 3). Formerly a diverse mix of shrubs, trees, and plant species, the vegetation has receded, consolidating into a dense zone along the northern edge, just before the international border. In this area, the convergence of contaminated soils, water runoff, and community gardens has unexpectedly fostered fertile landscapes, reshaping the canyon's ecological and cultural identity (Figure 4).

Figure 4. Morning fog and vegetation at Parque de los Sauces Norte, 2016. Photo by Adriana Cuéllar

Urban edges

The canyon is bisected by the international border to the north and a boulevard to the south, displaying two contrasting building approaches to the canyon. The northern edge of the canyon is home to *Yogurt Place*, a family-owned restaurant that has occupied a small footprint within the canyon since 1976. Known for its alternative healthy Mexican recipes, this establishment has served the community for decades and offers a rare connection to a wild landscape in a city that is largely deprived of green spaces. The restaurant's radial design, modulated by the canyon's topography, leads visitors from the street to a courtyard and ultimately into the main dining space. A lower platform inside the restaurant provides a wide view of the tree foliage framed by a continuous hexagonal glass wall (Figure 5). A third underground level that is accessible from the canyon hosts special community events that directly connect visitors with the surrounding landscape. The interaction between the building, the landscape, and the community at *Yogurt Place* reflects how architecture can nurture the environment and vice versa, illustrating ways to create symbiotic relationships between living and the environment.

Figure 5. Yogurt Place Restaurant Interior. Photo by Adriana Cuéllar

In contrast, four high-rise housing towers have been constructed inside the canyon on the southern side of the road (Figure 6). Vegetation has been removed for new foundations and ground-level parking structures, interrupting the flow and three-dimensional complexity of the canyon. Between these two contrasting edges—the *Yogurt Place* on the north augmenting the canyon's natural oasis and the towers on the south erasing it—a strip of mid-rise health clinics and condominiums lines the west edge. These buildings face the street, with concrete parking surfaces and the perimeter wall of the *Plaza Monumental* bullfighting ring. On the opposite side, they terminate abruptly at the canyon with retaining walls and enclosed facades.

The canyon's main road intersection, marked by a small *OXXO* convenience store and a concrete fence, further illustrates this paradox as the built environment turns away from the natural landscape. The dramatic change in elevation from street to canyon has also transformed this space into a refuge for migrants and houseless populations who find shelter within the canyon's landscape and often linger to cross the border. However, local police have been clearing trees and vegetation for visual control and surveillance, further destroying the canyon's natural habitat. On the canyon's east edge, this boundary opens to fenced terraces and homes in a gated residential development.

These urban paradoxes that define the canyon's perimeter embody the complex ecology between borders, where decay, fragility, and renewal coexist. Additionally, sewage flows continuously from an open trench, passing through a nursery down the hill into the canyon's stream. During rainy seasons, this fermented water floods the canyon, transforming it into a green oasis. Despite its pollution, the landscape is shaped by this interplay between neglect and growth, mirroring the border region's history of migration and opportunistic adaptations.

Figure 6. Housing towers over Parque de los Sauces canyon. Photo by Adriana Cuéllar

Conservation challenges

The small distributary stream within the canyon raises important questions about the coexistence of urban voids with broken infrastructures and divided landscapes. Despite its modest size, Yogurt Canyon has evolved into a resilient micro-ecology that mitigates the city's environmental oversight of urban developments. In 2011, the municipality of Tijuana designated the north and south areas of the canyon (3.5 hectares) for conservation thanks to the activism of *Proyecto Fronterizo*. This civic, non-profit organization achieved unprecedented restoration in the south of the canyon, behind the towers, by securing public access, maintenance, and implementing educational programs to protect, restore, and connect the community.

Despite this successful conservation initiative, the challenges in adopting comprehensive actions for the coexistence of city and nature reflect historical divisions among local, state, and national jurisdictions. Water, sewers, roads, and buildings are managed independently by different authorities. However, community advocates, such as those in *Parque de los Sauces Sur*, demonstrate the necessary civic collaboration to align pathways that prioritize the common good across jurisdictions.

After the designation, Tijuana now has three areas for conservation, two of them which include this canyon: *Parque de los Sauces Sur* and *Parque de los Sauces North (Yogurt Canyon*). However, the designated conservation areas across the border in the United States have no comparable counterparts. *The Tijuana River National Estuarine Research Reserve* alone spans 928 hectares, established in 1982. While environmental initiatives in Tijuana face significant challenges, the construction of private housing towers inside the canyon highlights additional pressures from real estate development, complicating conservation efforts in the absence of urban-environmental measures. Over the past decade, new towers with exclusive amenities have reshaped Tijuana's urban landscape while the city increasingly crumbles from high-risk erosion sites.[10] Seasonal floods and landslides, once rare, have become regular occurrences, leading to the collapse of two apartment buildings and a major highway in 2023.[11]

In spite of rapid densification and geographic changes, ecologies are never erased but transformed. Yogurt Canyon, caught between neglect and development, embodies the competing forces of urbanization, civic advocacy, and environmental resilience. Its complex conservation processes and limited legal protections underscore the border's ecological and social injustice. Yet, the canyon's evolving micro-ecology invites reflection on community-driven strategies to bridge gaps in policies and urban planning. Beyond division and neglect, Yogurt Canyon serves as both a fragile reminder of what is at stake and a potential conservation model that can reimagine urban development as a negotiator of humans and all forms of living.

EARTH AS GARDEN

How we humans live with the prevailing diversity, and how that diversity, for its part, live with us? Gilles Clément [12]

According to Gilles Clément, gardens contribute to the spread of species around the world. From the smallest garden to the "planetary garden," the Earth moves and intimately connects with human gestures toward nature.[13] If we recognize that all humans are gardeners and accept gardens as diverse yet protected spaces for interaction and production with surrounding ecologies, how can this thought transform our approach to border ecologies? In our global world, the "planetary garden" according to Gilles Clément and other contemporary thinkers migrates conceptual thought to border landscapes, transforming our cultural understanding of place and divided territories. The limiting horizon of Yogurt Canyon, as with any piece of land, moves beyond its edges. As earth rotates with air, clouds, water, seeds, animals, and humans in unforeseen ways, this border ecology is never enclosed despite architectural boundaries that neglect, continuing to support biodiversity.

This notion of a third landscape, which borrows its name from the "third estate," a term coined by the Abbé Sieyès during the French Revolution to define those who were neither the nobility nor the clergy, identifies in this case "the totality of all those places abandoned by man." Gilles A. Tiberghien [14]

What if the "otherness" of Yogurt Canyon is no longer a deviant to a border system? This shift in perspective demands a reevaluation of design values urging us to recognize that buildings create new boundaries with nature—boundaries that often remain unexplored by humans. In the words of Leibnitz according to Clément, "Nothing in the world can be separated".[15] Boundaries will never erase history; they transform it. As nature and animals adapt to our cycles of destruction and construction, this interconnectedness could fundamentally change not only our approach to architecture and urban planning, but also our daily actions that drive control and economic systems.

A mediating border landscape

A world composed of objects does not have the same type of resistance as a world composed of agents. Bruno Latour [16]

In our contemporary world, the relationship between preservation, experimentation, risk, and social values is rarely addressed in architecture.[17] Elke Krasny highlights that projects in the city could be imagined as opportunities for invisible actions of care to switch to the foreground, challenging the autonomous and independent tradition of architectural practice into strategies of interdependency, connectedness, and intensification.[18] However, the results of critical building practices in Tijuana are often diluted by powerful economic interests and lack of collaboration.

In the fall of 2023, architecture students from the University of San Diego developed architecture projects for Yogurt Canyon, speculating on a myriad of opportunities for urban transformation as preservation. Students explored architecture as garden processes that activate natural ecologies in co-existence with new and existing buildings and community programs with awareness of bi-national and

interior tensions. This refers to an adaptation to architectural spaces and the processes behind them from architects, planners, zoning jurisdictions, citizen's needs, and cultural values. This adaptation involves rethinking how space may intensify existing buildings and actions of attention to the environment, how it may build interdependency with the community, and how it may become a resource that intensifies the connections between nature, buildings, residents, and both national and international development.[19]

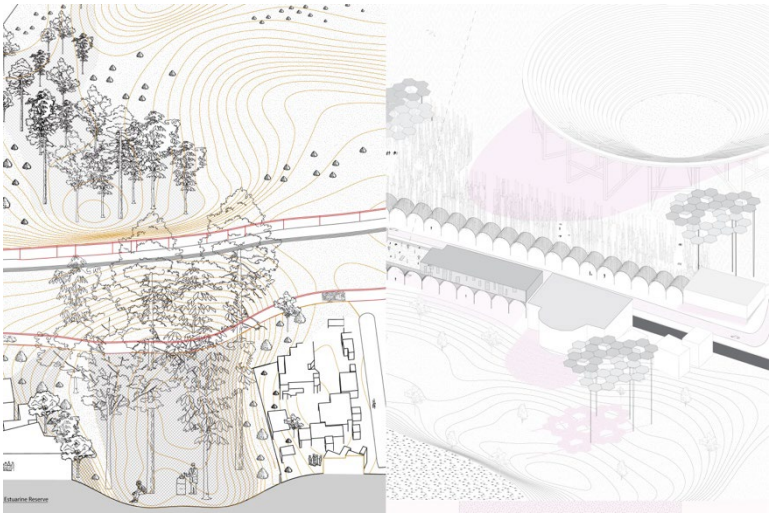

Figure 7. Student project by Aleena Haddad and Monica Jabro.

Figure 8. Student project by Owen Myall and Ari Espinosa-Sirvent.

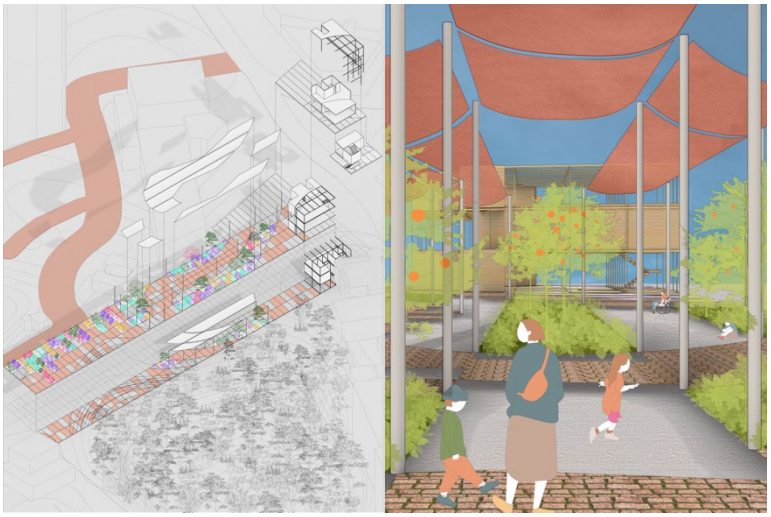

Figure 9. Student project by Covadonga Gordillo.

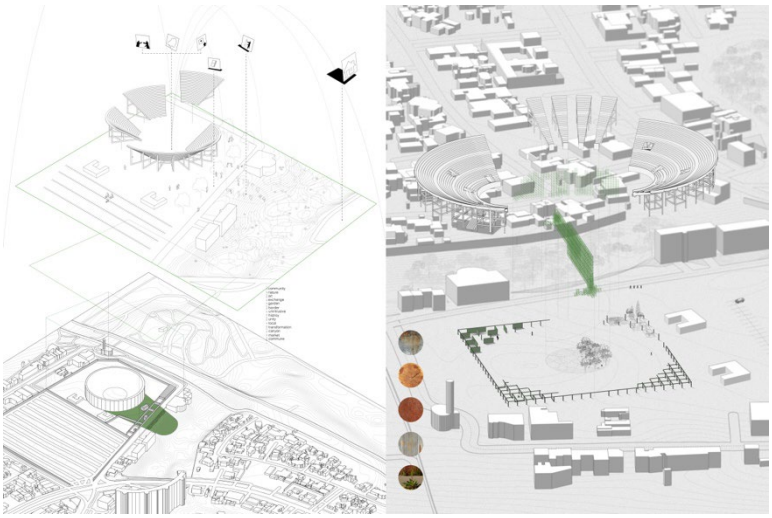

Figure 10. Student project by Joseph D. Washburn and Emmery Speed.

Within this framework, student projects ranged from interior structures for plants to grow as canopies, mitigating toxic water and air, to widening street edges with new gardens to harvest materials for construction (Figure 7). Another project involved reconfiguring the topography at the top of the canyon to support food gardens, strengthening the symbiotic relationship between the restaurant, production, and community (Figure 8). Additionally, the re-routing of roads for a civic plaza was proposed to reframe the views of the canyon for new community passages and engagement (Figure 9). Other students explored the transformation of the *Plaza Monumental* into a cultural heritage site by re-orientating urban monuments to nurture and readdress the canyon's vulnerability (Figure 10). The diversity of design strategies mirrors the collective imagination rather than a single, materially sustainable solution, emphasizing the importance of addressing complex conditions as hybrid multi-layered scales and programs.

The second phase of this research will involve a recent bi-national partnership between *The Border Design Lab* at the University of San Diego and *Promotora Bellas Artes* in Tijuana. Deepening our understanding of the conditions and opportunities within border ecologies underscores how independent identities are inherently linked to the forces that exclude them. Transversal collaborations become essential for transforming civic values and fostering deeper connections in mutual reciprocity between the built and non-built environments.

CONCLUSION

Pressures and challenges encountered at borders drive innovation, resilience, and new forms of collaboration and coexistence. The future of Yogurt Canyon and similarly divided landscapes hinges on our ability to recognize and embrace our interdependent systems. By seeing the canyon not as a marginalized "other" but as an integral part of the border region's essence, we can develop design strategies that transcend traditional boundaries and foster a more comprehensive coexistence.

This shift in perspective from the scale of the garden to the scale of the city challenges us to rethink our way of life and our role as caregivers of land, people, and buildings. We must advocate for critical design practices that are as adaptive and dynamic as the changing human and non-human ecosystems they inhabit. Through the recycling of buildings, readapting programs, reconnecting the urban fabric, and designing spatial actions that bridge connections with our environment, nurturing the ground, the views, the people, and the ecosystems, we can build new imaginaries to mend broken systems and transcend our self-imposed boundaries. In doing so, we may discover that the true potential of these divided landscapes lies in their inherent ability to connect and sustain the richness of borders. Binational educational efforts and the sharing of knowledge and resources are crucial for transforming the border's political, cultural, and spatial ecologies, strengthening environmental and human connections, and paving the way for a new era of transborder ecology.

ACKNOWLEDGMENTS

I sincerely thank my collaborators, Aleena Haddad and Hannah Covington, and my architecture students at the University of San Diego for their valuable contributions, enthusiasm, and passionate commitment to border projects. Without their vigorous participation, this study would not have been possible. To our new partners, Victoria Zepeda from *Promotora de Bellas Artes* and Germán Chávez from *Taller Común*, for their invaluable trust and shared passion in mobilizing our border region toward positive futures. I also wish to thank my colleagues from the Department of Art, Architecture, and Art History for providing a platform to make these studies possible. Special gratitude goes to Marcel Sanchez for his caring partnership in all aspects of this project and to my two children, who inspire the fight for a better planet.

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DESIGN STRATEGIES FOR ADAPTATION TO CLIMATE IN THE SARABHAI AND THE SHODHAN HOUSES BY LE CORBUSIER IN INDIA

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INTRODUCTION

This paper is focused on the study of the application of architectural design strategies in the Sarabhai and Shodhan Houses by Le Corbusier in India, responding to the conditions of Ahmedabad's climate, classified as Aw Tropical wet and Dry or Tropical Savanna Climate. The pertinence of the study of Le Corbusier's design process using climatic data is argued in this chapter. In the Sarabhai house, it was achieved a model of low energy consumption that was designed mostly for optimised natural ventilation and rationalized use of ceiling fans during the warmest summer hours, while in the Shodhan house, a model for efficient use of air-conditioned and standing fans during the warmest hours was achieved. This efficient performance adapted to the climate doesn't neglect the aesthetics and poetry of space that characterise the masterworks of modern architecture in the 20th century.

The design methods of Le Corbusier in India

Le Corbusier was commissioned by the government of India under the leadership of Mahatma Gandhi and Jawaharlal Nehru for the design of the new capital of independent India, Chandigarh and its public buildings; that should embody the modern aspirations of democracy, freedom, progress, equality and peace of the recently independent country, which had radically broken with the former colonial structures of power. Le Corbusier signed a contract that started on the 18th of February of 1951, which included biannual travels to India,[1] and would result in an endeavour that would take 15 years. During this process, he also got some private commissions, including the design of the Shodhan House (1951-54) and the Sarabhai House (1951-56) in Ahmedabad.

To carry on the commissioned work according to the requirements and local context, Le Corbusier contracted a consultancy with the French engineer André Missenard, author of the book *L'homme et le climat* (1937), about the adaptation of modern architecture to tropical climate.[2] Le Corbusier gathered information about temperature, hygrometry, and prevailing winds during his trip to Chandigarh in November 1951. Le Corbusier and his specialist team developed a new design methodology driven by the climate conditions in the region, entailing the use and exploration of new scientific tools like the so-called Grille climatique[3] to respond to the climatic needs of the place.

The Sarabhai House (1956) together with the Shodan House (1954) (Ahmedabad, India) are considered two of the most important works of Le Corbusier produced in the last stage of his career.

There are some academic publications that study the compositional and formal aspects of their architectural design,[4] however, there is no in-depth investigation into how the climatic conditions were a determining factor in the design decisions applied to these projects and their energetic performance. This paper focuses on providing this analysis of the houses.

METHODOLOGY

For this analysis, the original technical information of the houses was obtained from the Fondation Le Corbusier, and the energy performance simulations were done using the software Design Builder and the Energy Plus weather data files for Ahmedabad for current conditions. A detailed 3D model with the thermal properties of the materials according to the construction details and a BIM model to analyse the formal and technical aspects were done in Design Builder and Revit respectively. Due to the high amount of climatic data needed to analyse the energy performance during a year and the limitations to obtaining it from on-site measurements, there is a range of inaccuracy on the outcome of the simulations if compared with real measurements for one day, however, the overall results are based on the reliability of the Energy Plus[5] weather data files, and the thermal properties, characteristics, and combinations of the materials found in the original construction details.

THE CLIMATIC ANALYSIS OF AHMEDABAD AW TROPICAL SAVANNA OR TROPICAL WET AND DRY CLIMATE

The Tropical Savanna or Tropical wet and dry climate is characterised by a wet and dry season less pronounced than in the tropical monsoon climate. Temperatures are hot and change little throughout the year.[6]

In summary, the weather of Ahmedabad is a complex challenge for a designer due to the variations of temperature and relative humidity throughout the year, which oscillate between 10 and 40 C^o and the relative humidity levels between 95% and 25% respectively. Another particular characteristic is the high level of solar radiation, which on average is 500 W/m^2, reaching monthly peaks of almost 1,000 W/m^2. Most of the year the temperature is warm, between 24 and 38 C^o with relative humidity levels changing progressively between the dry and the wet season (between June and October) when the cloud coverage area is above 60%. The winds are of a maximum speed of 4 m/s, the prevailing wind coming from the southwest between April and August.

The average values of today coincide with the climatic data collected by Le Corbusier in 1951, however, climate change is recorded in the maximum and minimum values (the green strips in the graph shown in Figure 1.)

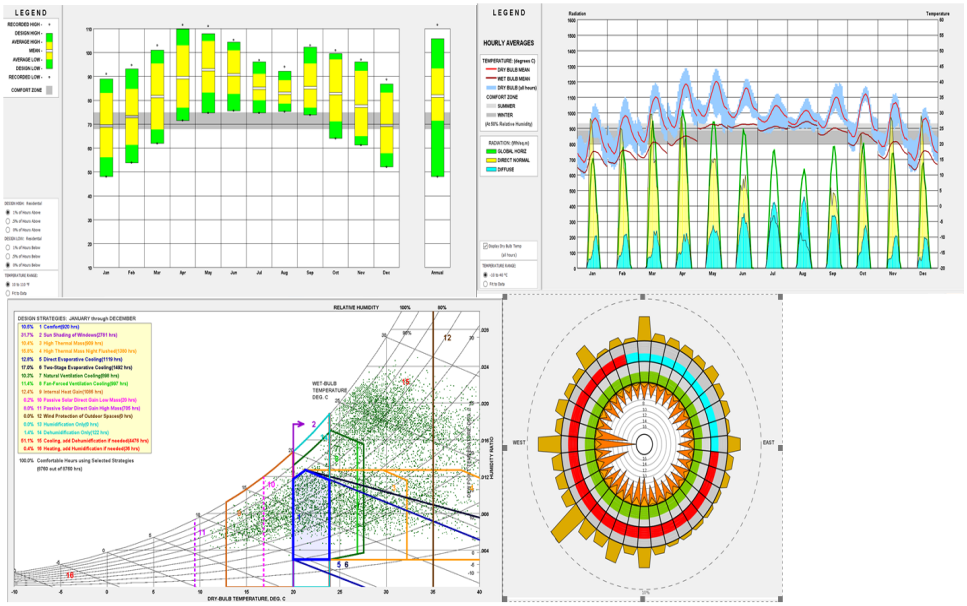

Figure 1. Climatic data for Ahmedabad, Temperature ranges, solar radiation ranges, winds wheel and Psychrometric chart of Givonni.[7]

THE SARABHAI HOUSE

Architectural Concept and Design Strategies for Adaptation to Climate

A system of half-cylinder Catalan vaults inside an axial grid aligned towards the main summer wind currents is supported by reinforced concrete beams aligned in the same direction and supported by bearing brick walls distributed according to the functional needs in the same grid, These structural walls are not too long to allow spatial continuity and connection between the different spaces, there is a system of wooden partition walls that can be opened and closed according to the needs of function and thermal comfort. Over the impermeabilized surface of the roof, above the Catalan vaults, there is a half-a-meter thick layer of soil covered with local grass and weeds that became a garden of lawn and charming flowers to be used at night when the outdoor temperatures are pleasant and which also acts as thermal shield tackling the high levels of solar radiation during most of the year and cooling the internal surface of the roof.[8] High thermal mass materials are used for the night flush effect and heat dissipation at night.

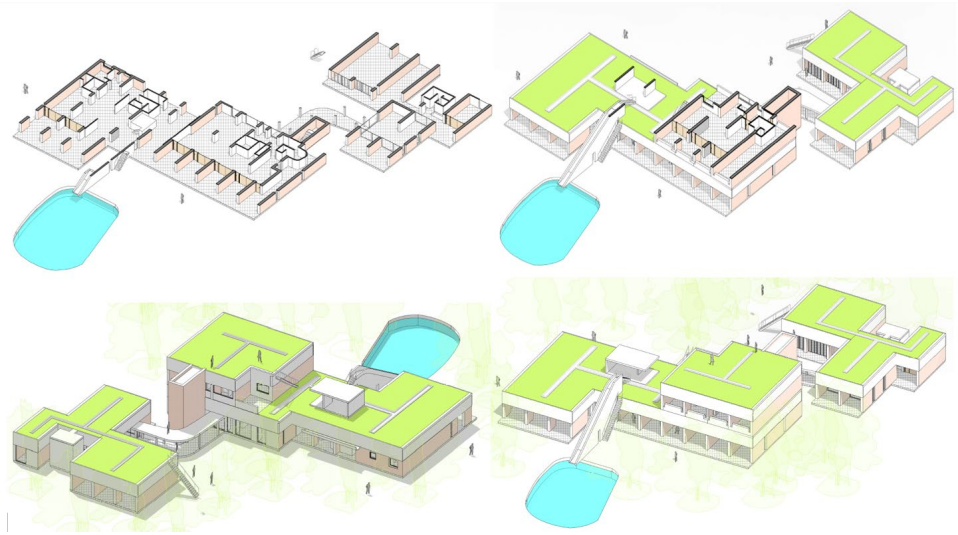

Figure 2. Axonometric views of the Sarabhai house. Source: Drawing by the author.

The Sarabhai house is designed to run almost the whole year only with natural ventilation. The system of Catalan vault modules is oriented towards, the main winds of summer. The extensive green roof with 50 cm of dirt over the impermeabilized surface of the Catalan vaults acts as a shield against solar radiation and has the effect of transpiration and cooling the internal surface of the roof. Two ceiling fans are in each vault module to be used during the warmest hours of the year, the doors are designed to be completely open or closed for natural ventilation, fans or air conditioning use. There are operable blinds of natural fibre to tackle the solar radiation in critical hours, of the afternoon. The walls holding up the vaulted ceilings have openings of various sizes, creating a flowing, interconnected space. Heavy wooden doors block out heat from the garden during the warmest hours of the day or are kept open to allow cross ventilation. Concrete fins and brise-soleils complete the composition of the exterior walls to further shield the building from the sun and block solar gains. The house includes an air conditioning system for three zones, although is almost not used as the natural ventilation and the ceiling fans are enough for thermal comfort in the warmest hours. Many high-canopy trees around the house act as natural parasols.[9]

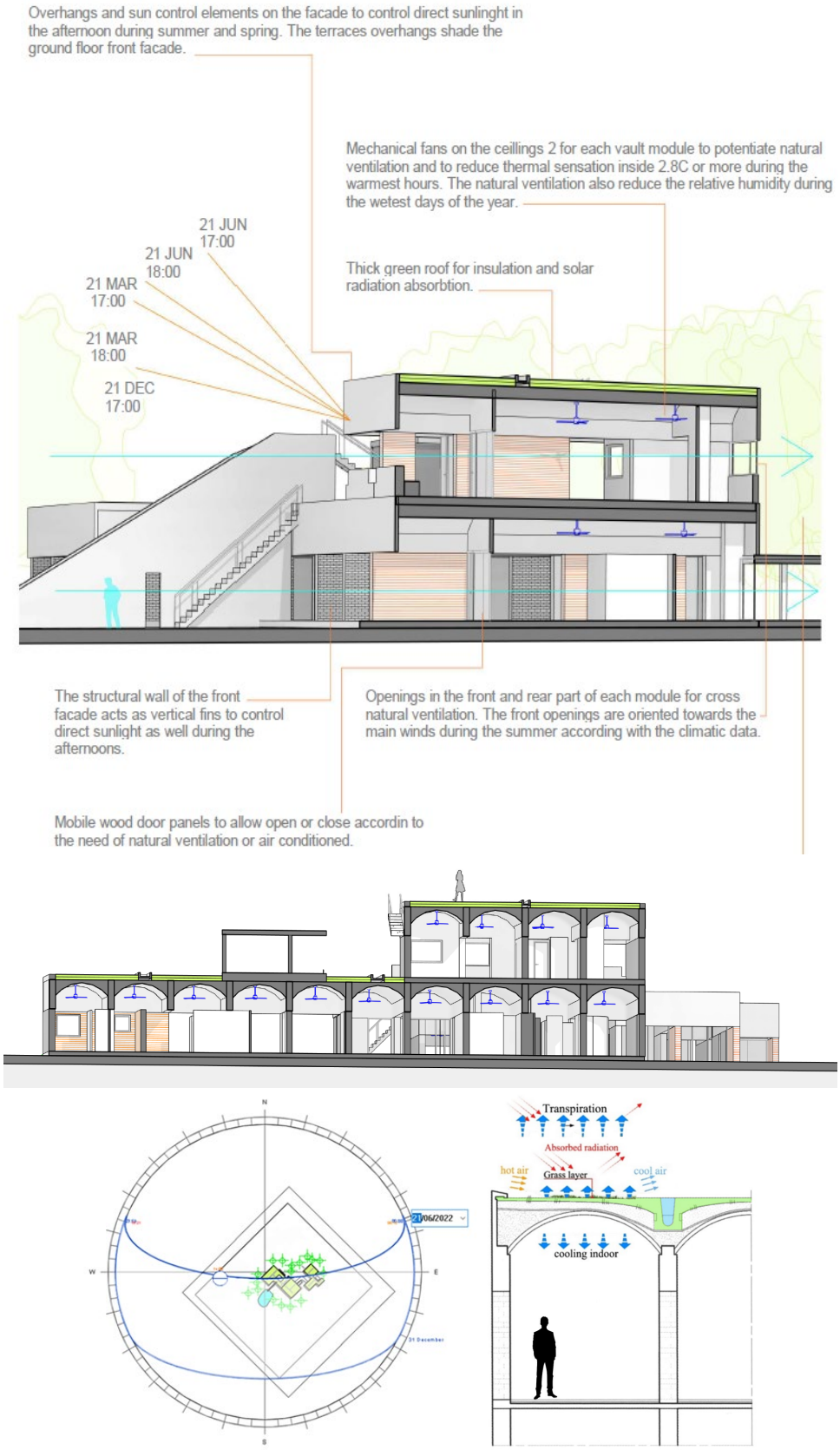

Figure 3. Design strategies applied in the Sarabhai House, longitudinal-section, location site plan with sun path and detail of the green roof. Source: Drawing by the author.

Design Builder Energy Performance Simulations for the Sarabhai House

Monthly simulation for one year with natural ventilation and fans turned off.

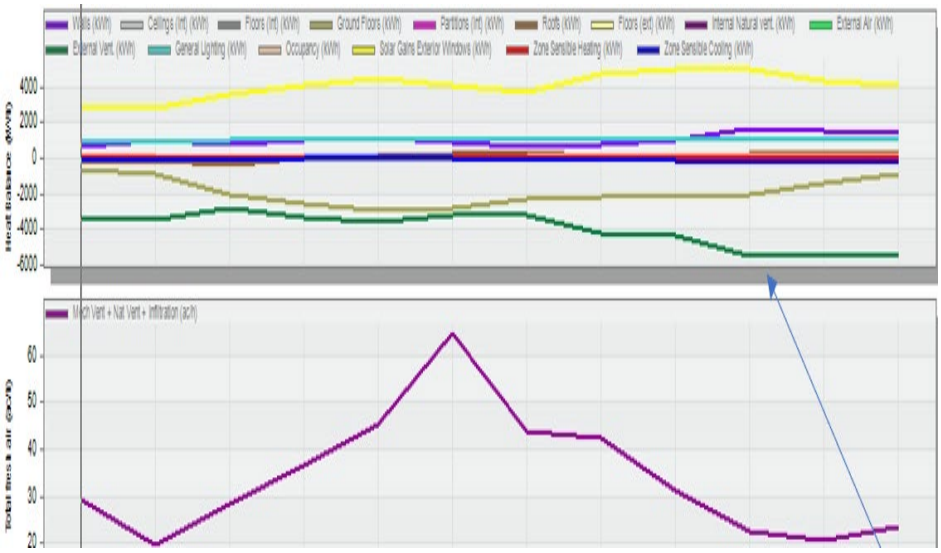

Figure 4. Heat balance graph and total ventilation graph for the monthly simulation for one year of Design Builder for the Sarabhai House.

In the monthly heat balance simulation graph, we can observe the negative green line showing the amount of energy saved by the natural ventilation[10] and the night flush effect generated by the high thermal mass materials of the ground floor at night like a negative brown line. In the upper part, the summatory of the heat gains shows a big amount for solar gains that in real life are less by the shade high canopy trees around and use of blinds in the critical hours of the afternoon sun (these factors are not simulated by the software). It should be noted that the ceiling fans are necessary when the outdoor temperature exceeds the thermal comfort temperature in some critical hours of summer, when the house should be closed, and the ceiling fans turned on. The cero line in the heat balance graph represents the thermal comfort: according to ASHRAE 55-2004 is between 24 C° and 28 C° wearing summer clothes.[11]

Hourly simulation for May 15th one of the warmest days of summer

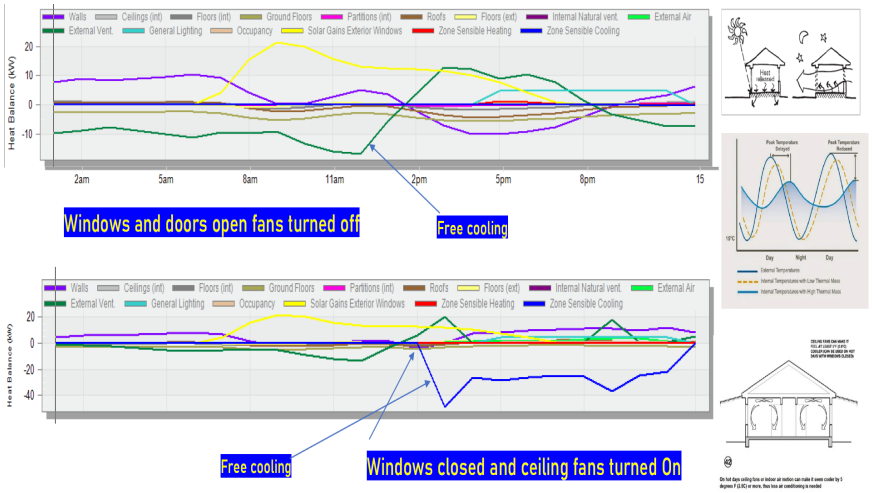

Figure 5. Heat balance graphs from Design Builder simulation with fans turned off windows and doors open, and doors and windows closed with fans turned on.

As we can observe in the graph for the hourly simulation of May 15th the outdoor air temperature rises above thermal comfort from 2 pm till 8 pm. In the heat balance simulation graph, with natural ventilation (with windows and doors opened) we can see that there is almost heat balance by the counter effect of the heat dissipation throughout the brick walls, the ground floor and the roof (purple, brown and dark yellow negative lines in the graph). It is important again to take into account that the high canopy trees and the blinds reduce the solar gains (positive yellow line) during these hours, however, the shade of the trees is not simulated by the software. On the other hand, we see that when the windows are closed and the fans are turned on, there is high efficiency, and thermal comfort is enhanced by the effect of sensitive cooling (negative blue line).[12]
This thermodynamic behaviour is described by the scholar Susan Ubbelohde who spent a day of summer in the house.[13]

THE SHODHAN HOUSE

Architectural Concept and Design Strategies for Adaptation to Climate

Compositionally the house is an eroded cube of reinforced concrete where the subtractions of mass under a parasol roof generate shaded interior spaces and staggered terraces. The design is similar to the Villa Savoy where the five postulates of Le Corbusier's modern architecture are applied, but in this case, adapted to the weather of Tropical Savana in a very accurate and rational way. The orthogonal structural grid of rectangular columns and beams of ferroconcrete allows the dynamism of the spaces in the different floors that are independent closed boxes, terraces, and voids while the independent enclosure walls of the façade and the shaders (vertical and horizontal) respond to the climatic needs and the sun movement of the place. Important as well is the use of the ramp as an articulation element for the different levels and the provision of an architectural promenade.[14]

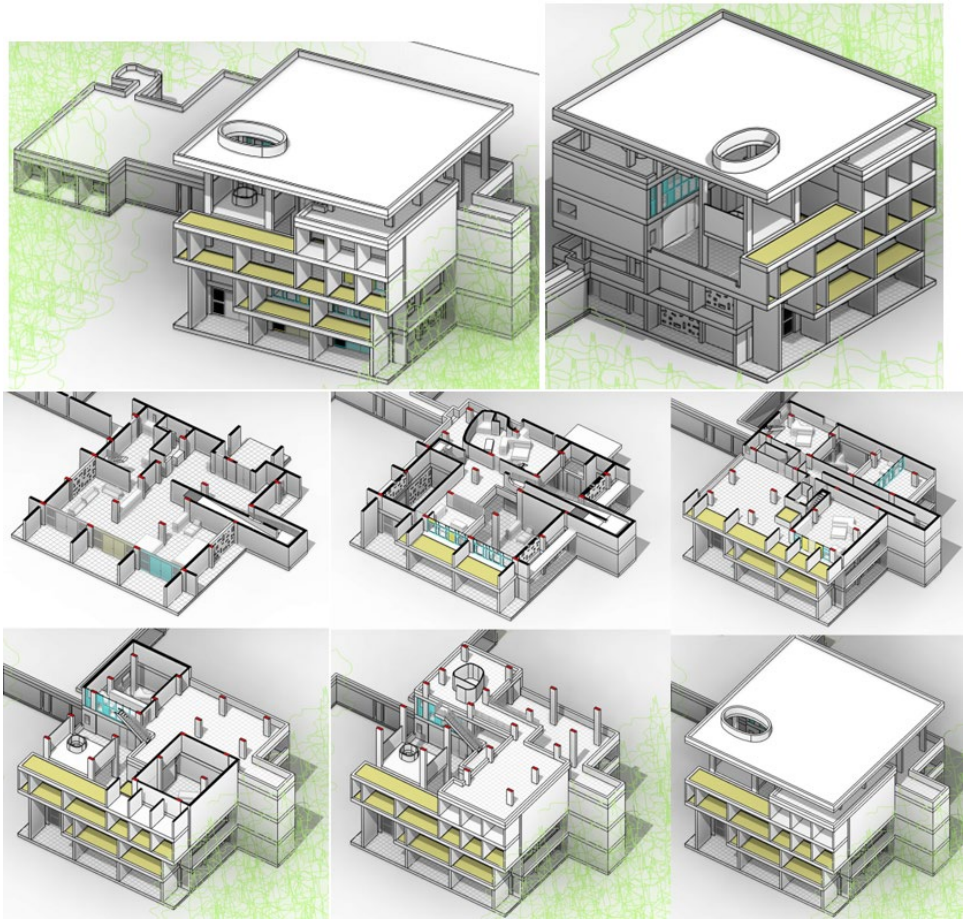

Figure 6. Axonometric views of the Shodhan house. Source: Drawing by the author.

The Shodhan house is designed to optimise the thermal comfort and energy efficiency for cooling in the internal spaces inside closed boxes under the parasol roof, next to and under the shaded gardened terraces. It is oriented towards the main winds of summer to enhance natural ventilation, but also it is designed to run with air conditioning or standing fans when needed. Operable windows are oriented towards the main winds of summer to enhance natural ventilation. The shaded-gardened terraces are designed to be used at night and to dissipate heat. Double-height private spaces with a mezzanine under and next to the shaded terraces are designed for both natural ventilation and air conditioning.

The external walls consist of three layers: concrete, air cavity with a vapour barrier, glass wool insulation and finished with painted wood panels to avoid external heat gains in the air-conditioned spaces.[15] High thermal mass materials are used for the night flush effect and heat dissipation at night.[16] The exterior walls of the interior spaces protected under the parasol roof are painted in white colour, as recommended in tropical climates to reflect any solar radiation throughout the year.[17] The brise-soleils enhance natural lighting. The set of design strategies applied tackle almost completely the solar heat gains.[18]

The house is designed for a minimised use of air conditioning in the closed boxes in the shadow next to the shaded and gardened terraces or for thermal comfort with standing fans.

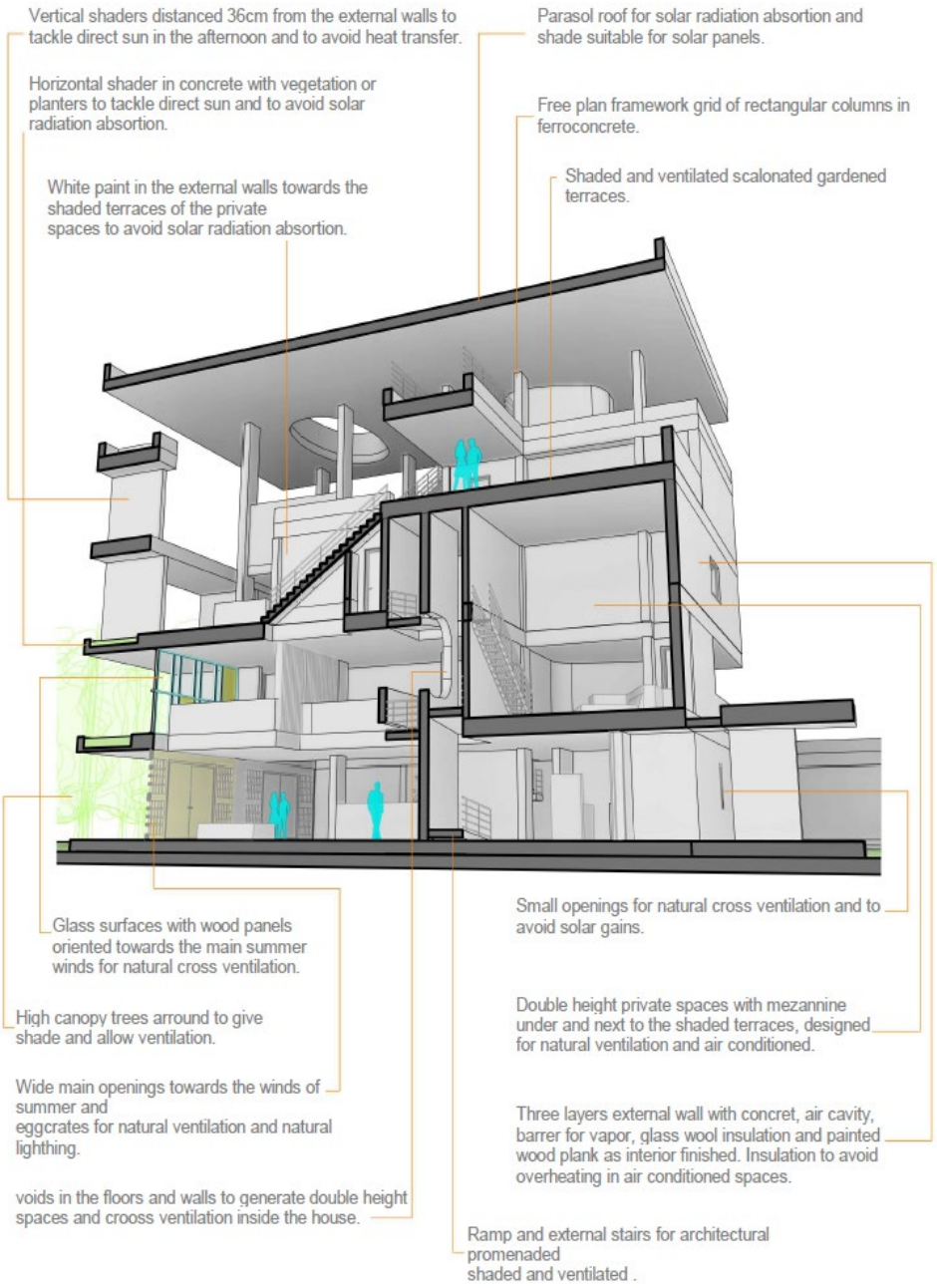

Figure 7. Perspective section of the Shodhan House showing the design strategies for adaptation to climate applied. Source: Drawing by the author.

Design Builder Energy Performance Simulations for the Shodhan House.
Monthly simulation for one year with fans turned on and windows and doors closed.

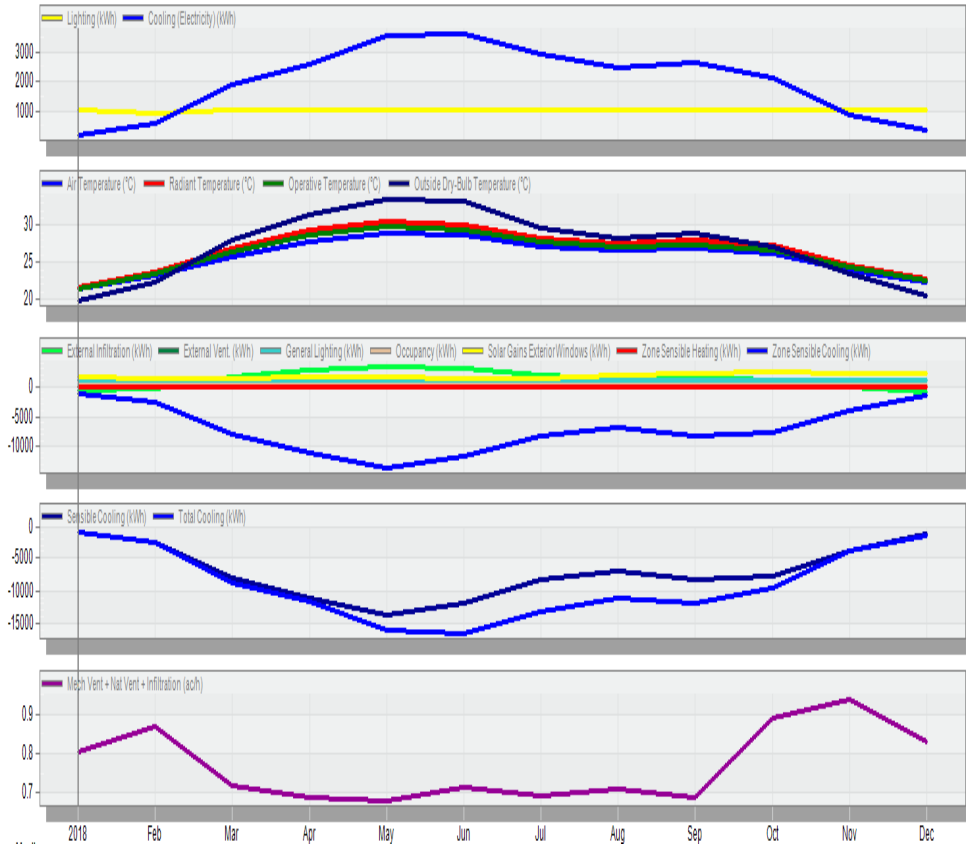

Figure 8. Simulations outcome graph for the Shodhan house, yearly energy consumption, air temperature, heat balance, total cooling savings and ventilation graph.

As we can observe in the simulation results for the monthly energy performance the heat gains of the house are very few, thanks to the set of strategies to avoid heat gains, being these: the parasol roof, the shaders, the insulated walls with air cavity and thermal insulation, the latticed shaded openings and the architectural configuration of closed boxes and shaded gardened terraces. As a negative blue line, we can observe the savings of energy for sensible cooling with the standing fans in combination with the set of design strategies. The house is especially efficient during the summer months, being an architectural concept ideal for functions that require air conditioning, steady thermal comfort and moist control throughout the whole year.

Hourly Simulation for May 15th one of the warmest days of Summer

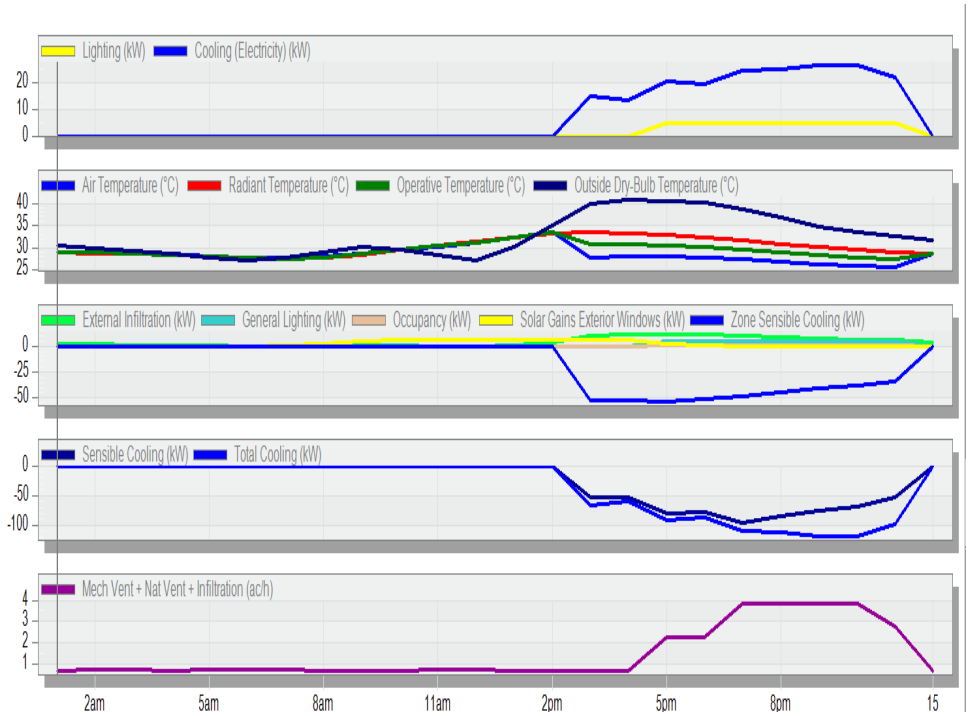

Figure 9. Simulations outcome graph for the Shodhan house, for 15th of May, air temperature, heat balance, total cooling savings and ventilation graph.

In the hourly simulation for May 15th, we can observe the high efficacy of the set of design strategies applied to tackle passive solar gains, there are almost no passive solar gains from 2 AM till 2 PM and the house is in thermal balance during these hours, from 2 PM till 9 PM, hours when the outdoor air temperature rises above thermal comfort, the standing fans are turned on, there are big energy savings for the sensitive cooling effect. The internal temperature of the house inside the thermal comfort range is steadier than in the Sarabhai house. The same would happen with the air-conditioning in any of the closed spaces, which would work very efficiently only for 7 hours a day during the warmest days of summer. In the cooling graph, we can observe that the sensible cooling effect is bigger than the cooling load representing big energy savings thanks to the effectiveness of the set of design strategies applied.

Figure 10. Interior photograph of the Shodhan house showing the latticed shaded openings from inside, the double height voids, the ferroconcrete frame and the standing fan.[19]

CONCLUSIONS

Le Corbusier achieved a high degree of energy efficiency and thermal comfort in these two houses, fulfilling the requirements of his clients who asked for low running costs for cooling. This was an alternative trend in the post-war period.

The efficiency of these strategies is verified in the heat balance graph of the energy simulations where is possible to measure the equilibrium between heat gains and losses, which keeps both houses in thermal comfort. Is possible to see how the design strategies tackle excessive solar gains and optimise natural ventilation. The combined effect of the design elements can be read as a big energy saving in Kwh yearly because the external energy necessary to equilibrate the thermodynamic system is very few compared with a building designed without design strategies for adaptation to climate.

The Sarabhai House, like many of Le Corbusier's projects, is acknowledged as a masterpiece of modern architecture and has been studied mainly for its spatial, aesthetic and compositional qualities as a relevant cultural production of the modern movement by authors like Kenneth Frampton, V. Doshi and Sussan Ubbelohde. In this paper, we recognise as well the early achievements of Le Corbusier in the attempt for adaptation to climate, sustainability, thermal comfort and energy efficiency.

In the case of the Shodhan House, the design strategies for adaptation to climate are highly effective for energy efficiency using air conditioning or standing fans and the design principles are applicable for contemporary practice in tropical zones due to the flexibility that allows it to be adapted to many contemporary uses like educational, health care, institutional, cultural facilities, single, medium, and high-density housing in parts of the tropical developing world where processes of modernisation are happening in remote regions.

It was also demonstrated the relevance and timelessness of modern architecture masterpieces and of the work of Le Corbusier that as mentioned by the architect Balakrishna Doshi established a standard and a framework for everything that was subsequent after it till our times and that opened possibilities for contemporary sustainable architecture after the end of the fossil fuels era.[20]

NOTES

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[4] Le Corbusier, *Sarabhai House, Ahmedabad, India, 1955; Shodhan House, Ahmedabad, India, 1956 edited and photographed by Yukio Futagawa; text by Balkrishan V. Doshi. (*Global Architecture N 32 1974*)*
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[5] Energy Plus Weather Data. https://energyplus.net/weather
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[15] Edward R Ford. *The Details of Modern Architecture. Volume 2. 1928-1988.* (The MIT Press 2003.) 6.41
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THE CULTURAL RELEVANCE OF QANATS IN THE LUT REGION

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INTRODUCTION

The qanat has allowed humans to transform harsh arid landscapes into lush desert oases for thousands of years. This ancient form of infrastructure consists of a system of low-sloping tunnels that extract groundwater from underground aquifers in precipitation-rich mountain regions and deliver it to arid desert plains for drinking and agricultural uses. A marvel of technological innovation, the system depends on a deep understanding of hydrology, geometry, geotechnics, biology, and economics. Interestingly, it also required an astute expertise in community politics.

Recognizing the qanat for its transformative potential invites one to contemplate one's relationship to our environment at a scale that is extremely rare. The full comprehension of these networks requires one to see past any one artifact, monument, or physical site and to recognize broader cultural notions of habitation, human interaction, and prosperity.

CULTURAL RELEVANCE

The civilization of ancient Persia and specifically the hot dry desert areas of the Lut Desert reflects numerous vernacular techniques used to address the harsh arid climate that made human habitation difficult. Most well-known of these vernacular techniques are the use of heavy mud brick walls, wind catcher towers, landscaped courtyards, water features, *mashrabiya*, vented domes, and other vernacular features that were developed over thousands of years.[1]

One of the region's great challenges is that yearly rainfall accumulations do not support the cultivation of agricultural production. And so, while these above surface and visible techniques are vital, it is perhaps the vast subsurface network of qanats that are most critical to the transformation of the region. This innovative water extraction method is believed to have been invented nearly 3,000 years ago in the Persian empire.[2] A seminal text, *The Extraction of Hidden Waters*, written by Abubakr Mohamad Karaji dates from the eleventh century and outlines the means and methods for planning, constructing, and maintaining the qanat.[3]

Developing these underground systems was difficult. First, one must have an intimate understanding of local geography and landforms. Second, there must be knowledge of the needs and capacity of the local farming class. Third, a sophisticated managerial skill will be required to not only secure and oversee funding from some governing entity. And finally, an acute knowledge of local politics will be necessary to quickly dispel any conflicts that could slow or jeopardize the operation.

THE QUANAT SYSTEM

The Iranian Plateau was the result of plate tectonics. Three plates, the Arabian Plate, the Eurasian Plate, and the Indian Plate collided and formed a series of mountains.[4] In essence, the qanat consists of near-horizontal underground channels which extract the groundwater and vertical shafts that provide access to the interior. The vertical shafts also allow for ventilation of gasses, soil to be removed, and access for maintenance workers. Qanats range in length from 5km to 50km below ground and transform dry arid desert landscapes into thriving settlements where access to water seems impossible.[5] They originate in mountainous regions where there exists ample precipitation and are daylighted at human settlements at lower elevations. Figure 1

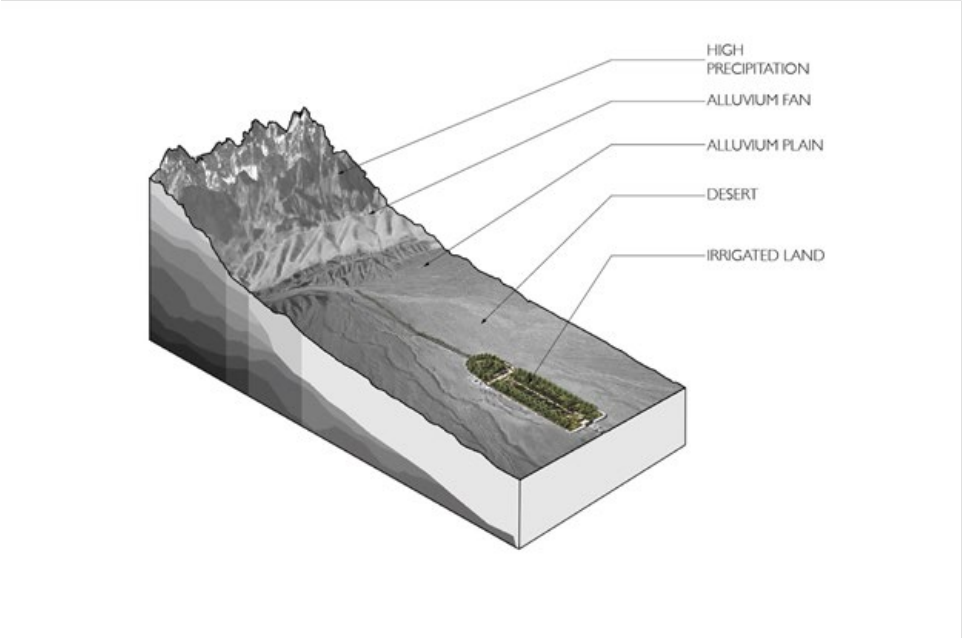

Figure 1. Typical desert transformation by a qanat system – Image credit: by author

The qanat channel is small, only large enough to accommodate crouching laborers. Not only was the worker at risk of drowning should a flash flood occur or being crushed by a qanat gallery collapse, but it was also difficult to monitor the oxygen levels in the tight cavernous voids. As the work required more accuracy and skill, the culture of specialized workers developed. The gentle slope that facilitates natural water flow is key to qanat success and ranges from 1:560 to 1:1500.[6] Due to the difficulty of the task, the construction crew became a well-respected close-knit group of specialists called *muqannis*. They dig the tunnel with small hand tools while an apprentice loads the dirt into a bucket. Laborers draw the dirt from the tunnel through the shaft openings. Over centuries, the pulleys, framework, ropes, buckets, structural reinforcing rings, and even hand tools became specialized to excavate the earth. Forming a circular crown, the excavated dirt raises the grade around the opening preventing runoff and other contaminants from entering the shaft. These mounds, called *karvar*, inscribe the landscape and mark the water source below. Seen from the air, one can distinguish the route of the qanat and necessary diversions that have had to be made over centuries. These pits, some abandoned, are sometimes the only visible evidence of an ancient settlement that once supported a farming village. From above, aerial photography reveals the eerie and abnormal tracings of ancient networks. Figure 2

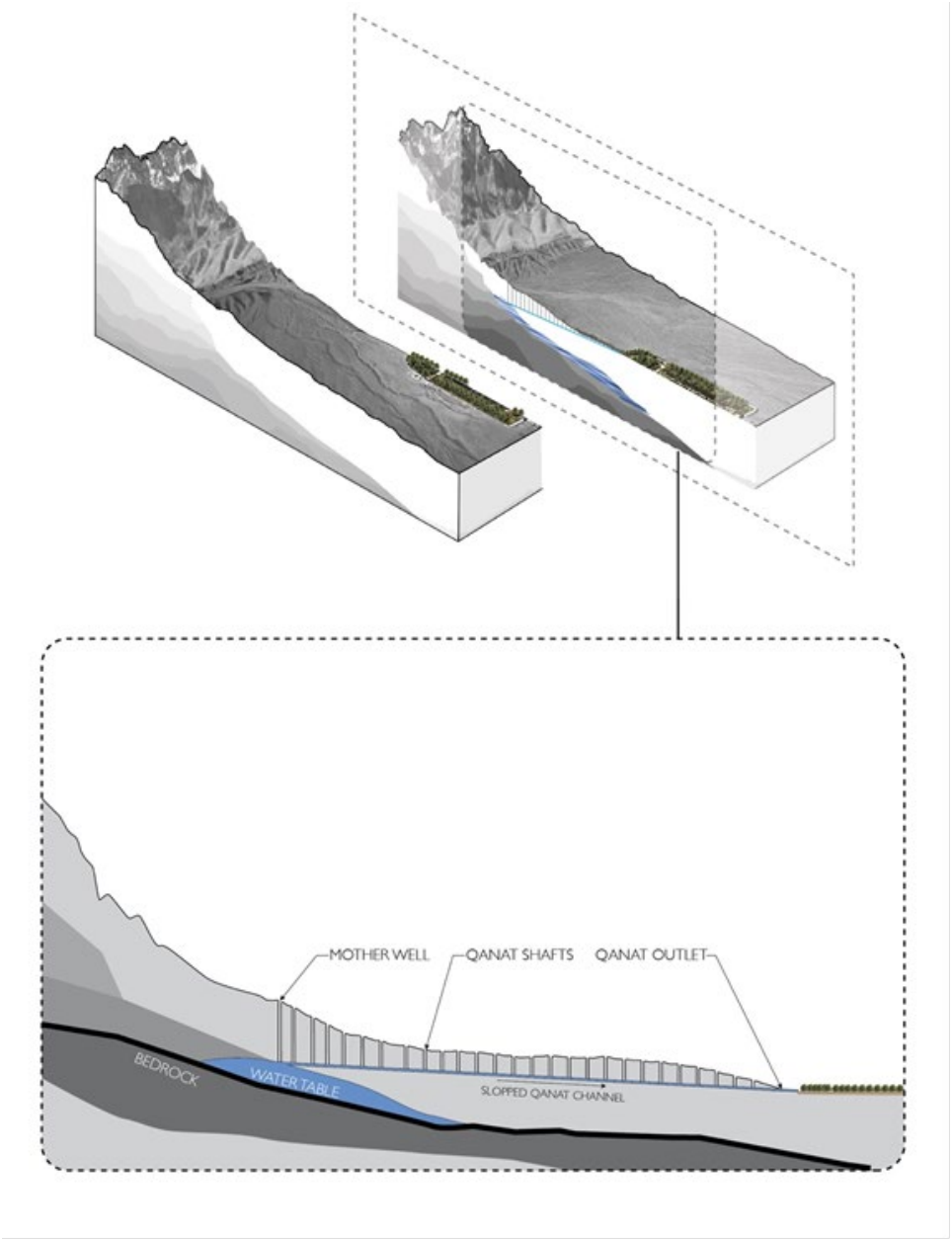

Figure 2. Section cut of a typical qanat system – Image credit: by author

Tools, techniques, and rituals associated specifically with qanat building have developed over time. In stable earth, the tunnels do not require reinforcement. In loose soil and areas prone to seismic activity, reinforcing rings of baked clay called *kowls* are used.[7] The *muqannis* maintain an essential relationship to the enterprise. Typically operating as a family business, techniques are passed from generation to generation. The repair, management, and necessary extensions are difficult and dangerous work. A primary component of agricultural processes, the qanat holds an important place in the operations of the state-owned farms. The better the agricultural yield, the more tax revenue they enjoy. The government did not hesitate to intervene when disorder threatened qanat construction or repairs. The agricultural tax funded its armies. For this reason, the *muqannis* and their heirs enjoyed a five-generation tax exemption.[8]

THE RISE OF QANAT CIVILIZATION

The development of qanats gave rise to a civilization untethered to a surface-based water source, and thus, greatly impacted the pattern of human habitation of the region. As in most hierarchies of wealth and power, those at the top control natural resources. Qanats entered towns and villages through the gardens and orchards of the wealthiest landowners and then ran downhill to the peasant homes and sharecroppers.[9]

The significance of the life-giving force of the qanat gave rise to several rich cultural traditions, rituals, and practices. The "qanat marriage" of an elderly village woman to the channel became much celebrated in some regions. The woman, very often a widow, would bathe in the water to guarantee the channel would not run dry. The woman would be well compensated for her trouble and the event would be celebrated much like a human marriage, there even exist stories of marriage soup being poured into the channel.[10] Folklore also describes the transport of water from one qanat and dumped into another in order to "marry" the two water sources.[11]

Traditions surrounding the qanat crew were rich as well. Many travelled from village to village as migrant workers making repairs and clearing obstructions. They practiced such superstitions as not working on days considered to be unlucky and performing a prayer ceremony each time a worker descended into the shaft.[12] Farming families had arrangements to work the land for wealthy landowners in exchange for qanat trenching and maintenance. These arrangements often were continued for generations ensuring a "feudal" relationship endured.[13] As was common for the time, it was not unusual for a peasant farmer to spend their entire life in one village; and, the village often operated as a single entity and was taxed as such. This shared responsibility in paying the taxes owed went far in creating community self-governance and developed into a well-established resource management process.[14]

Qanat civilization also created highly structured social hierarchies for overseeing the water resources. Just like vernacular architecture practices, these traditions and customs developed alongside the qanat systems as increased structure and predictability was required in managing the flow of water and cultivation of crops. An important unit of agriculture is referred to as *Boneh* in the regions around Tehran, *Sahra* in the east, and *Harasseh* in the central regions.[15] The *Boneh*, or parcel of land, was determined by the amount of water allocated to it. These were divided by a group of 6 to 12 farmers.[16] The *Boneh* received water in a predetermined ration. Since the qanat flowed continuously, the irrigation was divided by time allotments. Water was assigned to each parcel for a time duration throughout a 24-hour cycle. The flow, rotation, planting, and harvesting was all highly systematized and overseen by a person in charge of distribution called the *Mirab*. One common technique for distributing water to the land used by the Mirab was a device called a water clock. Often consisting of a copper bowl with a hole in the bottom, the bowl is placed in a larger vessel filled with water. The time expended for the bowl to fill and drop to the bottom of the larger vessel became a consistent measure of time. While rudimentary, the technique ensured that each parcel was divided water equitably.[17]

The qanat depends on the slopes of alluvial fans, intermontane basins, and alluvial valleys to distribute water to various destinations.[18] Conical earth formations serve to collect underground water and deposit it into an aquifer or underground river.[19] The underground qanat held two distinct advantages over traditional techniques of irrigation. First, proper surveying and planning allowed the channel to day-light at grade. This eliminated the need for pulley systems or manual extraction of water from below the surface with buckets. Second, allowing the water to flow from source to field underground reduces the evaporation that would occur if at grade.

Access to drinking water and irrigation required civic participation at the highest level. Collaboration was required on resource management and rights. Out of necessity, clans, villages, and later towns,

came together to fund and operate the qanat systems. Once the transport of the water from its source to its destination was accomplished, the difficult task of distributing the water among farmers needed to happen. This process of dividing the water also comes with a rich tradition. Accurate grading, levelling, and assigning quantities of water to each plot was tedious and required great precision. Accomplishing such a feat without modern timing, pumping, or measuring equipment was complicated.

Underlying this precision and accuracy was the efficient use of the water. Water was not to be wasted, and communities practiced great intolerance for irresponsible stewardship of the qanat.[20] Likewise, great authority and respect was bestowed upon the local qanat expert. This person not only oversaw the maintenance of the qanat but also served as community and civic leader often brokering agreements between neighboring villages to keep the water infrastructure safe and unimpeded. The reliance on the qanat network became a means of controlling political power. The tax revenue generated by plentiful crop production allowed for the funding of great armies and military might. This source of funding was critical to the expansion of the Persian Empire.[21] The qanat thus had transformative power over the local landscape, village social structure, regional habitation patterns, and broader impact on the Persian Empire.

The literal imprint of the irrigation on the surface of the land was highly varied and evolved to local needs and traditions. The geometric patterns of lush gardens seen on the estates of wealthy landowners were highly designed. Trees and shading features provided areas for contemplation and rejuvenation. Planting species and layouts developed into several specialized and distinct typologies. The notion of recreating a paradise on earth was prominent in Persian literature and quickly spread to other areas of the Empire. Figure 3

Figure 3. An oasis outside of Mahan, Bagh-e Shahzadeh, Iran, copyright S.H. Rashedi

This method of garden design became influential throughout the world. The inscribing of an artificial, or human-made, sensibility on the land and the attempt to bring our relationship with the natural world into a more clear understanding was only heightened by the knowledge that the very water system itself had been engineered to flow to that very spot. This recognition of artificiality or intervention in natural forces is powerful and the stylization of naturally occurring forms into geometricized patterns is evident throughout Islamic art and architecture. As water moved from the wealthy landowners to the farmland, crop layout took a much more utilitarian and efficient layout. Qanats made it possible for several varieties of fruits and trees to be cultivated. Surrounding these

were field crops such as corn, wheat, cereals, pea, beans, potato, alfalfa, clover. Forage crops included eggplant, okra, onions, tomato, melons, watermelons, and cucumbers. Even summer crops such as cotton and tobacco were able to be harvested. Water channelled from the qanat was also necessary for the raising of farm animals.

In some ways, the qanat gave the people of the desert plains some control over their destiny. The ever-constant monitoring and maintenance of the system ensured a steady stream of water. It was predictable and under their control. Unless the water source began to recede and the qanat needed to be extended, the community could count on the flow of water. This reality is in stark contrast to many parts of the world where the rainfall patterns were less reliable. Many ancient cultures held festivals, dance ceremonies, and rituals of sacrifice to coax the rains to come. This is in stark contrast to the qanat civilization whose ingenuity overcame the threats of drought.

THE DECLINE OF QANAT SYSTEMS

It is estimated that the Persian Empire once had between 30,000 and 50,000 qanats.[22] Inevitably, fuel-powered well- and ground-water extraction began to replace qanats in the 1970's. Also, Iran nationalized its water resources in 1968.[23] The qanat infrastructure became viewed as naïve and inefficient. Demand for water rose exponentially with the increased population following the 1979 Islamic Revolution. Deep well construction began to deplete qanat sources. Also, uncoordinated well operation along with extended periods of drought have resulted in the depletion of both qanat systems and wells. Across the Middle East, mechanical drilling techniques have replaced traditional qanat operations.[24] Also, despite the need for surface storage and active distribution, dams have also contributed to this decline. Ironically, such distribution systems often require the transport of water to towns and villages upstream of the facility. Such enterprises are not only inefficient but susceptible to run-off contamination and increased salinity.

While several qanats were named to the UNESCO World Heritage List in 2016, preservation efforts have largely been ineffective. Cave-ins and natural erosion have left many qanat systems indistinguishable. Also, due to the area's seismic risk, many earthquakes have led to the collapse of such networks. The most well-known of modern times is that of Bam. This disaster in 2003 caused the collapse of dozens of qanats resulting in sinkholes and collapsed roadways.

Great wealth inequality in the region prevents prioritization of long-range sustainable planning strategies such as cities organized around mass transit or broad water conservation efforts. Despite clogging traffic and stifling pollution, wars and geopolitical conflict have taken priority over long-range resiliency efforts. The primary use for freshwater in most countries is agriculture.[25] While for centuries it has been generations of farmers who have developed irrigation efficiencies, it may now be incumbent upon government to establish regulations to develop more stringent water conservation efforts.[26] There are also new technologies that can further water conservation efforts in Iran such as sensor-activated precision drip systems and irrigation monitoring drones. And, of course, there are calls around the world for the development of more plant-based proteins to reduce water intensive meat-rich diets.

The collection of water from alluvial fans is a renewing supply of water to the water table. The oversight of this dynamic of replenishment and extraction is tenuous and complex. Understanding the rainfall and runoff at mountain slopes has provided a reliable water source for centuries. However, faster and less labor-intensive methods of water extraction have developed into the introduction of large industrial pumping enterprises. It has exploited groundwater levels and resulted in increased contamination and salinity. Most alarming, competing demands for water supply have resulted in the loss of agricultural land, reduced crop production, and economic recession.[27]

CONCLUSION

Qanat systems are vernacular infrastructure that has allowed for the transformation of harsh arid landscapes to habitable garden city oases. This ability to extract water from mountain basins to desert plains has given rise to a qanat civilization that later became the powerful Persian Empire. Today, however, the qanat is largely seen as a provincial technique of the past whose careful planning and meticulous maintenance does not align with the current stress on water resources caused by massive population growth. However, there is much to learn from the enterprise and growing interest in the use of qanat technology to complement water resource management. The rich cultural heritage surrounding the qanat reflects a time when the consequences of insensitive conservation and resource mismanagement was more immediate. An obstructed qanat could threaten drinking water for an entire village. Response was immediate and robust.

Analysis of the qanat networks allows one to see a system and our relationship to the land at a scale that is quite rare. One must see past any one artifact, building, physical site to recognize the broader conceptual space of habitation, human interaction, and prosperity.[28] Collaborative, local action in resources management may offer key lessons in creating a more water-secure society.

Another lesson to be learned from the qanat system is the efficiency and adeptness with which communities were able to alter, renovate, and reconstruct the network to alleviate threats from natural disasters such as flood, cave-in, earthquake, or contamination. As governments throughout the world attempt to create urgency surrounding the devastating consequences surrounding climate change, one can look to the ancient qanat civilizations for examples of how communities embraced long-range strategies instead of short-term payouts. Even sea-level rise, dangerous pollution levels, and extreme weather events brought on by climate change do not seem to be able to bring a collaborative nature to our efforts. The qanat impacted every economic and social decision a community needed to make. Its survival depended upon it. There is growing appreciation by the global community for the ingenuity and innovation represented by the qanat and increased efforts to preserve this important part of cultural heritage.

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THE METHODOLOGICAL IMPLICATIONS OF USING UPCYCLED TEXTILE WASTE FOR FLEXIBLE-FORM RAMMED EARTH CONSTRUCTION

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INTRODUCTION

It is crucial to tackle the growing problem of textile pollution and wastefulness due to the exposure of harmful emissions to the environment and the rapid depletion of our natural resources. For one, the production of textiles contributes to ten percent of carbon emissions to the air, twenty percent of global wastewater (dyeing of fabrics and chemical treatments)[1] and immense quantities of discarded fabrics as refuse in growing landfills around the globe, some of which travel across the oceans and negatively impact residents from other countries. In a time where resource scarcity is an alarming issue, it's easy to consider that clothing waste is resource waste, not only in terms of textiles as a reusable material, but in terms of material investments and production. It requires about three thousand liters of water to produce one cotton shirt and about eight thousand liters of water to produce a pair of jean pants.[2] Polyester and cotton are two of the most highly produced textile materials in the world,[3] with a rough estimated global production of fifty million tons per year for each. Polyester, a gas-based plastic fiber, produces about five-hundred-thirty million tons of greenhouse gas emissions while cotton, a plant-based fiber, consumes about eighty-four and one half billion cubic meters of water globally.[4] In the United States, of the seventeen million tons of textiles generated in 2018, only 14.7% was recycled. While 18.9% was converted into energy, the remaining 66.4% was sent to the landfill, which equates to over 11 million tons of textile waste.[5] When one considers, not only the pollution emitted during clothing production, but the wasted costs of throwing garments away, one can see the severity of fast-fashion textile waste, which only accelerates the issue. Additionally, the added chemical treatments and the synthetic fiber blends that improve a fabric's durability, only serve to extend the life (or death) of textile waste in the landfill. Yet, such characteristics would also help extend their life as an earthbag made from post-consumer textiles. These materials could be intercepted in the waste stream and given new life in architecture through earthbag construction. Through earthbag construction, architecture be used as a vehicle for change, and encourage or offer alternative uses for clothing at the end of their life and reduce the premature destruction of valuable materials.

Pollution occurs at all stages of the clothing life cycle

Pollution occurs at all stages of clothing's life cycle—during fiber production, where raw materials are grown, harvested, processed, and spun into fiber, carbon emissions are released into the atmosphere during vehicular transportation of materials. Industrial factories where fibers are spun into yarn and fabrics also release pollutants during the weaving, knitting, and bonding processes.[6] This is especially the case for synthetic fabrics and blends that incorporate inorganic materials (such as petroleum, plastic, and chemicals) during the manufacturing process. As textiles are cut and fashioned into garments, bleaching, dyeing, and washing of fabrics also introduce pollutants to water and contaminants to the environment.[7]

Post-consumer clothing, which is repeatedly shipped and transported to retail stores across the globe, has several fates at its end-of-life: garments are either donated for reuse, recycled into alternative fabric items, combusted as waste-to-energy, or consolidated in landfills alongside refuse and trash.[8] The latter is extremely detrimental to the environment, as synthetic materials contaminate the soil and harm its fertility for future generations.

Integrating earthbag construction into textile circularity

It is without question that finding alternative and creative uses for post-consumer clothing and preventing it from prematurely becoming waste is of great urgency. In recent years, there is a push for circularity and regulation over the material consumption and degradation by the fast fashion industry, as highlighted by regulations such as France's Anti-Waste Law, Sweden's Textile Strategy, and the United States's EPA Initiatives, all of which aim to encourage textile circularity within these countries.[9] On that note, earthbag construction, which utilizes flexible sandbags and can be made from scrap cloth and other fabrics, can be used to address this issue.

To start, earthbag construction is an earth-based wall system that uses sandbags (or equivalent containers) to contain, transport, and stack earth as it is compacted and cured on the wall. Bags are laid in courses, like in masonry construction, with two rows of barbed wire in between each layer for tensile strength.[10] Within earthbag construction discourse, the earthbag has different names. For landscaping, road foundations, and embankment reinforcement, it's been referred to as soilbags or donow.[11] It's also been referred to as sandbag technology for building systems that employ sandbags or, more colloquially, as SuperAdobe, a type of coiled earthbag system developed by the Iranian architect Nader Khalili at CalEarth.[12] It's also been coined as a type of flexible form rammed earth construction, which emphasizes the importance of the bag's form in containing earth as it is rammed.[13] To clarify, it isn't to be confused with monogamous rammed earth construction, as earthbag construction separates the earth mass into units, making it more analogous to adobe bricks.

Given the inherent flexibility, ease of use, and embedded humanitarian spirit of earthbag construction, integration into local textile circular economies where there is a desire to encourage change and existing networks for textile recycling is a logical step. The growing textile waste surplus and pollution is a global problem—the earthbag construction method, which is applicable globally, is simple in concept and does not require building experience to put into practice. Unwanted textiles can be removed from the waste stream and upcycled into wall components as sandbag substitutes in earthbag construction. In fact, post-consumer textiles that remain in the waste stream in the U.S. have been found to be predominately discarded since they can still be worn.[14] Furthermore, depending on the fabric, clothes can be more durable than the conventionally used polypropylene in earthbag technology.

Goals and Methodology

The goals of this research are to (a) verify whether recycled clothing waste can be used to create earthbag structures of comparable strength to conventional polypropylene earthbag structures, (b) to develop a methodology for making earthbags from post-consumer clothing waste, and (c) to increase empirical research of alternate earthbag materials and improve the reputation of earthbag construction as a building method to be included in building codes.

Second-hand post-consumer garments were collected from various clothing donation resellers and thrift stores in the American state of Pennsylvania, such as Goodwill. Currently the research focuses on post-consumer clothing that are not suitable for resale but are usable as a garment or for scrap fabrics, rather than soiled clothes from a landfill. Initial explorations used clothing of varying cotton and polyester blends and sought to examine tactile differences in handling the fabric during the earthbag production process. Small scale earthbag samples were sewn from the garments, filled with non-stabilized soil, and tamped.

Understanding Centre County's textile recycling material economy

The research is currently situated in Centre County, a region in central Pennsylvania that happens to be the state's fifth largest county. The landscape consists of forested steep hills and agricultural lands in the valleys historically used for farming. Over time, the number of farms has decreased with the increase of non-farm residents moving into the area.[15] Recycling is mandated in Centre County, albeit not contractually, and residents are required to recycle their refuse and waste or else they are fined. Following interviews with thrift stores and recycling centers in the area, it was found that at the retail level, while there is a recycling stream for post-consumer waste, there isn't one for textiles at the upper level, despite municipal mandates for residential and commercial recycling for other materials, such as plastics, metals, cardboard, and glass. In fact, textiles that enter the waste stream are often not accepted at recycling and refuse centers and are instead transported to landfills due to a lack of DEP (Department of Environmental Protection) salvage certification. As a result, a majority of textile circular flows for garments revolve around thrift stores, donation centers, and various faith-based organizations that function on volunteer labor. Simply put, there is a lack of textile recycling in the area at the district-wide level.

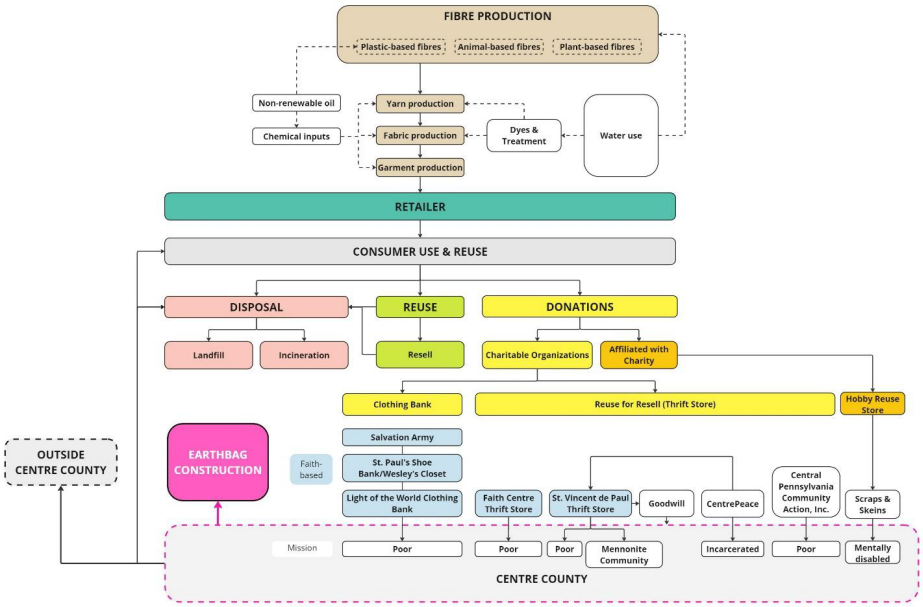

Figure 1. Textile circularity in Centre County, Pennsylvania, modified from Weber (2015).[16]

As indicated in Figure 1, in Centre County PA, post-consumer clothing is either sent to the landfill with other refuse, reused, or donated to charitable organizations or donation boxes. Charitable organizations are either faith-based clothing banks or community-run thrift stores that systematically screen donations for reuse and resell for the explicit purpose of providing aid to the vulnerable. Within this stream, clothing is also exchanged between community organizations based on the skill of their personnel and the organization's goals. A thrift store that prioritizes clothing may send another store furniture or kitchen appliances if they do not have the capacity to furnish or screen the items. Likewise, a thrift store specializing in hobby and craft supplies may prioritize scrap cloth, fabric sheets, and sewing tools rather than articles of clothing. That is to say, clothing as a material resource is not circulated in isolation– it is oftentimes donated alongside other materials and home goods. Although these thrift stores generate revenue based on similar items, they are not in explicit competition with each other. (One of the reasons why materials, clothes, and items are sent between stores is the common goal to help vulnerable communities in need in the Centre County area.)

The methodological challenges of textile variety in relation to earthbag construction

After surplus garments in the recycling stream were collected from local thrift stores and charities in the area, each piece was dissected into parts (i.e - sleeves, bust, legs) and used to create small earthbag samples, as shown in Figure 2. One challenge that arose during the process was the simple fact that the garments were of varying sizes—this made patterning difficult as there were different amounts of material. The variety of materials proved to be a difficult challenge as well, as the different weaves and fibers resulted in different mechanical properties. From the experimental standpoint, it was also difficult to empirically define the materials used to create new bags—as all of the garments were acquired secondhand, identifying the age of the pieces was not feasible, especially given the breadth of fabric types, colors, dyes, and consumer treatment (i.e.- number of washes, stains, and bleach treatments) for each garment.

Figure 2. Unfilled earthbag samples cut from various textiles salvaged from secondhand clothing

Therefore, a classification system is needed to quantify the amount of fabric and identify the type of fabric necessary to create larger earthbag structures with specific materials (i.e. – a cotton earthbag wall versus a polyester wall). Not being able to differentiate the types of used fabrics or classify second-hand clothing greatly inhibited the earthbag production process, as certain fabrics did not cut as well as others, or leant themselves toward easy tailoring with the same shape. The amount of time

invested in de-stitching simple versus complex stitches also resulted in many hours sitting in one position, taking everything apart. The different textile blends also resulted in varying levels of elasticity when filling the earthbags with soil.

However, the process of transforming an article of clothing into an earthbag is promising and aligns with the do-it-yourself spirit of earthbag construction. Throughout the earthbag wall assembly process, the earthbag undergoes many geometric transformations thanks to the flexibility of the earthbag form—bags can have diddled corners or be tamped into a wedge form to create keystones for earthbag arches for openings.[17] In addition to the geometry of the bag, earthbag builders can also decide to use sandbag-like substitutes, such as grain bags or animal feed bags that do not exceed 50-lbs in capacity.[18] Since earthbag construction celebrates craftiness and hard work, it is a construction system that is popular among do-it-yourself builders interested in constructing their own dwellings for cheap, with or without construction expertise. Because the essential quality of an earthbag is to be a container for transporting and holding earth medium on the wall, seamstresses and do-it-yourself craftspeople can sew their own bags from textiles.

Proposed methodology for identifying and quantifying fabric type and weight

To better facilitate the organization of large quantities of clothes for same-fabric earthbag wall assemblies, a methodology[19] that used few and affordable tools was determined. It was important to find ways to measure the clothing at limited cost in the interest that future earthbag makers would be able to easily replicate it.

1. Preliminary separation of clothing based on material specified on the garment tag. While the tags do not specify the subtype of certain fabrics (for example, denim is a type of cotton but can be described as one-hundred percent cotton on the garment tag), they prove useful in differentiating organic fiber fabrics from synthetic ones.
2. Weigh a garment on a scale (grams).
3. Take a picture of a garment laid flat on a white or black surface and use ImageJ software to complete binarization analysis and calculate the surface area of the garment. ImageJ is open-source and free for public use and is capable of quickly isolating color differences in 2D images.
4. To calculate the density (GSM, grams per square meter) of the fabric, simply double the surface area measurement and divide it by weight.
5. Finally, use image upscaling to measure the warp and weft of the fabric in order to identify the weave type. ImageJ binarization can be used to clarify the image.

By identifying the type of fabric and organizing the garments by density (or the amount of woven material), earthbags from old fabrics can be more closely compared to new fabrics of similar density and weave. This also helps establish a baseline or means of quantifying the material characteristics of post-consumer clothing, which have more unknown variables such as age and wear.

NEXT STEPS

Next steps in the research include a refined organization of post-consumer clothing using the quantification methodology mentioned. Using this method, a greater number of garments with specific materiality can be collected and sewn into multi-course structures for comparison, rather than smaller samples. In that regard, future stages in the research would involve considering the original geometry of the garments instead of dissecting them into parts. A t-shirt, for instance, is essentially a tube that wraps around the body and can be modified with a few stitches to contain the earth. Tailoring garment geometries instead of fitting the fabrics into a specific template would eliminate the need for patterns, de-stitching, cutting, and ultimately reduce sewing labor during the earthbag production process. Although garments will still vary in size and shape, it will be easier to replicate

simple stitches instead of whole bags from scratch. Because earthbag construction's strengths lie in its replicability and ease of instruction, a simpler methodology for producing new earthbags from clothing is essential. Moreover, integrating sewing craft with earthbag construction creates opportunities for the earthbag builder to tailor an easier to handle bag for their bodies. Since earthbag construction involves the on-site movement of large quantities of earth, it is very laborious and involves high caloric work. Seamstresses and tailors could potentially revise the earthbag's size and weight so that smaller bodies could have easier access to earthbag construction or create alternate geometries for tailored wall assembly methodologies. Future research could also consider explorations in creating earthbags from clothing acquired from the landfill or intercepted during disposal, which would involve garments with greater imperfections and damage. Doing so would result in an earthbag construction that is fully integrated in circular textile systems, or at the minimum, open discussions for establishing a textile recycling system in contexts where it is lacking.

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IS AGENDA 2030 ENCOURAGING A BENIGN ANTHROPOSYSTEM IN CITIES?

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INTRODUCTION

At the turn of this century, the Nobel laureate Paul Crutzen suggested that we are no longer living in the Holocene era, but had entered the Anthropocene, a new geological epoch in which humankind is altering the planet and its systems.[1]

There are countless ways in which humankind is bringing about these changes that are cumulative, accelerating and altering planetary systems with dire consequences for humankind and all life on the planet. Once one set of variables causes interaction with others, a system is in play where *actions working together as an interconnected and complex network can bring about changes and outcomes that are often unpredicted and can be irreversible*. [2]

If humans, by our actions, are bringing about discrete, cumulative and complex changes whose outputs are unforeseen or unpredicted, we are, in effect, curating by accident or design an *Anthroposystem* that has been gathering momentum. There have been warnings for decades, but finally, there is near universal understanding and acceptance that these changes are disrupting the Earth's systems with toxic complications for human and natural ecosystems. This existential pre-occupation for humanity is not only the pace and reversibility of these changes but whether, by human intervention, this *Anthroposystem* can be moderated to make it tolerable to human and natural ecosystems and even make it benign.

This paper begins with "*Transforming our World: The 2030 Agenda for Sustainable Development"* (Agenda 2030), the Sustainable Development Goals and Targets it introduced (SDGs), and research, policy and action based on it.[3] We have now passed the halfway point in the journey to 2030 since the adoption of Agenda 2030 in 2015 and it is now appropriate to reflect on progress and raise questions as we enter the final 5 year period to 2030.

With the Paris Agreement and Habitat III as starting points, the case study reviews work of the UNECE Committee on Urban Development, Housing and Land Management to consider its work in support of Agenda 2030 in anticipation of the adoption of the Pact for the Future at the UN General Assembly in September 2024.[4] The case content has been selected to provide more granular insight into the realities of enacting the SDGs in cities.

AGENDA 2030 & THE SDGS

"Transforming our world: the 2030 Agenda for Sustainable Development" (Agenda 2030) was adopted by the General Assembly of the United Nations in October 2015.[5] Agenda 2030 was a key text presented to, and adopted by, the Parties at the UN Climate Change Conference (COP21) in Paris

on 12 December 2015. The Paris Agreement was signed formally on Earth Day 2016 at the United Nations Headquarters in New York[6] and was entered into force in November 2016 after ratification by 55 countries responsible for at least 55% of global greenhouse gas emissions.[7] The Paris Agreement is a legally binding international treaty on climate change.[8]

Agenda 2030 is a "*supremely ambitious and transformational vision*" [9] to be achieved through global action based on the three pillars of Sustainable Development – economic, social and environmental. Given that documents adopted by the UN and its agencies must reach consensus agreement among member states, Agenda 2030 is a remarkable achievement in international diplomacy. Arguably, from a global perspective, it is the principal instrument currently in force that can and does, inform and underpin action in support of Sustainable Development to combat climate change, and it provides a common and .universally accepted language and framework for partnership, communication, implementation and action.

To the credit of those who drafted it, Agenda 2030 is a concise document comprising a preamble, a declaration and a schedule of 17 Sustainable Development Goals with 169 Targets. It commits the UN and its signatories to advancing the five "Ps" (*People, Planet, Prosperity, Peace and Partnership*) and to "*working tirelessly for the full implementation of this Agenda by 2030*".[10] This paper is interested in exploring examples of research, implementation, outcomes and lessons learned from action contingent on the Agenda's principles and goals.

The language of Agenda 2030 is clear and urgent in tone with little use of conditional tenses. Anyone with experience of the UN, its agencies and committees, will understand how challenging it is to achieve consensus on any use of language that is unambiguous in intent, positive in tone and affirmative in commitment to action. In this respect alone the Paris Agreement and Agenda 2030 are a testament to the process by which these were brought into play. Agenda 2030 touches on every aspect of life, economy, society and species on the Planet. With its internationally adopted legal mandate and widespread support, it gives agency to member states, their regional governments and cities, to become involved in, and prosecute advancement of, the Agenda and the Goals to work towards common outcomes that will contribute to meetings its Targets locally, nationally and globally. This is easier said than done.

"All countries and all stakeholders, acting in collaborative partnership, ***will*** *implement this plan."*[11]

From the outset, the SDGs were presented, communicated and discussed using a visual identity made up of the individual graphic icons for the 17 SDGs illustrated as a matrix. This was an effective mnemonic to imprint the SDGs in the collective consciousness and served well (and still does) as an identifier. But it gives little insight into the interactive and systemic action required and a circular logo was adopted to help signify this dynamic reality.[12]

As work began in earnest in the dedicated pursuit of individual SDGs, ever more complicated diagrams were developed to communicate the complexity of interactions between the SDGs such as UN-Habitat's infographic about SDG 11.[13] By the time of the COVID-19 pandemic in 2020, the overarching importance of the systemic nature of forces influencing the SDGs was abundantly clear and communicated in the Secretary General's Policy Briefs along with the stark message that the pandemic as a global event had significantly delayed progress with the SDGs.[14]

Urbanism is an integrative discipline that seeks to design and deliver intentional positive outcomes for the city rather than succumb to entropy in the system.[15] To a researcher, policy adviser and practitioner in urbanism, there are key passages in the text in support of putting Agenda 2030 into operation for cities, and building procedures for their implementation, delivery, outcomes and monitoring. There is a clear message that encourages the integrative and systemic nature of design and urbanism:

"On behalf of the peoples we serve, we have adopted a historic decision on a comprehensive, far-reaching and ***people-centred*** *set of* ***universal and transformative*** *Goals and targets." (*Article 2*)*
and
"These ... universal goals and targets ... are ***integrated and indivisible*** *and balance the three dimensions of sustainable development."* (Article 5) [16]
As an urbanist, these phrases, with author's emphasis, are an invitation to put people, and the agency they have from the communities, cities and governments that represent them, at the centre of delivering Agenda 2030 working locally for community benefit coincident with global action for humanity and life on the planet. It is a manifestation of the aphorism "*think global, act local*".[17] It puts redemption in our hands, and invites systems thinking. The case study described here for the UNECE looks at this in practice, building on the significance and legacy of Habitat III that acted as an accelerant in the implementation of Agenda 2030 before the COVID-19 pandemic acted as a break.

THE CENTURY OF THE CITY: HABITAT III & THE NEW URBAN AGENDA

"One in every ten people lived in urban areas a century ago ... by 2050 ... almost three-quarters of the world's population will call urban areas home." [18]
In the first years of the 21st century, this trend and its consequences, became a central preoccupation in the collective consciousness and a primary focus of attention for the United Nations. In 2008, the Rockefeller Foundation captured this zeitgeist in the provocatively titled work *Century of the City: No time to lose* published following their 2007 urban summit with an ambition to reach a global audience.[19] This simple title captured the essence of the proposition in a phrase and added an attention-grabbing strapline to convey urgency in addressing the issues before us. The book, a collection of essays, factual, polemical, informative and timely, was ultimately a call for global leadership to confront the challenges faced by the prevailing direction of travel. It is a seminal work with three aims: a simple, concise expression of a complex trend in human habitats; a need for urgency in understanding and facing the consequences of this trend; and, a convincing call for enlightened global leadership to address the complexities of this paradigm shift in human living with its consequences for human and planetary systems. Arguably it achieved all three.
Every 20 years, the United Nations stages a global conversation to produce a 'report card' on the human habitat. These vicennial world conferences began in Vancouver 1976, continued to Istanbul in 1996 and Quito in 2016. Habitat III was configured to embrace and advance Agenda 2030 to address climate change and, in recognition of the rural to urban shift, the Secretary General signaled a change in emphasis for Habitat III to focus on cities, with the express intention of developing a new manifesto for action expressed as *the New Urban Agenda*.[20] This became the fountainhead for, and principal driver of, Habitat III.
The New Urban Agenda aimed to be a concise, action-oriented, forward-looking and universal framework of actions for housing and sustainable urban development. As part of the preparation for Habitat III, the Secretary General asked each of the five regional Commissions of the UN to produce a report on trends affecting the cities of their region. The brief was two-fold: to identify trends in cities of the region between Habitat II (1996) and Habitat III (2016); and, to speculate about the continuation of these trends towards 2030, the time horizon adopted for Agenda 2030.

THE UNITED NATIONS ECONOMIC COMMISSION FOR EUROPE – DELIVERY

The United Nations Economic Commission for Europe (UNECE) is one of five regional economic and social commissions that together cover the territory of the inhabited earth.[21] The UNECE has 56 member states extending in scale from the three continental countries of Canada, the United States and the Russian Federation to the three microstates of Andorra, Monaco and San Marino together

with 50 states of Western and Eastern Europe, and Eurasia.[22] The UNECE territory encircles the Arctic Ocean and extends across the northern hemisphere from Vancouver, Canada to Vladivostok, Russia and is home to 17% of the world's population. The Regional Report was commissioned jointly by the UNECE, the European office of UN-Habitat and the Habitat III Secretariat. The report was submitted in evidence to Habitat III, adopted by the UNECE through its committees and published in 2017.[23]

The UNECE territories have over 260 cities of 500,000 or more population with six megacities – Moscow, Istanbul, Paris, London, New York and Los Angeles.[24] The report's findings and conclusions may be summarised briefly as follows:

(i) The Shift from The Industrial City to The Knowledge City

Since 1976, there has been a paradigm shift from industrial cities where the means of production is based on primary and secondary industries (extraction of raw materials and manufacturing) to knowledge cities where the means of production is predicated on tertiary industries (science, technology, tourism and place). The research identified this trend across the territories of the UNECE and gives clarity to the proposition of *post-industrial* as a transition away from one state or type of city to an urban outcome yet undefined. The search for this outcome has been a pre-occupation of many cities across the UNECE for decades.

This predominant trend is real and demonstrable, but not universal. Not every city will be able to make this transition and there are systemic cycles for cities in transition in the 21st century that generate radically different and, at times, dispiriting outcomes.

This analysis casts the soubriquet *post-industrial* as an urban purgatory where redemption is represented by smart sustainable cities [25] and perdition by shrinking sprawling cities. This imperfect metaphor helps us understand the likely destination for successful and declining cities today. Research for the UNECE Regional Report produced written descriptors for various positive and negative urban cycles – shrinking, sprawling, compact, resilient – that were later published with accompanying system cycle diagrams.[26]

(ii) A trend to urban concentration and the "Jet Age/Net Age paradox"

The forces driving the industrial to knowledge transition have caused urban concentration. A predicted centrifugal force in cities leading to dispersal of activity and hollowing out of centres, described by Cairncross in *the Death of Distance*, Mitchell in *City of Bits: Space, Place, and the Infobahn* and Kasarda in *Aerotropolis,* has not come about.[27] Instead, the huge growth in affordable air travel in the period 1996-2016 together with the onset of fast and interconnected internet (the internet of things) have compounded urban concentration through a concentrating centripetal force.

The *jet-age* of fast cheap air travel combined with the *net-age* of fast digital access have reinforced urban concentration in successful cities but can lead to urban sprawl and urban shrinking in those less fortunate. The *death of distance* (with remote rather than home working) and the dispersed *city of bits* (where internet access rather than physical access predominates) have not come about. Face to face contact remains important in the knowledge and experience economy. The global-local paradox is real. The more similar and inter-connected we become, the more we value local distinctiveness.

(iii) Few megacities, clusters of knowledge cities and the rise of northern metacities clusters

The term metacity is used to describe the extremely large metropolitan centres (of a scale order different to megacity) with populations of 20 million or more such as Tokyo (37mio), Shanghai (25mio), Lagos (21mio), Sao Paulo (22mio), Mumbai (25mio), Seoul (25mio).[28] The UNECE territories have six megacities but, as yet, no metacities, although some come close. However, the combination of mobility and communication that has accelerated urban concentration has also led to the clustering of cities, where cities within a one-hour travel distance of one another can combine to

share scale of economic activity. These polycentric clusters and powerhouses of economic activity were described as *supercities* by the report's authors.[29]

(iv) A basket of systemic trends combining in different ways in different cycles of cities

Ageing, fertility, migration, climate change, automation and artificial intelligence combine in systemic ways that create cycles that move at different rates and different combinations in different cities. These can become self-fulfilling cycles and once embarked on can accelerate and become irreversible.[30]

These trends stimulate different cycles in cities, some of them are negative, shrinking or sprawling, and some are positive, compact, resilient and competitive cities. In some cities transition is driven by social, economic and environmental advantage, for others a degree of subvention and encouragement in the transition process is required. With others more existential challenges are present. As Swinney and Thomas have pointed out, there are risks associated with attempting to replicate past success.[31]

The cities that have made, or are making, the industrial to knowledge transition are those that can demonstrate willingness and capability for reinvention with clear progress towards SDG targets. Those that cannot, present risks to themselves and to progress with Agenda 2030. In most urban systems in the advanced, developed and developing economies of the UNECE all of these sub-types are present and therefore hinder, to varying degrees, overall progress of the system towards Agenda 2030 goals and targets. Understanding of, and radical action in, shrinking and sprawling urban subsystems will be essential for delivery of the SDGs and any escalation of the pace of their delivery. To achieve this will require a more sophisticated understanding of urban systems and how intervention may be brought about for the whole urban system, not just the individual city.

These changes are very clear in certain cities and help to inform why all cities might aspire to being smart and successful, but not all can without significant intervention, and a more radical and enlightened appraisal of what makes cities fail and what change can be brought about in their fortunes. These trends have produced stars and have also produced duds, where the cities and their communities feel left behind engendering alienation and despair in their people. Many UNECE member states experience this dichotomy. The debate it stimulates is particularly prominent in the USA and the advanced economies of Europe (UK, France, Germany) stimulating discord and unhelpful political discourse.

Taking forward the findings of the Habitat III Regional Report lies with the UNECE's Committee on Urban Development, Housing and Land Management. It is important to note in passing, that a significant Committee initiative preceded the publication of Agenda 2030 and the preparation of the Regional Report. The *Geneva UN Charter for Sustainable Housing* was adopted by the Committee in 2013.[32] With core principles of Environmental protection, Economic effectiveness, Social inclusion and participation, and Cultural adequacy, the Geneva Charter stimulating a great deal of interest and support among member states, and the Committee determined that this work should be congruent with action aligned through the Goals and Targets of Agenda 2030 and the Regional Report's findings. This was achieved though expert best practice groups in regional meetings and conferences.[33]

Progress with this work stimulated an intent to be more explicit in references to Agenda 2030 goals and targets to assist member states and their cities through recent initiatives including:

a) *People-smart sustainable cities*: that highlights how different cities have different capacities to cope with crises arising from the COVID-19 pandemic and how the economic effects of lockdown have disproportionally affected different cities as well as different groups of the population with the most vulnerable groups of society suffering most.[34]

b) *#Housing2030:* effective policies for affordable housing in the UNECE region developed within through a joint international initiative of UNECE, UN-Habitat and Housing Europe, exploring housing affordability challenges and existing policy instruments for improving housing affordability

in the UNECE region and the exchange and dissemination of good practices in best practice among countries and cities of the UNECE.[35]

c) *Place and Life in the ECE – A Regional Action plan for 2030*: that brought city trends and housing trends into alignment with Agenda 2030, SDGs and the UN Geneva Charter and principles.[36]

d) *Development of indicators:* for recording, monitoring and evaluating progress. [37]

This has been accompanied by the development of two networks to help localise the work in cities within member states:

– The Geneva UN Charter Centres.[38]

– The Forum of Mayors.[39]

This granularity brings the SDGs closer to people, communities, neighbourhoods and cities where outcomes can be effected and aggregated.

Following through the evolution of this work, it is clear that there is an interrelated and systemic relationship between the 17 SDGs and whereas the pursuit of a particular SDG though specialist expertise is to some extent inevitable, it cannot be undertaken in isolation. Action and work in pursuit of a specific SDG with particular targets is sound in terms of Agenda 2030 but also requires understanding and balancing of effects on other SDGs and, in systems terminology, may mean that the best action in pursuit of an individual SDG target maybe suboptimal in terms of the specific, but with a better outcome for the overall result. Systemic interaction is important but often implicit or little understood.

CONCLUSIONS AND REFLECTIONS

As one of five commissions of the UN responsible for Regional Development, the UNECE has, at the halfway point to 2030, made huge steps forward in understanding, coordinating, promoting and advocating the implementation of Agenda 2030 and the SDGs within and across its member states. Working with UN-Habitat and other partners, the Committee on Urban Development, Housing and Land Management has documented and disseminated strategic urban challenges and solutions across the region.

Through actions, publications and advice the Committee has brought into register research on cities, on housing, and has developed an action plan with policies, goals and targets for coordinated implementation. It has done this consensually with members states through developing and guiding the formulation of Charters and Declarations. The Committee has acted creatively to inform and empower cities across the region to participate in the delivery of Agenda 2030 through the development of two co-created networks and it has worked to overcome the delays to delivery of Agenda 2030 brought about by the COVID pandemic.

This work has informed an understanding of the complexities of Agenda 2030 SDGs and their interactions and brought into sharp focus the need for a better systems understanding of the interactions that is not yet in place. Goals, principles, targets and indicators are undoubtedly necessary and useful tools. They tell us where we are going, what we have achieved and where, but do not inform us how to confront and overcome challenges to escalate action. The Secretary General has rightly avowed to accelerate and “turbocharge” the implementation of the SDGs through the Pact for the Future. More work will be required to develop better tools for understanding the systemic relationship of actions pursuant on delivery of the SDGs and also provide insight into the different types of cities where some, by their nature and/or circumstances beyond their control, are moving in the opposite direction of travel to Agenda 2030. For example, where ill-informed intervention can replicate old habits in the interest of short-term economic benefit such as the opening of new licenses for carbon extractive industries like fracking and further oil exploration and development.

We can expect willing from the proto-knowledge, people-smart sustainable cities and push back from those who feel left behind. A system is needed to embrace both groups, or the promise of sustainable development as defined by Agenda 2030 will be inhibited.

Figuring out how the *Anthroposystem* can be made benign to human and natural ecosystems remains the biggest challenge to the *turbocharging* process. This requires a system that has the elegance, simplicity, promise and accessibility of the Agenda 2030 mission document. Tools need to be developed and adopted to smooth out imbalances and inequalities for all, not just some, cities. On-going and urgent research is required, particularly in artificial intelligence with the engagement of the Big Tech giants. They can afford it, and the ethical ones must do it. We can't all afford, or want to, indulge in planetary escape.

The Pact for the Future will drive updates and amendments to *turbocharge* Agenda 2030 that will require systems thinking, design thinking and an inversion of the process – to "see out" from communities as well as "see in" from governments. Action at speed is required to confront the climate, housing, and biodiversity emergencies and why we need enhanced systems.

NOTES

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[17] The phrase “*think global, act local*” is thought to have originated with Patrick Geddes, a Scottish urban planner and conservationist in the early 20th century. The phrase is used in many contexts including environmental challenges, where it's more effective to reduce individual energy consumption than wait for global action and international marketing, where brands need to be globally consistent while also having local reach.
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ACHIEVING CLIMATIC RESILIENCE IN URBAN AREAS: AN EVALUATION FRAMEWORK FOR THE IMPLEMENTATION OF NATURE BASED SOLUTIONS IN BROWNFIELDS REGENERATION

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INTRODUCTION

Brownfields are a widespread land resource in European cityscapes and, due to urban expansion over the last century, many of these sites have transitioned from peripherical locations to central areas within our increasingly polycentric cities. This shift presents substantial opportunities for urban regeneration and redevelopment. The research is grounded in the premise that, rather than further densifying these areas, they can be leveraged to enhance ecosystem services in urban environments through the application of Nature-Based Solutions (NBS). By doing so, these sites could play a crucial role in helping cities become more resilient to the impacts of climate change.

This paper presents a multilevel analysis of a sample of brownfields located in Umbria region (Italy), with the aim of identifying the challenges and opportunities associated with implementing NBS in regeneration processes. The research began with a set of vector data provided by the regional administration, to which additional informational layers were added to conduct geospatial analysis. This analysis was used to assess the presence of necessary parameters and to identify critical issues at the territorial scale that might influence the suitability of specific NBS over others.

This study offers a methodology that is both scalable and replicable across different contexts, providing a preliminary framework for assessing the potential adoption of NBS in brownfield sites. It underscores the regenerative potential of these strategies within urban environments. However, the research also highlights that each brownfield site possesses unique characteristics and a strong connection to its surrounding urban area, indicating that a site-specific approach is more effective than a generic strategy.

Research Context

The climate resilience of urban areas is a central issue on the European agenda and in national government policies. This focus comes not only from the need to achieve internationally set goals[1] but also from the pressing reality that climate change is severely disrupting ecosystem balances, resulting in significant consequences for urban settlements and people wellbeing.[2]

The impact of climate change is particularly acute in densely populated urban centres. For instance, the urban heat island effect leads to increasingly extreme temperature peaks, while altered

precipitation patterns result in unpredictable droughts and extreme weather events. These changes strain urban infrastructure, particularly drainage systems and watercourse management, exacerbating vulnerabilities and risks within cities.[3]

Despite these challenges, urban population density has been steadily increasing over the past decades, and this trend is expected to continue into the future, with population projections for 2050 indicating further growth,[4] driven both by geopolitical instability and climate change. Indeed, as regions closer to the equator become less habitable, there is a growing migration toward more temperate regions. In this context, the Mediterranean area, and European cities in particular, must implement policies and operational strategies to effectively manage the consequences of these profound changes in the coming decades.

Research Framework

The European Union (EU) has established an extensive system of policies aimed at achieving sustainability goals, central to these efforts is the European Green Deal,[5] a comprehensive framework designed to make Europe the first climate-neutral continent by 2050. This framework integrates policies across multiple sectors, including climate change, energy, agriculture, biodiversity, and pollution, while promoting a circular economy, green energy transition, and sustainable agriculture. A key focus of the Green Deal is enhancing climate resilience in urban centres, with recent policies advocating for the use of planning tools and strategies to mitigate climate risks and support urban adaptation. Among them, the European Climate Change Adaptation Strategy[6] underscores the importance of adaptive design in mitigating the impacts of climate change, emphasizing the need for site-specific studies to tailor urban regeneration efforts and the use of tools to monitor the effectiveness of adaptive solutions.

Within this policy framework, Nature-Based Solutions have emerged as effective tools that leverage natural processes and ecosystems to provide infrastructure, services, and strategies for enhancing urban resilience.[7] NBS not only bolster climate resilience but also deliver significant environmental, social, and economic benefits. Traditionally, efforts to reduce disaster risks and enhance climate resilience have relied on grey infrastructure. However, grey infrastructure may not always be the most cost-effective, resilient, or sustainable option.[8] In contrast, NBS offer a more flexible and adaptive approach to managing ecosystems, while simultaneously enhancing human well-being and biodiversity.[9]

The regeneration of brownfields presents a valuable opportunity for cities to incorporate NBS in the redevelopment of underutilized areas, thereby providing ecosystem services alongside green spaces and public amenities.[10] Furthermore, systematic studies on the factors that support the inclusion of NBS and their ability to address local challenges can facilitate the implementation of EU and national policies at the local level. Indeed, despite the well-documented benefits of NBS for urban climate resilience in both scientific literature and EU publications, widespread adoption remains limited. This is particularly true at the local level, where public administrations and urban development stakeholders, especially outside of large metropolitan areas, often lack the technical tools and knowledge necessary to implement NBS in urban regeneration projects.[11]

This article proposes a methodology that utilizes public data to analyse the key parameters necessary for assessing the feasibility of integrating NBS into the regeneration of brownfield sites. The proposed methodology considers both the intrinsic spatial characteristics of these sites and their specific relationship with the unique territorial features of each location.

METHODOLOGY

State of the art

Although providing a comprehensive overview of the literature on Nature-Based Solutions falls beyond the scope of this work and would likely be incomplete due to the vast and evolving nature of the topic, it is important to reference key sources that have informed this study. The following essential literature is also recommended for a deeper understanding of the subject matter discussed in this article.

Among publications funded by the European Union, the European Environmental Agency reports 12/2020 and 1/2021 both provides a robust and up-to-date evidence base on local and urban planning actions bringing forth an overview of effectiveness of adaptation measures related to climatic hazards[12] as well as a classification of NBS organized by thematic areas.[13]

Additionally, the European Commission-funded document ″Nature-Based Solutions: State of the Art in EU-Funded Projects"[14] summarizes outcomes related to NBS in key policy areas, drawing from EU research and innovation projects. This document includes monetary evaluations, cost-effectiveness analyses, and explores how NBS support the implementation of EU policies.

Furthermore, "A Catalogue of Nature-Based Solutions for Urban Resilience" provided by the World Bank[15] offers technical descriptions and examples to better assess the potential of NBS in urban areas. It includes cost-benefit estimates to evaluate economic viability and suitability considerations to guide the implementation of NBS in various locations.

Among the extensive academic literature, Bologna and Hasnaj[16] outline a comprehensive and systematic catalogue of design solutions for climatic adaptation in urban areas. This publication offers a structured classification both of NBS and artificial solutions, highlighting the difference between those typologies for categories and sites of intervention.

Also the “Nature-Based Solution Technical Factsheet” published by UNaLab[17] provides an exhaustive catalogue and summaries of existing NBS highlighting for each of them technical and design parameters, conditions for implementation, benefits, limitations and performance indicators.

Finally, an abundance of reliable resources and data is available online on platforms such as the Resin Adaptation Library,[18] an official European Union website. This platform allows users to search for adaptation strategies filtered by climate hazards, scale of application, measure type, targets, and effectiveness.

Data selection

The research focuses on a case study involving 90 brownfield sites in the Umbria region of Italy, catalogued by the regional administration in 2012. The vector data associated with these sites was provided for this study. The census offers a comprehensive set of information for each dismissed industrial site, including historical and construction details, as well as geospatial data such as location, size, and the presence of environmental or architectural constraints that may necessitate specific protective actions. Additionally, it includes data on soil conditions and urban planning regulations that could influence potential site transformations.

However, only selected data from the census were utilized, as the information is somewhat outdated and incomplete, with many details either missing or inconsistently reported across the dataset. Furthermore, since the study integrated additional data sources, a significant amount of information was omitted to streamline the analysis and focus on the key parameters necessary for assessing the implementation of NBS.

Indeed, a distinguishing feature of this study is its broader approach, which not only evaluates the brownfields based on their intrinsic characteristics but also considers the various anthropogenic and natural contexts in which they are embedded. The research is based on the premise that these

decommissioned industrial sites will be regenerated to include green spaces, thereby enhancing urban ecosystem services.[19] Accordingly, following guidelines from the literature[20], a 300-meter buffer zone around each analysed site was considered to assess the potential benefits of such transformations through NBS.

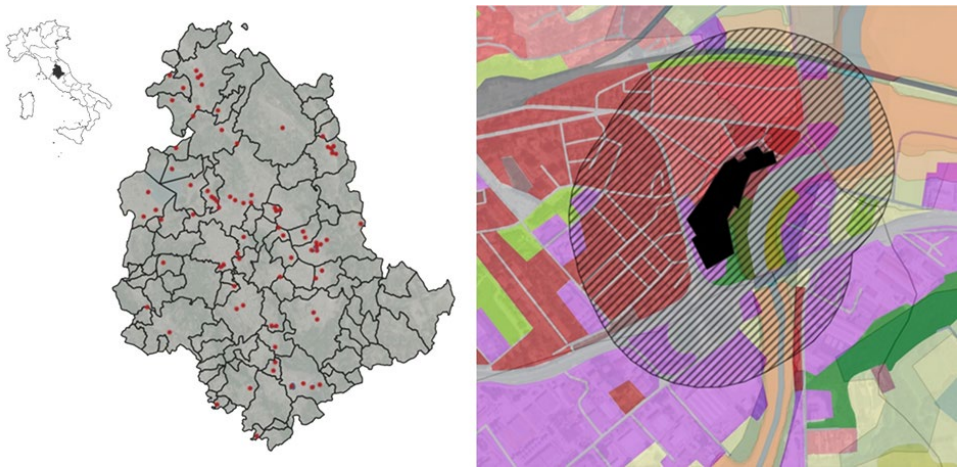

Figure 16. on the left: geoposition of the 90 brownfields registered in the regional census. On the right: an example of the 300 m buffer zone around one of the analyzed brownfields.

Subsequently, additional layers of information were selected from public platforms to analyse the characteristics of the designated areas and to identify any environmental issues that might necessitate the application of specific NBS in the regenerative process. Specifically, data extracted from the Corine Land Cover dataset were used to characterize land use across the region, based on satellite data on urban and riparian areas provided by Copernicus.[21] In addition information on hydrogeological risks were provided by the Italian Institute for Environmental Protection and Research (ISPRA).[22] The complete list of sources and selected data is presented in Table 1.

Data Source	**Data Origin**	**Year**	**Selected Data**
Census of brownfield sites	Umbria Region	2012	Geoposition Total Surface Covered Surface Preservation state Architectural Value
Corine Land Cover	ISPRA	2018	Land Use (lvl.3)
Urban Atlas - Corine Land Cover	Copernicus	2018	Land Use (lvl.4)
Riparian Zones - Corine Land Cover	Copernicus	2018	Land Use (lvl.4)
Hydraulic hazard areas	ISPRA	2020	Flood risk areas

Table 1. Data Collection

Data Analysis

These data were processed using a Geographic Information System (GIS) application to facilitate a multi-criteria evaluation of NBS for regenerating decommissioned industrial sites. The analysis was conducted through four distinct geospatial evaluations.

The first analysis assessed the availability of space, determining the suitability of sites for various NBS solutions. This analysis considered the available surface as the difference between the total surface and the one occupied by buildings, if existing in the areas. These parameters were compared with literature data[23] to assess the potential for different types of interventions, ranging from point elements to landscape-scale projects.
The second analysis examined the land use of areas surrounding the decommissioned industrial sites. Understanding the relationship between these sites and the existing urban fabric is crucial for determining appropriate NBS as climate change mitigation and adaptation strategies can vary depending on urban planning designations. For example, NBS to reduce the urban heat island effect may be more relevant in residential areas, while natural drainage systems may be preferred in infrastructure zones. Although not specifically investigated in this study, this analysis provides an initial indication of how NBS might interact with existing grey infrastructure. For this instance various sources, offering varying levels of detail have been compered. In detail Copernicus Land Monitoring Service provides higher resolution data (Level 4) for specific areas included in the Urban Atlas mapping, namely the territories around regional capitals Perugia and Terni, as well as for Riparian Zones mapping areas around major hydrological basins. Precisely 32 of the 90 registered sites are included in the Urban Atlas mapping while 45 sites, with some overlapping, are located within Riparian Zones. For the remaining 26 sites, a level 3 land characterization was used due to lack of more detailed data. The following Figure 2 shows the difference between different Land Use maps.

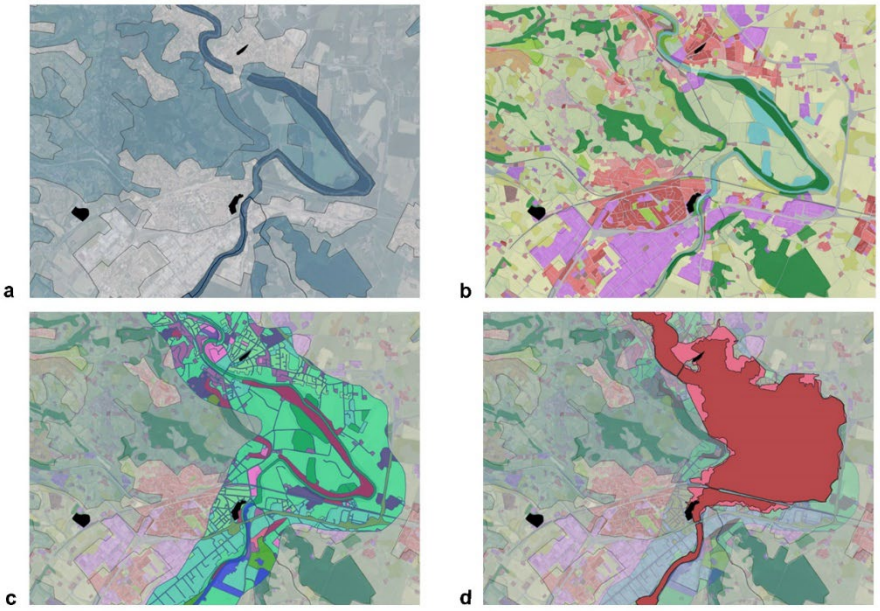

Figure 17. Different levels of detail in the characterization of Land Use: a) Corine Land Cover- level 3, b) Urban Atlas - level 4, c) Riparian Zones - level 4 d) Flood-prone areas.

The third analysis evaluated environmental hazards from a hydrogeological perspective, identifying sites located within major water basins and flood-prone areas. For these sites, NBS selection is likely to focus on watercourse management, embankment maintenance, and enhancing water retention to improve resilience against sudden flooding events.
The fourth and last analysis investigated the conservation status and architectural value of the decommissioned industrial sites. This analysis aimed to assess how these factors might influence the feasibility of adopting certain NBS, particularly those involving existing buildings. For example,

buildings under heritage protection or with compromised structural stability may not be suitable for green roofs or green facades solutions.
The results from these analyses were used to perform a multi-criteria characterization of the 90 industrial sites, then each site was assigned an alphabetic code that describes its suitability for adopting specific NBS, based on the findings from the four analyses. This coding helps in understanding and prioritizing the sites for potential regeneration interventions.

RESULTS

The following table (Tab.2) illustrates the division of the brownfield sites sample based on the four analyses previously described.

	Brownfields n.
Available Surface	
Less than 1 ha	38
Between 1 and 5 ha	40
Between 5 and 10 ha	10
More than 10 ha	2

Surrounding Land Use	**Brownfields n.**
Mainly residential or infrastractural	16
Mainly residential and rural	41
Exclusively residential or infrastractural	6
Mainly infrastractural and rural	5
Mainly rural	22

Riparian Zones and Flood Risk	**Brownfields n.**
In riparian areas with flood risk	22
In riparian areas without flood risk	23
Not in riparian areas	45

Conservation status and Architectural Value	**Brownfields n.**
Bad conditions without architectural value	33
Bad conditions with architectural value	7
Good conditions without architectural value	40
Good conditions with architectural value	10

Table 2. Analyses Results

The analysis of available surfaces reveals that nearly the entire sample is evenly divided between small sites comparable to neighbourhood-scale areas, and medium-sized sites comparable to quarter-scale areas. Only a few sites are large enough to be considered at the district scale.
The land use analysis of the surrounding areas indicates that most of the sites are located in less densely populated contexts, often featuring natural or semi-natural environments. This finding is particularly relevant when considering the historical settlement patterns in the Umbria region, which is characterized by small, sparsely populated urban centres. The regional industrial fabric, with some exceptions such as the city of Terni, remains closely tied to an agricultural background and has not experienced significant industrial development.

The environmental analysis of hydrogeological risk revealed that exactly half of the sample is situated within riparian areas of the regional hydrological network, with 23 sites located in flood-prone zones. This suggests an urgent need to incorporate specific NBS for flood risk mitigation in these regeneration projects, although it would be beneficial to consider NBS for all these sites, including those currently not at risk.
The final analysis showed that most of the sites are not subject to protection constraints, but about one-third are in poor conservation condition.
Subsequently, the analyses and results were categorized into classes and tiers, as illustrated in the following Table 3. This categorization assigned each site an alphabetic code based on its classification across the four criteria, resulting in a total of 55 different codes. Each code reflects the site's suitability for NBS implementation.
For better understanding, a site classified with the code ABCD is characterized by an available surface area of less than 1 hectare, is located in a predominantly residential and rural land use context, is situated in riparian areas without flood risk, and is in good conservation status, while also being subject to protection constraints.

	Class 1 Available Surface	**Class 2 Surrounding Land Use**	**Class 3 Flood Risk**	**Class 4 Conservation state and Architectural value**
A Tier	Less than 1 ha	Mainly residential or infrastractural	In riparian areas with flood risk	Bad conditions without architectural value
B Tier	Between 1 and 5 ha	Mainly residential and rural	In riparian areas without flood risk	Bad conditions with architectural value
C Tier	Between 5 and 10 ha	Exclusively residential or infrastractural	Not in riparian areas	Good conditions without architectural value
D Tier	More than 10 ha	Mainly infrastractural and rural		Good conditions with architectural value
E Tier		Mainly rural		

Table 3. Classification and coding parameters

DISCUSSIONS

Limits and constraints of the research

The research involved processing a large volume of data. While the results are significant for the purposes of this study, the approach presented is not suited for detailed analysis. The need to standardize information across the entire sample, as well as to describe land use among different characterization, inevitably led to a reduction in data quality, affecting case studies where more accurate data were available. Similarly, data influencing the decision to adopt specific NBS, such as soil contamination levels or property type (public or private), were excluded. However, these factors can be addressed in future phases of the research by focusing on specific case studies.

Key findings and future scenarios

This paper introduces an innovative evaluation framework for the implementation of Nature-Based Solutions in the regeneration of brownfield sites. While NBS are widely recognized for enhancing urban resilience and providing environmental, social, and economic benefits, their adoption has struggled to gain traction, primarily due to the lack of technical knowledge and resources in local administrations. This framework could serve as a valuable tool for both public and private stakeholders during the preliminary stages of urban regeneration, guiding informed decision-making processes.

Additionally, the classification of case studies using an alphabetical code, though still in its early stages, offers intriguing opportunities for future development, some of which were unforeseen during the research. The potential to create a code that describes the capability of brownfield transformations through NBS could pave the way for a more systematic classification, or even a rating system, to evaluate the transformative potential of an area.

This makes the research methodology not only replicable for other collections of decommissioned industrial sites but also suggests that it could be scaled to evaluate other types of areas with a focus on climate resilience.

Moreover, as a side comment, this work may also support other studies related to settlement models. Despite the predominantly numerical treatment of brownfields in this paper, the results indirectly reveal the relationship between territories and historical and socio-economic developments over the centuries. Specifically, land use patterns and investigations of riparian areas hint at the unique ways in which industry has settled and altered landscapes, driven by infrastructure needs and access to energy sources and communication routes.

CONCLUSIONS

Climate resilience in urban areas is a critical issue on the European agenda, as evidenced by the extensive policies that promote the adoption of mitigation and adaptation strategies. Nature-Based Solutions are valuable tools for providing ecosystem services and achieving sustainability targets, and their implementation is widely endorsed by international bodies and academic literature. However, their application in urban regeneration processes remains limited, especially outside major urban centres.

The regeneration of brownfields presents a concrete opportunity to foster the broad adoption of these strategies on a territorial scale. These sites are ideal for transforming large abandoned areas into green spaces and public services while contributing to climate resilience. This paper offers an original and systematic model for the preliminary assessment of decommissioned industrial sites based on their potential to host NBS. It not only considers the intrinsic characteristics of these sites but also evaluates their regenerative potential in relation to the specific territorial context in which they are located.

This model serves as a ready-to-use tool for both public and private stakeholders, facilitating informed decision-making in urban transformation processes. Additionally, it opens up promising future research and application scenarios for NBS, contributing to the development of more resilient cities in the urgent quest for viable and lasting solutions to the impacts of climate change.

NOTES

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CARBON SEQUESTRATION THROUGH LANDSCAPE DESIGN IN TROPICAL URBAN AREAS: A CASE OF COCHIN

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INTRODUCTION

Pollution levels in metropolitan cities have worsened daily. This study discusses the carbon sequestration in landscaped areas and considers the case of Cochin, India. Plants absorb carbon dioxide (CO_2) through photosynthesis. The carbon sequestration capacity of plants is higher than that of other bio-building materials. Most cities are heavily populated and are densely packed with buildings. Identifying the substantial green spaces in these areas is a significant challenge. The two potential green spaces for landscapes in cities are the roof gardens and vertical greenery systems. The area of the vertical surfaces is larger than that of the rooftop areas. Vertical greenery systems help reduce the temperature inside the buildings and concentrate to the carbon sequestration levels in the area. The aim of this research is to analyze carbon absorption potential of a vertical greenery system in Cochin and finding out its relationship to temperature and humidity. A pilot study was conducted with a frequently used plant to understand the variations in CO_2 levels in a controlled environment.

The rapid urbanization of rural areas in metropolitan cities has intensified numerous environmental challenges. One-third of the world's land mass and 31% of the forest area are covered by tropical regions. By 2030, there will be 1 to 3 % annual growth is anticipated in rural areas within these climatic zones.[1] The rising greenhouse gas emissions are a critical factor contributing to the increasing atmospheric temperature, currently rising by1.5°C annually. The results in climate change hazards like heat weaves, heavy rainfalls, and also affect human health.[2]

Building industry is a major contributor to these environmental issues, emitting major source of pollution comparing with many other sectors. The data from 2021 shows that India is the third largest emitter of CO_2 globally (figure-1), highlighting its significant role in global green gas emissions.[3] Carbonation of concrete structures is one of the main reasons for climate change after industrialization. This process, driven by CO_2 absorption in concrete, accelerate infrastructure degradation and increases the carbon footprint of construction activities.[4] Research have been shown that CO_2 concentration in the atmosphere is increases by 0.5% every year.[5]

Urbanization is a key factor for all environmental challenges, with an increasing population in cities will surge CO_2 and greenhouse gases content in the air.[6] Urban areas host the largest share of global

population, a figure projected to rise 68% in 2050.[7] Increase in population lead to rapid growth in construction industry, which produce 30% of total world's CO_2. Many urban areas face difficulties in acquiring sufficient land spaces for vegetation. However, the potential for improving urban microclimate lies in vertical green spaces and roof garden.[8]

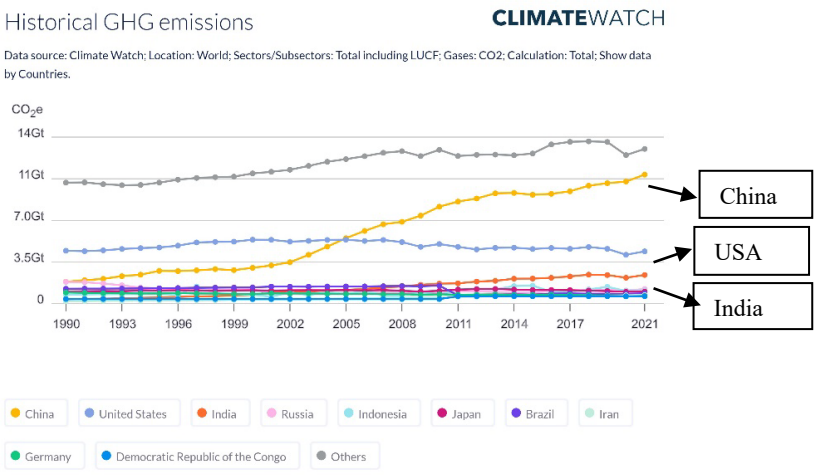

Figure 18. CO2 emission map[9]

The high temperature levels of the building surface materials and lack of evaporation causes Urban Heat Islands (UHI). A vertical greenery system refers to the growth of plants on building facades using supporting structures or planting modules.[10] Vertical gardens are famous from historical times. For example; Babylon introduced a hanging garden approximately 2500 years ago. Vertical greening system was divided in to two types: 1. Green façade 2. Living walls. The first requires a trellis panel or wire rope net system to support the plant. Climbers are mainly used in this area, and the height of green facade is restricted by the plant growth. Second can be used in high-rise buildings using modular system,[11] where herbaceous plants and small shrubs are commonly used. They can even support other plants such as ferns, groundcovers, grasses, sedges and even mosses.[12] More than visual enhancement vertical greenery will lower indoor temperature during summer and serve as an insulator during winter. It also protects the wall surface from rain and effectively filters out dust particles. It functions as a noise barrier and also generates microclimate.

Beyond its aesthetical appeal, vertical greenery system (VGS) significantly enhances the thermal efficiency of a building by reducing the diurnal temperature difference on the surface of a building. The processes of evaporative cooling provided by the plants helps to mitigate the UHI effect in the urban area, creating a microclimate. Additionally, VGS contributes to the reduction of greenhouse gas emission, as plants absorb CO_2 through photosynthesis. These processes will help to reduce green gas house effect by capturing CO_2 from atmosphere. VGS also serves as an effective air purification method for both indoor and outdoor environments by filtering dust particles and volatile organic compounds through biofiltration. They also prevent noise pollution.[13]

Carbon sequestration can be done in two different ways, biotic and abiotic, Biotic sequestration occurs through natural process, photosynthesis by plants and microorganisms, which is good for human beings. While abiotic sequestration is using manmade engineering techniques to capture Carbon. Both methods play a vital role in capturing carbon but biotic sequestration is often seen as more sustainable and eco-friendly method.[14] There are three different ways of biotic carbon sequestration: VGS; Green Roof & Algae Curtains. Out of which Algae absorbs more CO_2 and Green roof has on the second absorption rate but has less surface area comparing with the VGS.[15]

MATERIAL AND METHOD

This study is examining Carbon Sequestration potential of plants using VGS. The study consists of two parts, the first part is taken from the literature where, carbon absorption level of plants has been assessed through the photosynthesis. The second part is an experimental study has done with '*Dracaena surculosa*' which is commonly used shrub for VGS in Cochin. It is an evergreen plant with low maintenance and with stand in indirect sun. The experiment was taken in a double story residential building where similar size bed rooms in the ground floor has been used. 1m x1m size VGS and HT2000x (CO_2 meter) was used for experiment. The measuring instrument recorded CO_2 concentration in ppm, humidity in percentage and temperature in degree Celsius. The data has been analysed using R-programme modelling to understand the difference of CO_2 level in different scenarios.

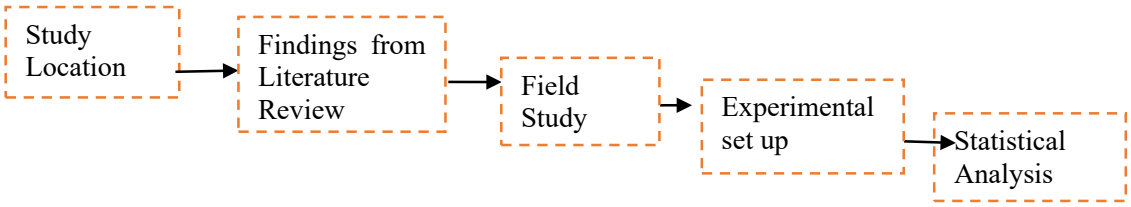

Figure 2. Study Method flowchart

Study Area

The Geographical coordinators of Cochin city are between 09^0 45' N and 10^0 20' N latitude and between 76^0 10' E and 76^0 35' E longitude. It is situated on the southern side of India (figure - 2). The substantial part of the city is submerged in water. Cochin is one of the developing cities and has a moderate to high UHI intensity during summer and winter. The highest UHI intensity was 4.6℃ in winter morning and 3.7℃ in summer morning.[16] This is coming under tropical climate with temperatures ranging between 23℃ to 35℃. During monsoon season, Cochin experiences heavy rainfall. The buildup area of the city is more than 34%.[17] The selected experiment location is 10 kilometers inland from the Cochin city.

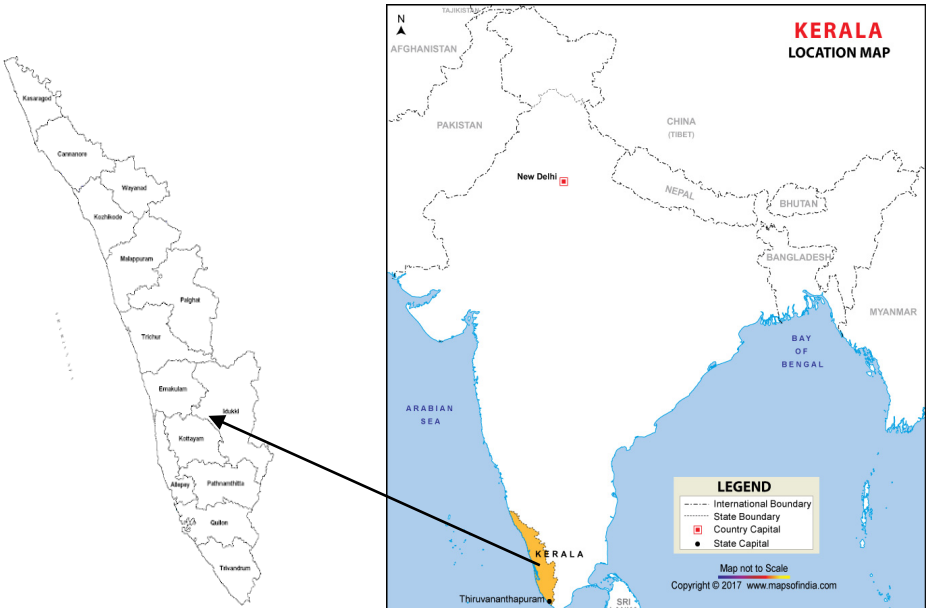

Figure 3. location map

Findings from existing studies

Patric Bank is credited as the father of living wall.[18] Compared with green roofs, green walls provide more surface area in the case of high-rise buildings. Different studies shown that VGS enhances to green buildings practice by saving energy between 24% -50% by reducing the indoor temperature. Consequently, the impact of green gas emission is minimized.[19] Sedum specious plants absorb more CO_2 with less maintenance.[20] *Dieffenbachia Compacta*, *Sansevieria Trifascacata, Chlorophytum Comosum, Epipremnum aureum* got the ability to absorb multiple gases and can purify indoor and outdoor air quality.[21] More than absorbing gases it improves the aesthetical quality of a space as well as mental health of human beings.

Plant Name		CO2 absorption	Source
Alternanthera paronychioides		23.59 143µmol$CO_2m^{-2}s^{-1}$	[22]
Sansevieriatrifasciata var. laurentii		12.43143µmol$CO_2m^{-2}s^{-1}$	[23]
Episciacupreata		14.32143µmol$CO_2m^{-2}s^{-1}$	[24]
Chrysothemispulchella		10.72143µmol$CO_2m^{-2}s^{-1}$	[25]
Mentha spicata		19.58143µmol$CO_2m^{-2}s^{-1}$	
Portulaca grandiflora		20. 143µmol$CO_2m^{-2}s^{-1}$	
Frankeniathymifolia		2.070µmolCO2 $m^{-2}s^{-1}$	
Sedum acre L.		0.143µmol$CO_2m^{-2}s^{-1}$	

Table 1. List of plants and its Carbon dioxide absorption capacity

From the above list of plants *Alternanthera paronychioides* has the highest absorption and *Sedum acre L.* has the lowest absorption capacity. In other experimental research has proven that following plants shows high rate of CO2 absorption

1. *Aloevera* - 487ppm cm^{-2}
2. *SpanishmossTillandsia Aerobic*(SMTA) - 276 ppm m^{-2}
3. *Spathiphyllums pp.* - 1036 ppm m^{-2}
4. *Syngonium podophyllum* - 827 ppm m^{-2} [26].

Plants from field study

Visiting different plant nurseries and meeting with different landscape architects following are three commonly used plants.

1. *Epipremnum aureum* (money plant)

2. *Dracaena surculose*
3. *Syngonium podophyllum*.
The first one and third one can use indoor and outdoor as well. *Syngonium podophyllum* is suited for semi shaded areas. In this research *Dracaena surculose* is used for the further experiment. It is an ever-green plant and need less maintenance.

Experimental Set up

In this paper we provide a comprehensive analysis of the carbon dioxide level in rooms across four distinct conditions. The temperature and humidity were considered as the supporting variables for each case. The experiment was conducted with two adjacent similar size rooms in ground floor levels.

Figure 4. Test setup for the present experimental study

A Modular living wall planting units has been fixed to a self-supporting metal frame measuring 1m x 1m square meters. This module can be easily moved between one location to another location, without removing the planter boxes. Carbon dioxide levels were measured using HT2000x. The measuring instrument recorded CO_2 concentration in ppm, humidity in percentage and temperature in degree Celsius. All the parameters were recorded in hourly over four-days period. The experiments were conducted in four different scenarios.
Case 1 – With people without plant
Case 2 – With people with plant
Case 3 – Without people without plant
Case 4 –Without people with plant
The planter boxes were filled with planting mixture (perlite, Coco pith, Vermicompost). Watering was done alternat days. The size of the rooms is 4.2mx3.6m and 3m height. Both rooms have similar opening positions and size of the opening was also similar. All the experiment were conducted in a normal room temperature from 20th to 24th of August 2024.

RESULTS AND DISCUSSION

	Minimum	Mean	Median	Sd	Maximum
Temperature (°C)	28.40	29.15	29.20	0.29	29.50
Humidity (%RH)	78.10	82.81	83.00	2.42	87.10
DP (°C)	24.90	25.92	26.00	0.38	26.50
CO_2 (PPM)	402.00	712.48	539.00	288.49	1,219.00

Table 2. Case1

For the Case -1 condition, the temperature ranges from a minimum of 28.40℃ to a maximum of 29.50℃, with an average temperature of 29.15°C, a median of 29.20°C, and a standard deviation of 0.29℃. Humidity values varied between 78.10% and 87.10 % relative humidity, with a mean of 82.81%, a median of 83.00%, and a standard deviation of 2.36%. CO_2 concentrations range from 402.00 PPM to 1,219.00 PPM, with a mean of 712.48 PPM, a median of 539.00 PPM, and a standard deviation of 288.49 PPM. There is a significant variation of night time and day time CO2 level due to rise in number of humans.

	Minimum	Mean	Median	Sd	Maximum
Temperature (°C)	27.50	28.46	28.50	0.48	29.40
Humidity (%RH)	79.10	85.87	86.60	2.31	89.90
DP (°C)	24.80	25.85	25.80	0.44	26.80
CO_2 (PPM)	405.00	606.40	469.00	234.52	1,083.00

Table 3. Case 2

For the Case-2 condition, the temperature ranges from 27.50°C to 29.40°C, with a mean of 28.46°C, a median of 28.50°C, and a standard deviation of 0.48°C. Humidity values varied between 79.10% and 89.90% relative humidity, with a mean of 85.87%, median of 86.60%, and standard deviation of 2.31%. CO_2 levels vary from 405.00 PPM to 1,083.00 PPM, with a mean concentration of 606.40PPM, a median of 469.00 PPM, and a standard deviation of 234.52 PPM.

	Minimum	Mean	Median	Sd	Maximum
Temperature (°C)	26.60	27.94	28.00	0.66	29.30
Humidity (%RH)	78.60	87.00	87.70	2.85	91.60
DP (°C)	24.70	25.56	25.60	0.36	26.30
CO_2 (PPM)	403.00	443.56	438.00	29.06	515.00

Table 4. Case 3

For the Case -3 condition, the temperature ranges from a minimum of 26.60°C to a maximum of 29.30°C, with an average temperature of 27.94°C, a median of 28.00°C, and a standard deviation of 0.66°C. Humidity values varied between 78.60% and 91.60% relative humidity, with a mean of 87.00%, a median of 87.70%, and a standard deviation of 2.85%. CO_2 concentrations range from 403.00 PPM to 515.00 PPM, with a mean of 443.56 PPM, a median of 438.00 PPM, and a standard deviation of 29.06 PPM.

	Minimum	Mean	Median	Sd	Maximum
Temperature (°C)	26.80	28.06	28.10	0.68	29.20
Humidity (%RH)	79.40	85.41	85.70	2.84	89.90
DP (°C)	24.40	25.37	25.40	0.42	26.30
CO_2 (PPM)	406.00	435.88	431.00	27.47	567.00

Table 5. Case 4

For the Case 4 condition, the temperature ranges from 26.80°C to 29.20°C, with a mean of 28.06°C, a median of 28.10°C, and a standard deviation of 0.68°C. Humidity values varied between 79.40% and 89.90% relative humidity, with a mean of 85.87%, median of 86.60%, and standard deviation of 2.31%. CO_2 levels vary from 406.00 PPM to 567.00 PPM, with a mean concentration of 435.88 PPM, a median of 431.00 PPM, and a standard deviation of 27.47 PPM.

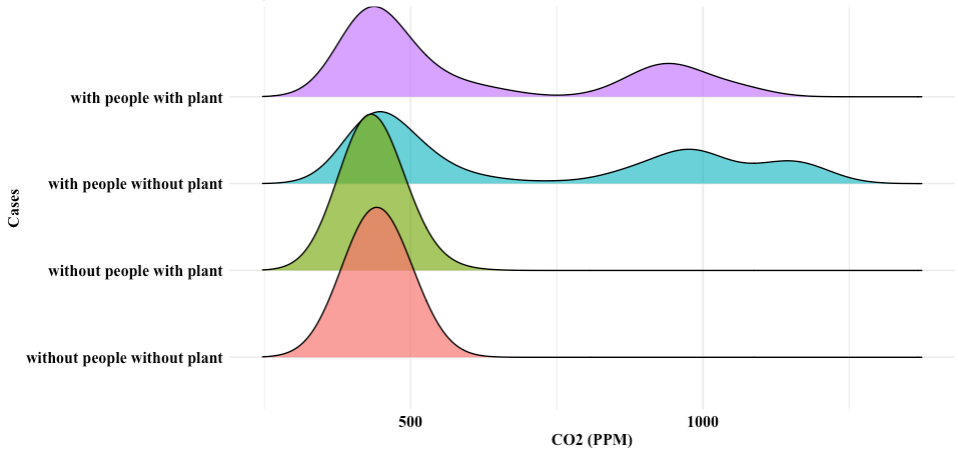

Figure 5. Ridge line plot of CO2 Across cases

Figure 5 indicates that maximum frequent CO_2 intensity lies below 500 ppm but the presence of people showing big difference in the quantity of CO_2. With people without plant has the highest record.

Analyzing CO_2 PPM for various rooms

To begin the analysis of CO_2 levels across different room conditions, we first tested for normality using the Kolmogorov-Smirnov (KS) test. The results indicated non-normality, leading us to use the Kruskal-Wallis test, which is a non-parametric method suitable for such data. The Kruskal-Wallis test was performed to evaluate differences in CO_2 levels among the four conditions: "With People, With Plant," "With People, Without Plant," "Without People, With Plant," and "Without People, Without Plant."

Cases	Mean ± SD	KS test	Kruskal-Wallis
with people with plant	606.404±234.520	0.000	0.000
with people without plant	712.485±288.486	0.000	
without people with plant	435.879±27.470	0.000	
without people without plant	443.556±29.057	0.000	

Table 6. Kruskal-Wallis with descriptive values

The Kruskal-Wallis test revealed significant differences in CO_2 concentrations across the conditions. Specifically, the "With People, Without Plant" condition had the highest average CO_2 level of 712.485 PPM, followed by "With People, With Plant" at 606 PPM. In contrast, the conditions "Without People, With Plant" and "Without People, Without Plant" had much lower average CO_2 levels of 435.87 PPM and 443.55 PPM, respectively. All conditions showed significant differences, with p-values less than 0.001.

Contrast	Mean defference	P-Value
with people with plant - with people without plant	-106.081	0.000
with people with plant - without people with plant	170.525	0.000
with people with plant - without people without plant	162.848	0.000
with people without plant - without people with plant	276.606	0.000
with people without plant - without people without plant	268.929	0.000
without people with plant - without people without plant	-7.677	0.992

Table 7. Post hoc Test

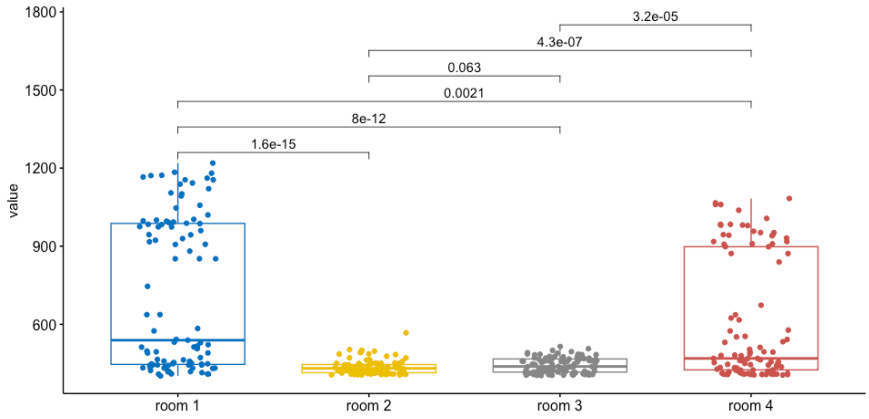

Figure 6. Pair wise comparisons between groups

Interpretation

The results indicate the following.

There are significant differences in CO_2 levels between the conditions and "With People, Without Plant," as well as between "With People, With Plant" and both "Without People, With Plant" and "Without People, Without Plant".

The highest CO_2 levels are observed in the condition "With People, Without Plant," followed by "With People, With Plant."

The conditions "Without People, With Plant" and "Without People, Without Plant" show very similar CO_2 levels with no significant difference in statistical analysis while comparing all the cases. However, in figure-7 shows the readings across all the four days. By providing 1 square meters of plant is creating an average between 7 ppm to 10 ppm difference.

These findings suggest that the presence of people and plants significantly affects CO_2 levels, with higher concentrations observed when people are present regardless of plants presence. The recordings also influenced the lack of controlled environment.

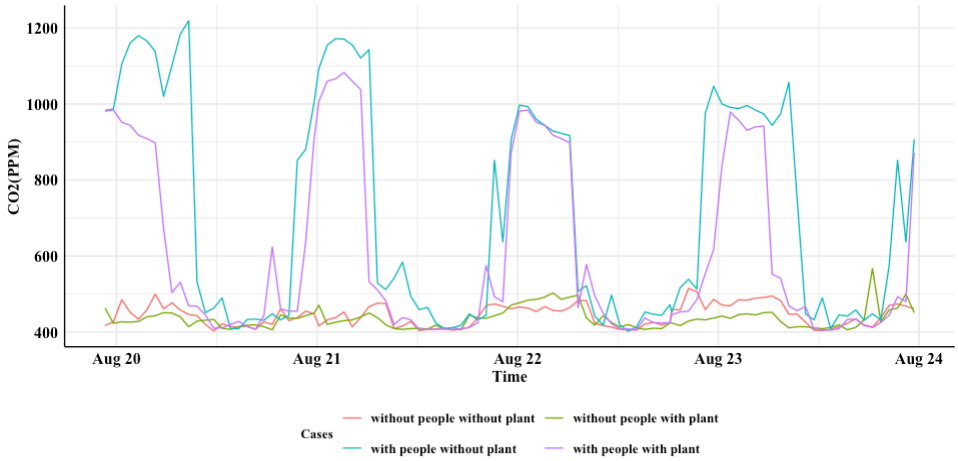

Figure 7. Comparison of all the cases

Analyzing CO_2 (PPM) for various rooms by considering Temperature (°C) and Humidity (%RH)
Here is our linear model

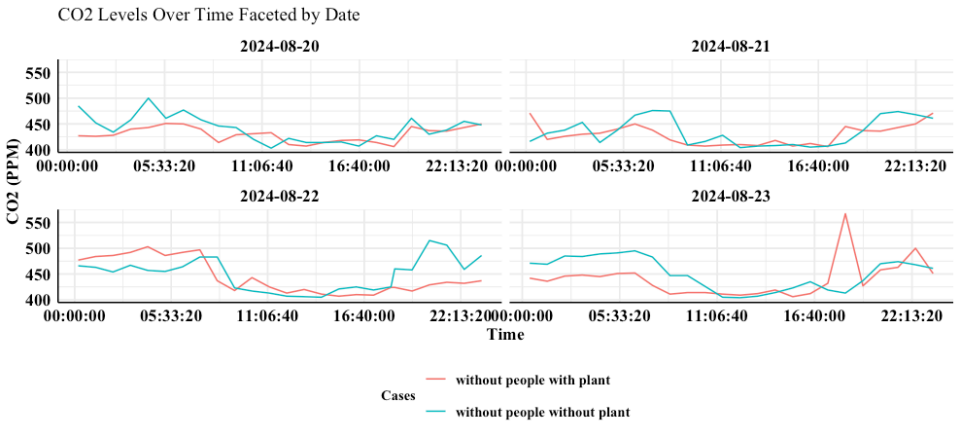

Figure 8. Case 3 &4

Predictor	Coefficient	Std. Error	t Value	P Value
(Intercept)	-7,414.297	938.508	-7.900	0.000
Cases without people with plant	54.944	23.985	2.291	0.023
Cases with people without plant	317.672	29.561	10.746	0.000
cases with people with plant	151.394	24.732	6.121	0.000
`Temperature (°C) `	129.406	21.830	5.928	0.000
`Humidity (%RH) `	48.758	4.571	10.666	0.000

Table 8. ANCOVA Model Coefficients

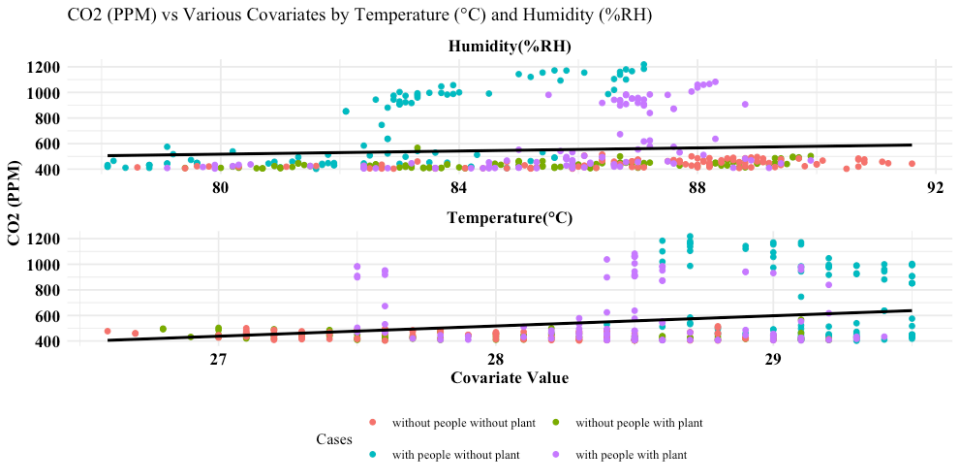

Figure 9. Comparison of all the cases

From ANCOVA its indicates that temperature and humidity levels influence the concentration of CO_2 levels. From figure -7 when temperature and humidity increases, the CO_2 level is also increasing.

CONCLUSION

This study illustrates that VGS has a significant role in carbon sequestration metro cities like Cochin, where the green spaces are limited. By analyzing the four cases under different conditions, presence of plants and people affecting the CO_2 concentration. The highest value of CO_2 shows in Case-1, with people without plant. But in Case-2 the presence of plant reduces the concentration of CO_2. This

observation indicates that by implementing VGS in urban areas will reduce the CO_2 levels in the atmosphere and can create microclimate.
Furthermore, ANCOVA analysis indicate that temperature and humidity play a major role in CO_2 concentration. This reflection emphasizes the need for green spaces in city centers to reduce the increasing temperature and CO_2 levels, contributing to over all climate change.
In conclusion, the implementation of landscape design in tropical metropolitan cities like Cochin, helps to reduce green gas emission. Instigating VGS in urban planning is a feasible solution for creating livable cities in the context of urbanization and environmental challenges.

NOTES

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GRADED DURABILITY OF INTERLOCKING COMPRESSED EARTH BLOCKS: A SAMPLE-INFORMED APPROACH FOR PLANNING BUILDINGS' OBSOLESCENCE

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INTRODUCTION

Drawing on the vernacular wisdom and craftsmanship of cyclical architectural typologies such as Iranian pigeon towers, this research explores graded durability and planned obsolescence in earthen construction. The study advocates for incorporating *graded durability* in the design and production of interlocking compressed earth blocks leading to a predictable/planned decay and obsolescence in the lifecycle of earthen block structures. This involved subjecting compressed earth blocks with various geometries and firing methods to natural/ environmental decay agents as means to explore, observe, and understand rate of decay. The observational outcomes were used in the design of durability-graded compressed earth blocks. In recent years, the construction industry has faced increasing scrutiny over its environmental footprint, particularly concerning the widespread use of concrete. Concrete plays a critical role in contemporary construction, not only as a primary component but also in the stabilization of earthen materials and as a binding agent in cement-based mortars for assembling structures made from earthen blocks. The research presented here attempts to mitigate the adverse environmental impacts traditionally associated with the building industry. Instead of striving for maximum durability through the incorporation of cement – which comes at a significant environmental cost – the explored method tailors and grades durability in earthen blocks to meet specific construction and programmatic needs without compromising environmental sustainability and cyclicality of the building material. Ultimately, this material and structural exploration could lead to the development of environmentally conscious practices that anticipate building lifecycle through controlled decay, expanding on traditional knowledge while enhancing efficiency in terms of materials, labor, and time. The sample-informed study that is the basis for this exploration combines the vernacular wisdom and craftsmanship of existing cyclical architectural typologies with contemporary technologies, resulting in sustainable and culturally rich architectural proposals. These vernacular heritage precedents show a resourceful attitude in response to specific environmental conditions of their context through tectonics, materiality, and functionality.

BACKGROUND: EARTHEN BLOCK, MATERIAL, AND PROCESSES LITERATURE

The planned obsolescence of earthen materials embraces affordances such as cyclicality, versatility, durability (vulnerability), and adaptability. As such, it is crucial to understand the challenges of building with earth, along with common approaches for managing these challenges. Exploration

presents opportunities to develop new methods and approaches to earth construction, promoting earth as a building material in contemporary architecture.

Focusing on the sustainability of compressed earth, Egenti & Khatib highlight the balance required between economic, social-cultural, and environmental factors in earth construction.[1] Their investigation identifies that earth construction research has to focus on the true sustainability of earth construction techniques and work towards adaptations and innovations that optimize the potential of earth construction. The research advocates for adequate rather than maximized stabilization to preserve earth's environmental advantages and improve societal perceptions. A shelled compressed earth block (SCEB) method is highlighted as an approach that balances sustainability and performance by adequately stabilizing earth construction materials. This approach aims to reduce cement use while maintaining durability of the block, employing two layers of earth with different stabilizer content - providing adequate stabilization to the exposed part of compressed earth block with less overall cement content and cost. Conventional compressed earth block presses typically produce blocks with one material mix, thus a mechanical kit had to be designed and fabricated to produce SCEB of two material mixes.[2] The arrangement of the blocks in a wall and their masonry composition are also highlighted, providing a supportive interwoven structure and protection for the inner core of the block.

The possibility of accelerating masonry construction with interlocking blocks is explored by Ramamurthy and Kunhanandan, noting that challenges such as slow construction speed, labour intensiveness, and structural inefficiencies could be managed by increasing masonry unit size and eliminating bedding mortar.[3] The inclusion of mortar delays the rate of construction, and leads to functional problems and structural compromises. Larger masonry units reduce the number of joints and enhance daily construction outputs. Techniques such as dry-stacking, surface bonding, and partial grouting also reduce the reliance on bedding mortar. It is mentioned that surface bonding and dry-stacking provide lateral stability, enhance flexural strength, and eliminates water permeation. This is due to the fact that the mortar joints in masonry serve as capillary wicks and become a source of moisture penetration.

Cottrell et al. explore the effects of block geometry on the mechanical properties of compressed earth blocks.[4] Their study involves manufacturing block geometries and subjecting them to compressive and flexural strength testing. Their tests indicate that the CEB geometry significantly influences mechanical properties. For instance, solid blocks exhibited the highest compressive and flexural strength, while complex block geometries including "frogs" and "indentations" showed lower strength. Variation in strength is attributed solely to the geometric differences, as sample manufacturing process and material density were consistent. The authors encourage further investigation into the influence of damage, local defects, stabilizers, admixtures, and fiber reinforcement in CEBs. Such research could contribute to enhancing mechanical properties in CEBs, promoting their use as a superior low-cost and energy efficient building elements.

While the results of studies on earth may be highly specific re: raw materials used, research conducted by Karaman, Ersahin, and Gunal and Tsega demonstrate the impact of firing duration and temperature on earthen material properties.[5] The authors demonstrate that firing temperature significantly influences mechanical properties of the material; higher firing temperatures result in increased strengths and density, and decreased water absorption and weight loss. In contrast, variations in firing time have less pronounced effects on these properties. It is emphasized that prolonged firing times do not improve brick quality and should be avoided to conserve energy and reduce production costs.[6] An optimal firing temperature for production (900-1000°C) is determined by both studies, highlighting firing conditions in defining the physical and mechanical properties of clay bricks.[7] While firing the blocks at temperatures exceeding 1000 degrees may enhance mechanical properties, this improvement

is accompanied by a reduced rate of water absorption, which may challenge mortar adhesion. Additionally, rapid firing forms an impermeable vitrified outer skin trapping existing gasses, such as water vapor and CO2, inside the block – resulting in a bloating effect.[8] It may also cause an inconsistent firing inside the blocks, leaving the cores less fired than the outer skin.

Contrary to Karaman, Ersahin, and Gunal's assertion about rapid earth brick firing, Bruno et al. propose a new firing method, combining earth compaction and rapid firing at low temperatures.[9] The proposed method's lower temperatures and shorter times suggest reductions in energy consumption and environmental impact. To achieve rapid-firing, a raw earth brick is placed in an electric furnace while temperature is rapidly raised to a specific target. Subsequently, the furnace is turned off, allowing the brick to cool within it. Bricks underwent firing at temperatures of 280, 455, 640, 825, and 1000 °C, with a consistent temperature increase of approximately 9 °C per minute. It is observed that hypercompacted bricks, when fired at moderate temperatures (455°C to 640°C), obtain a very high compressive strength.[10] Their study also found that quick firing of hypercompacted bricks at moderate temperatures (455°C to 640°C) achieves good water durability. However, the hypercompaction method leads to high density within the block, potentially trapping gases and moisture, which could cause damage or even explosions during firing.[11] As a result, this requires the blocks to undergo a thorough drying process before being fired.

IRANIAN PIGEON TOWERS: A CASE STUDY IN EARTHEN BLOCK CIRCULARITY

Designing & constructing these unique earthen structures has been approached with an advanced architectural solution that integrates material efficiency and tectonics. The development of Iranian pigeon towers as an interdependency of radically different scales—from material to architectural—is substantiated by collective empirical knowledge, expertise, and ingenuity in brick/masonry tectonics and earth construction.[12] The tectonics of these towers, based on the accumulation and repetition of blocks (in this case, un-fired mud bricks local to the site), led to this architectural typology.[13]

Repetition is an integral quality of the brick's tectonics, a quality that leads to constructing variety; forms that are linear, curvilinear, manifold striated, stepped, and screened, as bricks connect and form a coherent whole – a monolithic earthen object.[14] The standard circular plans of Iranian pigeon towers are important because the tectonic logic of earthen blocks requires the entire structure to be under compression, limiting tensile stress.[15] The functional role of the ornamentation and patterning of solid and void resulting from a repetition of pigeon nests and perches showcases function and aesthetics in the design of Iranian pigeon towers. Built entirely out of earth, the durability of these structures depends on earth's tectonic capabilities and durability (Figure 1). These qualities present the idea that decay – or a logic of falling apart –is prioritized in these structures through extreme void-making, and material/tectonic porosities.[16]

Figure 1. The pattern of solids and voids in the interior of an Iranian pigeon tower resulted from the repetition pigeon nests and perches

PROTOTYPING: BLOCK SCALE AND BUILDING SCALE

Our research categorizes explorations in two scales: block scale and building scale. The initial phase (block scale) involved exploring production techniques, material mixtures, low-temperature firing methods, and block geometries. The behavior of sampled blocks within wall assemblies (building scale) will be studied to observe their response to natural decay agents and determine how block placement and patterns enhance material/structural decay. This assessment evaluates the impact of material mixture, firing method and duration, and block geometry on the structural durability and load-bearing capacity of assemblies. Compressed blocks were prototyped at different scales (1:4,1:2, 1:1). To evaluate the stack-ability, functionality, and design of each prototyped block, they were 3D printed at 1:4 scale. Subsequently, molds for producing 1:2 scale blocks were fabricated. The objective here is to explore the possibility of producing compressed earth blocks with a specific design at half and full scale (1:1).

This research expands and further develops previous work that explored the integration of decay processes into architectural design, including compressed earth block prototypes informed by salt-induced decay in earthen structures.[17] Here, prototypes were designed to accelerate the deterioration process in areas of block most susceptible to decay. Block designs featured a central indentation that caused stacked blocks to rest on their edges, a modification intended to speed up erosion and disintegration in larger fabricated assemblies/structures. The indentation also resulted in a non-homogeneous firing process, as heat penetrates a thinner section more rapidly, leaving thicker edges less-fired and prone to deterioration. Additionally, gaps between stacked blocks provided space for material to crumble, facilitating a controlled and predictable decay (Figure 2).

The next step in this research was to further develop/refine the decay-informed block. New prototypes reduced stacking surfaces to the block edges and minimized contact points further by reducing stacking surface to the corners. This was achieved by extending the indentation to the block's central axis; resulting blocks contacted adjacent blocks only on their corners.

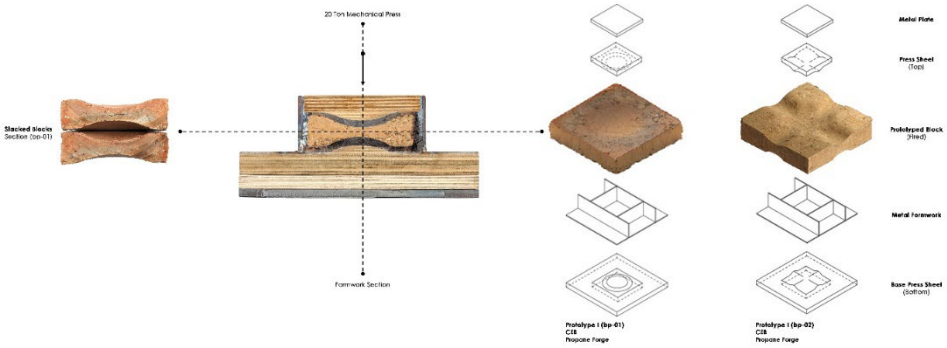

Figure 2. Prototype 1 (bp-01) and prototype 2 (bp-02) production detail

BLOCK SCALE: THE EFFECT OF GEOMETRY ON BLOCK ENGAGEMENT

To further investigate the role of block geometry on blocks within an assembly, subsequent research explored introducing *interlocking* into the design of new prototypes (bp-03). This refinement aimed to optimize stacking patterns, enabling construction of decay-informed earthen block assemblies with graded durability. The design improvements redefined engagement between the stacking surfaces of each block, enhancing interdependencies among blocks within assemblies and the structural porosity of the assemblies (Figure 3).

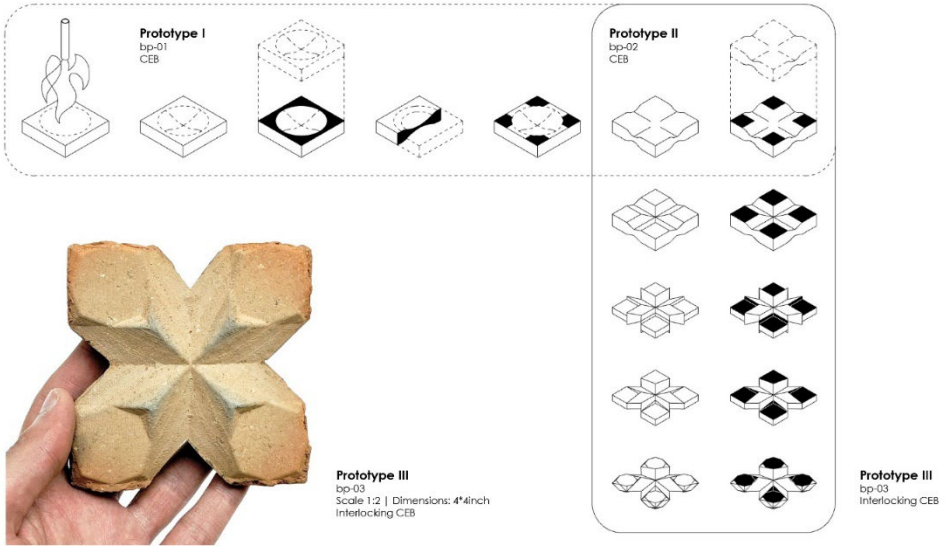

Figure 3. The development process of prototype 1, 2, and 3 (bp-01, bp-02, bp-03)

Although prototype 1 (bp-02) and prototype 2 (bp-02) feature identical stacking surfaces on both top and bottom sides, prototype 3 (bp-03), due to its interlocking design, rests on four protruded ends when laid on a flat surface. This design facilitates the use of separate bedding blocks to support recessed areas, preventing weight from being placed on the protruding ends. Separate beddings also regulate the amount of moisture absorbed from the bottom of the blocks (Figure 4).

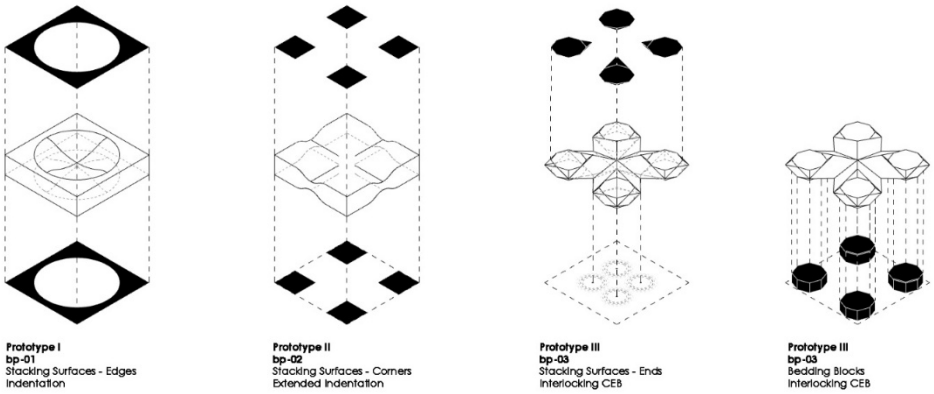

Figure 4. Comparison of the engagement areas across each prototype, shaped by the extended indentation and interlocking design

The Effects of Geometry on Firing

In addition to examining geometry and block-to-block engagement, this research also investigated block geometry impact on firing and how heat/fire moved across block surfaces and within structures, as blocks with varying thicknesses could lead to non-homogeneous firing/stabilization (Figure 5). This factor is critical to block design, particularly when aiming to achieve graded durability in earthen blocks. Comparing geometries of the prototypes (bp-01, bp-02, and bp-03) reveals differences in their engagement with other blocks and how heat moves around them in the firing process. The central indentation of prototype 2 (bp-02) prevents direct exposure of the four corners (stacking surfaces) to heat/fire. In contrast, prototype 3 (bp-03) has stacking surfaces positioned lower relative to other parts. While the sloped, raised diagonal sections of this prototype direct heat and fire away from the lower stacking surfaces, it is evident that these surfaces are more exposed to fire compared to the surfaces of prototype 3 (bp-03).

Figure 5. Block shape and geometry influencing the flow of heat and fire across the surface of prototype 2 (bp-02) and prototype 3 (bp-03)

BUILDING SCALE: TECTONIC POROSITY AND ANTICIPATED DECAY

The extended indentation in prototype 2 (bp-02) optimizes the amount of material used in block production, maximizing structural porosity and making it more resource-efficient. By engaging other blocks on their corners, they create gaps that enhance porosity in an assembly. The gaps and spaces implemented as structural porosity contribute to the decay and deterioration of the compressed earth

blocks and the overall structure. The larger surface area of the blocks in contact with the ground/base of prototype 1 (bp-01) directly influences capillary absorption rate, a key factor in earth block decay. This introduces a "tectonic porosity" in which the form of each block as a singular unit provides porosity to the constructed structure/assembly at architectural scale. The blocks, in a specific masonry form that accounts for exposed block bottoms and engaged corners in the structure, allow for the planning of lifecycle, obsolescence, and decay of the blocks and resultant structures (Figure 6).

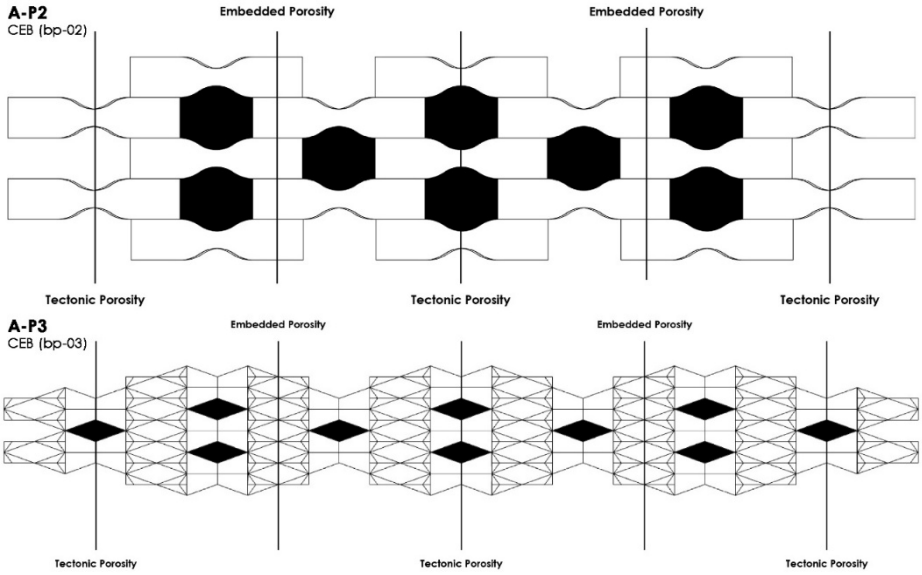

Figure 6. Depiction of areas with different types of structural porosity resulted by block geometry and stacking pattern of the assemblies

Observing the Behavior of the Blocks Within the Context of an Assembly

Three types of assemblies were prototyped for each designed block based on two distinct firing methods: 1. assembly of compressed earth blocks fired in a propane forge for 30 minutes, 2. assembly of compressed earth blocks fired in a sawdust kiln for three full firing rounds, and 3. a mixed assembly combining blocks fired in a propane forge and sawdust kiln. The differences in these firing processes provides a distinct level of durability within the blocks and their structural characteristics. The firing temperature in both methods was kept below 1400°F (800°C) to prevent sintering (material melting/fusing) within the blocks and the material. This is what distinguishes fired earth blocks from bricks. The low-temperature firing approach preserves the cyclicality of earth without altering the structure of its components. Prototyped assemblies were monitored and photographed over time to document their decay process and obsolescence. The observation of these assemblies leads to understanding of the way each part of the prototyped earth block parts (keyed into the wall or the unsupported) contribute to the implementation of tectonic and **embedded porosity** in earthen structures.

Close observation of the assemblies of prototype 2 (bp-02) (Figure 7) shows that the tectonic porosity of the stacking pattern accelerates decay in the unsupported parts of the blocks. The supported/structurally-engaged parts, however, show a slower disintegration rate, maintaining the overall integrity of the assemblies. This is evident in both assemblies with uniformly durable blocks (A1-P2, and A2-P2) and the assembly with mixed-durability (A3-P2).

Figure 7. Documentation and observation of the decay and disintegration process of prototyped assemblies (A1-P2, A2-P2, and A3-P2)

CONCLUSION

This research proposes and explores an approach in earthen construction by focusing on graded durability and planned obsolescence, combining traditional knowledge with modern techniques. The study explores how block geometry, firing methods, and material composition can be adjusted to control and predict the decay of compressed earth blocks. By introducing the concept of tectonic porosity, the research shows how intentional structural vulnerabilities can enhance the functionality and aesthetics of earthen structures. This approach aligns with ecological principles, promoting a cyclical relationship between construction and decay, and reducing environmental impacts compared to conventional concrete use.

The prototypes developed in this study demonstrate the potential of these strategies to optimize resource use and improve labor efficiency, redefining earth as a versatile and sustainable material in modern architecture. By anticipating the lifecycle of structures, this approach offers a new perspective on building design, where decay is considered an integral part of the process rather than a problem to avoid.

Moving forward, the research will further refine these concepts through additional prototyping and testing, expanding their practical applications. A second set of assemblies will be studied to observe the decay process of the block prototype 3 (bp-03) and compare it with the first set of assemblies (A1-P2, A2-P2, AND A3-P2) (Figure 8). This observation will inform potential refinements and adjustments necessary for the development of additional block prototypes.

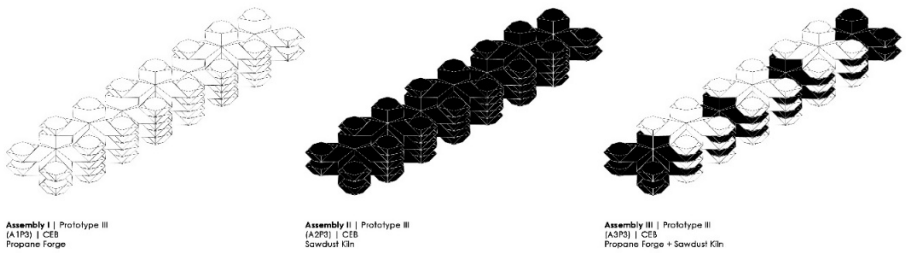

Figure 8. Prototyping assemblies of block prototype 3 (bp-03)

To broaden the scope of observations, the assemblies will be expanded in both horizontal and vertical directions. This expansion will add complexity and introduce a new set of block engagements and dependencies. Additionally, incorporating layers in both directions offers an opportunity to investigate the concept of layered functionality within structures with graded durability (Figure 9).

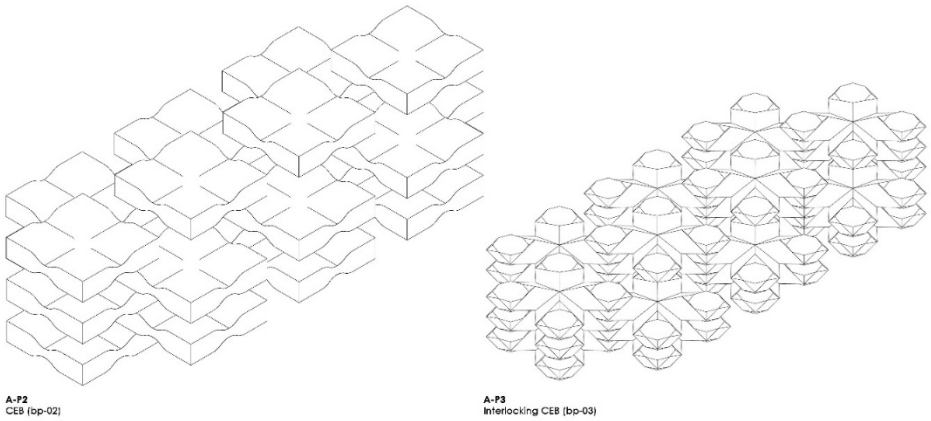

Figure 9. Vertical and horizontal expansion of prototyped assemblies for investigating block engagements and dependencies

This work represents a step towards creating resilient, adaptable, and environmentally conscious architecture that draws on both cultural heritage and contemporary needs. By integrating the process of decay into design, this study lays the foundation for innovative and sustainable architectural practices that respond dynamically to their environment.

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BEYOND HUMAN REALMS: EXPLORING THE COMPREHENSIVE ECOLOGICAL PERSPECTIVE OF SPATIAL AGENTS AND THEIR CONTRIBUTION TO NATURE-BASED SOLUTIONS

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INTRODUCTION

Integrating greenery in urban spaces has been widely discussed as one of the most efficient forms of overcoming critical sustainability issues. More recently, urban green spaces have been considered to benefit human health and well-being, and after COVID-19, this stance was ratified in heavily urbanised cities. Nevertheless, despite the boom in Nature-based Solutions (NbS) in projects across the globe, the mechanisms of development have a history of only focusing on the provision of urban green infrastructure that disregards the roles of key agents and their relative contributions across time.[1] Furthermore, it is argued that conventional ecosystem services overlook the environmental agency performed by non-professionals or community experts that create community networks in urban green spaces.[2] Empirical research revealed that such networks encompass a subtle participatory dimension that considers human and biological diversity agents (e.g., plants, trees, and wildlife) fundamental to sustaining healthy urban ecosystems.[3] Furthermore, such networks' contribution to cultural ecosystem services is highly valued for the non-material benefits derived from interaction with nature.[4] However, considering more than human agents in planning and urban green space design might be challenging due to regulatory planning laws and the strategies for urban integration that often overlook the inter-relationships and dependencies between critical resources, e.g., natural ecosystems, socioeconomic, and cultural.

To solve the environmental crises by creating/designing spaces that foster balanced inter-relationships with the natural environment, we must first question the view of nature as a human-centred commodity in urban planning and challenge any developmental agendas that reduce biological diversity as merely utilitarian[5] or as an object used to evoke or derive meaning or benefits from. Instead, scholars propose ascertaining natural organic life as active agents capable of reproducing their organisation in space by establishing their conditions and interactions with the rest of living organisms, including humans.[6] This might be achieved if relatedness is enabled, implying that the benefits of natural habitats are not thought for people alone but for the wellbeing of local ecosystems and their organisms.[7] This perspective, nonetheless, is not exclusionary of human agents; on the contrary, it acknowledges the need to include people in natural landscape management.[8] Studies by Monica Gagliano[9] and Sara Elton[10] suggest recognising the agency of more-than-human species

beyond an ecological theory, understanding and integrating these organisms as political actors that promote and improve the health and well-being of human beings. Similarly, Atchison[11] draw attention to the relational qualities of interventions that produce new natures, conceived from the understanding that humans and biological diversity exert agency through constituted relationships. From this perspective, agency includes all living beings. Sometimes, with or without intentionality, human agency is situated within a realm of manifold actants (i.e., organic biological organisms)[12] and shaped by ongoing exchanges.

Robinson and colleagues[13] propose multispecies urbanism, which considers the reciprocal relationships between humans and biological diversity. This approach aims to promote the benefits of natural environments on human health and well-being, provided that these urban environments are healthy ecosystems. The proposal is based on the idea that all organisms' lives are interconnected through the cycle of environmental microorganisms, starting from soils and extending to plants, animals, and, ultimately, the entire human and built environment. To achieve this interrelation, Robbinson[14] suggest that urban green spaces should adhere to ecosystem principles and promote natural habitats that connect to sustain a healthy urban ecosystem in the long term. While this proposal offers practical insights, further research is needed to develop a more comprehensive understanding of the multispecies approach, including spatial ecosystem quality, urban green connectivity, and the governance dynamics among various agents.

Recent studies on human and non-human relationality and multispecies urban solutions have examined community gardening initiatives, such as Elton's study in Toronto.[15] The findings highlight the varying degrees of interaction and distributed agency between human and non-human actors and the interplay with the urban space. Such studies contribute to the discussion on the multispecies paradigm, which, although challenging, could influence urban design and planning agendas. Nevertheless, despite the numerous studies and contributions on the topic, issues of applicability and translation in spatial governance persist. Furthermore, research methods incorporating multispecies perspectives in urban design and planning are limited. This raises three critical questions: How can the multispecies approach inform new design frameworks in urban greening and urban design? What methods are available? How can these perspectives be best integrated within NbS models?

In this study, I argue that more nuanced and empirical studies are needed to further the discussion on multispecies agency and its integration into NbS. I propose Nature-Placemaking as a pathway to understanding multispecies relationality, offering a comprehensive view of the spatial, ecological, and social dimensions. To illustrate this conceptual proposition, I suggest a multispecies mixed methodology with a qual-quant approach,[16] tested in an exploratory study conducted in Singapore - a city renowned for integrating urban green infrastructure within its architectural and urban development.

PROPOSING NATURE-PLACEMAKING FOR MULTISPECIES METHODS

Nature-Placemaking is a concept that promotes the connection with nature in biodiverse urban green spaces and the participation of environmental managers. This practice, conceptualised by Lumber et al.,[17] introduces a notion of exercising agency in urban space in conjunction with the natural environment. Taking inspiration from deep ecology theories, ecology models in ecological psychology,[18] geography and health and wellbeing,[19] community stewardship and participation, plant politics[20] and anthropology,[21] non-human organic life such as plants, trees, biological organisms, and microorganisms are positioned as integral agents in the process of making green spaces capable of sustaining balanced spatial biotic dynamics based on mutual benefit vis-à-vis. That is, man promotes the protection of space to allow the organic growth and propagation of the plant world, which, in return, maintains an ecological balance, providing food and spaces that optimise man's psychological

and physiological well-being. A particularity of Nature-Placemaking is the recognition of biological diversity, such as plants and microorganisms, as agents and subjects who create space and place. This means that 'making place' is not an exclusive practice of man; on the contrary, it is speculated that the more-than-human world plays a determining role in the configuration and use of space, which becomes a network alive with interrelations that respond to the particularities of the spatial characteristics in which it develops, an experience similar to the idea of mutually constituted beings.[22]
The practical unfolding of Nature-Placemaking begins with establishing the components that define the spatial policies of urban green spaces in which non-human living beings express agency in space. It is first necessary to explore the spatial configurations, characteristics and particularities. It is speculated that the transcendental interactions between man and nature, either as an extension of the ecological being or as part of a unit of diverse ecological beings, influence these spaces' biotic and ecosystemic quality. For example, Elton[23] and colleagues suggest that engagement with plants in an orchard and urban garden spaces helps forge plant agency, as both man and the more-than-human organic world relate in the process of mutual representation shaped through the communication of ecological signals, which facilitates synergistic cooperation and reciprocal benefits.[24] The cooperation between agents is discriminated according to the spatial and governance characteristics exercised in the green space, which are conditioned by spatial policies at the level of their locality (e.g., urban regulations) and at the neighbourhood level (e.g. community organisations that regulate space).
In questioning how Nature-placemaking initiatives can contribute to the larger area of NbS, it must first be recognised that urban green interventions cannot be assumed to be a fit-for-all and applied to any other given context. In fact, any nature provision should depend on *'community and ecosystem needs'*[25] while prioritising the pros and cons of each scenario.[26] Furthermore, a distinction should be made between the different categories of NbS interventions and its governance style, as these could impact its contribution. For instance, nature integrated into buildings might derive different benefits from the natural organisms, and its ecological contribution might also be different compared to urban landscapes. The degree of relationality and agency in the space might also differ**.**

MULTISPECIES METHODS IN RESEARCH

This study draws inspiration from the idea of mutually constituted spaces[27] and the reciprocal relationship between biological diversity and humans, manifested in their networks of meaning, which can be linguistic, gestural, or biochemical, among others.[28] To analyse the ecological signals in space and the quality of asymmetric relationships, it is necessary to consider participation and representation in space, temporal variations, and the compatibilities and incompatibilities between living agents.[29]
For this purpose, a mixed methodology of multiple species with a qual-quant approach is proposed and employed in research that seeks to understand multispecies agency.[30] The multiple species approach, as defined by Van Dooren and colleagues, focuses "on the multitude of living agents that create each other through relationships that include, but always exceed, dynamics of predator and prey, parasite and host, researcher and researched, symbiotic partner or indifferent neighbour".[31] In this sense, the contexts to be studied do not constitute only static and homogeneous environments but form a dynamic and mutually constituted ecology of beings, where there is an exchange of meanings, interests, and even affections. This multiplicity of perspectives gives meaning to the multispecies methodology.
Different types of NbS are present in Singapore: iconic buildings characterised by a high density of natural elements on their facades and interiors, urban green spaces, parks managed by government entities, and urban green spaces managed by communities. Drawing from the findings obtained in a previous study,[32] the last category is further investigated following a comparative principle within the

neighbourhood's context. This allowed us to trace iterative and contingent relevant factors in the social and physical space that exposed the processes that produced these initiatives (Figure 1).

Figure 19. Urban green spaces managed by communities in Singapore.

The research methods were based on observations of the agents constituting the biological diversity. This implies an intimate observation where it is possible to "show, observe, walk, discuss, imagine, and be guided by the living organisms to appreciate their agency".[33] This included notes, photos, videos, a review of secondary documentation, and informal interviews with users of green spaces. The time spent in the spaces making observations entailed interaction with the organic life and organisms, making sense of their function and actions; this requires being attentive and understanding their authority in the space, as Van Dooren and Elton suggested.

However, the biggest challenge is making sense of ecological signals and finding ways to analyse this information so that it can be understood and applied in urban studies. For this reason, the organisms' agency was first explored according to the spatial and ecosystemic context, followed by the interrelationships woven with the space users. Spatial quality was considered a key component for objectively understanding how ecosystems are formed and respond to design characteristics. To better understand this component, spatial evaluations were carried out, consisting of a system of ecological vegetation units evaluated against specific structural characteristics, as suggested by Daniels.[34] For example, ecological integrity was measured by considering the provision of biotic and abiotic conditions, plant and animal habitats, and pollinator diversity. To measure spatial quality, elements such as proximity to avenues and streets, visual quality, access, landscape, spatial coherence, spatial fragmentation, water elements, grass, flowerbeds, and hedges were considered (IBID). The therapeutic quality of each space was also evaluated, considering aspects such as noise, positive sounds (e.g., wind, birds), privacy, security, fractal fluidity, and stimuli. Finally, a measure of plant agency was integrated, considering units like direct interaction between humans and nature, physical space conducive to ecological signals, and a clear network among ecosystems.

MULTISPECIES EVALUATION CONCEPTUALISING NATURE-PLACEMAKING IMPLEMENTING MULTISPECIES METHODOLOGIES

The initial conceptualisation of Nature-Placemaking formulates that the agency exercised by non-human organisms in urban green spaces is reflected in 1) the spatial ecosystem quality determined by the variety of species and their biotic quality (e.g., number of organisms); 2) the level of connectivity with other green spaces; 3) degree of human intervention in the space (e.g., moderating agents and expression - governance); and 4) degree of transcendental connection with nature.

The evaluation of community-led green spaces on the structural elements, including ecological integrity, habitat for plants, habitat for animals, and pollination, revealed differences in the structural design and their ecological contribution (Table 1 and Fig. 2). These green spaces seemed to support a variety of ecological elements that enhance ecological health measured by the presence and performance of insect-pollinated plants and pollinators. In terms of the level of connectivity with other green spaces, the spatial mapping denoted intentional structural connection in the community-led green spaces.

Performing multispecies methodology enabled an immersive experience in the space to conceive the relationality that manifests at the level of plant beings, similar to what Elton explains in her proposed methodology for identifying plant agency[35] which, although scattered through the neighbourhood space, together, they became a community. Instead of seeing plants as dispersed green elements disseminated throughout space, plants, even in their singularity, produce space as a collective being, organic, loose, a 'disorganised assemblage'.[36] Hence, if the green spaces are spatially perceived as disconnected, conceptually, they come together as a network. Interestingly, the network was forged with gardeners and volunteers, creating an ecosystem. Man was a mediator for plants to express their agency in space, which often reached far-located areas, as seen in the exchange of seeds, plants, and pollinators.

Community gardens represent a more robust form of interaction with non-human living agents. These spaces emphasise activities that galvanise lifestyles understood and shared by social groups. Different social dynamics are observed in these interactions, generating a unique spatial representation of the natural environment through activities designed by humans for non-human entities; this suggests a common ground for social action.

Spatial containers (e.g., spaces where plants and trees grow) reflect fundamental elements theorised in "nature place-making," such as the agency of non-human agents in green spaces and the participation of environmental managers. The frequent recognition of contextual spontaneity is another particularity of these spaces. In these environments, plants grow organically without following a pre-established design pattern. This phenomenon has fostered people's participation in a communicative universe that promotes coexistence and transcendence with the natural environment. This involves paying attention to and listening to plants and other non-human creatures to cultivate multispecies practices based on ethical behaviours.

	Ecological Integrity	Habitat Plants	Habitat animals	Pollination	Space	Therapeutic value	Plants Agency	Median	STD
GUI	5.00	4.93	5.00	5.00	4.09	4.90	5.00	5.00	0.34
FsC	4.50	4.83	4.50	4.25	4.00	4.30	4.67	4.50	0.28

Table 15. Descriptive values

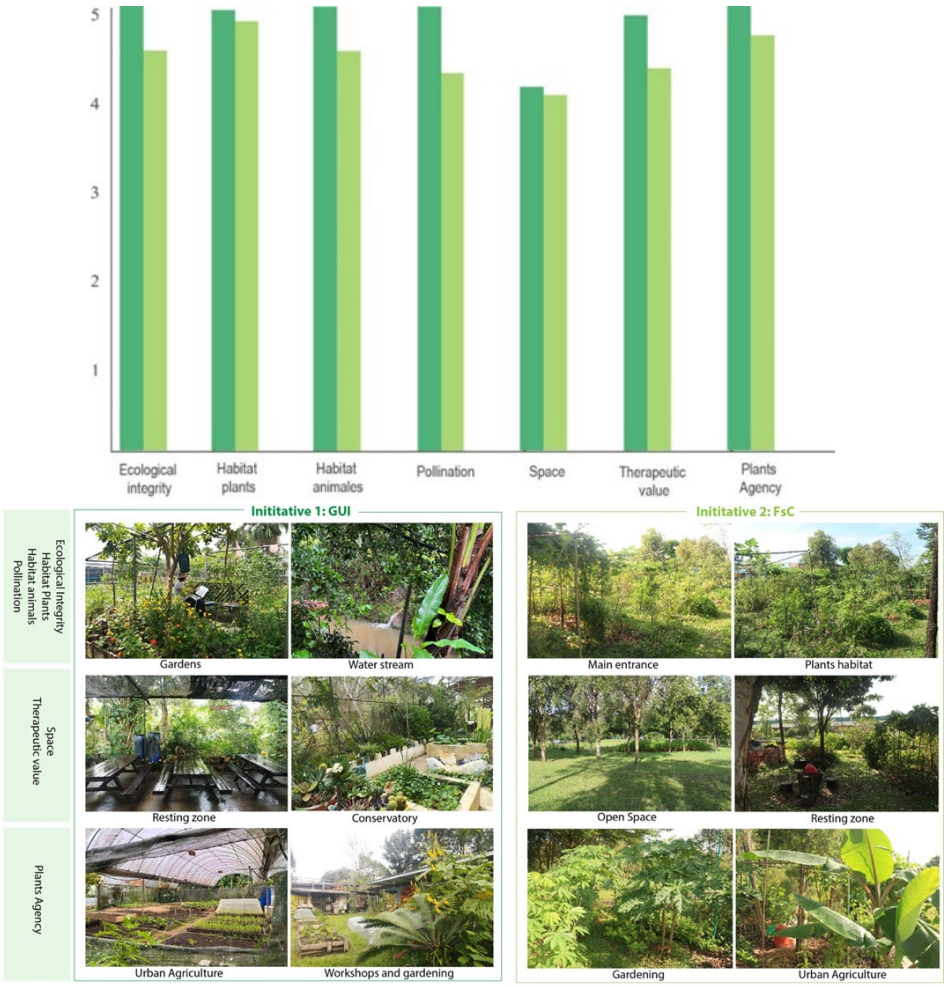

Figure 20. Spatial visualisation.

According to Jhargroe,[37] this dynamic reconfigures the channels of relationship with more-than-human environments, placing them in an ethical horizon where urban gardens and community interventions establish a unique communication system based on mutual respect. This perspective introduces a new vision of multispecies agency in space, considering all the micro-processes that weave relationships for the subsistence of living organisms. Jhargroe's conceptualisation of "political assemblies of more-than-human entities" suggests that these environments can provide an understanding of the tensions arising in daily practices resulting from human-nature interaction. Unlike other government-led or private interventions, this relationship seeks to promote the sovereignty of beings that make up green spaces, distancing from anthropocentric ontologies that only emphasise human benefit.[38] This leads to the proposition of understanding place-making in space as a practice not exclusive to humans.

CONCLUSION

Through these findings, it was possible to explore the preliminary conceptualisation of Nature-Placemaking as part of a multispecies method that acknowledges both spatial configurations and characteristics and the transcendental interactions between humans and nature. This approach views these interactions as an extension of the ecological self or part of a diverse unit of ecological beings[39] that influence spaces' biotic and ecosystemic quality. A key aspect of this proposition is the expression of agency by more-than-human organisms, mediated by human relatedness to this realm.

This agency was primarily evident through 1) the spatial ecosystem quality, determined by the variety and biotic quality of species (e.g., number of organisms); 2) the level of connectivity with other green spaces; 3) the degree of human intervention in the space (e.g., moderating agents and expression - governance); and 4) the extent of transcendental connection with nature.

It is essential that NbS not only address structural problems but also avoid treating biological diversity as mere tools to achieve an external end, as Maller suggests.[40] This relates to practices that, while projecting environmental responsibility, retain aspects of domination over the natural environment without necessarily promoting its ecological integrity and respect for more-than-human organisms. Therefore, the multispecies conceptual method is developed to discern the extent to which interventions in urban green spaces foster a symbiotic interrelation with nature or integrate into the city to address climate change and improve human well-being and productivity.[41]

The primary concern of our era is to reduce toxic pollution, extreme climatic variability, and humanitarian crises. Therefore, urban planning should not be detached from integrating multispecies planning methodologies considering interconnected eco-social realities. A multispecies approach can enhance our understanding of how these realities are configured and manifested spatially. This perspective can also help establish theoretical foundations for future studies in urban planning and the interactions between urban environments and nature.

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EARTH-BASED SGRAFFITO: HISTORIES, SUPPLY CHAINS AND CULTURAL INSTALLATION

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INTRODUCTION

Raw earth construction has been found in almost every region worldwide, including many structures throughout Europe, South and East Asia, Africa, Middle and South America. Earth was, and still is, an accessible material resource, often chosen for its local availability, innate thermal mass, acoustical properties, compressive strength, fire resistance, and durability. Despite its many benefits - adaptability, accessibility, and circularity, there are still many barriers and unrealized opportunities for the implementation of earthen materials in construction, especially because they are, by definition, local and idiosyncratic, less readily labeled with commodified technical data, and often perceived negatively (and mistakenly) as "low-tech". The Raw Earth Sgraffito pavilion is an experimental project that studies material pathways and construction techniques as social enterprise. It introduces traditional techniques within a contemporary context and represents the material geographical procurement lines within its design. This paper presents the historical references to the use of sgraffito. It articulates the construction process and carbon tracking research conducted as part of the realization of the pavilion, including design elements that resonate with the site-specificities and histories of the installation location in Paris.

Material Geographies and the Case for Earthen Architecture

Buildings are more than fixed objects; they consist of materials that are moved and shuffled around. Therefore, the question that arises is: *Where do building materials come from?* They come from production sites—quarries, excavation sites, production facilities, plants, and other value-add processes—that are often treated as peripheral, overlooked spaces. The materials used in the built environment thus embed the qualities, histories, and transformations of the sites that they move through.

Los Angeles' highway system, for instance, exemplifies how materials embed the history of the place into its built environment. With the discovery of petroleum in the Los Angeles area and the proximity of gravel in the San Gabriel foothills, a rapid expansion of the highway system was possible. Figure 1 shows Irwindale, California, in the early days of aggregate mining. That aggregate, eroded from the Sierra Madre, came to be embedded everywhere in Los Angeles concrete, especially in its freeway system beginning in the late 1930s. The Cahuenga Pass Freeway opened in 1940 and is considered the

first freeway in the US; it plowed through Downtown Los Angeles, establishing a practice of eminent domain deeply ingrained in social inequity.[1] To give a sense of the scale of aggregate mining for the freeway system alone, consider that according to the US Geological Survey, one km of contemporary highway may demand approximately 1,006 m^3 of concrete and nearly twice as much aggregate.[2] At present, Los Angeles has about 830 km of freeway, not including onramps and interchanges.[3] Materials that are extracted and processed leave scars: most of contemporary Irwindale is a flooded extraction pit. In the context of global trade, especially as extremely heavy materials like concrete are moved around the world, the imperative to define an alternative metabolism for excavated soil and fill is great.

Figure 1. Gravel mining in the San Gabriel foothills, 1929, north of Los Angele; construction photos/planning photomontages for the Hollywood Freeway, 1956 https://homesteadmuseum.blog/2017/02/07/women-at-work-san-gabriel-valley-sand-and-gravel-plant-circa-1929/ and https://tessa2.lapl.org/digital/collection/photos/id/12865/rec/86

All buildings come from the earth, and yet, the raw materials of modern buildings are highly processed by mechanical, chemical, thermal, and industrial methods, transforming their original matter beyond recognition. Contemporary designs often highlight the Promethean capabilities of transformed materials without addressing or fully capturing their consequences. Critically, people most affected by those environmental consequences are invariably the ones least responsible for them; as scholars and activists have long argued, disadvantaged and Indigenous communities are disproportionately impacted by rising global temperatures, drought, environmental degradation, and loss of biodiversity.[4] Despite this reality, language and policies readily attribute ecological breakdown to the whole of humanity, most conspicuously under the complicated and contended neologism Anthropocene.

As opposed to conventional mass materials like concrete, earth construction uses raw substances from within and around the building site, even in urban contexts. As raw soils and geological products are combined with crop by-products and living additives to gain structural integrity, mixtures can be adapted to local geophysical and thermal environments. This adaptation can be termed *Farm to Building;* The shorter the supply chain, the more environmentally, socially, and economically sustainable the building product is.[5] This direct supply chain makes earth-building materials—modernized versions of ancient technologies—a promising component of climate-friendly design that requires further exploration and demonstration. Raw earth construction mixtures, often combined with crop by-products and living additives to increase structural integrity, can be adapted to a range of building elements, from monolithic to structural modular elements and sculptural finishes.

What is Sgraffito?

Sgraffito is a sculptural finish method that refers to a historical technique used in decorative plasterwork. Traditionally, sgraffito involves the application of two layers of lime render: a darker, often earthen-toned base layer, followed by a lighter, white top coat. The design is then achieved by

scratching through the top layer, revealing the contrasting color beneath, creating a visually rich, carved effect. While often associated with Renaissance and East European architecture, its practice extends across cultures, revealing a broader engagement with materiality and surface manipulation in architectural design.

In the Global North, the technique spread across Europe in the 16th century with several quintessential examples, as shown in Figure 2; the Scultetus Tenement House in Legnica, Poland, for instance, where Italian artisans introduced sgraffito to the region in 1611. The facade of the building, adorned with allegorical figures representing the seven liberal arts, exemplifies the intricate layering of lime plaster and the skilled craftsmanship involved. Similarly, in Switzerland, the Padrun House showcases the widespread application of sgraffito in Graubünden, with entire exteriors covered in geometric patterns and mythological characters. In Prague, the House at the Minute offers another depiction, where the Habsburg rulers and Renaissance motifs were etched into the plaster. These examples of lime sgraffito demonstrate its role as both an ornamental and symbolic tool in European architecture, often communicating cultural, political, or personal narratives.

Figure 2. (Left) Sgraffito decorations at the Scholz House in Legnica. In the niche on the left, the self-portraits of the contractors (master Giovannini and his assistant), on the right, the personification of Grammar;[6] (right): The House at the Minute, exterior detail view of second and third floors. (Source: Richard Guy Wilson, 1999 via Artstor)

However, this historical backdrop sets the stage for the use of more natural and earthen materials in sgraffito. Kaavi Kalé, for instance, is an ornamental technique found in the Konkan region of India, particularly in Goan temples between 1500 and 1775. It primarily features geometric and floral patterns on architectural elements like plinths, facades, ceilings, and thresholds. The word "Kaavi" refers to "red oxide", and "Kalé" means "art form." The red pigment used in this technique is derived from laterite soil rich in iron oxide, while the lime mixture is sourced from burned seashells and riverbed sand. Skilled artists applied the plaster using steel trowels and wooden floats, aided by compasses and rulers, to create precise geometric designs.[7] The origins of kaavi are debated, with some suggesting it was introduced by the Portuguese, while others believe it has Indian roots, brought to the region by artists from the Punjab-Sindh area.

Using Sgraffito with Earth-Based Materials

Earthen sgraffito techniques have ancient origins, and what we will introduce as "mud sgraffito" is an evolving, more ecologically integrated version of the classic technique, utilizing earthen materials. For example, in the funerary complex of Senusert III, located at South Abydos, Egypt, dating to around 1850 BCE, an early example of sgraffito-like techniques was applied on top of raw mud bricks. Shown in Figure 3, boat figures were etched into the outer layer of white plaster, revealing an interplay between thematic continuity and informal tableau. Over 120 distinct boat images were inscribed into the plaster, suggesting a collective effort by multiple artisans.[8] This variety in execution underscores the diversity of skill among the craftsmen, suggesting a collaborative and commemorative spirit inherent in the creation of these artworks. The process of creating these sgraffito images was likely expedited by the use of freehand incising techniques, reflecting a hurried yet deliberate effort to produce a cohesive decorative scheme within a relatively short time frame.

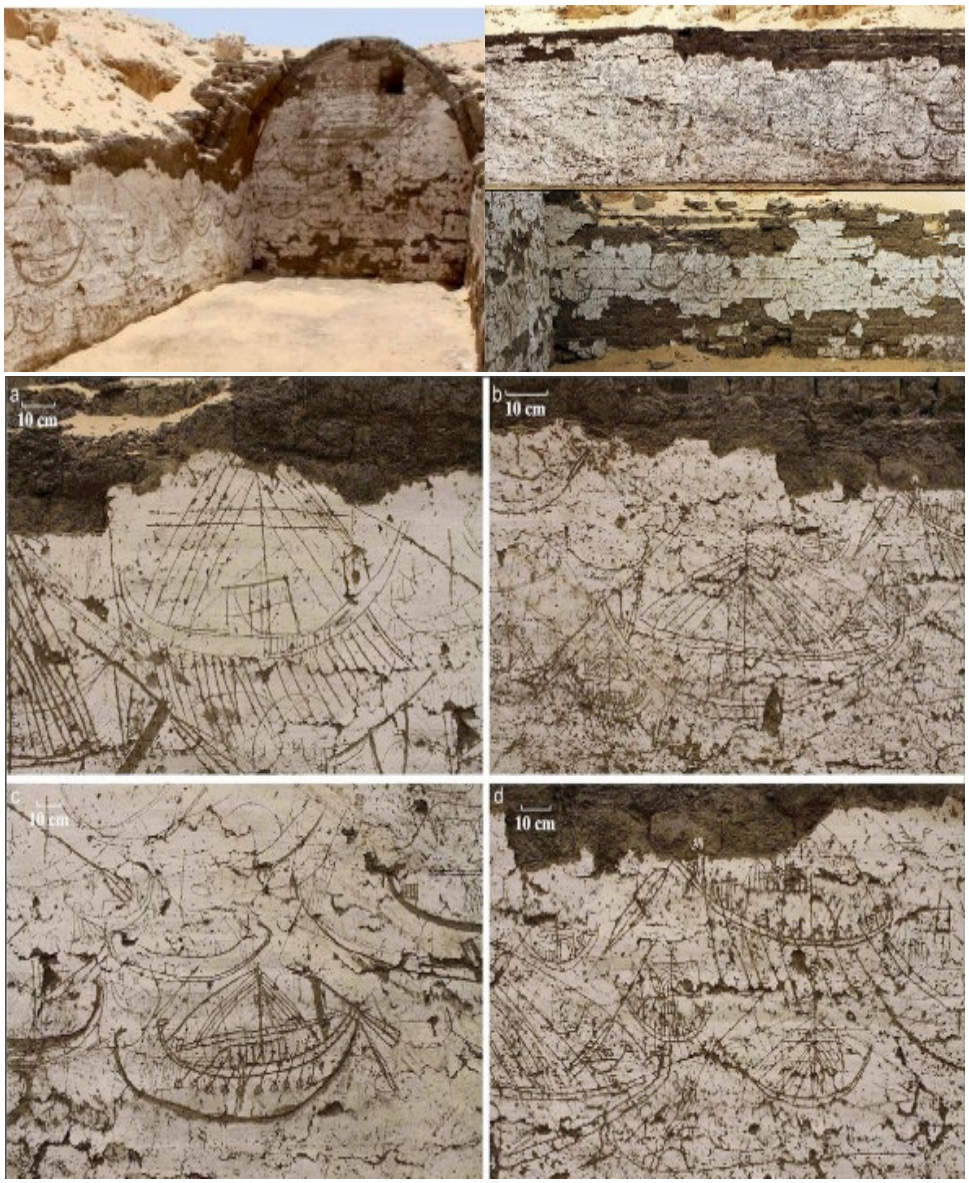


Figure 3. Boat images on the walls of the funerary complex of Senusert III, at South Abydos, Egypt.

Other, more contemporary applications of sgraffito, such as those by Athena and Bill Steen of the Canelo Project in Arizona, USA, continue this tradition with clay-soil layers. By studying both

historical and contemporary examples, we gain valuable insights into the evolving practices of earth-based sgraffito, informing our approach to new projects like our commissioned pavilion, where we integrate these rich traditions with innovative applications.

INSTALLATION AS CASE STUDY: THE RAW EARTH SGRAFFITO PAVILION

To address the above argumentation and to introduce a circular construction and material metabolism in a built example, an experimental pavilion was developed, using raw earth materialities and sgraffito techniques. To demonstrate at small scale the environmental benefits of low-carbon earthen building materials and the complexity of construction geographies, the pavilion was designed to leverage geospatial technology, data, and visualization to track the routes traveled by the materials used in a demonstrative manner.

Specifically, the objectives of this demonstration project were threefold: first, through tracking, visualization, and field trips, to communicate the local pathways taken by the materials used in our installation and, by extension, many of the construction materials in Paris; second, to engage students in the building process with alternate, low-carbon materials; and third, to use the surface elaboration and the sub-construction of the pavilion as a means to communicate the benefits of raw earth construction. By interweaving hands-on and analytical knowledge of building materials, this project was intended to convey construction pathways while also contributing much-needed data on material procurement and transportation emissions, data currently omitted from most carbon and lifecycle accounting because of its complexity and variability.

Materials and Methods

The inner core of the Raw Earth Sgraffito Pavilion was constructed using Compressed Earth Blocks (CEBs) from Cycle Terre, a public-private partnered factory on the periphery of Paris whose partners include a construction company, a hauler, and the municipality. The earth blocks produced by Cycle Terre comprise soil excavated from tunnels dug to expand the Paris Réseau Express Régional (RER) rapid transit system.

Grey and burgundy surface plasters were purchased from a nearby facility in the Ile-de-France region. The mineral content of the clay creates the pigment of the soil-based mixture. Splintered straw from agricultural by-products was mixed into the clay for the grey base coat. The top coat was enriched with sand and mica to create a finer grain and sheen.

The earth-based sgraffito surface was sealed using a raw cold-pressed flax seed oil purchased at a nearby bio store. The wood elements placed on the roof and sitting area were sealed using a non-VOC linseed oil-based product.

Carbon Analysis Method

Although there is some initial research on the life cycle assessment (LCA) of natural building materials,[9] this kind of comparison has yet to be undertaken for a specific innovative project. The vast majority of modern buildings are constructed from highly processed materials, critically depleting global natural resources. There is generally little awareness of the complexity and impact that accrues to the supply chain of building materials in an urban context. For each constituent material, the phases of production should be calculated. Transportation, variable with supply chain, is an often-hidden component of life cycle analysis that we chose to focus on in our project.

CARBON ANALYSIS RESULTS

As the mapping diagram below depicts, using local materials for the block and plaster, the two heaviest of our inputs, is important when considering transportation within greenhouse gas emission calculations. By comparison, the flax seed oil used in the pavilion as a sealant on top of the raw earth plaster was shipped in 0.7 liter bottles; its weight shows as higher than, for example, the plywood by virtue of its packaging. Since truck efficiency is calculated relative to weight of payload, weight is a primary variable when CO_2 equivalent (CO_{2e}) for material transportation.[10] The tracking of the ground transportation routes to Paris is shown in Figure 4. The different materials are color-coded by types, shown at the European and local Paris scales.

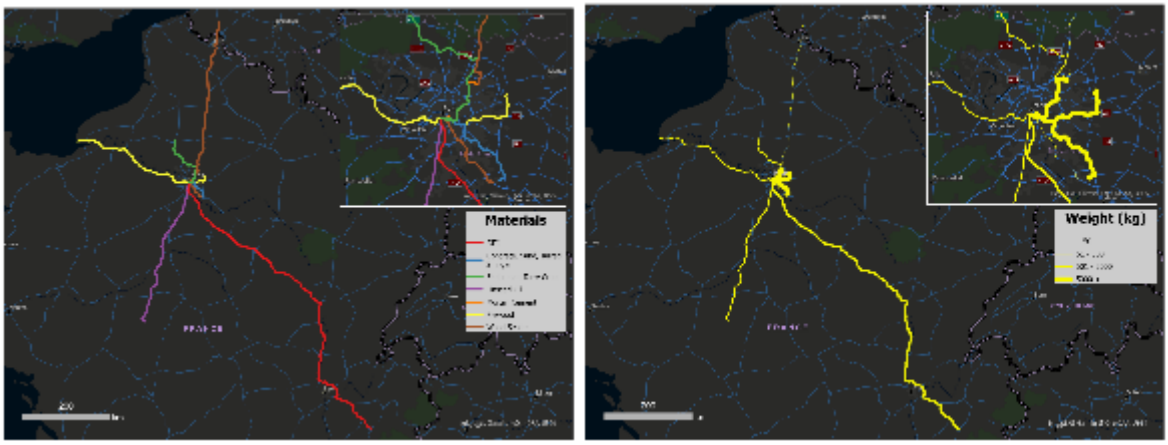


Figure 4. Tracking of ground transportation routes for the installation materials, in and around Paris. "BTC" signifies the compressed earth block; "Enduits de Terre Crue" signifies the raw earth plaster. Images and mapping by Greg Yetman, CIESIN, Columbia University (See Acknowledgment).

Tracking and comparing localized supply flows of materials across urban regions was a central research priority of this installation, as well as in the sgraffito design. The analytical maps that resulted from tracking the soils and fibers used in this project, were translated into the incisions on the sgraffito wall. As shown in Figure 5, the installation is both a case study of how the transportation of materials played out in terms of distance, mass, and CO_{2e} and a record of our findings.

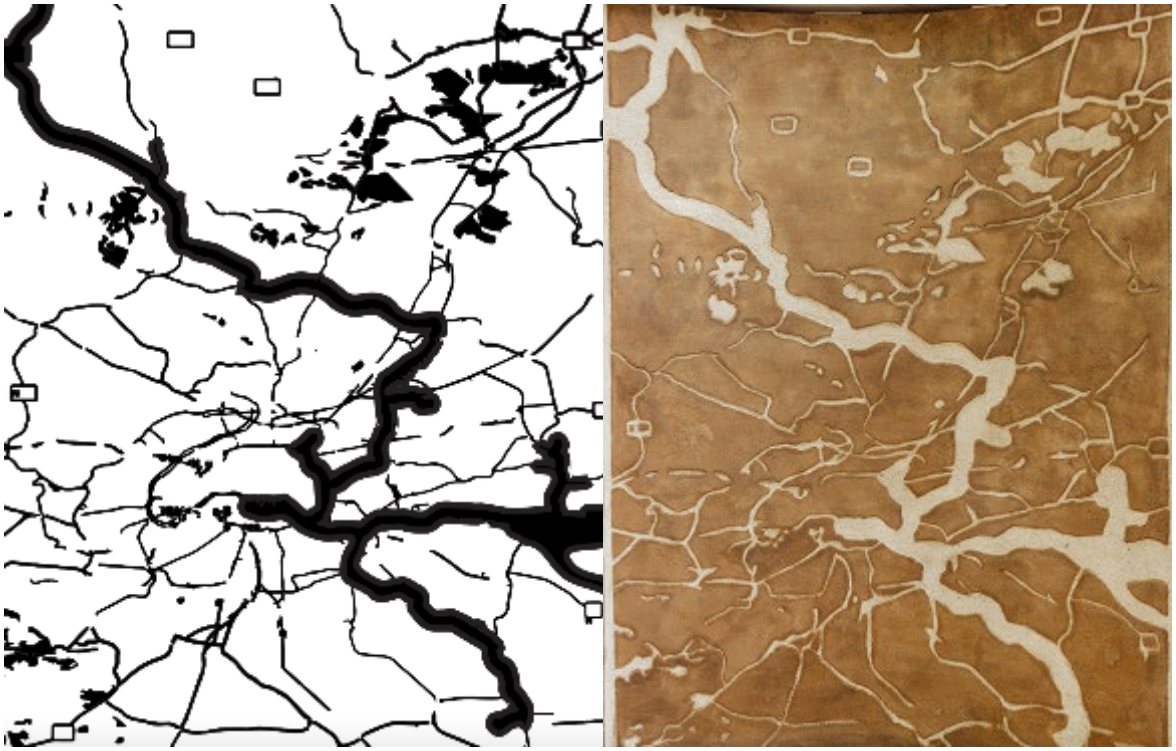
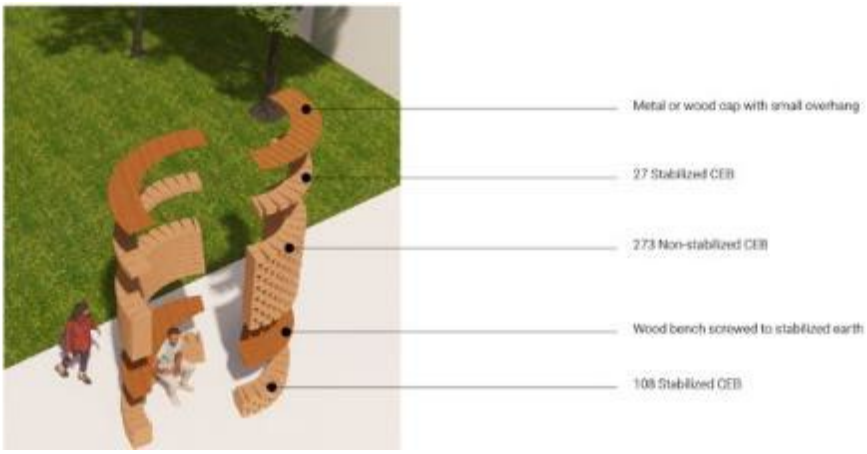


Figure 5. The graphical tracking of the pavilion's materials (left) and the translation onto the earth-based Sgraffito surface (right).

To address the quantitative resource tracking, we calculated the seating provided and space enclosed. Based on those dimensions and the inventories provided by the contractor, the total weight of material that went into the pavilion was assessed. Shown in Figure 6 and Table 1 is a cost-benefit analysis of materials to spatial enclosure. The calculated total carbon from transportation alone was conducted based on weight, truck capacity, and engine efficiency.[11]



Vendor	Products	Distance (km)	Truck class	Rate (g/t-km)	Weight (kg)	Carbon (g)
Cycle Terre	BTC, mortar, cement	573	4-RD	197	519	58,591
Cycle Terre	BTC, mortar, cement	28.1	light duty	42	5,524	6,513
Briqueterie de Wulf	Reclaimed earth	99.5	4-RD	197	225	4,415
General Plywood Company	plywood	202	4-RD	197	51.3	2,042
Leroy Merlin	mélange de béton, sable, rouleau bardeau goudronné	43.1	light duty	42	145	263
Naturalia/Huilerie Vigean	Flax seed oil	255	4-RD	197	3.9	197
Acheter Rubio	Sealant for wood	242	4-RD	197	24	0
Acheter Rubio	Sealant for wood	35.1	light duty	42	0.5	1
Plywood shipping	Plywood	2,777	ship	136	51.3	19,332

Figure 6. and Table 1. Material quantification in axonometric and tabular forms.

THE DESIGN PROCESS

Guiding principles

No less important to the project is its experiential possibilities in the historic courtyard where the pavilion has stood for a year, from May 2023 until August 2024. The pavilion was located between a more formal portion of the courtyard and an open lawn, providing a sheltered area for reading and conversation. For the students and public that use the courtyard space, it has been a seating area that provides cooling in the summer and warmth in the winter due to its thermal mass.

The nature of raw earth as a material is variable: blocks are friable, and plaster is often used to offset irregularities and protect against weathering. Our design juxtaposes the plastered interior, with its articulation of material trade routes and referential edge patterns, to a highly textured exterior. Blocks splay as they array along the arced radius of the walls, and the offsets were regularized and emphasized by expertly applied plaster that aligned the plane of set-back between blocks. Over time, the weathering of the exterior brick began to reveal the sand and gravel aggregate naturally embedded in the clay and silt matrix, expanding on the narrative of origins on the interior.

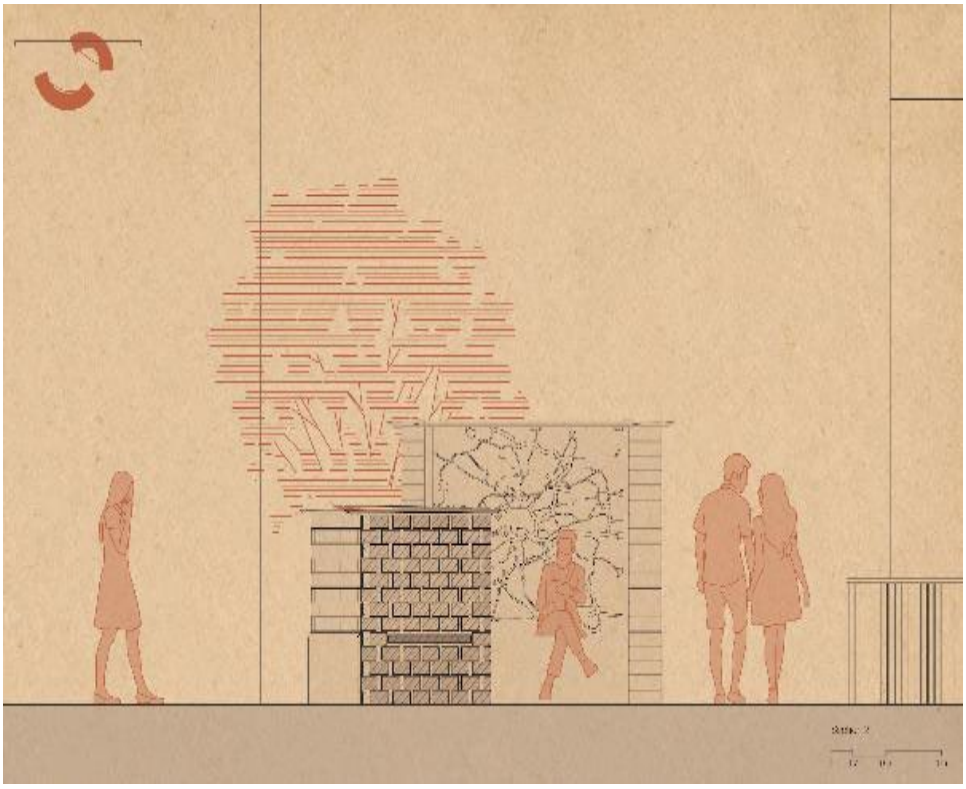


Figure 7. Design drawing, plan and elevation, showing intended spatial consequences of being within, but separate from, the social life of the courtyard. Drawing by Zina Berrada.

Construction Process

The block construction was entrusted to Les Bâtisseuses, a local social enterprise dedicated to fostering equitable labor practices by training newly arrived immigrants in raw earth construction techniques. Beyond technical skills, this initiative provides essential social services, addressing broader systemic inequities faced by immigrant workers. Under the guidance of master masons and plasterers, the team collaborated closely with us, navigating the material and logistical constraints of the site, while contributing invaluable knowledge rooted in their lived experiences and evolving expertise.

Figure 8. Construction of the base courses is complete, April, 2023. Photo: Barry Bergdoll.

Following the completion of the base construction and the base layer of grey plaster, a team of architectural students, alongside the authors and two of their colleagues, used a perforation technique borrowed from traditional fresco cartoon transfer to incise a graphic adapted from the GIS maps that depicted trade routes. Using tools intended to work clay, the team excavated the areas within the perforations, as shown in Figure 9. Once the top layer of plaster was fully dried, six coats of protective raw flax seed oil was painted on top. The collaborative process engaged workers of different skills and backgrounds.

Figure 9. Image transfer perforation and plaster etching processes. Photos: Charlotte Force.

The final erected pavilion proved remarkably robust, with only the oil as a protectant, in no small part because of the tilted overhanging roofs that prevented water penetration into the walls, and the thick coat of plaster at the base. For the limited time allowed by Paris heritage regulations, it was a beloved asset in the courtyard.

Figure 10. Completed pavilion, Fall 2023. Photo: Fred Jagueneau.

ACKNOWLEDGMENTS

The Raw Earth Sgraffito pavilion is a collaborative project that was made possible thanks to numerous people and institutions. The Columbia GSAPP Natural Materials Lab contributed space and resources for a mock creation.

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The carbon analysis and geospatial mapping in this project was created by Greg Yetman, director for the Geospatial Applications Division at CIESIN, Columbia Climate School. Research Assistants on carbon analysis are: Emine Taha and Ines Ben-Taher.

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ENCODING ARTIFACTS: STORMWATER MANAGEMENT AND SURFACE GEOMETRY

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INTRODUCTION

In collaboration with Kentaro Tsubaki at the Tulane School of Architecture, a student design project was undertaken to transform the complexities of large-scale manufactured watershed landscapes into tangible physical artifacts, specifically fabricated water vessels. This four-year research studio[1] used computational design and fabrication techniques to explore the interaction between stormwater management infrastructure, public space, and precast systems at urban, street, and component scales. The project sought to address the inherent obduracy[2] within urban planning frameworks—those fixed, immovable systems that resist change once established—by challenging conventional approaches to stormwater management.

A rain garden in New Orleans, Louisiana, served as a case study to establish specific design criteria for the water vessels. Students were challenged to design and fabricate vessels within a limited five-week time frame and physical volume parameter, considering the relationship between geometric surface attributes, accessibility, permeability, and the spatial implications of visible, surface-level water detention. The resulting projects demonstrated the expressive potential of design methods that respond to large-scale infrastructure constraints and reinterpret them through small-scale, physically fabricated artifacts.

STORMWATER MANAGEMENT AND URBAN SURFACE TRANSFORMATIONS

Around the turn of the 20th century, the introduction of centralized stormwater management had one of the most significant impacts on the social terrain of modern American city surfaces concerning its spatial and volumetric impact. Due to social pressures for increased sanitation and the maintenance of dryer spaces for circulation and gathering, stormwater's presence became problematic. As a result, this removal of stormwater from urban cores transitioned from the surface articulation of open gutters and ditches to a centralized subsurface condition embedded in the ground plane, primarily invisible from sight (Figure 1). At the time, no American city may have benefitted from this technological endeavor as much as New Orleans. Once physically constricted by its low-lying topographic conditions and built-up levee perimeter, which trapped water within city limits, the crescent city's technological mastery of discharging stormwater allowed it to effectively remove standing water and rapidly expand its physical footprint, resulting in a seven-fold increase in urban acreage.[3]

The constant reconfiguration and excavation of the urban surface was a physical and symbolic representation of progress, a continual renewal of societal values.[4] Subsurface piped networks,

mechanical pump systems, and the transition from rough modular stone paving assemblies to smooth, impervious surfaces all work together to assist in the rapid discharge of stormwater.[5] These accelerated systems of mechanization and movement became embedded in the city fabric through a persistent social construction of governance over natural systems.[6] This technologically dominant approach to shaping urban environments has reinforced the Promethean expectation of the human relationship with nature as dominant rather than symbiotic. Furthermore, this relationship stems from the narrow framing of environmental problems as technical issues that only techno-centric solutions can address. However, unforeseen impacts later counteracted the system's benefits. The efforts that succeeded in keeping New Orleans dry would lead to accelerated subsidence rates since moisture within the soil helped stabilize groundwater levels and prevent organic matter from decaying, resulting in hastened soil consolidation.[7] Rapid water discharge also frequently affects overwhelming drainage systems, causing chronic flooding in areas where stormwater cannot be released into an inundated system. This condition perpetuates a negative perception of visible water in city settings that reinforces the notion that city surfaces should remain dry, an obdurate view stifling alternative solutions for stormwater management.

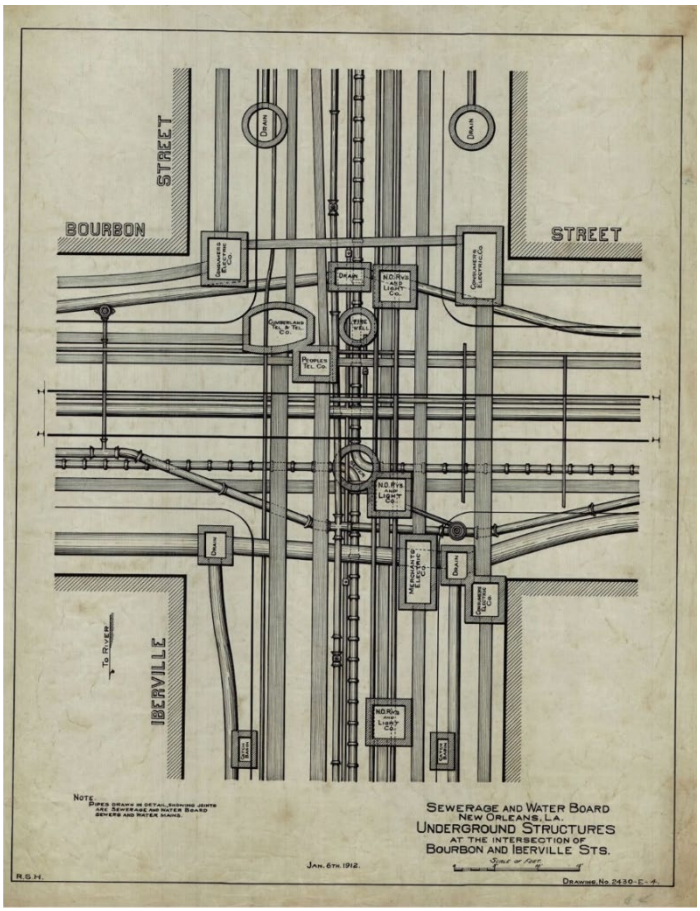

Figure 1. 1912 Plan detail of underground utilities in New Orleans. Image by The Sewerage and Water Board of New Orleans.

PARADIGM SHIFTS IN STORMWATER MANAGEMENT

As a city rooted in environmental adaptation and social celebration, the urban surface represents a regenerative spatial terrain for the land and the people, given that the scope of human activity has fundamentally altered naturally occurring ecological processes across the earth's surface. Local

planners, practitioners, and residents have increased efforts to strengthen environmental literacy and resilience in everyday city life. The New Orleans Urban Water Plan[8] emphasizes water as a vital resource that strengthens resilience rather than treating it as a nuisance to discard. The creation of educational programming, master plans, and surface-level stormwater rain gardens have contributed to this increased public understanding of the necessity of cities to adapt to an ever-changing environment. Experts now view the 20th-century design features of stormwater infrastructure as a technical overcorrection, like emergent views on the adverse impacts of smooth, impermeable streetscapes.[9] In contrast, it is now preferable to design systems that slow water down through diffusion and dispersant, incrementally releasing it from permeable urban surfaces horizontally and vertically.

RESEARCH STUDIO FRAMEWORK

The studio's disciplinary approach embraced this paradigm shift while reinforcing the understanding that the crisis of stormwater management is a spatial problem and that architectural projects can produce transformative spaces and experiences that challenge humanity's knowledge of the environment and foster new forms of engagement. This system of inquiry allowed us to strategically define research studio projects, instilling in students an ethical obligation to reshape future urban landscapes that infuse infrastructure with ecological identities like saturated wetland surfaces lost to technological innovation in New Orleans.

All four iterations of the research studio concluded with an urban-scale design project located on a portion of the Lafitte Greenway, an underutilized post-industrial infrastructure corridor parallel to one of New Orleans's primary open canal drainage systems. The first iteration of the research studio in 2018 quickly delved into the urban scale projects, which presented some challenges. Planning and analyzing a programmatically complex, half-kilometer-long linear park in an urban context demanded most students' energy throughout the semester. Additionally, the program required students to accommodate an increased volume of stormwater to supplement the capacity of the open-air drainage canal that channels it away from the downtown area and out to Lake Pontchartrain. Diverting the stormwater from the adjacent canal and detaining it on-site can reduce the overall demand on the centralized system during high-intensity storm events. Initially, this requirement's volumetric and spatial magnitude was hard to grasp. Consequently, integrating computational design to test and measure design solutions was not as rigorous as initially hoped.

In the subsequent iterations from 2019 to 2020, the studio introduced the fabricated water vessel as a medium-sized street-scale project that could be deployed across vacant residential lots throughout New Orleans. This approach allowed the students to understand the spatial complexities of surface-based stormwater storage while working within manageable constraints, as these vessels had to be fabricated within five weeks. The students' adaptability was evident in their ability to work within the small-scale nature of the vessel, implementing an iterative feedback loop between design and computational analytical tools without being overwhelmed by the intricacies of the forthcoming urban project.

NORA RAIN GARDEN AS A CASE STUDY

As of 2018, the New Orleans Redevelopment Authority (NORA) has undertaken a pioneering initiative, converting eleven vacant lots into innovative stormwater detention systems. One specific rain garden, a standout part of NORA's initiative, was a case study to develop the water vessel performance criteria. Located at the corner of Wildair Drive and Fillmore Avenue in the Gentilly neighborhood, this rain garden can be geometrically characterized as a subtle, circular depression spanning two vacant lots with a high point in the middle (Figure 2). According to a NORA Rain

Garden Fact Sheet, the garden has the largest stormwater storage capacity of the eleven listed on their website.[10]

These projects, which manipulate the ground plane horizontally and vertically, not only serve the primary goal of reducing the strain on the city's centralized stormwater system but also celebrate the rediscovery of a lost ecological identity in the region. The re-emergence of visible surface flooded conditions is a testament to these projects' historical and ecological significance. Historically, these subtle sectional undulations were a common feature throughout and around New Orleans, spanning pre- to post-colonial eras before disappearing around the turn of the 20th century.

The revealing[11] quality of these surface-level detention systems allows them to be expressed beyond mere efficiency, taking on new symbolic meanings through their geometric forms. They suggest an opportunity to investigate the transformative potential of design artifacts that balance the science of quantitative performance criteria with the qualitative art of aesthetic expression, translating historical and ecological principles into designs that resonate functionally and symbolically.

The vessel design prompt was formulated based on the following full-scale criteria. The horizontal proportions are based on the full width and half the depth of a typical residential New Orleans lot, which measures 30 feet wide by 120 feet deep. This results in a horizontal dimension establishing a 1:2 proportion, where the depth is twice the width. The maximum section depth of 36 inches ensures that the ground plane in New Orleans remains above the groundwater table, preventing prolonged stagnant water that could encourage mosquito breeding. Additionally, the minimum rain storage volume requirements align with New Orleans City Ordinance 27702, Section 121.8-10, which states that new or substantially improved construction projects with five thousand or more square feet of impervious surface area must detain the first 1.25 inches of rainfall on-site for no longer than 24 hours. Tripling this requirement accounts for more frequent and intense rain events. Finally, considering the human occupation of the water vessel surface, some percentage of the overall area should be designed as accessible areas for universal pedestrian access on site. These specifications translate at 1:20 scale: The horizontal dimensions are 12 inches wide by 24 inches long, with a maximum depth of 1.5 inches. The water storage should be equivalent to four 500 ml water bottles. Additionally, 30% of the area needs to have a 1-10% slope.

This scalable relationship allowed students to achieve high technical specificity at the vessel scale and later apply it to larger urban scales. While the four primary constraints guided their designs, additional considerations related to site manipulation and fabrication techniques played a crucial role. Students could explore cut-and-fill ratios by establishing a horizontal datum at the top of the vessels to subtract from or add to the landscape. Fabrication constraints, such as the need for material economy in mold making and casting, were important factors, alongside designing the vessel's base condition to minimize surface contact with the ground, ensuring stability with or without water. An aesthetic prompt further guided the designs, emphasizing that neighborhood rain gardens are often more visually and physically accessible to community members as dry, open spaces rather than inaccessible, inundated areas. This approach aligns with the research studio's overall framework, challenging traditional design responses that prioritize maximum water storage capacity over other functional and aesthetic considerations.

Figure 2. Digitally simulated flooded conditions at NORA rain garden case study. Image by author

DESIGN BENEFITS OF SUBTLE SURFACE CONTINUITY

Designing within a vertically limited envelope of 1.5 inches presented new territory for architecture students familiar with design projects with much more expansive dimensional boundaries. Additionally, introductory design methods allowed students to explore the simultaneous manipulation of horizontal and vertical geometry while avoiding a typical 2D planning to 3D extrusion design process. The first example shown to students each semester used a singular point depression located within a larger rectangular frame like a watershed bay on a flat roof with an internal drainage system or that of the surface-level parking lot with distributed drains at low points. Four triangulated surfaces created a continuous Rhino polysurface, connecting the outer profile to the depressed point. This design emphasizes the importance of surface continuity for computational analysis of water volume capacity and surface slope ranges, continuous 3D print output of design iterations, and CNC programming of molds for casting.

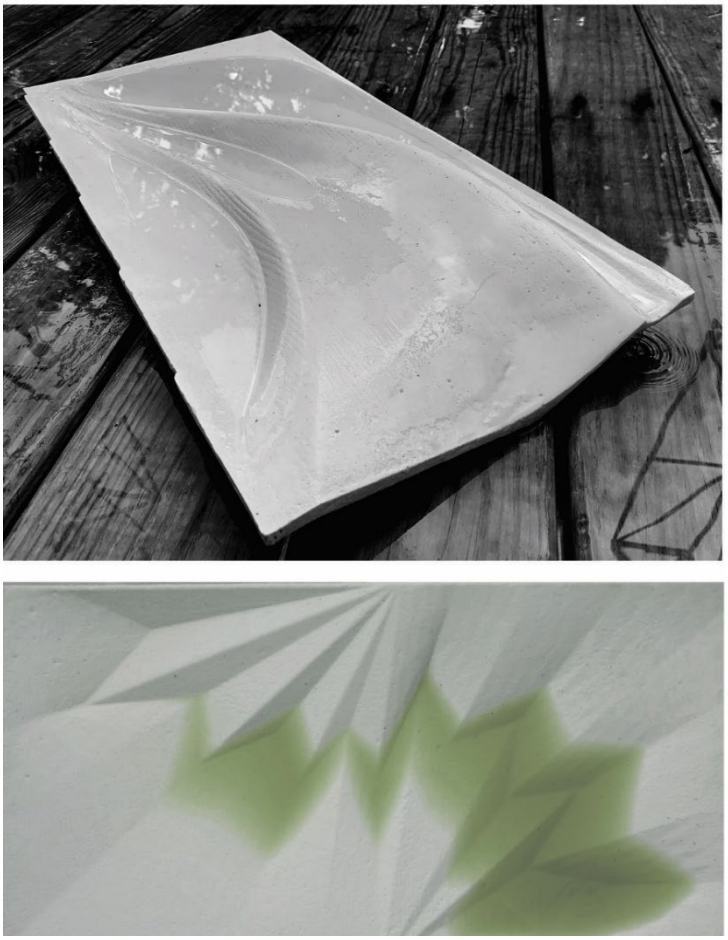

Figure 3. Water vessel full-scale casts 08 (top), 09 (bottom)
Images by Author and Katharina Tomasito

WATER VESSEL DESIGN, ANALYSIS, AND FABRICATION

The water vessel project spanned five weeks, beginning with physical and digital design techniques, rapid prototyping, and culminating in the casting of water vessels (Figure 3). In the first week, students prepared initial design iterations for 3D printing at a 1:4 scale of the final required size. This allowed them to visually and tactilely confirm the surface geometry and identify aspects for refinement. In the second week, they integrated volumetric and slope analysis tools to create an iterative design feedback loop. By the third week, as students continued with 3D print prototyping, they also learned to design two-part molds at full scale and programmed them for CNC cutting from foam. The last two weeks were dedicated to casting and troubleshooting issues, such as adjusting material thicknesses to prevent breakage and reducing volume to speed up the curing process. Over two years, sixteen students participated in this project, and this paper documents nine of the water vessels they created.

Regarding analysis, surface continuity was crucial as it enabled the computation of surface slope and water volume percentages on the Rhino poly surface. The associated triangular surfaces' storage volume and slope increased when the point moved down. Horizontal shifts in the point altered the slope differently on shorter and longer ends. For fabrication, this continuity ensured that the geometry was “watertight,” facilitating easy 3D printing and CNC milling for two-part molds, regardless of geometric complexity, during the casting stages. This approach validated modeling techniques and encouraged further design exploration. Attention to sloped surface geometry, as opposed to vertical

extrusion, also improved the reliability of casting processes, doubling as draft angles to assist in releasing the cast vessels from the molds. The first iteration of water vessels included 3D-printed drain plugs, functioning like drains in a rain garden, with strategically placed outlets to release water slowly at specific vertical levels. However, this design element was phased out in the second vessel iteration of 2019.

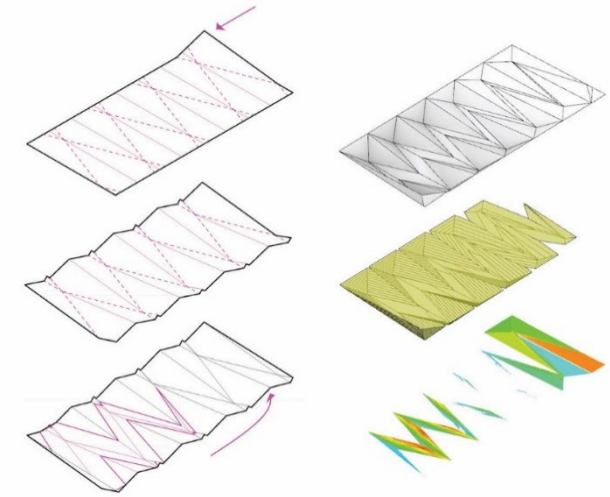

Figure 4. Water vessel 04 design process and computational analysis.
Image by Author and Gabrielle Rashleigh

RESULTS

Techniques typically used rational geometry networks of points, lines, and arc segments to define topographic conditions. The relationship between frameworks of lines and surfaces allowed a high degree of flexibility in form while maintaining geometric specificity. Repeatable operations with parametric variability also emerged (Figure 4). Vessel 01 utilized a continuous sloped surface spiraling down from the highest edges to a centralized low point. As a result, a single volume holds the water. Vessels 02 and 03 share this characteristic but rely on less geometric variability in their surface geometries. Vessels 04 and 05 utilize different densities of transverse modules shaped by triangular ridges and valleys. Vessel 06 depends on a series of offset rectangles with softened edges, sloping in alternating directions as they decrease in size, resulting in a series of disconnected water storage volumes. Vessels 07 and 08 rely on lofted surfaces networked with Bezier spline curves that undulate vertically and horizontally. Lastly, vessel 09 uses a series of radial lines originating from two opposite edges, which create a continuous valley defined by the intersection of alternating high and low points, which resemble an abstracted meandering river valley.

Students employed computational tools to analyze storage volume and surface slope at any point, aiding in iterative design processes—water storage analysis aimed for a target of 120 cubic inches, equivalent to four 500-milliliter water bottles. Slope analysis tools tested whether 30% of the surface area fell within the 0-10% slope range. This documentation covers nine of the sixteen water vessels to demonstrate how the final designs met the parameters. Seven of the nine met or exceeded the water storage requirements, while only two met the minimum threshold for accessible surface area. Although only one of the vessels achieved both (Vessel 02), the degrees of success varied across the nine, with some coming closer to the minimum requirements than others. Figure 5 illustrates all nine vessels from a top view. Each is accompanied by two vertical bars that indicate minimum

requirements for water storage and accessible area, and each vessel's measured statistics are displayed graphically. Each vertical increment for water storage is equivalent to 30 cubic inches (in^3) or one 500 milliliter water bottle. The vertical increments for the accessible area, measured as any surface slope of a particular water vessel between 0-10%, indicate 12.5% of the overall surface area. In addition, the list below provides the specific surface area percentage and storage volume (indicated as cubic inches using the in^3 unit descriptor) for each Vessel in Table 1.

Vessel #	AccessibleArea	Water Volume	Student Name
01	71%	88 in^3	Hannah Bannister (2019)
02	44%	180 in^3	Aaron LaGraize (2019)
03	25%	160 in^3	Seneca Gray (2019)
04	27%	180 in^3	Gabrielle Rashleigh (2019)
05	25%	148 in^3	Emma Olson (2019)
06	19%	160 in^3	LeBryant Bell (2020)
07	27%	100 in^3	Hang Liu (2019)
08	12%	84 in^3	Charles Jones (2020)
09	01%	215 in^3	Katarina Tomasito (2020)

Table 1. Vessel design data

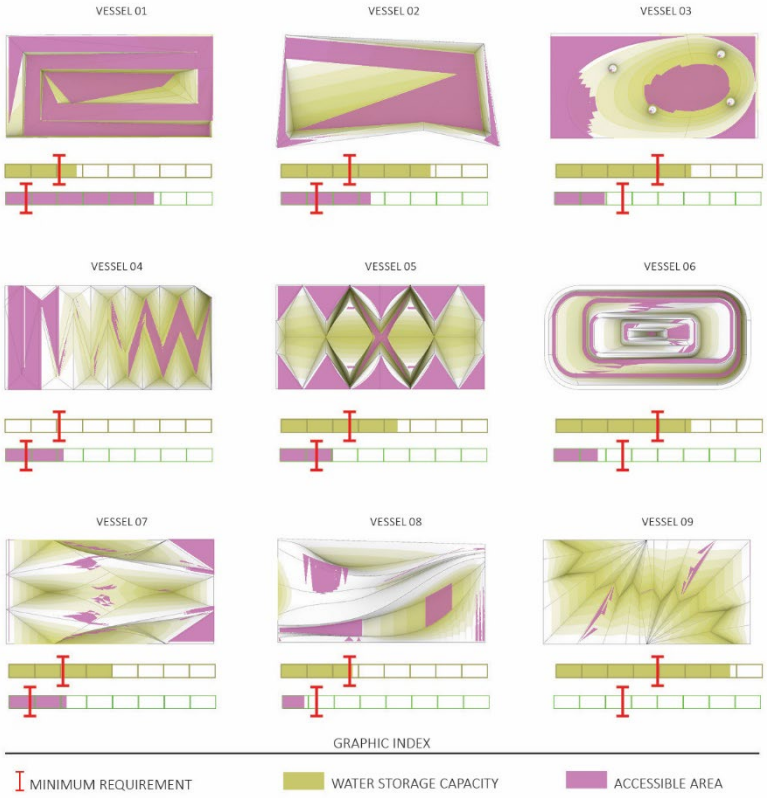

Figure 5. Design graphic docuemntation of water vessel storage capacity and accessible area. Image by Author

CONCLUSION

The project's results raise an ethical dilemma for students, as they must balance practical functionality with social responsibility in design. Specifically, the challenge of achieving adequate water retention and accessible surface areas prompts critical questions about whether the design should prioritize pedestrian interaction or maximize stormwater storage. This debate reflects broader discussions in urban design regarding the role of technology in shaping cities. Historically, urban networks, including water management systems, represented progress and modernist ideals. However, as these systems became hidden, their social and environmental significance waned, contributing to a disconnect in urbanization processes.

Anique Hommels' concept of obduracy is particularly relevant here, as it highlights the inherent resistance within urban planning frameworks to alter pre-existing courses. Once in place, these established systems become fixed and deeply rooted in their historical context, making change difficult. The project aims to challenge this obduracy by bringing surface-level stormwater systems back into visibility, thereby questioning the entrenched trend of burying essential networks. By confronting this resistance, the project seeks to shift the perspective on urban infrastructure from purely functional to recognizing its aesthetic and ideological roles. In doing so, it underscores that design is not just about solving technical problems but also about reshaping how we perceive and interact with the urban environment, challenging the immovable frameworks that have long dictated urban development.

NOTES

[1] Charles Jones and K. Tsubaki. “Resilience Reinforced: Performance of Surface Geometry for Climate-Adaptive Urban Surfaces.” ACSA/EAAE Teachers Conference, Educating the Cosmopolitan Architect. Reykjavik, Iceland. June 22-24, 2023. Proceedings. 412-419.
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[5] Charles Jones. “No Royal Roads: Diffusing the Constraints of Smoothness on Local City Streets” ASCA 110th Annual Meeting Empower. Virtual. May 18-20, 2022. Proceedings P. 661-668.
[6] Maria Kaika. “The Urbanization of Nature.” In City of Flows: Modernity, Nature, and the City. 11-26. (Routledge, 2005).
[7] Richard Campanella. “How Humans Sank New Orleans.” *The Atlantic*, February 7, 2018. https://www.theatlantic.com/technology/archive/2018/02/how-humans-sank-new-orleans/552323/.
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EPHEMERAL LANDSCAPES: CIVIC ENGAGEMENT FOR URBAN PERMEABILITY

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INTRODUCTION

Urban landscapes are confronted with a number of challenges associated with traditional impermeable surfaces, including the issues of water runoff, the formation of heat islands, and the fragmentation of habitats. Permeable surfaces offer a solution by allowing water infiltration, promoting biodiversity, and mitigating environmental impacts. Previous studies have highlighted the importance of permeable surfaces in urban environments for mitigating stormwater runoff[1] and enhancing ecosystem services.[2] Overviewing these studies and drawing upon the concept of *seed bomb*, this paper presents the first steps of an ongoing research which aims to integrate ceramic clay with seeds and herbs to create permeable tiles that support urban vegetation. The concept of *seed bomb*, originating from guerrilla gardening movements, encapsulates the idea of dispersing seeds within a protective casing to facilitate spontaneous vegetation. By applying this thinking to ceramic clay tiles, the paper explores the ways in which durable yet biodegradable surfaces can support plant growth, as studies have demonstrated the potential of incorporating vegetation into urban infrastructure to enhance ecological resilience[3] and urban aesthetics.[4]

METHODOLOGY

The research incorporates four different phases to conduct the experiments in the following order as (1) material selection, (2) experimental design, (3) tile fabrication, (4) field testing and lastly (5) civic engagement. Each phase feeds back into the other, ultimately leading to a non-linear approach that goes back and forth, learning and trying to find the best solution to produce the most suitable result and the easiest way to achieve permeable surfaces.

As for the material selection step, ceramic clay is chosen for its malleability, durability, and eco-friendliness. Seeds and herbs are carefully selected based on their ability to thrive in diverse environmental conditions, informed by studies on plant adaptation to urban environments.[5] In the experimental design step, controlled trials are conducted to determine optimal clay-to-seed ratios, herb combinations, and tile dimensions. Variables such as soil composition, watering frequency, and sunlight exposure are systematically manipulated, following methodologies outlined in previous research on green infrastructure. Tile fabrication step involved mixing ceramic clay with seeds and herbs, shaping the mixture into tiles, and allowing them to dry and cure. Quality control measures are implemented to ensure structural integrity and seed viability, drawing from established protocols for

ceramic production. Following these stages, the field-testing step involved installing prototypical tiles in outdoor environments to evaluate their performance under real-world conditions. Factors such as vegetation establishment, soil erosion prevention, and user experience are assessed through observational studies and user feedback, utilizing methodologies employed in previous studies on green infrastructure evaluation.[6] In the final step of the research, civic engagement was encouraged by incorporating a workshop with students to disseminate the work and share the information on a broader level. This helped to connect designers with users of the city.

Background on guerilla gardening and seed bomb

The literature review revealed a multitude of studies that prompted us to reflect on the existing knowledge in this field. In particular, the *seed bomb* concept was one of the studies that was closest to our research which became a starting point from which we could get different results. Drawing inspiration from the *seed bomb* concept, the research started with the aim to integrate ceramic clay with seeds and herbs to create permeable tiles that support vegetation and water infiltration. The rationale behind the development of these tiles was to create a versatile product that could be used for a variety of purposes. These included the ability to withstand human traffic, the provision of permeability on vertical and horizontal levels, and the facilitation of the addition of plant life to concrete surfaces without the necessity for substantial soil depth.

The *seed bomb* concept, originating from guerrilla gardening movements, encapsulates the idea of dispersing seeds within a protective casing to facilitate spontaneous vegetation. Guerrilla gardening, on the other hand, is described as the practice of planting and growing crops, flowers, or various plants on land without legal rights. Neglected or underused areas such as vacant lots, public parks, or abandoned properties are often the main targets of guerilla gardening to enhance the urban environment, increase green areas, promote biodiversity, and draw attention to the importance of urban agriculture and sustainable living. It also raises awareness of land use and property rights[7] as part of its political agenda.[8] Guerrilla gardening practice often plants flowers in neglected areas, but sometimes vegetables or other crops are incorporated. Compost or other organic matter is mostly used to improve the quality of the soil and often return to their land for watering plants, weeding, and general maintenance. Despite its benefits, guerrilla gardening faces challenges such as legal issues, lack of water resources, poor soil quality, and potential vandalism or removal of plants by property owners or municipal officials.[9]

The *seed bomb* concept however incorporates a specialized compound produced by forming small aggregates, termed as seed balls or bombs. These seeds are encapsulated within a blend of clay and compost. The clay helps protect the seeds from being eaten by birds or insects and provides a small amount of moisture to aid germination, while the compost supplies essential nutrients for the seeds as they begin to grow. The objective is to disperse them onto the land, allowing them to disintegrate, germinate, and develop into plants. Seed bombs represent an efficient and straightforward approach to introducing vegetation to areas that are out of reach or where traditional planting methods are impractical. They are commonly employed in guerilla gardening to expediently and inconspicuously sow seeds in urban settings.[10] Together, guerilla gardening and seed bombs empower individuals to take direct action to improve their communities, promote biodiversity, and foster a greater connection with nature.

Adaptation of seed bomb concept: Material selection

By adapting these concepts into ceramic clay tiles, the project seeks to create durable yet biodegradable surfaces that support plant growth. Previous research has demonstrated the potential of incorporating vegetation into urban infrastructure to enhance ecological resilience[11] and urban

aesthetics.[12] We started with very simple experiments in the laboratory of Izmir University of Economics, by conducting basic experiments in the lab. The question that intrigued us the most was *what kind of seed bomb could be formed to achieve our goals. What kind of seed tile could a seed bomb be?*

The initial stage of the experimental process involved the selection of appropriate materials. It was decided that ceramic clay, in both its solid and liquid forms, would serve as the primary binder. Ceramic clay is chosen for its malleability, durability, and eco-friendliness. Seeds and herbs are carefully selected based on their ability to thrive in diverse environmental conditions, informed by studies on plant adaptation to urban environments.[13] A variety of combinations were employed, utilizing quinoa and lentil seeds.

Playing with seeds and clay: Experimental Design

Controlled trials are conducted to determine optimal clay-to-seed ratios, herb combinations, and tile dimensions. Variables such as soil composition, watering frequency, and sunlight exposure are systematically manipulated, following methodologies outlined in previous research on green infrastructure.[14] The mixture was augmented with an assortment of seeds and supplementary binding agents, including straw and sawdust. Additionally, perlite was incorporated into the mixture.

Forming the bombs: Tile Fabrication

The process involves mixing ceramic clay with seeds and herbs, shaping the mixture into tiles, and allowing them to dry and cure, as illustrated in Figure 1. Quality control measures are implemented to ensure structural integrity and seed viability, drawing from established protocols for ceramic production.[15] A tile form was created by pouring the liquid clay into triangular gypsum molds. Triangles were selected for their versatility in achieving a variety of patterns through combination. The solid clay was also hand-shaped into triangles or processed by filling it into the same molds. The tiles were then placed in the university garden and subjected to irrigation. One section was covered with a membrane underneath, while the other was left directly in the soil.

The best results of the tiles we made by hand came from those we left in the ground, as illustrated in Figure 2. The tiles were not scattered, and they bloomed easily. Especially, the tiles we mixed with lentils grew very quickly. In addition, due to its liquid clay content, it gave a much more sensitive result and broke than solid clay. We especially observed that lentil seeds were very strong-rooted and cracked without good binders. The smaller size of quinoa seeds results in weaker roots that spread over the entire surface and cover the tiles more effectively.

Figure 1. Experiments with liquid clay, lentils and mixed seeds.

Figure 2. First experiments of vegetated tiles with quinoa seeds.

Experimenting in an un-tiled fashion: Field Testing

In the subsequent phase of the experiment, a liquid mortar was obtained and applied to the aerated concrete blocks. The seeds and liquid clay mixture were then used, but no greening was achieved. The most successful outcome was achieved with the combination of solid clay and quinoa seeds. Upon completion of this phase, we proceeded to the expansion phase of the project within the city. We identified impermeable, low-depth concrete surfaces in our neighborhood in the Bostanlı district of Izmir. Given that conventional shrubs are unable to thrive on these surfaces, which are insufficiently deep for the soil height, this application seemed a logical choice. Our objective was to place the tiles we had manufactured and observe the results obtained with natural irrigation.

Prototypical tiles are installed in outdoor environments to evaluate their performance under real-world conditions. Factors such as vegetation establishment, soil erosion prevention, and user experience are assessed through observational studies and user feedback, utilizing methodologies employed in previous studies on green infrastructure evaluation. The seeds underwent rapid germination within a few weeks, and as they melted with the precipitation, they assumed the shape of the container and developed a smooth green surface – as illustrated in Figure 3. It was observed that the tiles attracted stray animals. While animals could destroy a normal on-ground seed application, the tiles protected the seeds and prevented them from being dispersed or consumed.

Figure 3. Field Testing.

Empowering Users: Civic Engagement

Subsequently, the project proceeded to the dissemination phase. At this juncture, a workshop was conducted with high school students who expressed an interest in design as part of the Design Days initiative of the university, as illustrated in Figure 4. The workshop also attracted a lot of interest from university staff (Figure 5), so it was opened up to them as well. This interaction with a variety of people also helped to disseminate the work and knowledge on a broader scale. This facilitated interaction between designers and users of the city.

A variety of tile alternatives were considered, and the potential combinations of different types of clay with which they could be used in the soil were calculated (Figure 6). Furthermore, this stage sought to enhance the visual appeal of the project. At this juncture, it is essential to consider the fact that certain locations may have varying hues of mud, the intended distribution of seeds, and the optimal configuration for the selected surface.

Figure 4. Civic Engagement through the workshop.

Figure 5. Civic Engagement through the workshop.

Figure 6. Workshop materials: various types of clay, seeds and soil.

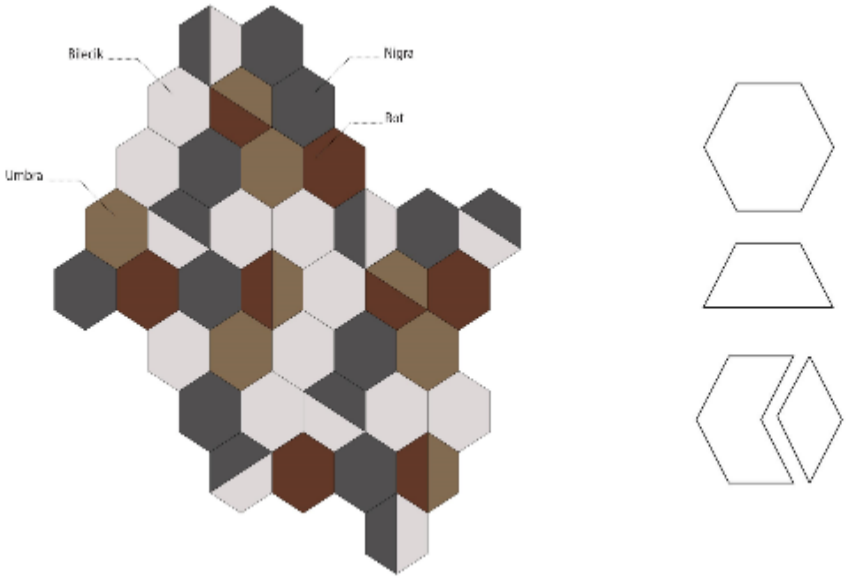

Figure 7. Tile pattern alternative 1.

In the study, which involved approximately 15 students, the students initially prepared mixtures comprising different clay types, which they subsequently placed on the patterns that had been printed, as illustrated in Figure 7. The objective was to disseminate the methodology and enable students to replicate the production process in their communities. Subsequently, the prepared tiles were positioned on the gravel floor of the roof garden, as illustrated in Figure 8. As a consequence, the objective of greening the area was not achieved due to the lack of precipitation during the summer months.

Figure 8. Testing the tiles on the roof garden of the university.

CONCLUSION

The study outcomes can be elaborated under three main topics: functional permeability, biodiversity enhancement, and user empowerment. As for functional permeability, the developed tiles have been shown to have the capacity to absorb water, facilitate plant growth, and withstand pedestrian traffic, thereby offering a sustainable alternative to conventional paving materials. This finding is consistent with the results of previous research on permeable pavements decreasing the heat island effect[16]. The tiles have the potential to enhance biodiversity and contribute to ecosystem resilience, pollinator habitat creation, and aesthetic diversity within urban landscapes by supporting indigenous plant species. This is consistent with the objectives of urban greening initiatives.

The project provides comprehensive guidance for replicating the experiment and customizing tile designs, fostering innovation and collaboration in sustainable landscape design. This approach draws from participatory design methodologies[17] and community engagement strategies in urban planning[1]. A preliminary examination of the results of the study, particularly because this is the initial phase of an experimental process, suggests that the optimal results may be attributed to the significance of application in the appropriate season and an outdoor setting. It was observed that the seeds produced favorable outcomes when the appropriate mixture was identified and applied at the optimal time of year. The seeds demonstrated effective adhesion to surfaces, rapid absorption when in soil, and green growth on concrete, even when combined with water. During the workshop, the subject matter aroused considerable interest among the students. It was evident from their enthusiasm and engagement that the project could yield promising outcomes in subsequent stages of public dissemination. Subsequently, the intention is to bake the tiles, insert the seeds at a later stage, and experiment with binders such as perlite to ascertain the most effective method of germination. The outcomes of the study underscore the multifaceted benefits of integrating ceramic clay tiles infused with seeds and herbs into urban landscapes. From functional permeability to biodiversity

enhancement and user empowerment, these innovative surfaces offer a holistic approach to sustainable urban design, paving the way for greener, more resilient cities.

Overall, through the fusion of ceramic clay with seeds and herbs, this project seeks a bottom-up approach in creating permeable surfaces, where functionality converges with ecological integrity. By sharing findings and methodologies, the project aims to inspire future generations of designers and practitioners to embark on their journeys of experimentation and discovery in sustainable landscape design, informed by interdisciplinary perspectives from ecology, material science, and urban planning.

It combines functionality with ecological integrity, creating a balanced relationship between human structures and natural environments. By carefully documenting research and techniques, the project serves as a source of inspiration for future designers and professionals. It aims to promote collaboration and knowledge-sharing to inspire a passion for exploring innovative sustainable landscape design. By incorporating insights from various disciplines such as ecology, material science, and urban planning, the project drives the advancement of sustainable design practices and encourages individuals to experiment and discover. The effects of this project are expected to bring significant changes in how we design and live in built environments, guiding us towards a more harmonious relationship with nature.

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EXPLORING WEATHER COMMONING WITH C.A.R.E: REFLECTIONS FROM A PILOT PROJECT OF CRITICAL ART, RESEARCH AND EXPERIMENTATION WITHIN JAPAN'S MOONSHOT GOAL 8 PROJECT FOR WEATHER CONTROL

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INTRODUCTION

Extreme weather events are increasingly frequent and severe,[1] and some governments are exploring local weather modification technologies. In Japan, the Moonshot Goal 8 project aims to create a society safe from extreme winds and rains through weather control by 2050.[2]

The Weather Commons Research Group at Ehime University, led by co-author Tsuyoshi Hatori works within the Heavy Rainfall Control project led by Kosei Yamaguchi from Kyoto University. The project aims to manage extreme rain using devices like ocean turbines, kite-curtains, cloud seeding, and urban fans. Our focus is on researching regional collaboration for implementing these technologies and developing the concept of a 'weather commons' to balance society, nature, and weather control.[3]

As weather technologies and their social implementation evolve to shape future human-weather relationships, we should consider how and when to use them and who should decide—experts and governments, or a more collective approach?

A weather commons approach can illuminate the complex relationships between people and weather that may be overlooked by purely technocratic methods. It allows for critical examination of technocratic solutions by emphasizing the practices of commoners who live with the weather. It also can provide guidelines for collaborative practices, uniting governments and local communities to tackle extreme weather events.

As part of our initial explorations into "what a weather commons could be" and to contribute to the development of a shared yet emergent weather commons framework we brought independent artist-researchers into conversation with the Weather Commons Research Group for a pilot Artists in Weather Commons project of critical art, research and experimentation (C.A.R.E.)

This paper starts with an introduction to the role of creative practice in research and a project overview, and then features documentation-vignettes from participating artists Adam Ben-Dror, Rumen Rachev, Marie Aoun, and Xin Cheng to illustrate their residencies. We conclude with preliminary insights before concluding with tentative future directions and an invitation for collaboration.

THE POTENTIAL OF CREATIVE PRACTICE IN RESEARCH

What is the goal of our research? Some of us aim to discover, some to understand, others to experiment, and many of us seek to drive change. Creative practices can aid in all these goals. Through the lens of Donella Meadows' leverage point concept[4] we can argue that creative practice can achieve what traditional research often struggles with: effective interventions for change. While much research focuses on measurable outcomes, creative practice introduces space for alternatives and new ideas by engaging with rules, questioning goals, and challenging mindsets.

How do we adapt to cities that regularly flood? Can we envision cities designed not only for humans but for resilience? These questions challenge traditional research approaches and require intervention in multiple areas. Urban planning that integrates adaptive strategies, community input, and innovative design to create resilient, multifaceted solutions is but one example.

Creative practices can be both insightful and a leverage point for change but one challenge when working with them is evaluation and shared frameworks for discussion. In this context, the CreaTures Framework,[5] a new tool for evaluating creative practices in research, is promising. While space limitations mean that we will only provide a brief reflection on Artists in Weather Commons through this framework in the next section of this paper, it offers a useful lens to keep in mind as you read about the works of the participating artists.

The CreaTures Framework, developed with practitioners, researchers, and funders, includes nine dimensions in three categories of change: changing meaning (embodying, learning, imagining); changing connections (caring, organizing, inspiring); changing power (co-creating, empowering, subverting). It helps evaluate how creative practices might transform societal imaginations and develop new capacities for individual and collective imagination.

In summary, as we navigate a stormy world, we believe that creative practices are essential for keeping our research engaging, meaningful, and playful.

OVERVIEW OF CRITICAL ART RESEARCH AND EXPERIMENTATION (C.A.R.E.) FOR ARTISTS IN WEATHER COMMONS

We used critical making as the foundation for exploring creative practice in weather commons research. Critical making integrates the “know/understand” focus of social scientists with the “make, do, and make-do” approach of artists and designers, bringing together researchers, artists, designers[6].

Despite being a short-term pilot project, our goal was to foster a space of care through collaborative making, cross-pollinating conversations, and diverse public activities. We aimed to engage existing concepts and theories in critical dialogue through iterative prototyping, leading to new insights into the emergent concept of the weather commons (Figure 1).

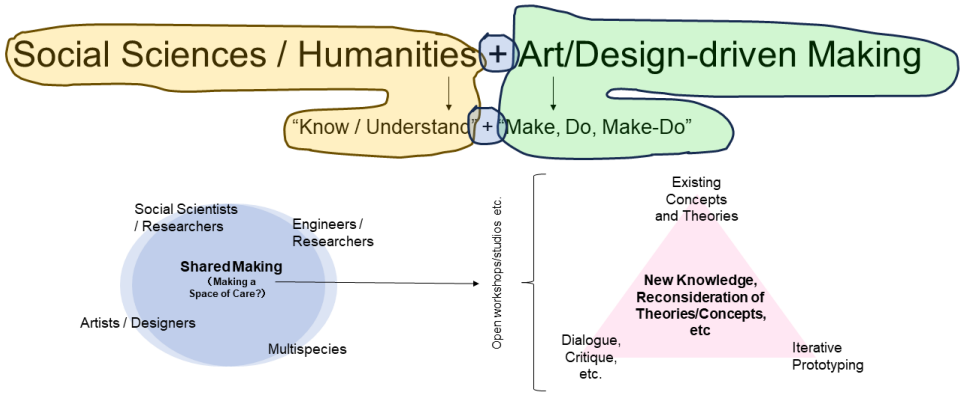

Figure 1. Artists in Weather Commons overview

The project invited four creative practitioners to freely interpret and play with the concept of "weather commons" in cross-pollinating conversation with the lead Artists in Weather Commons researcher (lead author Chris Berthelsen) (Figure 2). Creative technologist Adam Ben-Dror developed *Cloud MillionAIRe*, an evolving speculative ethnographic project blending real and fictional elements. Institutional performance dancer and crucial European artist Rumen Rachev came up with *Performing the Weather*, an iterative weather-commoning performance across the city. Natural perfumer Marie Aoun created *Smelling the Weather (Volatile Molecules)*, a deep dive into the conceptual and practical aspects of scent as it relates to the weather. Finally, polymathic artist and designer Xin Cheng contributed *Tuning into the Weather (What Could be a Weather Sommelier?)*, a generative series of discussions and walks.

Figure 2. Four cross-pollinating projects

As space limitations permit only brief reflection on the project through the lens of the CreaTures Framework Table 1 presents a summary of a tentative analysis carried out solely by the lead author, reflecting on his involvement.[7] Note that the dimensions aren't a required checklist for evaluating creative practices and that practices that don't engage with all dimensions aren't inherently inferior to one that does. They're meant to spark discussion and highlight aspects that might otherwise be overlooked.[8]

Category	Dimension	Comments
Changing Meaning	Embodying	Strong focus on embodiment in all projects brought out broad plurality of approaches to "being with" the weather.
	Learning	Participants questioned some of their basic assumptions, but this has not been conveyed or transferred to the wider research group. How can we encourage social learning?
	Imagining	Wild, unexpected, and often difficult to comprehend/handle imaginaries were brought forth.
Changing Connections	Caring	Developed and dug out new ways of caring for, about, and with the weather.
	Organizing	Low immediate focus on creating structures for collaboration but many outputs/activities could be the foundation for such structures in future iterations.
	Inspiring	Inspired those directly involved and one-step removed in individual small group interaction. Explore scaling "out", "up", "across", and "through"[9] in the future.
Changing Power	Co-creating	Several communication tools/methods for co-creation were developed and tested "in the wild" but their use remains at the level of the immediate participants.
	Empowering	Little evidence at this stage but the emotional energy of the creative practitioners and lead researcher that was fueled by working within this project bears further consideration, as does the issue of discursive power.
	Subverting	Evidence of potential for "quiet" or "modest" subversion[10] as documentation filtered through presentations at higher and more engineering-focused levels of the wider Moonshot project. Care needs to be taken with regard to precarity of minority participants who are fulltime contract workers within the project.

Table 1. Summary of tentative CreaTures Framework analysis

The next section presents four free-form documentation-style vignettes from the work of the four participating artists. To preserve the voices of the artists they have been included with a minimum of editing.

ARTISTS IN WEATHER COMMONS DOCUMENTATION-VIGNETTES

Cloud MillionAIRe: A Real and Increasingly Fictional (and then Increasingly Real) Ethnography (Adam Ben-Dror)

My investigation of the remains of the Cloud MillionAIRe's abode after the devastation of a freak electrical storm uncovered myriad fragments and items.

We do not have time to go into them in detail here, but I will present three.

One: A Cloud Golem falls to earth as a guardian spirit roaming a place called Omaha which is populated by Richlist Minecraft Copyright Infringement Holiday Homes which are built on cultural appropriation (Figure 3). The Cloud Golem shows a sense of dismay which is evidenced by it being perturbed by the imbalance caused by extractive capitalism in the area.

The Cloud Golem must bless ALL!!!!

Figure 3. A cloud golem blessing Richlist Minecraft Copyright Infringement Holiday Home built on cultural appropriation

Two: The Cloud MillionAIRe was working on a camera specifically designed to capture photos of clouds. It enables you to become a millionaire with the things around you, like clouds and ewaste cameras.
The camera is always pointing up towards the sky. You kiss or lick the cloud via exposed wires connected to the shutter mechanism to take a photo and “capture” the cloud (Figure 4).

Figure 4. Camera for tasting/kissing the clouds

Three: The Cloud MillionAIRe invited its friends, some “exiles” from Gauteng in South Africa, to play a game of “cloud oracle” (Figure 5).

They took turns, throwing the felted clouds onto the play surface of cloud imagery. They used the position where the cloud landed to divine answers to life questions and threw multiple clouds onto the play surface to get more information.
At one point they were blessed with a vision of the “cloud prophet”.
Unfortunately, the camera was not rolling at that point but it was a “wonderful” moment that was influenced by the Cloud MillionAIRe’s mother’s ancestral rituals.

Figure 5. Playing “Cloud Oracle”

PERFORMING WITH WEATHER COMMONS (RUMEN RACHEV)

My tenure as an Artist in Weather Commons was a stimulating experience that deepened my understanding of what a weather commons and its societal implications could be. The activity “Build a Moon, Build a Weather Commons” (Figure 6) encouraged free exploration and creativity, sparking my imagination. My key question was: “What do I truly desire from the weather?” This goes beyond personal preferences to include the responsibilities I have toward the weather - “What might the weather desire from me?” Playing this activity forced me to challenge my views. Why is sunshine often linked to happiness while rain is associated with sadness? I began to question cultural biases and recognized that weather perceptions can vary widely. It made me rethink what “normal” weather is.

Figure 6. Playing "Build a Moon, Build a Weather Commons"

Reflecting on "good" versus "bad" weather, I questioned my own desires: Do I crave more sunshine, or do I value rain? This led me to consider the reciprocal nature of our relationship with weather. If we ask for "good" or "bad" weather, what might the weather seek from us in return? Could it desire a particular response from humanity, whether "good," "bad," or "mild"? Exploring these ideas encourages a deeper engagement with weather, urging us to view it as a dynamic, interactive element of our existence that shapes and is shaped by our actions, communities, and environments.

We also explored language. The term "weather literacy"[11] came up while playing "Build a Moon, Build a Weather" implies the existence of "weather illiteracy," raising critical questions about how to address disparities if we aim to build a collective weather commons. How can we educate the public about this concept if many are unaware of their own weather literacy? Establishing a community requires fundamental literacy but sometimes illiteracy can be useful: As co-author Chris Berthelsen questioned: "Is the first tragedy of the weather commons the moment we are forced to see weather as a collective resource?"

The activity/performance "Weather Chances: Roll the Weather Dice" under a trig station (Figure 7) explored parallels between gambling and weather forecasting. These domains appear distinct - gambling is driven by chance, while weather forecasting relies on science. Yet, both are unpredictable. In gambling, chance can drastically shift outcomes while minor atmospheric variations can alter the weather.[12] Meteorologists, like gamblers, navigate uncertainty, and the Moonshot Goal 8 project wrestles with chaos theory.[13]

Figure 7. Performing "Weather Chances: Roll the Weather Dice"

Reflecting on my residency, I see how gambling and weather forecasting both highlight the role of chance in prediction (Figure 8). This experience reshaped my view of weather and its uncertainties. As we confront climate change, recognizing environmental fragility helps us better coexist with our surroundings. Ultimately, we are the weather, and the weather is us… or rather, we are all weather.

Figure 8. Gambling with and within the weather

SMELLING THE WEATHER: VOLATILE MOLECULES (MARIE AOUN)

Our sense of smell is truly ancient. This is borne out by anthropological findings and classical literature.

Upon being lodged in our nasal fossae, the scent particles communicate directly with the amygdala. This little almond-shaped part of our brain resides within the limbic system. It is our primal nerve centre: where emotions (both fear-based and pleasure-based), memory and even sexual urges reside.

The fact that our scent receptors bypass our conscious brain is just as well, since we need to free up this part of our brain to sight and sound and goes a long way to explain the intangible nature of scent. Studies estimate that the human noses are able to distinguish between 80 million smells and a

thousand trillion smells, which is indicative of the load that our noses are saddled with at any particular point in time.

In “The Sense of Smell” Bedichek writes: “Let not the stillness of this innocent rural air deceive you for it is as full of nasal talk and back talk as it is of that auricular babble of television and radio which require only the random fingering of your dial to break the stillness with a crashing cacophony of sound.”[14] Add to this that smells are carried on the in-breath and released immediately after. They are flighty and elusive. Those who wish to pin them down are obliged to quiet their minds and focus their attention on the ephemeral, rendering the act of smelling a form of meditation.

Finally, the odor molecules that we smell come from the inner substance of the things that we smell.

In “The Smell of Fresh Rain” Shaw writes, “Sight gives us superficial qualities like shape and colour, sound gives us the vibration of air around things; but smell gives us volatile fragments of the thing itself”.[15]

I have therefore introduced volatile molecules that capture the forces of the weather and delivered them to the weather modification scientists and engineers in tiny bottles (Figure 9). I would be pleased if they could occasionally smell them while they work on regulating the weather. This would not just serve to remind them of the physical thing itself in a visceral way but to also enable the weather to affect the scientists and engineers on a subconscious level.

I have created five scents - two bottles of 10ml of each, since little is required. They capture the various phenomena discussed earlier: geosmin; ozone; petrichor; sweating plants; and white floral carried by a breeze.

Figure 9. Ingredients for capturing the weather

TUNING INTO THE WEATHER, WITH YOUR OWN UNIQUE AND INTRICATE HUMAN-BODY (A.K.A. WHAT COULD BE A WEATHER SOMMELIER?) (XIN CHENG)

'Your body loves breathing... the river of breath'

'Feeling your body like a log lying on the forest floor... your body is mother nature...mother nature lying in mother nature' (Figure 10)

I hear this in the yoga sessions offered by the School Yoga Project[16]

Figure 10. Xin Cheng tuning into the weather

Over the past few months, I have been tuning into the Tuis (a native NZ bird) in my neighborhood.
It started with me trying to record their singing for a film.
They like to sit on the big trees above our house. Trees planted over 60 years ago by our elderly neighbors.
The tui has very distinctive songs. They like to sing in a couple of rhythmic notes, in the dark, before the sun rises. They are very aware of their surroundings, even in the dark. Somehow whoever was singing always flew away when I walked out with my recording gear. Or I would get up too late, then the song thrushes, rosellas and mynas would take over.
Now my ears seem attuned to the tui calls, I wake up in the dark, before 6am, and hear them. Like a very subtle alarm clock.
I have also noticed, over the past month or so, since the prunus trees have been bursting with magenta and pink flowers on the volcano across the creek (Ōwairaka) that there have been a lot more tuis around. As I bike up the shoulder of Ōwairaka to go to work in the mornings, I would find them feeding on the trees and singing.
The other morning I saw around 15 tuis on a single tree covered in magenta flowers.
That was only sound and sight. We also have other senses in our body.
Traditional Chinese medicine considers the '7 pores' 七竅 on our head as being interconnected to our 五臟 (5 organs): nose - lungs; tongue - heart; eyes - liver; mouth - spleen; ears - liver 精氣 or spirit/energy circulates between them. We breathe in qi氣, which also means energy, they are constantly in flux, within and without our bodies.[17]
There is a calligraphy by the Zen master Thich Nhat Hanh: 'Smile to the cloud in your tea.'[18]
When you drink a cup of tea, you are drinking the cloud. The cloud is becoming you.
What would happen if we gave the more-than-human we live amongst the same kind of mind-body-full attention that we currently devote to screens?

DISCUSSION: PLURAL WEATHERS AND CRITICAL PLAY (AN ALTERNATIVE GAME THEORY FOR COMMONING?)

Plural weathers

The pilot Artists in Weather Commons project led us to consider "weathers" in the plural. The artists' diverse practices showed that a singular view of weather fails to capture the complexities of human-environment interactions. Each contribution demonstrated that weather is more than an objective scientific phenomenon; it is a rich tapestry of experience and critique. This highlights that singular narratives often overlook the varied local contexts and emotional landscapes tied to different weather experiences.

Bringing a pluriversal[19] perspective to the wider weather commons research project makes space for and encourages diverse and inclusive discussions on weather modification and its societal implications, helping us to imagine alternative and speculative strategies for weather management, valuing local knowledge, community practices, and emotional responses. It challenges prevailing technocratic narratives and encourages deeper understanding of how societies can collectively address climate change and extreme weather.

Critical play (an alternative game theory for commoning?)

We started the Artists in Weather commons through the lens of critical making[20] but what emerged was more like critical play. While critical making focuses on the hands-on creation of artefacts and the ways these artefacts reflect and interrogate the conditions of their production critical play emphasises the importance of playful exploration and the ways in which play can be used to challenge norms, question assumptions, and explore new possibilities.[21] It involves creating spaces where rules are flexible and experimentation is encouraged, leading to new insights and perspectives.

The word play is often paired with "game". This is useful in our exploration of the weather commons because mainstream commons theory à la Ostrom[22] utilises game theory as a way to analyse how individuals make decisions with regard to scarce common resources, resulting in the design of institutions (rules, norms, and strategies) to govern appropriation. In Carse's[23] language such institutions (and game theory in general) can be viewed as "finite games" with fixed rules, clear distribution of resources, and definitive endpoints. In contrast, we view the critical play in this project as an alternative type of game theory, with properties of Carse's "infinite game".[24] Key principles of the "infinite game" (as opposed to finite games) that are relevant here include:

- Endless play: The only goal is to keep on going.
- Fluid and open participation: No entry/exit barriers.
- Evolving rules: Rules can be changed to keep on playing and bring new participants in.
- Continuous learning: Participants must continue to learn as rules and participants change.
- Intrinsic motivation: The game is played for joy and engagement, not external rewards or victory.

LIMITATIONS/FUTURE DIRECTIONS

This exploratory pilot project opened up many areas for future development and had plenty of limitations which indicate possible future directions. Based on the tentative CreaTures analysis (Table 1) some key areas are as follows.

First, there is ample opportunity to broaden the speculative horizons further. Future iterations should actively encourage more radical imaginings and interdisciplinary approaches that transcend traditional boundaries, inviting a wider array of speculative practices. At the same time, more attention could be paid to modes of communicating the activities to others.

Next, despite the diverse backgrounds of the participating artists, there is always room for more diversity. Broadening the range of voices and perspectives (e.g. identity, geographical, social, and

disciplinary backgrounds) will enhance the discourse and better reflect the varied realities of weather experiences across cultures and contexts.
Moreover, integrating quantitative and other methods from different disciplines could enable a richer analysis of weather impacts. An interdisciplinary framework that combines artistic exploration with empirical research will enhance the depth and rigor of future discussions.
Looking forward, Artists in Weather Commons could establish collaborative platforms that promote dialogue among artists, scientists, policymakers, and community members.[25] Such platforms can foster co-creation and stimulate innovative strategies for weather management that are inclusive and socially accountable.
Additionally, it is important to develop educational initiatives that enhance both weather literacy and illiteracy within communities, empowering individuals to engage actively in discussions about the complexities of weather and its socio-political implications.
Finally, expanding the weather commons framework to encompass a wider range of environmental phenomena and speculative narratives will deepen our understanding of the interplay between weather and climate systems and social dynamics. By continuously challenging and reframing our weather perceptions, we can more effectively and pleasurably live with extreme weather events.

INVITATIONAL CODA

This is just an initial step in our journey to develop practical and theoretical convivial weather commoning approaches. If you've reached the end of this article, we're delighted! Please feel free to contact us at the Weather Commons Research Group—we look forward to playing and collaborating together!

NOTES

[1] Eduardo Lastrada, Guillermo Cobos, and Francisco Javier Torrijo, “Analysis of Climate Change’s Effect on Flood Risk. Case Study of Reinosa in the Ebro River Basin,” Water 12, no. 4 (2020): 1114, https://doi.org/10.3390/w12041114.
[2] "Moonshot Goal 8: Realization of a Society Safe from the Threat of Extreme Winds and Rain by Controlling and Modifying the Weather by 2050," Japan Science and Technology Agency, accessed August 28, 2024, https://www.jst.go.jp/moonshot/en/program/goal8/.
[3] "Progress Report: Heavy Rainfall Control for Living Together with Isolated-Convective Rainstorms and Line-Shaped Rainbands [1] Development of engineering methods based on numerical computations," Japan Science and Technology Agency, https://www.jst.go.jp/moonshot/en/program/goal8/appeal/83_yamaguchi_ap01.html, accessed August 28, 2024.
[4] Donella H. Meadows, "Places to Intervene in a System (in Increasing Order of Effectiveness)," Whole Earth, Winter (1997): 78–84
[5] Joost M. Vervoort et al., “9 Dimensions for evaluating how art and creative practice stimulate societal transformations,” Ecology and Society 29, no. 1 (2024), https://doi.org/10.5751/ES-14739-290129.
[6] Matt Ratto, “Critical Making: Conceptual and Material Studies in Technology and Social Life,” The Information Society 27, no. 4 (2011): 252–260.
[7] We plan a fuller discussion in future publications.
[8] Joost M. Vervoort et al., “9 Dimensions for evaluating how art and creative practice stimulate societal transformations,” Ecology and Society 29, no. 1 (2024), https://doi.org/10.5751/ES-14739-290129.
[9] Joost M. Vervoort et al., “9 Dimensions for evaluating how art and creative practice stimulate societal transformations,” Ecology and Society 29, no. 1 (2024), https://doi.org/10.5751/ES-14739-290129.
[10] This is also characteristic of most of the projects that were analyzed in the development of the CreaTures Framework.
[11] See e.g. Nadine Fleischhut, Stefan M. Herzog, and Ralph Hertwig, “Weather Literacy in Times of Climate Change,” Weather, Climate, and Society 12, no. 3 (2020): 435–452.
[12] Tim Palmer, “The Real Butterfly Effect and Maggoty Apples,” Physics Today 77, no. 5 (2024): 30–35.
[13] ムーンショット型研究開発事業@JST, “Moonshot goal 8 : PD portfolio,” *YouTube Video*, 7:04. Published March 17, 2023, https://www.youtube.com/watch?v=mBe_I0qgCG8.
[14] Roy Bedichek, *The Sense of Smell* (New York: Doubleday & Company Inc., 1960).
[15] Barney Shaw, *The Smell of Fresh Rain* (London: Icon Books Ltd., 2018)
[16] “Landing Page,” Heart of Yoga, accessed August 29, 2024, https://www.heartofyoga.com/yes.
[17] “《中醫詞典》解釋「七竅」的意思,” 雲端中醫, accessed August 29, 2024, https://cloudtcm.com/dic/10720.
[18] “Drinking a Cloud with my Sangha,” Opening Heart Mindfulness Community, accessed August 29, 2024, https://www.openingheartmindfulness.org/weeklytopic/drinking-a-cloud-with-my-sangha.
[19] Ashish Kothari et al., eds., *Pluriverse: A Post-Development Dictionary* (New Delhi: Tulika Books; AuthorsUpFront, 2019).
[20] Matt Ratto, “Critical Making: Conceptual and Material Studies in Technology and Social Life,” The Information Society 27, no. 4 (2011): 252–260.
[21] Mary Flanagan, *Critical Play: Radical Game Design*, 1st ed. (Cambridge, MA: MIT Press, 2009).
[22] Elinor Ostrom, *Governing the Commons: The Evolution of Institutions for Collective Action*, Canto classics ed. (Cambridge: Cambridge University Press, 2015).
[23] James Carse, *Finite and Infinite Games* (New York: Free Press, 2011).
[24] James Carse, *Finite and Infinite Games* (New York: Free Press, 2011).
[25] One example of a potential structure is the Urbanist School run by For Cities https://www.forcities.org/school/.

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“DE-TEACHING” WEATHER LITERACY AS A FORM OF CONVIVIAL WEATHER COMMONING: EARLY INSIGHTS INTO ADAPTING THE THERAPEUTIC PRACTICE OF TŌJISHA-KENKYŪ (当事者研究) FOR THE AGENCY OF VULNERABLE COMMUNITIES IN THE CONTEXT OF EXTREME WEATHER EVENTS

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INTRODUCTION

This paper presents a case study of “de-teaching” weather literacy as a form of convivial weather commoning that emerged out of an early attempt at adapting the therapeutic practice of tōjisha-kenkyū (当事者研究) in the classroom at an intermediate school in Aotearoa as part of our activities and research as part of the Weather Commons Research Group.

At the time of writing, we are one and a half years past the worst floods in recorded history in Tamaki–Makaurau (Auckland), Aotearoa New Zealand (Figure 1). The rain was worse than the National Institute of Water and Atmospheric Research’s worst forecast for a 1-in-250-year storm event, damaging thousands of homes.[1] The first author’s home was partially flooded and semi-uninhabitable for over 9 months until repairs were completed.

The supermarket near my house.

Source: https://www.reddit.com/r/auckland/comments/10mtcd9/where_the_hell_is_noah_with_his_ark_everyone_ok/

Our local sports centre.

Source: https://rangitoto-observer.co.nz/massive-flood-damage-disrupts-shore-sports/

Figure 1. 2023 Auckland Anniversary Weekend Storm near co-author’s home

In another hemisphere, we are working within the Weather Commons Research Group at Ehime University, Japan, as part of the Moonshot Goal 8 project which aims to create "a society safe from the threat of extreme winds and rains by controlling and modifying the weather by 2050".[2] Our focus is on developing and operationalizing the concept of "weather commons" in the context of the weather calming technologies being developed in Moonshot Goal 8. We also integrate Illich's concept of "conviviality," which emphasises autonomous and creative interaction among individuals and between individuals and their environment,[3] into our approach.

One practice with a convivial commons-based flavor is tōjisha-kenkyū, a radical therapeutic research practice developed by and for vulnerable communities in Japan.[4] Initially created within Japan's institutionalized mental health system, its use has since expanded into fields such as autism, depression, robotics, communication theory, and language teaching. Its key innovation is that the research is conducted by, rather than on, the concerned parties, shifting from a therapy-focused to a research-focused method for addressing individual and group difficulties. While there is evidence of its usefulness in disaster contexts[5] further research is needed.

In this context, we have been exploring how tōjisha-kenkyū might be used by vulnerable communities to live as "convivial weather commoners" who have agency and self-determination in living with (preparing for, encountering, and recovering from) extreme weather events. This paper presents a case study of early activities at an intermediate school in Aotearoa New Zealand.

The next section introduces the concept of convivial weather commons. The subsequent section focuses on tōjisha-kenkyū and its potential for fostering togetherness through experiencing rather than eliminating disaster. We then present the case study of "de-teaching" weather literacy as an emergent form of weather commoning in a school setting. We conclude with final remarks and an invitation.

A CONVIVIAL WEATHER COMMONS?

Extreme weather events are becoming more frequent and severe,[6] prompting governments worldwide to explore weather modification technologies to protect their citizens. As mentioned above, Japan's Moonshot Goal 8 project aims to create a society safe from extreme winds and rains by 2050 through weather control and modification.[7]

The Weather Commons Research Group, led by co-author Professor Tsuyoshi Hatori at Ehime University's Faculty of Collaborative Regional Innovation, is part of the Heavy Rainfall Control project under the broader Moonshot Goal 8 initiative. This project, led by Associate Professor Kosei Yamaguchi of Kyoto University's Disaster Prevention Research Institute seeks to develop a comprehensive weather calming system while considering impact assessment and social accountability.[8] The Weather Commons Research Group was established to research regional collaboration for the social implementation of these technologies, focusing on developing and operationalizing the concept of "weather commons", which considers the interactions between society, nature, and weather control technologies.[9]

As weather control technologies advance, the relationship between humans and weather will increasingly be influenced by both these technologies and their social implications. It's important to consider the timing, methods, and decision-makers involved in their use. Should decisions be made solely by authorities, or can a more inclusive, collective approach be adopted? A weather commons approach highlights the complex connections between people and weather, often missed by technocratic perspectives, and encourages critical reflection on dominant narratives. It underscores the importance of community practices in weather management and promotes collaborative efforts among diverse stakeholders.

"Hard" techno-centric approaches to disaster management, like those developed by the Moonshot Goal 8 project, are vital for saving lives and property. However, these approaches are insufficient in

the long term, particularly for the most vulnerable minority groups.[10] This concern has been emphasized in both Japan[11] and Aotearoa New Zealand.[12] The weather commons approach can be an alternative framework to ensure that weather resources are not appropriated only by authoritative or affluent groups but shared by vulnerable minority groups as well.

In this light, a core concept for our exploration of a weather commons approach is Ivan Illich's "conviviality". Illich defines conviviality as the autonomous and creative interaction among people, and between people and their environment.[13] He contrasts softer conviviality with harder institutional activity, emphasizing human needs and personal fulfilment over easily measurable outputs and advocates for tools that enhance rather than constrain human creativity and interdependence. Such tools empower individuals and communities to shape their environment and lives according to their values and needs, whereas industrial society often creates dependency on complex systems and experts, eroding personal autonomy and community bonds. For this paper, Illich's critiques of the education system in *Deschooling Society,*[14] which he argues enforces conformity and dependence rather than fostering independent learning, and his examination of impersonal, hierarchical medical institutions in *Medical Nemesis,*[15] as opposed to community-based healthcare, are particularly relevant.

TŌJISHA-KENKYŪ 当事者研究

As mentioned above, tōjisha-kenkyū is a practice by vulnerable communities which has an essentially convivial and commons-based flavor. At its most inclusive application it can be said to address the question: What are the difficulties that people face due to the mismatch between their unique perceptions and the standardized world, and what can we do about it?[16]

The word "tōjisha" lacks a direct English translation but this paper follows Nakanishi and Ueno's proposal that tōjisha is anyone who "makes and needs the concept of an alternative world".[17] In this sense, tōjisha is a useful shorthand for expressing the increasing precarity, vulnerability, and debilitation of many groups. While "kenkyū" means research in contrast to "participatory"[18] or "co-designed"[19] research it is a self-led practice where individuals who are experiencing "troubles" conduct practical research on themselves, engaging with peers and specialists. This approach, illustrated by the motto "by myself, with others" is characterized by self-realization peer dialogue, creation of unique languages, humor, embracing weakness as a mode of connection, eschewing cures in favor of creating new worlds to live in, and communicating such worlds to the wider public. Rather than simply a research-based problem-solving methodology it shifts perspectives, allowing one to see hardships as unique qualities that might be valuable to others.

A core principle of tōjisha-kenkyū is "治すより活かす" *naosu yori ikasu*[20] which can be loosely translated as "don't fix/eliminate it, make use of it/bring it to life". This idea resonates with the works of Rebecca Solnit and Azumi Tamura, especially in the context of extreme weather events and other disasters. Solnit, in *A Paradise Built in Hell*[21] and *Hope in the Dark*[22] explores how disasters can foster community and social transformation, offering a glimpse of a brighter future. Similarly, Azumi Tamura's work shows how affective knowledge can be brought into politics to offer a space for experimenting with how vulnerable peoples might live. Tamura's book *Post-Fukushima Activism: Politics and Knowledge in the Age of Precarity*[23] looks at the activism of everyday people after the 2011 Fukushima triple disaster and proposes that such activism cracks open space for individual bodies to encounter each other and thus be forced to feel and think in new ways.

From this perspective we believe that tōjisha-kenkyū offers a useful method for building diverse togetherness through the celebration of weakness and hardship as a common resource (i.e. the commoning of struggle) rather than forging community through strength, defense, and risk

elimination (Figure 2). As such, it could be a valuable contribution to the field of urban resilience, which explores how communities can flourish in new ways after extreme weather events.[24]

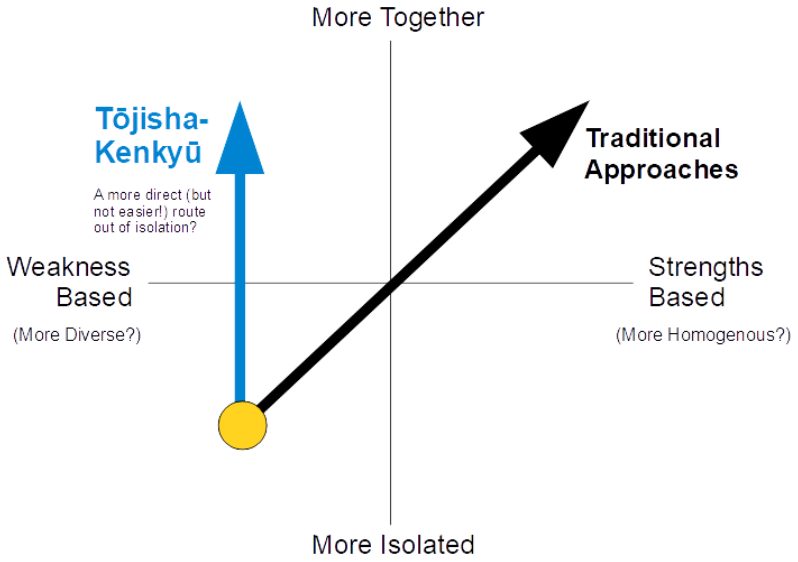

Figure 2. Tōjisha-Kenkyū as weakness-based community building

The next section presents a case study of our activity in a public school in Aotearoa (New Zealand) which was a tentative first attempt at operationalizing tōjisha-kenkyū in pursuit of fostering a practice of convivial weather commoning.

CASE STUDY: DE-TEACHING WEATHER LITERACY AS CONVIVIAL WEATHER COMMONING IN AN INTERMEDIATE SCHOOL IN AOTEAROA (NEW ZEALAND)

To convey the vivid atmosphere of this unique class, the following is a reportage-like description based on the practitioner's (first author's) point of view.

As mentioned, the city where I am based experienced historic flooding at the start of 2023. Since 2019, I had been working in a local school and, in 2024, had the chance to develop a short "creative-focused" course there. Given our recent encounter with extreme weather, the vulnerability of children in disasters, their often-overlooked role in disaster risk reduction programs, and their potential contributions before, during, and after disasters,[25] we decided, in conversation with the lead teacher, to adopt a soft and experimental approach to "living with the weather" and see what emerged.

The school involved was an "intermediate" school in the New Zealand public school system, catering to years seven and eight. The approximate ethnicity breakdown of the entire school is European (50%), Asian (47%), Māori/Pacific (9%).[26] The students involved in this activity were aged eleven and there were twenty-five students in the class. Seven 1.5hr sessions were held weekly between May 1 and June 19 (with some breaks due to school scheduling). Table 1 presents the focus of each session.[27]

Session	Focus
1 (May 1)	Introduction; Student interests; Where is the weather?; Discuss good/bad weather dichotomy.
2 (May 8)	Perception of boundaries between body and weather.
3 (May 15)	Discussion on “where is the sky?”
4 (May 22)	Continue discussion on “where is the sky”. Transition to “where is the rain?” and “what is the sound of rain?” Conduct practical experiments on the sound of rain.
5 (May 29)	Investigate making instruments that collaborate with the rain (in heavy rain!)
6 (June 12)	Rain-body improvisation session.
7 (June 19)	Make and perform weather songs (using body, traditional instruments, AI song generators, or the rain).

Table 1. Sessions and focus

The next sections frame the approach, set out its basic stance and principles, and present an illustrative episode by way of text fragments from a multi-session discussion.

Method of Ignorance

Combining the method of tōjisha-kenkyū and the stance of conviviality revealed an emergent method for a small-scale instance of Illich’s idea of deschooling where the teacher, students and I reveled in our lack of knowledge and in the process commonned our own kind of weather literacy (Figure 3). Let me explain.

I am not a trained teacher, and I have very little weather-specific knowledge. While this might be troublesome in traditional educational settings, it is actually very helpful when trying to work in a convivial tōjisha-kenkyū style where the objective is to (1) not take control and (2) nurture students to explore their own unique languages and learning practices. Even so, my “uselessness” still made me feel nervous and inadequate standing in front of a class of “eager young minds”. Luckily, Rancière’s concept of the ‘ignorant schoolmaster’[28] gave me confidence.

What emerged was an exploration in de-teaching weather literacy as a form of convivial weather commoning. While this was but a tentative first step, we propose that de-teaching weather literacy in this way can foster “convivial weather commoners” who might gradually develop the mindset and skills to live with and care about the weather as our climate changes.

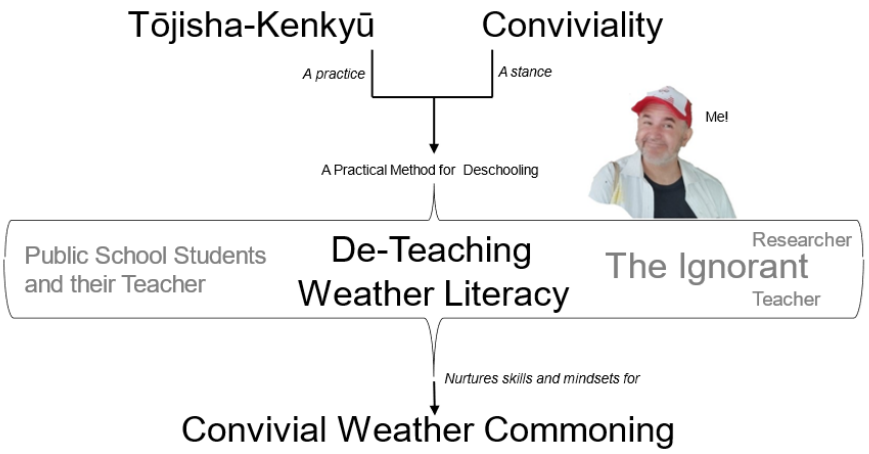

Figure 3. Conceptual framework

Basic Stance and Principles

Our modest starting point was simply to talk about the weather, together. Instead of focusing on accepted knowledge, we aimed to develop our own ideas about the weather through conversation and exploration of what we didn't know. In this case, I was present in the class as an "ignorant teacher/researcher." I downplayed my (limited) weather-related knowledge and forefronted my belief in the students' ability to learn, encouraging them to discover and understand the subject on their own terms. Everyone acted as teacher and student. Our weather-learning was an (often hilarious) adventure of autonomous exploration and discovery without a goal of "filling up" the "void" in the students' heads external content. Even so, I did bring my own goal of engaging in play and dialogue and helping the students not to slip into rote learning and other ingrained institutionalized behaviors. This encouraged learning that was self-directed, with each other, and regarded our mutual weather-illiteracy as a resource for play and the generation of alternative knowledges.

The basic principles (tentative) for working in this mode (from an adult perspective) are summarized in Table 2, with brief examples from the case study.

Principle	Example
Enjoy ignorance, shed knowledge	I had NEVER imagined that the wind is still "weather" when I breathe it into my body and only changes to "not weather" when my lungs process it, but that is what one student taught me - my body is a weather control device!
Deflate yourself (we are all student-teachers)	The students frequently "fired" me and appointed new teachers from their ranks (Figure 4). They also expressed concern about my financial situation, questioning whether I was paid for what I was doing (or not doing) with them. Additionally, they offered personal grooming advice, such as suggesting I "shave properly."
Always remember to forget your goals (and sometimes come back to them)	In the third session the students forced me to do an impromptu speech (interspersed by interrogation by the class) about electric fences for 15 minutes. This had very little to do with my "goal" of talking about the weather but the lightness and humor that emerged from straying from the official path definitely contributed to the flexibility to try out new things.
Laugh!	Rather than asking for an explanation or making a comment, sometimes simply enjoying the moment and laughing encouraged dialogue, e.g. Student brainstorm of the connection of "vomit" and weather: Vomit: Is a storm in your body; is a watery substance that originates from rain; vomiting while looking up is a type of rain; you can translate "vomit" into "monkey" and a monkey sits in a tree, and a tree needs rain to survive.

Table 2. Basic Principles (Tentative) and Examples

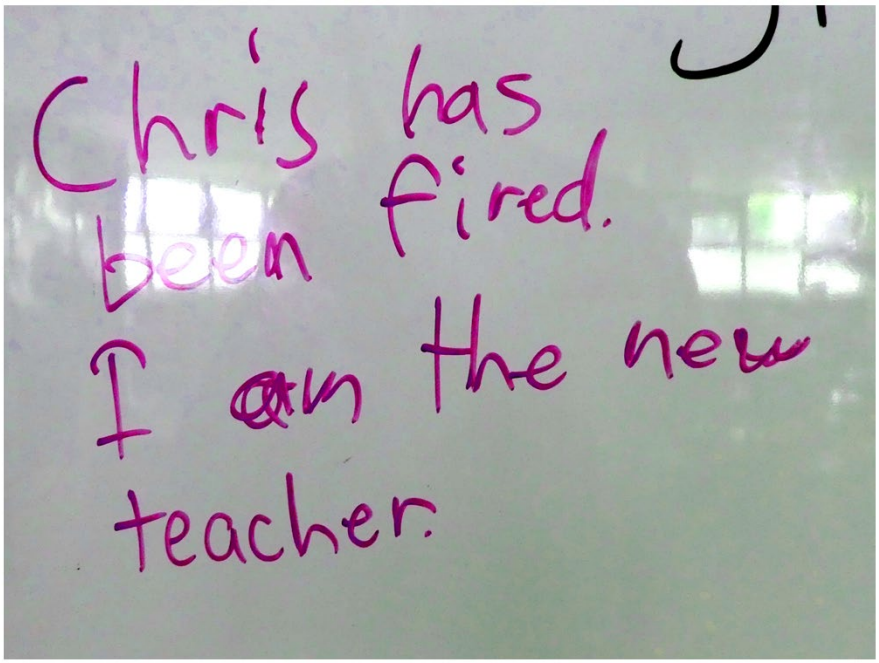

Figure 4. Evidence of being fired by students

Illustrative Episode: Where is the Sky?

To illustrate the above approach of de-teaching weather literacy as convivial weather commoning this section presents edited fragments from one of our ongoing in-class conversations on "where is the sky?" The method we followed was simply to ask, "where is the sky?" and then follow our noses without, riding the energy of (rather than rejecting) any weird ideas (Figure 5).

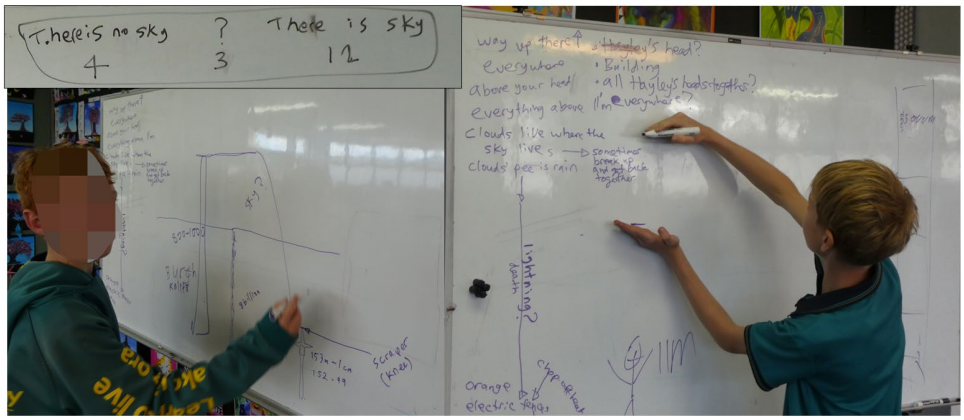

Figure 5. Classroom during "Where is the Sky?" discussion

>>>>>>

If the sky is everywhere above ground can we increase the sky by digging holes?
If we increase sky by digging holes can we bury extreme weather?
Can we turn it into reclaimed land?
The sky is everywhere.
The sky is above our heads.
The sky is above the head of the tallest person in the world (11m).

If the tallest person in the world walks up a hill, the height where the sky starts increases (amount of sky decreases)
Clouds cannot live without sky, but sky can live without clouds. A complicated relationship!
Is the sky above the tallest building?
New Zealand: Sky Tower (153m).
Dubai: Burj Khalifa (800-1000m).
Thus, the sky starts differently depending on the country.
Countries have different amounts of available sky.
Shorter buildings = more sky.
More space for things in the sky = less space for things on the ground.
The term "skyscraper" implies that the building scrapes the sky, similar to when you scrape your knee.
OUCH!
If that is the case then the sky does not start above the skyscraper but starts in an indeterminable point at which the building scrapes the sky.
We called "anything above a certain height" the "sky" but what is below?
"Undersky"?
To briefly summarise, as our idea of where the sky starts changes, the available space for us changes.
The earth is a sphere and the sky is all around it.
All other planets and stars must have a similar structure.
If so, most of the universe is sky…
If we consider all the planets other than earth as in the sky, then the earth in the sky from the point of view of other planets.
This means that even our ground is the sky!
Now, let's vote.
12 people think that the sky exists, 3 are not sure, and 4 people think that there is no such thing as sky.
>>>>

CONCLUSION

This paper introduced the emerging concept of a convivial weather commons and introduced the practice of tōjisha-kenkyū before presenting a case study.
The case study presented a tentative example of operationalizing tōjisha-kenkyū with a stance of conviviality to de-school the classroom and de-teach weather literacy for convivial weather commoning. It focused on the "weakness-based togetherness" (outsiders, together) and "dialogical play" aspects of tōjisha-kenkyū as methods of de-schooling the classroom, showing how playing with our weaknesses and limitations as resources for becoming "outsiders, together" can foster exploratory knowledges which may or may not be "useful", are weird, and are "ours but also for you". This approach repositions authority figures as "ignorant" teacher/researchers who engage with uncertainty, chaos in search of "weather illiteracy," allowing them to "become" rather than control their students. This method does not disregard existing knowledge but aims to create space for alternative, exploratory, and diverse forms of weather literacy (Figure 6).

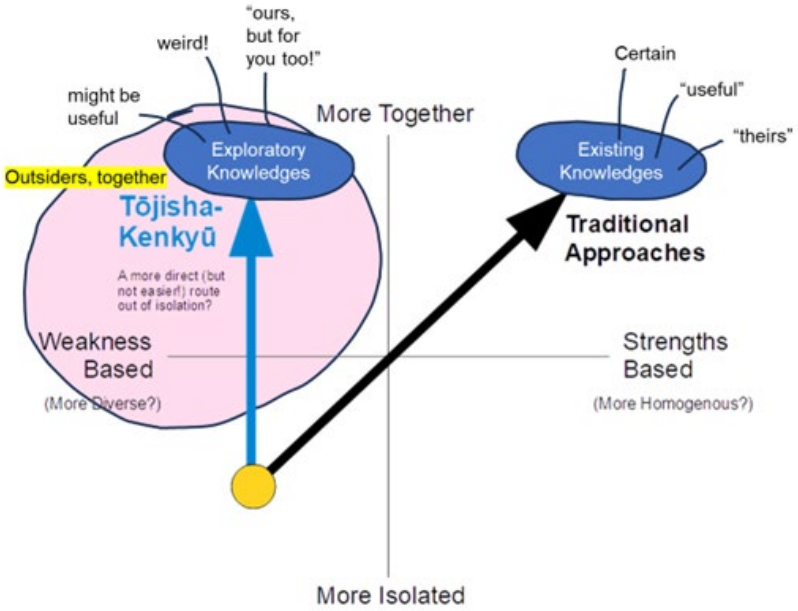

Figure 6. Exploratory weakness-based tōjisha knowledges vs. strength-based existing knowledges

Just as tōjisha-kenkyū is not anti-psychiatry but rather meso-psychiatry which repurposes existing knowledge in new ways in the process of creating new languages[29] the de-teaching of weather literacy described in this paper does not promote anti-weather-literacy (or weather-illiteracy).[30] Instead, it proposes fostering meso-weather-literacy for convivial weather commoning. This approach does not dismiss dominant knowledge but sets it aside "for the moment" to explore new terrain. In this way, the unique research aspect of tōjisha-kenkyū can be seen as both a practice of commoning and "becoming-commoner," where "research" returns to its roots of "re-" "search". This involves repeatedly wandering around familiar paths to find new insights and going off the beaten track to find previously overlooked areas, rather than settling at official "resting zones" of established knowledge (Figure 7). The delight and value of such research is in the meandering lines and entanglements of wandering/wondering, rather than the static dots of the "fact".[31] Maybe what we have stumbled upon here could be an "art of noticing" which Tsing regards as a core aspect of the practice of communing.[32]

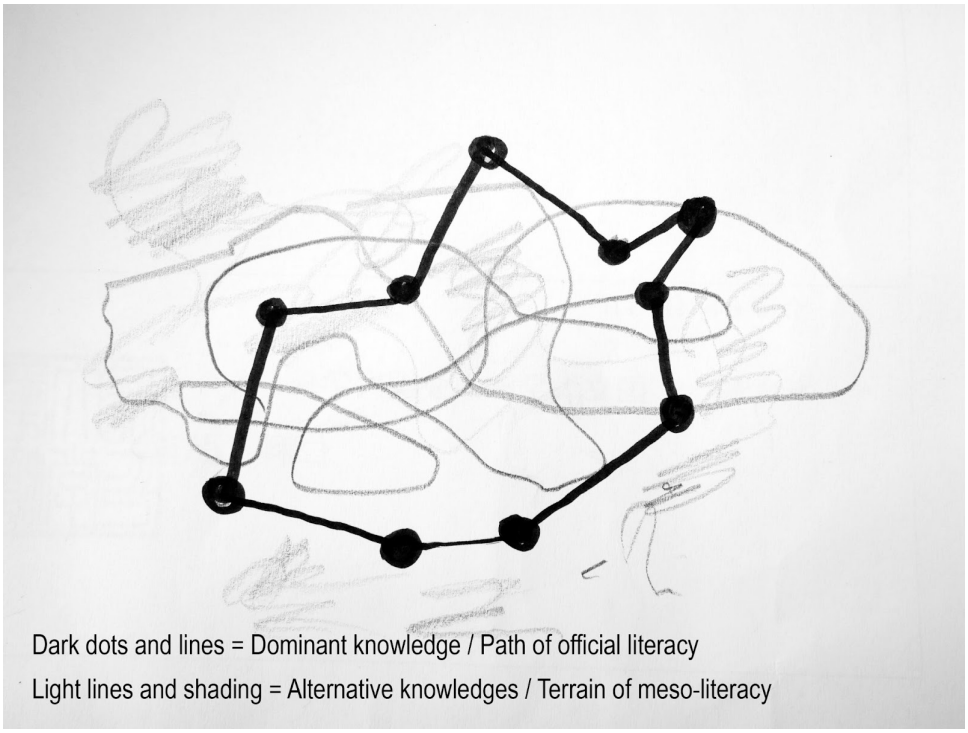

Figure 7. Meso-literacy terrain vs. dominant knowledge path

INVITATION

This is just an initial step on our journey to develop practical and theoretical approaches for convivial weather commoning. If you've reached the end of this article, we're delighted! Please feel free to contact us at the Weather Commons Research Group—we look forward to playing together!

NOTES

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CULTIVATING URBAN RESILIENCE THROUGH CULTURAL ECOSYSTEM SERVICES IN HERITAGE GARDENS

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INTRODUCTION

Urban heritage parks are crucial to city landscapes, providing green spaces that enhance urban life through aesthetic beauty, recreational opportunities, and a sense of historical continuity.[1] While these parks offer significant cultural benefits, an excessive focus on specific aspects, such as aesthetics, can sometimes lead to trade-offs that reduce their overall multifunctionality. This may result in decreased biodiversity and narrower range of benefits these parks can offer.[2]

This paper explores how gardeners' efforts to enhance the cultural aspects of historic gardens affect their overall multifunctionality, exploring the balance between preserving historical significance and adapting to modern environmental needs.

Focusing on three historically significant sites—The Garden Society of Gothenburg, Gunnebo House and Gardens, and the Gothenburg Botanical Garden—this research employs the Ecosystem Landwheel framework to compare management strategies and their effects on various ecosystem services. This approach highlights the strengths and limitations of different practices and provides a nuanced understanding of how historic gardens can contribute to sustainability while preserving their unique heritage.

By integrating traditional practices with contemporary sustainability efforts, this study underscores the importance of innovative and respectful approaches to managing green spaces, balancing historical preservation with ecological stewardship.

Integrating Ecosystem Services and Traditional Craft Skills

In Sweden, authorities, municipalities, businesses, and organisations are now working in different ways to integrate the principles of ecosystem services into urban planning. This aims to improve decision-making regarding the management of ecosystems in a more sustainable manner.[3]

In 2005, the UN-led 'Millennium Ecosystem Assessment' (MA) defined 'ecosystem services' as the benefits that people derive from ecosystems. These services include the various ways in which the natural environment supports human well-being. As a result, ecosystem services link and integrate ecology, economics, and societal well-being. They demonstrate how ecosystems and their functions serve as the fundamental, yet historically undervalued, resources that human quality of life depends upon. The ecosystem services received from healthy ecosystems are broken down into four categories: supporting, regulating, provisioning and cultural. Supporting services include primary production, nutrient cycling and soil formation. Regulating services manage climate, purification of

air and water, decomposition and pollination. Provisioning services include the supply of food, materials, medicinal resources and energy. Cultural services may be spiritual, educational and aesthetic relationships with nature, as well as recreational and physical engagement in natural landscapes.[4]

Research often highlights the critical oversight of undervaluation of cultural services and values in landscape planning and management.[5] This underscores the need for a socio-ecological system perspective,[6] and the empowering of local communities and integrating local institutions and traditional knowledge into natural resource management within cultural landscapes, including historic urban parcs.[7] In Swedish academia, this local knowledge is increasingly recognized as a burgeoning field of craft science, where traditional tools and methods are explored through innovative methodological development.[8] This study, closely related to the craft science of gardening[9], contributes to understanding how these traditional practices can enhance the multifunctionality of historic gardens.

METHOD

Interviews were conducted with thirteen gardeners at three historically significant gardens in the greater Gothenburg area: The Garden Society of Gothenburg, Gunnebo House and Gardens, and the Gothenburg Botanical Garden. These sites were selected for their historical importance, urban locations, and differing funding sources at the regional and municipal levels. Each gardener works under unique conditions, drawing on their personal preferences and experiences, yet they all agree on the need for changes to address climate change.

The study of each garden began with a work-along, where Grönlund worked alongside the gardeners as a professional, experimenting with new techniques and discussing gardening practices. This was followed by a two-hour, semi-structured indoor interview that focused on the use of pesticides and herbicides or organic alternatives, and how the gardeners approaches promoting and enhancing biodiversity. The interviews also explored the tools they use and how, if at all, they incorporate traditional craft methods into their work.

For the analysis, a comparative approach was employed using the Ecosystem Landwheel (Figure 1).[10] The Landwheel served as a framework to categorise and assess the ecosystem services provided by each garden, particularly focusing on how gardeners safeguard and enhance cultural ecosystem services. This analysis allowed us to explore the interconnectedness of cultural services with other ecosystem service categories, highlighting how effective management in one area can benefit others.

We study how individuals select their tools and methods based on a blend of pragmatism and ideals, focusing on the dynamic decision-making processes involved. Building on the concept of heritage management as negotiation,[11] we understand heritage management as a continuous negotiation between preserving cultural heritage values and addressing contemporary challenges, such as climate change.

Our analysis adopts a past-present-future approach, where heritage management should be based on a comprehensive understanding of the past while influencing the future, acting as custodian of intrinsic and extrinsic values in a heritage context.[12] This study explores how traditional knowledge informs current garden management practices and how modern challenges drive the re-evaluation and adaptation of historical tools and methods. This approach facilitates a reflection on how historical influences shape current trends and future aspirations in heritage conservation. Through this lens, we examine the interplay between practical tool choices and the evolving ideals of heritage management, highlighting the nuanced balance between maintaining cultural integrity and adapting to environmental demands.

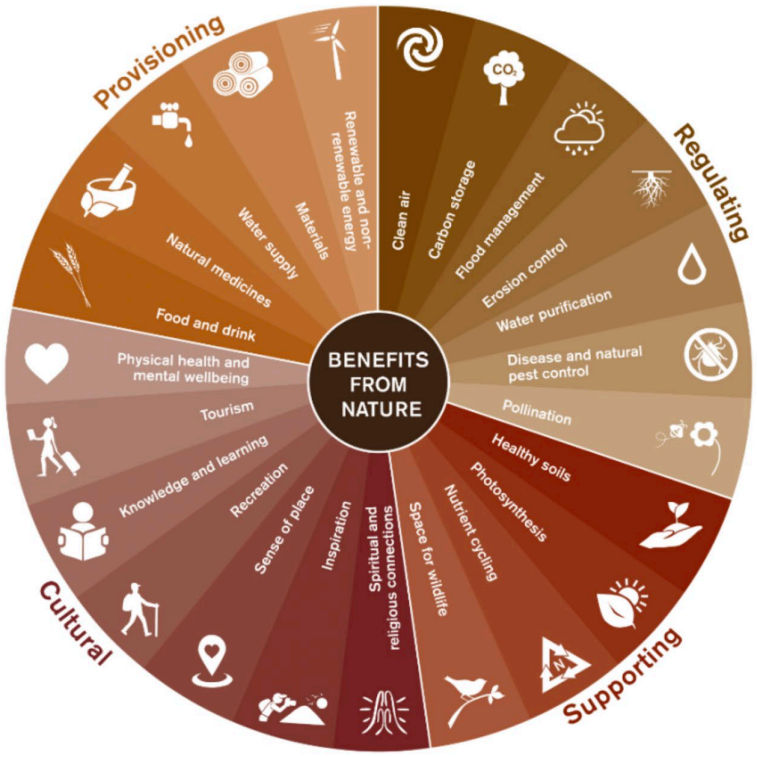

Figure 1. Ecosystem landwheel describing the benefits derived from nature. Courtesy of NatureScot. Cultural ecosystem services include e.g. sense of place, recreation, knowledge and learning, while supporting services include e.g. healthy soils, photosynthesis and nutrient cycling.

RESULT

Norms regarding chemical vs organic pest control

All three gardens have stopped using pesticides and herbicides outside, reflecting a broader shift in Gothenburg that began around 2000. However, the Gothenburg Botanical Garden makes selective exceptions for particularly resilient pests in its indoor environments.

While the respondents acknowledge that numerous eco-friendly alternatives are available for gardeners today, they admit that few match the effectiveness of chemical pest control. They are also aware that many of their colleagues in other parks resort to chemical methods rather than manual labour due to cost-effectiveness, particularly to preserve the cultural ecosystem services—such as the aesthetic aspects—linked to garden tradition.

Some respondents emphasised that the gardens attract between 600,000 and 1,800,000 visitors annually. These visitors are essential for securing funding and expect the gardens to be well-maintained and visually appealing. Weeds and dead plants are contrary to traditional garden norms, which are linked to the ecosystem services of inspiration and sense of place. Consequently, maintaining these standards with organic pesticides, which need to be as effective as chemical alternatives, poses a challenge.

The head gardener at the Gothenburg Botanical Garden's tropical greenhouses highlights the importance of starting with ecological methods. This includes regular inspections and using biocontrol agents such as nematodes and predator wasps to prevent pest outbreaks. He observes a strong correlation between staff size and the use of chemical pesticides, noting that smaller teams are less

likely to detect pests promptly. Given these challenges, plants with significant historical or cultural value, such as the Easter Island tree at the Gothenburg Botanical Garden—now extinct in its native habitat—may necessitate the use of chemical pesticides to ensure their survival.

The gardeners suggest that discontinuing the use of pesticides and herbicides could benefit most services outlined in the Ecosystem Landwheel. Specifically, they highlight that organic pest control supports healthy soils, nutrient cycling, and habitats for wildlife such as butterflies and bees (supporting services). Healthy soils and plants enhance pollination, natural disease regulation, and natural pest control (regulating services), and contribute to the provision of food, drink for humans and wildlife (providing services).

As shown in Table 1, while both chemical and organic pest control support cultural ecosystem services like aesthetics and sense of place, opting for organic methods has minimal impact on these services and preserves seven additional ecosystem services that chemical options can harm.

Figure 2. Perceived impact of chemical pest control on ecosystem services. The table illustrates that chemical pest control contribute to a low number of ecosystem services.

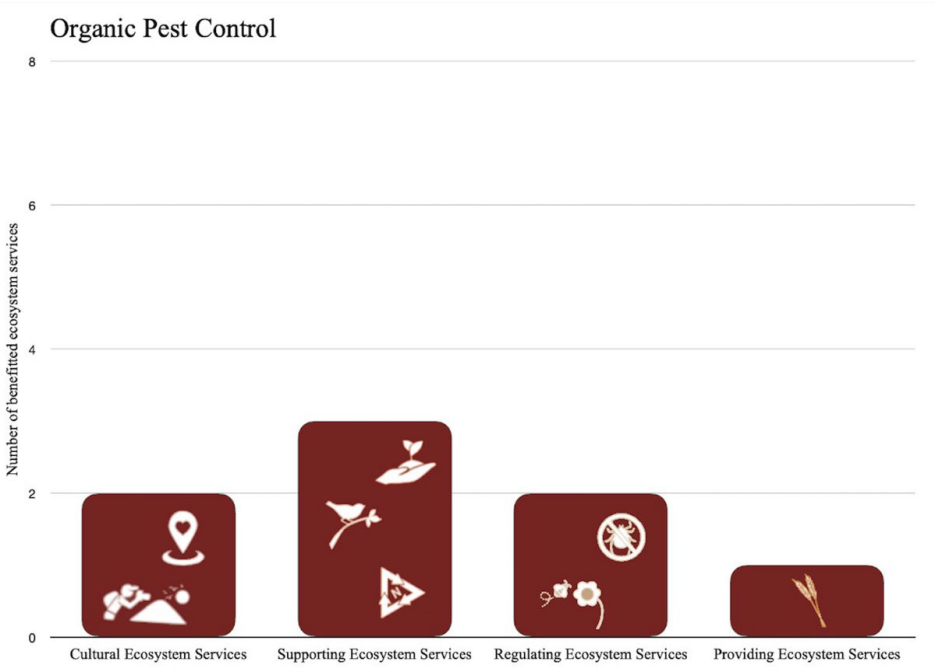

Figure 3. Perceived impact of organic pest control on ecosystem services. The table illustrates that organic pest control contribute to a high number of ecosystem services.

Approaches for Biodiversity in Urban Heritage Gardens

The gardeners focus on enabling and enhancing biodiversity through three main approaches: genetic diversity, pollinator-friendly practices, and habitat creation.

Genetic Diversity

In Sweden, the national POM (Program for the Preservation of Historic Varieties)[13] scheme underscores the significance of maintaining genetic diversity. Both the Garden Society of Gothenburg and the Gothenburg Botanical Garden participate in this initiative. According to respondents from the Gothenburg Botanical Garden, considerable effort is dedicated to seed collection and managing seedheads to prevent cross-pollination. Additionally, they engage in plant repatriation efforts to reintroduce species to their native habitats. Notably, they are collaborating with the Chilean government to re-establish the Easter Island tree on Easter Island. This effort is part of a broader initiative aimed at safeguarding plant material threatened by climate change through international exchange and collection trips.

Pollinator-friendly Practices and Habitat Creation

All gardeners emphasised their commitment to attracting and sustaining pollinators and other wildlife. This commitment is realised through a blend of contemporary and traditional methods. The contemporary methods are named Naturalistic and build on biology and climate research to create gardens with the highest possible pollinator value. The traditional methods are guided by historic practices and knowledge.

At the Garden Society of Gothenburg, naturalistic techniques are employed, such as planting an early-flowering bulb meadow that provides vital nourishment for early-awakening bee queens.

In contrast, Gunnebo House and Gardens has embraced traditional methods by recreating historical meadows. This approach not only supports native meadow plants but also serves as a sanctuary for the associated insect populations.

Both approaches to supporting pollinators and wildlife are thoughtfully designed to cater to distinct ecological niches. From an ecosystem services perspective, these meadows enhance supporting services by providing crucial spaces for wildlife, which in turn benefits soil health and pollination through the provision of food and habitats for insects and other wildlife.
The cultural ecosystem services impacted by these meadows differ in their benefits. Both types of meadows contribute to Inspiration and Knowledge and Learning, as they both educate visitors about biodiversity and different meadow plant types. However, the meadow at Gunnebo House and Gardens also serves to impart lessons about Swedish cultural heritage and the traditional craft skills involved in meadow maintenance, thereby enriching the sense of place.
Another traditional technique employed by the gardeners at Gunnebo House and Gardens and the Gothenburg Botanical Garden is the "veteranisation" of trees. This method involves stabilising old trees to prevent their removal, which is often distressing for frequent visitors. The head gardener at Gunnebo shares that he is using “cues to care”[14] and that by preserving these trees, this technique not only supports the ecosystem service of Sense of Place but also safeguards both cultural and natural heritage while creating valuable habitats for wildlife.
In summary, traditional techniques generally provide broader benefits compared to contemporary methods. While both approaches effectively support pollinators and wildlife, traditional methods not only provide supporting, regulating and providing services but also offer significant cultural benefits by preserving heritage and enriching the sense of place. Contemporary methods, while effective, tend to focus more narrowly on specific ecological needs.

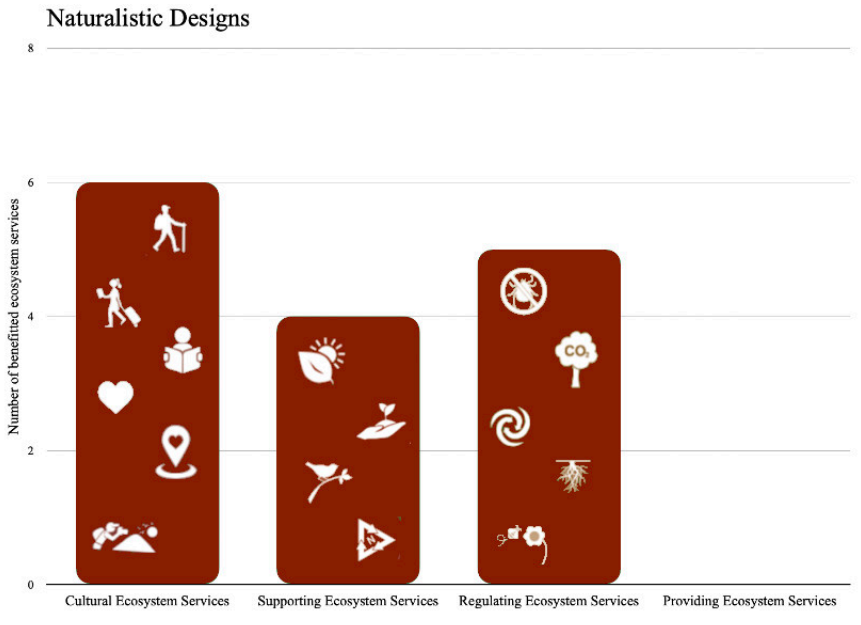

Figure 4. Perceived impact of naturalistic plantings on ecosystem services. The figure shows high scores for the impact of gardeners’ choices in methods and practices on cultural ecosystem services, which in turn positively influences the two additional categories on ecosystem services.

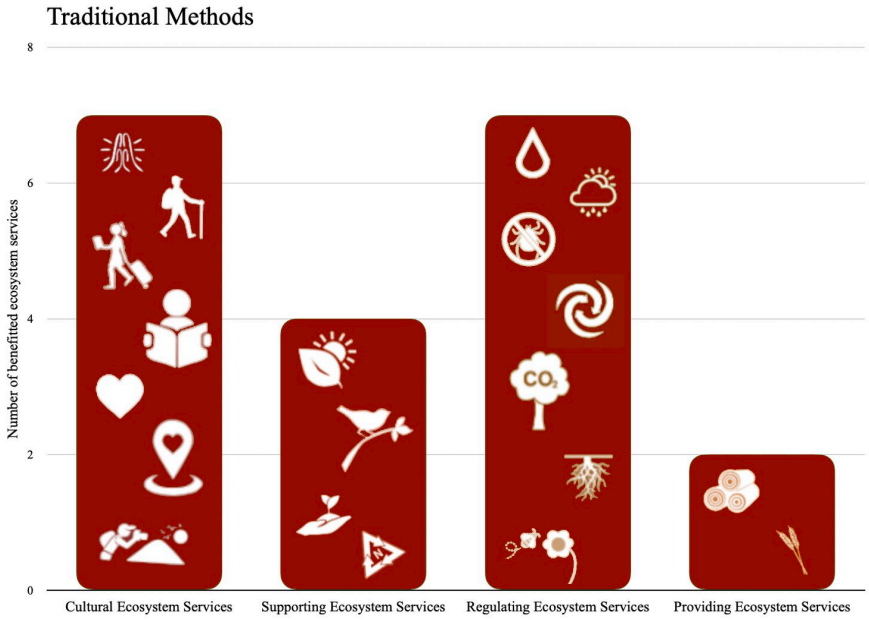

Figure 5. Perceived impact of traditional methods on ecosystem services. Compared to figure 4, the traditional method benefits additional services in the regulating and providing categories.

Traditional Crafts and Modern Solutions

Regarding the tools used by gardeners, there is a consensus on the benefits of electric tools. These tools are considered more eco-friendly, quieter, and often lighter than their petrol-driven counterparts. The main drawback is their higher initial cost, though prices are decreasing as their adoption increases. Additionally, the visitor experience is improved due to the reduced noise from electric machines, as seen at all three gardens. However, modern tools lead to modern management, and a short cut lawn provides few ecosystem services beyond the recreational.

In contrast, some gardeners employ traditional craft methods, such as scythes, pruning hooks, and hedge shears. For instance, a gardener at Gunnebo Castle and Gardens notes that using a scythe instead of a mower result in less frequent cutting, which enhances biodiversity in lawns and supports a variety of visiting insects. This method allows grass to grow longer, increasing its resilience to drought and offering valuable educational opportunities for visitors on topics like biodiversity, climate change, and historic lawn maintenance. The traditionally tended landscape provides space for wildlife, healthy soils and nutrient cycling. Meadow and grazelands provide opportunity for pollination, carbon storage, erosion control and flood management, while coppiced woods provide carbon storage and habitats for natural birds and predator insects which serve as important natural pest control. Finally, traditional craft methods allow for the utilisation of the material, such as coppiced wood or the summer hay of the meadow. Additionally, these traditional techniques play a crucial role in preserving intangible heritage for example the preservation of the historic soundscapes, as seen at Gunnebo House and Gardens, and contribute significantly to cultural ecosystem services, such as knowledge and learning, and a sense of place. They deepen connections to both cultural and natural heritage, providing a richer understanding of traditional practices and their historical significance.

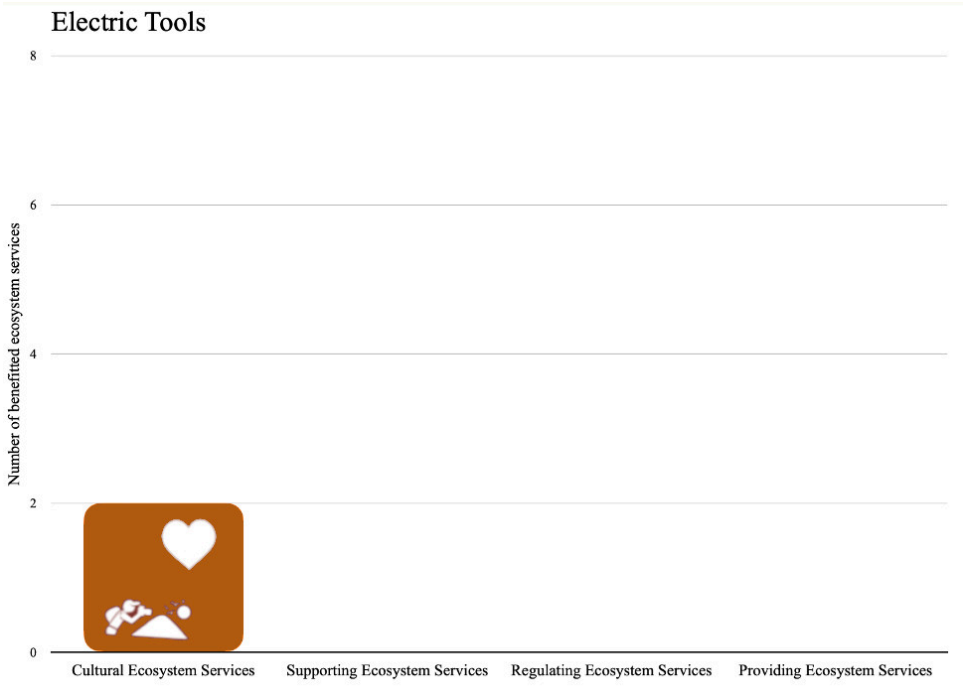

Figure 6. Perceived impact of electric tools on ecosystem services. The figure show low scores in all categories, even though it is perceived as a eco-friendly option.

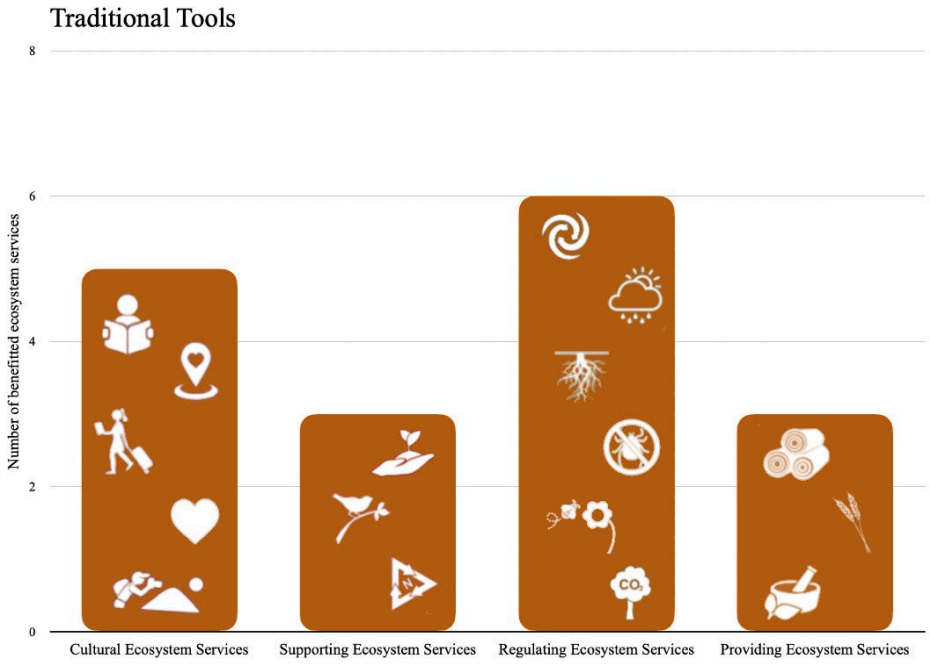

Figure 7. Perceived impact of traditional on ecosystem services. The figure shows how traditional methods can offer additional cultural and environmental benefits.

DISCUSSION

The past-present-future approach provides a valuable framework for understanding how historic gardens navigate the negotiation[15] between cultural preservation and modern challenges. This approach allows us to examine how traditional knowledge informs current practices and how contemporary issues necessitate a reevaluation of historical methods. By integrating craft skills and

historical knowledge with modern practices, gardeners can enhance both cultural heritage and ecological resilience. We have shown how historic gardens serve as living laboratories where cultural and ecological values intersect.

Past: Historical practices, such as the use of traditional tools and methods, offer valuable insights into sustainable garden management.[16] Scythes and manual methods, while less efficient by modern standards, contribute to higher biodiversity and provide educational opportunities about historical maintenance techniques. These practices embody cultural values and ensure historical continuity.[17] The increasing popularity of meadowcare, as seen in interviews with practitioners, has led to maintenance practices that further benefit ecosystem services like healthy soils, nutrient cycling, pollination, and wildlife habitats. This approach encourages a reduction in harmful pesticide and herbicide use, the planting of historically significant plants to protect genetic diversity, and the creation of meadowlands. Overcoming these challenges also brings additional benefits, such as lower maintenance and cost-effectiveness.

Present: Modern challenges, such as climate change and biodiversity loss, require gardeners to adapt their practices. The study highlights how gardeners are integrating contemporary eco-friendly methods, such as organic pest control and habitat creation, to address these issues while preserving the gardens' historical significance. This reflects a present-day negotiation where traditional practices are reassessed in light of new environmental needs. Interestingly, electric tools, although widely regarded as eco-friendly alternatives, score low in terms of ecosystem services. This underscores that practicality, effectiveness, and ergonomic sustainability often take precedence in gardening practices, as no gardener should endure back pains or injuries. Gardens must balance maintaining aesthetic standards and visitor satisfaction with the use of organic pesticides, which are less effective than chemicals and therefore have a high labour cost. Plants of significant historical or cultural value may justify the use of chemicals to ensure their survival.

Future: Looking ahead, the integration of traditional and modern practices in historic gardens suggests a path towards a more sustainable and culturally enriched future. The focus on biodiversity, genetic conservation, and habitat creation indicates a forward-looking approach that seeks to ensure the long-term ecological health of these gardens while preserving their historical legacy.

As cities grow and modernise, the lessons learned from these gardens provide valuable insights into how urban landscapes can be managed to enhance biodiversity, cultural heritage, and the well-being of urban populations.

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INTEGRATED STRATEGY FOR BUILDINGS AND URBAN ENVIRONMENT TOWARDS SUSTAINABILITY

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INTRODUCTION

The energy crisis has imposed a new approach to the study of the built environment, based on the close link between the building and the surrounding environment, especially in energy exchanges. Energy efficiency measures adopted on buildings are unable to have a substantial impact on city consumption. The approach to the energy requalification of existing buildings almost always concerns only the buildings and not the surrounding environment, but these interventions deriving from environmental contingencies can be an opportunity to make cities sustainable towards energy, environmental and social terms. As Federico Butera states in his 2024 latest book,[1] the biosphere is governed by a system of relationships and interconnections that even small changes, such as the redevelopment of a neighborhood, determine chain reactions in other areas, influencing nature and human being on a global scale.

Neighborhoods, as parts of the urban fabric, referring to the etymological meaning of “fabric” or “held together”, must be considered in a systemic vision of social and ecological systems (of culture and nature). This is a very current concept: the EPDB directive on the energy efficiency of buildings, in fact, recalls these concepts and objectives as essential factors to be achieved for the near future.

Recently, this awareness has led to new settlement models, the eco-neighborhoods. Among the best examples of eco-neighborhoods in Europe, we include BedZed (Beddington Zero Energy Development),[2] in south London, the Vauban[3] neighborhood in Freiburg, Germany, the Clichy-Batignolle[4] in Paris, the Bo01 neighborhood in Malmö, Sweden, the first neighborhood in the world where total energy comes from renewable sources, the eco-neighborhood Montale, in Italy.

The traditional approach to energy requalification of existing buildings usually does not concern the surrounding environment. Integrated interventions on buildings and urban surroundings can be an opportunity to improve the life quality of citizens. Many energy redevelopment interventions[5] still remain at the building scale, leaving some fundamental issues for the regeneration of the city unresolved.

Also in the world, some eco-neighborhoods were realized in recent years as urban regeneration projects, with the redevelopment of entire abandoned areas/spaces. Among the few recent urban regeneration processes at European and international level, we include the Plinio park in the south-east of Rome,[6] the urban regeneration of Santa Giulia in Milan,[7] the 'urban pockets' participatory micro-regeneration interventions in Tirana. These cases demonstrated the benefit of the

transformation of common spaces to establish a sense of belonging and care of public space, with clear positive effects also on the management of energy consumption.[8]
The constant factors in the projects of these eco-districts are:
• energy saving
• use of renewable sources
• use of sustainable materials to construct buildings
• reduction of land consumption and the enhancement of green areas
• lower water consumption
• careful management of water
• inserting recovery and reuse systems
• sustainable mobility
• polluting emissions reduction.
The objective of this study is to outline the strategies for a new model of sustainable living, introducing people, places in which they live and planet into a system. However, not only by building new buildings in a sustainable way, but above all through redevelopment processes of existing buildings and neighborhoods.
This is an innovative approach that is redefining the standards of contemporary design.

CASE STUDY: PIAZZA EUROPA, ENNA, SICILY

This approach was tested at an educational level through the study conducted on a case study of the Sicilian city of Enna (Piazza Europa's neighborhoods built in the 1950s) by students of the Faculty of Architecture of local Kore University,[9] exploiting the peculiarities of the existing built environment (fig. 1).
A cross-diagnosis was the basis of the neighborhood redevelopment intervention. In fact, various assessments were carried out (urban planning, environmental, mobility, sociological, climatic, energy, etc.) to arrive at the definition of interventions for the design of an eco-district. It is through this systemic approach that we believe it is necessary to choose between the different design solutions of Piazza Europa district.
The innovation of the teaching methodology is a new design direction focused on the composition of the urban morphology, on technological characteristics of the buildings and neighboring urban spaces and on the related environmental relationships through an approach that concerns the environment design using natural resources (sun, wind, water and urban green).
Through this study, it was possible to demonstrate the effectiveness change in the environmental conditions of the urban space on the hygrothermal behavior of buildings and therefore the added value in sustainability terms by integrated intervention strategy.

Figure 1. Piazza Europa's neig borhood in Enna, Sicily (1950s)

The study

First part of the study_ Didactic

The task assigned to the students was to imagine a new life for the neighborhood by integrating principles of sustainability, innovation and collective well-being.
This meant not only transforming unused spaces into meeting and leisure places, but also contributing to the fight against climate change and improving the quality of urban life.
Students were challenged to think innovatively, using eco-friendly materials, sustainable water management practices and green solutions supporting biodiversity, in Solutions based on Nature (SbN).
The decision on what use to give to urban spaces was left to the discretion of the students: gardens, urban vegetable gardens, spaces for carrying out play and recreational activities, etc.

Second part of the study_ Scientific

The second part of this study was dedicated to the evaluation, through a numerical analysis, of the energy efficiency of buildings, before and after the interventions, considering both the interventions on the buildings and the interventions on the external spaces that modify the urban microclimate.
The environmental assessments conducted on the Piazza Europa neighborhood concerned:
• Evaluation of energy consumption of buildings for heating and cooling and CO_2 reduction.
• Thermographic analysis of building surfaces and urban space.
• The evaluation of the thermal benefits allowed by the use of "cool materials", permeability and green pavement in the urban space, comparing them with those obtained with conventional materials.

PROPOSE FOR THE ECO-TRASFORMATION OF EXISTENT NEIGHBORHOOD

While in the case of a new design, it is possible to define the geometry of the building, the orientation, the height of the building and the distance between buildings (road width), factors that influence shading, exposure to solar radiation and natural ventilation, in case of interventions on existing buildings, these geometries and these relationships are already predefined.
Therefore, the analysis of the state of fact is fundamental. Climate/environmental analysis, material/technological analysis, energy analysis, functional/social analysis.
The experimentation on this neighborhood highlighted various critical issues and weaknesses, but at the same time, many opportunities and strengths (table 1).

Weaknesses	Strengths
1. *Social*:	1. *Social:*
– Presence of cars near the buildings	– space equipped for citizens
– internal traffic interrupted	– pedestrian routes
– privatization of outdoor spaces	
– architectural barriers (insufficiently large sidewalks, etc.)	
2. *Environmental*:	
– continuous sun exposure of the facades of the buildings on the panoramic south-east side	2. *Environmental:* – micro climatic improvement
– reduced and not very functional vegetation	– sun protection
– fully paved external areas	
3. *Material:*	3. *Material:*
– heat absorption	– cool materials
– water impermeability of external floors	– permeable surfaces

Table 1. List of weaknesses and strengths of the case-study

To achieve the goal of carbon neutrality and energy passivity, a global strategy was implemented in the design of the neighborhood. Overall, priority was given to an urban organization to guarantee the wind flow as well as the creation of heavily vegetated outdoor spaces to create a “island of coolness”. Seven of the seventeen United Nations Sustainable Development Goals (Agenda 2030) were applied to the neighborhood (number 3, 6, 7, 11, 12, 13, 15) as in fig. 2.

Figure 2. The goals of Sustainable Developments Goals Agenda 2030 applied to the case-study

Social approach. Analysis and strategies

It is a neighborhood built in the 1950s with No. 5 apartment buildings and the spaces between them, next to a large square. Currently, the space in the square and the rest of the unbuilt spaces in the neighborhood are almost entirely occupied by the mobility and parking of private vehicles (fig. 3).

Figure 3. Views of Piazza Europa’s neighborhood in Enna

In the neighborhood with many alleys and little greenery, mobility has been transformed from vehicular to pedestrian. A circular road network with No. 3 axes has been created: a central one for pedestrians (with flowerbeds and social spaces) and No. 2 perimeter axes for mixed traffic. The road that runs alongside the building complex to the West for slow vehicular traffic for the citizens of the neighborhood and the road to the East for public traffic and parking areas, appropriately delimited by the pedestrian areas adjacent to the buildings.

In particular, other functions such as shops, local services, urban social spaces, green areas, urban gardens and children's play areas were planned into the neighborhood, which is now exclusively residential. This diverse range of features can make the neighborhood livelier.

The creation of shared urban gardens allows the communication between neighbors, family gatherings to dedicate themselves to gardening for their own consumption and to eat healthy.
The creation of diversified urban social spaces, such as children's play areas, allow the establishment of an intergenerational social mix within the neighborhood, further support social inclusion and aim to reduce the vulnerability of isolated people (fig. 4).

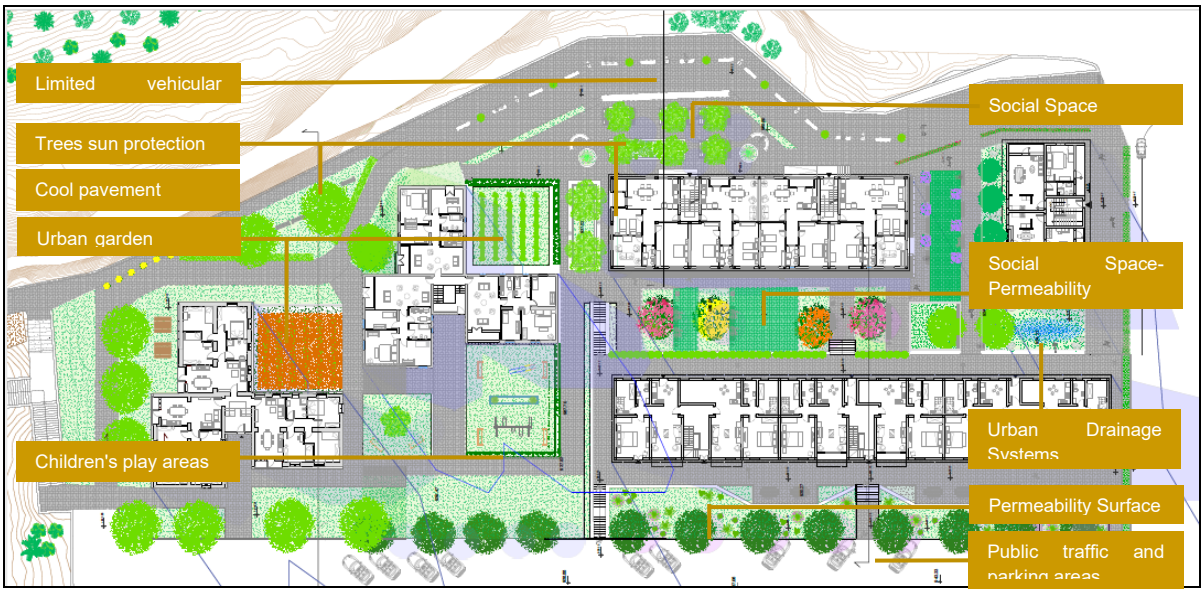


Figure 4. Proposal for the neighborhood

Environmental approach. Analysis and strategies (building & urban aspects)

In this section, we analyze the environmental aspects, both of the building and the urban space, and the strategies to follow to achieve improvements in this aspect.
Much importance has been given to the climatic analysis of shadows and solar radiation into the building & urban scale, because served to develop an environmental matrix that allows the identification of *ad hoc* strategies for the different areas. [10]
The objective of the redevelopment of the neighborhood to transform it into an eco-neighborhood is that no air conditioning is installed (unless there is a clear and proven need), thanks to the energy efficiency of the buildings and the structuring of the surrounding spaces in real own “islands of coolness”.
The design solution proposed for the Piazza Europa district focuses on passive strategies (fig. 5). For each single building, an advanced bioclimatic approach has been developed for the envelope, for its thermal insulation and solar protection, using mainly passive solutions:

- solar greenhouse;
- green wall;
- increase solar collection surfaces on facades; [11]
- internal spaces redistribution for natural ventilation and solar gains; [12]
- external thermal insulation system for envelop with sustainable materials;
- sun protection with brise-soleil and trees.

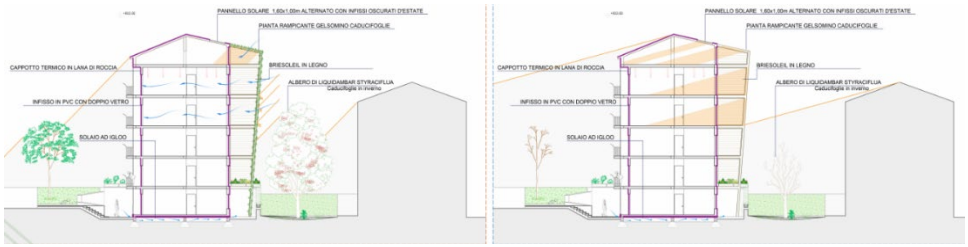


Figure 5. Particular building thermic strategy with solar collection on the façade (summer and winter)

An energy calculation[13] was carried out (conducted according to Italian regulations) of the buildings' consumption before and after the intervention. The results of energy consumption were that 90% of the buildings have an average energy performance index of 600 kWh/m^2 per year before the intervention and 140 kWh/m^2 per year after the intervention, very different from the energy consumption of an NZEB building, equal to approximately 20kWh/m² per year. However, with the intervention a significant improvement was achieved with an increase of 5-6 energy classes.

In particular, with the interventions carried out on the buildings, a reduction in Epi of 62% was achieved for "building 1", 88% for "building 2", and 73% for "3 and 4 buildings" (following figure 6 left).

The following figure 6, on the right, shows the detail of the percentage incidence of the energy requirement factors for "building 1". In particular, the intervention achieved a decrease in transmission losses (Ht) of 21% and an increase in energy inputs Qs and Qi, respectively by 12% and 7%.

Furthermore, a pre-diagnosis of the project's carbon footprint was carried out. Considering the reduction in energy consumption of all the buildings in the neighborhood, there is a reduction of 100,000÷150,000 kg of CO_2.[14]

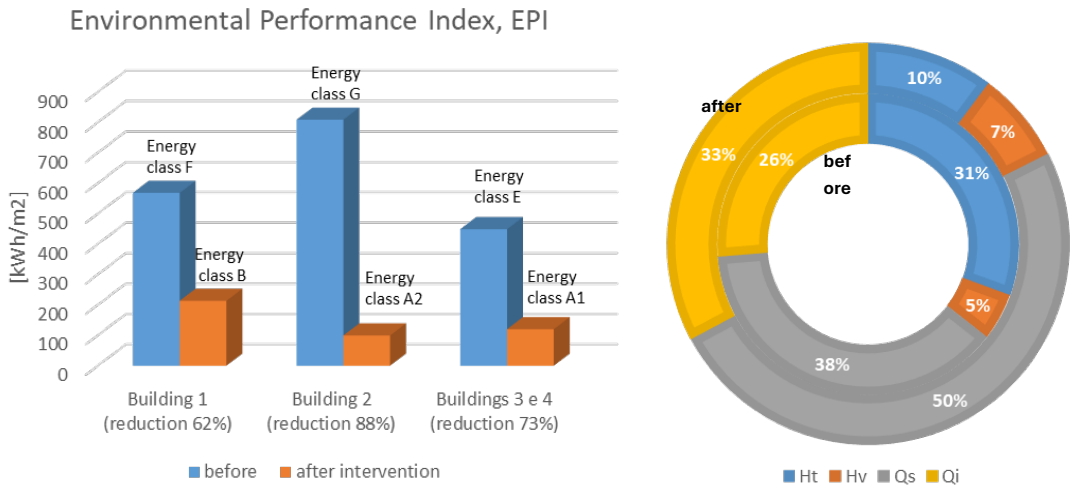


Figure 6. Reduction of the Epi of the buildings after the intervention (left) and percentage incidence of the energy requirement factors of building 1 (right)

Material approach. Analysis and strategies (building & urban aspects)

In this section, we analyze the material aspects, both of the building and the urban space, and the strategies to follow to achieve improvements in this aspect.

Much importance was given to the analysis of the surface temperatures of road pavements, which depends on various factors, solar reflectance, thermal emissivity and draining power.

Reflective surfaces would limit solar gains, and permeable materials would allow the evaporation of accumulated water to be exploited to keep cool.
The design of a suitable technological solution for road pavements[15] can significantly influence urban heat island (UHI).[16] Several studies have quantified this phenomenon and it has been possible to record heat island intensities above 12 °C. Furthermore, UHI has severe implications on the performance and energy costs of buildings, which represent approximately 40% of total energy consumption for end uses and 36% of CO_2 emissions in Europe.[17]
The design solution proposed for the Piazza Europa district focuses on the following passive strategies:
• Introducing cool materials on urban surfaces.
• Increase green and permeable areas.

Introducing cool materials for building and urban areas

The need to provide cool material was found following the high surface temperature values of building walls and urban pavements detected with thermographic analysis (irradiated and in the shade) fig. 7.
Regarding building surface, South-East walls show these surface temperatures: 43°C for stone walls and 41°C for concrete elements directly exposed to sun. North-East walls (non-radiated) show 31°C for stone walls (10 degrees less) and 36°C for concrete elements (5 degrees less).
In addition, different types of urban surfaces were taken: asphalt, concrete and natural terrain, which can be commented (table 2). Concrete has temperatures of approximately 7÷8°C lower than asphalt. Natural soil has temperature of approximately 12°C less than asphalt and approximately 5÷7°C less than concrete.

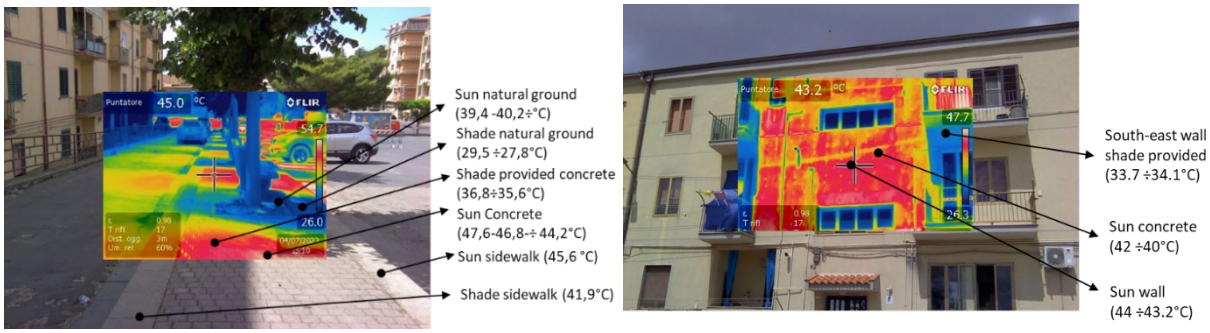
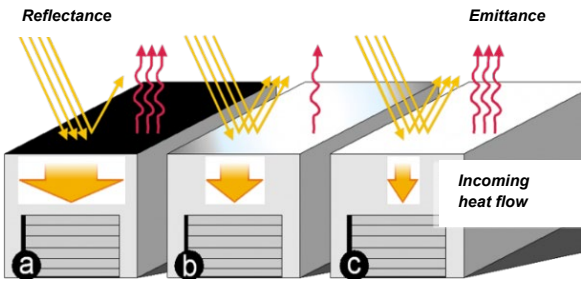


Figure 7. Facade and urban photothermography's

	Building surface		**Urban surface**			
Temperature surface	*Stone wall* [°C]	*Concrete* [°C]	*Asphalt* [°C]	*Natural ground* [°C]	*Concrete* [°C]	*Sidewalk* [°C]
shade (provided)	33.7÷34.1			29.5 ÷27.8	36.8÷35.6	
shade	30 ÷32	36 ÷38	37.5÷36.7			41.9
sun	44 ÷43.2	42 ÷40	52.4÷53.9	39.4 ÷40.2	47.6÷44.2	45.6

Table 2. Main table of urban and building surface temperatures.

The peak surface temperatures of the materials analyzed reach very high values, even 10-20°C higher than that of air. The stored thermal energy is released into the environment first through a heat exchange by conduction between the solid layers and then by convention between the surface of the materials and the air, with a consequent increase in the ambient temperature. Since streets, sidewalks, parking lots and pedestrian areas represent approximately 30-45% of the urban footprint, they play an important role in the neighborhood's energy balance. It was, therefore, decided to intervene on them, replacing them with “cool materials”.
The “cool materials”[18] are characterized by high reflectance, obtained both through light colours and through new technologies. These materials are generally used in roofs and recently for urban pavement. Their high reflectance allows them to limit the increase in surface temperature when subjected to solar loads, the high emissivity also allows greater thermal release of the heat stored heat (fig. 8). These characteristics influence, in the case of an application on urban paving, on the reduction of the heat released to the external environment by convection.[19]
The following table shows the emittance, albedo and solar reflectance index characteristics of the main materials used for urban paving[20] (fig. 8).



Solar Performance of coating materials

Material	Emittance (%)	Albedo (%)	Solar Reflectance Index (SRI)
Asphalt	90-95%	15-13%	6
Reflective concrete light	90-95%	39-22%	19 ~ 52
Draning coating	95%	30-20%	37
Loamy Soil	90-95%	15-35%	15
Grass	96%	20-26%	25

Figure 8. Solar performance of some cool materials

In the redevelopment project of the Piazza Europa district, the asphalt surfaces of the streets were replaced with concrete blocks that combine high reflectance with a water-permeable structure. Pervious concrete is establishing itself as a “cold material”, as it allows air, water and water vapor to be stored in its interstices.

Increase permeability surfaces & urban green areas

The processes of urban climatic environment degradation are partly produced by the waterproofing of surfaces. The impervious floor and soil and the vegetation absence determine an increase the temperatures of the external environment.[21] The inclusion of vegetation, however, with evapotranspiration, the dust fixation and harmful gases absorption could mitigate the negative effects.
In the case in question, the level of permeability was increased (over 30% on the entire site) by inserting green areas in the public spaces and favoring the use of porous materials for the external surfaces.
In particular, the design solution involves the use of low-thickness, cement-based “draining” flooring which has a reduced thickness ranging from 5 cm to a maximum of 8 cm with high values of resistance to compression and friction, making them also suitable for transit of light and medium vehicles.
It has also proposed to introduce Sustainable Urban Drainage Systems (SUDS) with permeable floors or with other devices integrated in the new urban green areas to increase infiltration like swales (fig. 9).

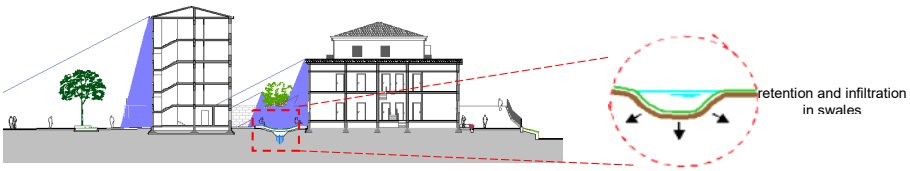


Figure 9. SUDS devices integrated in the new urban green areas

The design solution for the Piazza Europa neighborhood also includes the insertion of urban greenery. Urban green areas increase the permeable surface,[22] mitigate summer temperatures and improve outdoor comfort, with consequent energy savings for air conditioning.[23] On a summer day the temperature of the lawn can be up to 5°C lower than bare ground and 15°C lower than asphalt and the air temperature can be achieved (from 0.5°C to 1.5 °C) during the day and around half a degree during the night.[24]

In the case study, it is planned to plant 28 tall trees and many plants of different species, mainly indigenous and endemic.

With the intervention on the neighborhood, with substitution of asphalt with concrete blocks and green area, the waterproofed surface on the ground would drop from 91% to 60%, therefore by almost 30%, with significant benefits on the water cycle and management (table 3).

	Extension surface [m^2]		**Percentage on total surface** [%]		**Variation percentage** [%]
	Before	After	Before	After	
Waterproof surface	4.583	3.035	91%	60%	8%
Permeable surface	480	2.028	9%	40%	33%

Table 3. Comparison of impervious surfaces before and after the intervention

CONCLUSION

This project serves as a laboratory for testing sustainable development and planning methods. The criteria adopted for the redevelopment of the Piazza Europa district, based on the concept of eco-neighborhood, can be replicated elsewhere.

The study presented in this paper has allowed demonstrating the importance and feasibility of an energy efficiency intervention of an existing neighborhood with a holistic approach, which considers the buildings and the surrounding urban areas as a single system. Furthermore, it is believed that the systemic design approach adopted is innovative at an academic level and very formative for Architecture students. In fact, it is planned to continue to apply the systemic design to other case studies. That will allow us to develop a reference framework (criteria and interventions) for the redevelopment of existing neighborhoods in terms of sustainability.

The scientific research could be developed by analyzing different scenarios, simulating the variation in air temperature, before and after the intervention, and calculate the percentage contribution to the total energy improvement of the neighborhood of each single intervention adopted in the case study (cool material, permeability surface, insulation envelope, green wall, green area, etc.).

NOTES

[1] Federico Butera. *Sole, vento, acqua. Italia a emissioni zero nel 2050*. Roma: Manifestolibri, 2023.
[2] In this neighborhood, you cannot drive by car, leaving space for public green spaces, pedestrian areas, cycle paths, playgrounds.
[3] In this neighborhood, you cannot drive by car, leaving space for public green spaces, pedestrian areas, cycle paths, and playgrounds.
[4] Waste collection is not carried out here because it is channeled through a system of pneumatic tubes.
[5] Such as those activated by the Rig.ener.a program (Cavedoe towers, Bologna).
[6] The neighborhood has various services, different housing solutions integrated into the context, leisure spaces and meeting places. All created to develop an intelligent ecosystem with sustainability adequate infrastructure.
[7] An innovative model by Mario Cucinella Architects that integrates infrastructure and green spaces with an advanced climate analysis of buildings to guarantee sustainability and environmental comfort.
[8] Giulia Maci, et al. Urbego Urban pockets: reclaiming the public in left-over open spaces, 2015, https://issuu.com/urbego/docs/urban_pockets-reclaiming_the_public.
[9] The authors thank students: Borzì Antonina, Cannino Sara Maria, Russo Flavia, Di Vincenzo Rosa, Frisco Giuseppe Mirko, Emma Selenia, Caverna Serena, La Versa Ivana, Di Stefano Floriana, Guerrieri Alessando Francesco Maria, Nicotra Alessandro (app design) for their contribution to the study.
[10] Allowed direct solar gains to be controlled to maximize the internal heating of buildings (through solar capture greenhouses). Allowed natural ventilation to be exploited to bring greater comfort to external and internal environments.
[11] Increase in window surface to the South-East and South-West.
[12] Changing the functionality of the rooms depending on the exposure; the living areas (kitchen and living room) were arranged on the south elevation and the bedrooms were exposed to the north.
[13] The energy performance of all buildings was calculated according to the simplified method for calculating the needs and related primary energy limit values for winter and summer air conditioning (considering constant, before and after the intervention, the energy for the production of domestic hot water, for the lighting systems, for mechanical ventilation and for process energy). The energy class of the building is determined on the basis of the global non-renewable energy performance index of the building EPgl,nren. Sum of various indices, expressed in kWh/m2/year: EPgl,nren = EPH,nren + EPC,nren + EPW,nren + EPV,nren + EPL,nren + EPT,nren. (EPH,nren ed EPC,nren)= non-renewable primary energy requirement for winter conditioning.
[14] Considering that to produce 1 kWh of electricity, 0.65 kg of CO_2 are emitted into the atmosphere.
[15] The thermo-physical factors that influence the properties of the materials used for covering the road surface are thermal conductivity, layer thickness, thermal capacity and convection.
[16] The urban heat island (UHI) depends on: poor vegetation; use of materials characterized by high solar absorption values, low per
[17] Energy Performance of Buildings Directive (EU 2018/844).
[18] Generally applied in the cladding of buildings and in particular roofs, but they can also be used for road paving.
[19] In both cases, in temperate climates, the “Cool materials” represent an important strategy to mitigate the increase in energy consumption and the urban heat island effect. Results from large-scale urban heat mitigation projects show that the implementation of innovative mitigation technologies, such as super cool materials, can reduce building cooling energy consumption by up to 40%, decrease the concentration of harmful pollutants by up to 50%.
[20] Typical solar reflectance values for materials representing urban structures are: 5-6% for freshly laid asphalt (the bituminous conglomerate uniformly covers the surface); 15% for dated asphalt; 10-52% for concrete, 37% for draining floors, 15% for soil and 25% for grass.
[21] That is because recirculation of atmospheric particulates, in addition to the rapid runoff in the sewerage system causing serious problems in the management of surface rainwater.
[22] Allowing the natural absorption of the water flow, thus avoiding the risk of flooding.
[23] Katia Perini and Adriamo e Magliocco, “Effects of vegetation, urban density, building height, and atmospheric conditions on local temperatures and thermal comfort”. *Urban Forestry & Urban Greening* 13, 2014: 495–506.
[24] Eniolu Morakinyo Tobi, The potential micro-climate of a new coastal city Eko Atlantic, a planned city south of Victoria Island in the Nigerian state of Lagos, ENVI-MET, 2023, https://envi-met.com/wp-content/uploads/2022/12/ENVI-met_world-tour-Lagos.pdf.

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ARCHITECTURAL MASTER-PLANNING ON COMPLEX TERRAINS

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INTRODUCTION

Designing in complex terrains[1], such as wetlands, poses significant challenges for designers and developers, often leading to suboptimal walkways, land reclamation and the introduction of vehicular pathways. These interventions can result in the destruction of sensitive areas and significantly alter the landscape. This paper proposes a computational workflow to optimises walkability in complex terrains by addressing contrasting topography and ecologically sensitive areas. The workflow incorporates an Agent-Based simulation model, which simulates the actions and interactions of entities inhabiting dynamic environment. These entities sense and act autonomously, working to achieve predefined goals or tasks. The generated walkway are tested using a generative workflow that includes analysing map data and building contextual models using population and amenity data. The applicability and effectiveness of the workflow are evaluated in challenging terrain, particularly those involving ecologically sensitive areas, such as wetlands. This research equips designers with tools to make informed decisions in mastering planning and can be leveraged by various stakeholders, including those in real estate, public services, public health and other urban development sectors.

BACKGROUND RESEARCH

Biologically Inspired Adaptive Network Design[2]

Transport networks must balance cost, efficiency and fault tolerance. Inspired by Physarum polycephalum, which forms adaptive networks efficiently. demonstrated its use in a mathematical model mimicking the Tokyo rail system. This model shows potential for creating decentralised networks that balance efficiency and resilience. The study suggests that nature-inspired designs could improve network development.

Discussion Points

- Swarm intelligence has multiple applications and can be modeled through various methods.
- Physarealm,[3] a Grasshopper tool for agent-based modeling[4], replicates natural swarm intelligence, as seen in Physarum.

A City is Not a Tree[4]

In *A City is Not a Tree*, Alexander critiques traditional urban planning models that rely on hierarchical "tree" structures, arguing they oversimplify and segregate urban functions. He advocates for interconnected, organic approaches, reflecting a "semilattice" structure where overlapping elements

form complex networks. The book significantly impacts urban design, architecture, and complex systems discussions.

Case Studies

- **Columbia, Maryland**: Demonstrates a “tree” organisation with separate villages connected by transportation, emphasising structural simplicity.
- **Cambridge University**: Illustrates a "semilattice" organisation where the interconnected fabric of buildings and streets supports mixed functions.

Discussion Points

- The "semilattice axiom" relates to agent-based modeling (ABM[5]) pathways.
- Alexander’s ideas challenge the necessity for a hierarchical route system, aligning with findings from this research to validate the ABM tool's viability.

Challenges of Designing in Complex Terrains

Designing in steep terrain comes with various challenges including uneven surfaces, and varying elevations requiring advanced engineering for stability and accessibility. This will also lead to higher impact on the environment and could disrupt the ecosystem. Ensuring accessibility for all users and integrating infrastructure with the terrain are a few other challenges. The unique microclimates often require designs that are adaptable to conditions like heavy rainfall, landslides, or snow.[6]

Walkability and Urban Design in Sensitive terrains

Walkable urban spaces in sensitive terrains balance functionality with preservation. Pathways should follow natural contours, using local materials to reduce disruption. Public spaces improve interaction among people within the community while preserving the environment, and mixed-use developments reduce vehicle dependency.[7]

Computational Models in Masterplanning

Computational tools Could aid the design process by running various simulations comparing multiple parameters. Software like GIS and Rhino helps with site analysis and prediction of environmental impact.[8] Tools like Physarem and other ABM based tools could adapt to different terrain variations and optimise layouts. Computational models could also evaluate energy efficiency and water management, alongside producing advanced visuals to improve communication and decision-making. This shows that there are research gaps including integrating traditional knowledge with modern computational methods and addressing long-term impacts of climate change on complex terrains. Participatory design processes involving local communities remain underexplored, particularly in sensitive regions. Additionally, scalable solutions for smaller, resource-constrained projects are limited.

METHODS

This research employs computational tools, such as Grasshopper and Physarealm to simulate optimal pathways in complex terrains while considering factors like travel time and amenity relevance. The methodology includes GIS-based topography modeling[9] to analyse the terrain, swarm intelligence for pathfinding, and the integration of environmental obstacles. Pathways are evaluated using metrics such as Amenity Demand Profile (ADP) and Walk Score from Urbano, ensuring walkability and accessibility. The approach combines qualitative and quantitative methods, including statistical

modeling in Rhino and Grasshopper,[10] to analyse mobility and enhance urban planning. The ABM simulation in Physarealm provides valuable insights into the dynamics of complex urban environments. The research uses a wet terrain as a sample site, located in Dartford, London, United Kingdom.

Identifying Entry Points (Emitters)

Entry points, which serve as the starting locations for agents within the simulation, are strategically positioned by analysing traffic flow patterns and evenly spacing them throughout the site. This step involves making informed decisions to ensure realistic agent distribution.

Assigning Amenities (Food)

Amenities, representing the targets for agents to reach during the simulation, are assigned based on key points of interest within the site. These could include locations such as commercial centres, recreational areas, or public transportation hubs.

Iterative Analysis

The ABM simulation is run iteratively as shown in figure .1, with adjustments made to the model parameters and configurations to achieve desired outcomes. This iterative process allows for refinement and optimisation of the simulation settings to better reflect real-world conditions.

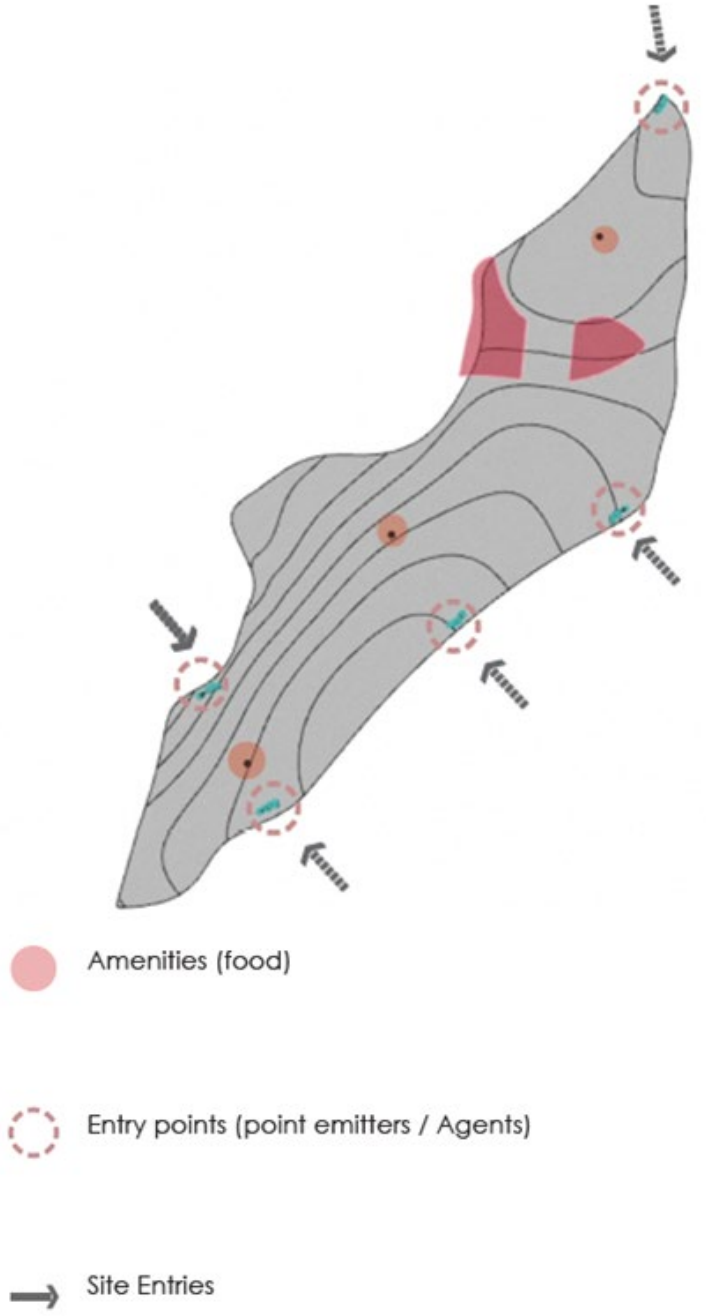

Figure 1. Setting up Agents and targets

Converting ABM Data to Usable Pathways

Upon completion of the ABM simulation, the generated data, typically consisting of discrete points representing agent movements, is processed to create coherent pathways. This involves tracing over the data points to construct pathways (Figure 2) that can be utilised for further analysis and design purposes.

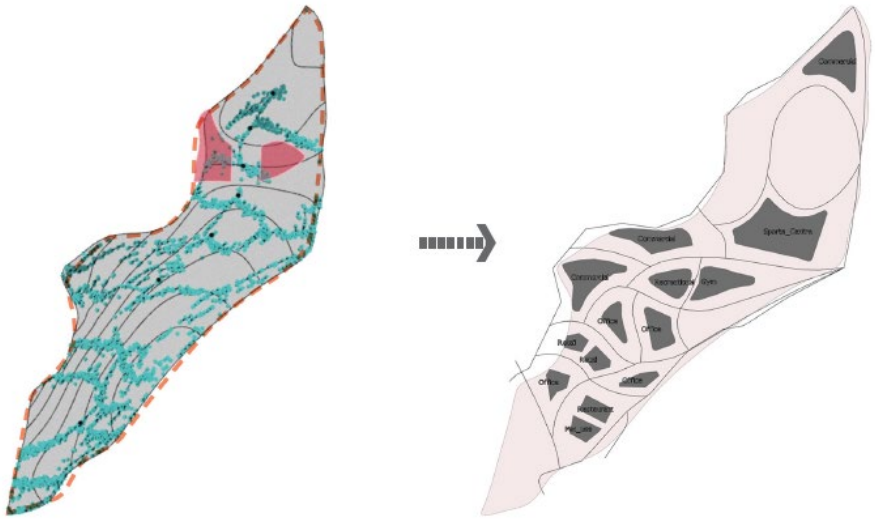

Figure 2. Converting simulation to lines

Setting up Urbano Toolkit

Concurrently with the ABM simulation, the Urbano toolkit is configured to facilitate the subsequent analysis and evaluation of the generated pathways. This section outlines the steps involved in setting up Urbano and integrating it into the workflow for assessing the effectiveness of the computational masterplan.

Building Amenities and Assigning Amenity Scores

In the process of building amenities and assigning amenity scores, we rely on data sourced from OpenStreetMap (OSM) to populate our dataset with relevant building information. However, while OSM provides a foundational dataset, we supplement this information with additional insights derived from

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Alongside the ABM simulation, the Urbano toolkit is configured to facilitate the subsequent analysis and evaluation of the generated pathways. This section outlines the steps involved in setting up Urbano and integrating it into the workflow for assessing the effectiveness of the computational masterplan.

Building Amenities and assigning amenity scores

In the process of building amenities and assigning amenity scores, we rely on data sourced from OpenStreetMap (OSM) to populate our dataset with relevant building information. However, while OSM provides a foundational dataset, we supplement this information with additional insights derived from Google's active hours data to enhance the accuracy of our analysis.

Initially, we extract building data from OSM, which serves as a valuable resource for obtaining detailed information about the physical infrastructure within the designated area of interest. This dataset includes a wide range of attributes associated with each building, such as its location, size, and purpose.

To further enrich our dataset and improve the precision of our analysis, we leverage Google's active hours data. This information offers valuable insights into the temporal patterns[11] of activity associated

with various amenities, allowing us to assign scores that reflect the level of engagement or usage during specific times of the day.
The integration of Google's active hours[12] data enables us to assign amenity scores that accurately capture the dynamics of human activity within the urban environment. By aligning these scores with real-world usage patterns, we can better assess the impact of amenities on pedestrian movement and urban accessibility. Moreover, the workflow allows for manual intervention in cases where certain data points are missing or require modification. This flexibility ensures that our analysis remains robust and adaptable to changing circumstances, empowering us to make informed decisions based on the most up-to-date information available.

Setting up ADP

In setting up the Amenity Demand Profile (ADP), we encounter a challenge regarding the adequacy of building metadata, particularly outside Manhattan. As a solution, manual configuration of the ADP becomes necessary to ensure accuracy and reliability in the evaluation process.
The ADP comprises 25 columns, each serving a distinct purpose in delineating the activity levels of amenities throughout the day. The first column serves as a reference for the name of the amenity, which can either be derived from existing metadata[13] or manually inputted. Subsequent columns, numbering 24 in total, correspond to each hour of the day. Within these columns, we specify the anticipated activity level of the building during each hour, or alternatively, identify peak hours of activity. While Google's active times serve as a valuable reference point for determining activity patterns, certain scenarios, such as new building developments, necessitate a more nuanced approach. In such cases, we rely on informed estimations based on comparable amenities within the surrounding context. By leveraging contextual cues and domain expertise, we can make educated guesses regarding the activity levels of these amenities at different times of the day. Overall, the manual setup of the ADP ensures flexibility and adaptability, allowing us to tailor activity profiles to specific urban contexts and design scenarios. Through meticulous attention to detail and consideration of various factors influencing activity patterns, we strive to create a comprehensive and accurate representation of amenity demand within the simulated environment.

Importing the ABM masterplan to Urbano workflow

Importing the ABM masterplan into the Urbano workflow involves several critical steps to ensure the seamless integration of the simulated urban environment into Urbano's analytical framework.

Creating Metadata

Before proceeding with the analysis, it's essential to create metadata[14] for the imported curves representing streets, buildings, and other urban features. This metadata includes relevant information such as building heights, functions, and amenity types. By accurately defining the attributes of each element, Urbano can effectively simulate pedestrian movement and assess urban design strategies.

Assigning Amenities and Respective Scores

In this step, amenities such as parks, schools, and commercial establishments need to be assigned within the simulated urban environment. Since the ABM masterplan may include imaginary buildings without corresponding data from sources like Google, amenities and their respective scores must be set up manually. This involves determining the importance and accessibility of each amenity based on its location and relevance to the surrounding area.

Adding New Street Network to the Existing One

Next, the street network generated by Physarealm needs to be integrated with the existing street data from OpenStreetMap (OSM) or other sources. This requires careful consideration to ensure consistency and connectivity between the different components of the urban infrastructure. By combining both datasets, Urbano can accurately simulate pedestrian movement and evaluate the effectiveness of the masterplan.

DATA

Physrealm Simulation

Simulation 1

Simulation 1 focuses on the initial design iteration, where one main amenity serves as the central point of focus. However, due to steep topography, approximately 25% of the agents were unable to establish connections. It's important to note that agents are emitted from all major entry points in each simulation.

Simulation 2

In Simulation 2, we explore an alternative approach by incorporating three major amenities instead of just one. This adjustment aims to provide agents with greater flexibility and creates a more complete pathway design. However, despite these enhancements, the utilisation of the wetland area still appears underutilised and warrants further exploration.

Simulation 3

In Simulation 3, we introduced the wetland area as an obstacle within the pathway design. This addition aimed to test how agents would navigate around the wetland and whether it would significantly impact the pathway. Surprisingly, the presence of the wetland proved to be a significant deterrent, causing the agents to avoid the path altogether. This observation highlights the considerable influence that environmental obstacles, such as wetlands, can have on pedestrian movement patterns within the urban landscape. Further analysis is required to understand the implications of this finding and explore potential strategies for mitigating the impact of such obstacles on pathway design and accessibility.

Simulation 4

In Simulation 4, we addressed the challenge posed by the wetland obstacle by introducing a bridge that spans over it. This solution effectively mitigated the issue of pathway interruption caused by the wetland, allowing agents to traverse the area without disruption. However, an unexpected observation emerged regarding the north entrance, which was found to be suboptimal in terms of pathway efficiency. As a result, it is advisable to minimise the use of this entrance to ensure smoother pedestrian flow and overall pathway optimisation. This finding underscores the importance of carefully evaluating the design and placement of entry points to maximise the effectiveness of the pedestrian pathway network.

Simulations and timeline

The visual shows different simulations and results that we've created using computational modelling. These visuals will help us explore different scenarios, like how people move around and access amenities in our site. We'll look at various setups, such as different entry points and where we place main amenities. By seeing how pedestrians interact with the space, we'll gain valuable insights into what design choices work best. Comparing and analysing these outcomes will give us a deeper

understanding of the urban environment and how we can improve it. This will guide us in making smarter decisions and refining our masterplan.

Testing the ABM Pathway in Urbano

Importing OSM Data for the Specific Site

For this analysis, the site located in Dartford. The images provide an overview of the site and its surrounding context, with the highlighted area indicating the specific site area selected for analysis.

Integrating the ABM Model

The ABM pathway and buildings are integrated into the Urbano workflow as polylines. This integration ensures that the simulated pathway and urban features are accurately represented within Urbano's analytical framework.

Setting up ADP

To simulate pedestrian activity realistically, amenities need to be specified manually. Building amenities are assigned based on contextual analysis, taking into account factors such as building function and nearby amenities. Additionally, the active time data for each building is set based on comparisons with Google active times data for adjacent buildings.

This image shows the Manually inputted data for the amenities and their relevance, regarding their active times. The data is normalised from 0-1. where 0 being least active and 1 being the most active.

Generating Street Hits

Once the OSM data is combined with the ABM data, the simulation is run to generate street hits. These street hits represent pedestrian traffic or activity on specific pathways within the simulated urban environment. The images illustrate the distribution of street hits for each pathway, highlighting areas of high pedestrian activity.

Generating Walk Score

The walk score is derived from the street hits and normalised[15] to a scale of 1-100 for better understanding. The first image displays the pathway ID, facilitating the identification of each pathway, while the second image shows the corresponding walk score in relation to the pathway. This walk score provides a comprehensive evaluation of the walkability of the urban environment, considering factors such as pedestrian connectivity and access to amenities.

Results

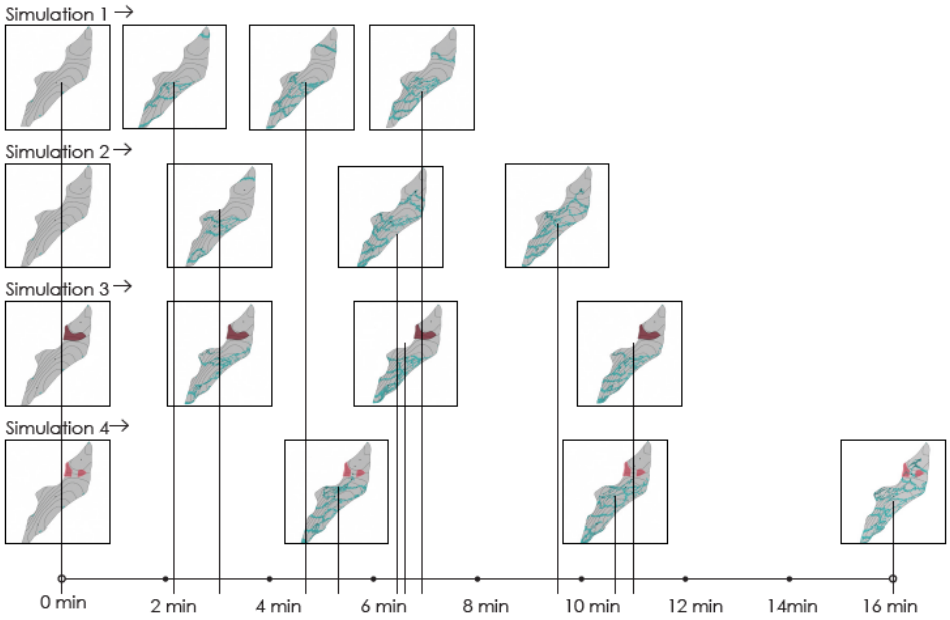

Figure 3. Simulation results from Physarealm

Pathway ID

Each pathway is uniquely identified by its ID, allowing for easy reference and analysis.

Figure 4. Translating Physarelm Simulation to Curves

Figure 5. Translating PhysarelM Simulation to Curves

Amenity

The type of amenity located along each pathway, indicating the diversity of amenities available within the urban area.

Figure 6. Amenities

Street Hit

The number of street hits represents the level of pedestrian activity observed on each pathway. Higher street hits indicate greater pedestrian traffic and utilisation of the pathway.

Figure 7. Street hits

Walk Score

The walk score provides a comprehensive evaluation of the walkability of each pathway, considering factors such as pedestrian connectivity and access to amenities. A higher walk score suggests a more walkable environment with better pedestrian infrastructure and amenities.

Figure 8. Street hits Noralised to 0 -100

Figure 9. Graph showing walk score, in co-relation to the pathway ID

The simulation results indicate varying levels of pedestrian activity and walkability across different pathways within the urban environment. Pathways associated with amenities such as restaurants, shops, and parks tend to have higher street hits and walk scores, reflecting their attractiveness and importance in promoting pedestrian activity.

Comparing Semilattice Axiom with ABM Generated Masterplan

In computational master-planning, particularly using swarm intelligence and tools like Physarealm, there is a resonance with Alexander's semi-lattice axiom. Swarm intelligence, inspired by collective behaviour in natural systems, involves agents interacting locally to achieve global optimisation. This aligns with the idea of interconnectedness and decentralised decision-making, adhering to Alexander's vision.

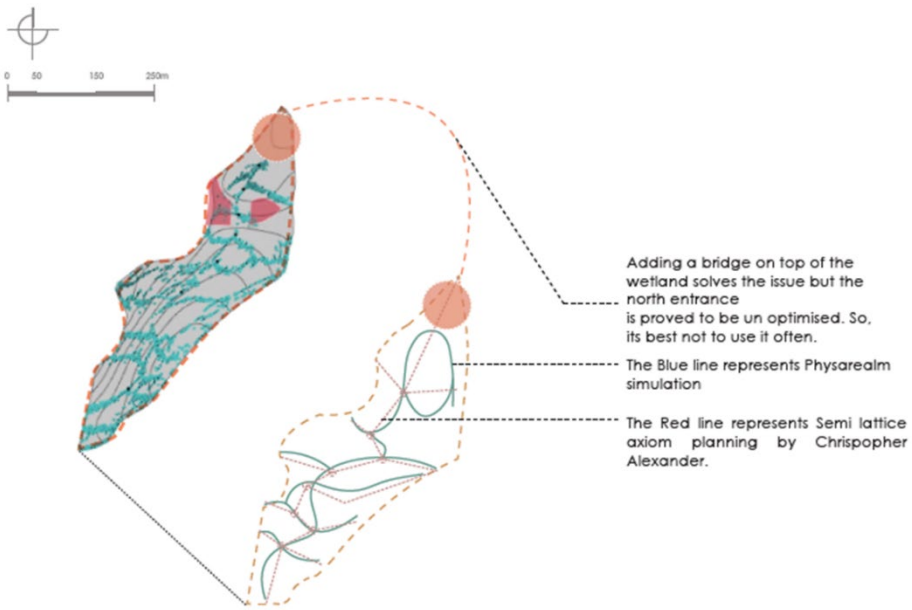

Figure 10. Comparing the ABM masterplan eith C.Alexander's Semilattice planning

CONCLUSION

This paper investigated the potential of computational design tools to improve pedestrian-friendly master planning in complex terrains. The research question centered on how these tools could be leveraged to consider both environmental and innovative aspects. The core of this research focused on creating a novel workflow that integrates agent-based modelling (ABM) with generative design tools. This workflow aimed to optimise walkability in complex terrains by simulating pedestrian movement and generating walkway layouts that prioritise pedestrian needs while respecting ecological sensitivities.

The findings of the research demonstrated the effectiveness of the proposed workflow in achieving its objectives. The results revealed that the ABM simulations successfully captured the dynamics of pedestrian movement, with variations in activity levels observed along different pathways. This suggests the capability of the workflow to generate walkable environments that consider pedestrian behavior. Furthermore, the research highlighted the importance of amenity allocation in promoting walkability. The analysis showed a positive correlation between pedestrian activity and proximity to amenities, underlining the need to strategically integrate amenities during the master planning process.

While limitations such as the exclusion of certain factors influencing pedestrian behavior (e.g., weather) were acknowledged, the research presented a significant contribution to the field. This research establishes a systematic and data-driven approach for evaluating walkability in complex terrains using computational methods. This approach offers valuable insights for urban planners and designers, empowering them to create more pedestrian-friendly and sustainable urban environments. Future research can address the identified limitations and refine the methodology to enhance the generalisability and accuracy of the results.

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A PARADIGM OF ECOLOGICAL ARCHITECTURE IN VULNERABLE CONTEXTS: *METHODOLOGY & TOOLKIT*

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INTRODUCTION

Ecological architecture is a known branch of sustainable practice & design, aiming to minimize the environmental impact of architecture using principles that respond to the local climate.[1] Ecological urbanism practices aim to imitate ecosystems in the city and integrate it as opposed to intrinsically supporting the ecological systems. Both fields use principles such as renewable resources, minimizing waste, energy consumption, and use of locally sourced materials. However, it is known that ecological design or "sustainable design" can be more prevalent in privileged contexts and seen as an attainable design style rather than an instinctive design approach designed for the community. Consequently, leaving vulnerable contexts behind in the discourse of its design & research, and raising a need to address the accessibility of vulnerable communities to ecological design and the resources necessary to implement and assess it. Hence, the aim of this thesis is to bridge the gap and provide a hybrid methodology, and tools to serve as a guideline for implementing ecological design in vulnerable contexts throughout different domains: Urban, socioeconomic and architectural. This is addressed by intersecting different definitions of vulnerability relating to low socio-economic status, environmental challenges, and with contextual parameters rooted in affinity, accessibility and risk to resources and the built environment, in order to provide a comprehensive overview of vulnerability, then contextualizing vulnerability in the case study of La Pau, Barcelona, to synthesize a vulnerability assessment tool, measures and strategies to reduce vulnerability as well as create a future framework for different vulnerable contexts throughout the world.

METHODOLOGY

Framework

The research's theoretical framework focuses on several main aspects, including: vulnerability, resource metabolism, and current methodologies. The vulnerability aspect aims to construct a comprehensive understanding of vulnerability based on common global definitions as well as what this research refers to as "contextual vulnerability". The common global vulnerability includes firstly: Environmental vulnerability's existing definitions by EPA & other international bodies and secondly Socio-economic vulnerability. Meanwhile, the contextual vulnerability is based on a Metabolic Vulnerability approach of the following: Urban ecology, Socio-economic, and Architectural metabolism, all of which are the focus of the vulnerability assessment in the case study, in an effort to shift from descriptive theory to normative theory to provide a more comprehensive theoretical premise in order to develop tools to diagnose and map vulnerability in the case study.

Steps

Throughout the mapping & research process the thesis includes the following three steps: 1. Common Global Vulnerability, 2. Contextual Vulnerability, 3. Synthesis of vulnerability diagnosis tools, and finally proposing some measures to reduce vulnerability. In step (1) global vulnerability parameters across environmental and socioeconomic domains were analyzed and mapped such as risks to natural disasters, temperature change, and air pollution, and displacement & immigration, informal settlements, and resource security poverty (energy) in the socio economic humanitarian vulnerability section. Step (2) focused on the case study of the La Pau neighborhood, the contextual vulnerability was addressed by analyzing the previously mentioned domains of: urban ecology, socioeconomic, and architectural metabolism and consequently identifying parameters per domain. In Step (3) assessment tools were developed to support the diagnosis process alongside the mapping of vulnerability and to address qualitative and quantitative assessment. The tools in step (3) includes a radar chart tool that quantifies vulnerability during the mapping process, and the second tool is a solution matrix that tests the effect of the solutions with the vulnerability parameters with the achievable goals and agency to implement the resilience action.

CONTEXTUALIZING VULNERABILITY THEORY

Traditional identification model of vulnerability

In 2012, a study used census data to measure urban vulnerability in Spain.[2] It identified four key aspects: socio-demographic vulnerability (e.g., age-based indexes), socio-economic vulnerability (e.g., unemployment and labor skills), residential vulnerability (e.g., dwelling area per resident), and subjective vulnerability (e.g., perceptions of pollution and noise). This research adjusted the traditional model to create a contextual model with three adapted categories *(shown in fig.1):* Urban Ecology Vulnerability (combining socio-economic and environmental indicators), Socio-Economic Vulnerability (combining socio-economic and demographic indicators), and Architectural Vulnerability (combining residential and subjective indicators).

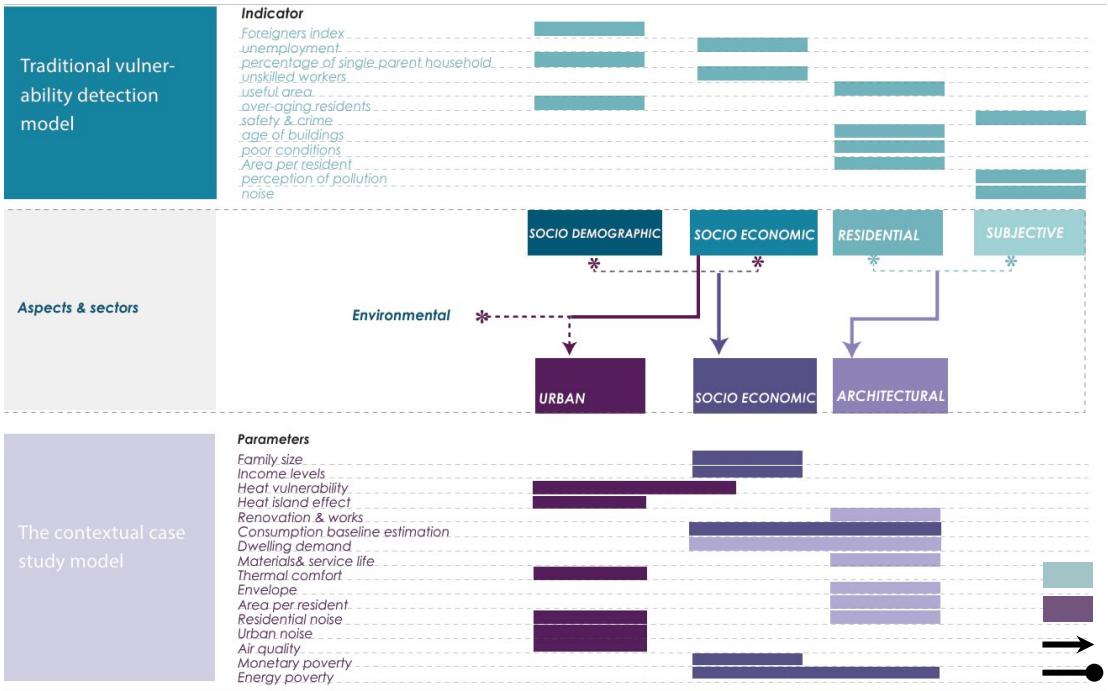

Figure 1. Traditional and contextual vulnerability detection models

Energy poverty & Underconsumption

To promote ecological design for vulnerable communities, it's crucial to address their specific needs. Family size impacts internal conditions like space requirements, overcrowding, and energy consumption.[3] Income levels were analyzed using 2020-2022 data from the Instituto Nacional de Estadística *(INE),* revealing that 30% of residents earn between €30,500 and €35,000 annually (income 1), 26.9% earn between €26,500 and €28,500 (income 2), and 43.2% earn between €28,500 and €30,500 (income 3).[4] In contrast, Catalunya's average household income in 2022 was €36,163,[5] indicating that La Pau residents are below this income average.

Underconsumption & the trade-off phenomenon

The energy demand needed for heating and cooling services differs based on various factors such as regional climate, season, thermal comfort temperature, efficiency of the appliances used, and thermal performance building.[6] Another factor is of a socio-economic nature, the potential of the families spend money on these services, therefore, the actual energy consumed in households can be less than the energy required to achieve the minimum thermal comfort. This behavior is usually known as underconsumption.[7] This can be also described as a trade-off phenomenon, meaning low-income families might have to potentially sacrifice major consumption such as heating and their comfort conditions to maintain their minimum comfort conditions.

THE CASE STUDY: LA PAU, BARCELONA

About La Pau

La Pau is a neighborhood located in the Sant Martí district of Barcelona, Spain. It was developed in the mid- 1900's to accommodate the growing population and new immigration to the city. To address this issue, the Spanish government initiated a program to build new housing developments, known as "Plan de Urgencia Social."[8] La Pau was one of the neighborhoods built under this plan, and construction began in the early 1960s. La Pau consists of 4 census zones and over 60 buildings of 5-16 stories high and includes 2499 dwelling units that accommodate 3-4 bedrooms *(review fig.2)*.[9]

Framework of the case study

Taking into account the socioeconomic conditions and the characteristics of the existing building stock in the different districts and neighborhoods of Barcelona, preliminary work identified the areas where there could be a greater potential for vulnerable conditions.[10] This included reviewing existing vulnerabilities research on the three main domains: urban ecology, socio-economic in the city of Barcelona as baseline then in the neighborhood of La Pau, and architectural metabolism which analyzes the common dwelling unit, and a typical residential building performance. It's notable that although all indicators have quantitative value, some indicators have qualitative value, hence, some indicators could be mapped into a qualitative final synthesized vulnerability map and some couldn't not, this is mainly due to the data scope and scale.

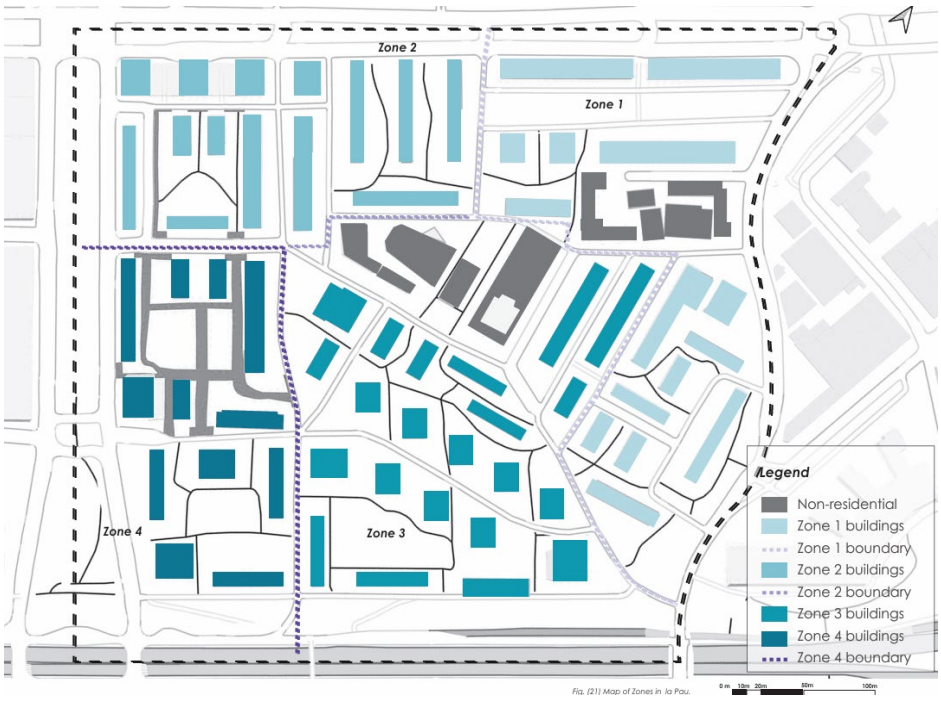

Figure 2. Map of La Pau

Process & methods in the case study

Firstly, regarding the urban domain is done by analyzing the parameters in the city of Barcelona with a closer examination of the La Pau neighborhood using GIS data and local official bodies reports such as *Barcelona regional's* study of climate change impact on the city of Barcelona (2017) and *Climate Fit City project* interactive website. Relevant urban indicators were selected that include environmental indicators such as air quality, urban noise, thermal comfort, heat vulnerability and heat island effect (UHI). Secondly, socioeconomic vulnerability is addressed by the analysis of *Instituto Nacional de Estadistica (INE)* data and maps in the city and neighborhood's census zones. Additionally using the data from *Institute for the Diversification and Saving of Energy (IDAE).* The indicators include: monetary poverty, energy poverty, an estimate of the energy expenditure for an average family in the city, to be compared to La Pau's actual income, as well as a baseline established of La Pau's expected energy demand relevant to the average city family demand. Thirdly, the architectural metabolism vulnerability was addressed by analyzing the following: service life of the building's material, thermal behavior of the envelope, reviewing 2011 census data of the conditions and renovations of the buildings (residential vulnerability), pathologies reported by the community, residential noise, in addition to using Revit modeling software to forecast the demand of an actual la Pau apartment.

The indicators in the contextual model

Figure 3 summarizes the indicators that were mapped across the three domains as follows:

	INDICATOR	UNIT	CONSIDERATIONS	DATA SCOPE	METHOD	SOURCE
URBAN	Heat vulnerability	Qualitative: intensity according to average	1. Population over 75. 2. cooling theoretical demand 3. presence and 4. health of vegetation, 5. percentage of illiterate or uneducated.	data available by zones	Based on 2015 census data mapped by Barcelona Regional in 2017 and resilience atlas. The study combines socio economic, demographic, environmental, and energy demand indicators and compares them to the city's average	Estudi dels impactes del canvis climatic a Barcelona"
	Heat island effect (summer intensity)	oC	The increased air and surface temperatures compared to the rural areas	100m by 100m grid	For a selected period, computed by subtracting the average rural temperature with an altitude correction from climate fit city project interactive map. Then focusing on La Pau by studying a 100m x 100m grids	Climate fit city project
	Thermal comfort	Numerical value	Light reflection, plant cover, radiation	areas in the city	Layering albedo (light reflection percentage), plant cover and solar radiation. Based on this it can be detected the areas that retain more heat,therefore have a lower level of thermal comfort.	Open data BCN & resilience atlas
SOCIOECONOMIC	Underconsumption	Qualitative: intensity	1. energy classification of buildings 2. income of households 3. density.	1. by community 2. by zone 3. by block.	Applying average income of zone and density of blocks on the buildings, within the blocks and zones. Layering of energy classification of the buildings obtained from Enersi.es mapping.	1. Enersi.es 2.INE, 3. Pla dels barrio
ARCHITECTURAL	Residential indicators	Qualitative: intensity	1. past renovation 2. past facade conservation 3. rehabilitation requests	by buildings in the zone	Selected residential indicators and layering of these indicators from the study " estudi i deteccio a la ciutat de barcelona d' ambits de vulnerabilitat residencial, 2017. "	Estudi i deteccio a la ciutat de barcelona d' ambits de vulnerabilitat residencial. 2017. "
	Pathologies	Qualitative: intensity	humidity, cracks, facade, balconies	by community	Visualized data in information sheets titled "FICHAS INFORMATIVAS SOBRE EL ESTADO DE LOS EDIFICIOS DEL BARRIO LA PAU Y OTROS PROBLEMAS QUE PADECEN LAS VECINAS Y VECINOS", " applied on each community in each session held by the association. Result was a map of communities whose buildings have pathologies or excluded or healthy.	Information sheet Associació De Veins La Pau

Figure 3. Mapped indicators in La Pau

A SYNTHESIZED VULNERABILITY

Between Qualitative and Quantitative vulnerability

To enhance vulnerability assessment, both qualitative and quantitative approaches were integrated in parallel to cross referencing the indicators and mapping of vulnerability, an attempt to quantify vulnerability using tools was employed. The goal is to use qualitative vulnerability intensity mapping alongside the quantitative radar chart tool *(fig. 4)* to formulate a more comprehensive diagnosis, additionally to detect priority of intervention as discussed in the following section. A heat map table was created to unify the scale of the indicators, serving as a foundation for the radar chart tool. This standardization was necessary due to the varying data types and scales, such as indicators with neighborhood average scale, or by statistical zone or by 100x100m grids data scale for the Urban Heat Islands (UHI). The scales of vulnerability were standardized using a percentage approach across five established steps in the heat map table ranging from 0% (least vulnerable value) to 100% (most vulnerable). Step 0 was the minimum value of indicator, and step 5 was maximum value, middle values were established, especially the standard threshold (*shown in blue)* that determines vulnerable values *(shown in red),* as well as La Pau's values. Moreover, this tool is crucial for evaluating potential interventions that could reduce vulnerability levels, ensuring a balanced approach across different domains, and ideally bringing vulnerability closer to the center of the radar chart, indicating lower vulnerability.

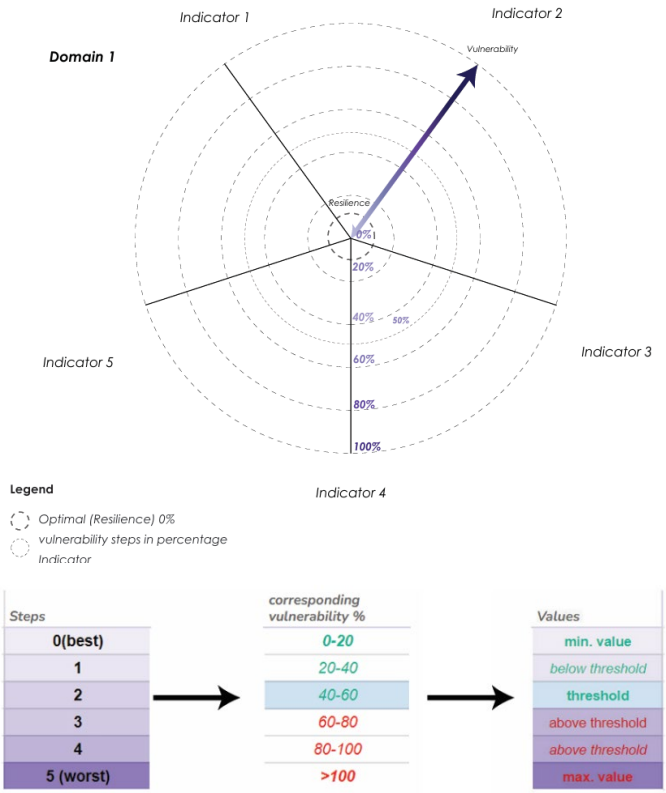

Figure 4. Radar chart tool and heat map conversion scale

Synthesized vulnerability across the three domains

The following map *(fig.5)* shows the layering of the indicators that were previously separately mapped across the three different domains, including some of the existing indicators and the newly synthesized vulnerability constructed by crossing referencing existing different sub-indicators. The charts in *(fig.5)* show the result of the analysis, allowing for the identification of high levels of vulnerability in the set of indicators as is the case of the architectural vulnerability chart *(fig.5, lower right)*, as well as detect the imbalance of indicators in each domain, as is the case in urban ecology vulnerability *(gif. 5, upper right)*.

In the urban ecology domain, this map includes thermal comfort, heat vulnerability and the heat island effect intensity in summer (UHI). In the socio-economic domain, this map shows the layering of a cross reference between income levels of households, energy classifications of buildings and density in order to synthesize underconsumption vulnerability. In the architectural metabolism domain, this map shows a cross referencing of the selected predefined residential indicators found in the study and pathologies reported in the building by the community.

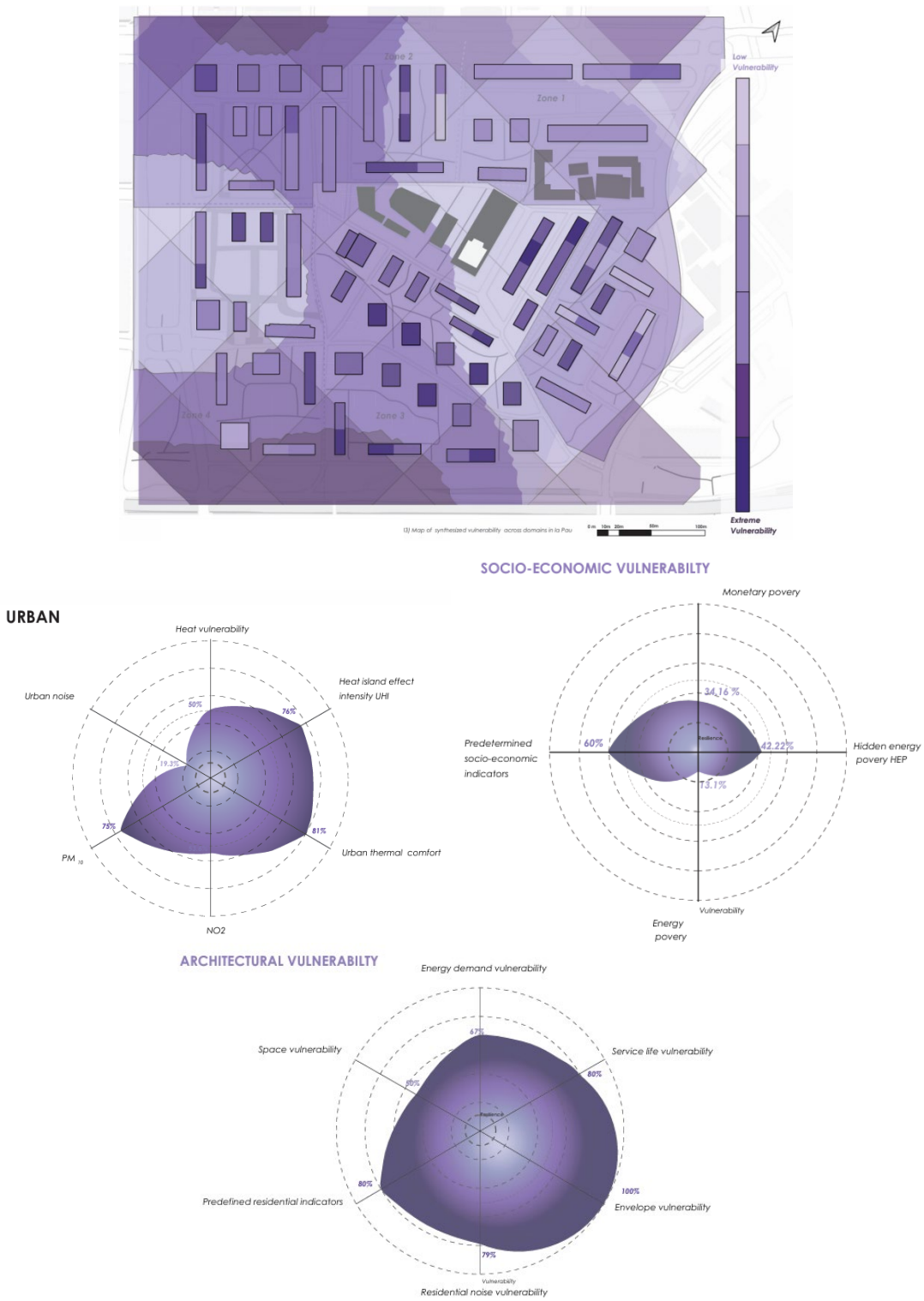

Figure 5. Vulnerability map and radar chart diagnosis

Priority detection

Using intensity vulnerability mapping and a radar chart tool, community blocks with the highest vulnerability can be identified for priority intervention. Three priority levels were established by first identifying the highest vulnerability levels on the chart, focusing on the outer rings per indicator. Then, maps were used to isolate buildings, community blocks, or urban spaces with the highest

vulnerability intensity. This can be applied either by indicator for more specific results or by domains or by cross-domain mapping. Figure 6 shows the result of the priority mapping by buildings and urban space.

CONCLUSION & RESULTS DISCUSSION

Urban ecology vulnerability

Regarding Air quality. La Pau's PM levels are within the medium range of (20-25) µg/m3, which also corresponds with average in Spain.[11] Pertaining to thermal comfort, La Pau's inner spaces , the comfort level dissipates quickly, while the Northern east area in Zone1 shows the highest thermal comfort factor, and the southern west corner on the main street has the lowest comfort. About the urban noise, 19.13% of its streets are of high noise levels above 70 dB considering the urban morphology of the neighborhood by which it is surrounded by and not penetrated with busy streets.[12] Regarding the heat vulnerability, it is evident that La Pau suffers from high heat vulnerability with a classification of "medium high" which is above the city's average.[13] Heat Island intensity (UHI) is more congested in the center of the neighborhood. On average in la Pau it is equivalent to 1.9 º C, while the threshold is 1º C.[14]

Figure 6. Priority detection

Socio-economic vulnerability

In monetary poverty, the city's income per consumption unit that is less than 60% of the median weighted average is calculated based on *INE* data to be 15.97% of population suffer from monetary poverty. In La Pau, the weighted average is 20.5% of the population.[15] Considering the estimated electricity bill based on the common electricity tariffs and estimated energy demand *(review table 2),* in a lower income household (income 3), the estimated electricity bill based on IDAE reports would represent an average of 11% of La Pau's income 3 residents total annual income.[16] Consequently, in a heating month which is considered the highest bill paying month, the electricity bill would be 17.9% of the monthly income. In a cooling month, it would be 10% of monthly income. Meanwhile the national Catalonian average of an equal electricity bill is calculated as 8.4% of the average annual income.[17]

Regarding predefined socio-economic indicators analyzed in previous research, in La Pau, the results were as follows: low aid for the payment of rent in all zones, high evictions in Zone 3 and low in others, high specific aid from social services in zones 1, 2, 3 and moderate in zone 4. Very high pensions or disability (PNC) in zones 2, 3, 4 and low in zone 1, high unemployment rate in the entire neighborhood on average. Lastly, very high unskilled workers in zone 2, followed by zones 3,4.[18]

Architectural metabolism vulnerability

Primary energy considers the activities of cooling, heating, SHW in kWh/m^2/year, this is directly based on the primary energy emissions scale used to identify the energy classifications from A-G. La Pau's average dwelling's primary demand is equal to 113 kWh/m^2/year, within the threshold of 111-136.6 kWh/m^2/year that is an equivalent of E classification.[19] It can be concluded that the total primary energy emissions in the modeled building is 53 kgCO2e/ (m^2.year), higher than the reference value of 49 kgCO2e/ (m^2.year).[20] Pertaining to energy demand Table 1 summarizes the baseline demand in the city summarized, and the forecast demand in La Pau is summarized in Table 2. These results lead to an adjusted bills expenditure and income as follows: La Pau's income highest income level (level 1) resulted in a 12.1% bills expenditure of total annual income, the middle income level (level 2) resulted in 13.1% of total annual income, and lowest income level (level 3) resulted in 14.1% electricity bills expenditure. Meanwhile, the national Catalonian average is 8.4%.[21]

Classification	Value
Yearly per household	8872 *kWh/(year.household)*
Yearly per m^2	112.3 *kWh/(year.m^2)*
Yearly per person	2218 *kWh/(year.person)*
Monthly per person	184 *kWh/(month.person)*

Table 1. City Baseline Estimation (energy demand)

Classification	Value
Yearly per household	11591 *kWh/(year.household)*
Yearly per m^2	173 *kWh/(year.m^2)*
Yearly per person	2898 *kWh/(year.person)*
Monthly per person	241 *kWh/(month.person)*

Table 2. La Pau Forecast (energy demand)

Regarding residential noise, that refers to the percentage of La Pau population that are exposed to urban noise levels; 33.44% of the neighborhood's population are located in the buildings with high level noise of (70-80 dB), and 45.43 % in the buildings of moderate noise levels (60-65 dB), and 21.13% of the population are located within (55-60 dB) noise levels or less.[22] Moreover, in La Pau, the percentages are more than double Barcelona's La Pau's exposed population.[23]

Physical performance

Firstly, the pathologies of humidity, cracks, facade and balcony pathologies were mapped based on a report created by the neighborhood association. The following results were found: the highest concentration of pathologies in the recorded communities of the buildings were in zone 1 in the north east area of the neighborhood, followed by zones 2,4,3 respectively.[24] Secondly, regarding thermal performance, the calculated average global coefficient of heat transmission in the building elements (K_{lim}) is 1.25 W/m^2K; calculated based on the simplified formula

$K = \Sigma x\ Hx / A_{int}$ (1)

for all envelope elements. Nonetheless, the required coefficient (K_{lim}) for this climatic zone and this typology is 0.81 W/m^2 K.[25] Furthermore, some materials have reached obsolescence such as fiberglass insulation, others have an estimated end of service life in the upcoming 5 years; based on analysis of insulation reports.[26] Thirdly, the predefined residential indicators (fig. 7) as analyzed in the study with the sub indicators of: inhabitants per dwelling, buildings over 40 years old with no works recorded, records of facade conservation, buildings over 40 years old without rehabilitation requests indicate the following: zone 3 was the most vulnerable, followed by zone 2, zone 1, zone 4, respectively.[27]

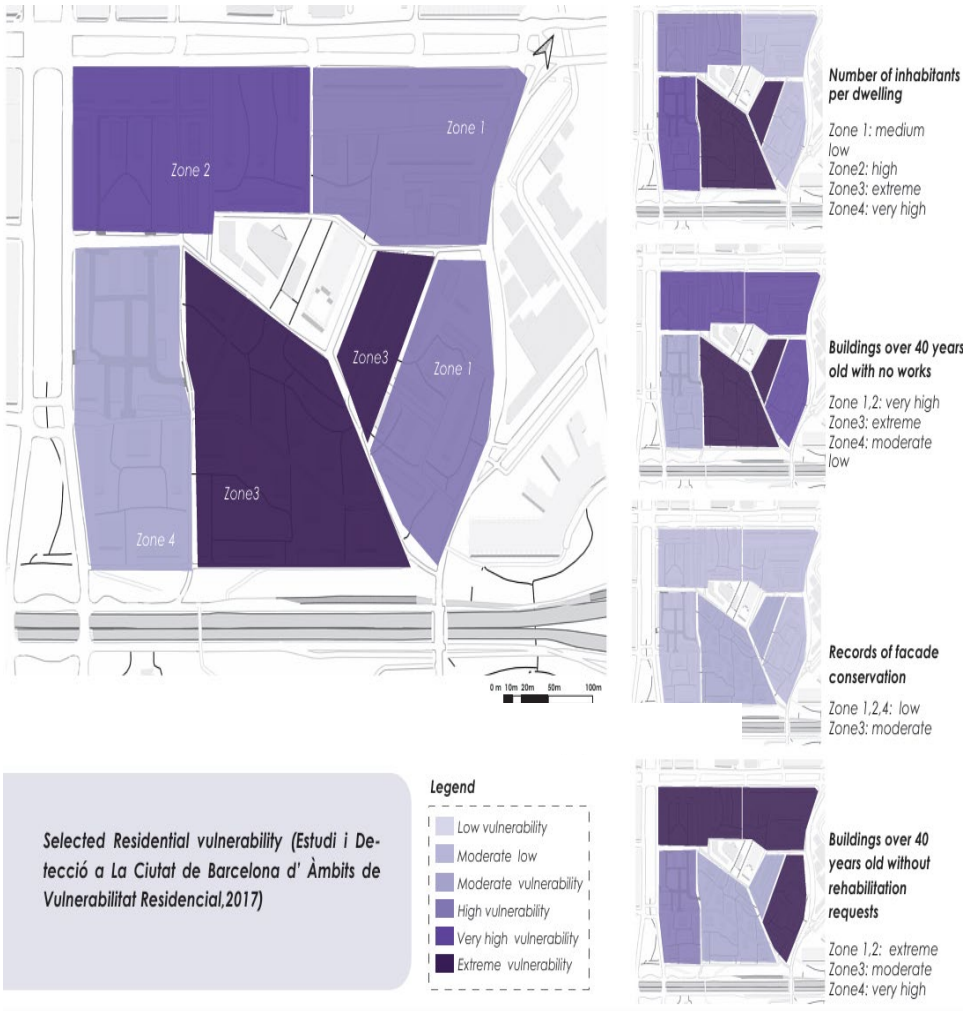

Figure 7. Residential Vulnerability

Solution testing

In the process of constructing a hybrid methodology for assessing interventions in vulnerable comments, another tool was developed as previously mentioned in the framework section. This tool's purpose is to aid in quickly assessing suitable solutions and their connection to the indicator across each domain as well as project goals, agency of implementation, and the relationship of the solutions themselves. This tool is referred to as the resilience matrix *(in fig 8)*. The matrix includes sub-matrices, known as affinity matrices, which analyze the relationships between indicators within themselves and solutions within themselves, aiding to group them effectively.

Figure 8. Solution testing matrix

The solutions in the matrix are drawn from common practices, municipal rehabilitation guidelines, and suggestions from the ENERHAT platform, a database that targets solutions for energy-efficient building rehabilitation in Barcelona.[28] The solutions explore possibilities to reduce the indicators per domain, applied on the discussed tools. (e.g. internal insulation of dwellings and their effect in reducing the envelope vulnerability by addressing thermal performance). As seen in the following figure, which demonstrates some of these solutions' effect on the vulnerabilities found. For example: against the urban heat vulnerability indicator, the goal would be to reduce heat vulnerability. This goal can be achieved in the urban domain by an agency of the local government, a suggested solution analyzed in this section is public space material for thermal inertia, this solution is directly related with the reduction of the UHI vulnerability and increases thermal urban comfort. Furthermore, this approach to testing solutions offers a more comprehensive understanding of the complexities of the built environment, especially concerning solutions that target different indicators across different domains. The following figure *(fig.9)* shows a summary of an example solution testing using figure, the solution was estimated to save 33% energy annually, after testing yielded a 27% vulnerability reduction in the energy demand. Similarly 10% reduction yielded a 7% energy demand reduction, and 3% yielded 3% in vulnerability reduction.

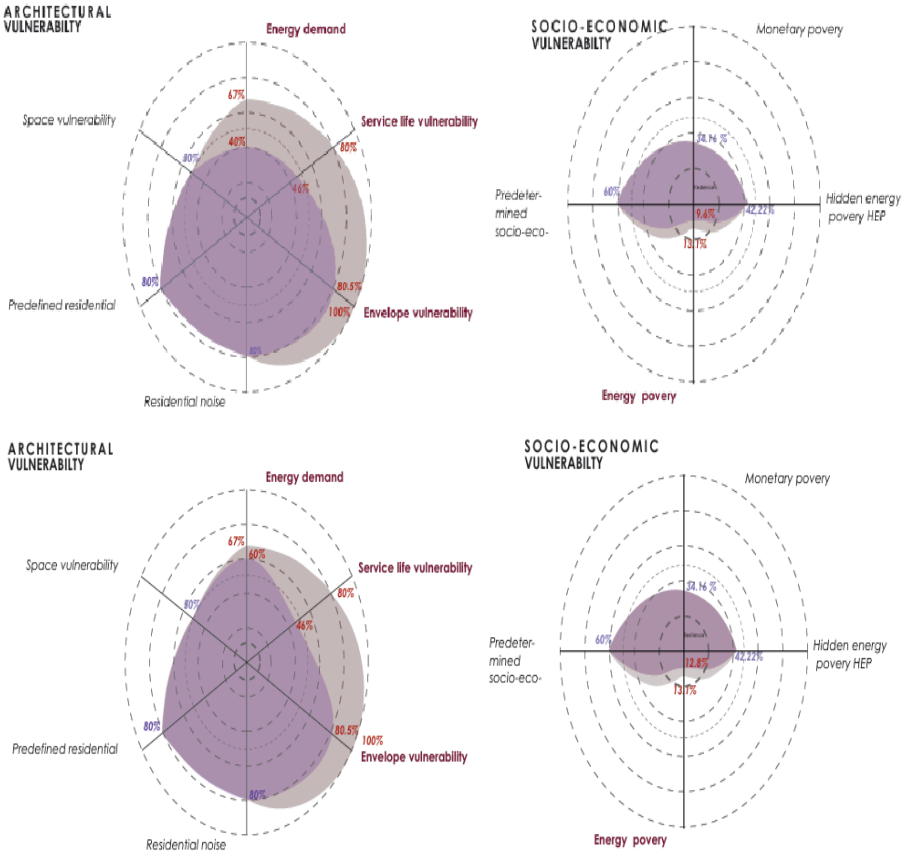

Figure 9. Residential Vulnerability

Future Research Lines

Future research lines can be addressed by: a. A more detailed data resolution, some indicators were only available as neighborhood averages, which can be represented on the radar chart as qualitative, however not mapped in the built environment, more detailed data can inform urban space design. b. The weight of indicators, all indicators were weighted equally, nonetheless future work can be explored to set specific weights for a composite index. c. Community adaptations lessons, by studying and analyzing existing adaptations in vulnerable contexts using limited resources.

In general, In identified vulnerable contexts and urban environments, there exists further hidden vulnerability than cannot be identified and diagnosed using a traditional vulnerability method that focuses on isolated domains. Hence, it is crucial to consider contextual vulnerability parameters.

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FROM WASTE TO RESOURCE: EXPLORING ECOLOGICAL URBANISM THROUGH COMPOSTING IN LA PAU, BARCELONA

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INTRODUCTION

The current relationship between humans and the environment is unsustainable and is contributing to the degradation of our planet. The food system, a significant contributor to this crisis, operates linearly, leading to the wastage of organic matter.

In Spain, the treatment of waste generates a significant amount of CO2eq emissions. To address this issue, a proposed methodology evaluates case studies focusing on reducing organic waste CO2eq emissions through composting. This approach will be applied to the case study of La Pau, Barcelona, Spain, along with proposed actions to improve the organic waste management system.

COMPOSTING INITIATIVES AROUND THE WORLD

Studying existing initiatives worldwide was considered to learn about what they do, how they do it, their limitations and successes, and how we can adapt these actions to a neighborhood such as La Pau in Barcelona. Nine different programs were analyzed in countries such as Colombia, the United States, Denmark, and Spain based on their different scopes of action: State policies, city policies, or community initiatives. Based on the quantity, quality, and similarity of the information provided by each of the programs, three were selected: Galicia, Spain (State scope), Figueres, Spain (City scope),[1] and New Haven, United States (community scope).[2]

Through a comparative matrix, at least 14 key aspects were considered in each of the programs in a similar way: governance, stakeholder involvement, education, the quantity of waste generated, transportation, and accessibility to waste treatment services, as well as their impact on reducing CO2eq emissions.

THE EVALUATION TOOL

Given the set of 14 key factors and after considering existing conditions in Barcelona related to organic waste treatment, a rubric system was used to develop 21 quality indicators, helping identify which data is optimal and which is less optimal (review Table 1)

#	Quality Indicators	Unit	1	2	3
1	Selective recollection per fraction of Total Waste (%)[3]	Percentage (%)	Below 30% of total waste is disposed of selectively	Between 31% - 69% of total waste is disposed of selectively	>70% of total waste is disposed of selectively
2	Containers for selective recollection [4]	Availability (yes/no)	Not available	3 types of selective waste	5 types of selective waste
3	Containers for selective recollection availability in time[5]	Time (Daily/weekly/ monthly)	Monthly	Biweekly	Daily
4	Clean points for recycling availability in time[6]	Time (Daily/weekly/ monthly)	Monthly	Weekly	Daily
5	Type of recollection[7]	Type (Door-to-door/containers on the street)	No recollection	Recollection spot	Door-to-door daily + containers on the street
6	Quantity of inorganic waste produced (FIRM)[8]	Tons per year (Tons/year)			
7	Quantity of organic waste[9]	Tons per year (Tons/year)			
8	Quantity of recycled material[10]	Tons per year (Tons/year)			
9	Proximity to recollection points[11]	Distance from each home (m)	Over 500 m	Between 500 m to 250 m	Less than 200 m
10	Proximity to clean points[12]	Distance from each home (m)	Over 500 m	Between 500 m to 250 m	Less than 200 m
11	Proximity to treatment points	Nearest Distance from neighborhood (Km)	Over 40 km	Between 39 km to 15 km	Less than 15 km
12	Proximity to composting plants[13]	Nearest Distance from neighborhood	Over 500 m	Between 500 m to 250 m	Less than 200 m

		(Km)			
13	Type of transportation for waste recollection[14]	Type of vehicle (motorized/electric/bicycle)	Gas motorized vehicle	Biodiesel motorized vehicle	Soft mobility
14	Type of transportation for organic waste recollection	Type of vehicle (motorized/electric/bicycle)	Gas motorized vehicle	Biodiesel motorized vehicle	Soft mobility
15	Quantity of organic waste diverted from Landfills or incineration[15]	Tons per year (Tons/year)	Less than 30% of total organic waste generated/year	Between 39% - 60% of total organic waste generated/year	71% - 100% of total organic waste generated/year
16	End use of the waste/closure of organic matter cycle[16]	Qualitative	Landfills and incineration/no end use	Composted in composted plants and used as soil for agriculture and parks	Composted on-site and used as soil for local production such as house gardens, community gardens, school gardens, local agriculture, and parks
17	CO2 emissions generated from total waste treatment[17]	CO2 equivalent per year (t CO2eq/year)	Less than 10% reduction in one year after actions	10% to 30% reduction in one year after actions	Reduction by 40% reduction in one year after actions
18	Cost-effectiveness of the service of organic waste management[18]	Money paid annually (EUR)	Over 250 EUR a year	Between 100 - 50 EUR per year	Less than 50 EUR
19	Educational programs[19]	Qualitative	Occasional programs only implemented in schools	Programs are given to the offices, business owners and schools	Common spaces are used monthly to provide educational programs for the general population. Offices and businesses, and schools must participate
20	Type of system	Centralized or	Centralized	Centralized +	Decentralized

	for composting[20]	Decentralized system		Decentralized system	(community based)
21	Governance of organic waste management[21]	Stakeholders involved	Institutional + private	Institutional	Institutional + public + private

Table 1. Quality Indicators for waste management programs

THE CASE STUDY

In Spain, where the case study is set, general waste (post-consumption) management ranks 8th on the list of the activities with the highest emissions, generating 13.14 million tons of CO2eq emissions annually, which has remained between 12 and 13 million tons of CO2eq since 2000.[22] In Catalunya, approximately 3,972,851 tons of waste are produced annually,[23] excluding industrial and specific waste. Of this total, 37% comprises organic waste disposed of separately from other types of waste, which does not account for the organic waste that is not separated when disposed of.

Up to 2023, 40.64%[24] of the waste in Barcelona was disposed of separately, leaving a considerable amount of work for treatment plants to separate the waste. Consequently, separating and treating, mostly through Mechanical/Biological treatment (see Figure 1), leads to at least 22,55% increase in CO2eq emissions, compared to other types of treatment, like composting.

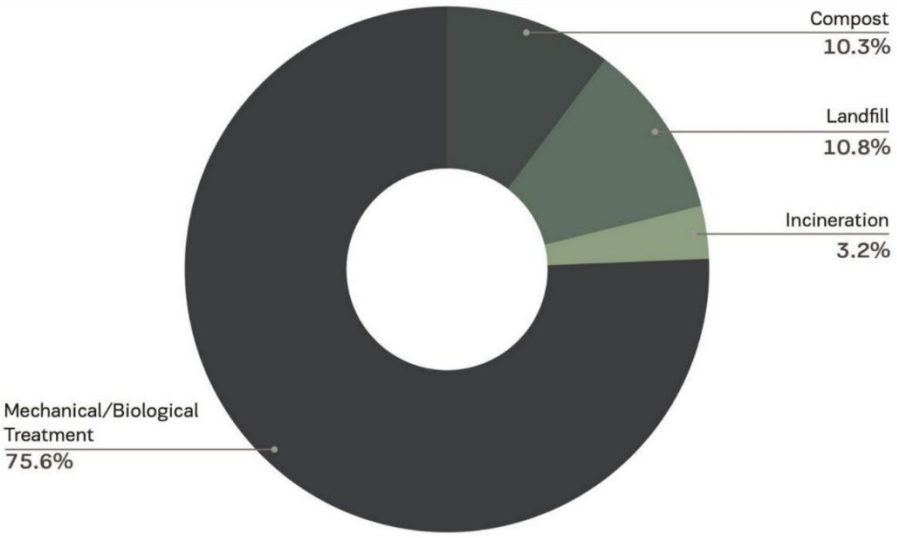

Figure 1. Types of waste treatment in Barcelona[25]

For the case study of La Pau, specifically, the residents can generate 2.763.06 tons of waste a year (review Figure 2). Overall, the biggest waste type is organic waste with 38,8%, where almost 60% of the waste generated is not disposed of separately by the population. It's important to consider, that given the availability of the information, as well as that the 95.5% of the space usage is residency, this proposal is limited to the study of waste generated in households.

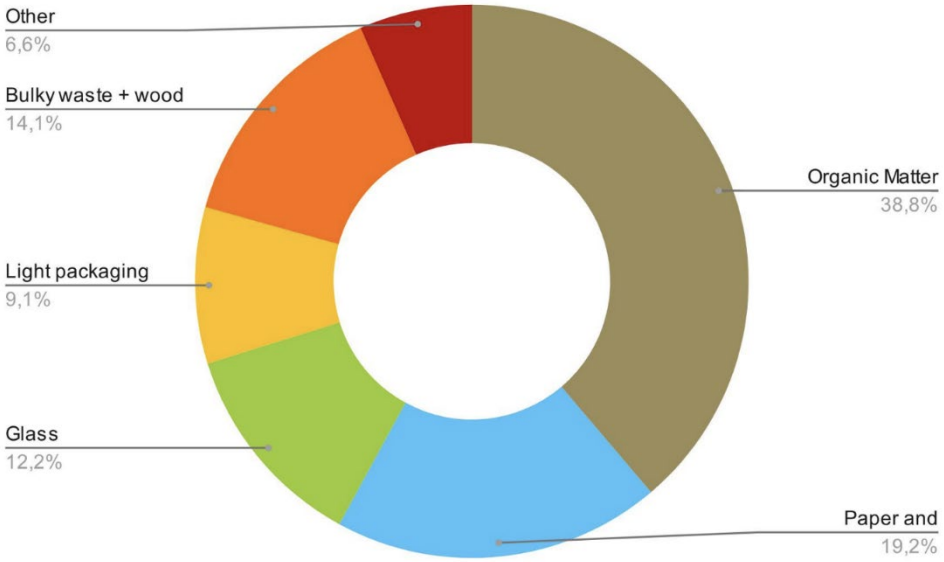

Figure 2. Proportions per type of waste.[26]

From the total of the organic waste generated, only 10.3% is used for composting. In the fraction that is not separated, the treatment plants can recover some of the organic material, and compost it as well. In this current scenario, the total waste management can produce 1.406.84 tons of CO2eq/year,[27] where the main contributor is the treatment of all the waste that is not separated (fracció resta in Figure 3).

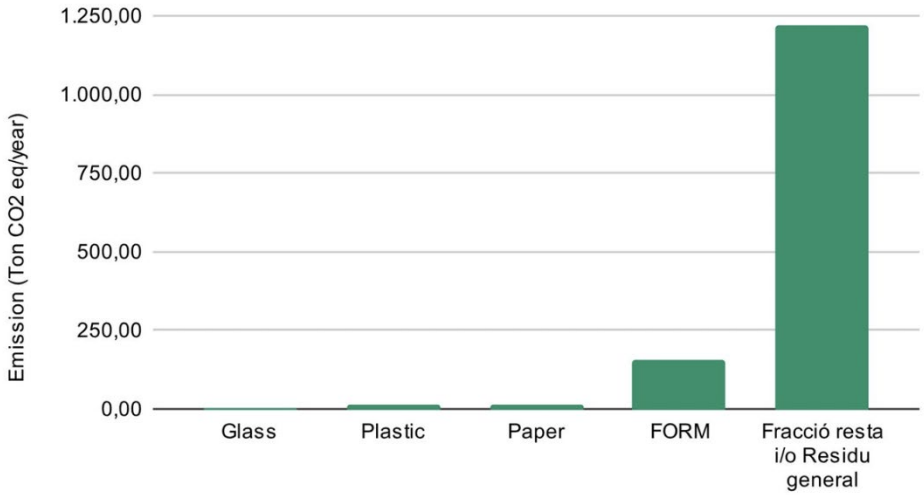

Figure 3. Emissions generated per type of waste and their treatment in La Pau, Barcelona.

Through the evaluation with the quality indicators developed of the current situation of la Pau, that also includes transportation of the waste, involvement of the population, quantity of waste generated, accessibility to composting services as well as treatment, we can conclude that the management system can very well be improved, as well as the inclusion of actions that can promote incentives for the population to get involved in the process and support a more efficient waste management system.

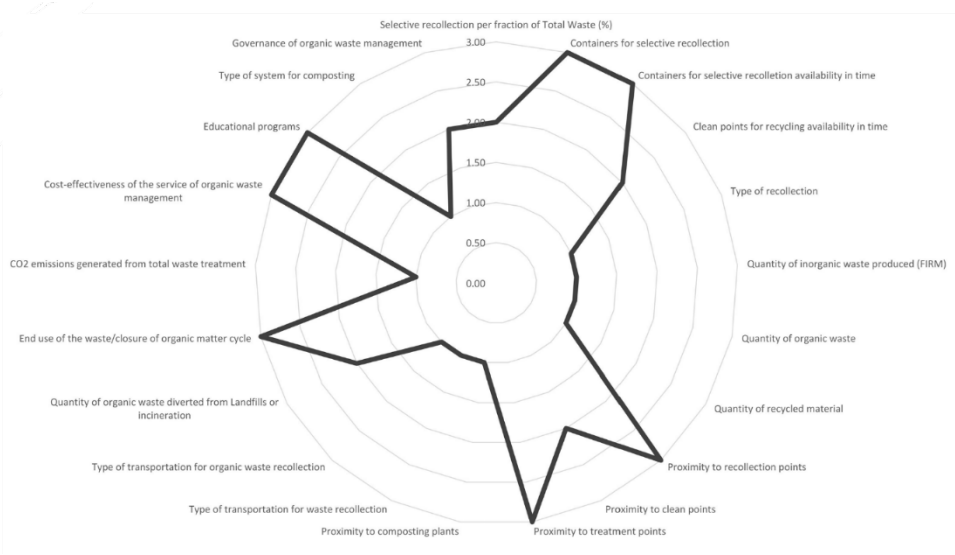

Figure 4. Evaluation of the Current Scenario of La Pau.

PROPOSAL

To improve the current scenario of the case study, two proposals were developed, one of which explores simple actions that are not very invasive in the urban landscape focused principally on participation promotion, education and incentives, and the other proposes a more aggressive approach, including policies, and small urban landscapes interventions.

Scenario 1

Through the proposed actions layout in Table 2, an ideal result was deducted, where little changes can make significant improvements to the current scenario of La Pau.

Action	Objective	Activities	Results
Reduction of quantity of waste generated in households	Reduce the quantity of waste that is produced in the households of La Pau, to decrease the volume of waste that must be treated.	- Public awareness campaigns - Food waste reduction - Plastic and glass waste reduction - Waste reduction and recycling programs in school.	Reduction by 10% of the total waste generated in La Pau.
Selective and non-selective fractions of waste	Increase in the fraction of selective waste disposal	- Education and awareness - Separation at home - School and workplace involvement. - Data monitoring and analysis. - Door-to-door recollection - Increase in availability of clean points.	Increase in the proportion of selective waste compared to non-selective waste: - 60% selective waste - 40% non-selective waste.
Community composting	Integrate community and home composting to the urban structure of La Pau	- Community composting education programs. - School as the center of the composting program - Incentives and rewards	30% of the organic waste goes to community composting instead of treatment plants.

Table 2. Set of actions and activities, with their deducted result for Scenario 1.

This scenario includes the intervention of two spaces: school located inside the neighborhood, and one located in the largest public space inside the neighborhood, ensuring that there is less than 150 m between the households and the on-site composting centers.

Through these actions, there is a decrease in the amount of CO2eq emissions generated by the neighborhood by 31,02%, principally by reducing the amount of total waste generated, increasing the proportion of waste that is separated, hence less need for processing at the treatment plants, and allocating 30% of the organic waste collected at the households to on-site community composting.

This is a less-than-ideal scenario, as it considers very low participation from the population of La Pau, but a big participation through the school, involving the students and faculty in the composting program, and creating awareness through education that can be brought back to the rest of the families living in La Pau. Still, even with small actions, there can be a significant improvement. In the graph

shown in Figure 5, there is a comparison between the current scenario and the scenario 1, where it clearly shows certain improvements.

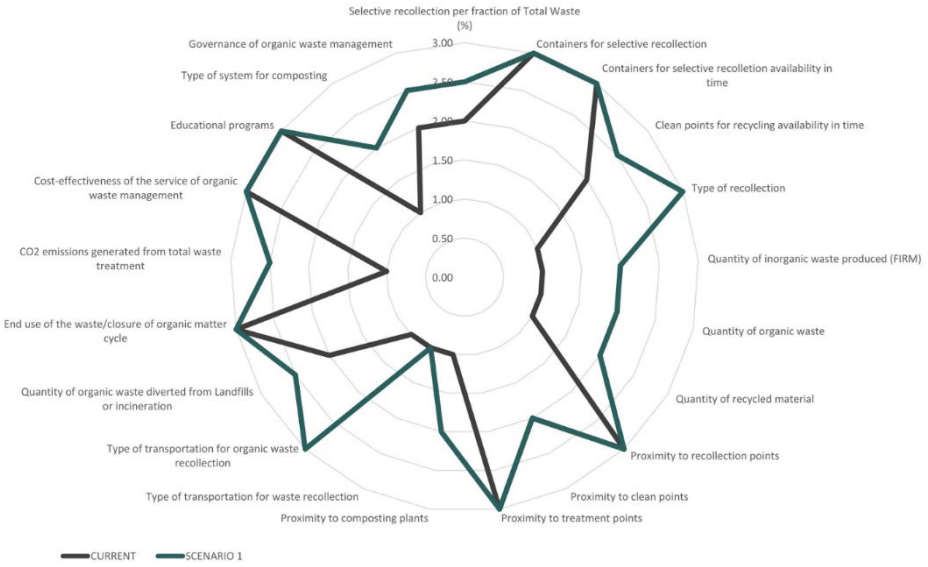

Figure 5. Comparison between the current scenario and scenario 1.

Scenario 2

Through the proposed actions layout in Table 3, including certain actions from Scenario 1, this proposal takes a more aggressive approach to achieving 100% organic waste going to on-site community composting and reducing the amount of waste generated by the population.

Action	Objective	Activities	Results
Reduction of quantity of waste generated in households	Reduce the quantity of waste that is produced in the households of La Pau, to decrease the volume of waste that must be treated.	- Public awareness campaigns - Food waste reduction - Plastic and glass waste reduction - Waste reduction and recycling programs in school. - Rewards on reduction of waste generation	Reduction by 30% of the total waste generated in La Pau.
Selective and non-selective fractions of waste	Increase in the fraction of selective waste disposal	- Education and awareness - Separation at home - School and workplace involvement. - Data monitoring and analysis. - Door-to-door recollection - Increase in availability of clean points.	Increase in the proportion of selective waste compared to non-selective waste: - 80% selective waste - 20% non-selective waste.
Community composting	Integrate community and home composting to the urban structure of La Pau	- Community composting education programs. - School as the center of the composting program - Incentives and rewards - Organic waste goes to composting - Urban agriculture	100% of the organic waste goes to community composting instead of treatment plants.

Table 3. Set of actions and activities for Scenario 2.

The difference between the two scenarios is to include more economic incentives for the population of La Pau to encourage more participation in the separation and reduction of waste, as well as relocating all the organic waste to on-site composting. The on-site community composting is expanded to five composting sites in the public spaces of the neighborhood, ensuring accessibility to all the households just outside their homes. This will be managed by the residents of La Pau, who are responsible for the

following the correct process of composting regularly and using that compost for the benefit of their parks, as well as establishing urban gardens from which they can benefit directly too.
Of course, part of the management also goes to the Adjuntament of Barcelona, ensuring a correct process is followed by the population, as well as regular educational workshops.
The impact of these actions means a 66,10% reduction of the CO2eq emissions generated in La Pau in their total waste management system. The reduction is significant due to the decrease in the generation of waste, no necessity of processing the organic waste through treatment plants, and no need of distribution through motorized vehicles (review Figure 6 for more detail).

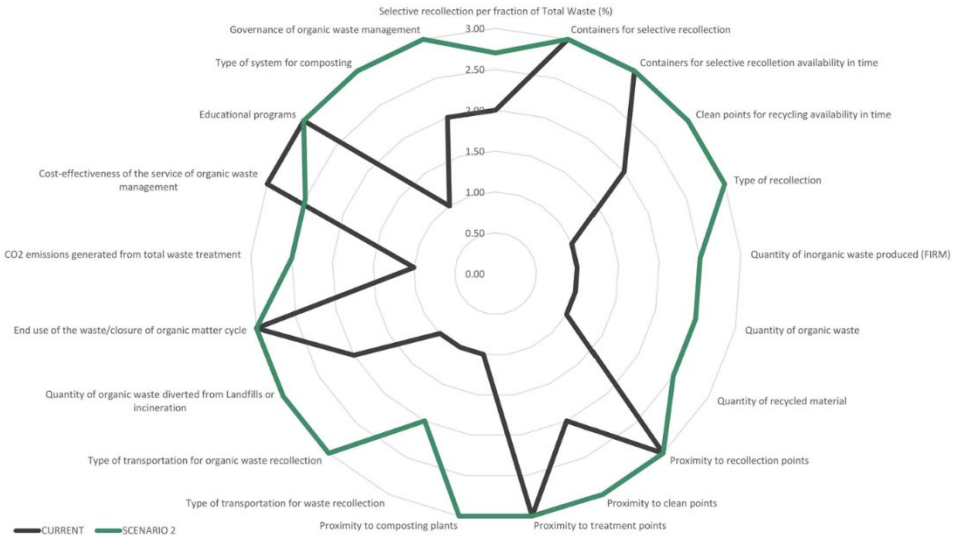

Figure 6. Comparison between current scenario and scenario 2.

CONCLUSION

A primary conclusion to this analysis is that small actions can have a significant impact. Even though we can't reach a zero-waste scenario or zero emissions, we can still improve the balance between our activities and the environment, taking advantage of the cycle. Also, little actions can become much stronger as the population becomes involved. This strengthens their relationship and sense of responsibility while also creating a sense of ownership, making them aware of their impact on their environment and how they are making a direct change.
Employing on-site community composting as a primary course of action is a significant part of the solution to reducing CO2eq emissions and contributes to a more balanced urban metabolism.
However, a more comprehensive approach is essential. It should not only encompass households but also extend to commercial entities, offices, industrial establishments, educational institutions, and cultural spaces. This approach needs to be tailored to the intricacies of the urban landscape and its myriad complexities, ensuring a more effective waste management strategy.
The primary objective should be to reduce food waste across the entire food chain. This is not limited to households but encompasses all stages, from production and distribution to consumption. A more comprehensive approach is needed to address these stages, as they are the primary sources of organic waste that often needs to be managed appropriately.

NOTES

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A CONSTELLATION OF "CENTRAL PARKS" IN THE MULTICENTER BARCELONA METROPOLIS

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INTRODUCTION

In recent years, the Barcelona Metropolitan Area has engaged in discussions about its future planning from a multifaceted perspective,[1] aiming to strengthen its identity as a multi-centre metropolis rooted in the historical villages that form the region. Within this framework, the potential of the so-called "Metropolitan Parks"[2] is noteworthy: fifty-two diverse parks of varying sizes, spread across thirty-four municipalities, are expected to serve a metropolitan function.

This term was coined by the Metropolitan Authority of Barcelona (AMB) that, additionally to urban planning competences, is also in charge of the park's policies and management. Currently, the structure of Metropolitan Parks refers to large green spaces of a primary order: in essence Llobregat Agrarian Park and Serra de Collserola Natural Park. Beyond these regional-scale spaces, however, the polycentric character of the Barcelona metropolis, which has evolved as a gathering of several municipalities with distinct identities, has brought with it an array of diverse green spaces. These are parks in contact with each of the towns, largely unknown to the whole, despite theoretical approaches and policies and projects to define the Green Metropolitan Matrix in the last few decades.[3]

Centrality is a key issue in the new Metropolitan Urban Master Plan, aiming to move from an administrative polynuclear structure, to a real polycentric one,[4] removing administrative borders in favour of real metropolitan dynamics. Actually, the binomial centrality-urban transformation can play a major role for enhancing this polycentric character, depicting a constellation of new and incipient diverse hubs through a set the guidelines for a more intense, more efficient, more intelligible and more signified metropolis.[5]

Whereas the public transportation network has always been linked with the metropolitan discussion, it's not obvious that parks can be, as they have been usually considered pieces of landscape more than places of intensity.

These parks are crucial as green infrastructure nodes and should also attract leisure activities for the 3.3 million inhabitants of a dense metropolis with limited inner-city green spaces: within Barcelona's municipal borders, citizens have only seven square meters of green space per person, excluding the off-lying Collserola hills, with only 30% of green spaces publicly accessible.[6]

On the other hand, open spaces make up over half of the Barcelona Metropolis area, with more than 70% of the population living within a ten-minute walk of a park, according to the Metropolitan

Authority of Barcelona (AMB). This indicates a need for a stronger network of "metropolitan parks" to connect with a green-less centre, as discussed in upcoming urban policy.[7]
Recent municipal and metropolitan initiatives such as the Barcelona Green Infrastructure and Biodiversity Plan 2020,[8] and the Pla Natura Barcelona 2021-2030,[9] aim to expand and enhance the city's green spaces. These efforts transition under-equipped open spaces into urban parks, potentially evolving into interconnected parks that provide eco-systemic services at a metropolitan scale.

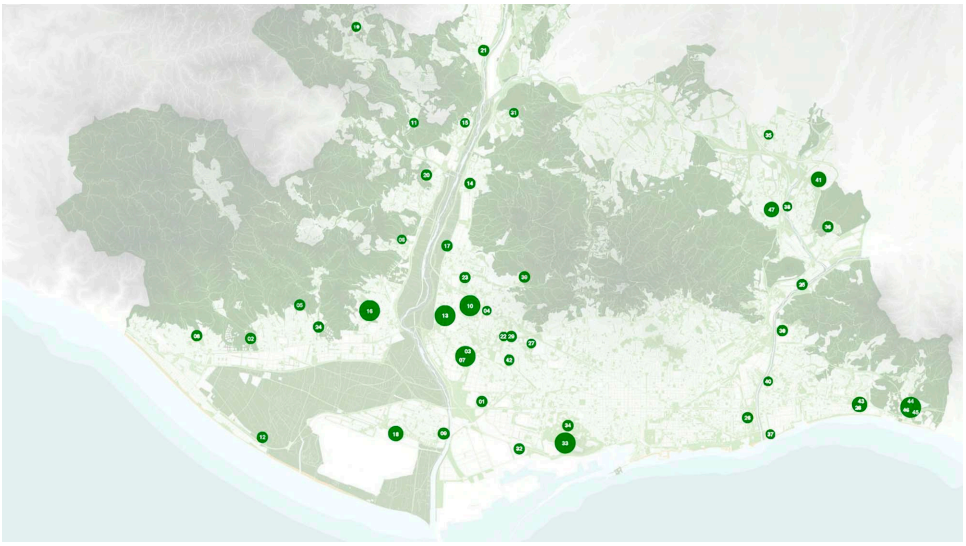

Figure 1. Metropolitan parks. The authors (2024), from AMB PDU (2018) and Barcelona Regional (2021).

Building on multidisciplinary reports,[10] the research examines the potential of these parks through eight case studies in the Llobregat Basin (Figure 2). These cases vary in size, internal features, urbanization levels, and environmental qualities. The study identifies both shared and unique attributes that give these parks metropolitan significance. They are linked not only to green infrastructure but also to the rail transportation network, supporting their role on a metropolitan scale.
Figure 3 depicts the case studies' locations and collective transport networks in a square area of twenty km per side, showing most parks situated within a five-minute walk of a station. These transport lines connect the parks to key urban centres and intermodal hubs like Plaça Espanya and Plaça Catalunya, with travel times ranging from fifteen to forty-five minutes. On the western side, parks one to four, along with Can Mercader (7), are connected via the FGC train line to Plaça Espanya, and further to Plaça Catalunya via metro. On the eastern side, parks five and six are connected to the metro network, which also serves parks seven and eight, linking them to a major intermodal station and the broader city.

Figure 2. Area of study (twenty km per side). eight selected parks.

Number	PARK NAME	MUNICIPALITY	AREA (ha.)
1	Pi Gros	Sant Vicenç dels Horts	27,5
2	Can Lluch	Santa Coloma de Cervelló	8,9
3	P. Cripta Güell	Santa Coloma de Cervelló	5,7
4	La Muntanyeta	Sant Boi de Llobregat	29,7
5	Torreblanca	Sant Just Desvern	11,7
6	Fontsanta	Sant Joan Despí	29,0
7	Can Mercader	Cornellà de Llobregat	25,1
8	De Les Planes	L'Hospitalet de Llobregat	8,3

Table 1. Number, name, municipality and area of the parks.

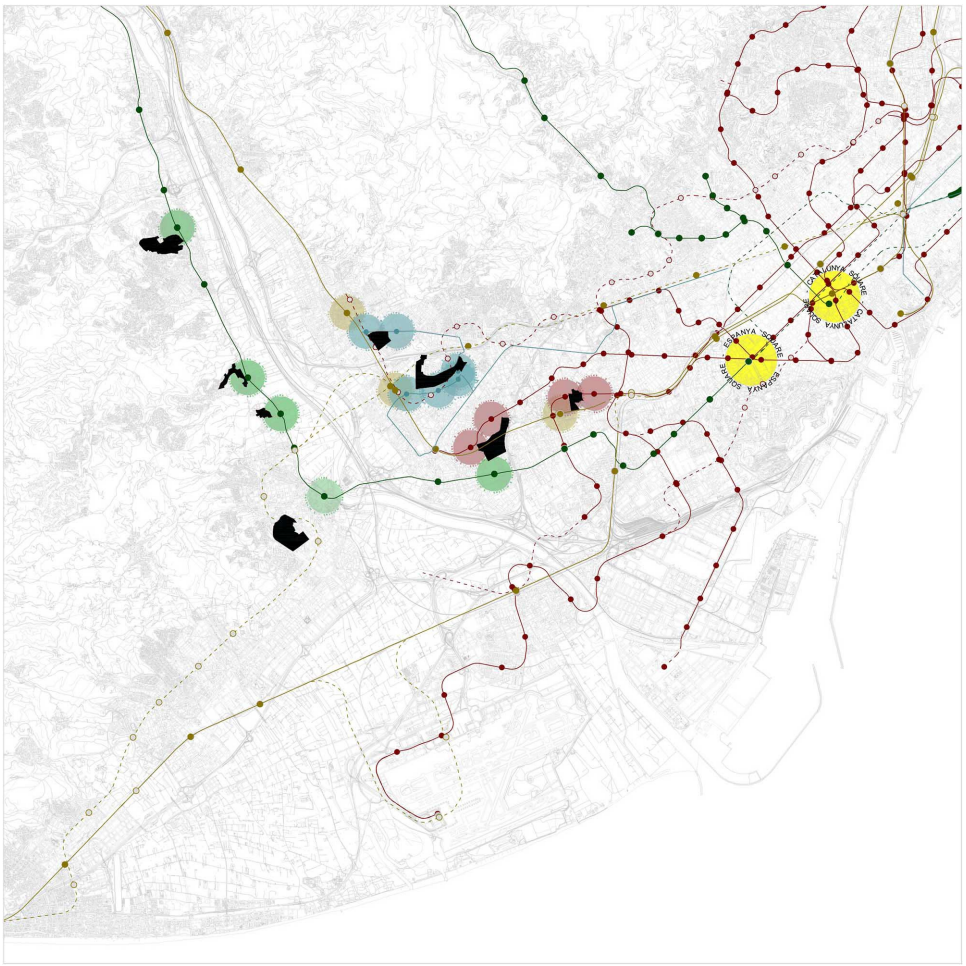

Figure 3. Connection to regional train (gold), metropolitan trains (green), underground (red), tram (blue). In yellow, the metropolitan centres of Plaça Espanya and Plaça Catalunya.

Number	PARK NAME	NEAREST TRAIN STATION	TO PL. ESPANYA
1	Pi Gros	6 min (W)	35 min (W+T)
2	Can Lluch	5 min (W)	30 min (W+T)
3	P. Cripta Güell	6 min (W)	29 min (W+T)
4	La Muntanyeta	14 min (W)	17 min (W+B)
5	Torreblanca	7 min (W)	42 min (W+B+T)
6	Fontsanta	3 min (W)	37 min (W+T+T)
7	Can Mercader	8 min (W)	22 min (W+T)
8	De Les Planes	2 min (W)	14 min (W+T)

Table 2. Time to nearest station and Plaça Espanya. Walking, Train, Bus.

CASE STUDY PRESENTATION. EIGHT PARKS IN THE LLOBREGAT BASIN

The downstream valley of the Llobregat is a territorial unit with an asymmetric configuration, as the river acts as a sort of a limit for the denser urban area (left margin) whereas a lower urbanization and the presence of natural features is more present at the western side (right margin). The eight selected parks are distributed in both sides and chosen for their representative configurations.

The western side of the Llobregat river basin

It is characterised by the Serra de l'Ordal range, which extends into nearby municipalities, creating green spaces that, while more artificial near urban areas, link the Llobregat Delta's agricultural areas, the river basin, and surrounding forests, with minimal car and rail infrastructure interference. Parks on the western side mostly retain a natural character,[11] but have limited potential as metropolitan parks due to their low-density surroundings and off-center locations. Three selected parks are near Serra d'Ordal, characterized by natural settings, while a fourth park is located between natural and urban areas.

- **Pi Gros (1)** holds the potential of being a "chain" between Serra d'Ordal and the Llobregat Basin ecosystems. Located in between, close to rail infrastructure, its highly permeable surface, composed of woods and scrubs, is part of a wider green infrastructure.
- **Can Lluch (2)**, at the tail-end of Santa Coloma de Cervelló, reflects its edge-condition in the composition of its surfaces: playgrounds, parking lots and other urbanized areas are frequent close to the town, whereas meadows and woods are common further away, in a gradient.
- **Cripta Güell (3)**. The park envelops the remarkable Cripta Güell, the remains of a church designed by architect Antoni Gaudí. Not administered by AMB, and with a high heritage value, the park is characterised by its pine trees, among which some unused materials for the church's construction can be seen.
- **La Muntanyeta (4)** features an urbanised lower section with public facilities interspaced with green areas such as municipal offices, libraries, sports clubs, educational facilities and a swimming pool. Its upper section is characterised by its notable topography, and is covered with scrubs, meadows and woods.

The eastern side of the Llobregat river basin

The eastern side is a densely populated area affected by vehicular and rail infrastructure, with fragmented green spaces. The ratio of open spaces to built-up residential areas is roughly half that of the western side.[12] Parks here are more anthropized, with high demands placed on them for leisure, specific needs (like sports facilities and a cemetery), and ecosystem services. Four significant parks are selected as case studies:

- **Torreblanca (5)** is in an urban setting and close-by to the Joan Gamper sporting facilities, is an amalgam of several green spaces: a nineteenth-century romantic park, a green canopy, and small fields used by neighbours to harvest vegetables. Furthermore, two small ponds with adjacent open spaces punctuate the park.
- **Fontsanta (6)** is a large, highly urbanised park, well connected with the rest of the metropolis and in close proximity to relevant public facilities such as the public television headquarters and a major hospital, along with local facilities.
- **Can Mercader (7)** is characterised by two environments, divided by topography and rail infrastructure: the nineteenth-century romantic park, with Can Mercader house as its centrepiece, has reached metropolitan renown as the building has been converted into a museum of mathematics; whereas the northern section of the park, characterised by its steep topography, is disconnected from the former, featuring closely-packed meandering paths among meadows.
- **Les Planes (8)**, flanked by the packed Cemetery of Hospitalet, is embedded within one of the densest districts in all of Europe.[13] As such, its surfaces are placed under a considerable demand, as its open spaces are segregated into playgrounds, sports areas, leisure spaces and car parks, with green spaces relegated to its perimeter.

N.	Woods		Meadow		Scrubland		Water		Paths & urbanized areas		Playground		Built-up		Parking lots		**Total (ha.)**
1	12,6	46%	0,7	3%	8,8	32%	0	0%	3,0	11%	0,7	0,3%	2,2	8%	0,6	0,2%	**27,5**
2	2,3	26%	2,3	26%	1,8	20%	0	0%	1,8	21%	0,3	3%	0	0%	0,4	5%	**8,9**
3	2,6	45%	0,3	6%	0,8	14%	0,05	0,0%	0,9	15%	0,6	10%	0,2	3%	0,4	7%	**5,7**
4	5,9	20%	6,4	22%	4,6	15%	0,5	2%	7,0	24%	3,3	11%	1,1	4%	0,9	3%	**29,7**
5	4,3	37%	2,0	17%	0,7	6%	0,4	4%	3,2	27%	0,2	1%	0,3	2%	0,6	5%	**11,7**
6	2,2	7%	5,9	20%	6,1	21%	0	0%	10,2	35%	1,6	5%	1,3	4%	1,9	7%	**29,0**
7	7,1	28%	5,8	23%	1,9	7%	0,3	1%	7,8	31%	1,1	5%	0,6	2%	0,4	2%	**25,1**
8	2,0	24%	1,5	18%	0,1	1%	0	0%	3,2	39%	1,1	13%	0,1	1%	0,3	3%	**8,3**

Table 3. Surface distribution of the parks.

DISCUSSION AND ANALYSIS

A study of the eight parks is developed through the dissection of square fragments at different scales, observing the parks' relation with its surrounding land through three different perspectives: 1) Land Cover and green connectivity in square areas three km per side; 2) Urban fabric and perimeter definition in square areas two km per side; 3) Internal composition, urbanization versus naturalization, in square areas one km per side.

Land Cover and green connectivity

A study of non-urban land cover near the parks reveals the differences and potential to weave continuities that would strengthen the green infrastructure system. On the western side, parks two and three can be seen as open spaces in urbanized areas that can work as transversal connectors to nearby ecological corridors between the mountain and the riverbank, whereas parks one and four are elevations near the valley, in contact with the open ecosystems of the higher elevations, providing opportunities to establish green filamentary connections between urbanized areas, connecting larger corridors.

On the eastern side, parks five to eight are immersed in a largely urbanized context. This circumstance enhances the value of their own generous surface, as attractive space, extending their influence by improving civic connections to nearby open spaces. Close contact with grey infrastructures and their leftover perimeters suggests the possibility of regenerating them via greening strategies so as to extend the influence of the parks' service.

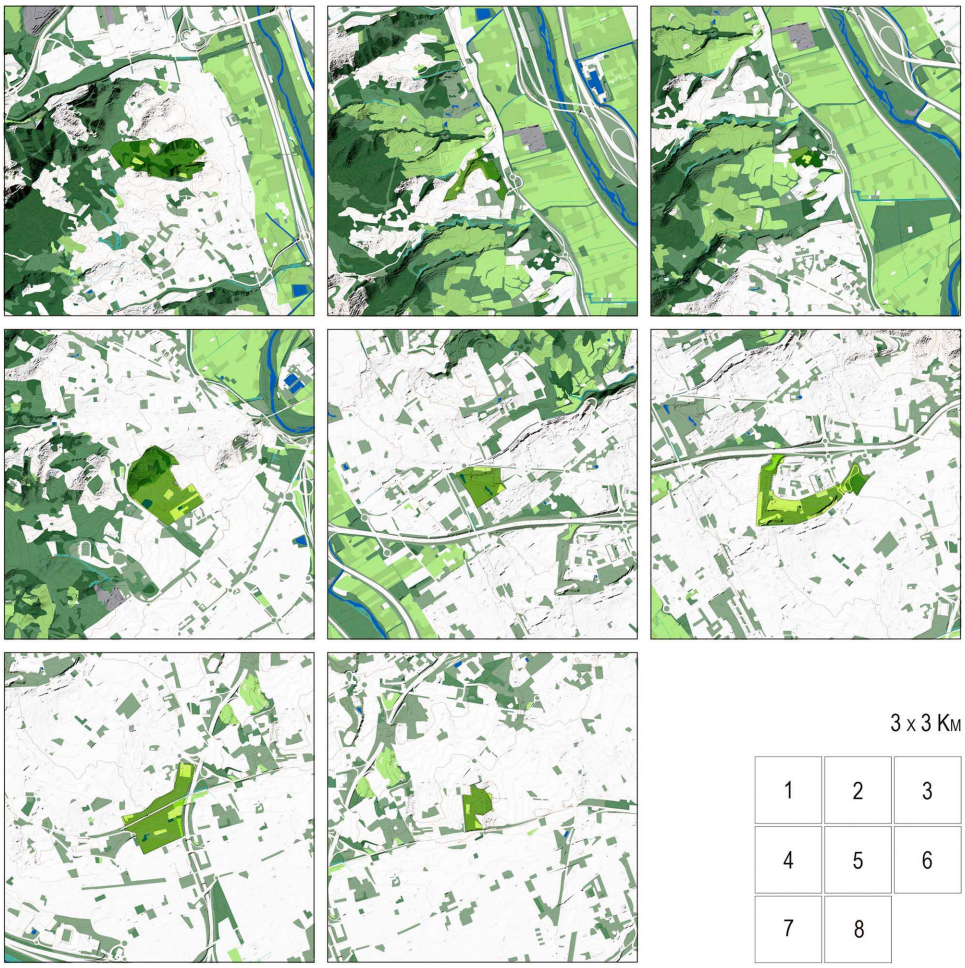

Figure 4. Land cover of the green spaces in the vicinity of the parks.

Urban fabric and perimeter definition

The morphology of the urban fabric around the parks shows a quite heterogeneous picture: the varying perimeter of each park is characterized according to changes in adjacent urbanization (more or less occupied, intense, connected to the city layout, etc.). Whereas park number eight is surrounded by similar fabrics, park number four has an eastern edge in contact with a compact and dense urbanization, and a more dispersed and low-density urbanization on its western edge. Park number seven would be at an intermediate point, with an eastern edge conditioned by the voids derived from segregated road infrastructure, and housing estates and compact extensions to its north and south, respectively.

Furthermore, the role of the park as a place of transit is seen in cases such as that of park number six, between the urbanized fragment to the north and the more continuous city to the south.

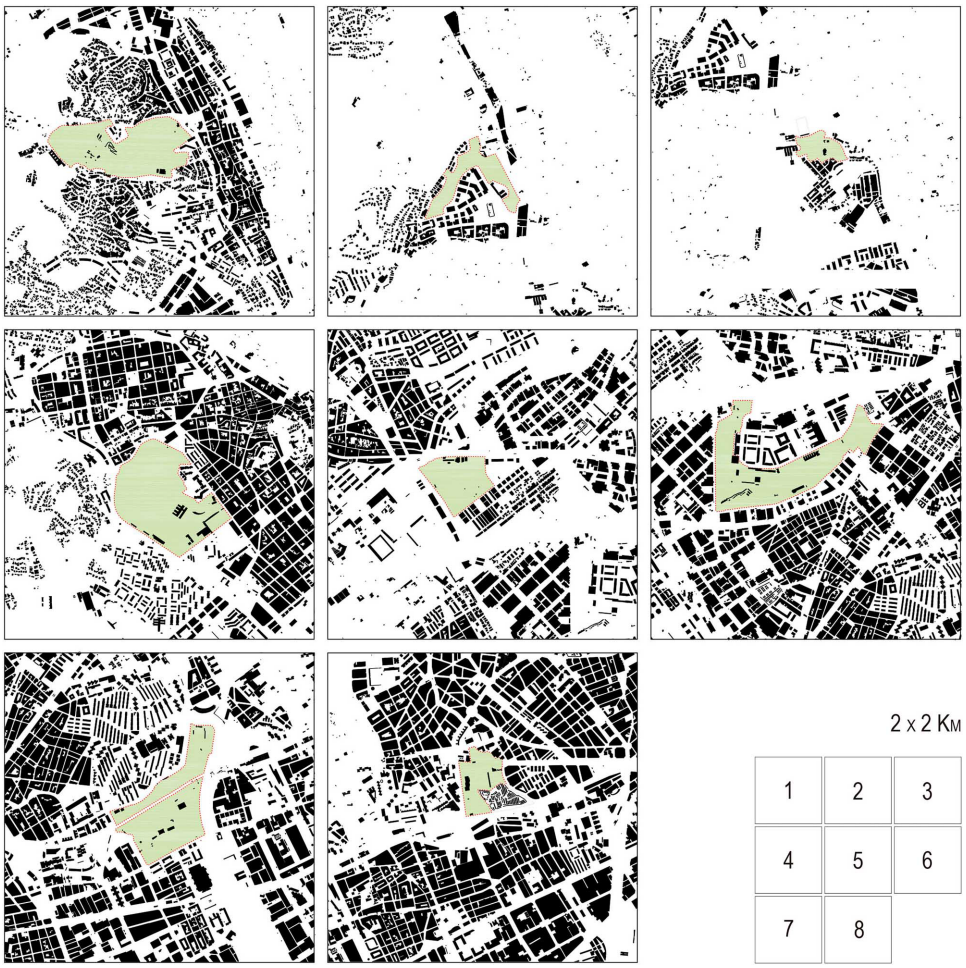

Figure 5. Urban fabric in the vicinity of the parks.

Internal composition, urbanization versus naturalization

The study of the internal composition of the parks, characterizing the different surfaces by type, allows comparisons in terms of landscape, degree of urbanization and imperviousness, preponderance of programmed leisure uses, etc. Cases one and six feature singular types of landscape patterns: one has a highly natural character and six is completely artificial, whereas Parks four, five and seven result from a combination of different types of spaces with particular compositions. "Romantic gardens" are joined with natural typologies, as well as fragments of contemporary designs and other urbanized spaces that include public facilities or playgrounds and sports areas. Following this, the analysis of the internal composition of the parks reveals some shortcomings, potential for improvement and areas of opportunity.

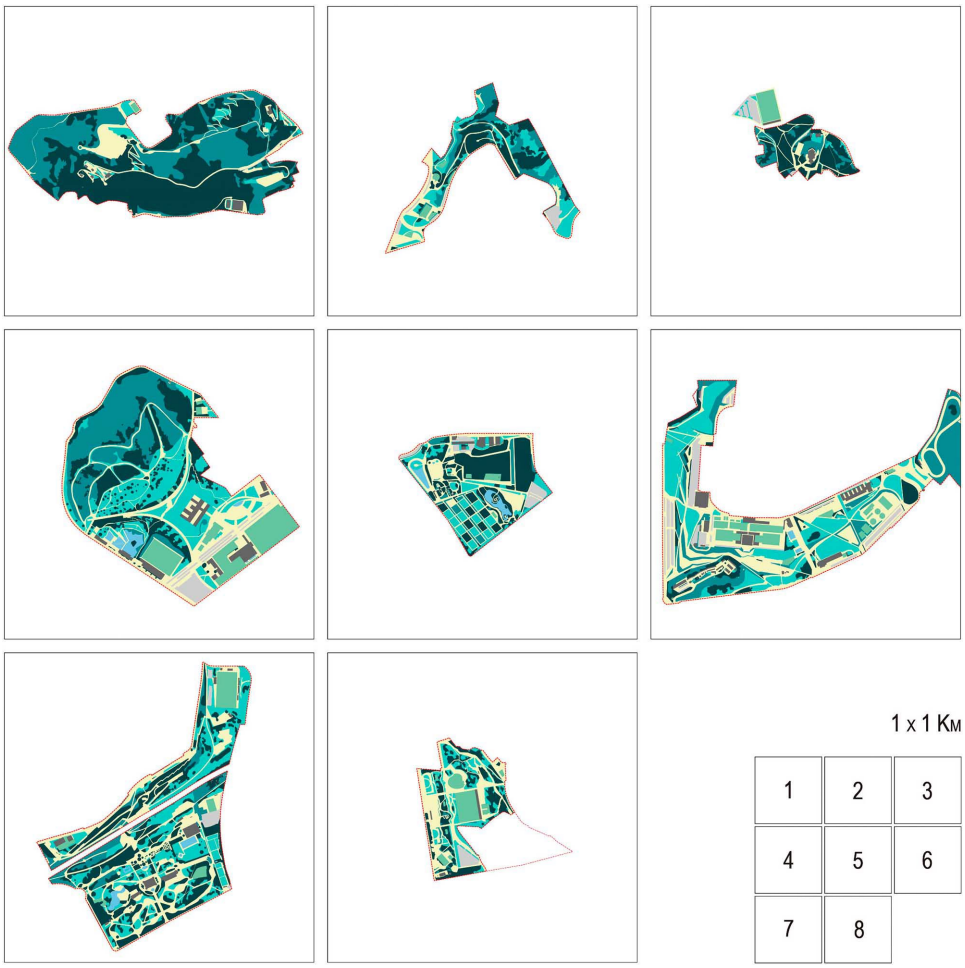

Figure 6. Internal composition of the parks by type: Woods, Meadows, Scrubland, Paths & Urbanized Areas, Playgrounds, Water, Built-up, Parking Lot.

Surface analysis

Quantitively analyzing the surfaces dedicated to the different types provides further topics for comparison. Based on their "natural" areas, cases one, two and three stand out due to the preponderance of vegetation, whereas cases four, five and seven present a balanced distribution. Cases six and eight do not feature a large proportion of natural spaces. Nevertheless, the distribution of vegetation in each of the parks is divided between canopy, grassland and shrubland, the resulting proportion of which characterizes the landscapes. Regarding urbanized areas, the parks on the eastern side show a higher percentage, which could be associated with a higher pressure to provide activities due to its position in urban contexts of greater intensity. As for programmed areas, some variables can be highlighted: the different rates of occupation (one, two and seven: low; four, six and eight: high), and the diversity of programs that make up this bar in each case and their different proportions.

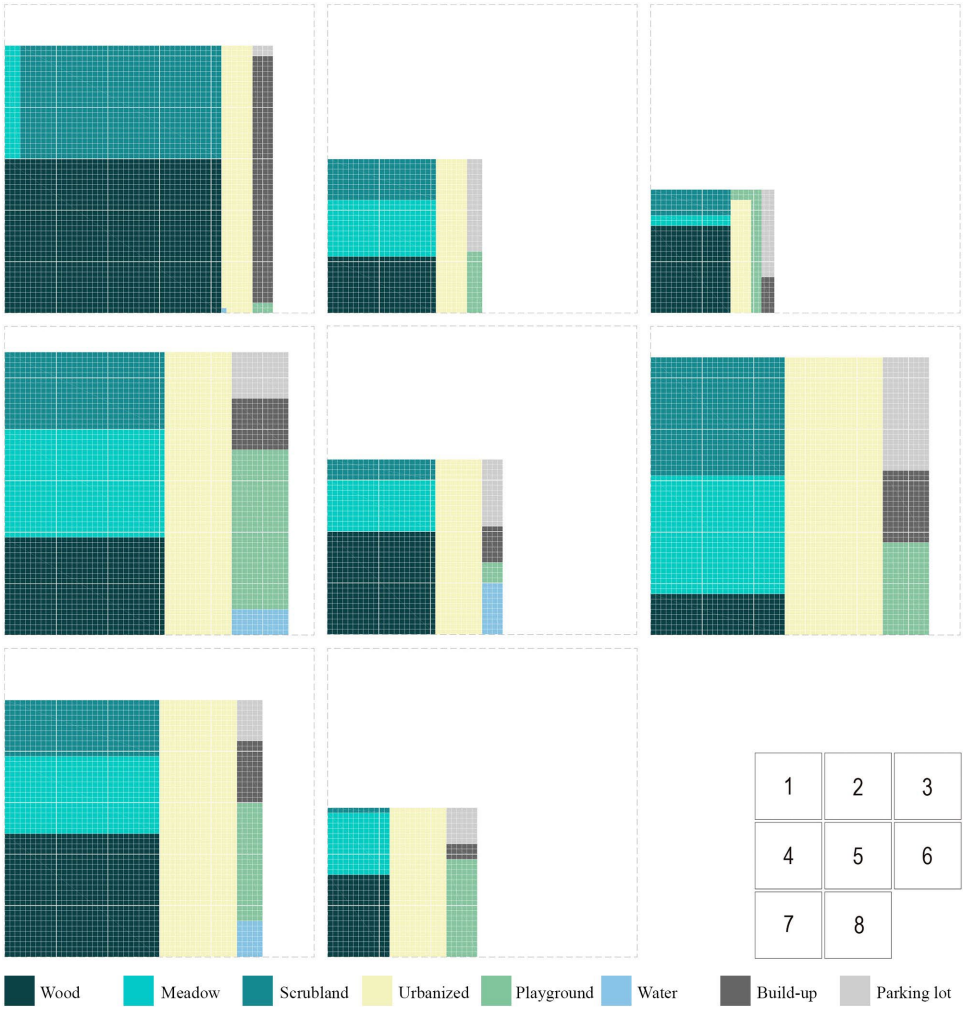

Figure 7. Analysis of the types of surfaces.

CONCLUSION. STRATEGIES TOWARDS UNLOCKING THE METROPOLITAN POTENTIAL OF LOCAL PARKS

In the framework of the ETSAB Urban Design Studio V – course 2023-2024, a teaching research-by-design experience was developed aimed at unlocking the metropolitan potential of the case studies. Students were asked to: a) detect those attributes of the parks that can project them towards a service of metropolitan scope; and b) propose site-specific transformation scenarios that enhance those attributes beyond the local level. A series of proposals addressed each park's aptitude for improving health and social interaction, its role in urban and peri-urban planning, its contribution to environmental and ecological balance, and its potential for leisure, recreation, and sport, highlighting their most common functions. The transformations to be proposed refer to both metropolitan and local scales, internal composition of the park, its relationships or externalities with its environment, and/or, as open spaces, mobility infrastructures and buildings (public and/or private) are integrated up to different degrees within the change.

In sum, several strategies were tested, enhancing the metropolitan role of the constellation of "central parks", connecting a past peripheral character with a potential future centrality. Actually, the strategies are not mutually exclusive and the projects for the parks should be understood in concert:

• **Increasing "Porosity" of the Limits**. Regarding the surrounding urban fabric and mobility infrastructure: low "porosity" limits, are unable to connect separate neighbourhoods such as in the

case of Can Mercader (7). An opportunity is present considering potential "stretching" of certain key traces, the position of relevant public transportation facilities and the park's relation with the diverse fabrics in its vicinity.

• **Strengthening "Green Infrastructure".** Consolidating metropolitan geo-ecological systems and promoting new ecosystem services both outside and within the park,[14] by accounting for metrics such as the amount of permeable soil, the presence of water surfaces capable of sustaining small-scale ecosystems, among other recognised parameters.[15] Parks located on the western side of the Llobregat could reinforce the connection between forests and river ecosystems, which could be emulated in the eastern side by reducing the fragmentation present in more urban parks through the greening of adjacent grey infrastructure.

• **Promoting New Public Buildings and Increasing Attractiveness.** A program capable of drawing publics from diverse parts of the city can act as a catalyser for the park's transformation, repurposing infra-utilized spaces, such as over-sized car parks and obsolete facilities present in parks like Fontsanta (06) to avoid encroachment on permeable soil. A constellation of "metropolitan facilities" could connect several of these parks also through the services provided.

• **Scaling up Local Built Heritage.** The integration of heritage evidences the interrelation between past and present as a boon for a park, reinforcing values of identity and place, as seen in Colònia Güell (3), a successful example of a park of metropolitan appeal through its appealing heritage value. Furthermore, the creation of post-industrial cultural landscapes is a chance to renew grey infrastructure within the park, as exemplified throughout Europe.[16]

• **Underlying or Intensifying Focal Points**. Certain areas of the park can be highlighted as "focal points", such as its entrances or gathering spaces. The aesthetic quality of a romantic park which carries a notable amount of history behind it can be enhanced through a new understanding of eco-systemic values, as "climatic shelters" can renew the idea of a self-contained "Eden" as a reference for the whole city. Parks such as Torreblanca (5), Can Mercader (7) and Les Planes (8) could combine their historic past with these new perspectives.

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SENSORY PASTS, PRESENTS AND FUTURES IN BUILDING A NEW MARITIME TURKU

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INTRODUCTION

This article studies the sensory experiences of and affective responses to the port of Turku, including the new district in its vicinity. The area is undergoing major changes in the 2020s because the port functions will be renewed, and at the same time, a lot of new residential houses are being built around the port. In this article, I delve into what the port and sea mean to local residents. How do they experience it in their everyday lives? How do they remember the past and sense the present? And what are their hopes for the future? The data were gathered via sensory ethnographic go-along interviews with residents and other people who are frequently in the area. This study is part of an ethnographic research project with the aim of studying the socio-material well-being of a new district through the residents' everyday experiences. I argue that the sensory ethnographic method is key to recognizing the unique character of a place and its elements. Understanding those elements with regard to the area's renovations is important because of residents' place identities and their attachments to it.

Linnakaupunki: A new maritime district

Linnakaupunki comprises a planning area of approximately 269 hectares that spreads north from Turku Castle. The area, which was dominated by industry in the past, is being transformed into an entity that will complement the structure of the city centre once facilities for residential, office and commercial uses have been built. The northern part of Linnakaupunki was already inhabited and is now being densified.[1] In total, apartments for around 15,000 residents have been planned in Linnakaupunki.[2] Several new housing areas are already inhabited in 2024, but a lot of building is ongoing.

In Linnakaupunki, several historical layers are simultaneously present. The oldest of these is Turku Castle, originating from the 13th century.[3] It is one the most prominent landmarks in Turku and an important tourist attraction. The new district is named after the castle, as *Linnakaupunki* freely translates to "Castle Town." The area is also known for its port, which has a long history of shipping and shipbuilding along the Aura River. Judging from old maps, the port began moving into the vicinity of the castle during the 18th century from its prior up-river location.[4] Many of the old port functions have already been dismantled and moved elsewhere, and the changes will continue over the next few years.

Figure 1. Surroundings of the port, with passenger terminals located behind the castle. Photo: Heikki Räisänen / City of Turku.

Regarding the new district, the most apparent part of the port is the passenger terminals, as cargo traffic is located further away from the settlement. According to development plans, the port surroundings (Figure 1) will change significantly. The current terminal buildings will be replaced by a new terminal, with plans also including a museum and other cultural services.[5]

The transformation of the Turku waterfront follows a global trend of waterfront regeneration, where former harbour and industrial areas have been turned into modern districts for living, working and entertainment.[6] These processes commonly adopt existing models built around success stories, such as Baltimore's Inner Harbor and the London Docklands Canary Wharf. These examples and others show that waterfront regeneration is symbolic of a city's new growth. The transformation often includes an attractive landmark, such as a cultural space with astonishing architecture, the purpose of which is to bring people to the area and create an image of growth and development. While many waterfront regeneration projects succeed, following general patterns overlooks local conditions. Considering each city's unique history, culture, and politics is crucial for gaining residents' acceptance, which is essential for healthy development.[7]

SENSORY ETHNOGRAPHIC WALKS IN LINNAKAUPUNKI

This study is part of an ethnographic research project, that maps factors affecting the well-being of occupants in a new residential area. The research team conducted sensory ethnographic go-along interviews during the summer and autumn of 2023.

Beginning in the 1990s, studies of the senses have been a significant part of social science and humanities research. For example, anthropologist David Howes[8] has emphasized the social and cultural significance of sensory experiences, and ethnographer Sarah Pink[9] has developed the sensory ethnographic method in different contexts. Researching senses is fascinating, but challenging, as it deals with the nonverbal, unspoken and often unconscious world of experience.[10]

Sensory ethnography is often put into practice in the form of go-along interviews, which offer insight into informants' spatial practices and, at the same time, allows access to their experiences and interpretations.[11] The movement contains different sensory experiences: kinaesthetic sensations combine with the sounds, visuals and haptic qualities of the urban environment.[12] Pink has suggested that walking with video can generate a deeper understanding of the formation of places and identities and that the video-making process also has a role in place-making.[13]

The interviews were recorded with action cameras so that the discussions and the interviewee's view are captured on the video. By walking in the urban environment, we were able to capture spontaneous, place-related sensory experiences – what is pleasant, what is disturbing or maybe even what is missing. The participants were asked to decide, at a minimum, the starting point of the walk and, preferably, also a route with some places they like or dislike. There was no fixed list of questions, but the interviewers could suggest topics for discussion. For the most part, the conversation was allowed to flow freely. The route choices were tremendously varied. Few participants walked through the actual port, but because the port covers a large area, many walked past it and had a visual connection to it, which prompted conversations about the port.

The interviews have been stored in the archives at the School of History, Culture and Arts Studies of the University of Turku.[14] Nineteen residents living in or near Linnakaupunki were interviewed, and this study is focused on their views. In addition, the interviewees included people working in the district and city developers. The residents were aged between twenty and sixtynine, and they presented different life situations – working life, studying and retirement. A clear majority were women.

The different pasts of the port's surroundings

What we now call Linnakaupunki used to be mostly in industrial use. Therefore, it was quite unknown to many people. In the interviews, it was described as uninteresting and shabby. One person described her previous thoughts: "Before, I felt that there was nothing in the direction of the port, so I did not go there."[15] Another stated, "It was a vague area between Portsa [another neighbourhood] and the port."[16] These comments reveal that the port was used as a reference point when trying to define a district without any recognised identity.

Because our participants had very different personal histories, there were also different perceptions of the history of the port's surroundings. First, for people who have lived near or otherwise used the area, there is a personally remembered past. This might include childhood memories: "I remember running around the harbour as a child when there were no fences next to the train tracks. I like the surroundings and the repurposed buildings, such as museum Forum Marinum."[17] This participant referred to fences that were built later to increase safety, leading us to consider how children used to move and explore the urban environment on their own, but their licence to move around independently has diminished internationally over the past few decades.[18] Planning should create opportunities for creative use of the environment for people of different ages, while still taking safety into account.

Participants remember the district as full of small industry, but not many knew exactly what kinds of industry. However, there were a few people for whom it was familiar through their work: "There was a former poultry slaughterhouse there. . . I used to work there a bit because we [the company] had a warehouse there. It was pretty shabby, water dripping from the roofs, and so on. But there was a nice sauna up there."[19] The harshness of the environment was mentioned in many other interviews, and the change from an industrial environment to clean streets was seen as positive.

The perspectives of the neighbourhood were very different when there was no earlier experience and memories. In that case, too, history is present. One person who moved to Turku only recently talked about learning something: "I read that there used to be a shipyard, but it's nice when it's gone and inhabited instead. However, it is interesting to look at old pictures and find out how it was."[20] He had received information about the history of the place, and by combining it with his own experience, he gained more perspective in his understanding of Linnakaupunki.

One more perception of the past is the imagined past. It is often linked with material history. During our walks, the most significant example of this came from the castle, which dates back to the 13th

century. Seeing the castle prompted interviewees to imagine the past in its surroundings: “Around the castle, I imagine what it was like when, probably, it was surrounded by water. I wonder how much the view has changed in 500 years.”[21]

The materiality of the port itself is much more recent. The oldest buildings, dating back to the late 19th century, are regarded positively within an otherwise barren environment. A good example of the materiality that embodies the distinctiveness of the surroundings is a clock with the Silja Line shipping company’s logo placed atop the pole (Figure 2). The clock has stopped, but it was considered sympathetic and nostalgic. In urban planning, nostalgia has been seen as an emotional reaction against urban development, but a better recognition of individual ways of remembering can also offer opportunities to create future healthy urban revitalization plans.[22]

Figure 2. The clock with Silja Line's logo embodies the place's history. Photo: Päivi Leinonen.

Sensing the present port

A central feature of the port is its changing rhythms. The cruise ships travelling between Finland and Sweden arrive and depart twice each day, defining the rhythm for a large area (Figure 3). Traffic to the ships includes cars, buses, trains and trucks. This heavy traffic was, at times, considered disturbing.[23] In the passengers’ terminal area, the change is significant, as outside rush hours, it is very quiet (Figure 4). In an interview in the port area, one participant commented, “The atmosphere is a bit dead.”[24] In addition to the lack of traffic and people, the interviewee noted that some of the buildings were a bit worn out and the yards were growing wild.

Figure 3. When the ships arrive, the atmosphere becomes lively. Photo: Päivi Leinonen.

Figure 4. Outside peak hours, the port is very quiet. Photo: Päivi Leinonen.

The port acts as a link to the world. The cruise ships bring tourists to town, and the international atmosphere was often mentioned. Many local dwellers appreciated the connections, and not only from a practical point of view. The interviews show that people had an emotional relationship with the port. For some, the attraction of the Linnakaupunki district is particularly the closeness of the port and sea: "Turku Castle and the river were of great importance to the fact that we decided to move here, and it is only a kilometre to the port. In addition, the port creates an atmosphere. It feels like an essential element."[25]

Participants described the feeling of freedom: "I like watching the ship traffic from the windows; it gives me a feeling of freedom."[26] Another participant said that he sometimes jogs to the port to watch people and ships move, because he finds it fun.[27] It was not always clear whether the freedom related to the port or to the sea. I interpreted that the port and sea are often experienced as a whole; the vicinity of the harbour cannot be separated from the sea. However, the sea can exist without a port. Some comments emphasized the sea and the seascape. "It is meaningful and unique to have a rental apartment in a good location and look out to the sea. I notice the proximity of the sea from the chatter of the seagulls, and I wake up to it in the mornings. I have lived near the sea since I was a child."[28] This person was concerned about the effect of future changes on her window view.

The port creates a special atmosphere, which was essential to some residents of Linnakaupunki. Atmosphere is an interweaving of the sensory, affective, spatial and material experiences.[29] In the case of the port, the special atmosphere is produced by the ships, seagulls and travellers for example. Individual experience is shaped by memories and future expectations.
The design details of the new residential buildings near the port include shapes familiar from ships, which was mentioned in some interviews. Such references were considered visually pleasing.[30]
Other mentions of visually pleasing elements at the port often focused on ships and the sea, while the physical environment was viewed as industrial and dreary. However, a different kind of perspective was given in the interviews: “I see the port area visually attractive. In a certain way, I also like barren landscapes. I have also photographed here.”[31]
The railway departing from the port stood out as an interesting detail. Many participants said they use the trackside path as a shortcut and enjoy its greenery and natural atmosphere.[32] The train passing slowly through the district was also seen as a pleasant element.[33] Walking along made it possible to pay attention to such a mundane matter that could have gone unmentioned in other interview methods.

Hopes anchored at future port of Turku

With the Linnakaupunki district in the midst of changes, thoughts about the future were also featured in the interviews. Imagining the future becomes possible by attaching it to concrete environments sensed at different times, and the imagining is based on sensory experiences and sensory memories of the present moment.[34]
The future came up in the form of concrete wishes or expectations. An often repeated wish for the future was that the seafront would be more accessible. At the moment, a large area is restricted to port operations (Figure 5). “It’s absurd that residents don’t get to experience the sea. This area would be a unique site for development.”[35] Another concrete wish was to move heavy traffic further from apartments and services. Instead, a tram was expected to improve public transport connections.[36]

Figure 5. Looking to the future, the residents hope that the seafront will become more accessible. Photo: Päivi Leinonen.

One participant wished for some action in the port area, but she couldn’t say exactly what type of action, just that it should not be full of residential houses.[37] Another person mentioned that the area does not have to be all new and is allowed to look a bit rough.[38] A couple of interviewees mentioned

that they dislike the industrial buildings in the surrounding area. Given the location near the port, they tolerate them, but they still prefer to look in the opposite direction.[39]
Generally, people hoped for more culture and services to enliven the area. However, we received an opposite point of view, too. The district was considered peaceful, and one participant stated that she was afraid of losing the peace with increased services.[40] Enlivening the waterfront is also the goal of the developers. Regarding the planned Museum of History and Future, everyone thought the new museum was welcomed. In best case scenarios, development of the cultural district combines the other wishes mentioned, such as freeing up the waterfront for people to use.

CONCLUSION

In this article, I have examined the changing vicinity of the Port of Turku using the sensory ethnographic method. The go-along interviews tell how people experience the area now, how they remember it in the past and what hopes they have for it in the future. The method supports the verbalization of everyday experiences that are easily overlooked in other types of conversations. I suggest that sensory mapping should be part of the planning process in the early stages, as it is an effective method for recognizing hidden values and possibilities, as well as potential disadvantages, that shape the unique character of a place.
The current atmosphere at the port is dominated by changing rhythms, heavy traffic and large asphalt fields. The symbolic meaning of the harbour was strongly present in the interviews: the feeling of freedom was connected to watching the ships and to the possibility of travelling. Many participants appreciated the sea itself, through visual connection or hearing the seagulls, for example. Hopes for the future were often focused on improving the connection to the sea. In addition, they had concrete wishes for public transport and services. Historical awarenesses and imaginings of history were strongly attached to material remains of the past, such as Turku Castle and other old buildings. The loss of the newer industrial environment was not regretted. Nevertheless, a certain amount of roughness was seen as acceptable and appropriate to the character of the area.
The transformation of the port follows global trends in waterfront regeneration. In Turku, as in many other cities, a new attractive cultural centre is planned for a central location. The concept of the Museum of History and Future includes a presentation of local history. The winning design of the architecture competition, announced in the summer of 2024, also takes local history into account with its design including features from the area’s old warehouses. The museum plan gives hope that the transformation is simultaneously in line with global trends and adapted to the local environment. The final result cannot be assessed for a long time, as the museum is not planned to be opened until 2030.
Understanding the key elements of the port – the sense of history, the sense of freedom, the connection to the sea – is important for developing the area without losing its uniqueness.

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EMPOWERING VULNERABLE CITIZENS THROUGH SERVICE-LEARNING IN THE SOCIO-SPATIAL DESIGN AGENCY COURSE

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INTRODUCTION

This paper introduces the Socio-Spatial Design Agency (SSDA) service-learning elective course taught at the KU Leuven Faculty of Architecture. In the context of this course, aimed at teaching and learning about social-spatial processes, co-creation methods and tools, and innovative approaches in (interior)architecture and urbanism, students are invited to design socio-spatial projects/installations/interventions/tools/… with and for vulnerable citizens and social organizations working with those. In this paper, the discussion is specifically on how, in the SSDA course, empowerment is not approached as a single-directional power transfer from the powerful to the powerless but as a two-way process, enriching all the involved parties.

The paper starts with a short introduction to the course itself. This includes an explanation of the course's aim, practical organization, and pedagogical approach, a brief introduction to three of the six 2023-2024 cases, and an elaboration on the course's overarching theoretical framework and concepts. Next, the methods and tools used to stimulate empowerment and the development of Transformative Literacy among all involved parties are discussed. Finally, the paper includes a reflection on the challenges and paradoxes encountered while teaching this elective. This involves a discussion on how these are not avoided, ignored, or concealed, but used to foster discussions on, for example, inclusion, power relations, and empowerment. The aim of the paper is to illustrate how, by stimulating collective reflections on the relationship between short-term, small-scale, and bottom-up initiatives and long-term, structural change, the SSDA course allows students and societal partners to gain knowledge and experience how architecture can become socially constructed and spatial design might become a critical, inclusive, and situated practice.

ABOUT THE COURSE

The SSDA is an optional course open to all master students of our faculty. This means the course can include students of the Master of Architecture, Interior Architecture, and Urbanism & Spatial Planning. As elective courses at our faculty can only span one semester and as that is a very short period for providing a meaningful contribution to a societal project, the SSDA course is organized as two courses: the SSDA_Foundations Elective in the first semester and the SSDA_Expansions Elective in the second semester. Each instance is worth 4 ECTS credits, and students can take up either one or both instances.

Aim, Practical Organization, and Pedagogical Approach

Aim

In a society increasingly confronted with complex challenges - such as climate change, loss of biodiversity, economic crises, and social exclusion - (interior) architecture and urbanism are not to be considered stand-alone disciplines.[1] The purpose of the SSDA course is to stimulate critical reflection on the link between 'the social' and 'the spatial' and the agency of design. The aim is for students to become more aware of how design is always a political act[2] and help them to gain knowledge on and experience with innovative (more inclusive and transitional) approaches in (interior)architecture and urbanism.

Practical Organization

Both SSDA instances are weekly, half-day courses, offering an alternation of guided on-campus sessions and non-guided on-site (inter)action periods. In both semesters, the (inter)action periods are five weeks long (3+2). However, since this always includes a holiday period (Christmas and Easter breaks), it is possible for students to spend more time on this if desired.

Pedagogical Approach

The SSDA course is developed according to the service-learning pedagogy. This means that, on the one hand, students are invited to work together with societal partners on concrete socio-spatial challenges faced by these partners. On the other hand, they are also being offered some theoretical frameworks or academic knowledge in a classroom context. The key element of service-learning is a conscious and regular dedication of time for critical reflection, aimed at triggering and enabling the students to make connections between what they learn in school and their practical experiences in the field. As illustrated in Figure 1, the aim is for students to grow not only academically but also professionally and personally (or civically) throughout this process.

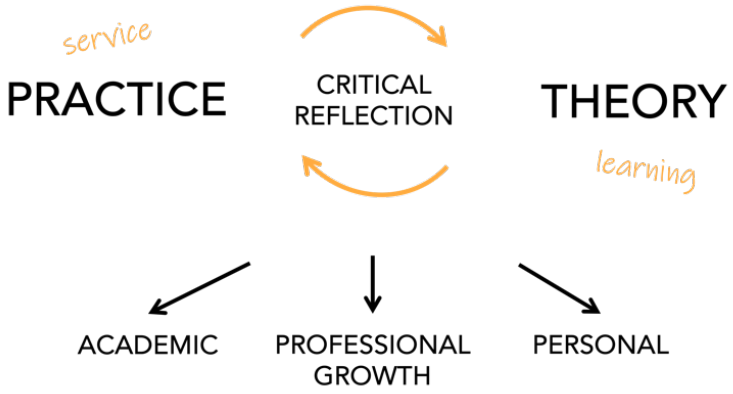

Figure 1. Service-learning scheme

Although, in literature, a variety of characteristics are attributed to service-learning, three basic principles can be considered a common denominator. Namely, that (1) it is integrated into the curriculum, (2) it focuses on real social needs expressed by societal partners, and (3) an attitude of reciprocity is assumed (meaning that all partners' knowledge and expertise are considered equally important and valuable).[3]

Overarching Theoretical Framework and Concepts

The SSDA course revolves around a series of theoretical concepts - such as '*housing as a verb*',[4] '*place-based solidarity*',[5] '*regenerative sustainability*',[6] '*urban controversies*'[7], '*design justice*',[8] and '*infrastructuring in design*'[9] - which the students are invited to research and reflect on and experiment with.

Moreover, Transition Design (TD), an approach aimed at providing designers with new tools and methods for facilitating the transition to more sustainable and inclusive futures[10] is used as the course's overarching theoretical framework. As illustrated in Figure 2, this approach is based on a radical focus on long-term visions for an alternative, more desirable future. From there, through backcasting, it projects back to the middle long term and ultimately to what can already be done today in the light of these long-term visions. Because of its focus on time and transitions, this approach is very suitable for triggering students to investigate the role of 'design' and 'designers' in the transition between the changes our society is undergoing today and the transitions we should be making.

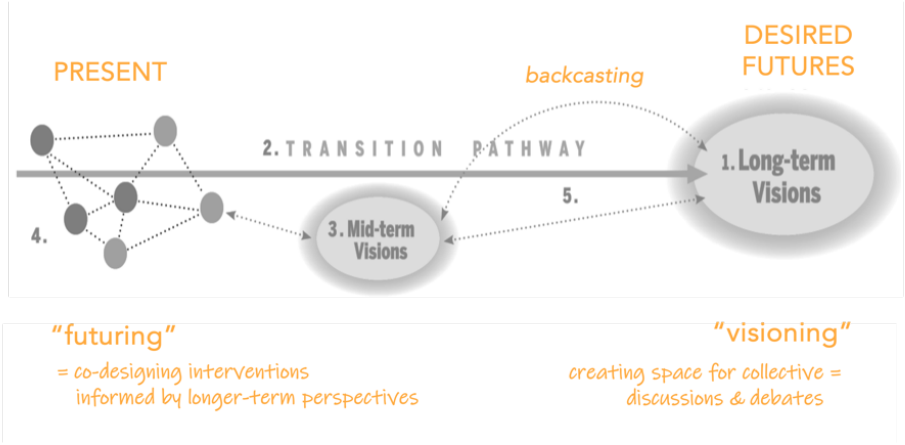

Figure 2. Transition Design scheme

In the context of TD, 'visioning' and 'futuring' are key concepts. On the one hand, 'visioning' involves creating space for collective discussions and debates about alternative futures and new ways of being with all the stakeholders involved. On the other hand, 'futuring' involves designing and realizing small-scale and sometimes even temporary interventions in the present, which are based on the long-term alternative future perspectives. The first one is something I also try to do with other students in another course that I also teach at our faculty, namely a design studio; the latter is what I do with my students in the SSDA Electives.

Example cases

The SSDA course is based on the premise that if one wants to go beyond local symptom control and strive for the structural change needed to address contemporary 'wicked problems', which are that are both social and technical in nature, a transdisciplinary and systemic approach is necessary.[11] Starting from this, the enrolled students are invited to work together with vulnerable citizens and social organizations on the design of socio-spatial projects/installations/interventions/tools/… aimed at addressing the challenges faced by these partners in an inclusive and sustainable way.

As an example, three of the six cases we worked on during the academic year 2023-2024 are '*Solidary Mobile Housing@Koekelberg*', '*Récupérathèque@Leiekaai*', and '*vzw Kompas@Wondelgem'*. In the context of the '*Solidary Mobile Housing@Koekelberg*' case, the students worked together with SAAMO, an organization focusing on social work and community

building, and two formerly homeless inhabitants on the co-creation of a temporary housing pilot project on an urban waiting space in Brussels (Belgium). In the context of the '*Récupérathèque@Leiekaai*' case, the students collaborated with the student community, faculty members, and administrative and technical personnel of our new campus in Ghent (Flanders, Belgium) to set up a material recuperation bank and investigate opportunities for interaction with the surrounding neighborhood. And, in the context of the '*vzw Kompas@Wondelgem*'-case, the students engaged with employees, managers, and inhabitants of a non-profit organization offering support to people with mental disabilities in a reflection on how to adjust to the changing context of de-institutionalization of care and how to better integrate the organization's residential care facility in Wondelgem (Flanders, Belgium) within its suburban environment.

FOSTERING EMPOWERMENT AND TRANSFORMATIVE LITERACY

This part goes deeper into how the SSDA course stimulates empowerment as a reciprocal growth process between the various parties involved. The focus is specifically on the methods and tools used to stimulate learning from, with, and by the societal partners and enable the development of Transformative Literacy among all involved parties.

Empowerment as a Reciprocal Growth Process

As mentioned above, one of the basic principles of service-learning is that an attitude of reciprocity is assumed. This is especially interesting when it comes to redefining empowerment as a two-way process, enriching all the involved parties. For, it is mainly through the actions that are aimed at ensuring 'reciprocity' that the different parties involved can grow by learning from each other, both within the smaller, case-based student teams, within the whole course group, as well as with the societal partners. Below, we are elaborating on how learning with, from, and by the partners is enabled step-by-step in the SSDA course.

First Reflection Assignment

Throughout the course, the students receive several individual and group reflection assignments. In the first reflection assignment, taking place at the very beginning of the course, one of the questions is: '*Before we look for new (design) solutions, we should look at what already works at the community level. What kind of existing/traditional/indigenous/local knowledge and/or practices could your intervention(s) help to preserve or uplift in this case?'* The aim of this question is, of course, to make students aware that they are about to get involved in an existing context, which is not a blank page, and to awaken their curiosity about what is already there.

Iceberg Analysis

At the same time, the students are also asked to draw up an initial iceberg analysis for their cases. As illustrated in Figure 3, this method allows one to gradually dig deeper, starting from the visible effects (or the symptoms) of a particular problem, towards an analysis of the patterns, structures, and paradigms of thought underlying this. As such, it helps to place a concrete issue in a broader social context.

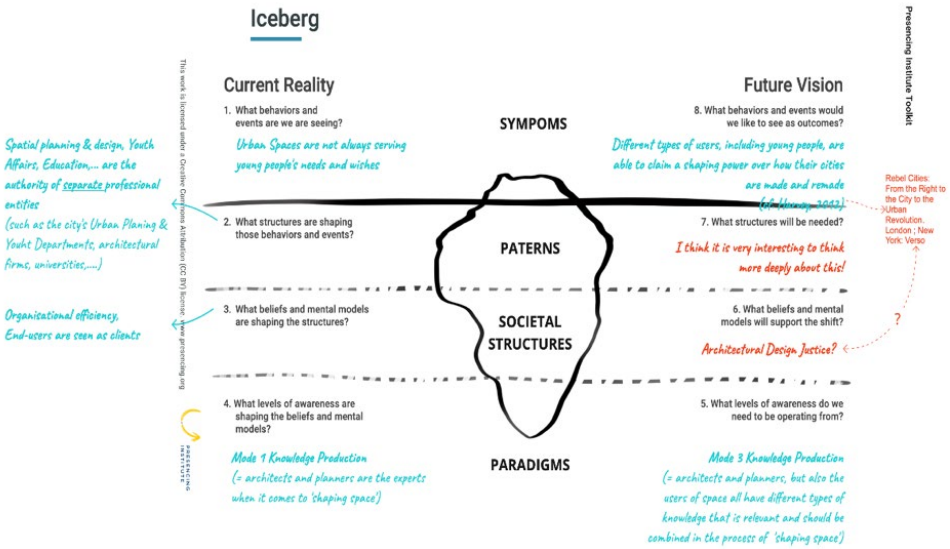

Figure 3. Initial iceberg analysis vzw Kompas Case by SSDA Students 2023-2024

Each group first makes this analysis separately and then presents it to the whole class in one of the first on-campus sessions. This allows for a discussion about the similarities and differences between the various cases, enabling everyone to learn from each other's insights, reflections, and questions. Consequently, the iceberg analyses are constantly elaborated on over the course of the sessions.

First (Inter)action Period

After these initial steps, it is time for the first (inter)action period, in which the students engage on-site with actors and stakeholders of 'their cases'. This thus enables a direct exchange of knowledge and experience. As shown in Figure 4, the result of the (inter)actions can take various forms. For example, in the case of '*Solidary Mobile Housing@Koekelberg*', together with the inhabitants and people from the SAAMO, the students designed and built two small porches for the modular housing units in Koekelberg. In the case of '*Récupérathèque@Leiekaai*', the students helped to develop the material bank, and they also organized a competition for a mural to draw attention to the project. And, in the case of '*vzw Kompas@Wondelgem*', the students organized a 'walk and talk' activity, bringing together the residents of the care facility with people from the surrounding neighborhood to discuss possible interventions for stimulating the shared use of a neighborhood park.

Figure 4. Photo collage of some of the 2023-2024 SSDA (inter)actions; from left to right: 'Solidary Mobile Housing@Koekelberg', 'Récupérathèque@Leiekaai', and 'vzw Kompas@Wondelgem,' by SSDA Students 2023-2024

Reflection session

After the students have worked on-site for several weeks, we all gather on campus for a group reflection session. In this session, amongst other things, the relationships between the students and the other case actors and stakeholders are explored. The aim here is to get a deeper insight into where they currently are and where they might want/need to be to take meaningful actions. For this, we are using Actor-Network Mapping,[12] and Bringle et al.'s 'Relationships Continuum Framework'.[13]

Moreover, we also work on getting a deeper insight into the scope of the actions of the different parties involved. The aim here is to make students aware that a double-pronged strategy - involving a dynamic interplay between bottom-up and top-down approaches - is necessary to realize successful societal transitions. For this, we are using Howaldt et al.'s 'Agency-Outcomes-Structure Model'[14] (Figure 5).

The overall purpose of this session is to enable the students to take more targeted actions and engage in a more profound dialogue with the partners during the second interaction period following right after this.

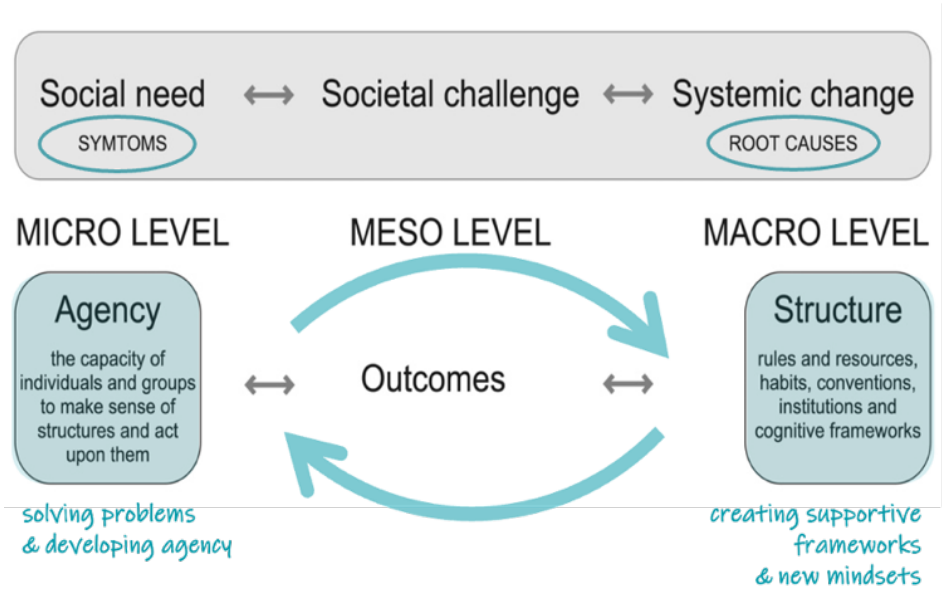

Figure 5. Agency-Outcomes-Structure Model[15] (adjusted by the author)

Second (Inter)action Period

During the second interaction period the students are re-engaging in on-site (inter)actions. Like in the first interaction period, it is always possible to plan a (remote, on-site, or on-campus) consultation to get counselling and guidance from the course tutor if needed.

Presentation and Celebration Session

Finally, in line with the rules of the art of service-learning, a 'presentation and celebration' session is organized at the end of each course instance (= in December and in June). During this session, to which all the involved actors are invited, each group presents (1) what they did this semester (process & results), (2) why they did that (link to the iceberg analysis), (3) what they learned from it (link to the course concepts), and (4) what that might mean for the future, for themselves and the other case actors (internalization of the experience & knowledge transfer). After which we engage in a discussion with the audience. This session is important as it offers the opportunity to bring people together who would otherwise not easily gather around the same table, and it allows for inter-case knowledge exchange. However, as not all partners can always be present, all the presentations are afterwards also shared with everyone (in a version including more explanations).

Developing Transformative Literacy

According to Göpel, Transformative Literacy (TL) can be defined as the skill to steward transformative change collectively across the boundaries of institutions, nations, sectors, and cultures to consciously change behavior to stay within the 'safe operating space' of the planetary boundaries.[16] As illustrated in Figure 6, this concept includes several sub-elements, namely '*future literacy*', '*human literacy*', '*institutional literacy*', and '*environmental literacy*'.

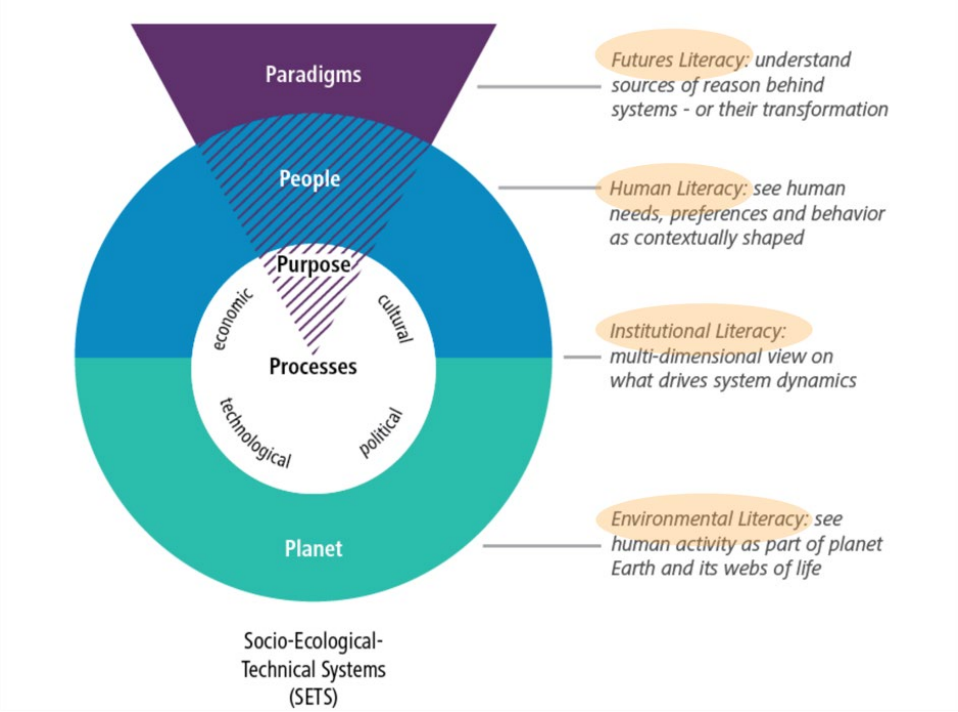

Figure 6. Transformative Literacy scheme[17]

As the societal partners are all trying to overcome the 'wicked problems' they are facing in an inclusive and sustainable manner, the cases at hand offer interesting environments to explore this notion. Additionally, as service-learning is inherently about the recognition of different types of knowledge, it involves a transgression of the expert/non-expert opposition. As such, it offers the possibility to develop TL, not only with students but also with the other actors involved. However, as the different TL sub-elements might be more obvious in some cases than in others, the group reflections and discussions are crucial for the students (and other involved actors) to reach a full understanding of the concept of TL.

CHALLENGES AND PARADOXES

While teaching this service-learning course, we are inevitably confronted with challenges and paradoxes. In this part, we want to show how these are not avoided, ignored, or concealed but instead used to foster discussions on, for example, inclusion, power relations, and empowerment.

Challenges

On the one hand, we might face practical challenges related to the complex and confusing nature of the course, potential financial and legal issues, and eventual literal and/or figurative language issues.[18] In case these challenges occur, we are trying to deal with them as much as possible in consultation with the partners and students. On the other hand, also some more substantial challenges might occur as the rhythm of academia does not always align well with the rhythm of the real world, it is sometimes hard to find the proper balance between 'service' and 'learning' activities, and it is not always easy to overcome a 'one-shot' approach. With respect to this, in the context of SSDA, we are trying to enable all the involved parties as much as possible by 'scaffolding' rather than strictly planning the course. This, for example, includes scheduling the course program as much as possible together with the partners, foreseeing enough time for the students to immerse themselves in the partners' context but also to take some distance and reflect on their experiences, and being open to

adjusting the course ‘on the go’ according to the students and/or the partner’s needs. To this end, we adopt a very accessible attitude and actively maintain an open line of communication with all the involved actors. Finally, we raise awareness with the students on the need to properly document their actions and prepare final documents that are readily understandable (also to non-spatial professionals) so that their work can easily be communicated and transferred to all stakeholders.

Paradoxes

The first paradox we are facing is related to the importance of the students carefully considering and planning their interventions versus the need for them to start the (inter)action quickly enough to be able to give back something tangible/meaningful in the end. To help the students (and tutor) manage this aspect, the (inter)action process is closely followed up (a.o. through the reflection exercises and by means of a ‘Structured (Inter)action Journal’ that is shared regularly with the tutor). The second paradox is related to the ‘innocent’ position of the students versus the ‘weight’ of the university. Sometimes, this weight can indeed be put on the scale for advancing a partner’s cause (e.g., during the (inter)actions or the presentation and celebration session). However, this cannot be done lightly. In many of the course sessions, the power inequalities that might exist between the different parties involved are brought to light and discussed.

The third paradox is related to spatial interventions versus social transformation. Throughout the (inter)actions, students might realize that short-term enthusiasm about a new project doesn't always guarantee long-term sustainable change or that a spatial intervention is not what is needed in a specific case. This offers an interesting opportunity to make them aware of the importance of also working on designing ‘rules of engagement’ for the management of new or redesigned spaces and/or the potential role of the (interior)architects/urbanists in initiating and feeding the debate about alternative futures and other ways of being.

CONCLUSION

This paper elaborated on how, in the SSDA course taught at the KU Leuven Faculty of Architecture, the potential of service-learning to transgress the expert/non-expert opposition is leveraged to reframe the notion of empowerment as a reciprocal growth process. Furthermore, it also demonstrated how the experiences gained through the on-site (inter)actions, along with individual and collective reflection on those and on the course’s theoretical concepts, enable the development of Transformation Literacy (TL) with all the involved parties, stimulating them to become aware of their potential to act as 'agents of change'.

By stimulating collective reflections on the relationship between short-term, small-scale, and bottom-up initiatives and long-term, structural change, the SSDA course thus allows students and societal partners alike to gain knowledge and experience how architecture can become socially constructed and spatial design might become a critical, inclusive, and situated practice.

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CHALLENGES IN PARTICIPATORY DESIGN RESEARCH: REVIEW OF EMPIRICAL CO-DESIGN STUDIES FOR INTERGENERATIONAL CONNECTEDNESS IN FAMILY CONTEXT

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INTRODUCTION

Studies have indicated the benefits of strong intergenerational connectedness to the wellbeing of people. Technological designs have thus been explored and developed for improving intergenerational connectedness. Also, technologies have been increasingly integrated in our everyday life as parts of the daily infrastructure, requiring everyone's engagement in the design process to better meet the everyday needs.

Co-design has been a feasible method of participatory design research (abbr. PDR), since it emphasises people's direct, collective contributions to design ideas as design partners throughout the technological development.[1] Although empirical PDR studies of technological designs for intergenerational connectedness in the past two decades have engaged families, previous reviews in the related contexts indicate a lack of engagement of participants in the generative stage as design partner.

This review study aims to identify empirical studies that have adopted co-design approach with family members of different generations (i.e., (grand)parents and children, and collateral relations) to design technological artifacts for enhancing intergenerational connectedness. By organising the literature, this paper provides insights into the existing methodological considerations of co-designing with families for mediating their connectedness, with a focus on the issues design researchers encountered throughout the co-design processes.

Technologies as mediators of family connectedness

According to Lee and Robbins,[2] social connectedness refers to the "internal sense of belonging and is defined as the subjective awareness of being in close relationship with the social world." Similarly, other scholars have also defined social connectedness as a short-term, emotional experience of belonging and relatedness, or closeness, among people,[3] which can be assessed by dimensions of the frequency of the social contacts, the quality of the social encounters, the (dis)satisfaction with contact quantity and quality, the (dis)satisfaction with relationships, and so on.[4] Since human beings are born to be social beings, the importance of establishing social connectedness to the physical and mental wellbeing of people of all ages has been highlighted.

Since late 1990s, people have seen the possibility of using technologies to mediate social connectedness. A review study in 2011 shows an increasing trend of research in the first decade of 21st century about technological development in addressing social interaction and connectedness.[5] Another review study in 2012 suggests that the most common theme of technology design for/with families throughout 1996-2011 was "promoting togetherness and unity" in family context.[6]
However, there is a lack of review study in this field in the near decade, while previous studies have not presented a summary of the approaches to engage families as design partners[7] in devising technology for mediating intergenerational connectedness. Therefore, this study aims to address this gap to take a close look into PDR in this specific area to dig out the existing approaches and challenges of engaging active participants.

Existing theoretical frameworks of co-design methodology

There are three existing theoretical framework that we referred to for this review analysis. First one is Druin's framework for defining the roles of participants, in which she categorises children as users, testers, informants, and design partners in PDR depending on their relationships to adults, to technology, and the goals of inquiry.[8] The second is Sanders and Stappers' framework of co-design, where they divide the whole co-design process into pre-design, generative, evaluative, and post-design phases, and have highlighted the usages of various tools, such as probes, toolkits, and prototypes at each phase.[9] Finally, Hanington and Martin's handbook recording 125 universal methods of design has mapped out the correlations of design research methods with the phases of research,[10] which is more up-to-date and referrable for identifying the design phase each study locates at.
To figure out challenges of active participation of families in this specific area of technology design research, we combined the three frameworks with Druin's and Sanders and Stappers' as main references and Hanington and Martin's as support for our review analysis. With such an endeavour, we attempted to provide a matrix of methodological considerations that links together roles of participants (i.e., families), co-design phases, and research methods and tools, so as to inform the analysis of the challenges revealed in the previous empirical PDR projects.

Research questions

With the main goal of investigating how technologies were proposed and designed with families to achieve the intention of mediating intergenerational family connectedness, we have specifically considered the below two research questions:
1. What are the existing approaches of engaging people as co-design partners to develop technologies for mediating family connectedness?
2. What are the challenges of co-designing technologies with intergenerational families?
By answering these two research questions, we attempted to inform future research in this area, as well as other research related to society and communities that incorporate PDR with families.

METHODS

The literature identification process has adopted the Title-Abstract-Keyword (TAK) searching strategy for efficiently find out the most relevant articles related to our research goal. Keywords for screening literature from the database *Scopus*, since it covers many interdisciplinary studies related to design, are listed in Table 1. There are mainly four steps of identifying literature as shown in Figure 1.

Key Concepts	Related Keywords
Connectedness	"Feelings of belonging", "belongingness", "relatedness", "social connectedness", "connectedness", "togetherness", "intimacy", "feeling of closeness", "closeness"; "awareness", and "love"
Participatory Design	"Participatory design", "co-design", "cooperative design", and "co-creation"
Technology	"Tangible technology", "tangible design", "more-than-digital technology", "technology" and "technological artifacts"
Family	"Family", "family members", "intergenerational", "cross-generational", "parent and children" and "grandparent and grandchild"

Table 1. Keywords for Identifying Literatures

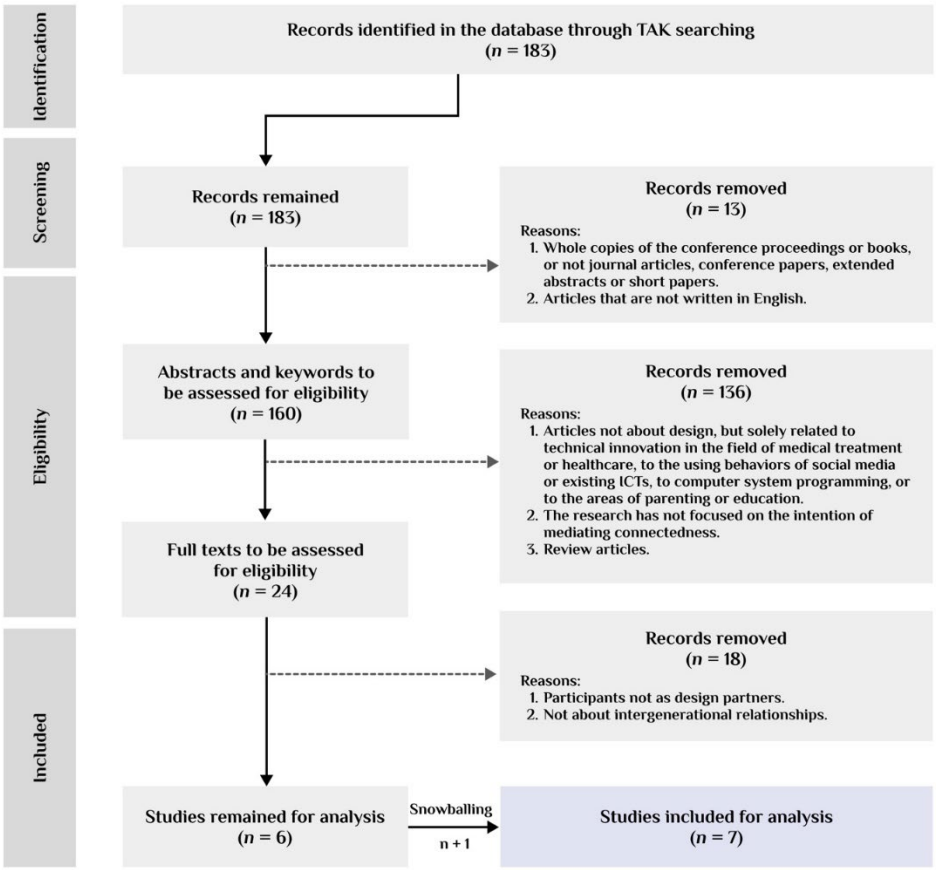

Figure 1. Diagram of Literature Identification and Screening Processes

We identified 183 research articles related to the topic at first. And then, literature screening was conducted, with some exclusion criteria set before and during the screening process. Firstly, we have screened out books or entire conference proceedings, as well as research that are not presented in English. Secondly, we have excluded those do not contribute to (technological) design or not focus on mediating connectedness and screened out review articles. Thirdly, through a thorough examination of the contents of the remined studies, we have excluded empirical studies where participants were not engaged as design partners according to Druin's criteria (i.e., participants who engage in all the stages of pre-design research and design generation to directly provide design ideas)[11] or where participants were not intergenerational families. There were 6 studies left for detailed analysis at this

stage. Throughout the process of analysis, we have snowballed one more research article through the examination of the reference lists of the included articles. In the end, there are 7 highly relevant articles included for thorough analysis.

RESULTS AND FINDINGS

Even though the included studies are limited in the amount (n=7), there is an obvious one-decade gap found between 2006 and 2016 where there is no related research publication (see Figure 2). Possible reasons can be the emergence of communication technologies like smartphones[12] and the global hit of social media that led to more research on how media technologies have influenced social behaviours or why people use these media technologies. Examples are the studies of Biemans et al.,[13] Sagoo and Rhee,[14] Sherman et al.,[15] Wei,[16] Whiting and Williams,[17] and Stuedahl and Lowe.[18] And thus, there can be less interests in exploring additional technologies for social connectedness in general. Another gap between 2019 and 2023 is also revealed, with the outbreak of COVID-19 as one of the possible factors. Even though there were still many research looking into measurements of and coping strategies for social connectedness and mental wellbeing during that time,[19] it can still be hard for design researchers to involve families in-person for co-design activities during that special period.

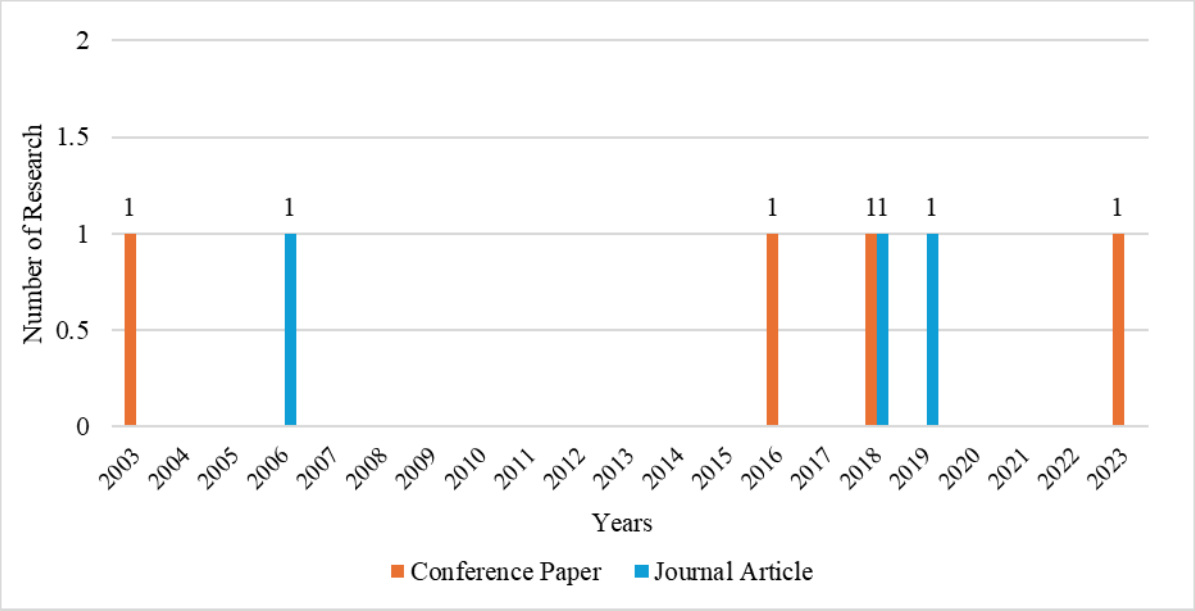

Figure 2. The Number of Conference Paper or Journal Article Published in Each Year

Among the included articles, three are journal articles and four are conference papers (see Figure 2). It seems that conferences welcome a bit more design research in relevant field than journals. But whether this insight is valid can be further investigated in future studies.

Except for one research article from India, all the rest included are from western countries or regions (see Table 2). This indicates another research gap for future research in the area, that is, to conduct PDR and co-design activities in countries and regions of different socio-cultural contexts to collect first-hand data about the insights of people from various backgrounds to avoid cultural biases or overgeneralization.

Research Article	Year	Country / Region
Technology Probes: Inspiring Design for and with Families	2003	Sweden, France, and the U.S.
Shared Family Calendars: Promoting Symmetry and Accessibility	2006	Sweden, France, and the U.S.
Confidence & Control: Examining Adolescent Preferences for Technologies That Promote Wellness	2016	Boston, the U.S.
Participatory Design for Creating Virtual Environments	2018	Mumbai, India
"I Just Let Him Cry…": Designing Socio-Technical Interventions in Families to Prevent Mental Health Disorders	2018	Oxford, the UK
Storywork In Stem-Art: Making, Materiality and Robotics Within Everyday Acts of Indigenous Presence and Resurgence	2019	the U.S.
Designing for in-Home Long-Term Family-Robot Interactions: Family Preferences, Connection-Making, and Privacy	2023	the U.S.

Table 2. Cultural Backgrounds of The Included Research Articles

Co-design methodologies and roles of participants

Looking into methodologies, all seven articles record at least one co-making process throughout co-design research. Details about the correlations of the methods and tools adopted and the phases of design research are shown in Figure 3. The descriptive data about the situations of each tool been adopted at each phase of co-design research in the included studies are displayed in Figure 4, while those of the methods applied are synthesised in Figure 5.

Specifically, two studies have reported research design throughout pre-design, generative, and evaluative phases; three studies have depicted the pre-design and generative phases; and for the rest two research articles, authors have recorded the generative phase only. No study has covered the post-design phase.

The most frequently adopted tools are low-tech materials (n=8), followed by technological probes (n=5), and then low-tech prototypes (n=4). Correspondingly, it is not surprising that co-design workshops (n=10), which have close relations with low-tech materials and low-tech prototypes, are the most applied research method, followed by interviews (n=7), an ethnographic method commonly used for digging deeper insights from people, and then technological probe deployment (n=5), closely attached to technology probes.

However, across the seven studies, there are only eleven methods adopted for PDR studies in this specific area, while way more methods for design research listed by Hanington and Martin[20] remained to be examined and incorporated in PDR studies.

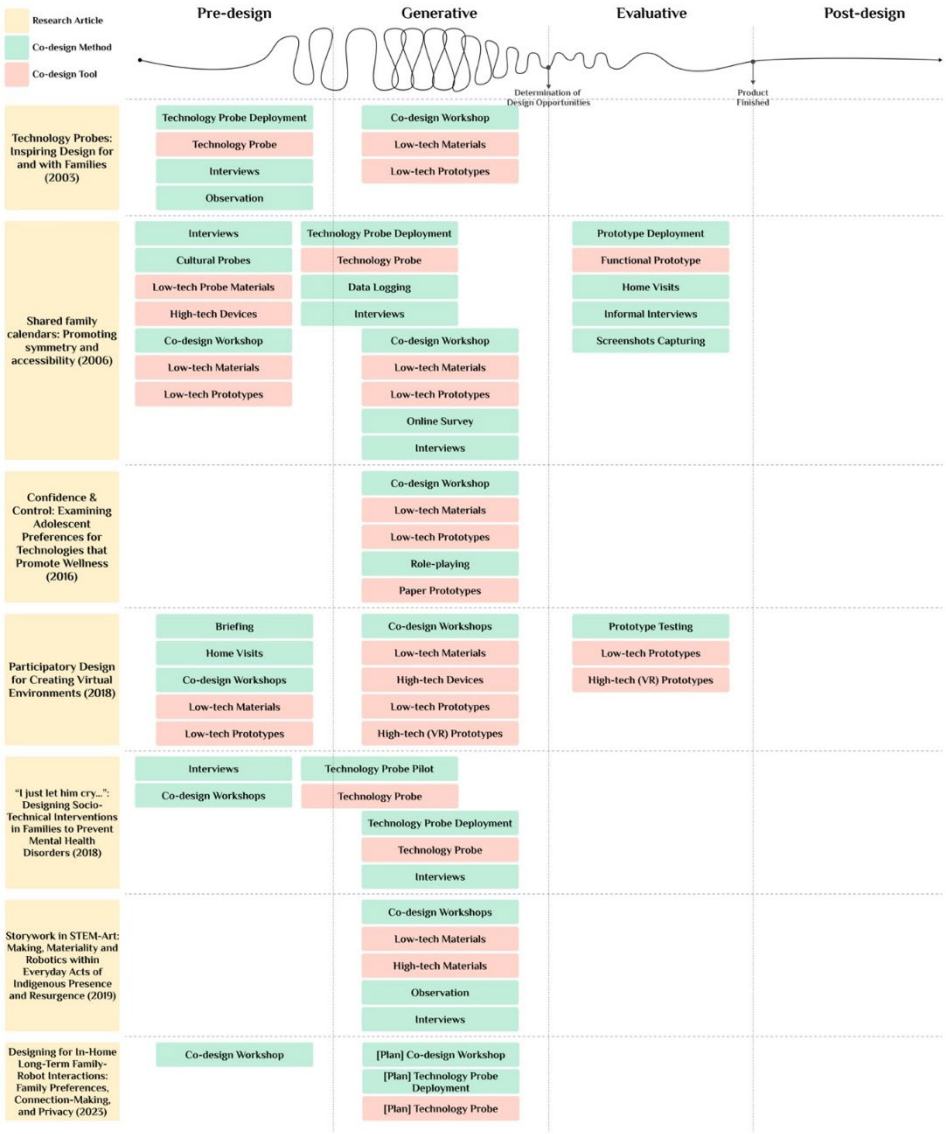

Figure 3. Matrix: PDR Methodologies of the Included Research

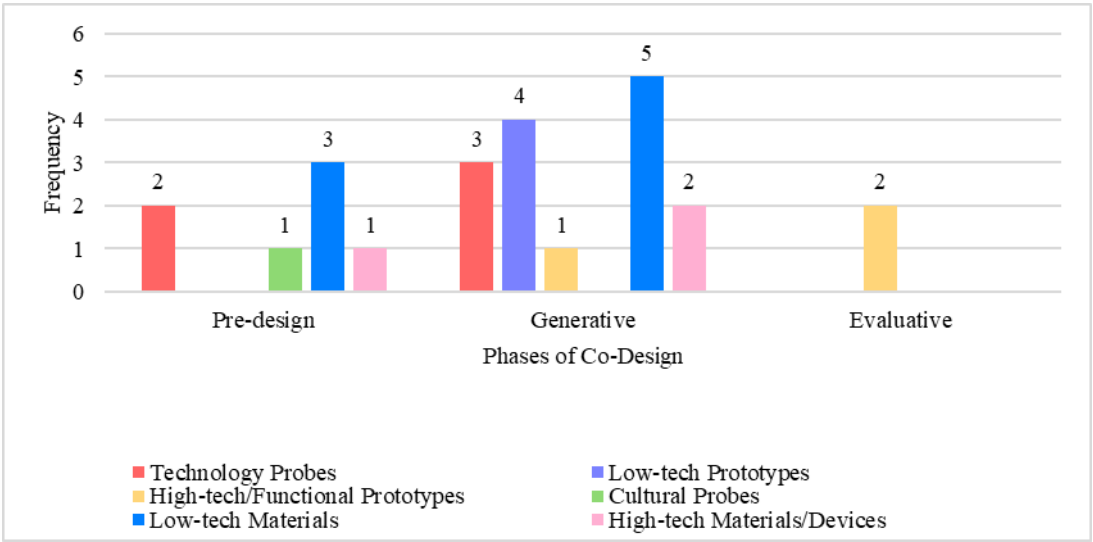

Figure 4. Frequency of Tools Adopted at Each Phase of Co-Design of the Included Research

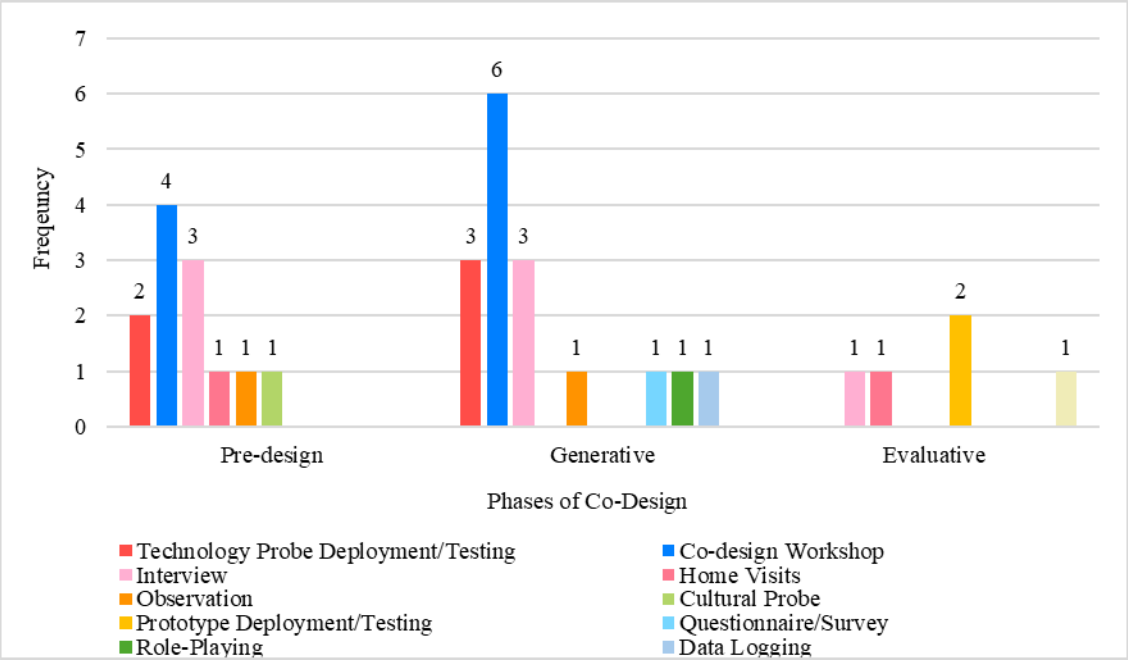

Figure 5. Frequency of Methods Adopted at Each Phase of Co-Design of the Included Research

As for the roles of participants, only four articles indicate how their authors define the roles of participants, while there is no clue about how the authors of the rest three studies define their participants (as sorted in the third column of Table 3). However, according to our revision of the roles based on the descriptions of the methods, tools, and the families engaged as in the final column of Table 3, we found that only in two articles can the authors correctly reflect role of their research participants, i.e., design partners, by the terms they use like “active partners” or “design partners”. Viewing together with the keywords of each research article (see the second column of Table 3), only one article explicitly positions its study as “participatory design” and “cooperative design”, and two involve “participatory design” as one of the keywords, while the rest four research articles have not provided any relevant indicators. These phenomena indicate that understandings of co-design as design research approach in the area is still lacking from both epistemic and methodological aspects.

Research Article	Keywords	Roles of participants (Author-defined)	Roles of Families (Revised)
Technology Probes: Inspiring Design for and with Families (2003)	Computer Mediated Communication, Home, Ethnography, Participatory Design, Cooperative Design	Active partners; Design partners	Design partners
Shared Family Calendars: Promoting Symmetry and Accessibility (2006)	Design, Experimentation, Human Factors; Home, Calendar, Digital Paper, Universal Usability, Family Technology, Elderly, Privacy, Layered Interfaces	Design partners	Design partners
Confidence & Control: Examining Adolescent Preferences for Technologies that Promote Wellness (2016)	Health Technology, Adolescents, Participatory Design, Socio-Ecological Model, Relationships, Healthy Eating.	N/A	Design partners
Participatory Design for Creating Virtual Environments (2018)	Participatory Design, 360-Degree Video, Intergenerational Storytelling; Methodology, User-Centred Design, Prototyping	Users	Design partners
"I just let him cry…": Designing Socio-Technical Interventions in Families to Prevent Mental Health Disorders (2018)	Prevention Science, Families, Mental Health Promotion, Emotion Regulation, Social-Emotional Learning, Interventions	Users	Design Partners
Storywork in STEM-Art: Making, Materiality and Robotics within Everyday Acts of Indigenous Presence and Resurgence (2019)	N/A	N/A	Design partners
Designing for In-Home Long-Term Family-Robot Interactions: Family Preferences, Connection-Making, and Privacy (2023)	Child-Robot Interaction, Social Robots, Interaction Design, Family-Centered Design, Multi-Party	N/A	Design partners

Table 3. Roles of Participants: Author-defined Ones versus Revised Ones

Co-design Challenges

There are methodological challenges disclosed related to the co-design activities. First is about scheduling the research activities. Design researchers have faced difficulties planning activities like interviews, home visits, or co-ideation since some family members were busy while some other older members of the family had unexpected travel plans or illness.[21] The participatory study had to be delayed in the end. Explorations on how we can coordinate our research plans and the schedules of our participants, especially the intergenerational ones, would be needed in the future empirical studies.

The second issue is related to instructions of co-design activities. Even though too much guidance from the facilitators of co-design workshops can hinder the creativity of the participants, without a clear goal in mind, participants would also be confused about what to do at the beginning, resulting in an initial failure of imaginative co-making.[22] Also, families may not have clear idea of the "who" they should be designing for. Families need a far better method of specifying with whom they communicate to constrain the context for their imaginations.[23] These situations suggest a need of a briefing session before each co-design session to make clear the goals to be achieved, so as to better set free of the imaginations and creativities of participants.

There are also issues related to participants recruitments and cultural diversity for co-design. It is hard to recruit people from various cultural backgrounds, hence not being able to evaluate the cross-cultural applicability of the design ideas for mediating family connectedness.[24] Also, two studies have identified the language barriers in co-design session for understanding the instructions and co-creating with people speaking a different language, and thus the co-design outcomes would be limited.[25] One of the studies has tried to deal with the issue by recruiting two bilingual student helpers to assist the participatory study,[26] but the feasibility of such a solution needed further examination since some information may lose during the translations and transmission.

There are some issues that may not directly affect the co-design planning but can influence co-creation. Firstly, a study indicates a "general distrust of speaking to 'authorities'" for young children,[27] which makes them not dare to talk to adults, including design professionals and other adult participants, who are considered as the "authorities" in their minds. As a result, they may not speak out what they actually imagine or concern about. This insight is in line with previous research suggesting the need of empowering the children and calling for figuring out strategies to enable equal power of children and adults in co-design.[28] Secondly, family coordination is important but difficult since different family members have different coordination needs, and everyone makes use of different methods and tools.[29] Such problems can lead to conflicts in opinions during discussion, which further hinder the people's capability to agree on final ideas. Thirdly, both design researchers and participants can have concerns regarding the functionality of technologies.[30] Although this seems to be a pragmatic perspective, such concerns reflect that these practical factors will also affect people's creativity.

DISCUSSIONS

Key findings

Through this review study, we found that all PDR studies in this research area have covered at least the generative phase with one or more co-making activities. And families' engagement can span from the pre-design stage to design evaluation, which is in line with Druin's statement that design researchers can involve participants whenever they feel like needed.[31] Also, there are eleven methods found that have been applied for conducting and supporting co-design research, with co-design workshops, interviews, and technological probe deployment applied most, but the tools adopted are not that adequate, with low-tech materials and technology probe mostly used.

However, the matrix of the methodologies mapped out through the review and the limited amount of research indicate that this area of study is still under-exploration. Both epistemic and methodological understandings are lacking. This can be due to the lack of cognitive preparation of both sides of design professionals and research participants that acknowledges the needs and benefits of engaging families in research to directly contribute ideas. Both parties need to know the importance of conducting co-design[32] – to provide equal voice to people and allow them to contribute directly to ideation for themselves – and hence the possibility to prepare for related research activities from the cognitive aspect.

Challenges in co-design practices can be another reason why there is limited research in this area. According to our review, we found difficulties related to scheduling participatory research, especially the co-design activities, recruiting intergenerational participants from diverse cultural backgrounds, building trust of children, coordinating different opinions, and setting free people's imagination. People's busy schedules make it hard to create a firm plan of participatory research which may affect the research progress, requiring a more flexible model of research design. As for engaging people of various cultural backgrounds and ages, issues are not limited to languages but also mindsets. Questions remained to be answered are how to make people engaged in the research understand each other, how to build trust between participants and design professionals of various generations and diverse backgrounds, and how we can integrate different ideas and coordinate those with different capabilities in manipulating technologies. Two factors can constrain people's imagination in co-design – instructions from the design experts and limitations of current technologies. Too many instructions would limit people's wondering, while people would not know where to start if there is no guidance at all. Even though people are supposed to speculate possible technological futures through co-design, their creativity can somewhat be constrained by what they know about the existing technologies. A balance needs to be explored in the future.

Finally, most of the identified research studies are conducted in a western context, whose possible reason could be lacking historical base of civic movements related to claiming the human rights and equality in other regions, especially in Eastern and Southeast Asia. But a deep understanding of the reason why and how we can incorporate and practice the co-design research approach that is originated from the western society to other regions require further investigation.

Limitations

Since the scope of this study has been constrained in a specific group (i.e., intergenerational families as design partners) with a strict screening and exclusion criteria, the sample size for review analysis is small. This can create potential biases in analysis and hence relatively weak validity and reliability. The theoretical frameworks for guiding our research analysis are from 2002, 2014, and 2019 respectively, which are a bit outdated hence affecting the overall soundness of the research findings. However, the limited frameworks that we can refer to also suggest a need of more up-to-date empirical studies in this area to refresh the epistemological knowledge and methodologies.

Future research opportunities

Viewing from the findings about limited exploration in design research methods, methodological challenges, and other factors that can affect co-design outcomes, further investigation about feasible methodology for co-design, especially for engaging people of diverse cultural background and various age groups will be needed. Difficulties in scheduling participatory research activities inform future endeavour on exploring how we can plan our participatory design research in a more flexible manner to better coordinate people's time schedules.

In terms of aspects related to cultures, current challenges in recruiting and engaging people from different cultural backgrounds and the lack of research in non-western regions indicate a need for more research in the area with cross-cultural collaborative investigation. Collaborative research can not only help with the issues but also make it possible to conduct comparative study to see whether and how cultural and demographic aspects influence people's ideation. Moreover, methods for helping people examining and combing each other's ideas requires further research as well, since the situations of multiple conflicting ideas coming up can happen easily in the research with various generations or of diverse backgrounds.

CONCLUSION

In conclusion, this review study investigated the existing approaches and challenges of engaging intergenerational families as co-design partners to develop technologies for enhancing family connectedness. By analysing seven relevant empirical studies following the theoretical frameworks of Druin, Sanders and Stappers, and Hanington and Martin, we identified the methods, tools, and phases involved in co-design with families. However, the matrix of methodologies of and challenges revealed in previous studies indicate the lack of epistemic and methodological explorations of participatory design research and co-design approach in this area. This review provides insights for future research to explore feasible methodologies for diverse cultural contexts and age groups. More studies are needed to address challenges like scheduling, trust-building, and idea coordination. Overall, this review sheds light on engaging families in technology design for connectedness through, mainly, a co-design approach.

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RE-INVENTING CARTHAGE: CHALLENGES AND PARADOXES OF URBAN FOOD PLANNING

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INTRODUCTION

Established in 814 BC as a Phoenician colony atop Byrsa Hill overlooking what is now the Gulf of Tunis in north-eastern Tunisia (fig. 1), Carthage grew, in the fifth century BC, into the capital of a powerful empire.

Figure 1. The city of Carthage enjoys connections to the Mediterranean (open) sea whilst being located in the metropolitan area of Grand Tunis. (UoB and CTC, 2021)

The best account of Carthaginian "agricultural genius" and its subsequent influence on Rome comes from the Carthaginian Magon, who compiled a twenty-eight-book treatise on agriculture.[1] Palaeobotanical research carried out by a Dutch team in the early 1980s has revealed an astonishing assortment of cultivated plants, including wheat, barley, lentils and peas,[2] figs, olives, pomegranates, vines and prunes.[3] For many centuries, Carthage's agricultural activities enabled its inhabitants to live on what they produced (fig. 2).

Figure 2. The number and diversity of Ancient Carthage's (surviving) Roman mosaics bear witness to the importance of food system activities: Fishing and hunting scenes (A-C); still life mosaics depicting here pomegranates and figs (D-E) and extracts showing scenes from agricultural life (F-G).[4]

However, this has changed drastically. Today, Carthage is a small town of around twenty-thousand inhabitants concentrated on one third of its entire area (640 ha).[5] Since 1979, the remaining area (two thirds) has been classified as a 'non-aedificandi' archaeological zone[6] (yellow and orange in fig. 4). The aura of Carthage's glorious past, liberated more than forty years ago following its inclusion on the *World Cultural Heritage* list, is now giving way to a static situation that leaves a shadow of uncertainty over the site's future. The slow progress, since 2006, of revising the *Urban Development Plan (PAU)*, the non-publication by decree of the *Protection and Enhancement Plan (PPMV)*, since 1990, and the absence of a management plan for the archaeological site, as well as the various forms of aggression and transgression against the heritage (fig. 3), are some of the factors that reflect the complexity of the problems.

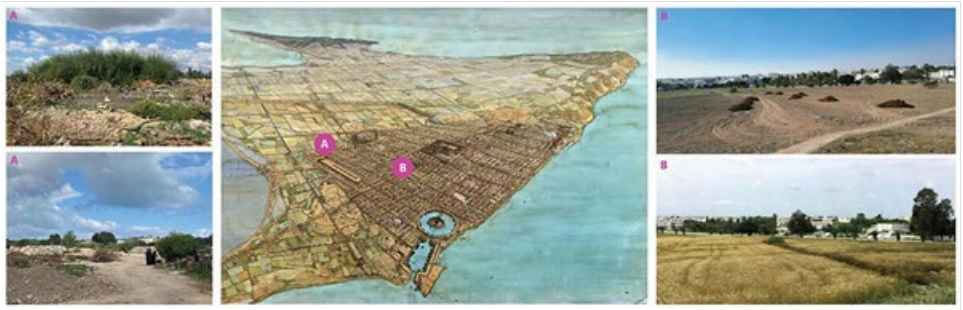

Figure 3. The former Roman Circus (A) is classified as "area of lesser archeological importance" and cannot be built on or used. Some locations around the Phoenician-settled Byrsa Hill (B) are occasionally used for temporary urban agriculture. (CTC, 2022 / Goldvin (map),[7] *2021)*

Neither the local authority, nor landowners or land users are allowed to build on the archaeological site and its close periphery (buffer zone). This ban can be seen as an advantage, as it makes it possible to contain urban sprawl and protect the integrity of the site. However, apart from tourist visits, the Carthaginians don't see the emergence of new development projects or initiatives on the vast areas dispersed within their municipal territory. This situation has left local residents, including those who own land in this "forbidden" zone, feeling powerless in face of the State's protectionist "dictat" and UNESCO's *'authorised heritage discourse'*.[8] This perception, which is expressed locally by the term "frozen land"[9] to designate large tracts of open space, is the source of social tensions that the local authorities are unable to control. This situation is exacerbated by the existence of a socio-spatial segregation, which has its origin in a hierarchisation of urban space[10] and is clearly visible in its land (and waste) management. At economic level, Carthage experiences a recession linked to the fall in

income from cultural tourism, compounded by the lack of a plan for adapting to climate change.[11] In short, several interlinked paradoxes characterise Carthage's current situation:

The heritage paradox:
The "asset" of a thousand-year-old heritage that is likely to play a driving role in the well-being of the people of Carthage, as described by the UNESCO convention,[12] has for some years been seen as not supporting local development, particularly for unemployed young people, industry (other than tourism) and the environment. This perception became particularly acute during the Covid-19 crisis, which demonstrated that cultural tourism alone, chosen as a strategic direction for urban development, had not enabled the local population to take ownership of its heritage.

The paradox of governance:
With its status as a municipality closely dependent on the Governorate of Tunis and the Ministry of the Interior, which is also on UNESCO's *World Heritage List* and therefore managed by the Ministry of Cultural Affairs, and which houses the residence of the Head of Government, the city of Carthage is subject to several "decision-making centres" that do not facilitate territorial governance. With their limited powers, the local authority finds itself paralysed in the face of ever-increasing demand for access to land, esp. from marginalised residents of working-class neighbourhoods many of whom are food-insecure.

The paradox of urban planning:
Faced with the Covid-19 pandemic, Carthage has proved to have little resilience and a vulnerable local food system. At the same time, urban farmers exploiting "forbidden" plots of land have managed to cover their needs and those of their neighbours for agricultural produce. Recognised as a reliable alternative, such initiatives have highlighted the significant fertile soil potential of certain open archaeological areas left fallow and the need to integrate them into a coherent urban planning scheme that both respects the integrity of the site and promotes the transition to a more sustainable food system.
Against this backdrop and driven by a strong desire to transform environmental planning in the city of Carthage, a group of local stakeholders has embarked on a collective reflection on 'the future we want'.[13] Seizing the need to rethink presented by the Covid-19 crisis[14] as well as the launch of the *EdiCitNet* project, funded by the EU's Horizon2020 program, to which Carthage is a partner,[15] these local stakeholders, now known as "City Team Carthage", chose *food as an aim and a tool* in the transformation process.

URBAN PLANNING APPROACH

Transforming local food systems in a long-term and sustainable manner requires awareness, sensitivity and behaviour change, both from decision-makers and users.[16] Whilst urban agriculture and food systems projects have (re-)entered the urban arena mostly through small-scale, bottom-up initiatives, we contend that participatory design and planning methods have since then proven the tools for successfully establishing larger or more systemic food projects involving a multitude of stakeholders and/or requiring spatial, logistical and temporal coordination.[17] We see similarities in our project to the early example of participatory design, the Collective Resource Approach in Norway, Sweden and Denmark which, already in the 1970s, *"put together the expertise of the systems designers/researchers and the situated expertise of the people whose work… [life and environment]... was to be impacted by the change".*[18] In this context, Elizabeth Sanders and Pieter Jan Stappers stated

further that *"the application of participatory design practices [...] to very large-scale problems will change design and may change the world".*[19] We contend that this is what Carthage needs.
Our paper describes the results of the City Team Carthage (CTC) research action implemented closely with *EdiCitNet* partners from the University of Brighton (UoB) and BOKU Vienna (represented by Bohn) on their urban planning project *Towards an Edible Carthage.*
The CTC began in 2020 by means of joint discussions and site visits to acquire an understanding of Carthage's current food system, the strength and weaknesses of its activities and its relationships to urban space as well as other urban systems, esp. the water system. Based on the contention that food can become an agent to tackle societal challenges,[20] the CTC identified through its own local and expert knowledge as well as through citizen interviews the most pressing local concerns (fig. 4) which became the target of their food-focused planning process.

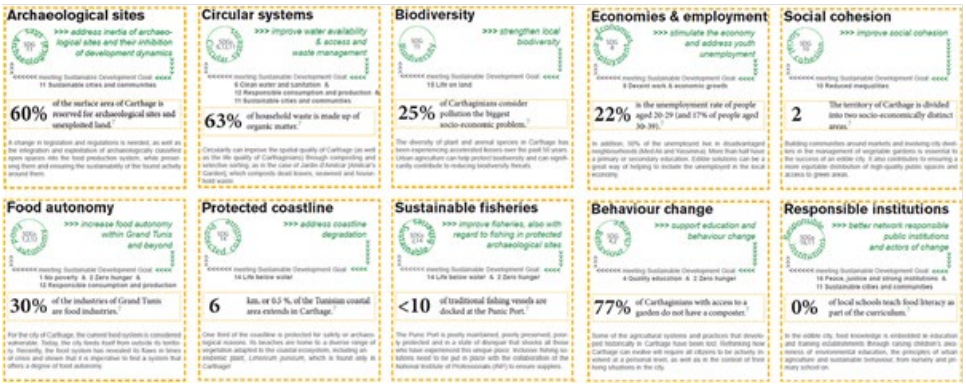

Figure 4. Ten specific local challenges were identified by the CTC which could be tackled through sustainable food system planning. (CTC, BOKU Vienna and UoB, 2020-21)

A key method in this process has been urban food mapping, an emerging area of practice and research as defined by Bohn and Tomkins in 2024.[21] Various maps and mappings helped us cross our disciplinary divides and connect the food issue to the spatial specificity of Carthage as well as to order and visualise our idea. Facilitated by project partner University of Brighton (UoB), the CTC used the *CPUL Opportunity Mapping Method*, a participatory urban design and planning tool, to generate a shared vision of a food-focused future by *'producing credible maps and mappings'* that can be used by the stakeholder group *'to develop a local food strategy and a local food masterplan'*[22] (fig. 4).

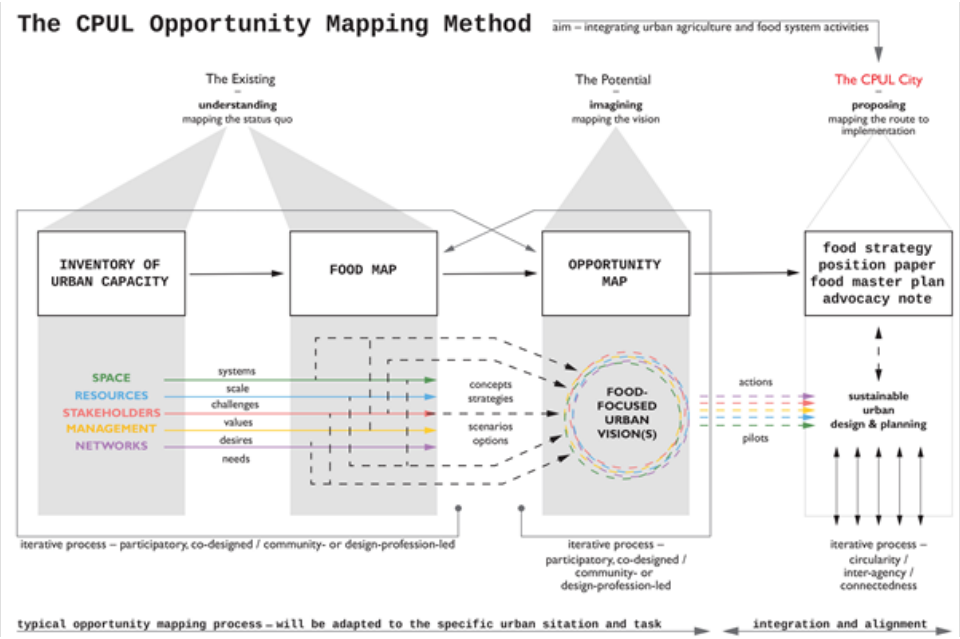

Figure 5. The CPUL Opportunity Mapping Method enables the spatial and strategic planning of food system opportunities for any given site (Bohn&Viljoen Architects [2012] with Ian Bailey, UoB, 2021)

FINDINGS

In parallel to the identification of societal challenges (fig. 4), the CTC began to build an edible city inventory. They mapped all existing urban food system activities in Carthage, such as commercial urban agriculture projects, community gardens, orchards, food markets, bakeries and restaurants (fig. 6). Led by REACT, they also searched for appropriate examples from elsewhere that show how historic spaces can be used for contemporary food (fig. 7).

Figure 6. Examples of existing urban food system activities: Amilcar (community) Garden (left), a food market (centre) and the olive groves of Mosque and Cathedral (right). (CTC, 2020)

Figure 7. Archaeological structures of lesser significance (A-C) could be used for food-growing businesses, such as mushroom farms (D), or re-used as water cisterns (E). New local businesses, such as Urban Green who grow micro-greens (F-G) and establish market gardens (H-I) could be offered archaeological spaces. (CTC (A-C) / www.pinterest (D-E) / Urban Green[23] (F-I), 2022)

However, moving on from recording *the existing* to capturing *the potential* and "designing" a joint edible city vision proved a hurdle despite the many oral meetings held, the identification of the 10 societal challenges and the profound collection of existing food system activities. Participation dropped, and the project slowed down.

With the integration of the *CPUL Opportunity Mapping Method* in 2021, the CTC gained a practical tool to continue its work. This became most apparent in an opportunity mapping workshop with about eighty people hosted by Carthage Municipality in October 2022. For two full days, at two levels of participation – decision makers and citizens –, we mapped out paths to a shared future with a number of ideas that the CTC had brought to the discussions they facilitated: from the coastline to arable land, from schools to museums, from research institutes to farmers... The more we crossed space-time-people around visual, cartographic documents, the closer we got to the vision of and masterplan for an Edible Carthage.

We learned how to capture *the existing* in various sketches, diagrams and a final food map (fig. 8), working iteratively and in parallel: Existing initiatives and existing open (available) spaces were categorised – by food system component the former, by specifically devised "own" categories the latter – and mapped on a geographical map. At the same time, the team mapped the previously identified societal challenges thematically and against the *Sustainable Development Goals (SDGs)* grounding its work in an internationally recognised discourse.

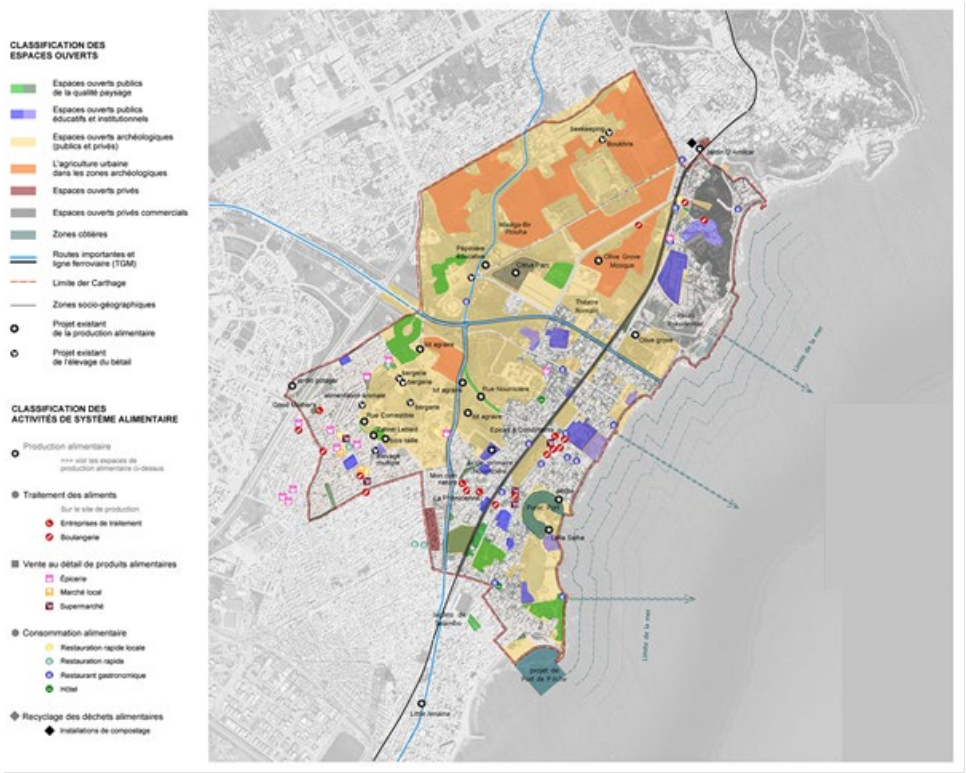

Figure 8. A collectively-drawn food map shows all existing food spaces of Carthage, as well as the city's existing food system activities. (UoB and CTC, 2021)

Through and in several iterative mapping workshops, we found a common language to discuss, order, synthesise and prioritise *the potential* and to enable the local team to generate and agree on their visions and concepts. A locally-specific "supporting map" was devised and collectively developed: the opportunity mapping diagram. This diagram makes visible the complex web of our three food-focused urban scenarios – *Edible historic urban landscape*, *Food knowledge networks* and *Sustainable*

coastline – and four urban development concepts – *Carthage in the world, Agriculture as economic pillar, Self-sufficient city* and *A new generation of farmers* (fig. 9). The diagram also shows how the team's visions and concepts relate to the city's societal challenges, its key stakeholders involved (or to be involved) and the (open) spaces to be used. It names a number of potential food-focused pilot projects and actions that began emerging during the four-year working process. Whilst this diagram could be the starting point for a food strategy yet to be engaged with, the food map (fig. 7) has already informed a food masterplan commissioned by Carthage Municipality.[24]

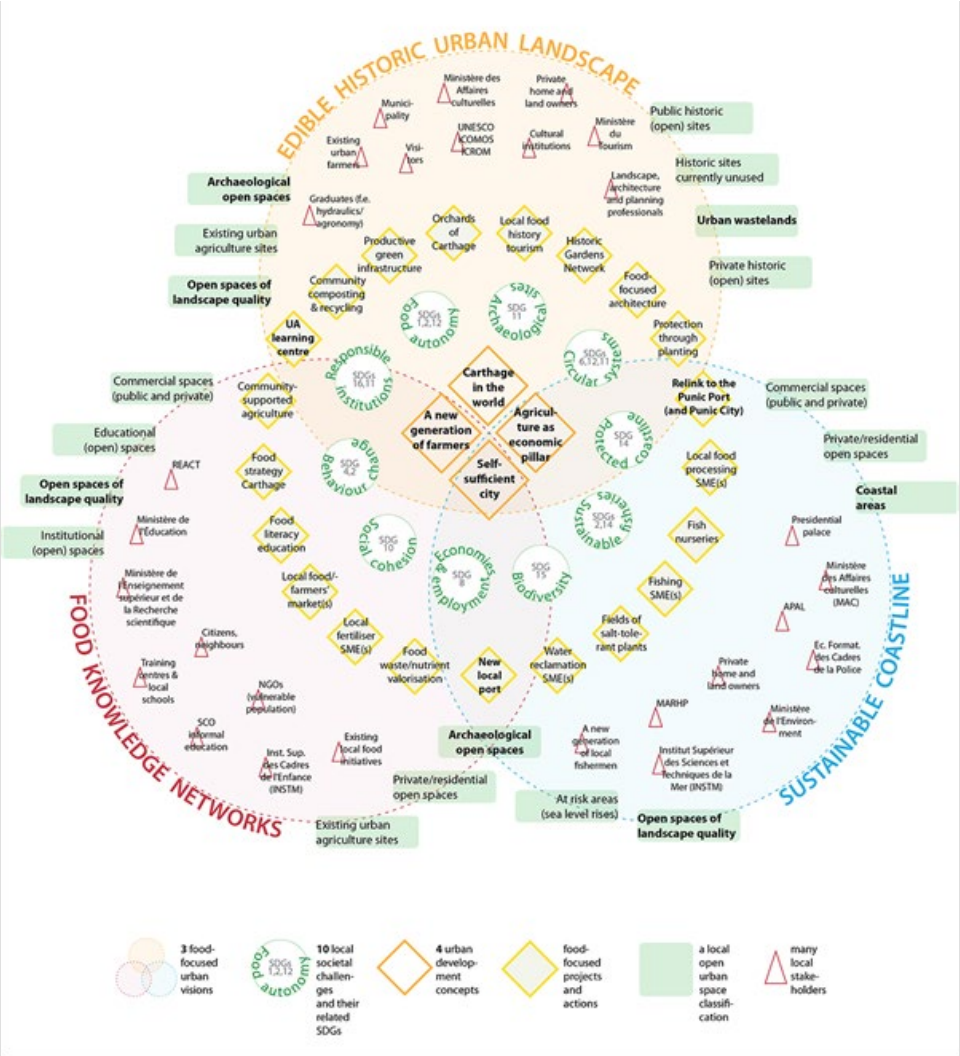

Figure 9. This opportunity mapping diagram was created especially for Carthage to capture the complexity of locally specific "edible city" criteria. (UoB, BOKU Vienna and CTC, 2022)

DISCUSSION

The significance of agreeing on a clear vision, in a participatory way

Navigating a complex environment, increasing responsiveness to uncertainty and building resilience to cope with cascading crises require the existence of a clear and shared vision of the future we want. How can such an objective be achieved in the case of the city of Carthage, which is perceived as a symbol of power, a UNESCO *World Heritage* site, and yet as a city of socio-spatial segregation, a changing urban system with unclear territorial governance and struggling food security? Are these not

a series of qualifiers that make it difficult to design a common future in which no-one is left behind, esp. in the long term and in the face of climate change?
Our complicated project context reinforced the relevance of choosing a participative and iterative approach, as it becomes increasingly common in urban planning internationally.[25] This approach was supported by a spatial analysis, using cartographic documents, of the food system opportunities offered by the area with its various natural, historical and human components.
As a tool, the food system lens could be considered an "alibi" for involving and, above all, listening to citizens and then turning their ideas into projects. Yet, *as an aim*, the same lens could revolutionise the way Carthaginians will use their open spaces in the future leading to an inclusive, sustainable and more beautiful city.

The significance of negotiating space

Understanding and mastering the spatial configuration of factors that shape our cities, is recognised as an important public policy subject and a lively area of research.[26] Closing the spatial opportunity gap becomes an essential objective of territorial equity and sustainable urban development. It can therefore not be stressed enough how important it was in our participatory process to think about precise open urban spaces when thinking about the opportunities of a food-focused Carthage.
At the same time, finding a common language to talk about these spaces has been the prerequisite for finding a common vision. Working with participatory maps helped us to *'articulate a more tangible approach to urban planning and design'* one that allowed *'a "way in" for many [...] [to] what is traditionally a tightly regulated professional realm'.*[27] Yet, whilst urban food maps and mapping gave our project local precision, planning content and a subject focus, participative discourse has been our structural finding. It was imperative to talk about Carthage's (potentially productive) open urban space, but also and above all about the relationship between that space and, f.e., the disadvantaged populations of the local housing estates.
We must critically assess that even when knowing this and with significant societal challenges identified, our project worked only loosely with these population groups, mainly via our work with local institutions. It will need another, much larger project in terms of human power, time and budget to be fully inclusive. Here we see an important practice-based direction of development for projects like ours and for the participatory urban (food) planning discourse as a whole.
Equally, while overwhelmingly positive and of increasing prominence as an outcome-oriented step forward for sustainable urban planning, the "institutionalisation" of food and opportunity mapping portends a need to examine critically its underlying foundations so as to avoid an erratic and unjustified collection of indicators intended to measure "opportunity". Maps are powerful vehicles for revealing spatial patterns but like any data visualisation technique, they can be misleading or misinterpreted if not underpinned by pertinent data or critically examined. Here we see an important theoretical and design research direction of development.

CONCLUSION

Faced with several interlinked paradoxes and urban challenges, the City Team's project chose food as an aim and as an entry point for spatial and socio-economic transformational change in Carthage. Driven by a strong desire to integrate the archaeological site into a coherent urban planning scheme that both, respects the integrity of the "frozen land" and promotes the transition to an inclusive, resilient city system, we reached our target in early 2024 with the formulation of a food-focused urban vision and spatial plan.
The key finding of our participatory planning process is that agreeing a joint vision needs a food mapping method that solicits the true perceptions of citizens for the future of their region. Using the

CPUL Opportunity Mapping Method allowed us to connect the food issue to the spatial specificity of Carthage and to create relevant and usable products, such as food and opportunity maps that could later be used to develop a local food masterplan.
Three crucial next steps now guide our path:
- *Advocacy:* We will share our vision with everyone involved, including UNESCO, using the tri-lingual *Advocacy Note* created by our team.
- *Integration:* We willl work to seamlessly integrate food into regional planning regulations, specifically the PAU and PPMV.
- *Micro-Mapping:* We will delve deeper into the inspiring local projects identified during our initial research, showcasing them as living proof of what is possible (fig. 10).
With its rich history and now a clear vision, the city is poised to become a model for sustainable urban development centred around its food and food systems.

Figure 10. Issam Chaabane (right) is running Zahret El Bled, an urban agriculture social enterprise within the city boundaries, located on fertile land of lesser archaeological value. A citizen is lending a hand (left). (CTC, 2022)

NOTES

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[12] United Nations Educational, Scientific and Cultural Organisation (UNESCO), 2023. The *Basic Texts of the 1972 World Heritage Convention* state that: '*each State Party to this Convention shall endeavour, in so far as possible, and as appropriate for each country: (a) to adopt a general policy which aims to give the cultural and natural heritage a function in the life of the community and to integrate the protection of that heritage into comprehensive planning programmes'.* https://whc.unesco.org/en/basictexts: 4.
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AUTONOMOUS DIALECTICS: MAPPING DESIRE AND CONFLICT IN THE SUBURBAN PERIPHERIES

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INTRODUCTION

This paper summarizes a body of design research that draws together a study of everyday ritual practices and objects with an urban mapping of financialized spatiality. This design research is situated in the Australian context, where the introduction of housing targets to counter the affordability crisis are increasingly met with ubiquitous, developer driven suburbs. This paper considers methods for embedding narrativist, generative design approaches to the understanding of these ubiquitous fringe developments, testing across three collaborative projects. The research examines and visually interprets the results of a participatory design method based on community-building role-playing games, that sequences a network of desirability. Through mapping that eschews traditional scaled and spatial drawing in favor of symbolic representation, the exercise invites participants to engage in collective drawings of territory from which emerges a set of relationships and adjacencies that indicate priorities and desirability, conflicts and congestions.

The three iterations are as follows:

1. A pedagogical test run through an Architectural Design Studio at Royal Melbourne Institute of Technology (RMIT), and The University of Melbourne, Australia. Students use the method to build a ficto-critical psychogeography, resulting in an imagined narration of territory that is not sited or scaled, but builds through event and object.
2. An urban scale test using the rapidly developing periphery of Melbourne. Looking to compare how the territory shifts when priorities shift. It operates as a bridging mechanism between the very real and abstract desires of participants, and the spatial expertise of architects, testing the emerging priorities of participants in a realized landscape and relaying subsequent relations and adjacencies onto the topography.
3. A scalar sequence, inviting desire and priority into the Block, the Street, the House. This narrowing of focus allocates and distributes these relations and adjacencies into the urban and intramural, creating a connective tissue of design that tethers participant to place in a blurred and mutually defining entanglement.

The three project tests offer a preliminary understanding of how relational design on an urban scale might embed existing community narratives and projections of desired outcomes and adjacencies, both in practice and pedagogy. Further, it demonstrates a method for cartographic representations of expanding, peripheral urban territories that breaks with the tradition of zoned maps primarily

visualized through finance focused documentation. As a tool for local and state government agencies, it represents an effective tool as an in-house participatory design method and an innovative means of community engagement. Pedagogically it provides a framework for learning about complex urban systems and infrastructures, allowing students to engage with this complexity in a playful and inviting manner.

World-Building Through Game Systems

The project adapts the narrative driven world building techniques of tabletop role-playing games (TTRPG) and embeds the agenda of building up a complex settlement that spans a yearlong development of a site. The mechanism of the game becomes a narrative "carrier bag" for world building, referencing minor interactions and everyday moments rather than hero overarching and common tropes, this method engaging with counter narratives and alternative histories, as set out by Ursula Le Guin, in *The Carrier Bag Theory of Fiction.*[1] Hélène Frichot concept of 'Thought-Tools' is also conscripted as another form of "carrier bag" [2] or container, a theoretical model that allows us to collect and organize ideas in a way that opens up new possibilities for thought and action.[3]

The structure of the game takes precedent from Avery Alder's map-building game *The Quiet Year*.[4] This project repurposes Alder's sequence and toolkit, rewriting the scenarios and player cards to embed our research focus, generating an Australia specific urban outcome. Over fifty-two cards, players are guided to make decisions about the type of community occupying the site and record actions, construction, crises and resources. This game is played out through drawing each decision onto a A1 sized piece of paper, utilizing abstract, symbolic and cartographic mark making to record the evolving territory. Unlike many TTRPG, players do not represent or control a particular individual or group, rather they are prompted by the scenarios set out by the cards to engage with different areas of the site and represent the needs, agendas and desires of various groups. This binds the players' actions not to individual desire, but in service of the diverse community they represent. Crucially, there is no forum for debate, disagreement is integrated into the game design, where players dissatisfaction is expressed by placing a small skull shaped bead on the item of the dispute, demarcating zones of conflict within the emerging cartography. The game and its potential to result in unconstrained design thinking and break with traditional, predetermined understandings of zones and adjacencies aligns with Jeremy Lecomte's call for "projectiles" in the composition and design of alternative worlds.[5]

Spatial and Urban Cartographies

Spatial practitioners and theorists often return to hand drawing, and collective mark making of territory as a tool for the co-design of narrative cartographies. The fluidity of drawing allows for fiction and a breaking of boundaries in the visualization of alternative worlds. The research considers the maps and drawings of Nikolaus Gansterer and Paul Broekhuisen alongside the writings of Manuel De Sola Morales to guide both the aesthetics of the cartographies and the nature of the mark making. Observing the ficto-critical and often borderless territories that are the result of the game rotations across participant groups, they exemplify what De Sola Morales terms "descriptive calligraphies", cartographic and symbolic visualizations of territory that are not literal, but literary in nature.[6]

Sites of Inquiry: Peripheral Suburban Sprawl

The research focus on desire and conflict in the peripheral suburbs of Australian cities carries within its remit a broader series of issues and questions. The answers to these questions, and interrogation of these issues seek to benefit the communities who inhabit these zones and contribute to discourses around housing policies on state and federal levels. The Australian design community have often been

removed from this discourse, as suburban sprawl is considered the result of regulation and market focuses, more economic than urban in their spatial configuration. The Australian Government's recent housing goal, of "800,000 new homes" in Melbourne targeting rental and ownership affordability, indicates that research in this typology is urgently required.[7] Our project seeks to engage with practitioners and students, to consider the livability, desirability and territorial nuances of these peripheral suburban zones. Through this, we hold the aim of contributing to the design of a built language that tethers inhabitants to place in a blurred and mutually defining entanglement.[8] Whilst 70% of these new homes are slated to be introduced into existing suburbs to increase density, 30% of them will continue to gather on the fringes.[9] This condition is not just an Australian issue and bears relevance and benefit to the conditions of all expanding urban centers, both national and international. Across the three tests, the project considers this context and its ramifications through engagement with both with a generic, fictive site and the conditions of the suburb of Cloverton, a development in Melbourne's periphery along the Northern Growth corridor, hard up against the metropolitan growth boundary. This development is six times the size of Melbourne's CBD, and four times the size of central London, and is currently being designed and delivered by a singular development company.

Pedagogical Testing

The first runs of the game were undertaken at RMIT and Melbourne University, in separate Architecture discipline specific design studios. Students at undergraduate and postgraduate levels used the game to generate narrative cartographies that would be collectively negotiated to actualize the site of their final projects. These were done in cross-class groups, emulating multi firm consortium urban design, common in Melbourne.

The students were shown the work of Gansterer and Broekhuisen as aesthetic and theoretical prompts prior to any drawing and were instructed to emulate the looseness and fluidity of their mark making.

In groups of four – five, students were forced to understand and negotiate the site through the card prompts, which were disconnected from the familiar tropes and heuristics of urban planning. Rather than a "gameist" approach, with win conditions, resource tokens, and full abstraction from the site, these students engaged with a goal-free "narrativist" system, assisted by the prompt.[10] Importantly, the conflict system designed into the game (the skull beads) allowed students to express their discontent with decisions made by others, without derailing or rejecting the propositions. This proved useful in the typically draining experience of university prescribed group-work scenarios. Earlier forays into negotiated group collaborations tended towards an unsatisfying and uncreative averaging of desire, as students tried hard to avoid offending each other. Using this mechanism of visualized conflict and desire, these projects were a collage of hyper-specificity that students could mine for theoretical and formal ideas. After development across the semester, the final projects situated within these fictional cartographies were intrinsically relational, drawing both from this imaginary version of the site and through their interrelated architectures, which in turn projected an entangled vision across scales: of suburb, of block and of individual buildings. An architectural response not typically achieved by students still grappling with the fundamentals of architectural representation.

Cloverton in Practice

The second phase of testing began with a workshop that included two invited groups of design experts. The first, 'Academic Architects', were studio leaders from the previous pedagogical tests, all of whom had played the game, directed the students through their iterations and engaged with the broader research goals. Further, they were all experienced with TTRPG's, and with ficto-critical design methodologies. The second, 'Practicing Architects', were embedded in industry and running live projects within the urban environment. They had mixed engagements with academic institutions,

but were not previously part of the research, had not seen the student outputs and had never played the game, nor any other TTRPG's.
In this iteration, the game prompts were rewritten using language from both Szyman and Newberry-Dupé's respective research into urban and home environments, and the participants were briefed on the specifics of the suburb, Cloverton. They were not prompted to solve or address the issues of the suburb, but rather to accept them as part of the territory which they would be working into. Over three hours, both groups worked through the deck of cards, arriving at the end of the session with Figure 1 and Figure 2. Unlike the students, who were allowed to freely move through the game with an emphasis on mark making only, these participants were asked to keep detailed notes on their actions throughout the game, for future analysis. Interestingly, each group developed coded notation systems, that became hard for the researchers to unpack later.

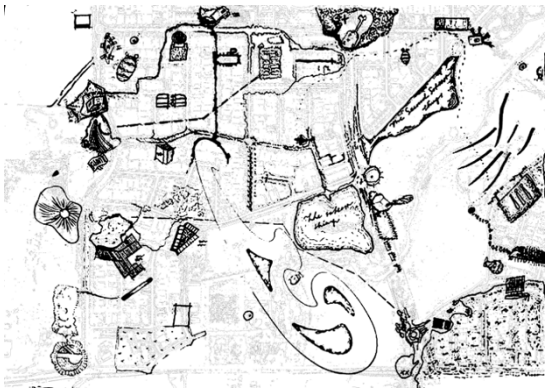

Figure 1. 'Academic Architects' cartography

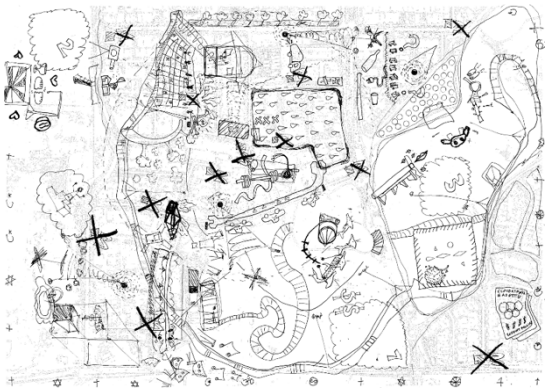

Figure 2. 'Practicing Architects' cartography

Analysis

These drawings have some interesting differences from the first iteration, and between the two Architect groups.

- The 'Academic Architects' were more willing to work within the bounds of the existing urban fabric, layering their new narrative cartographies into the plan. The specific events and forms that they indicated tend to follow along these trajectories, establishing traversals that resemble walking routes through medieval cities far more than they resemble contemporary hierarchical roadway systems.
- The 'Practicing Architects' were more willing to create territory wide, speculative infrastructures that dramatically altered the surrounding area. This included: a winding skybridge, inner-suburban wetland revitalization, and distributed networks of fast-food restaurants. While there were moments of

intense multi-round design objects distributed across the map, these sites are more often obscured by sweeping disseminations of narrative forms, rich with conflict and specificity.

- Unlike the student groups, these players were not given explicit instructions about the kinds of marks expected, nor was there an aesthetic standard or precedent set. As a result, the mark-making was authentic to how the two groups communicated. Interestingly, they were much more chaotic than the students, who were pedantic in controlling the consistently of the drawing.
- The marks were of an inconsistent scale, that seemed not to indicate importance or relation. Both groups intuitively understood this kind of cartographic marking and were unconcerned with accuracy.
- The 'Academic Architects' were more comfortable using table-tools to generate further forms to respond to, using and often tracing existing shapes to guide their decision-making.
- The 'Practicing Architects' relied more on cartographic symbols representing their imagined scenarios. They were more inclined to make sweeping changes to the site, such as adding floods or site-wide bridge networks.

There was no discussion with the groups about the outcomes of their work, as the communication of their desires and conflicts was assumed to be embedded in the mappings and notations. Across several sessions the researchers met to analyze the drawings and notation so it might be carried through into the third iteration. The above observations about the nature of the results from the two groups were analyzed and broken into two modes.

Analysis Mode 1

Key concepts were extracted from our research practices to identify them within the mappings. The focus here was returning to the conceptual language embedded in the question cards and analyzing whether it was recognizable in Figures 1 and 2, or if it had transformed, or been translated into something new, or vanished all together. Out of the seven concepts embedded and examined, 'Objects of Significance', 'Sites of Labour', and 'Rules and Techniques' were derived from Newberry-Dupé's inquiries into domestic space, while the four dialectical pairs 'Hard/Soft', 'Costed/Pursued', 'Allowed/Necessary', and 'Expected/Common' where brought in from Szyman's inquiries into the housing typologies of Cloverton.

Analysis Mode 2

The second mode of analysis assessed the typologies of marks made. Unlike the student groups, the practitioner/academic players were not given explicit instructions about the kinds of marks expected, nor was there an aesthetic standard set. As a result, the mark-making was authentic to how the two groups communicated. As mentioned above, the marks were also rarely scaled, both groups understood this kind of cartographic marking and were unconcerned with accuracy. There were four forms consistent across both groups.

1. 'Specific Objects', which were given proper nouns and were generally associated with a strong part of the urban narrative, included marks that were often figurative or pictorial. For instance, a house surrounded by security cameras.
2. 'Distributed Objects', which were repeated and sometimes arranged in a network, included simpler or symbolic marks such as the golden arches representing fast-food restaurants.
3. 'Trajectories' denoted movement through the site or presence across the site, such as a sky bridge.
4. 'Zones' marked boundaries between areas, with the area within the zone being "other" compared to the business-as-usual state outside it.

Based on their notes, and observations made over the duration of the game, players did not consciously develop this system of mark-making, nor were the marks accreted in any special order;

they arose in response to player decisions. Specificity often developed alongside narrative around the place, reflecting a real-life distinction between a chain of fast-food restaurants and a fast-food restaurant with a story-driven character in a particular part of town. Some marks also transitioned between symbolic and diegetic, like a French curve forming a boundary around which a trace on the map could spill.

Drawing Together

The third iteration involved combining the seven concepts with the image analysis to develop a method for translating these maps from symbolic, emergent, visual narratives into something that could offer knowledge back to the site of Cloverton. Both researchers took a map to illustrate with, Szyman in charge of the 'Practicing Architects', and Newberry-Dupé in charge of the 'Academic Architects'. Following discussions and through detailed analysis of the notations provided by the groups, a space was identified in both maps where each of the seven concepts was visible. The then proceeded to undertake a stepped-out translation and illustration into and over these identified sites.

- The areas were bounded with 10cm x 10cm squares of tracing paper and then the four forms were extracted and resolved from the drawing, as seen in Figure 3. There was need to check back with the participant groups at times, due to the inscrutability of their notetaking.
- The traced squares were then placed back onto a clean image of Cloverton, revealing where the two groups had built upon existing site forms, where they had remained within the scale of the space, and where they had chosen to diverge. Figures 4.
- A final drawing was produced, identifying a house, a street, and a block within the suburb, and layering back in the concepts embedded through our own symbolic notation. Figure 5.

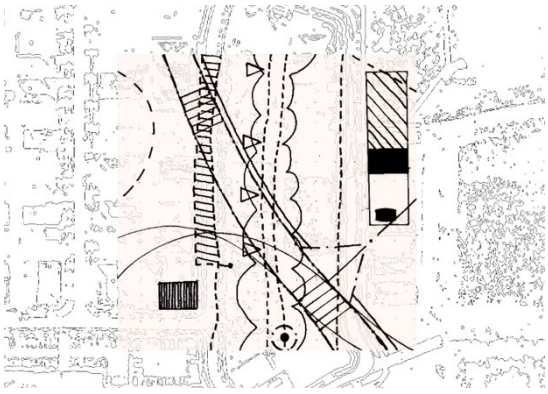

Figure 3. 'Extracted and resolved form, taken from 'Practicing Architects' map

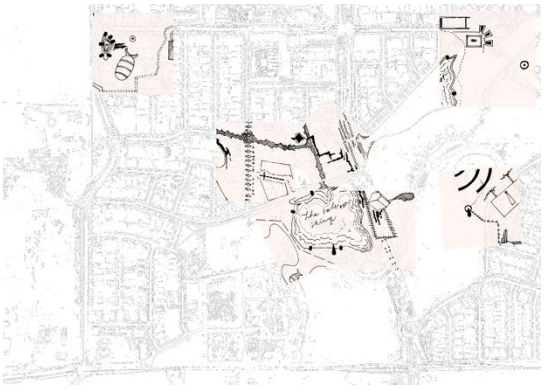

Figure 4. 'Clusters of activity, taken from 'Academic Architects' map

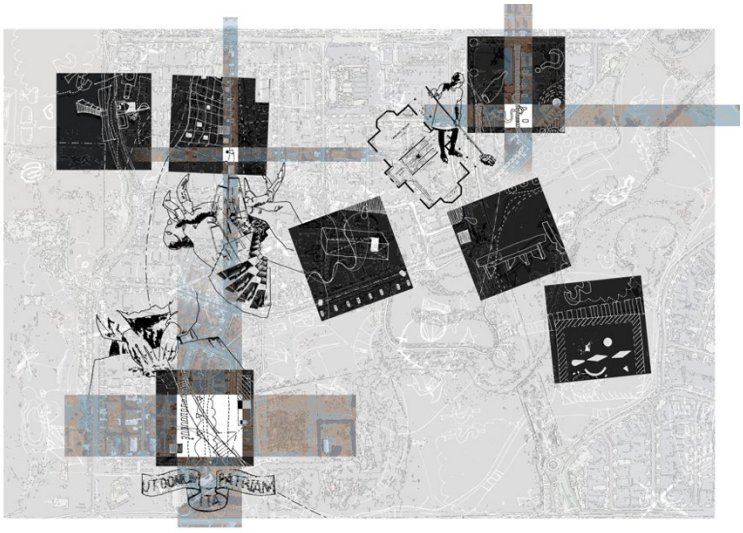

Figure 5. 'Block, Street, House'. Cartographic overlay with concepts embedded

CONCLUSION

Through this drawing process and in the resulting cartographies the iterations demonstrate several key points. Firstly, the language embedded in the question cards was found to be present in the final outcomes, successfully embedding the substance of the theory and illustrating them across the three versions of co-designed mappings. Secondly, the projects demonstrated a method for creating world-building "projectiles" that cast a different future through their trajectory.[11] This contrasts with existing uses for TTRPG's already in use in built environment design scenarios, such the 'Play the City' model designed by Ekim Tan, which prefigures the existing as a base prior to any play.[12] Thirdly, the final analysis revealed a core visual language that both groups deployed when necessary. The result recalled pre-modern maps, such as the Catalan Atlas, which were effective for articulating economic, cultural, and socio-political relationships between medieval spheres of influence over accurate spatial representation.[13] Further, the project demonstrates a method for cartographic representations of expanding, peripheral urban territories that typically prefigure restrictive zoning and plot boundaries as the basis for their design. As a tool for local and state government agencies, it represents an effective tool as an in-house participatory design method and an innovative means of capturing community feedback and representing narratives. Pedagogically it gives a point of access to students engaging with complex urban systems and infrastructures, whilst also engendering new ways of collaborating and co-designing. *Autonomous Dialectics* offers a preliminary understanding of how relational design on an urban scale might embed existing community narratives and projections of desired outcomes and adjacencies, both in practice and pedagogy.

NOTES

[1] Ursula K. Le Guin, Donna Jeanne Haraway, and Bul Lee. *The Carrier Bag Theory of Fiction* (London, England: Ignota, 2019).
[2] Le Guin, *The Carrier Bag Theory of Fiction*, 2019
[3] Hélène Frichot. *Creative Ecologies: Theorizing the Practice of Architecture.* (London, United Kingdom Bloomsbury Publishing USA, 2018). http://ebookcentral.proquest.com/lib/monash/detail.action?docID=5557323.
[4] Avery Alder. “The Quiet Year”. Last modified 2019, https://buriedwithoutceremony.com/the-quiet-year
[5] Jeremy Lecomte. “Can the Possible Exist in Physical Form?” in *Construction Sites for Possible Worlds* ed Beech, A., R. Mackay, and J. Wiltgen. (MIT Press, 2020). 145-169
[6] Manuel de,Solà-Morales. "The Culture of Description. *Perspecta* 25 (1989): 16-25. https://doi.org/10.2307/1567136
[7] Victorian State Government. *First Look at Housing Plans Across Ten Melbourne Suburbs (*Premier of Victoria, Melbourne, Vic, 2024), 1.
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[9] Sonya Kilkenny, Minister for Planning. *Housing Statement: Media Release 29th March 2024. (*Melbourne, VIC 2024). https://www.premier.vic.gov.au/first-look-housing-plans-across-ten-melbourne-suburbs
[10] Patricia Reed, "Heuristic Fictions and Literary Technologies," in *Dead Minutes*, ed. Tom K. Kemp, 2024
[11] Lecomte. “Can the Possible Exist in Physical Form?”. 146-169
[12] Ekim Tan. *Play the City: Games Informing the Urban Development.* (Heijningen, Netherlands: JAP SAM Books, 2017).
[13] Abraham Cresques, and Georges Grosjean. *Mapamundi, the Catalan Atlas of the Year 1375.* (Dietikon-Zurich: Urs Graf 1978).

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LOCAL, COLLABORATIVE, BOTTOM-UP – CO-DESIGN-PROJECTS WITH CHILDREN AND YOUTH AS CATALYST AND RESEARCH-INSTRUMENT OF URBAN TRANSFORMATIONS

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ACTION IN PUBLIC SPACE

We all put on white painter's suits so that we are recognizable as a project group. Then we set off, one carrying the model, one carrying the donation box. This is what it's all about: we want to collect donations from the neighborhood so that we can turn our idea into reality: to build a mobile swing as a new meeting point and hangout for the neighborhood. We have been developing this idea together over the last few weeks. Unfortunately, the project budget is not enough to actually build our idea. So the children spontaneously said: let's collect donations - and started making a donation box!

So we set off. The children lead the way and head straight for the first passers-by. They tell them about our idea and ask for a donation. The passers-by usually respond in a friendly and interested manner and also donate something. So it goes from passer-by to passer-by and from shop to shop. After two collection afternoons, we have actually collected enough donations to buy all the materials. We can now start building the mobile swing!

Figure 1. Collection of donations by the project team in a shop

The scene described here took place as part of the co-design project “RaumTeiler” in cooperation with the Expedition Metropolis theater in Berlin Kreuzberg. It is an excerpt from the ongoing project work on site and illustrates the lively working process. The description is exemplary for the step-by-step, collaborative design and development process in the project.

CO-DESIGN-PROJECT: CASE RAUMTEILER

The intentions, objectives, working methods, results and potential, but also the challenges of the co-design-project (CDP) concept are explained in more detail in the article. A project process is described in more detail here:

Starting point

The RaumTeiler project, initiated by Expedition Metropolis and in co-operation with the Rosa-Parks primary school in Berlin Kreuzberg in 2015, offered the opportunity to build on the experience already gained and to gradually enter into continuous project work with the co-design approach.
Expedition Metropolis runs a community theater. The community art approach1 uses the artistic methods of theater and collaborative discussion to develop independent positions that are publicly presented and discussed in performances and presentations. This approach complements the co-design approach well. On this basis, a very open and free project work could be developed.
RaumTeiler was a four-month community-oriented research and exploration project to investigate hospitality in the neighborhood. The topic of hospitality was investigated and worked on in four research workshops. In the “Change your city! - Object and Performance” workshop, we started an open co-creation process with 5 interested children.

Development and realization

We started by getting to know each other and talking about our homes, neighborhoods, the way to school, beautiful and ugly places. We asked ourselves: Where do we like to be? What connects us? Where and how do people meet? We shared our experiences, collected everything in mind maps and interviewed passers-by in the street. We then worked together to develop ideas for a new meeting

place that could connect people in the neighborhood and be inviting and interesting for a broad target group. We researched and built models. Finally, we considered how we could realize our idea: How much time do we need? What materials? What tools? And how much money? We collected donations in the neighborhood, bought materials, built the mobile swing over several days and presented it to the neighborhood.

Figure 2. Insights into the project process of the co-design-project RaumTeiler

Results

The “mobile Hollywood swing” is a swing, climbing frame and stage all in one. Since it was finished, all kinds of people have been swinging: it invites everyone to sit and swing and is also a climbing frame and mobile (multifunctional use). It is fun and encourages communication. In the school playground or on the pavement, it has turned out to be a favorite place for chilling out, talking, dreaming, moving, acting, climbing and much more. It awakens the desire to try things out, to leave the beaten track and experience the place in a new way. It can be used wherever people need to be invited to socialize. It works across all milieus. The spontaneous swinging with unknown people helps people to get to know each other.

The project made it clear that, on the one hand, the intensive collaborative working method on site can be used to develop specific, innovative design approaches that are inherently linked to the local residents and users. On the other hand, it became clear that this way of working enables deep insights into the local area, its qualities and deficits, into the attitudes and views of the residents. The joint design work allows people to get to know each other and enter into a relationship. The basis for this is the equal openness of all participants to their respective views, ideas and needs and the willingness to enter into a mutual learning process.

CO-DESIGN-PROJECT: PRACTICAL APPROACH

The working method of open co-design used in the example projects can be summarized as an independent project approach, the collaborative design project or open co-design project.

Co-design projects are situated in a neighborhood. They implement local processes as co-designs of space and community and create interventions. The starting point is the qualities and difficulties on site, the questions, needs and interests of the residents and users of the city. Generated from an architecture and design-approach, this practice uses artistic, creative and craft methods to involve interested parties, to express feelings and to create new ideas. Basic is the open and open-ended

development process, in which all participants have an equal say. It has strong relations to the educational concept of Dewey[2] and the approache of urban pedagogy3 as well as placemaking.[4] Voluntariness, acting with equal rights and observing ethical principles of mutual respect and appreciation are essential. In this way, a space of trust and experimentation can be created in which people can exchange ideas, learn from each other and create new things. With a continuous way of working, shared experiences, ideas, goals and specific practices emerge with a focus on collaborative work, the do-it-together (DIT). In this way, a community of practice5 can be established.
The project format focuses the joint work on a result to be developed together. It opens up ways of direct collaborations and local developments.

CO-DESIGN-PROJECT: RESEARCH APPROACH

In addition to the artworks and designs produced as visible results, the localized exchange, learning and development process is just as fundamental as it is relevant. It accumulates locally available knowledge and is the resource for understanding the project approach as a research approach. As a “research through design”[6] this practice has a great potential for a collaborative and transdisciplinary research of spatial needs and transformations. Here the approach is in reference to Scandinavian Participatory Design (PD)[7] and to Participatory Action Research (PAR).[8]
Participatory design works on the premise that "those affected by a design should have a say in the design process".[9] It thus calls for a radical democratization of design processes. Since the 1970s, PD has been developing ways of opening up design processes, developing collaborative working methods and organizing decision-making processes collectively. It thus provides an effective theoretical foundation for design research.
PAR also aims at collaborative, joint knowledge production and research. In contrast to the widespread research approach in which researchers in academia design research questions and projects and then go into the field to analyze them, PAR aims to work together with those affected on the problems encountered, to jointly develop research questions and processes and to discuss, evaluate and develop these from multiple perspectives.
Based on the research approaches of PD and PAR, the work presented aims to contribute to a better understanding of collaborative design processes and to help define methods, structures and attitudes in order to make participatory and collaborative design and planning more effective and qualitatively sound. To this end, the approach uses a hybrid way of working and researching, namely direct side specific project work and the parallel reflection and analysis of the process as research through design and urban transformation. Being active in the process brings about a direct perception of emotions, nuances, constellations, evolving situations, thwarted concepts, etc. It leads to deeper insights, to a deeper understanding of the ongoing process. However, this also requires a conscious perception and critical reflection of one's own actions in the interactions that take place and the relationships that arise.

TO WORK WITH CHILDREN AND YOUTH

Vulnerable

Children and young people are a vulnerable population group. During their personal development, they are strongly characterized and influenced by their spatial environment. In contrast, however, they have hardly any influence or direct opportunities to help shape their spatial environment. Children and young people are still heard far too little in planning, architecture and urban development and are marginalized. Projects such as RaumTeiler show how much creativity remains unused as a result and what ways of direct participation could look like.

Highly dynamic

Research work with children and young people is insightful, refreshing and challenging on many levels. Working processes with them are highly dynamic and can only be planned to a limited extent. They therefore offer a multitude of opportunities for gaining new insights and new perspectives. Research work with children and young people can provide fundamental knowledge that is also enriching and can be used in other constellations, e.g. when working with adults.

Ethic

When working with children and young people, particular attention must be paid to the ethical principles of respectful interaction. The project work was organized in such a way that the children and young people were treated as fully-fledged project members. Trust was placed in them. The premise is that everyone can contribute something exciting. Every opinion counts. Everything is voluntary. Elements such as play and spontaneity are integrated. Ideas are discussed, developed and implemented together. This allows children and young people to act directly and honestly, do what they like and also reject things spontaneously. The respective project is thus in the hands of the children and young people - without them it would not take place and develop. This means that the children and young people become independent players in the project, helping to determine and develop it.

Public funding

The projects were made possible by social support for the neighborhood and for cultural education. They are intended to support the development of the neighborhood and of children and young people outside of school. In terms of content, these grants have only limited suitability for the co-design approach. In addition, the funding budgets are small and therefore not very lucrative for designers, architects and planners. However, funding enables open project work. However, the research part and all the preparatory work necessary for the development of the projects are not eligible for funding. This makes a holistic and transdisciplinary project approach very difficult.

BOTTOM-UP COOPERATION

Meet on an equal footing

The key basis of the bottom-up approach is cooperation between local organizations and local designers. Local organizations are usually well networked. They have their own locations, lively relationships with parts of communities and a lot of insider knowledge. An organizational infrastructure is also more or less in place. The mix of experience and disciplines in the cooperation offers an exciting starting point. Limiting factors for scaling up are the mostly precarious working conditions, limited organizational resources and limited ranges as well as little contact with supra-regional funding opportunities.

It is essential that the partners meet as equals and develop a common goal. The starting point is an examination of the location with its qualities, deficits, history and, above all, its people as side-specific work. Current social issues and problems raised by the participants are also addressed. The bottom-up approach is characterized by a close look, an interest in local issues and a willingness to get involved. It makes it possible to find specific things on site, to bring in new aspects from outside and thus to develop new ideas and qualities with an artistic approach.

PROJECT LINE

As a result of the project, the author's long-term, continuous collaboration with Expedition Metropolis led to a series of projects that worked with the co-design approach. Many methods were applied in these projects, independent formats and settings were developed and specific objects and spatial interventions were realized. The collaboration between the author and Expedition Metropolis has enabled the co-design approach to be further formulated and deepened.

Figure 3. Line of co-design projects in collaboration with Expedition Metropolis

KNOWLEDGE AND SPACE PRODUCTION IN CO-DESIGN-PROJECTS

Co-design projects as bottom-up approaches generate a wealth of experience with working tools and co-creative processes. Based on many years of experience, a pattern of local knowledge production can be identified. Working methods from the fields of art, design, architecture, crafts and organization are used in the project work. The result is a collaborative design process. They enrich the skills, approaches, experiences and practices of the participants and thus expand their familiar, perceived normal experiences. Combined with direct use or action in semi-public and public space, these practices are extended into public space and developed into formats and settings for interacting, intervening and researching. In this way, content-related, targeted, complex, multi-layered and dynamic approaches and forms of action emerge as urban practices and as an approach of direct urbanism,[10]

Open, mutual learning process, collective authorship, identification, new relationships

An important feature of the collaborative project work is the openness and open nature of the project content. The underlying project structure serves to support the intended collaborative work and development process. It is explicitly designed to allow openness and autonomy. This means that new perspectives, aspects and ideas can constantly emerge and be integrated (increasing complexity). At the same time, all participants are free to actively contribute and take on their own roles (experience of self-efficacy). Roles in the project are understood as variable and changing. The use of different working methods and the open process create a mutual learning process for all participants. Collective decision-making is established in the project – all participants are as equal as possible. This leads to joint or collective authorship. The high degree of personal responsibility promotes identification with

the process and the place. In this intensive joint working process, all participants get to know each other better and new relationships and networks can develop.

Co-spaces of opportunity

At co-design-projects, the process is at the center. The process is the collaborative design work as being together, as individual trying and discovering, as experimenting, as organizing together, as routine work in a protected and at the same time open project framework. But in addition to the emerging worlds of experience and knowledge and the shared practices, the process generates results as materialized ideas. Material co-design objects are created that carry the process within them and thus become carriers of ideas and identities. When placed in public space they become autonomous and can be the starting point for new associations and developments. They can attract attention and become a connecting element between different interests and viewpoints in a neighborhood – a boundary object.[11] The sum of these effects is the creation of co-spaces of opportunity, that is, spaces that actively generate a sense of community and enable development.

Challenges

There are no specific funding structures for co-design projects in Germany. Very often the approach does not fit into the traditional funding guidelines. The conditions in the funded projects are often precarious and poorly paid. The application and accounting mechanisms are complex. A prerequisite for the development of the projects is therefore personal initiative combined with the will to open up and facilitate the creative process for everyone. This approach requires a lot of additional effort in terms of organization, coordination and methodical implementation. Different funding logics and requirements of funding programs, institutional structures, interests of participants and local conditions must be brought together and coordinated in the project in a target-oriented way. The open process with no predefined goals also increases complexity. It is labor-intensive and time-consuming. Collaborative design processes require professional (art, design) as well as organizational, pedagogical and social skills. Personal connections and initiative are also required for integrated research. Such projects are often not linked to existing research activities, which is a major research gap.

In order to scale up the approach, all these challenges need to be addressed systematically.

A METHOD OF URBAN DESIGN AND IT'S RESEARCH

Practice

Co-design-projects bring people together through open co-creation. These projects seek out local qualities, challenges, opinions and attitudes. They offer direct action by engaging with public spaces and individual interests. They directly involve children and young people, but also adult residents, create new co-knowledge and lead to new forms of action as urban practices and co-spaces of opportunity. Using artistic, design and craft methods, combined with open and meaningful collaboration, they support the self-efficacy of participants, the development of communities of practice, and can reach out to marginalized groups through their local presence. They challenge the use and rules of urban spaces. In this way, co-design-projects become catalysts for local urban transformation.

Research

Co-design-projects offer a rich field of experience and make visible a spectrum of local and tacit knowledge and local issues. Site-specific, they discover and produce new knowledge about places, people, working methods and collaborative processes. New acquaintances and relationships develop

in the projects. The projects are supported and co-determined by the participants. This new quality of project work opens up the possibility of joint research. The local can be explored together in a participatory way through co-design-projects. With the knowledge made visible and newly produced in the process, co-design-projects become research tools for local urban change.

NOTES

[1] "Erfahrungen & Methoden", Expedition Metropolis, accessed August 08, 2024. https://expedition-metropolis.de/erfahrungen-methoden/.
[2] cf. John Dewey, *Democracy and Education: An Introduction to the Philosophy of Education,* New York: Free Press, 1966.
[3] cf. Stephen Dobson, "Urban Pedagogy and the Need to Develop City Skills," In *Learning Cities: Multimodal Explorations and Placed Pedagogies*, edited by Sue Nichols and Stephen Dobson, 111–29. Cultural Studies and Transdisciplinarity in Education, Singapore: Springer, 2018.
[4] cf. Victoria Derr, Louise Chawla, and Mara Mintzer, *Placemaking with Children and Youth: Participatory Practices for Planning Sustainable Communities,* First edition, New York: New Village Press, 2018.
[5] cf. Etienne Wenger, *Communities of Practice: Learning, Meaning, And Identity,* Pbk. Cambridge, U.K.; New York, N.Y.: Cambridge University Press 2000.
[6] cf. Wolfgang Jonas, "Research through DESIGN through research - a cybernetic model of designing design foundations," *Kybernetes 36 (9).* special issue on cybernetics and design, 2007.
[7] cf. Pelle Ehn, Elisabet M. Nilsson, and Richard Topgaard, *Making Futures* (The MIT Press, 2014), Jesper Simonsen, and Toni Robertson, eds. *Routledge International Handbook of Participatory Design,* London New York: Routledge. 2013. and Jesper Simonsen, ed. *Situated Design Methods,* Design Thinking, Design Theory, Cambridge, Massachusetts: The MIT Press, 2014.
[8] cf. Jacques M. Chevalier and Daniel J. Buckles, *Participatory Action Research: Theory and Methods for Engaged Inquiry,* Abingdon, Oxon ; New York, NY: Routledge, 2013 and Sara Louise Kindon, Rachel Pain, and Mike Kesby, *Participatory action research approaches and methods. Connecting people, participation and place,* Abingdon, Oxon: Routledge (Routledge studies in human geography, 22), 2010.
[9] Erling Bjögvinsson, Ehn Pelle, and Per-Anders Hillgren, "Design Things and Design Thinking: Contemporary Participatory Design Challenges," *Design Issues* 28 (3): 101–16, 2012, 103.
[10] cf. Barbara Holub and Paul Rajakovics, *Direkter Urbanismus: transparadiso = Direct urbanism,* Nürnberg: Verl. für moderne Kunst, 2013.
[11] cf. Sanne F. Akkerman, and Arthur Bakker, "Boundary Crossing and Boundary Objects," *Review of Educational Research* 81, no. 2 (June 1, 2011): 132–69.

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SELF-BUILDING IN MUNICH: THE HOUSING IN NEUBIBERGERSTRAßE BY DORIS AND RALPH THUT

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INTRODUCTION

The reporter of *Nature*, Katharine Sanderson, wrote that the built environment provides a huge opportunity to move to a circular economy since "*buildings and the construction industry are the world's biggest consumers of raw materials and contribute to 25-40% of global carbon dioxide emissions."*[1] Although interesting, innovative technical solutions are presented as possible solutions, no word is spent on low-tech and self-organized solutions that could be available without completely relying on new products or waiting for a new organization of the market (circular economy). Plenty of examples can be found by looking at pre-industrial ways of building or creative and community-driven approaches to face the ecological and social challenges posed by global growth.[2] Architectural history, focused on specific building experiences, researched through archival materials and oral history with a polyvocal intention can be handy in revealing the original motivations, who and how contributed to the realization, and how much of the original intentions were fulfilled. It is a matter of analyzing architectonic and technological means, materials, and following some telling social interactions. If architectural history, as recently recalled by Mario Carpo, is an *"inventory of solutions already found and problems already solved"*[3] architectural historians should intentionally direct their gaze and redefine their methods to unfold past events and vivisect their ongoing processes. Rather than a purely historical study this text proposes a hybrid version where the reconstruction of the past is combined with an ethnographical interest. This research was possible thanks to a prolonged engagement with the community and the building, with participant observation and interviews conducted by a group of students and young researchers.[4]

THE CASE STUDY

Given this broader scope, I will present the analysis of a telling case study, the housing for 6 families in Neubibergerstraße (1975-1978), Munich, designed by Doris (Gröschel) and Ralph Thut, to show how the type of architectural history that I argued above, can help contemporary architects to reflect on their possible role in the future. The whole process will be analyzed according to the different stages of the project, such as: purchasing a lot of land; planning phase; considering the needs expressed by the residents; design draft; construction phase; occupancy phase; maintenance, and alterations. The last phases reveal how viable the concept of community living and self-governance structures are in the long term.

Around 1968

In 1968 Doris and Ralph Thut met three engineer's students, Lenz Brandl, Peter Mülbauer, and Sigfried Lederer of the Technical University of Munich (TUM). Unaware of their common future, they used to get together to read Karl Marx's ***Das Kapital***[5] with the loose aim of writing a book, which eventually never materialized but became for the Thuts a theoretical milestone in the Neubibergerstraße project.[6] Even though close to the students' upheaval, the Thuts, being foreigners, could not join the protest because they risk expulsion from Germany. However, they brought some of the `68 ideas into the profession, like do-it-yourself, self-organization, mutual aid, circular building and solar energy.[7] Climate crisis had a great echo among the New Left –the broad political movement that emerged from the counterculture of the 1960s and continued throughout the 1970s– especially after the successful publication of the Club of Rome's first meeting: ***The Limits of Growth***.[8]

Preliminary Work Experiences

After graduating from Munich's Academy of Fine Arts, the Thuts considered leaving Germany for France or the US where they thought they could find more exciting work environments. Not being quite sure about their future, they spent the summer working for Arnold Thut, the father of Ralph, who had an office in Klosters, Switzerland.[9] The office was opened in the 1903s and greatly contributed to the physical development of Klosters. Still, it was not the environment the young couple was searching for.

On Jen Freiberg's advice, Otto Steidle asked the Thuts to help him with the Housing in Genterstraße 13.[10] Interested in the proposal, the Thuts returned to Munich and started working with Steidle + Partner.[11] For the Housing in Genterstraße (1968-1971), the Thuts proposed a flexible building able to adapt to different lifestyles. To do that, they developed an open construction system, made with on-site parts and prefabricated elements, produced ad hoc. Popular among Western architects, the "systems approach" of the 1960s was accused of being technocratic. Still, during the 1970s a more holistic interpretation of it emerged where environment and community were the new values.[12] For example, the Metastadt (1965-1975) by Richard J. Dietrich was a closed system where a single company should have produced all the parts for a specific purpose and had exclusive control over the pieces and their assembly, protected by several patents.[13] On the contrary, the Thuts were interested in giving the user an open-ended system, increasing their possibilities of choices among ready-made components, no matter from which company these pieces were produced, and the modifiability of their dwelling over time was one of their main concerns.

Figure 1. Doris and Ralph Thut with Otto Steidle (on the left) and Jen Freiberg on the building site of the Genterstraße housing project. Thut Archive.

The building was finished in the spring of 1971 and was highly appreciated by the professional media and news magazines, like *Der Spiegel*.[14] Thanks to this project,[15] Steidle made his breakthrough and exploited the load-bearing system developed for the Genterstraße project, with variations, on other buildings in the neighborhood like the Peter-Paul-Althaus-Straße (with the Thuts) and Osterwaldstraße; and on bigger housing scheme like the "Elementa" housing complex in Nuremberg (1972-1974) and the "Housing with external circulation" for Documenta Urbana in Kassel (1979-1982).
At the end of the summer of 1971, The Thuts left the office of Steidle to pursue an independent career.
The experience gathered with prefabricated elements allowed the Thuts to found in 1972 the Büro für Bauplanung und Systementwicklung (BPS) with Wolfram Koblin. This office aimed to work side by side with companies producing innovative prefabricated elements for the building industry. Despite the enthusiasm, they never got any commission.

Who's in?

To give a boost to their career, in 1974, the Thuts decided to self-build and design a housing together with a group of people as a process of self-realization.[16] They searched for people to join them but it was not easy. Some people from the Hochschule für Fernsehen und Film who initially joined the group left after a while because they didn't want to live outside the city, where it was more likely to find a lot at an affordable price. For this reason, they got again in contact with the friends whom they met in the reading circle, which happened to be the core group for the housing to be erected. The building group[17] was now formed by the Thuts, Lorenz Brandl and Ulrike Krakau, Christa and Sigfried Lederer, Rocque and Dorothea Lobo, and Peter Mühlbauer. After the planning process was over, the group realized that with the construction of an additional row house, the construction would have been cheaper. The 6th house was then sold to Ursula and Jürgen Renner.

Christopher Alexander

In the spring of 1975, the Thuts made a trip to California to meet some friends and search for inspiration.[18] On this trip, they got to know some hippie communities and visited the Etna Street cottage, designed and built in Berkeley by Christopher Alexander.[19] Alexander was an architect focused on human-centered design whose seminal book ***A Pattern Language***, was largely influential in different fields, especially in computer science. With the cottage, built in 1973, Alexander tried for the first time to develop an organic and non-conventional building system to let the users design their own buildings, and later expand, modify, and repair them.[20] While Alexander's Etna Street cottage and subsequent experiments aimed to develop "an on-site production process," the Thuts at the time were interested in a building system that took advantage of the materials readily available on the market and use them in their "as manufactured" state, without any additional processing to reduce the costs. Despite those differences, Alexander and Thuts were interested in empowering the users in the design process.

Figure 2. The Etna Street cottage Bekeley, California, Spring 1974. Thut Archive.

Walter Segal

To find a closer precedent we have to look at the Walter Segal method, as was later mentioned by Jon Broome and Brian Richardson, collaborators of Segal. The Segal method was not a proper building system but suggested "how to build" with materials available on the market used in their original size, without cutting them.[21] In its most common iteration, this method was based on 600 mm fiber-cement panels and 50 mm-wide wood posts. It consists of a rigorous simplification of the whole building process, including design, documentation, and the processes on site.[22] Walter Segal, a British architect born in Berlin, proved the value of this approach for the first time in 1962 with the little house built in his garden as a temporary building meant to host his family while rebuilding a brick house in Highgate, London. With this method, people without expertise could build their own house alone, except for the lift of the load-bearing frame where two persons were needed.

Planning Phase

To design without having yet found a lot and involving the future inhabitants, the Thuts developed two specific design tools: the "Standard Buch" and the "Regie Buch."[23]

Standard Buch

The Thuts started developing the "Standard Buch" in 1975. This "book" was intended as a set of drawings representing the constructive system and the building materials (wood, plasterboard, mineral wool, onduline,…), together with the costs. In this way, the construction could start without having already defined the single rowhouses in detail. The building was financed primarily thanks to building savings contracts (*Bausparverträge*) (taken from the parents), bank credits and own resources.[24]
This "book" contained simplified –mainly vertical or horizontal– sections in scale from 1:20 to 1:1 represented in single A4 or A3 sheets of paper intended to explain to non-professionals how to build. It was a sort of instruction manual, conceptually similar to the one we receive to build an IKEA furniture.

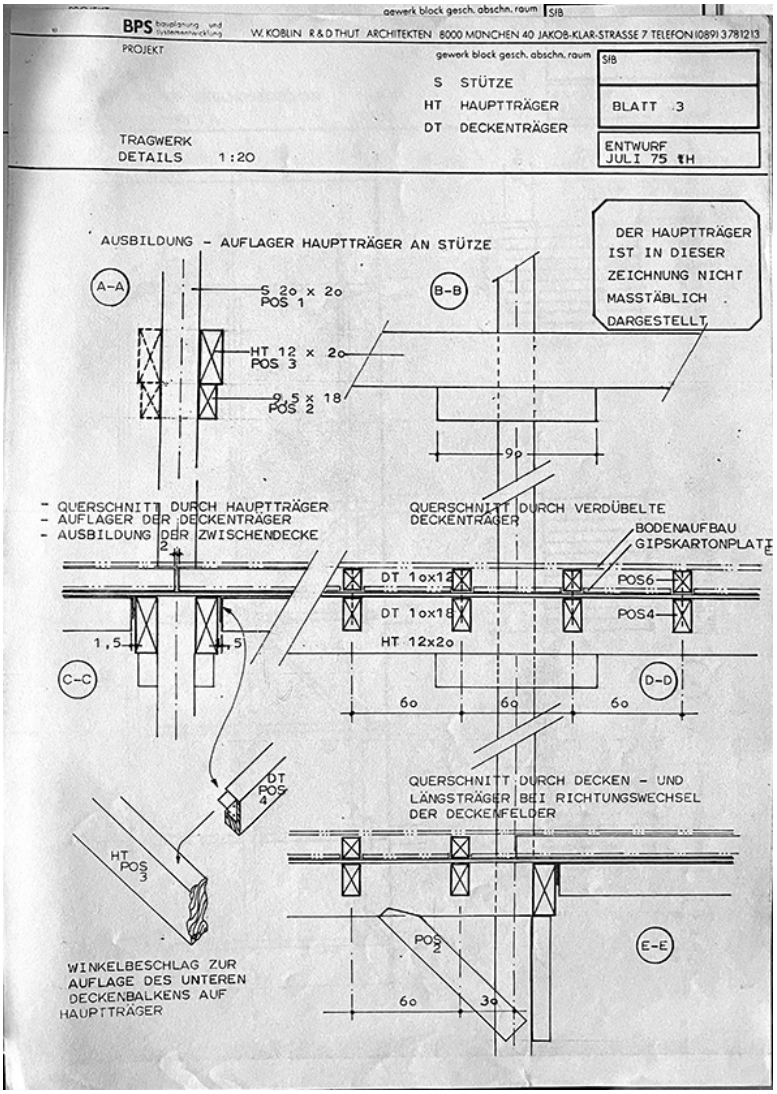

Figure 3. Load bearing system, detail 1:20, 7.1977. Thut Archive.

Regie Buch

While the group was not yet stabilized and the lot was not yet found, the architects' couples asked each future inhabitant, unaware of the technical concept, to compile a "Regie Buch" to express his or her needs, ideas, and desires, about building and living together. It was important to state clearly how much or how little each wanted to be confronted with the other, whether in the kitchen or just in the basement, what habits they wanted to keep. The surviving notebooks are filled with handwritten annotations, cutouts from newspapers and magazines, sketches and scribbles. No matter if some of the ideas were unfulfillable,[25] the script's scope was to create the conditions for intensive communication.[26] These artifacts are a fundamental part of the design process because they register the contribution of the inhabitants to the whole project but they have to be seen also as elicitation tools to foster a fruitful contribution to the discussion.

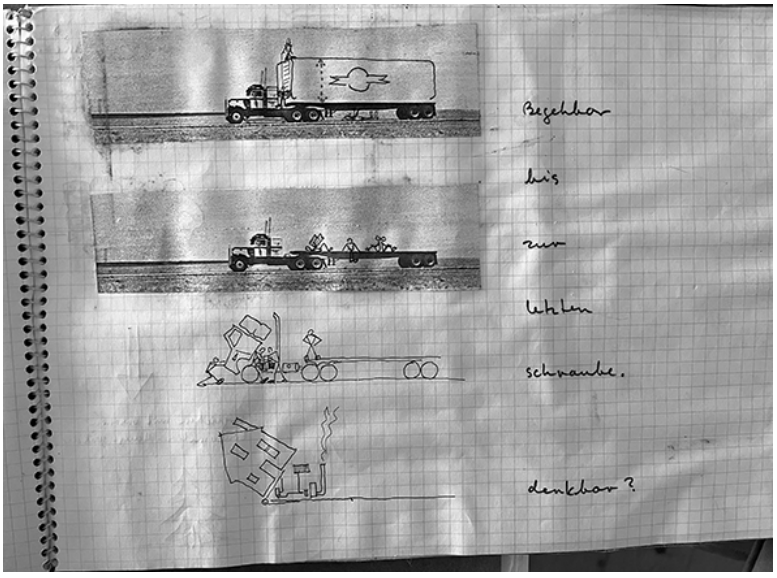

Figure 4. Page from Ralph Thut's "Regie Buch". Thut Archive.

Lot Search

Finding a lot was not easy and the budget was very limited. After a long period, Ralph Thut met a real estate agent who wanted to realize a project on a lot of 3000 square meters.[27] This piece of land was regulated by the *Staffelbauordnung,*[28] which limited the construction of one ground floor and a first floor. This made any speculative project unattractive but was enough for the building group. The group rented with a leasehold contract the plot from the owner who was living nearby. The leasehold contract was a great opportunity for the group because they didn't need to spend money to buy the property. In 1979, after the death of the owner, the lot was bought for a fair price, thanks to the mediation of Mr. Brandl.[29] After the construction and the occupancy, the building group took the form of a homeowners' association according to the German Condominium Act (*Wohnungseigentümergesetz*) and the lot became shared propriety, together with the conservatory, the wooden deck, and the spaces on the underground: a common room, the technical rooms and the wood workshop, already in operation during the construction.[30]

Third Planning Phase

After the "Standard Buch" and the "Regie Buch," the needs and the dreams of the future inhabitants had to be verified according to the possibilities offered by the lot, the construction technique, and the construction costs. This phase showed a strong interaction between clients and architects on the design of the single dwelling and the architects leg their influence according to the different design skills of the inhabitants. One meeting per week over 3 years was necessary for the disclosure of all the necessary information about the planning decision to be taken.

Solar Energy

The main communal space is a big conservatory which is connecting the 6 row houses on the west side. Besides its social role with its complementary role of hosting the plants, the greenhouse also absolves to climate regulation. In summer, thanks to external sun protection, the conservatory shades the ground floor and part of the first floor from direct sun exposure. Furthermore, cross ventilation is enhanced thanks to ventilation flaps on the highest part of the conservatory. Cross ventilation is also

facilitated because the whole building is elevated from the ground 70 to 100 cm. The roof, conceived as a cold roof[31] also helps remove unwanted warm air accumulated on the upper part of the house.
In winter, the "airspaces" (greenhouse, hollow space between the ground and the floor of the first level, roof space) are closed thanks to doors, flaps and tilting sashes to create heat pads between inner and outer spaces.
Solar collectors integrated on the south roof were planned but weren't initially implemented.[32] For this reason the roof inclines to 60%.

Building Permit

Since the building in Neubibergerstraße was probably the first in Munich to adopt a wood structure of this dimension (45m long), a concept for special approval was elaborated together with the fire department. To withstand the fire resistance class F 30 of 1976, the pillars were four times oversized, resulting in a section of 24 x 24 cm.[33] Furthermore, to avoid the propagation of the fire from one unit to the other, the pillars in the middle of two units are covered from each side by a plasterboard and the hole is filled with mineral wool.
The conservatory enclosed the whole sud façade, giving no direct escape way to the outside, therefore, could not receive the building permit. The director of the local building commission, excited by the innovative proposal of the young architects, suggested designing two provisional inner courtyards to split the conservatory into three sections.[34] In this way, the conservatory could have been accepted.

On the building site

The punctual foundations and the basement, are made of concrete and were realized, as recounted by Mr. Brandl in an interview conducted for this research, by the brother of Mr. Lederer, who led a small construction company.[35]

Figure 5. The foundations and the functional spaces underground. Lorenz Brandl Archive.

The timber frame was built by Merk, a specialized firm from Aichach (Augsburg), in two weeks, while the roof, the ceilings, the inner walls, and the outer walls were built afterward by the architects and the future inhabitants.[36] To further simplify the work on the building site, all the wood elements needed to be represented with exact measurements and delivered already cut by the carpenter.

Figure 6. The wood frame. Lorenz Brandl Archive.

After the load-bearing structure was lifted up and fixed by the contractor, the building group started to work on the building site, at first with the help of Lederer's brother for the concrete parts and then on their own or with the occasional help of friends and other interested people. Four people were constantly working on the building site, the rest mostly on the weekends, holidays, and now and then in the evenings, after work. Mr. Brandl, about the construction, said: *"That was a nice time, but it was a stressful time as well because the men had to coordinate with each other, and we worked 12 hours a day."* And Mrs. Brandl added: *"And we had to work 7 days in a week […] We did the quiet things on Sunday. We weren't allowed to make any noise with a saw or anything."*[37]

Figure 7. The building group. Thut Archive.

The flexible workload was a big advantage, especially for those who could not dedicate the same amount of time to the building site. This flexibility was possible because the participants wrote down the hours they worked and then passed it on to the others who couldn't work as much.[38]
About this period, Ursula Renner recalls: *"[…] we didn't really want to [take part] either. Because at the time I was pregnant and thought that the money was all too much for me. I worked full time, and [thought it was too much to] build a house. I have no time at all. And then Doris Thut convinced me*

that I should be involved now more than ever, and here with the house and the child in the garden and so on. And I am always grateful, it was very good for my life." [39]

Reuse

Mr. Brandl, in the same interview, reveals that his house unit was realized using as much as possible recycled materials to cut costs. He removed radiators, doors, kitchen, and bathroom from the house of his brother, which was going to be demolished, and managed to store them on a farm nearby for the time it was needed.

Occupancy and alterations

The Brandls were the first to move in (Unit 3), on July 15, 1978, when the building was not yet finished. Since then, they made many changes, redid the insulation, and changed the windows, all on their own with some external professional help. The biggest change in their original layout is the division of the house into two flats (one of them is inhabited by one of the sons), which is visible outside due to the addition of a spiral steel staircase.

Many events affected the lives of the other families too and resulted in the transformation of many units: the Thuts moved their office out (Unit 1); three male inhabitants died and two went away after separation; two children with their family moved in.

Moreover, the Lobos bought the house of Mühlbauer (Unit 2), after his death, and moved in, leaving their house (Unit 5) to the daughter with her family. The ground floor of Unit 2 was used by Mrs. Lobo for yoga classes and now by her daughter as an exhibition space.

According to all the interviewees, kids were a glue for the community. After the children had grown up interactions among the inhabitants diminished. The aging of the original inhabitants, the growth of the children and the move-in of new inhabitants had consequences in the community, especially in the occupation of the shared spaces, which eventually led to the splitting of the conservatory. Otherwise, some social relations cemented over the years, sometimes outside the physical limits of the lot. For example, Mr. Lederer who is not living there anymore has contacts with Ms. Renner and Christa Lederer, Ursula Renner, and the Brandls even if they are not doing activities in the shared space together, they are still renting together a vacation house in the mountains after all these years.

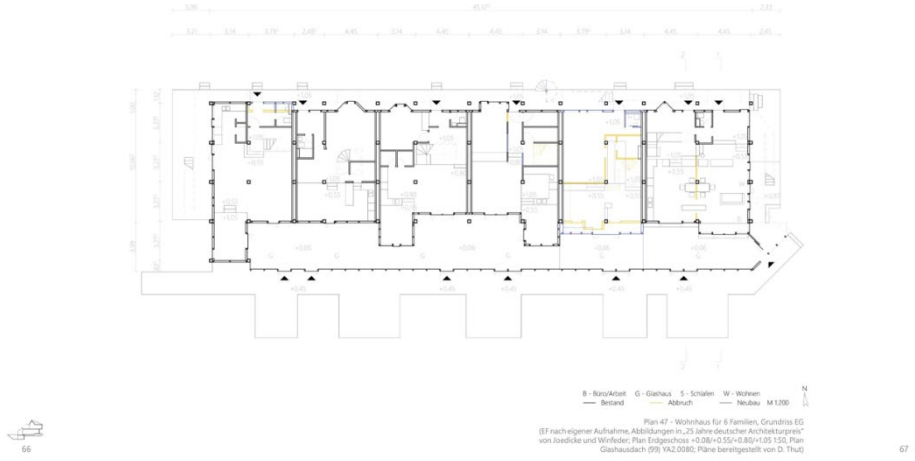

Figure 8. Alterations. From Elisabeth Freundorfer (2022).

CONCLUSION

The present analysis shows how the result achieved in Munich is due to the technical and spatial concept of the architects but also the contribution of the inhabitants. The group of people involved worked hard, made sacrifices, put their hopes for a better future, and above all wanted their kids to grow up in a good community. Furthermore, I tried to underline external specific contributions that helped in shaping the built result, like the fire department and the local building commission. These external contributions are the result of an open dialogue established by the architects and were possible because the innovative concept behind this building was recognized. The same importance in shaping the spaces, even though not extensively narrated because of word limits, is to be attributed to the process of dwelling which over time affected the actual state of the building substance. The project can be considered a success as it maintains its promises of flexibility, not only in terms of modification of the spaces but also in terms of the plurality of uses that it offers to the inhabitants, even to the second generation.

This project could not have been built without the idealism of the people involved, sharing the ideas of the 1968 student movement, strongly believing in it and embracing its social and political meaning. This is the main reason to preserve its built result. But how? Due to the unique social process behind the construction, the housing in Neubibergrerstraße needs special care and a specific preservation concept has to be developed. All the material changes correspond to changes in the lives of the people and show the flexibility of the project. This flexibility was not related only to the building site but was conceived also to offer the possibility of changes over time. As described above, some families did it on their own, like the Brandl, and others, like the Lobo or the Renner, consulted the Thuts. These two approaches produced different results that should be evaluated concerning the original spirit of the project.

To preserve the original concept, especially when the future generation will have taken over all the housing, a conservation plan has to consider first the original “Standard Buch.” Technical improvements and changes in the physical space should be accepted as long as they are following as much as possible the “Standard Buch,” with its structural concept, technique, flexible plan and corresponding differentiated façade solutions, and aesthetical choices (with out-of-the-shelf materials and simple technical solutions).

The open-ended self-building process is part of the multivocal design ideas and cannot be forgotten for any serious conservation attempts. Therefore, we have to interpret this building as having an open form with clear structural and constructive principles but with mutable boundaries between the different rooms (partition walls; stairs) and between the interior and exterior (façade concept; windows).

On the one side, the conservation plan must preserve the ideas of the architects, as manifested in the “Standard Buch,” on the other, it has to allow the modification of the inhabitants. Moreover, the act of self-building contributes to the awareness about the construction, allows for self-maintenance, and eventually determines the aesthetic result, therefore it is important to pass this knowledge to the future inhabitants.

Figure 9. Neubibergerstraße Housing. Photo by Wolfgang Gröschel (1980s).

NOTES

[1] Katharine Sanders, “Greener buildings,” Nature 611, November 17, 2022: 18, doi:10.1038/d41586-022-03650-3
[2] The United Nations on this regard speaks about health issues, the ability to grow food, housing, safety, and work. https://www.un.org/en/climatechange/what-is-climate-change
[3] Mario Carpo, “Opinion: We Can’t Go on Teaching the Same History of Architecture as Before,” Metropolis, November 5, 2018, https://metropolismag.com/viewpoints/architectural-history-pedagogy-opinion/
[4] This study would not have been possible without the contribution of Elena Spatz, Zoe Kleinbongartz, Jonathan Hoff, students at some of the seminars on participation in architecture I taught at the Chair of History of Architecture and Curatorial Practices at TUM. Great contributions to this research were coming from the active engagement of Shimizu Shunsuke, PhD student at Keio University, guest at the same chair. Besides these people, I want to thank Elisabeth Freundorfer who shared with me the data she collected for her Master Thesis, quoted below. I want also to thank Prof. Andreas Putz and Irene Meissner for their encouragement, their practical support, for the fruitful discussion and their appropriate suggestions.
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[6] Lorenz Brandl, in discussion with Shimizu Shunsuke, Munich 21.11.2023.
[7] Doris Thut and Ralph Thut, “Einfluss Technik-Mensch oder Mensch- Technik?,” Das Werk 59, no. 8 (1972), 435–437.
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[12] Andrew Rabaneck, „Whatever Happened to the Systems Approach?,” Architectural Design 46, no. 5 (1976), 298–303. And Richard J. Dietrich, “Von Metastadt zu Ökostadt: Denken und Planen in Systemen,” in Schneider, Martina J. *Systeme als Programm,* (Cologne: Rudolf Müller, 1989), 19–29.
[13] Richard J. Dietrich, Gebäude bzw. Gabäudekomplex, DE Deutsches Patentamt 1810434, filed November 22, 1968, and issued Juni 11, 1970.
[14] “Ehrlich rauh,” Der Spiegel 15, April 2, 1972, https://www.spiegel.de/kultur/ehrlich-rauh-a-7be7043a-0002-0001-0000-000042971902?context=issue
[15] Irene Meissner, “Otto Steidle,” in Neue Deutsche Biographie 25 (2013): 121–123 [Online-Version]; URL: https://www.deutsche-biographie.de/pnd118570609.html#ndbcontent
[16] Doris Thut and Ralph Thut, “Nach der Genter Straße,” Bauen + Wohnen 30, no. 4 (1976): 116.
[17] *“Individual clients who plan their homes independently of one another and take joint action only where needed form a building group. This usually involves pre-existing shared objects, such as non-detached houses.”* Hilde Strobl, Natalie Schaller and Heike Skok, eds., *Keine Angst vor Partizipation! Das Kleine ABC des Gemeinsamen Bauens und Wohnens. Don’t be afraid to participate! The Brief ABC of Communal Planning and Housing* (Berlin: Hatje Cantz, 2016), 14.
[18] *“[We] saw how the Americans approached things with great freshness and joy, with a lot of energy and without the concerns one has here [in Germany]. That impressed us very much and we decided that we also have to do things like the Americans.”* Doris Thut, in discussion with Elena Spatz, Zoe Kleinbongartz, Jonathan Hoff, Munich 17.12.2022:
[19] Thanks to Artemis Anninou, from the Center for Environmental Structure, who helped me identifying the Etna street Cottage from a foto found on the Thuts’ archive.
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[21] Jon Broome and Brian Richardson, *The Self-build Book. How to Enjoy Designing and Building Your Own Home* (Ford House: Green Books, 1991), 173.
[22] Alice Grahame and John McKean, *Walter Segal Self-built Architect* (London: Lund Humphries, 2021), 124.
[23] Manfred Hegger, Wolfgang Pohl, and Stephan Reiss-Schmidt, *Vitale Architektur. Tradizionen, Projekte, Tendenzen. Einer Kultur des Gewöhnlichen Bauens* (Braunschweig: Vieweg, 1988), 48.
[24] Roswitha Näbauer, et al., ed., *Selber und gemeinsam planen, bauen, wohnen* (München: Self-printed, 1979), 52.

[25] *"Yes, especially mentally [speaking about the participation process]. Yes, we thought about how I wanted to live, how I wanted to communicate with others, how much I wanted to be able to withdraw and how my children would grow up in such a community. We discussed this and there were many evenings, very nice evenings, but they were fantasies."* Ursula Renner in conversation with Shimizu Shunsuke, Munich 24.11.2024.
[26] Näbauer, 49.
[27] Lorenz Brandl, in discussion with Shimizu Shunsuke, Munich 21.11.24.
[28] A planning instrument whose first version was developed by Theodor Fischer in 1904.
[29] Lorenz Brandl, in discussion with Shimizu Shunsuke, Munich 21.11.24.
[30] Strobl, Schaller, and Skok, 92.
[31] In the "cold roof" design the load-bearing frame is primarily outside of the building thermal envelope. In a "warm roof" design the structure is primarily inside the building's thermal envelope.
[32] Doris and Ralph Thut, "Randbemerkungen zu Möglichkeiten in der Architektur," in *Deutscher Architekturpreis 79. Dokumentation,* ed. Jürgen Joedicke (Stuttgart: Karl Kramer, 1980), 22–23.
[33] Elisabeth Freundorfer, " Ökohäuser. Grünes Bauen in den 1970/80er Jahren" (master's thesis, TUM, 2022), 62, https://www.arc.ed.tum.de/en/nb/lehre/master-thesis/masterarbeiten/ecological-houses-green-buildings-from-the-1970-80s/
[34] Doris Thut, in discussion with the author, Munich 6.08.2024.
[35] Lorenz Brandl, in discussion with Shimizu Shunsuke, Munich 21.11.24.
[36] The construction of the building started in October 1977 and finished in June 1978.
[37] Lorenz Brandl, in discussion with Shimizu Shunsuke, Munich 21.11.24.
[38] *"We calculated 10 D-Marks or something like that for the transfer."* Lorenz Brandl, in discussion with Shimizu Shunsuke, Munich 21.11.24.
[38] Ursula Renner in conversation with Shimizu Shunsuke, Munich 24.11.2024.

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DISPLACEMENT IMMUNE: A NON-TRADITIONAL APPROACH TO SITE RESEARCH IN MARGINALIZED COMMUNITIES

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INTRODUCTION

An essential part of the design progress is the traditional site analysis. As displacement becomes a larger issue in many urban communities today, the traditional methods of site analysis must address factors that contribute to community resilience. When conducting site research in urban areas with marginalized communities, insights into the preservation of community character and culturally significant assets offer practical and educational insights. By reassessing a community's cultural assets' role in helping to ward off displacement, we can gain a wealth of knowledge into understanding the social, cultural, and historical knowledge essential to good urban design. Our aim is to understand how traditional site analysis methods can be reevaluated and reframed towards a comprehensive contemporary understanding of how some cities are immune from displacement and gentrification.

TRADITIONAL APPROACH TO SITE ANALYSIS

Traditionally, site analysis as it relates to architecture focuses on assessing current physical attributes of a site and its potential future uses.[1] This analysis includes assessing: the spatial and infrastructural needs that determine one's understanding of the site's current conditions and its future potential for development; climate trends, zoning, and regulations that determine the economic and logistical feasibility of a potential site; and social needs that consider the impact of potential development on the surrounding community and minimizing negative impact such as gentrification and displacement.[2] Through this traditional approach, designers learn how to develop a design to best suit climatic conditions, adhere to jurisdictional laws and regulations, and address community concerns with the least amount of pushback. As site analysis becomes an increasingly impactful part of professional practice, particularly as it relates to addressing the social needs of the site's local community,[3] there is a growing need to address and rethink this initial stage.

This traditional approach to site analysis and research historically fell into two main lines, Process-Driven research focused on academic exploration and theoretical frameworks, and Output-Driven research concerned with professional applications and outcomes.[4] As laid out in Ayşe Zeynep Aydemir and Sam Jacoby's concept of Impact-Driven Research which evaluates the value of architecture in commercial, cultural, and social dimensions,[5] further questions arise regarding 'Who might benefit from this research? And 'How might they benefit from this research?'.[6] Building on this

concept of Impact-Driven research offers a way to bridge the gap between short-term and long-term goals of the academic versus the professional when critiquing the traditional site analysis process. Beyond traditional methods that prioritize physical site factors and immediate concerns, integrating impact-driven questions into the process can provide a more comprehensive understanding of how site analysis contributes to broader societal outcomes and addresses both immediate design needs sought in professional practice and future-oriented speculative solutions sought in academic design research.

TRENDS AND CONTEMPORARY REFLECTIONS ON SITE ANALYSIS AND URBAN PLANNING

Recent architectural exhibitions such as the 2021 Chicago Architectural Biennial entitled *The Available City*, curated by David Brown, highlight evolving perspectives on site analysis and "shifting the focus away from spectacle and esoteric discipline discussions, to contextual and cultural impact."[7] The exhibition tackles the problem of urban space and architectural practices particularly how aging urban cities like Chicago can revitalize marginalized neighborhoods through recognizing the role of creativity in enhancing livability and cultural vibrancy. By emphasizing these two factors, the Biennial promotes a broader and more integrated approach to site analysis as well as interrogates the effects architecture has on the site, which in turn, questions how architects and the public engage with each other.[8]

Additionally, recent urban planning trends in Europe exemplified by initiatives in Barcelona, are shifting focus toward enhancing community well-being within cities. One example are urban planning initiatives that prioritize pedestrian spaces and mobility over car-friendly streets.[9] This approach aims to foster community-centric urban environments by reorganizing the urban grid to emphasize pedestrian place making. Such changes reflect a growing emphasis on creating spaces that prioritize local residents' daily wellbeing through nature, the localized environment, and community interactions rather than accommodating non-resident commuters.

As urban planning and design evolve, trends in site analysis reflect a broader understanding of what constitutes a comprehensive site evaluation and shifting professional priorities. Understanding current trends more broadly and its increased focus on marginalized local communities is crucial in addressing contemporary challenges in site analysis and design.

APPLYING HOLISTIC APPROACHES FROM UNESCO TO SITE ANALYSIS

One effective approach is to examine existing institutions engaged in relevant research and to explore how their work can be integrated into architectural site analysis. The United Nations Educational, Scientific and Cultural Organization (UNESCO) established in 1945, "promotes knowledge sharing and the free flow of ideas to accelerate mutual understanding and a more perfect knowledge of each other's lives." [10]

Historically, UNESCO's commitment to cultural preservation and promotion is evident from the organization's first General Conference which laid the groundwork for heritage protection[11] to its adoption of the World Heritage Convention which created a formal system for preserving both natural and cultural heritage on a global scale.[12] Today, UNESCO continues this mission by advancing education, science, and culture through a network of international standards and humanistic values. Among their key initiatives are the World Heritage Cities Programme, which identifies cities that provide a global model for leveraging cultural heritage in urban development, and the UNESCO Global Network of Learning cities, which creates best practices in teaching, funding, and research. These initiatives collectively offer valuable insights and practical examples for integrating cultural and educational frameworks, yet it is the Cultural Cities initiative and its focus on the role of culture in urban environments that provide a more nuanced approach to site research.

The Cultural Cities Network by UNESCO (UCCN) was created on the premise of community retention by encouraging cultural activities, supporting artists and cultural professionals, promoting public engagement in cultural events, and supporting sustainable urban development that addresses the local population's practical needs.[13] In this context, culture serves as the key standard to challenge and reevaluate the traditional site research process, which often overlooks cultural factors when explaining urban resilience. Of particular importance is the role of culture in community asset mapping. Pivotal in enriching the methodologies for conducting community asset mapping useful in the site analysis process is the work of John McKnight and Jody Kretzmann.[14] By including a broader array of cultural factors and artifacts, a deeper understanding of the interplay between cultural assets and urban resilience can be achieved.

UNESCO provides a clear framework for cities seeking UCCN status, emphasizing the identification of significant cultural contributions that support a more sustainable urban development. [15] Included are a set of guidelines for conducting a thorough analysis of the city's cultural landscape and using that analysis to create an informed strategy for how the city will work to maintain and improve cultural assets while preserving their unique cultural identities. For architects, this approach of respecting local culture aligns with their ethical responsibility, as part of fulfilling professional duties and maintaining professional standards.[16] A critical component to the UCCN framework is the delineation of seven cultural categories for UCCN status: Music, Gastronomy, Design, Media Arts, Crafts and Folk Art, Literature, and Film. These seven categories serve as the base for understanding how cities present their cultural identity to the world. When thinking about a site, considering how culture is currently perceived within the city and its larger global potential can guide architects in aligning their projects with community values and building on latent capabilities in the community. The twelve guidelines outlined in the UCCN application provide architects with a structured understanding of a city's cultural context from a top-down perspective. Using this framework, academic and professional researchers can guide their site analysis and subsequent design processes in marginalized communities by exploring ways to bridge the gap between unrecognized cultural significance and the enhancement of urban assets that ultimately contribute to urban resilience.

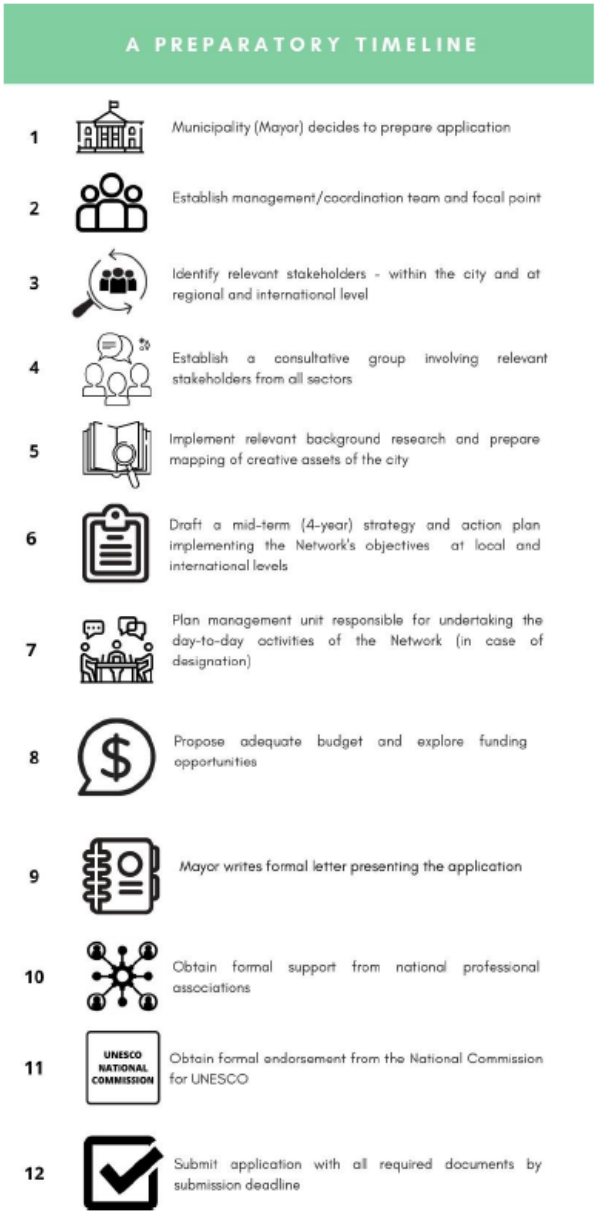

Figure 1. Sequence for preparing an application from "UNESCO Creative Cities Network Call For Applications 2023 Application Guidelines".

UNESCO's criteria for designating a city as a Cultural City, unlike traditional site analysis which typically prioritizes physical attributes, assets, and conditions, provides a holistic view of the health of the city's culture as an indicator of its long-term resilience. The guidelines align with contemporary social goals by requiring analysis of how new assets will affect existing community elements and evaluation of whether planned future actions will sustain existing cultural assets over time. This approach takes on more significance when understanding, supporting, and designing within communities that are marginalized or threatened either through gentrification or through any number of other cultural declines. An example of this would be Covilhã, Portugal that recognized its population was quickly aging and that its cultural heritage may soon go extinct if its population is lost. Their initiatives to seeking UCCN status jumpstarted a commitment to retaining the dying culture of the city and bring improvements for "creatives, the community, academia" by: "The commitment to design, and the project culture it calls for, aims to improve endogenous potential, diagnosis, and

resolution of persistent impasses in demographic areas, talent fixation, cultural hegemony, urban regeneration, employment, industry, and crafts innovation, especially textiles, promotion of a new look at the rural world and the relationship with new sectors, such as digital, in which design is a privileged agent. That is, through the professional, social, cultural, and economic components of design, to boost the local innovation ecosystem and enable the community to respond to concrete problems and improve its relationship with its environment".[17]

APPLICATIONS AND LIMITATIONS

Both educational applications and practical applications must be explored in order to take a holistic view of how applying the UCCN concept can benefit both the execution of site analysis and its teaching.

Practical Applications

As cities grapple with a more homogenized design landscape, the UCCN tries to combat this in a structured top-down governmental approach. Using a tailored version of this approach, architects can ensure the designs of buildings become integrated into the site. This requires taking an active role in ongoing engagement with key demographics in the community, not just as an initial input, to maintain cultural continuity and longevity. As a result, new buildings and, by extension, businesses and/or new residents will have a leg up on ingratiating themselves into the local community.

Educational Applications

How can these insights be applied to improve the teaching of site analysis in architectural education? One approach is to integrate them into live-work or commercial design studio courses. In one such example, students in the School of Public Architecture at Kean University are revealing the broader educational implications of this approach by exploring marginalized cities in New Jersey. Working in collaborative teams, they are tasked with developing community asset maps for ten marginalized communities and translating their maps into design proposals which aim to be more social, affordable, and financially sustainable than current or non-existent architectural solutions. What has been revealed in this process are gray areas of complexity that have the potential, if addressed, to drive the final proposals towards innovative solutions.

Through design studio, students perform traditional site analysis through the modern day convenience of the internet. Online sources like maps, business directories, and transit data make it possible to conduct analysis from a laptop, an approach at odds with how a potential client interacts with the built environment and one that misses out on potential design opportunities that come from direct experience. By walking the site, students gain a deeper understanding of the place and people who inhabit it. In this studio, once general site analysis is completed, students are given the opportunity to interact directly with the local community throughout the semester. This includes interacting with city and community leaders and talking with residents to gather valuable input. As a result, many of the student projects are shaped in unexpected ways. For example, one group discovered the extent of air and water pollution by having brief conversations with people in a local park, a problem likely overlooked without direction connection with local residents and direct experience breathing the air for themselves. Another group researching an abandoned high school gained critical information about the building's history as a former trade school after meeting with the zoning and planning board and understanding the town's open information process to obtain building plans. Not only does this on-the-ground engagement create connections to the community, it allows students to dig deeper into the underlining questions that could potentially create more interesting and thought provoking design

strategies for their projects. As a result, these projects become much more about the process of community building than the final structure.
The students are encouraged to maintain contact with the community members throughout the semester to ensure a truly collaborative effort both with their peers and the broader community. All members of the community are invited to the final review, presented in a gallery style. This format of presentation allows more time for the students to engage in a dialogue with the invited guests and gives the community a less formal and intimidating space to ask the questions. By the end of the review, all attendees witness an impassioned student body that is excited about their projects and motivated by the potential to contribute to something greater than the pages in their portfolio.

Related Fields

The potential impact is not only in architecture but in related fields such as urban planning, community development, and social policy. By engaging with and aiming to maintain the cultural assets of existing communities, cities can shift how they decide to grow in the future. While speculative designs will continue to emerge, how they interact with the site and the local population could bring more localized and site-specific developments.

Limitations to Cultural Categorization

Is there a way a site analysis process that considers proven globally valued categories of culture and values-driven community asset mapping can maintain and grow the potential of marginalized communities through improvements of infrastructure that do not displace the local community? As research deepens, it becomes evident marginalized cities are not easily classified neatly into UNESCO's seven cultural categories without excluding or overlooking certain demographics. The more one examines the socio-economic disparities that divide these communities and more affluent neighboring communities, the more a critique of the benefit of using culture as a measure for community retention and resilience becomes. Though these challenges and complexities exist, there are still valuable reasons to maintain these frameworks and general guidelines as a convenient starting point for introducing architects and students to critically think about their site research.

CONCLUSION

Taking a more nuanced look into cultural systems presents an opportunity to enhance our understanding of urban resilience, ultimately creating a more hospitable physical environment for the existing community both short-term and long-term. By integrating traditional site analysis with contemporary frameworks like those proposed by UNESCO, coupled with a capacity-oriented approach to asset mapping that emphasizes the intrinsic value of cultural assets championed by McKnight and Kretzmann, we can develop a more holistic understanding of urban environments, particularly in marginalized communities. Using the UCCN guidelines to accomplish this goal gives a clearly delineated approach that, taken step by step, gives the designer clear questions that need to be addressed not just in the short term, but the length of the building’s life.
As we continue to reevaluate and refine these processes and methodologies, a more detailed evaluation process to identify which community assets already foster a sense of community is needed if it is to be used as a teaching tool for students. This process should enable students to identify gaps in the community fabric that could be improved on that could drive their site selection or design process. While McKnight and Kretzmann offer a conceptual framework that identifies three categories of assets as individuals, associations, and institutions, a comprehensive step-by-step guide for students to specifically identify existing community members is still needed. In addition, community surveys and focus groups can be challenging for students, specifically those with limited

community engagement experience or those without larger networks of support, requiring additional practical and procedural guidance.

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FROM SPACE TO PEOPLE: CULTURAL POTENTIAL REINVENTING IN RYBINSK, RUSSIA

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INTRODUCTION

Researchers exploring Russia's governance system outline the hinterlands' modest municipal autonomy and a high financial dependence on the centre.[1] Indeed, minor resources of Russian non-central cities are the reason for hesitant decision-making processes and problems with promoting initiatives. However, this assumption is limiting due to underestimating the potential cities possess. The periphery[2] does not necessarily undertake practices of the centre. Some problems with implementing local urban projects can be currently observed in non-central cities, yet the municipalities are discovering a new resource for space development — people.

Heritage planning in Russia follows a similar approach. There, heritage projects tend to be highly centralised. Usually, the budgetary resources of peripheral cities are limited, so federal funding becomes the most likely source for urban heritage policies. Besides, heritage is often seen as material rather than symbolic. This poses a risk of focusing exclusively on the physical restoration of the cities' cultural heritage with federal subsidies.

In this regard, heritage planning in Rybinsk[3] represents a unique example of a comprehensive approach considering both its material and symbolic aspects. The impetus for the development of its urban heritage policy came from a project for reconstruction of the city centre, wherein an initiative citizen cooperated with municipal administration and businesses.[4] By his concept, buildings in Rybinsk were restored to resemble their pre-revolutionary architectural appearance, and all modern signboards were replaced with old-fashioned ones. Subsequently, the image of the merchant city has become an identity-reshaping one and was reflected in the projects that followed the reconstruction of the central space.

LITERATURE REVIEW

Defining heritage

Over the past decades, interest in urban and regional cultures has increased immensely, which made urban planners focus on historic landscapes and the future of urban heritage.[5] This in return led to discussions about the performative concept of heritage: it can be a type of use,[6] a metacultural product,[7] a process,[8] a resource for unfolding social capital potential,[9] an economic growth factor,[10] one of the means of attracting tourists.[11] Heritage can be viewed as a connector between past, present, and future[12] — that is true for tangible property such as historical buildings, monuments, sites, towns, and landscapes as well as for intangible elements like traditions, values, customs, and narratives.[13]

Such urban heritage can be perceived in several ways and is driven by various motives, placing the notion of heritage value in a state of constant evolution.[14] A common theme in scientific research[15] is the social aspect of defining urban heritage. Today we can define urban heritage as a social construct — a collection of resources in urban contests that communities hold in common and value, and, therefore, are willing to preserve.[16]

Accordingly, approaches to working with heritage have evolved from focusing on authenticity to a more holistic understanding of identity. Modern concepts emphasise creating enjoyable urban experiences that embrace historical identity rather than simply preserving authentic history.[17] This comprehensive approach considers both material and symbolic elements of urban space, aiming to support the integrity and identity of a place while fostering sustainable development.[18] However, there is a need to develop and evaluate tools for effective implementation of complex decisions, considering the relative and participatory nature of the heritage.[19]

Participatory heritage planning

Plenty of studies confirm the necessity of public participation in heritage planning.[20] We pay attention specifically to the "producers" view,[21] i.e., the local and expert knowledge and skills of the participants — governmental and non-governmental actors (organisations, experts), citizens and users. Foroughi et al.[22] group participants into public (politicians, policy makers, officers) and private (experts, daily users, occasional users).

A prerequisite for a collaborative approach to heritage protection is interdisciplinarity which requires more effective risk management at every stage of planning.[23] It has been shown that the all-stages-participation of stakeholders not only increases the level of civic loyalty and awareness about the heritage but also contributes to further public discussion.[24] Planning is effective when a consensus is reached. Consensus allows the community to clearly identify heritage and agree on its cultural significance.[25] Generally, the balance of forces remains a critical task for urban governance. Additional challenges in heritage planning, such as sufficient resources, technical capabilities, and institutional engagement practices, should also be noted.[26]

While public participation is becoming an increasingly common tool for sustainable urban development,[27] the majority of communities still face barriers in public engagement policy.[28] Despite the intuitive perception — that non-democratic policies impede participation, — Connelly[29] concluded that engaging even under unfavourable political conditions (within the "hostile state" framework) is possible by using implicit opportunities. In Russia, participation opportunities are usually represented in urban environment improvement as it is the most accessible dialogue field for citizens and the authorities.[30] In this study, we claim that heritage planning in Russia should also include several sorts of publicity and participation.

METHODOLOGY & DATA

This study is based on interviews with participants of Rybinsk urban development projects. We have verified the data by field observations, analysis of media publications, as well as an overview analysis of cultural heritage sites.[31]

For research purposes, we held 10 interviews with 15 people (table 1). The participants were (a) local officials from the Department of Urban Planning and the Department of Tourism, (b) an activist — author of the project, (c) visiting consultants, (d) federal corporation experts, (e) members of local communities and organisations.

Interview (№)	Role	Number of interviewees	Date
1	Local officials from two Departments	3	January, 2023
2	Activist, the author of the "Museum of Living Old-fashioned Signboard in the Open Air"[32]	1	March, 2023
3	Federal corporation experts	2	April, 2023
4	Public engagement consultant	1	October, 2023
5	Architect of urban project bureau	1	October, 2023
6	Chairperson of the Rybinsk Historical and Cultural Society	1	October, 2023
7	Member of the tour guide community	1	October, 2023
8	Activist of Rybinsk cycling community	1	October, 2023
9	Deputy Editor-in-chief of "Rybinskie Izvestia" newspaper	1	October, 2023
10	Active members of the All-Russian Society for the Protection of Cultural Monuments and Heritage, Rybinsk branch (VOOPIiK)	3	June, 2024

Table 1. Information about the interviews

HERITAGE PLANNING: EVIDENCE FROM RYBINSK

Introduction to Russian heritage planning

In Russia, work with cultural heritage objects is carried out within the framework of Federal Law №73.[33] According to this statutory act, a cultural heritage object is defined as a physical something which has been officially assigned the status of a cultural heritage object.

The status of a cultural heritage object is determined by its kind, type and level of significance, which specifies its governance and regulates restoration and other types of work with the heritage object. Regarding the kind or form of volume-spatial expression, cultural heritage objects can be divided into monuments, architectural ensembles, and places of interest. Based on the type, or functional variety, objects are diverse: archaeological, historical, monumental art, architecture and urban planning, garden and park art, landscape design. In addition, there are four levels of significance, or categories of protection, of these objects: UNESCO-listed, federal significance, regional significance, and local significance.

An important aspect of heritage planning is the funding mechanisms for working with cultural heritage objects. In Russia, the significance of a cultural heritage is determined by the organisation responsible for implementing measures to maintain and preserve the object. For example, federal significance means that the object is protected by the state (federal authorities). The restoration of cultural heritage objects can be achieved through government programs at various levels of

significance. Traditionally, work with cultural heritage objects takes place within the framework of the national project "Culture".[34] In addition to government funding, private social and charity organisations, such as Timchenko Foundation[35] and Potanin Foundation,[36] also contribute to the restoration of cultural heritage objects.

To summarise the description of the heritage planning and governance system in Russia, we can highlight the following points. Firstly, the governance of an object of cultural heritage significance and the nature of work with it are determined by its official status. Secondly, federal law regulates the physical form of cultural heritage as a specific object or set of objects but does not include issues of identity. Thirdly, the funding mechanisms related to cultural heritage objects present a lack of self-sufficiency of municipalities in this matter.

Rybinsk context

The Rybinsk case stands out amid the general Russian practice because of its unique approach to the preservation and promotion of cultural heritage. The goal of the current project is to recreate the pre-revolutionary historical appearance of the city centre. To achieve that, in Rybinsk special attention is paid not only to the physical appearance of buildings but also to the identity of the city.

We overviewed the context of cultural heritage objects in Rybinsk through some facts. There are 99 cultural heritage objects in Rybinsk, including 16 of federal, 63 of regional, and 21 of local significance. According to the kind of cultural heritage objects, they diverge: there are 18 ensembles and 81 monuments. It is worth mentioning that 82 of the 99 cultural heritage objects represent the heritage of the pre-revolutionary period. This fact explains the choice of working with cultural heritage through recreating pre-revolutionary period identity.

For shaping the city's identity and projects implementation the local administration uses various combinations of resources. The municipality receives budgetary funding in the form of federal and regional subsidies to employ urban projects. It is important to note that the work on heritage is carried out not only within the framework of the national project "Culture", but also as a part of other national projects. Reconstruction of the historical environment in the city centre is being accomplished primarily through subsidies of the federal project "Creating Comfortable Urban Environment".[37] Municipal officials also use non-governmental sources of funding. For example, local entrepreneurs co-finance the replacement of signboards in the city centre with the pre-revolutionary-style ones.

The chronology of key urban projects and stakeholders' actions should be explained since they form the basis of a complex approach to development in Rybinsk. As told by members of the VOOPIiK community,[38] the process of changes began with the MArchI[39] research group visiting Rybinsk. Together with VOOPIiK, they came up with an idea to recreate the pre-revolutionary merchant appearance. Simultaneously, in 2016, the activist conducted research on the historical outlook of Rybinsk and as a result, he presented the idea of adding authentic signboards to the city streets to the municipal officials. That coincided with the city administration thinking about renovating the main city square — they accepted the idea and tested it at the Rybinsk Red Square in 2017 (Figure 1).

Figure 1. Red Square.[40]

The next year the activist was working on the design code for the signboards and facades (Figure 2). When the first signboards were made, the city administration held negotiations with entrepreneurs to convince them that changing signboards to old-fashioned ones is profitable for them as it attracts more attention and tourists to the city.

Figure 2. Implemented design code

In 2019, more projects of city transformation were implemented and a complex improvement of urban space was achieved by building facades and replacing modern signboards with stylised ones (Figure 3). In 2020-2021, well-known brands agreed to change their outer signboards, and the project went viral. Rybinsk brand was finally formed in this period, and the COVID-19 pandemic served as an advantageous factor for domestic tourism development.

Figure 3. Pre-revolutionary-style signboards examples

Historical reconstruction of the central streets started active Rybinsk development: the city was transformed with the help of both external and local projects. As for federal projects, in 2022 Rybinsk was included in the master plan of the "Great Golden Ring"[41] — a spatial strategy for the development of a macro-regional tourist zone (Interview 3). In 2022-2023 Rybinsk won a prize in a contest for small towns and historical settlements[42] for renovation of its Boulevard street. In 2024, new projects of complex environment improvements are in progress, and the work with cultural tangible and intangible (merchant outlook) heritage continues — the restoration of 60 facades of historical buildings is planned.[43]

Rybinsk "living" signboards

Launched in 2020, the Rybinsk "Museum of Living Old-fashioned Signboard in the Open Air" still attracts people from other regions of Russia. Brand new signboards continue to shape the city's news agenda.[44]

According to the interviews, the objective to increase tourist flow and attract attention to the city was set initially (Interview 1, 2, 10). The notion of revitalising the centre and imbuing it with the authentic pre-revolutionary ambience was in the air. The merchant heritage of Rybinsk is a significant cultural value, widely recognised and appreciated by the interviewees.

The local officials deem it was the unified collective vision of the aim and the desired result that contributed to the positive effect on the urban economy (Interview 1). The activist (as the main author of the idea) and the local government (as an intermediary) participated in the idea implementation. Through lengthy discussions and conflict resolution, business and real estate stakeholders have also gained a better understanding of the project goal. To achieve it, the Department of Urban Planning developed regulations on information construction in the "special control zone"[45] based on the activist's artistic requirements.

On the one hand, the aim of the local government, the activist and VOOPIiK is essentially the same: urban development through the representation of heritage authenticity to tourists.

On the other hand, the motives of the participants diverge. For the activist, creative self-actualisation was of paramount importance. The media promotion of the project resulted in him being invited to make signboards in other cities (Interview 2). For VOOPIiK, the museum project is rather a "feature" of the city, but not a genuine "preservation of the general historical environment" (Interview 10). The organisation is concerned about the increasing tendency towards the demolition of historical landmarks. Members of VOOPIiK promote repurposing of historical structures and look for tenants to preserve the buildings.[46] The motivation of the local government is more pragmatic: they were seeking ways to attract funding.

Where is the consensus?

The experience of an independent urban project implementation was reflected in the book "The Heart of the City" published by local officials. The objective of this work was to establish "a consensus on the cultural code of Rybinsk" (Interview 1). This incident can be described as reinventing the cultural potential of the city by municipal actors. The significance of public assent and involvement was likewise underscored.

In 2022, the Cheremukha River embankment improvement became the first site for participatory planning. Following the requirements for federal subsidy applicants, an engagement process was established in the project. The participants were citizens, local communities, and visiting experts. The role of VOOPIiK remained as it continued to oversee the project's compliance with its vision for the preservation of the historical environment. A distinctive characteristic of the Rybinsk experience was the integration of heritage planning issues into the urban policy agenda.

The interview findings show that consensus is elusive even in a city acknowledging the value of its heritage. Discourse on future development led to the "confrontation of innovators and conservatives" (Interview 9). However, this is an arbitrary categorisation that lacks substantiation. While the city authorities believe that VOOPIiK adheres to conservative ideas preventing the city from extra income, VOOPIiK, likewise, perceives the authoritative vision of growth (through demolition and new construction) as outdated and unprofitable.

Consequently, in Rybinsk, challenges of progress rested on the issues of heritage development. The embankment improvement project became a subject of heated debates. On the one hand, visiting experts proposed a novel and modern use of space. On the other hand, VOOPIiK advocated for the application of traditional methods to contemporary purposes. Thus, VOOPIiK suggested employing an obsolete Russian system of measurements (e.g. arshin, sazhen) in the design. As the engagement expert noted, the initial plan was heavily revised to accommodate the concerns of some stakeholders (Interview 4).

The perspectives of citizens and communities were elicited through a variety of methods including surveys, public discussion sessions, and private conversations, to devise scenarios for the use of the site. According to the interviews, the demand for a say in the matter caused a favourable response (Interviews 7, 8). This allowed the authorities to discern the "diversity of ideas about the city among the residents" (Interview 1).

We identified that the consensus is in fact unstable. Despite the agreement between the authorities, the inclusion of a broader range of participants forces them to find a new common point. Local communities amplify the voices of citizens who have demonstrated a keen interest in heritage planning. Primarily, the local government is interested in being introduced to the federal agenda. While federal experts contemplated including Rybinsk in their initiatives, this proposal was not put into action. Furthermore, the government envisions actively courting investors for the city, and this perspective is not universally shared among all stakeholders.

CONCLUSION

In this study, we came to understand the local policy of Rybinsk, where material and symbolic heritage are harmoniously combined. While the work with urban heritage in Russia is still focused on physical objects, Rybinsk aims at forming identity. Its stylised signboards aren't proper material heritage but constitute intangible urban heritage through the resurrection of the pre-revolutionary city centre image and atmosphere. The signboards project became a driving force for further transformations and brought heritage issues to the forefront of the urban planning agenda.

The work with heritage in Rybinsk is local, particularly within the context of the Cheremukha River embankment improvement project, which has seen the application of participatory planning tools. The expansion of engagement in urban projects highlighted consensus deficiency and generated new directions for dialogue. In the Rybinsk case, we observe the switch of the focus from space to people: the way locals modify and develop the urban area.[47]

NOTES

[1] Centre — metropolitan cities.
[2] Periphery — Russian non-central regions.
[3] Rybinsk — a city in the Yaroslavl Region in the central part of the Russian Federation. The population of the city in 2024 is about 179,000 people.
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[14] Yang Liu, Xin Jin, and Karine Dupre. "Engaging Stakeholders in Contested Urban Heritage Planning and Management." Cities 122 (2022): 103521.
[15] For example, Llorenç Prats. "Concepto y Gestión del Patrimonio Local." Cuadernos de antropología social 21 (2005): 17-35.
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[32] “Museum of Living Old-fashioned Signboard in the Open Air” — the central streets of the city have been reconstructed in a historical pre-revolutionary style.
[33] Federal Law №73 “On Cultural Heritage (Monuments of History and Culture) of Peoples of the Russian Federation”. It was adopted by the State Duma (the highest legislative institution) on May 24, 2002. Establishes the competencies of authorities and financing, requirements for protection, approves the register of heritage objects, and regulates property rights.
[34] National project “Culture” — a national-scale project setting key performance indicators (KPI) and targeted funding for the execution of objectives in the realm of culture.
[35] The Timchenko Foundation — a charity organisation implementing social strategic programs. In particular, it is engaged in the development of small territories through socio-cultural projects.
[36] The Potanin Foundation is a non-profit organisation that has been providing grants for large-scale projects in the fields of culture, education, sports, and charity in Russia since 1999.
[37] Federal project "Creating Comfortable Urban Environment" — a federal-scale project formed to achieve certain key performance indicators (KPI) outlined in the national project "Housing and Urban Environment".
[38] VOOPIiK — Vserossiyskoye Obshchestvo Okhrany Pamyatnikov Istorii i Kul’tury (All-Russian Society for the Protection of Historical and Cultural Monuments).
[39] MArchI — Moscow Architectural Institute
[40] The photo was taken from a news source: https://rybinsk.ru/news-2018/13950-krasnaja-ploschad-rybinska-priznana-luchshim-proektom-po-blagoustrojstvu.
[41] “Great Golden Ring” — the project of tourist macro-territories was launched in 2022 as part of efforts to develop tourism and promote interregional cooperation among 9 participating regions, including the Yaroslavl Region.
[42] Federal contest "Small Towns and Historical Settlements" — contest within the framework of the Federal project "Creating a Comfortable Urban Environment" permitting small settlements to receive additional funding for their growth.
[43] The information is sourced from a news resource “Komsomolskaya Pravda” from 2023:

https://www.yar.kp.ru/online/news/5533032/?ysclid=m09t8188v1278537119

[44] The information is sourced from a news resource “Rybinskie Izvestia” from 2024: https://gazeta-rybinsk.ru/2024/07/17/136278

[45] Per the amendments to the Urban Planning Regulations of Rybinsk (2018), the territory of the city was zoned into three categories: special information control zone, strict information control zone and general information control zone.

[46] It should be noted that this work is achieving success: for instance, the photographer Sigson’s house was spared from demolition following the establishment of a museum within its walls.

[47] Acknowledgements: We want to thank all of the people who helped us to accomplish this research. Surprisingly, not a single person denied helping us — we are truly grateful to all our interviewees for insights on the case. We especially want to thank our editor Sophia Kuchina for proof-reading our work, for her valuable comments and for careful editing.

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3-DIMENSIONAL GEOSPATIAL ANALYSIS AND VISUALIZATION FOR URBAN ENVIRONMENTAL ASSESSMENTS: A CASE STUDY OF A NEIGHBORHOOD LOCATED IN THE BRUSSELS CAPITAL REGION

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INTRODUCTION

Urbanization presents opportunities and challenges, particularly in the context of achieving the Sustainable Development Goals (SDGs).[1] Ensuring that cities are inclusive, safe, resilient, and sustainable[2] requires framing innovative urban planning processes. This paper presents an interactive and participatory3-Dimensional geospatial analysis and visualization framework, for the development of urban environmental assessments. The framework allows for the evaluation of environmental impacts linked to land use and reallocation strategies, to streamline urban planning scenario testing informed by environmental considerations. A case study is presented for a neighborhood in the Brussels Capital Region (BCR), where environmental indicators are integrated on a 3-Dimensional, parcel-by-parcel basis. These indicators encompass representations of the built environment, green spaces, soil, and geology, providing essential support to experts and developers in the decision-making process.

Environmental assessments are necessary for identifying potential environmental impacts that are a priority for consideration in urban decision-making processes.[3] These assessments play a vital role in contributing to the development of sustainable urban proposals.[4] However, the understanding and adoption of urban environmental assessments remains a significant challenge for many stakeholders. To tackle these challenges, this research proposes revisiting and refining the interfaces used for the analysis and evaluation of urban environmental assessments, with the aim of enhancing their accessibility to a broader audience. A particular emphasis will be placed on the parcel scale, given its importance in urban policy-making, along with a focus on both subsurface and aboveground urban assets. This approach aims to address the multifaceted nature of urban environmental systems more effectively.

Public Participatory Urban Planning Processes

In recent years public participatory processes have gained increasing recognition as pivotal in planning processes due to their ability to democratize decision-making and improve project outcomes.[5] Public participatory methods can also enhance public understanding of environmental

challenges by providing platforms for education and dialogue,[6] bridging the gap between environmental and social aspects for a more sustainable and socially equitable urban development[7]. Participatory methods can not only foster environmental stewardship but also promote a sense of ownership among community members, which is crucial for the long-term success of environmental urban planning initiatives.[8] Participatory approaches enhance engagement and collaboration, leading to more sustainable and inclusive planning outcomes.[9]

Interactive Planning Support Systems (PSS)

Interactive Planning Support Systems (PSS) have become increasingly important in achieving the objectives of modern urban planning, particularly in fostering collaborative environments and facilitating informed decision-making. For instance, a study by McEvoy et al.[10] demonstrates how PSS tools, particularly in collaborative urban adaptation workshops, contribute to participant learning and better planning outcomes, albeit their impact is often more indirect and process-dependent. Similarly, Vonk et al.[11] and Pettit et al.[12] highlight the role of PSS in integrating various data sources and models to facilitate scenario planning and stakeholder engagement, which are crucial for achieving sustainable urban development goals. PSSs are essential tools that enable the sharing of knowledge and establish robust feedback mechanisms among stakeholders, ensuring that all voices are considered in the planning process.[13] Recent studies demonstrate that PSS significantly improve stakeholder engagement by providing accessible platforms for data visualization and scenario modeling, which help participants better understand potential outcomes.[14]

Moreover, through workshops and collaborative sessions, PSS can allow for in-depth analyses of results, enriching the overall quality of decision-making, and incorporating diverse perspectives and expert opinions into the planning framework. The integration of new Information and Communication Technology (ICT) ICT into smart cities enhances spatial planning through collaborative governance PSSs, as demonstrated by case studies from China, Finland, and the USA, highlighting that effective communication and transparency in decision-making depend on advanced technology and suitable institutional frameworks.[15] Additionally, research by Flacke et al.[16] underlines the importance of integrating PSS workshops into planning stages, as they provide critical insights that can guide the development of more sustainable and equitable urban environments.

City Information Modeling (CIM) is a transformative tool in urban planning, offering a holistic approach that integrates BIM, GIS, and comprehensive urban data, essential for meeting current and future demands through participatory and interactive environmental assessments.[17] CIM uses advanced 3D modeling to create comprehensive and interactive representations of urban environments, making data accessible and engaging for a wide range of stakeholders.[18] Web-based Geographic Information Systems (WEB-GIS) enhance these capabilities, and multidimensional web-mapping platforms further improve citizen participation by enabling better assessment of the spatiotemporal evolution of cities.[19]

The 3D visualization of urban development plans and within CIM protocols has been deemed important for facilitating public participation within urban planning process, as it helps stakeholders better understand and contribute to the planning decisions.[20] This approach enhances transparency and allows both policymakers and citizens to visualize and understand real-time urban dynamics, leading to more informed decisions and greater community involvement in shaping city development.[21]

Despite advancements in participatory methods and Interactive PSS, significant research gaps persist in their integration with environmental assessments. Key areas requiring further exploration include the development of 3D visualizations that encompass both above-ground and underground elements to enhance stakeholder engagement through comprehensive urban representations. There is also a need for studies on optimizing participatory processes to ensure effective stakeholder input in

completing environmental data. Furthermore, the integration of participatory methods with environmental assessments, particularly in addressing both environmental and social factors, remains underexplored. Similarly, research on the application of interactive 3D interfaces for detailed, parcel-by-parcel analysis in environmental assessments is lacking. Addressing these gaps could significantly improve participatory urban planning, leading to more sustainable and equitable urban development. The current study developed a framework for a 3D WebGIS application that aims to improve participatory urban planning related to environmental assessments, leveraging 3D GIS capabilities throughout all stages of the process.

METHODOLOGY

The general framework

Data Collection and Preparation

A diverse set of data was compiled and formatted including: GIS cadaster data, soil data, 2D geographical information, 3D models, and LiDAR data. Additionally, Digital Elevation Models (DEMs) and geological data were collected to gain a comprehensive understanding of terrain features (e.g. Table 1).

Data Standardization and Integration

Following the data collection, the next step involved the standardization and compatibility assessment of the various datasets.

Spatial Analysis and Visualization

Once the data was prepared and standardized, we proceeded with the spatial analysis and visualization using GIS desktop software. This phase involved converting the data into 3-Dimensional.

User Interface Design

The final stage focused on designing an interactive user interface with the goal to create a seamless CIM experience into a unified 3-Dimensional WebGIS environment. Moreover, the data interpretation was enhanced by visualizing 3-Dimensional data through dashboards. To empower users further, interactive data download and customization features were included, facilitating tailored analyses and informed decision-making.

Case study: Brussels Capital Region (PAD Hyvaert neighbohood)

The case study focused in the PAD Heyvaert neighborhood outlined in the located South west of the Brussels Capital Region (BCR) (Figure 1). The Heyvaert district has evolved into an international hub for automobile-related businesses, since the late 1970s, replacing earlier slaughtering and butchering trades. The district now houses around 60 businesses over 60,000 m². However, this economic activity has led to significant environmental challenges, including pollution, poor housing conditions, limited green spaces, and mobility issues, negatively impacting the quality of life; initiatives aimed at renewing economic activity and creating collective, convivial spaces in the Heyvaert district are crucial for preserving its vitality.[22] Bossard et al.[23] explain that the transformation of this former industrial area into a mixed-use neighborhood aligns with city goals like reducing urban sprawl, improving quality of life, and enhancing resilience; the district's challenges, including soil contamination, private land ownership, heritage building protection, and densification, create an ideal setting to study the impacts of urban soil transformation.

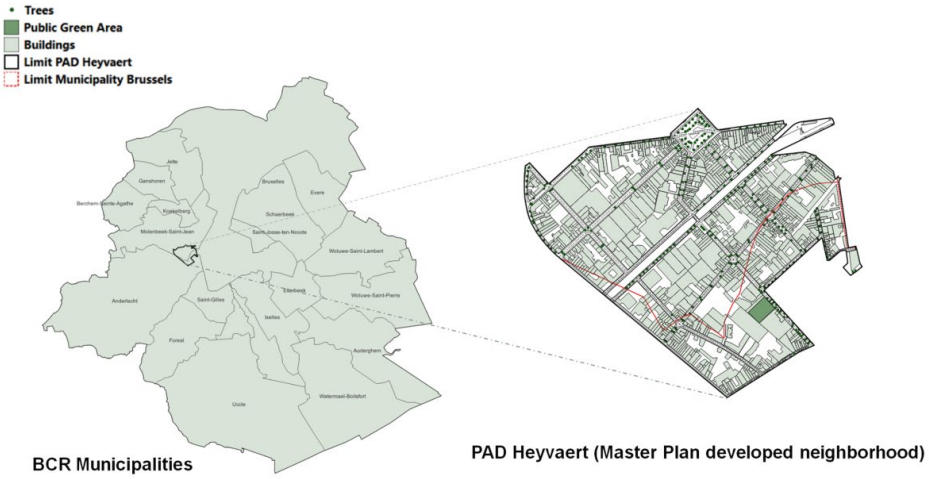

Figure 1. Case study: Brussels Capital Region (PAD Hyvaert)

The Data sources

The data used to build up the Geodatabase combined different data sources: i) raster data such as DMT or tif to define each stratigraphic layer, ii) vector 2D data such as points and polygons, iii) vector 3D point cloud or multipatch data and iv) environmental data such as report or studies to compute new attributes (Figure 2, Table 1). For each type of data different procedures were performed to create the Geodatabase as shown in Figure 2.

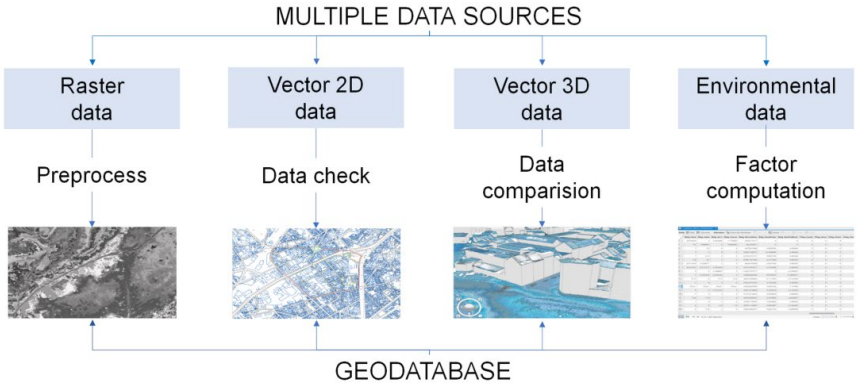

Figure 2.The data sources

Data type	Dataset title	Data source	Year Adquisition	Format
Geological stratigraphic rasters (height)	uhrbc1_quaternaire	Brussels Enviroment	2020	TIF
Geological stratigraphic rasters (depth)	uhrbc1_quaternaire_epa	Brussels Enviroment	2020	TIF
Digital terrainmodel (res.10m)	Topo_lidar_srtm801_ajust	Brussels Enviroment	2021	TIF
Digital terrainmodel (res.1m)	UrbDTM_2021_147170	UrbIS	2015	TIF
Statistical sector boundaries	UrbAdm_STATISTICAL_DISTRICT	UrbIS	2015	SHP
Municipality boundaries	UrbAdm_MUNICIPALITY	UrbIS	2015	SHP
Region boundary	UrbAdm_REGION	UrbIS	2015	SHP
Block boundaries	UrbAdm_BLOCK	UrbIS	2015	SHP
Sidewalk boundaries	UrbAdm_SIDE_WALK	UrbIS	2015	SHP
Street axis	UrbAdm_STREET_AXIS	UrbIS	2015	SHP
Street boundaries	UrbAdm_STREET_SIDE	UrbIS	2015	SHP
Bridge footprint	UrbAdm_BRIDGE	UrbIS	2016	SHP
Building footprint	UrbAdm_BUILDING	UrbIS	2017	SHP
Land data use	Pras_Affectations_2018	Perspective Brussels	2018	SHP
Block boundaries and data	Bpn_CaBl	Cadastre | SPF Finances	2023	SHP
Parcel boundaries and data	Bpn_CaPa	Cadastre | SPF Finances	2024	SHP
Building footprint and data	Bpn_ReBu	Cadastre | SPF Finances	2025	SHP
Building Type	typo_batiCanalDROIT_OK_20190528	Barbara Lefort	2019	SHP
Tree point mantained by B.Enviroment	tree	Brussels Environment	2020	SHP
Tree point mantained by B.Mobility	trees	Brussels Mobility	2022	SHP
Tree point mantained by Communes	UrbTop_BG0101P	UrbIS	2015	SHP
Vegetation boundaries	vegetation_2020	Brussels Enviroment	2020	SHP
Vegetation canopy boundaries	vegetation_2020_canopy	Brussels Enviroment	2020	SHP
Public green areas boundaries	public_green_area	Brussels Enviroment	2021	SHP
Green projects boundaries	green_projects	Brussels Mobility	2022	SHP

3D beta version model	CTU_URB_A_3D_147170	UrbIS	2020	SKP
3D ground model	UrbAdm3D_146170_Bu_Ground	UrbIS	2020	SHP
3D outerceiling model	UrbAdm3D_146170_Bu_Outerceiling	UrbIS	2021	SHP
3D roof model	UrbAdm3D_146170_Bu_Roof	UrbIS	2022	SHP
3D solid building model	UrbAdm3D_146170_Bu_Solid	UrbIS	2023	SHP
3D wall model	UrbAdm3D_146170_Bu_Wall	UrbIS	2024	SHP
Point cloud data	UrbLiDAR2021_147170	UrbIS	2021	LAS

Table 16. Data types and data sources

Processing the data

GIS software was used for data manipulation, database preparation, and visualization including 3D representations. The data were imported into ArcGIS Software and formatted to guarantee compatibility. After the relative transformations, the spatial analysis, and geoprocessing of the data, the final database 3D Cit-is Database was generated. This database was used for the publication in the 3D Web GIS interface, to guarantee full operability to visualize and interact with 3D urban data.

A critical stage in theproject involved defining the attribute table, which is essential for extracting detailed information from various spatial datasets, including underground layers, buildings, and roofs. Each dataset—such as those for soil, streets, buildings, and greenery—is paired with an attribute table that provides geometry details and associated environmental factors (Figure 3).

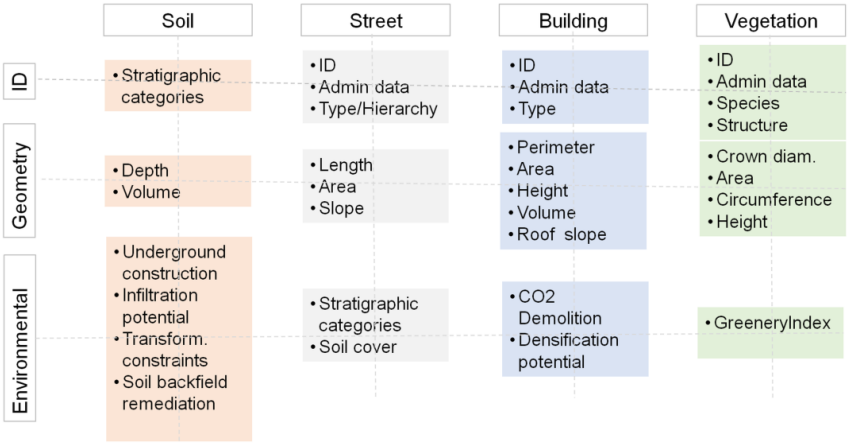

Figure 3. The attribute table

The result: The *Beta 3D Cit-is WebApp*

ArcGIS Online provides the capabilities for creating interactive 3D maps that enable users to navigate within a web browser. This interactivity aims to increase user engagement to deepen their comprehension of geographic information.

The Scene Viewer suitable for 3D visualization, was chosen as the platform for constructing the 3D Cit-is WebApp. All data have been integrated into the scene interface as layers and have undergone adjustments for the visualization including layer style changes (colors and symbology, as well as properties like attribute appearance, transparency, etc).

The WebApp was constructed using the ArcGIS API 4. for JavaScript. This platform offers a range of interactive map options. The chosen template for this purpose was the monitor template, which includes dashboard properties.
Using the monitor dashboard layout, we assembled a combination of widgets that help organize, track, and display data visualizations. This resulted in WebApp - Dashboard.
The WebApp – Dashboard consists of two pages:

A. The WebApp

The first page provides the Model visualization and the information about its components (Figure 4); by clicking any object (e.g. buildings, trees, subsoil layers, street/sidewalk segments) within the 3D view, the information relative to their geometrical and descriptive characteristics appears as a pop up.
The 3D Toolbox widget[24] adds 3D effects and analysis tools to the scene. For example, it provides the option of the daylight and shadow cast in any location.
The Daylight tool employs simulated real-world sunlight and shadows to illuminate the scene, thereby providing a daylight simulation based on the user's specified date and time.
The Shadow Cast generates shadows from 3D input features by sunlight for the selected date and time, providing a mode for analysing shadows (e.g. calculating the amount of time that a given location is in shadow).
Clicking on the button named PARCELS, the data associated with each parcel can be visualized. This button will open a WebApp - Dashboard showing the parcel level statistics.

Figure 4. TheBeta 3D Cit-is WebApp

B. The WebApp - Dashboard

The second page provides the Model visualization and the summarized information for each parcel. In other words, it is a dashboard showing the parcel level statistics. In this case, another scene of the 3D model has been added, where only the parcels are activated to trigger the pop-up layer; clicking on a parcel, which appears as an extruded polygon (it has extruded from the bottom of the model towards a top of 120m above the surface), all its attribute table information pops up (Figure 5).
The layout of the scene is finalized by incorporating text, images, and interactive diagrams/charts, thereby enhancing the Model's interactivity; each kind of information appears in either a textual or diagrammatic way (Figure 5).
To the left of the dashboard, the parcel ID references, surface and perimeter values, soil, building, and vegetation information are included in the form of graphical tabular data. At the bottom of the

dashboard, the sealed and unsealed soil, and the built cover percentages are displayed for the parcel and block levels as pie charts. The index following the soil classification is displayed as a bar plot differentiating their Infiltration potential, and transformation potential. Also as bar plots, the densification potential computed as the *sqrt (building volume)/sqrt(plot area)*, and the greenery index computed as the *vegetation area/the parcel area*, are included for the parcel and block levels. Finally, for the parcel level, the max building, façade and vegetation heights are displayed.

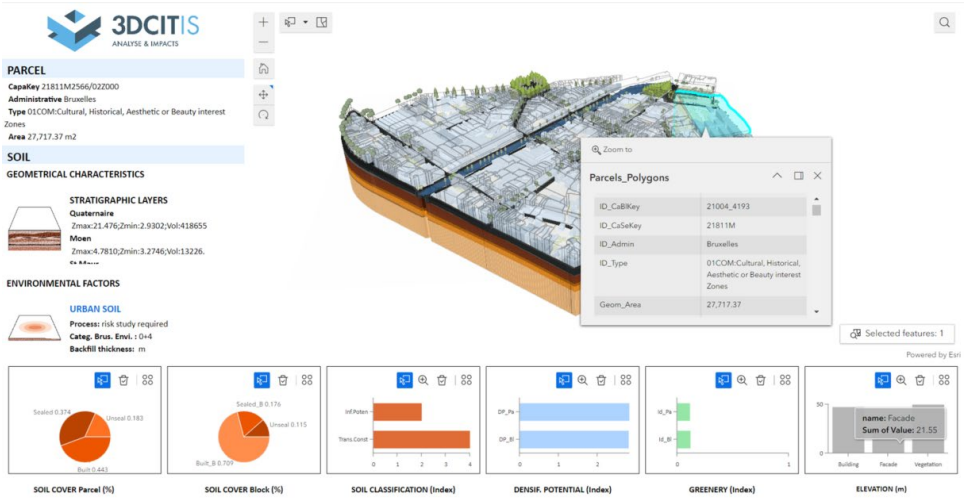

Figure 5. 3D Cit-is WebApp - Dashboard, second page

CONCLUSION

The presented approach of aggregating parcel- and block-level data has demonstrated significant effectiveness in addressing key project implementation priorities and parcel consolidation strategies. By facilitating comprehensive access to information, from subsurface layers to rooftop details, decision-making processes for urban stakeholders are enhanced. This is particularly impactful in areas such as water management, where a thorough understanding of subsurface conditions is critical, and in urban green infrastructure planning, where the integration of built and natural environments is essential.

Furthermore, the capabilities of our proposed interactive application for data download and visualization have shown considerable potential in enhancing participant engagement. This tool not only fosters a deeper understanding of environmental and socio-economic impacts but also empowers stakeholders by providing them with the means to explore and analyze urban environments in a more informed and participatory manner. Looking ahead, future studies will focus on further enhancing the interactivity and user-friendliness of the model, ensuring that it adapts to the evolving needs of stakeholders and urban planners. Additionally, we plan to expand the model's applicability to other densely populated urban areas, potentially integrating more complex environmental and socio-economic indicators.

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SAN BLAS SOSTENIBLE: DESIGN STRATEGIES AND CO-CREATIONAL EXPERIENCES BETWEEN DESIGNERS AND COMMUNITY ACTORS IN ANCESTRAL NEIGHBORHOODS

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INTRODUCTION

This paper presents the experiences and strategies carried out by a team of design professors within a design course focused on a co-creational approach with various stakeholders involved in a neighborhood that is part of a UNESCO World Heritage site.[1] Over two academic periods, design students and faculty members interacted and collaborated with citizens, private entities, and government and civil authorities in the San Blas neighborhood of Cusco, Peru, intending to improve specific areas of the neighborhood. These improvements ranged from mobility through its steep streets and public waste management to enhancing the value of San Blas's identity, history, heritage, and cultural landmarks. Various design approaches were employed to achieve this goal while conceptualizing a project called "San Blas Vivo." These approaches and concepts were developed through co-creational activities integrated with methodologies and principles based on product, service, and system design. Critical aspects such as legal considerations related to a UNESCO World Heritage site, relationships between iconic neighborhood families and locals, the overall impact of tourism, and the opportunities and challenges of a local/global design perspective were considered. The resulting proposals and prototypes addressing specific areas integrate critical aspects into products, services, and systems that are viable, feasible, desirable, and sustainable within the context.

BACKGROUND

The courses Proyecto Avanzado de Diseño 1 and 2 (Advance Design Project 1 and 2) are taught over one academic year at the Pontificia Universidad Católica del Perú (PUCP) as part of the Industrial Design program. During these courses, final-year students participate in a project that integrates the knowledge acquired throughout the Industrial Design program, concluding in designing products, services, and systems for real-life implementation. From an empiric iterative and constructivist perspective, this pedagogical approach represents good practice in teaching and applying systemic design: It encompasses meaningful learning experiences through a real-world case while promoting social engagement and the responsibility of future professionals toward their surroundings.[2] The understanding of systems as a group of interrelated elements with specific objectives, as proposed by

Drew et al. for "human systems," is aligned with the objective for students to develop capabilities oriented towards integrating solutions that improve existing systems, transform them, reorient them, or, if necessary, create new ones.[3] Previous editions of the courses developed proposals for contexts such as Barrio Leticia in 2022 and the San Bartolo District between 2020 and 2021. In 2023, the San Blas neighborhood in Cusco, Peru, was the chosen context for the project.

The Historic Center of Cusco (as illustrated in Figure 1), particularly the San Blas neighborhood, has been the subject of various research and development projects over the past few decades, focusing on the preservation of Cusco's cultural and natural heritage, urban environment improvements, and the promotion of sustainable economic activities.[4] Nevertheless, the various social, political, cultural, and economic changes of the past two decades, including the pandemic experienced four years ago, have brought challenges that impact its residents' and visitors' quality of life.[5] Recently, foreigners have been part of the neighborhood community, and daily activities influencing economic activities in San Blas are related to tourism.[6]

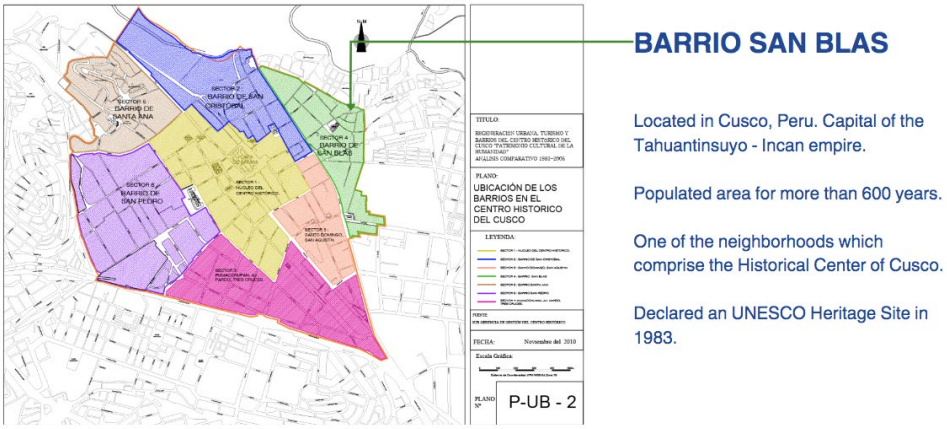

Figure 1. "Map of the San Blas neighborhood". Final presentation of the San Blas Vivo project by PAD 1 students based on the information from Gerencia del Centro Histórico - Cusco 2018.

As a response, the Provincial Municipality of Cusco developed and implemented the "Master Plan for the Historic Center of Cusco 2018-2028",[7] establishing clear guidelines for heritage protection and sustainable development in critical areas such as San Blas. However, the pandemic significantly affected its completion to the detriment of its development and implementation process.

Challenges and opportunities between academia and San Blas

Academia plays a crucial role in exploring innovative solutions to societal and contextual challenges present in San Blas. Through research theses, institutions such as the National University of San Antonio Abad del Cusco have analyzed the changes in the neighborhood's cultural traditions due to the arrival of foreign citizens from various nationalities as new neighbors. Similarly, research theses and studies propose multiple solutions for the latest economic environments that arise primarily from tourism.[8]

"San Blas Vivo," a novel approach from Industrial Design at PUCP, is a project aligned with PUCP's University Social Responsibility focus.[9] It represents a vital commitment to the university's holistic and humanistic educational approach and positive societal impact. "San Blas Vivo" links academia with social innovation, sensitizing students to the importance of a social approach through direct collaboration with the local community.

Social and spatial contexts of San Blas Vivo

Months before beginning PAD 1, the San Blas Lodging Companies Association (AEHO) president contacted PUCP to propose the project. Initial interactions were conducted virtually due to geographical constraints, focused solely on mobilization in hopes of an economic reactivation after the pandemic. The interactions between AEHO's representatives and some San Blas residents and lodging owners unveiled a need for a sense of community and belonging. That situation drove a rethinking of the project's objectives while maintaining the need to develop a sustainable tourism potential while strengthening the sense of community identity by collaborating with local and tourism actors.

During both courses, the necessity of contacting and interacting with actors such as representatives of the San Blas Municipality, the Ministry of Culture in Cusco, and neighborhood residents arose. These included representatives of the neighborhood association, business owners, and long-standing San Blas residents who have lived in the neighborhood for over 30 years. Some of the latter group members are artisans with a historical trajectory that represents San Blas.

As previously mentioned, San Blas Vivo allowed practical applications of design education. Students actively participated in the co-creational process, working with the mentioned actors to understand and prioritize their needs and desires. Guided by PAD 1 and 2 professors, students developed empathic and positive recognition of contextual differences. Their active participation and contribution were instrumental in strengthening communal relationships, ensuring the dignity of all involved actors and the community's sustainable development. The 'San Blas Vivo' project thus reflects the synergy between education, social responsibility, and social design, promoting academic training alongside community service and enriching students' education while contributing to community well-being. As an outcome, students, alongside San Blas' stakeholders, prioritized mobility, waste management, and the neighborhood's cultural heritage valorization. These thematic areas were observed in situ thanks to trips organized within AEHO and PUCP involving students and professors to San Blas.

It's important to note that the priorities of the 'San Blas Vivo' project necessitated the integration of various complementary disciplinary approaches to design, such as the social sciences, urbanism, and management. Students took on the responsibility of addressing and implementing this integration, reaching out to specialists in these areas as the project unfolded.

Stakeholders and coloniality

During these in-person visits, interactions occurred in public and communal spaces, such as Casa de la Cultura. The power dynamics among San Blas residents began to manifest. Furthermore, the presence of PAD's students and professors as representatives of PUCP, an institution that not only belongs to academia but also hails from the capital, Lima, could activate perceptions that occasionally were obstacles to fluid interactions, as academia and the capital city are often associated with symbolic values of separate power.

The separation is not merely geographic: in Peru, approaching a community outside of Lima from an academic perspective established in the capital carries significant social, cultural, and political meanings rooted over centuries. Aníbal Quijano might refer to this condition as the 'coloniality of power',[10] a Eurocentric power structure that remains prevalent today, inherited from colonialism and present across various spheres, from the state to everyday relationships.

A significant area in reproducing this Eurocentric power pattern is the hegemony of Western knowledge, which is highly prevalent in Latin America, a concept referred to as' the coloniality of knowledge'.[11] This is evident when academia is considered an 'official' (and sometimes the only valid) source of knowledge. As a result, Western heritage displaces knowledge that originated in other

cultures because it does not align with scientific knowledge principles. The objection towards PUCP's presence arose from its academic origin and locality in Lima, the capital. Furthermore, the objection towards Limenian residents going to cities with different cultures within the country to solve a problem or contribute to a project represents another manifestation of the coloniality of power in Peru. In many cases in Peruvian history, there has not been a horizontal dialogue but rather an imposition of ideas from the capital. The problem of centralization in Peru is a clear manifestation of power dynamics, as many regional decisions come from Lima.[12]

Students embarked on active dialogues combined with horizontal relationships to overcome the above and create a bond of trust. Furthermore, an attitude of listening and learning prevented one from assuming a position of academic authority. There is a tradition of "not speaking to each other" in Peruvian society. As long as this tradition exists, Peruvians will never conceive themselves as a historical community in a city (or neighborhood) for diversity.[13] Thus, students organized dialogue meetings between different actors to discuss the project's themes. Moreover, in the meetings, the concerns and viewpoints on the impact of the neighborhood's social practices and relationships on San Blas's identity were also discussed. Thus, students and professors conducted an intercultural approach, whose principle is to build based on diversity and seek to incorporate and negotiate thoughts, practices, and values[14] for the project's proposals.

Gentrification

San Blas has a significant presence in tourism-related businesses such as hotels, restaurants, bars, and laundromats, whose services and messaging focus on foreign tourists. These material and visual manifestations, representing the new tourist residents of San Blas, have led to a new neighborhood configuration. The neighborhood's landscape fosters the production of meanings in which the inhabitants can see their identity challenged.[15]

The aforementioned is part of the phenomenon of gentrification, which involves the displacement of low-income residents who have lived in these spaces.[16] In the case of San Blas, certain groups of locals lacked the same opportunities to participate in the tourism market, so they were displaced.

The perception of the lost meaning of the identity of San Blas is a result of the discomfort of traditional residents who still live in the neighborhood. According to Tamayo and Wildner,[17] one of the components of identity is the sense of belonging, appropriating the space, and participating in it.

Another component is the permanence related to time in close connection with being in a place, which generates levels of rootedness. These components are strengthened in everyday life, which is organized and gives meaning. Gentrification had caused a rupture of the social fabric, hence the loss of identity in San Blas. Addressing said problem, alongside the project's themes, was desirable to the residents and represented a crucial part of the project's sustainability.

METHODOLOGY

As previously mentioned, participatory design and co-creational activities in close collaboration with the community were held during PAD 1 and PAD 2 courses. Methodologies and principles derived from product, service, and systemic design were applied to generate proposals focused on the mentioned priorities. The students constructed the resultant methodology and empowered them through stakeholder engagement, allowing them to lead the development of different proposals.

Co-creational approach with involved stakeholders

Contemporary approaches in design proposed a new way of thinking about design education. Authors such as Noel, Ruiz, Van Amstel, and others vouch for a new way to guide the teaching design process and to recognize design as a pluriversal practice with the capacity to be activist, democratic, and

dialogic while addressing interculturality and interdisciplinarity.[18] Furthermore, students, guided by the professor team, choose to follow a human-centered design approach. People are the fundamental reason for conceiving new solutions, including products, services, interactions, and organizations. To achieve this, it proposes that designers develop a comprehensive understanding of the needs, motivations, behaviors, and activities that shape human experiences. Finally, it frames the created solutions according to the criteria of desirability, feasibility, and viability.[19]

The Double Diamond model was the guiding methodology for the overall design processes. This model delineates two principal phases (diamonds) and four sub-phases (shown in Figure 2). The initial diamond represents the discovery and definition of the problem, while the subsequent diamond encompasses the development and delivery of solutions.[20] The methodology applied in the design and development of the solutions focused on technical-functional, aesthetic-emotional, and social-natural considerations, which align with the approach of the Industrial Design program at PUCP towards designing new solutions for the world. Throughout the processes mentioned above, the participation of the residents of San Blas was crucial for identifying the problem and opportunity areas and generating solution proposals.

Implementing the San Blas Vivo project demanded organizational and management considerations so the students could guide their experience firsthand. In managerial terms, the overall experience involved forty-five students and five trips to Cusco (groups of 3-5 students and 1-2 professors per trip (shown in Figure 2). To strengthen the bond between students and San Blas actors as the project progressed, during the last two visits, the same group of students repeated the visits to create consistency and trust with the stakeholders to generate proposals more effectively.

Thanks to that, community actors were not just convinced but were self-convinced and committed to collaborating with the students. Their support was unwavering, as they facilitated the articulation with other social actors and provided the necessary locations for students and professors to stay, prototype, and discuss its progress in San Blas (shown in Figure 3).

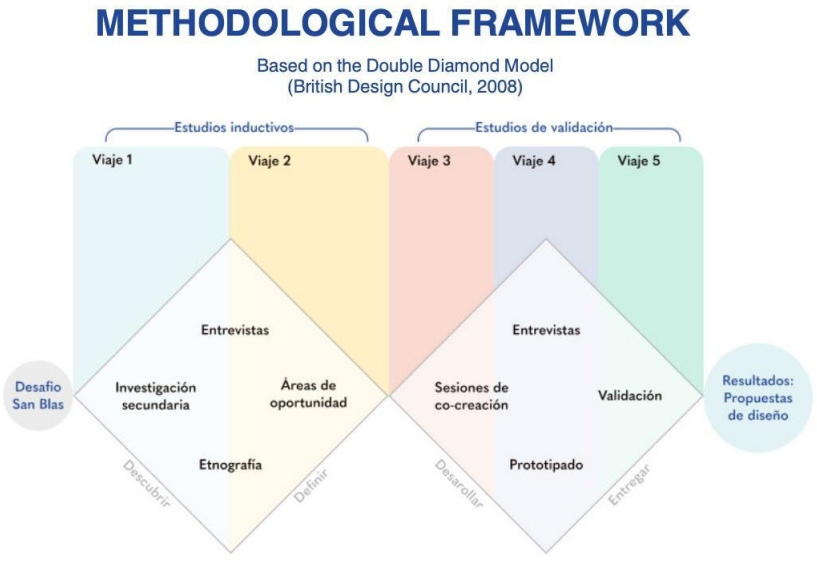

Figure 2. Methodological scheme used in the development of the San Blas Vivo project". Final presentation of the San Blas Vivo project by PAD students.

Figure 3. Student visits. Final presentation of the San Blas Vivo project by PAD students.

RESULTS

Throughout this teaching experience, significant accomplishments occurred in revitalizing San Blas and empowering design students as agents of change. Implementing a collaborative design methodology in San Blas has been crucial in creating an innovative academic project that fuses product, service, and systemic design. "San Blas Vivo" and its final iteration, "San Blas: Historias en Cada Paso," have become powerful visual representations of urban futures that harmonize cultural heritage with innovation.

During the project's development, different challenges arose: the lack of a detailed diagnosis of the problems and sub-problems, the need to coordinate with multiple stakeholders and a large number of students, the legal complexities associated with a UNESCO World Heritage site, the logistics and financial aspects, and geographical distance were among them. These logistical challenges demanded additional effort but strengthened our planning and resource management capabilities. From a conceptual standpoint, addressing the impact of tourism and the opportunities and challenges inherent in a local/global design perspective in conjunction with power dynamics unfolded as the project progressed. From the outset and in the context itself, skepticism and distrust originally appeared toward the proposals from Lima-based students for a historical setting in Cusco and the complex relationships between emblematic neighborhood families and locals.

Through a reflective and self-evaluative process, the importance of collaborative, empathetic, and flexible work and the need to maintain a listening attitude revert many of the mentioned challenges. The resultant experience was a significant milestone, obtaining valuable insights that will undoubtedly contribute to innovation in the university education field. The project resulted in proposals for improving urban infrastructure, mobility, historical revalorization, waste management, communication between citizens, authorities, and tourists, and promoting cultural identity in San Blas (shown in Figure 4). Students successfully translated the co-created ideas into tangible proposals through prototypes and an ebook titled "San Blas: Historias en Cada Paso" for the project's dissemination and communication. The students recognized the importance of contributing to preserving and revitalizing a historic area in the city of Cusco, fostering respect for cultural heritage.

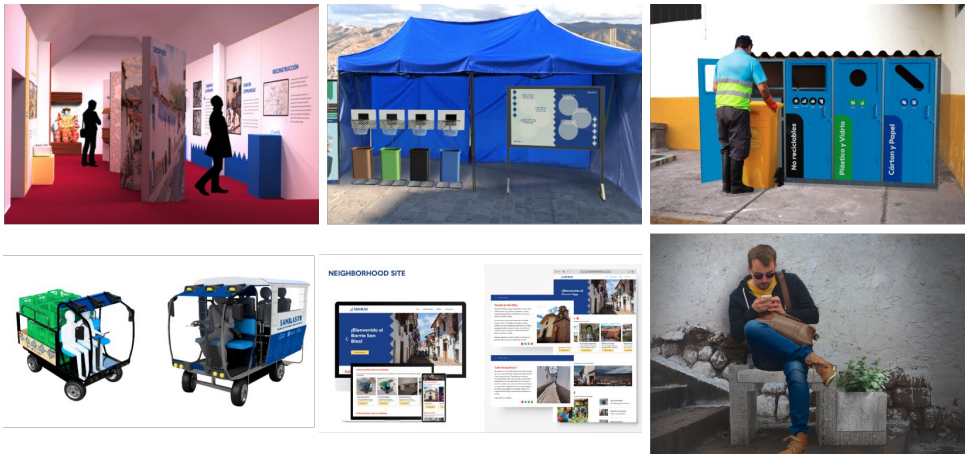

Figure 4. "Students' proposed solutions". Final presentation of the San Blas Vivo project by PAD students.

CONCLUSION

The methodology applied, which focused on autonomous and empowering learning and problem-solving developed during this teaching experience, has been redesigned based on the insights gained to better manage time through phases of uncertainty, exploration, conclusion, and definition, leading to the formulation and achievement of objectives. The resulting methodology is easily replicable in future course iterations or similar contexts.

The proposals and prototypes generated through this process are not just models but conversation starters for the community to improve their environment. The lessons learned can be shared with other educators and professionals interested in social and sustainable design, amplifying their impact.

ACKNOWLEDGMENTS

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NOTES

[1] UNESCO, “Qhapaq Ñan, Andean Road System,” UNESCO World Heritage Centre, accessed January 1, 2025, https://whc.unesco.org/en/list/1459; UNESCO, “City of Cuzco,” UNESCO World Heritage Centre, accessed January 1, 2025, https://whc.unesco.org/en/list/273. UNESCO recognizes in its ´World heritage list´ as a cultural property the city of Cusco in its entirety and the Qhapaq Ñan as the Inca road system, which impacts the neighborhood that we take as a case study.
[2] Luz Marina Hermoza Samanez, “La Evaluación Formativa-Colaborativa Para La Construcción Del Aprendizaje En Los Alumnos de Arte y Diseño.”
[3] Cat Drew, Cassie Robinson, and Jennie Winhall, “System-Shifting Design Report,” 24.
[4] Tatiana Adela Valencia Becerra, “Nuevas Relaciones, Viejas Tradiciones En San Blas: Impactos Del Turismo En Un Barrio Tradicional Del Cuzco”; Rodriguez Achata and Esquivel Bobadilla, “Cambio y Continuidad de La Tradición Cultural En El Barrio de San Blas, Cusco.”
[5] Kelly Verónica Barrios Paucarmayta, “Covid 19 y Reactivación Económica En Los Artesanos Del Barrio Tradicional de San Blas Cusco - 2021.”
[6] Daphne Atenea Velasco González and Mariela Rodríguez Rivera, “Caracterización de Un AIRBNB Con Denominación de SUPERHOST En El Barrio de San Blas - Centro Histórico Cusco 2022.”
[7] Gerencia del Centro Histórico del Cusco, “Actualización Del Plan Maestro Centro Histórico Del Cusco 2018-2028.”
[8] Liseth Fabiola Alcazar Rosales and Hussein Fabricio Vallenas Colpaert, “Planteamiento de Un Sistema de Movilidad Vehicular y Peatonal Sostenible En El Barrio de San Blas”; Valencia Becerra, “Nuevas Relaciones, Viejas Tradiciones En San Blas : Impactos Del Turismo En Un Barrio Tradicional Del Cuzco”; Ochoa Castillo, “La Actividad Turística y El Impacto Social En El Barrio Histórico de San Blas de La Ciudad Del Cusco, 2020”; Rozas Giraldo, “Estudio de La Actividad Turística En Tiempos de Covid 19 En El Barrio de San Blas de La Ciudad Del Cusco 2021.”
[9] Dirección Académica de Responsabilidad Social, “Manifiesto RSU Desde La PUCP.”
[10] Aníbal Quijano, “Colonialidad Del Poder, Eurocentrismo y América Latina.”
[11] Aníbal Quijano, “Colonialidad y Modernidad/Racionalidad”; Walter Mignolo, “Preamble: The Historical Foundation of Modernity/Coloniality and the Emergence of Decolonial Thinking.”
[12] Edgar Quispe-Mamani, Hernán Porto Bravo, and Joffre Omar Chaiña Flores, “Experiencia de Descentralización En Perú 1980-2023: Intentos Fallidos y Recentralización.”
[13] José Ignacio López Soria, “Ciudad e Interculturalidad.”
[14] Catherine Walsh, Álvaro García Linera and Walter Mignolo, *Interculturalidad. Descolonización Del Estado y Del Conocimiento*.
[15] Licia Torres, “Imaginando La Ciudad: Discursos Visuales Desde El Sector Inmobiliario En Lima, Perú”.
[16] Ruth Glass, “Aspects of Change”; Clark, “The Order and Simplicity of Gentrification: A Political Challenge”.
[17] SergioTamayo and Kathirn Wildner, “Espacios e Identidades,” 16–20.
[18] Lesley-Ann Noel, “Envisioning a Pluriversal Design Education”; Lesley-Ann Noel et al., “Pluriversal Futures for Design Education”; Lesley-Ann Noel, “Designing New Futures for Design Education.”
[19] IDEO.org, “The Field Guide to Human-Centered Design,” 14.
[20] Design Council, “The Double Diamond - Design Council.”

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CHALLENGES IN PARTICIPATORY DESIGN OF A NEW MANAGEMENT PLAN FOR TALLINN OLD TOWN

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INTRODUCTION

Like many historical city centers, Tallinn Old Town has been subject to touristification while losing its population density in the past decades. Internationally, this issue has been widely researched,[1] while in the context of Estonia, the first wide-scale research project was conducted in the Estonian Academy of Arts in 2019-2022.[2]

As researchers, we emphasized that the Old Town should be developed as part of the active city centre, not a separate tourist destination. The key issues were identified as supporting the preservation of local life and functional diversity: retaining living and working spaces, activities and services oriented towards local people, and the Old Town's overall quality as a living environment.[3]

In the following years, I had the opportunity to put the theory into practice by leading the working group in charge of drafting a new Management Plan for the conservation area of Tallinn Old Town.[4] This article describes and analyses the main issues that arose between different stakeholders during the participation process, and the controversies between my own initial intents and the outcome.

Figure 1. Aerial view of Tallinn Old Town. Source: Estonian Land Board.

DOES THE NEW MANAGEMENT PLAN CHANGE ANYTHING?

While drafting the new Management Plan for the conservation area, the goals of preserving local life and functional diversity were kept in mind, but at the same time, it was predetermined by the legal framework, what can and cannot be regulated with this document. Due to that, some critics have said that the new Management Plan is not bringing any real changes at all. Some, on the contrary, have claimed that it sets unprecedented restrictions. The truth is somewhere in between. There are six main changes that the new Management Plan is bringing as compared to previous documents.[5]

1) The conservation area is divided into two zones

Tallinn Old Town consists of two very different urban areas: the densely built-up core and the bastion belt around it (see Figures 1 and 3). The previous heritage management documents mentioned the different areas but did not set a clear distinction between requirements in them.

The new Management Plan describes a separate set of principles and requirements for the two zones making it clear that the bastion belt (zone 2, illustrated in Figure 3) should mostly be retained as green and public spaces while the core of the city (zone 1, illustrated in Figure 3) can be further densified.

2) The buildings are divided into three categories

So far, all buildings in the conservation area were subject to the same legal requirements: the owner had to get a permit for all renovation works regardless of the age and value of the building. The new Management Plan divides all buildings that are not listed as individual monuments into three categories. Only the highest one, category A, retains the same requirements: the Heritage Board must give a permit for all changes, including the interiors. Category B means, that the interiors are exempt from the Heritage Board´s permit requirements. Category C was given to buildings with no architectural or historical value, and they can be reconstructed or demolished without a permit from the Heritage Board (standard requirements for a building permit still apply as for all houses in the country).

Figure 2. An example of a building in category C – a former public toilet built in the Soviet era. Source: Tallinn Heritage Department.

The alleviation of demands is not big, because about half of the buildings in Tallinn Old Town stayed in category A (see Figure 3). But at least the Heritage Board's permits and other heritage-specific documents do not have to be issued any more for changing the interiors of modern shopping centers and apartment buildings (typically in category B) or rebuilding simple sheds and garages (mostly in category C, see Figure 2).

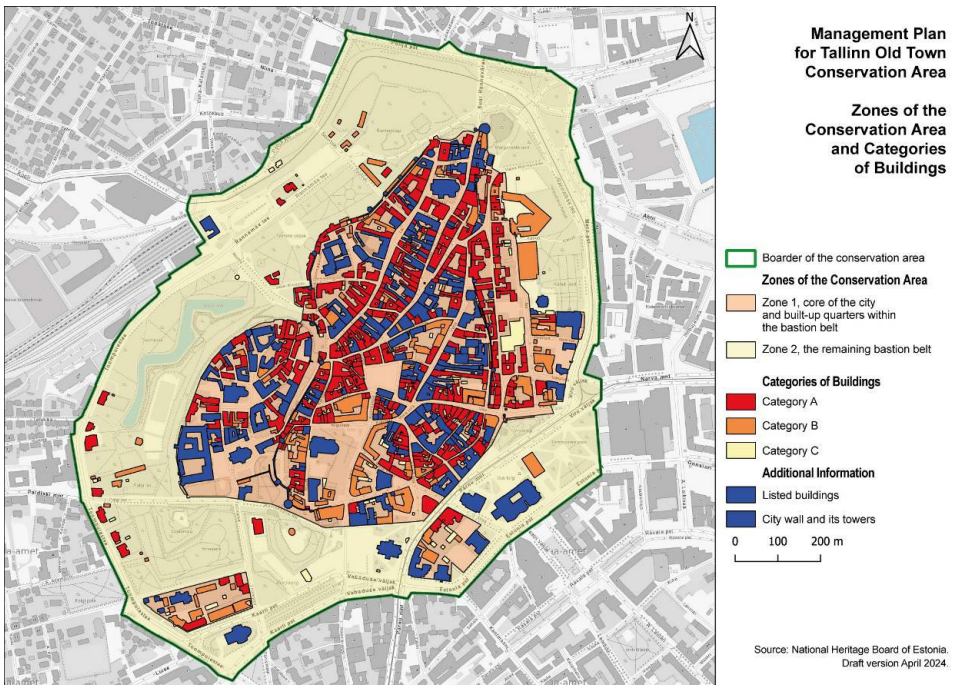

Figure 3. The categories of buildings and two zones of Tallinn Old Town.

3) Valuable parks and alleys are accentuated

It has always been one of the goals of the conservation area to protect historical parks, but it was unclear which are the ones that are considered valuable. Thus, on some occasions there have been decades long disputes whether some green areas should be retained or can houses be (re)built instead. Now, several parks and alleys have been drawn on a map (see Figure 4) to accentuate their value in the context of the conservation area and set requirements for their preservation.

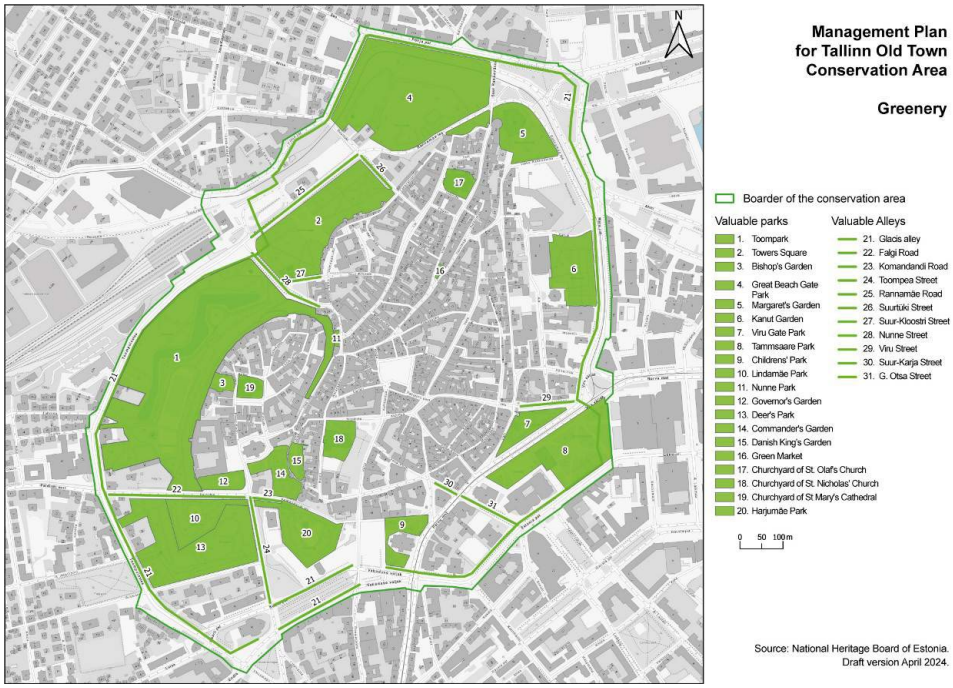

Figure 4. The valuable parks and alleys of Tallinn Old Town.

4) The goal of restoring the pre-war situation is dismissed

The previous heritage management documents had strongly set the goal of rebuilding houses lost in the Second World War and they allowed new buildings only in the locations and sizes of prewar houses. In practice, these rules were almost never punctually abided as new buildings need to fit the current urban situation as well. In some cases, the written rules had to be knowingly ignored: for instance, the Heritage Board has repeatedly forbidden to erect a house in the middle of the Town Hall Square even though there was one before the war.

The new Management Plan is much more flexible when it comes to adding new building volumes naming several instances when it is impossible to allow houses where they used to be (protection of valuable parks, integrity of a historical square etc) and different aspects to consider when planning new buildings (including both the pre-war building pattern and current surroundings).

5) The protected views of the Old Town become three-dimensional and longer

The long-distance views of the Old Town are protected as part of the buffer zone. So far, all requirements of the buffer zone also applied to these vast territories between the viewing points and the conservation area.

Now, a 3D-analysis was done to show how tall buildings would influence the view at any given point.[6] Based on the analysis, the long-distance views were divided into sections with elevation marks (see Figure 5). Building anything lower than those elevation marks will not need coordination with the Heritage Board anymore.

It has become evident, that views can also be strongly influenced by skyscrapers erected behind the silhouette of the Old Town. Consequently, some views were extended well beyond the Old Town so that from a certain hight, the Heritage Board could also be involved in planning skyscrapers in the background of the protected views (see Figure 5).

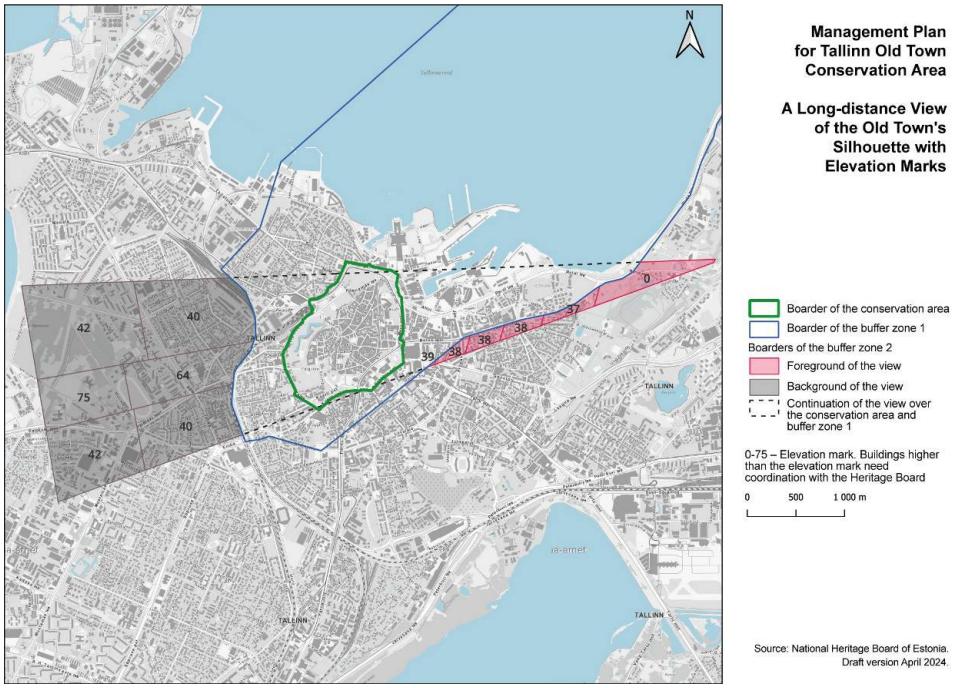

Figure 5. A long-distance view of Tallinn Old Town with a background and elevation marks.

6) "Softer" principles added to the requirements

While the previous heritage management documents were quite short and concentrated on listing all the legal requirements, the new Management Plan incorporates some wider goals and principles as well. This section gave us the opportunity to communicate longer-term aims that are not strictly derived from the law. These are general guidelines for future decision-makers, agreed upon by today's city planners, heritage specialists and citizens who participated in the process.

BETWEEN THE PARTICIPATION IDEAL AND LEGALITY

The participatory ideal has been transferred into heritage management from the broader development field, where it emerged in the 1970s.[7] The so-called "four C-s" of the World Heritage Convention (credibility, conservation, capacity-building, and communication) had a "fifth C" for community added in 2007. The communities to be involved in World Heritage activities were specified as indigenous, traditional or local ones.[8]

In the Estonian context, participatory processes were widely enforced at the turn of the millennium through the Administrative Procedure Act.[9] According to the Act, an administrative authority shall, before issue of an administrative act, grant a participant in proceedings a possibility to provide their opinion and objections. But if the number of participants exceeds fifty, an administrative proceeding may be conducted without hearing the opinions of the participants. The latter does not mean, that the communities' voices shouldn't be heard in the process, but people can be involved through public announcements, without sending individual letters and waiting for a response from each and every person who can be influenced by the act.

At the start of the process of drafting new Management Plans the National Heritage Board decided to use this as a possibility to engage local communities much more thoroughly than the law requires. Public discussions were expected to build awareness and foster appreciation of the protected areas among the local communities because in a sense, all heritage is intangible[10] and is taken care of only if cared about by the current society.

The Process of Composing the Management Plan in Practice

To compose the management plans for Estonian conservation areas, a working group was put together in each town involving local specialists. Already after the first meeting of Tallinn's working group, we organized a public consultation event, where the initial ideas were introduced. The event was announced through media and e-mails to all property owners of the Old Town and the most relevant NGO´s and institutions. The participants could contribute through small working groups, where they were asked to give their opinion about the most important values of Tallinn Old Town, what should be done to maintain it better, how to support it as a living environment and improve collaboration between citizens and officials.

Taking this input on board, the working group continued their discussions, and the first draft version of the Management Plan was put together. Instead of organizing a second public event to discuss it (as had been initially planned) the draft was sent directly to the relevant NGO´s and institutions, and they could add questions and proposals into the online document. The initial plan was changed, because the format of a big meeting had been criticized by some participants for being too superficial and curated. Also, the Heritage Board´s leadership had changed and spending time and money on large scale public engagement events was temporarily not favoured. Instead of one big meeting, we held thirteen small ones with different stakeholders. The process of consultations was concluded by an open meeting of the working group, where all those who had given input were invited to discuss the changes made into the draft according to their suggestions.

The official public engagement was announced in newspapers and the Management Plan was on public display online and in two offices in the Old Town. In addition to those legally required actions, all property owners of the Old Town were again informed by e-mail, and an open-air exhibition was set up. During the official public engagement, we received opinions and objections from 21 persons and institutions, which is not a lot considering the amount of property owners and other stakeholders. The main topics of discussion were the buildings´ categories, protection of certain parks and the living environment of the Old Town.

1) Which buildings are valuable enough to get the highest category?

Like the members of working group, other involved specialists and citizens had the most controversial opinions about the buildings´ categories. During the long process of categorizing over 500 buildings, views varied from one extreme to the other. Initially, the city´s Heritage Department gave an opinion, that inventarisation of all buildings is not necessary, because most of them are very valuable together with their interiors and only a few can be selected out that can have a lower category than A. In the letter the city´s Heritage Department proposed to select the less valuable buildings out themselves, but that did not happen. Thus, I took it largely upon myself to fill in a chart with suggestions for categories for all the buildings of the Old Town based on existing photos, documents and knowledge derived from the long-term heritage specialists in the working group.

On the first meetings of the working group, the prevailing opinion was, that due to Tallinn´s extraordinary value and density, only two higher categories should be used (A and B). During the first public consultation, it was strongly argued that the lowest category should be used as well. After some consideration, all three categories were indeed incorporated.

Even though the overall principles and definitions of the three categories are directly derived from the law, agreeing on what is "valuable enough" for category A was very complicated. Many historical buildings have suffered some damage in WW2 or were partly rebuilt during the Soviet time. How much of the original must be preserved to be considered an A-category building and how could we even know how much has actually retained under new layers? Some claimed, that if we don´t know for sure that there are valuable interiors in the building, we shouldn´t set any restrictions, and that just

old stone walls and wooden ceilings cannot be considered “a valuable interior.” At the same time, if there were no restrictions to rebuilding inner walls and ceilings, the historical layers and details that are usually the only elements that make up valuable historical interiors in multi-layered buildings, are probably never found. Also, there was the question whether some Soviet-time or even younger interiors have acquired a cultural value of their own. Why would we appreciate all layers of history in built heritage except the last eighty years?

The discussions became even more complicated with newer buildings: there is a considerable number of buildings from the 19th century, the first independence period of Estonia (1920s-1930s), Soviet time (1940s to 1980s) and new buildings from the re-independence era (since 1991) in the Old Town. Some heritage specialists asked whether 19th century apartment buildings are valuable enough to interfere with their interiors (especially if only the central staircase is accessible, and we do not know anything about the apartments). At the same time, some architects insisted that the best examples of postmodernism and even high-quality architecture from the 2000s should also be considered category A. An NGO representing real estate owners argued against any protection of Soviet heritage while some architecture historians were fighting to preserve a modest Soviet modernist building that had been heavily rebuilt. The NGO representing real estate owners also claimed that state-level heritage protection is not justified at all, and the Old Town should be protected on the municipal level, which would make any protection of interiors impossible.

Houseowners and the Heritage Board sent several objections against higher categories (A or B) and argued for lower ones. Most of those objections were justified and the category could be lowered. During the process, the number of A-category buildings diminished from 360 to 325, mostly by heavily reconstructed buildings and Soviet architecture, but also some 19th century buildings and architecture from the 21st century. In hindsight, some buildings´ categories are difficult to justify in comparison to other similar ones and it seems that none of the involved is completely satisfied with the outcome, which means it is probably a good compromise.

2) How old should a park be to be protected as heritage?

Another issue that came up repeatedly was the protection of parks, especially a relatively new one in the bastion belt. A neighbouring theatre is interested in using its territory for erecting an annex. Even though this plan had already been denied not only by the Heritage Department, but also the Environmental Board and the City Government, the representative of the theatre claimed that the new Management Plan creates unprecedented restrictions. At the same time, three citizens sent letters emphasizing the need to protect this park and the historical theatre building from the proposed annex which was widely discussed in the media. This was quite extraordinary, because citizens mostly sent opinions only concerning their own property, not wider issues.

All involved heritage specialists and city planners were unanimous about the need to preserve this park as part of the green bastion belt, even though it got its current design and trees only in 2018. When it comes to greenery, there was generally no disagreement that all layers are valuable and worth preserving, and this park has remained as valuable in the Management Plan so far.

As expected, the last big lacuna from WW2 within the core of the Old Town by Harju Street caused disputes as well. This area has been a public green area since the 1950s (see Figures 6 and 7).

Figure 6. The public green area of Harju Street in 1952. Source: Estonian Film Archive.

In the beginning of 2000s, the City Government bought up most of the lots and renovated the green area. Initially, the Working Group supported the city´s landscape architect´s suggestion to include it as one of the valuable parks that should be preserved. But the Architects´ Union and city´s urban planners were strongly of the opinion that the area should be built up again – if not now, then we shouldn´t at least block this possibility in the future. Even though some residents and specialists are certainly not happy about it, the last version of the Management Plan does not protect this urban lacuna and new houses can be built there in the future (as the previous heritage management documents had actually implied as well).

Figure 7. Dwellings of Harju Street before the Second World War. Source: Tallinn City Museum, TLM F 7309.

3) Can the Old Town be protected as a living environment?

The issues brought up by the Old Town Society, an NGO that unites the residents of the Old Town, were mostly concerned with everyday life (traffic, parking, noise) and the changing functionality of the neighbourhood (the increase of tourism facilities and nightclubs, and the decrease of permanent residents). At the same time, the current Heritage Act does not provide tools to cover these topics – as I was repeatedly reminded by dear colleagues, the Management Plan can only regulate what the Heritage Act allows.

Nevertheless, as we had used the opportunity to add a softer section of "principles" into the Management Plan, these legally unregulated topics could be reflected there. For instance, the principles include that "the preservation and increase of the permanent population is promoted and the diverse use of the heritage protection area is preserved: the public use of buildings and properties in public use and the use of buildings as residential premises will continue. As a rule, the intended purpose of residential land, land for public buildings or land for public use is not changed, the spread of accommodation services and noise-producing establishments is avoided."

CONCLUSION

Surprisingly, the main changes brought with the Management Plan did not rise many questions, but some things that remained the same did: e.g. preserving parks in the bastion belt, the protection of interiors, preservation of relatively new buildings, and allowing new houses where they used to stand before the Second World War.

The participatory ideal was in principle followed as well as possible given the time frame and budget for the process, but as several key actors changed positions during the process, the roles of the deciders and participants became fluent and blurry. It is even hard to say, who was I in the process – an "involved expert" who helped the Heritage Board with putting together other peoples' ideas and suggestions, or the main author? Sometimes, it felt like being the first, sometimes the latter.

The opinions of the engaged citizens and NGO´s were often contradicting each other and it was not possible to include all the suggestions into the Management Plan. Decisions about the contradictory proposals had to be made quite fast (after the written opinions had arrived and before the official public discussion). This could only be done with a small group of heritage officials, not the whole Working Group or other committees that take weeks to gather. Thus, even in a highly participatory process there was inevitably a stage where the most critical decisions had to be taken by a few people to finalize the work and not keep going around in circles accumulating new ideas and rewording the already existing ones. In some cases, it was necessary to ignore the input from public co-creation and go back to standard sentences from other Management Plans, because it would be confusing to have the same regulations in different towns expressed differently.

My biggest regret about the outcome is that the Management Plan is not directly helping to preserve the Old Town´s diversity and liveability, which are far more important issues than the categories of individual buildings or the visibility of church towers from another side of the city. At least some important ideas could be added as non-binding "principles". Hopefully, these principles will be carried forward into the General Plan and other municipal documents that have more legal power over such issues. It seems like changes might be on the way as some local politicians and entrepreneurs have taken initiative to steer the business scene towards a more diverse direction. The Management Plan might not regulate every important issue in the Old Town, but the discussions around it seem to have encouraged locals to take some of the discussed ideas further – isn´t that the most valuable outcome a public engagement process can have?

NOTES

[1] Harald Pechlaner, Elisa Innerhofer and Greta Erschbamer, eds., *Overtourism. Tourism management and solutions* (London: Routledge, 2020); Claudio Milano, Joseph M. Cheer and Marina Novelli, *Overtourism: Excesses, Discontents and Measures in Travel and Tourism* (CAB International 2019), etc.
[2] "Tallinn Old Town: Sustainable Management and Presentation," Estonian Academy of Arts, accessed August 3, 2024, https://www.artun.ee/en/tallinn-old-town-sustainable-management-and-presentation/ .
[3] Triin Talk, Raul Kalvo, Katrin Paadam and Liis Ojamäe, *Vanalinn: pärand, elukeskkond, turism* (Tallinn: Estonian Academy of Arts, 2023).
[4] The Management Plan of a heritage conservation area is a regulative document described in the Estonian Heritage Conservation Act. The Heritage Conservation Act, accessed August 7, 2024, https://www.riigiteataja.ee/en/eli/ee/531032023002/consolide/current .
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[6] "The Views of Tallinn Old Town Conservation Area," Tallinn Strategic Management Office, accessed August 3, 2024, https://gis.tallinn.ee/vanalinnavaated/?page=Koondkaart-2&views=Vaatesektorid .
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[8] Christoph Brumann, "Community as Myth and Reality in the UNESCO World Heritage Convention," in *Between Imagined Communities and Communities of Practice: Participation, Territory and the Making of Heritage*, ed. Nicolas Adell et al. (Göttingen: Göttingen University Press 2015), 275.
[9] The Administrative Procedure Act, accessed August 10, 2024. https://www.riigiteataja.ee/en/eli/ee/513032023002/consolide/current .
[10] Laurajane Smith, *Uses of Heritage* (Milton Park: Routege, 2006).

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REIMAGINING WOODLANDS, A MODEL VILLAGE. A CASE STUDY OF PARTICIPATORY METHODS FOR EXPLORING SUSTAINABLE AND EQUITABLE NEIGHBOURHOODS

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INTRODUCTION

This paper discusses a methods case study involving bottom-up community engagement with the aim to support neighbourhood planning with the local council. It embedded principles of co-production, intergenerational learning and knowledge exchange between local residents, local government and third sector organisation partners and citizens, bringing together arts, inclusion and social innovation research and practice.

The interdisciplinary project was initiated by academics from Sheffield Hallam University within the Gender Design and Creative Practice Network, Lab4Living and The Sheffield Business School, and was funded by Sheffield Hallam University's Levelling Up Innovation Challenge. Levelling up is a contentious, UK conservative government initiative to 'Level up' geographical disparities within the north of England (in comparison to the south/central government) with funding and initiatives.

Based in Woodlands, Doncaster, a city in the north of the UK, we worked with local residents to explore diverse understandings of pride in place within the Woodlands area, with the aim of creating a neighbourhood plan to structure potential Levelling up grant funding. We present and critique litter picking as a method, one of the participatory methods we used (others were participant led walks and talks; a festival and a work in progress exhibition) when engaging with the communities in Woodlands. Through analysis we review our methods and data and present findings that aim to support others in rethinking ideas of user engagement and co-designed research. We end by offering some reflections and recommendations for non-extractive ways of researching.

CONTEXT & SITE

The project is based in, and responds to, the context of Woodlands. Built as Woodlands Model Colliery Village in 1907, a development of tied cottages for miners of the Brodsworth Colliery Company, between 1907 and 1913, it has a wealth of social and industrial heritage. This newly created neighbourhood was influenced by 'Garden City' holistic planning principles: integrating modern and convenient housing with green spaces to address the many critical health and well-being challenges of urban life in industrial Britain. Its design aimed to balance the benefits of urban and rural locations, with planned amenities such as schools, libraries, community halls and parks to enhance well-being and community unity. It was designated a conservation area in 1979.

The principles of the Garden City movement have seen a resurgence of interest in contemporary planning for sustainable and equitable neighbourhoods, with a focus not only on physical aspects of urban design to support well-being, such as walkable neighbourhoods and green infrastructure networks, but also the organisational and economic principles of land value capture for the benefit of the community, community ownership of land and long-term stewardship of assets, and strong vision, leadership and community engagement.[1]

In 1990 the coal mines closed, causing generations of trauma and poverty that is still seen today. Social and economic deprivation across the area is high and exceeds England's average in many areas. 9.5% of households have an annual income of less than £20k. The impact of deprivation can be seen in the significantly higher levels of child poverty (31.5% compared to the England rate of 17.1%) and significantly higher proportions of older people living in poverty (22.8% compared with England's 14.2%).

Within the UK government Levelling up agenda,[2] there were twelve missions to 'work towards ending geographical disparity within the UK. To situate this project within the levelling up agenda to receive the funding we applied for, we aligned with the mission Pride in Place. The mission aim was that by 2030, pride in place, such as people's satisfaction with their town centre and engagement in local culture and community, will have risen in every area of the UK, with the gap between top performing and other areas closing. The logic of place competition, creating pride through aesthetic improvements which will then attract private investment and provide economic salvation, seems to underpin the role of pride in place alluded to in the Government White Paper:

"A beautiful built environment, access to leisure and cultural amenities and safe neighbourhoods can [...] attract businesses to high streets, leading to increased footfall and private sector investment in communities. To make this a reality, communities must have strong civic institutions, assets and relationships that anchor local pride in place."[3]

Through our work with community groups, civil society and the local state to coproduce situated knowledges and initiatives in and of place, we are cognisant of the discursive and material violence done to people and places by both 'big society' and 'austerity' policies. These have seen the local state starved of resources to the point that each social service is pitted against the others, with no winners, only a landscape of losses.

Woodlands Library, although owned by council, has changed hands to first be managed by local charity 'Woodland Speaks'. This organisation failed to uphold the council's service agreement: the library was only open 6-8 hours per week, while the car parking provided on library grounds was shut off from local use, impacting residents' access to local shops. The library is now run by a team of volunteers, very successfully… but with an awareness of the potential precarity of an arrangement that relies on goodwill and volunteer labour rather than state funded provision of such a necessary service. The library is now run by a team of volunteers, very successfully. We observed an awareness of the potential precarity of an arrangement that relies on goodwill and volunteer labour rather than state funded provision of such a necessary service. Ownership is key but there is also a need to avoid exploitation of people's time and energy. To support relationship building we based our activities in this key site to meet key actors/ stakeholders.

PROJECT APPROACH, PARTNERS & EVIDENCE

The interdisciplinary project brought together arts, inclusion and social innovation research and practice, with a particular focus on participant's relationships to place, and how this might shape or influence capacities for collective practices of both spatial visioning and climate action. Informed by feminist epistemology the project looked to create knowledge with participants, in place, recognising the different ways of knowing brought by different residents and community groups. These may be

shaped by experiences, mediated by gender, race, class and age. Material factors and power dynamics shape who can or will participate in knowledge exchange and co-production activities, who has the time to give, who feels able to participate, who feels able to speak.

We are feminist researchers and as such, our research approach is situated within a feminist epistemology, who clarify this approach not defined by a gender focus as such, but as an epistemological position which amongst other things 'positions feminist research as proceeding from the organizational and intellectual location of the feminist researchers, as the person who makes sense of the 'the world' and produces generalized knowledge-claims on the basis of this;'.[4] As a methodology it is well placed to support inquiries such as ours since feminist social epistemologies have a specific commitment to 'to develop rich accounts that tease epistemic normativity out of a power-sensitive social understanding of knowledge production'.[5] Doing epistemology as a feminist involves bringing one's feminist concerns and sensibilities to the epistemological table.

The project approach takes a particular focus on participant's relationships to place, and how this might shape or influence capacities for collective practices of both spatial visioning and climate action. Thus, feminist social epistemologists have a particularly strong motivation to develop rich accounts that tease epistemic normativity out of a power-sensitive social understanding of knowledge production. We see that understandings of place are both personal and social, shaped through shared cultures of understanding and collective practices and patterns of behaviour. In this sense, "Space is more abstract than place. What begins as undifferentiated space becomes place as get to know it better and endow it with value".[6] Thus the values the community members hold is what we intended to capture through creative and participatory methods, working with the local Councillor as a key actor and stakeholder in the project, as well as with the local Brownie pack, the local history group and a community Arts agency.

The project's starting point was at the local level, building on a small number of successful events-based community gatherings which drew together intergenerational members of the community and have already impacted through small-scale direct, participatory and representative democratic actions (painting of the play equipment in the park; development of environmental concerns from youth groups, then voiced by their Council representative in council meetings). Events were designed to engage with existing community and civil society groups such as the local history group and the Brownies girlguiding unit, and to create spaces and activities where they feel able to form and articulate beliefs and emotions about the neighbourhood,[7] in its present, past and imagined future states. Walking and participatory mapping in place have shown to support communities to become stewards of their local environments[8] and litter-picking walks were a form of stewardship already being practised by the Brownies. This prompted us to build litter-picking into our proposed mapping walks; a material practice of care around which to shape wider conversations of affect and place.

LITTER PICKING AS A METHOD

Litter picking was a pre-existing activity that was introduced to us by the local councillor and was already being utilised by some of the community groups. Used as a tool for bringing together two different community groups, litter picking was used with both an adult and children group. The adult group included initial project stakeholders, including members from the local council, wellbeing services, the local museum and the key art practitioner. The children group were members of the local Brownie troop and completed within one of their evening Brownie meetings.

Litter is one of the largest forms of environmental pollution,[9] also known as garbage and trash, it can be defined as 'trash, discarded or scattered about in disorder over a socially inappropriate area'.[10] In Woodlands, Doncaster, the scattered litter over the shared common spaces was considered by residents and participants who we worked with as an 'eye sore'.

Litter picking is a act of single (but often groups of) people using a ‘litter picker’ and their own rubbish sack (see fig.1) to pick up and collect bits of rubbish that has been left around and not put into a rubbish bin.[11]

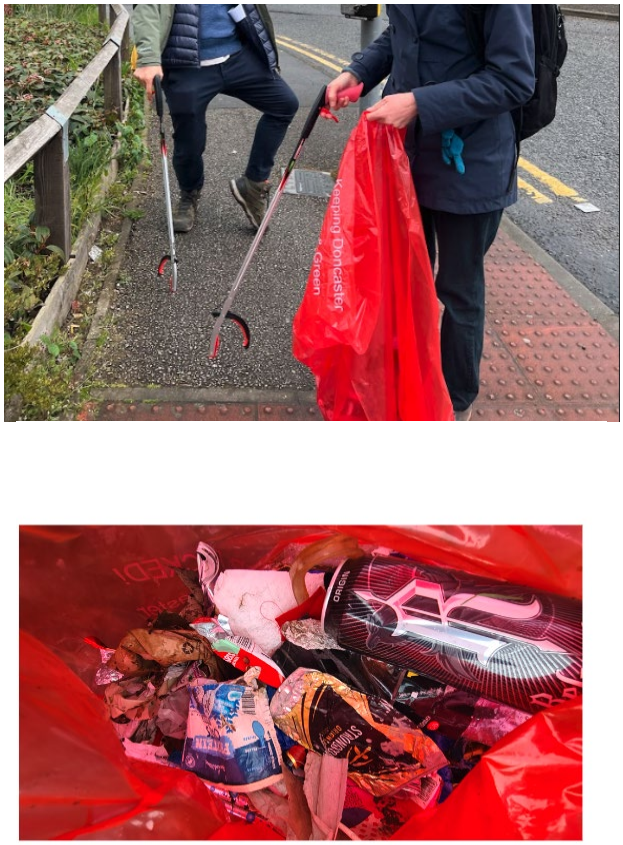

Figure 1. Litter picker ‘tools’ and bags and inside a bag of litter.

As we worked with the community, we realised there were multiple layers of the community we could access through the act of litter picking with our participants.
What we did:
- Litter picking with the stakeholder group to get to know the community spaces (see fig.2),

Litter picking with the Brownies (along with a drawing express how they felt about the area they were picking and then at the end of the litter picking an exercise that asked them to reconceptualise a more positive future for the spaces of Woodlands by asking them to imagine what they would do if they were ‘the boss of Woodlands’’).
The litter picking usually lasted around an hour, along with time before and after to chat, review the litter picked and debrief about the experience together. The drawing activity with the Brownies was outside and in situ with the litter picking activity.

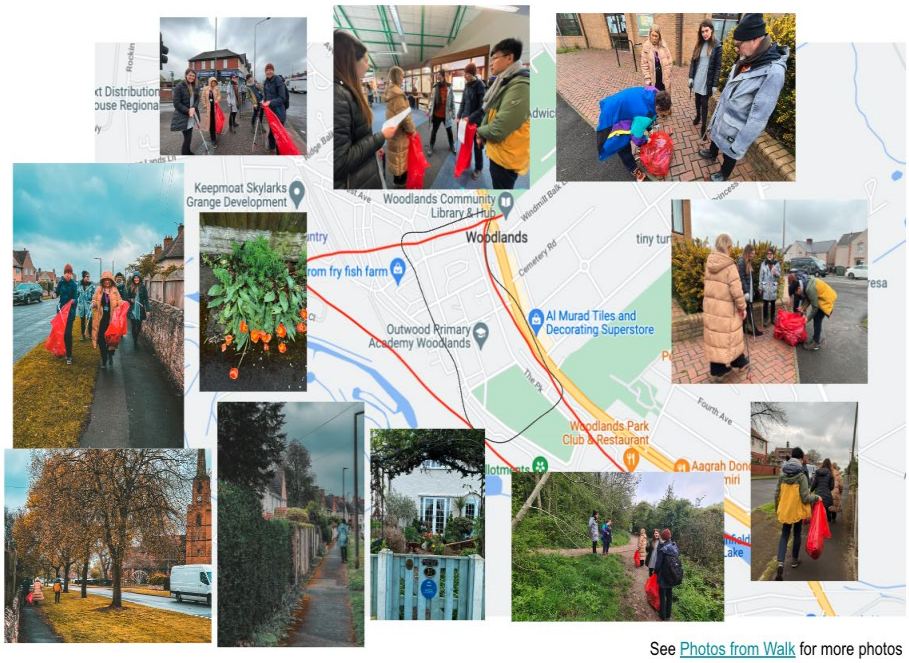

Figure 2. Mapping the walk, spaces and litter

What we learnt:

1. **Wellbeing benefits:** Walking and talking and litter picking gave a general sense of physical and social benefits. Participants found the walk allowed one to be active, going outdoors and getting fresh air. There were spontaneous and natural conversations along the walk. The socialisation aspect was appreciated.

Walk and community matters in place: Litter picking was a successful way to get people together, out in their environment, and talking and sharing. It allowed the group to stop at particular corners to assess, highlight and discuss issues around a location; we stopped at one point at the corner of the street to discuss housing arrangement in the area. This led to an idea about the possibility to share about local history/ heritage at different points to discuss past, current and future plans.

Researchers were visible to the community: while out and about litter picking, researchers met other members of the community who were not already involved who wanted to become participants in the project.

2. **Comfort in an existing activity:** Brownies had done litter-picking before and having a previously established task helped as the Brownies seemed confident to get involved and then share what they saw and felt through drawing in the follow up task.

Engaging young people in caring for community: Engaging young people in caring community activities reinforces healthy and positive behaviour and benefits the individual as well as the collective. Doing a pre-existing activity as part of data collection also reinforces the value and importance of that activity and may mean young people engage in more litter picking activity outside Brownies.

Creative activities: Art-based data alongside litter picking helped the participants feel comfortable to verbally talk about their drawing and reflections. It helped having very relaxed, excellent and well-established Brownie leaders.

REFLECTIONS AND LEARNING

Establishing relationships and connecting with what was important to community members was important. Walking, talking and caring for the local environment with the participants had a 'grounding' effect on the participants and for the research team, enabling meaningful and authentic discussions to take place. Participants and researchers felt connected to the project aims and each other through the shared activity, purpose and outcome of litter picking (e.g. doing good, making a collective difference). Litter picking was an act of 'care' and stewardship and in this way was part of our aim to have authentic purpose, process and experience

This 'grounding' as we put it is important in participatory methods, not only to create the best conditions for rich and authentic data but also to be able to work towards rebalancing power, avoid 'extraction' and move away from assumptions about who owns the 'expertise' in a given group or space. Another way to provide a sense of ownership by the participants and reduce power imbalances was to carry out data collection within familiar participant environments (e.g. library, local spaces) and during familiar activities (e.g. litter picking), allowing for relationships to be built with mutual respect and reciprocity and to embed in participants place-making rituals.

However, the more time you have with people and within a place the better and the stronger and more authentic these relationships and goals can be achieved. 'Time' in research is often expensive and thus minimised. Time to develop relationships and understanding within and between participant groups is essential to build into the fabric of the research as this is often the best way to be non-extractive in the research if one is also taking account of the participatory principles and actions. Time creates greater depth, sensitivity and breadth whilst also providing opportunities, with the well-considered place/context-based strategies, to access 'hard to reach' and potential ostracised groups within the community.

Power within communities, e.g. local/public vs council power, is therefore also important to consider, rather than just between researcher and participant.[12] We do not feel we fully reduced power imbalances or extractive ways of researching due to the lack of time which was frustrating and disheartening to all. Funders need to empower us with enough resources to allow for time and for this to be fully realised, and should be seen as an ethical obligation, along with 'giving back to the community' (e.g. time, resources, motivation, vision etc.) particularly within participatory community approaches to research.

With a deeper more authentic relationship with communities we may also have been more successful with the future facing work which was difficult to engage participants in. Creating clear 'take-away messages' from the research for participants and stakeholders is key in achieving long-lasting generative relationships and the goals of the research, especially enabling participants to see the product of their efforts and inputs and encourage them to continue to engage with research as well as promoting wider participation.

CONCLUSION

Through our discussion in this paper, we begin to understand litter picking as a method, the shared community stewardship activity we were invited to participate in. This was one of the participatory methods we used when engaging with the communities in Woodlands and should be read within the context of the other participatory methods we used (participant led walks and talks, a festival and an exhibition) when rethinking ideas of user engagement and co-designed research. Litter picking, in this setting, offered us a way to connect with residents and community members and stakeholders in a way that was situated in the local environment, meaning that we understood, in some small way, the everyday challenges of living in Woodlands. The act of litter picking with participants builds on our

project ethos of using the project grant to resource the community, being mindful of giving, not extracting: A co-production approach that put our knowledge and skills at the disposal of our research partners however they choose to use it,[13] rather than one's predefined methods. In this way we act as research stewards - a form of research stewardship materialised through the careful and responsible management of the research project.

When considering using litter picking as a research method we recommend it is not used as a single tokenistic activity but to consider ways to build a culture with participants around the activity in place. Time is a key component of this activity, and it needs to be carefully supported by resources.

NOTES

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THE TRANSGENERATIONAL WALKING INTERVIEW METHOD: INSIGHTS AND REFLECTIONS FOR COMMUNITY RESEARCH IN PLACE AND MEMORY

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INTRODUCTION

Our relation with space and the meaning we give to places is affected by our individual perspectives as well as our social and cultural environment. The notion of 'place' generally contrasts with that of 'space'. While space refers to a geographical location, place embodies an emotional component connected to a particular setting.[1] From a socio-cultural perspective, while in Aboriginal tradition people's relationships with the land tend to be more spiritual, in Western tradition, land is often viewed as property, with its value as a commodity being more prominent.[2] Thus, "different peoples might "see" different places in the same "place"".[3] This observation is not only applicable at the socio-cultural level but also at an individual level. For example, a park where one person recalls childhood play and familial bonds might, for another, be associated with solitude or loss. Thus, the same location can evoke vastly different meanings and emotions depending on personal experiences.

Through these meanings, individuals and communities develop emotional connection towards their physical environments,[4] and this phenomenon manifests itself as place attachment.[5] Throughout one's lifetime, new bonds are continually formed. The significance attributed to a particular location is subject to change and transformation over time and also across generations.

In Belgium, and more specifically in the region of Wallonia, where our study was conducted, the significance of place has undergone a substantial transformation across generations, particularly perceptible in post-industrial landscapes. This shift is closely linked to the transition from an industrial economy and the subsequent economic crises. Locations that were once sites of industrial work, factories, and symbols of national pride have, in many cases, become ruins or landmarks, sometimes repurposed for new uses.[6] While some places have retained their original function, they have often been subject to significant renovations. Over time, the physical characteristics of these places have evolved, their societal roles have been redefined, and the demographics of the surrounding communities have shifted.[7] Consequently, different generations may perceive these places differently, depending on their personal connections or lack thereof to the site's historical or contemporary significance.

For communities, the new generation's understanding of a place can play a crucial role in its reintegration, revitalization, and reuse. Beyond being a sustainable approach to resource management, repurposing space and preserving its inherent value can also serve as a means for younger community members to learn about and connect with the past.[8]

In this context, we explore how engaging in memory work within a transgenerational setting can alter the relationships between participants and the place.
To address this inquiry, we propose a specific methodology: the transgenerational walking interview (TWI). This exploratory paper seeks to establish an appropriate protocol while identifying the potential and limitations of this method, as well as the types of data it can yield. Our focus is not on analyzing the content of the interviews themselves, but on critically evaluating the methodology itself, with the goal of developing a robust approach that can effectively be used in community research and by community researchers.

THE TWI METHOD

Walking interviews, also referred to as "go-along interviews" or "commentated walks," involve the interviewer and interviewee walking together in a location relevant to the research question. This method effectively situates narratives within their spatial context, using the environment to trigger discussions through various stimuli.[9] The approach is sensory, spontaneous, informal, and less structured, allowing participants to have greater influence and take a more active role in the conversation. Walking interviews offer several advantages: they enable a deeper understanding of individuals, challenge assumptions, improve communication skills, and build connections between participants.[10]
Transgenerational interviews involve two individuals from different generations, with the younger participant typically taking on the role of the interviewer. These interviews are particularly valuable as they recognize and respect the distinctiveness of each individual's life experiences.[11]
In the context of intergenerational research, we use peer interviewing, a method where researchers do not ask questions but instead observe as participants take the lead in the conversation.[12] Unlike traditional interviews where the interviewee passively responds to the researcher's predetermined questions, this approach enables both the interviewer and the interviewee to collaboratively construct meaning. In our context we consider both participants as "peers" as they are part of the same family, and consequently belong to the same community, social group and therefore share social codes. This method promotes greater flexibility and creativity in the dialogue, allowing for a richer exchange of ideas and experiences.
The method that we define here as "Transgenerational Walking Interview" thus refers to an interview in which two people from different generations come together; the younger person taking on the role of main interviewer to conduct a walking interview in a place significant to the older participant. To conduct these interviews, researchers explain the research protocol to participants, who are then asked to guide the visit. The younger participant has question cards to inspire them, prepared and provided by the researchers. We, as researchers, document the experiments and try to remain very passive to also assess the ease of use of the method, only intervening with questions if there is a blockage.

STUDY METHODOLOGY

Throughout the study, we conducted our research with two pairs of relatives at two distinct sites in Wallonia, Belgium.
In the first interview, Nathan and his grandmother Marie-Anny visited a high-school in Fontaine-L'Eveque (Figure 1), a school where Marie-Anny had taught for many years. The school, still operational today, had undergone significant renovations but retained some of its original structures. This setting provided Marie-Anny with an opportunity to share her experiences in a familiar environment, though it was Nathan's first visit to this place. Given its rural context, the site was primarily known only to those who used it.

Figure 1. Nathan and his grandmother Marie-Anny in the classroom where Marie-Anny used to teach

In the second interview, Gérôme and his grandfather Charles explored Haut-Fourneau B in Liège, an industrial site where Charles had worked (Figure 2). Despite partial dereliction and ongoing construction, the site still permitted engagement with its historical significance. Located in an urban area and adjacent to a frequently traveled road, this site was more widely recognized.

Figure 2. Gérôme and his grandfather Charles walking to the old factory site for a closer view.

During the interviews, participants discussed a range of themes, including their typical workday and the main activities they were involved in. They also reflected on the people they encountered regularly at the location, whether colleagues, students, or other individuals connected to the site. Additionally, participants recalled special events that stood out in their memories, such as a particularly significant incident that occurred on-site or a unique anecdote that happened with students.

"*One year, a student in the fourth grade... I taught geography. And there were 15 atlases in the bookcase. And so, at the end of the lesson, the students put their atlases back in the cupboard,*

themselves, not me. And then, I saw that an atlas was missing. So I wondered what I was going to do, but I knew that it was a student from 4e technique who had taken over the atlas [...] And so the following week, I came into the classroom, waited for absolute silence and […] explained that an atlas was missing and that if it was a student who was passionate about geography and didn't have enough money to buy an atlas, well, he could come and tell me and he could keep the atlas. [...] And so, the next day, the atlas was left in the boys' bathroom downstairs. The student returned the atlas. So, the next time, I said we'd found the atlas, but no one ever came to ask for an atlas. Otherwise, we would have given it away." (Marie-Anny during the TWI)

Post-evaluation interviews were conducted later on by the researchers to capture participants' perspectives on the transgenerational interview method. These more conventional semi-structured interviews took place immediately after returning from the sites, with each participant individually reflecting on their personal experiences of the place, impressions of the walking interview, and perceptions of the methodology. The interviews were recorded using audio and video and later transcribed for thematic analysis.[13]

RESULTS

Experience of the place-related insights

Both younger participants noted that being physically present at the sites made the stories more immersive, allowing them to better appreciate their grandparents' experiences, and helping them visualize the scenes described, which enhanced their understanding and connection to the shared stories. This aspect was especially highlighted by one of the younger participants, who found it more vibrant compared to a museum experience:

"*It was more vibrant than a museum visit for example*" (Nathan in his post-evaluation interview)

Both older participants expressed positive emotions about revisiting significant places from their past. During the post-evaluation interviews, they mentioned that they didn't find the on-site experience essential to their storytelling. However, they also acknowledged that being on-site was naturally beneficial, and both had at least one memory elicited by being in the place. On the same subject, younger participants observed a change in the attitude of older participants during the walks, noting that they became more engaged with the place.

"It's nice, it shows that... Michel, he would be... He's passed on. He died a long time ago. He'd be happy to see us here. And your mom, she had class here. She was sitting over there." (Marie-Anny during her TWI)

Learning about the site and changing perspectives on heritage value

Learning more about the site and connecting it to personal stories also changed the perception and value of the place for the younger participants. One of them, who already knew the industrial site where his grandfather worked as a site of urban heritage, shared that re-exploring it with his grandfather enabled him to gain a deeper understanding of the place and its significance. He shared that the TWI has changed his perspective on the site.

"For example, one idea that changed was that I thought it was going to disappear completely. [...] As the interview progressed, when we were on the site, we heard the [construction] worker say that they were going to preserve part of it for heritage purposes, and I thought that was really interesting. Basically, I'd never have given it much thought. I didn't grow up with it, so it didn't have much of an impact on me. I'm not particularly attached to the industrial landscape, etc. to go through history, to understand how the Liège basin developed. I don't think it's essential, and I don't think you have to force it on everyone, but I do think it's nice to preserve." (Gerome during his post-evaluation interview)

While asking questions, the younger participants also shared their own vision of the place as well as their own experiences in contexts similar to the ones shared by the elder.
"It's funny because last year, when I had to come back to high school [after my graduation], it was already very strange for me to come back when I'd only been away for one year." (Nathan during the TWI)

Participants' perceived participation

While both grandparents shared that their engagement would be similar without their grandchildren present, both grandchildren perceived their grandparents to be more engaged when sharing stories with them rather than with researchers they didn't know.
Additionally, although the grandparents mentioned that they were not particularly emotional about returning to the sites of their careers, the grandchildren believed their grandparents were emotionally affected by the visit and thought that it was a deeply personal experience for them.
Both grandparents and grandchildren expressed that they would have preferred if the researchers had taken a more active role in the interview by asking questions and participating more in the discussion.
"Your presence isn't at all distracting, absolutely not, but what you can perhaps do is ask questions during the visit, ask the person you're interviewing, ask what they're thinking at the time. But otherwise, no, your presence is not at all awkward. In fact, it was nice to be able to show you a place we've known and loved for a long time." (Marie-Anny in her post-evaluation interview)

Participants' preparation before the TWI

None of the participants had prior experience with interview methods. In that case, the quality of questions posed by participants can vary depending on their personality and lack of experience. The younger participants, in particular, who were expected to ask more questions, initially felt unprepared but grew more comfortable as the interviews progressed. They found the prepared question cards helpful for initiating the conversation or when they encountered difficulties.

Driving around the neighborhood

Conversations in cars were also found important, as they provided a comfortable setting for the older participants to share their memories while driving around familiar neighborhoods and discussing the evolution of their former workplaces' surroundings. This mobile aspect of the interviews allowed for dynamic interaction with the environment, which sparked additional reflections and stories.
For instance, Marie-Anny shared her nostalgia upon seeing the closure of shops in the village center, a consequence of the economic shifts following the deindustrialization process in the Walloon region. This context added depth to her narrative, illustrating how the broader socio-economic changes had impacted her local community.
Similarly, Charles noted the dramatic transformation of the industrial landscape in Liège, contrasting the vibrant activity of his working days with the current state of dereliction and ongoing redevelopment. These in-car discussions not only enriched the storytelling experience but also highlighted the interconnectedness of personal and communal histories, providing a more comprehensive understanding of the participants' pasts.

DISCUSSION AND CONCLUSION

Our method proved particularly beneficial for younger participants who assumed the role of interviewer, deepening their understanding of the place through firsthand narratives. These experiences, centered on the sharing of personal stories, were found to be more engaging than traditional methods, such as guided tours in heritage institutions.

Some researchers suggest that peer-interviewers can enhance the quality of data, as participants may respond more authentically to someone who understands their life circumstances. Such interviews also empower participants by giving them the lead and opening up a space for expression. Therefore, their use is highly recommended for community research settings. Yet, a key limitation is that peer-interviewers may lack the formal training needed to conduct interviews effectively, which could impact the depth and consistency of the data collected.

Furthermore, the method encouraged younger participants to critically evaluate the heritage value of the site, making it a valuable tool for involving younger generations in memory work. By connecting generational memories, this approach fosters a transgenerational understanding of such places, effectively contributing to heritage sensitization.

While older participants may not always recognize the significance of sharing their memories specifically with their grandchildren, the younger participants valued these moments as opportunities to learn new aspects of their grandparents' lives. However, the younger participants' perceptions of the older participants' experiences were sometimes contradictory. Investigating the reasons behind these differences would be valuable for gaining a deeper understanding, and future studies could include focus group interviews to compare and contrast these perceptions.

Despite the method's minimal guidance, participants were able to apply it successfully. Our experiments with TWI suggest that this methodology is easily applicable in community research settings. However, adjustments are necessary to enhance its adaptability. Our conclusions on these adjustments are summarized below in our improved methodological guide.

IMPROVED METHODOLOGICAL GUIDE

Before the TWI – preparation of the participants

With no prior interview experience, participants—especially the younger ones—initially struggled but became more comfortable as the interviews progressed, finding prepared question cards helpful for guiding the conversation. Therefore, we recommend allocating time for a brief training session before going on-site. Additionally, we suggest preparing basic, inspirational questions to serve as ice-breakers.

During the TWI

The use of a clip-on microphone was found to be beneficial for recording clear audio, especially in environments with difficult weather conditions. It also allowed the younger participant to focus more on the conversation, eliminating the need to hold a phone or device for recording.

After the TWI

Because we found conversations in the car before arriving on-site valuable for gathering general information about past events and the neighborhood's history, we recommend starting the recording as early as possible and continuing it for as long as possible. Meaningful discussions can emerge at any moment. Additionally, we observed that upon returning to the location, participants introduced more themes, eager to connect their experiences with other places in the neighborhood.

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A LOCAL COMMUNITY AGAINST CULTURAL HERITAGE ACTIVISM: A CASE OF THE RUSSIAN ORTHODOX CHURCH ARCHITECTURE IN THE 1990S – 2010S BELARUS

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INTRODUCTION

The community-centred and the participatory approaches to design emerged in the 1990s as a reinterpretation of the 1960s political urbanism movements[1] (mainly situationism and new urbanism) and have had various applications[2] in urban planning[3] and place-making[4] since then. From the early 2000s, community-oriented and participatory strategies are gaining momentum in cultural heritage preservation and heritage studies.[5] Citizen rights to cultural heritage and the role of community in their preservation have been specifically addressed in the "Council of Europe Framework Convention on the Value of Cultural Heritage for Society" ("Faro convention"), adopted in 2006 by the Council of Europe.[6] 2000s and 2010s have seen a plethora of successful heritage preservation projects that employed the participatory[7] and community-centric[8] approaches and a development of various frameworks for implementing those policies.[9]

However, community participation in heritage preservation and management remains a controversial topic[10] both in heritage studies[11] and in the conservation practice. It has long been observed that community-centered policies may ignite conflict when groups with varying interests claim a single historic site[12] and "local community" interests get uncompromisingly prioritized over the interests of other stakeholders, mainly the heritage activists.

The renovation of historic Orthodox churches in the 1990s – 2010s Belarus presents a number of illustrious cases of conflicting interests among various stakeholder groups. This period saw a wave of bottom-up unauthorized church renovations by the Russian Orthodox Church (ROC) parish communities. Though unauthorized renovations on listed buildings are illegal in Belarus, no repercussions followed, as the ROC enjoys a privileged position under the current Belarusian government.[13] In this climate, architects had to develop ingenious approaches to navigate the parish communities' wishes and design preservation projects according to the globally accepted policies and the Belarusian cultural heritage law.

Drawing from the positive and the negative cases of the Orthodox church renovations in the 1990s – 2010s Belarus, the article aims to define viable ad hoc solutions for balancing out the conflicting interests of the parishioners and the heritage preservation activists, and underline the tactics which may prove beneficial when searching for compromise between the competitive stakeholders' interests.

The research employs the review of related news articles on the state and independent websites, newspapers, and news portals; and interviews with architects Henadz Lauretsky and Alena Schasnaya. The case study of parish engagement in Kalozha church conservation is based on the ethnographic and autoethnographic methods, drawing from the author's own experience at the conferences dedicated to the building's preservation. The observation of the government representative, expert, clergy member, parishioner, and activist behaviour allowed to define the approaches which effectively facilitated the dialog between those groups.

ORTHODOX CHURCH RENOVATION IN THE 1990s – 2010s BELARUS: THE HISTORICAL CONTEXT

The underlying causes of controversial Orthodox Christian church renovations in the 1990s – 2010s Belarus are hidden in the turbulent history of the local sacred architecture.

After the adoption of Christianity by the Kyivan prince Volodymyr in 988 and its subsequent spread to the neighboring lands, the Orthodox Christian architecture of the modern-day Belarus (then the realm of the Principality of Polatsk, the Principality of Turau, the Principality of Hrodna, Kingdom of Galicia–Volhynia, and other states) developed within the stylistic trends common for the whole newly-christened Eastern Slavic realm. From the 11th to the 13th century church architecture evolved under a strong Byzantine influence that utilized the cross-in-square plan in decorated brick with the (supposedly) helmet-shaped domes.[14]

However, after the lands of the modern-day Belarus formed a part of the Grand Duchy of Lithuania in the 14th century, Orthodox Christian architecture adopted the styles of the Western Europe: Gothic[15] (example: of St. Michael church, Synkavichi, Hrodna voblast, 1407 or 1511), Renaissance[16] (example: St. Peter and Paul cathedral, 1612, Minsk), and Baroque[17] (example: St. Nicholas church, Mahilyow, 1667–1672). This trend was further expanded after the creation of the Polish–Lithuanian Commonwealth in the Union of Lublin of 1569 and the 1595–1596 Union of Brest, which formed the Ruthenian Uniate Church (also called Greek Catholic) that recognized the Vatican authority while retaining the Eastern Orthodox rites. The 17th and 18th century saw the construction of numerous Orthodox and Uniate churches in the Vilnius baroque and the Sarmatism baroque styles.

From the Partitions of the Polish-Lithuanian Commonwealth (1772, 1793) and until the Russian Revolution (1917) the territory of modern-day Belarus was a colony of the Russian Empire called the Northwestern Krai ("krai" meaning "lands"). At this stage, the local westernized Orthodox architecture was replaced by the new eclectic styles (Russian-Byzantine, Russian, Neo-Russian), which were based on the medieval traditions of Russia's central regions (12th – 14th century Vladimir-Suzdal, late 12th – early 16th century Pskov-Novgorod, 16th – 17th centuries Moscow-Yaroslavl architecture schools).

The construction of Orthodox churches in the newly-created imperial styles was a part of the grand unification project of Russian colonies under a single imperial culture. The creation and forceful implementation of the Russian-Byzantine style was initiated and supported by Emperor Nicholas I (1796–1855) after the Polish November uprising of 1830–1831. In the Northwestern Krai, the mass construction of the "Russian"-style Orthodox churches started after the suppression of the January uprising of 1863–1864, a national liberation and an anticolonial uprising on the lands of the ex-Polish-Lithuanian Commonwealth. The territory of the modern-day Belarus was covered in hundreds of uniform churches in the Russian-style model designs based on the Moscow-Yaroslavl school, which developed in a different state almost 1000 kilometers away from its easternmost parts.

Gothic, Renaissance, and Baroque Uniate and Orthodox churches remaining from the Grand Duchy of Lithuania and the Polish-Lithuanian Commonwealth were rebuilt according to the Russian-Byzantine and the Russian-style mold. Authentic baroque domes were being replaced with the onion domes (a

Moscow-Yaroslavl late 16th century innovation), the stucco decor was altered according to the Russian style models, extra domes were added, etc. Examples of such reconstructions include the Gothic church of St. Boris and Gleb (1519, Navahrudak), the Renaissance St. Peter and Paul cathedral (1612, Minsk), the Baroque Holy Trinity church (1695, Mir).

It is necessary to mention that this implementation of the uniform architecture styles in the Russian empire was a part of a broader 19th century European trend of the invention of traditions, an instrument employed by the emerging nation-states to create secular national cultures[18].

The state atheist regime of the USSR (1917–1991) placed an informal ban on the construction of new churches and initiated the destruction of much historical sacred architecture, accompanied by mass repressions and extermination of the clergy and the closure of religious institutions. Those actions eventually broke the religious tradition and the transfer of both formal and tacit knowledge of Orthodox Christianity. As a result, not only the general population and the remaining clergy, but also the architecture scholars and practicing architects lost knowledge of the local forms of Orthodox Christian architecture.

The invention of tradition of the modern Russian Orthodoxy happened in the late USSR and the Perestroika of the late 1960s – early 1990s. It was shaped by the convergence of Russian nationalism and the Russian Orthodox Church.[19] One of the major symbols of this convergence was the ubiquitous imagery of a cross-in-square white Orthodox Church with mythologized elements of the medieval Vladimir-Suzdal and Pskov-Novgorod architectural schools and anachronistic golden onion-shape domes.[20] This imagery was imprinted in the imagination of the architects, the clergy, and the parishioners who returned to the Russian Orthodox Church after the fall of the USSR.

CONTROVERCIAL RENOVATIONS OF THE 1990S – 2010S ORTHODOX CHRISTIAN CHURCHES

After the fall of the USSR, most Orthodox, ex-Uniate and even a number of Catholic churches were transferred to the rapidly growing ROC parishes that required new places of worship.

From the 1990s to the 2010s, Gothic, Renaissance, and Baroque churches that had survived the 19th century Russian empire reconstructions and the USSR anticlerical policy have undergone a wave of bottom-up unauthorized renovations by the newly formed parishes.

In the rural and small-town communities, it has become a widespread practice to install golden onion-shaped domes in place of the Baroque or Renaissance ones or to attach new onion domes to the basilicas that had never had these architecture elements. It is not just the Baroque, Gothic and Renaissance style masonry churches that fell prey to such illegal renovations, but also Belarusian wooden churches of the 17th–19th centuries, which historically incorporated Baroque elements in their forms.[21] Among the examples of buildings with newly-installed golden onion-domes are the churches of the Assumption of the Blessed Virgin Mary (1590, Novy Sverzhen village, Minsk rayon), the Nativity of John the Baptist (1742, Vishnevets village, Minsk district), the Annunciation of the Blessed Virgin Mary (1794, Malye Lyady village, Smolevichi district), the Virgin Mary cathedral in Hlybokae (1639).

Such renovations go against the state law (called “The law for the historical and cultural monument preservation” until 2017 and replaced by “The Codex of Culture” in 2017), but there is no working instrument for its implementation: the Ministry of culture has no specialists to monitor illegal changes to the listed monuments. When local heritage activists raise awareness of illegal renovations, the parish gets penalised, but the fine is a small sum, and the Ministry of culture cannot force the parish to return the building to the original state. The changes to the building’s appearance eventually get legalised until the next reconstruction.

It is necessary to note that in the case of small rural parishes the intent of such renovations is not malicious: neither the community nor the priest recognise the changes as harmful. Due to the 19th century cultural assimilation by the Russian empire and the 1960s – 1990s Russian Orthodox nationalist revival, the parishioners came to view the golden onion-shaped dome as an essential element of an Orthodox church. The golden onion dome with its supposedly sacred symbolism became an integral part of the identity of the post-USSR believers. The new parishioners who grew up within the atheist Soviet society with no knowledge of either religious tradition or religious dogma and no remaining institutions to gain the lost information from, so they compensated with building their belief system around instantly recognisable Orthodox imagery like the golden domes, the arched windows, or the Eastern-style icons. The potential tactics that heritage activists could have adopted to prevent illicit renovations would have been to educate the rural parishes in the local history of sacred architecture, but mutual mistrust and antagonism between the two groups couldn't bring this approach into consideration.

Unlawful yet legal reconstructions present another case of controversial historic monuments' transformation. The Gothic church of St. Boris and Gleb (1519, Navahrudak) was preserved in an almost intact state until the late 19th century, when the Russian Empire installed golden onion-shaped domes and kokoshniks on its towers and rebuilt the basilica to make it more similar to the sacred architecture of Central Russia. However, during a USSR renovation in late 19th century additions were removed. In 2010, when the state provided funds for the church conservation, Henadz Lauretsky, the architect in charge, decided to reinstall the Russian empire additions. The claim was that as even though early 19th century detailed paintings of the exterior are available, the early 20th century photographs present the latest historically-verifiable historic appearance of the monument. Therefore, as the architect claimed, the reinstalment of the kokoshniks and the golden domes is justified by the guidelines of the 1964 Venice charter for the Conservation and Restoration of Monuments and Sites (*the information was provided during a personal interview with the architect and had been present in online articles which have since been taken down*).

In the case of the Gothic St. Michael church (Synkavichi, Hrodna voblast, 1407 or 1511), which is a grade 1 monument added to the UNESCO World Heritage Tentative List in 2004, there was no legal way to erect a golden dome on the structure, so Henadz Lauretsky created a supplementary kiosk on the church's territory and added a golden dome above. The mid 12th century Renaissance St. Peter and Paul cathedral (1612, Minsk) that had been converted into an archive building in the USSR and subsequently lost a Baroque iconostasis was given a new one in 1996, this time in the 17th century Northern Russian tradition. In 2024, the 18th century Baroque iconostasis of Holy Blessed Virgin's Assumption cathedral (1650) in Zhirovichy is planned for replacement by a new iconostasis created in the Moscow-Yaroslavl Russian style. This replacement contradicts the state law and is strongly opposed by the architect in charge of the cathedral preservation. However, as the local branch of ROC enjoys a privileged position under the contemporary Belarusian government, the Ministry of culture has given the Church full autonomy to conduct any alterations to the cathedral interior, outweighing the architect's expertise (*the information is provided by two anonymous sources and the viewing of the iconostasis reconstruction project documentation*).

These renovations are presented as repairs (conducted either with the architect's help or against the architect's judgement) which are always aimed to make buildings stylistically similar to the Orthodox churches of Russia. They may be interpreted as a neo-colonial practice when those renovations are endorsed by the state and the upper-clergy of ROC, and an act of self-colonisation when it is a bottom-up local initiative.

The heritage activist groups attempted to draw the government attention to unlawful reconstructions with petitions[22] and to raise public awareness through independent press,[23] but after the mass-protests of 2020 both pathways have become illegal and may result in a prison sentence for the initiators.

SEARCH FOR THE COMMON GROUND: THE CASE OF THE KALOZHA CHURCH CONSERVATION

The conservation and restoration of the St. Boris and Gleb church in Hrodna (also known as Kalozha church) presents a promising case for finding a common ground between various groups invested in a historic site. The monument was built in the second part of the 12th century, and its various stages are preserved in etchings, paintings, and drawings from the 16th to the mid-19th century. In 1853, a year after detailed technical drawings with exact measurements of all the elements of the church facades had been made, the southern wall was destroyed by a landslide and fell into the Neman River. 1889 saw the collapse of the southern apse. In 1935, a fundamental conservation attempt was made by the Polish architects and archaeologists, who created a temporary and easy-to-dismantle wooden wall in place of the lost one. In modern Belarus, thechurch is a grade 1 monument added to the UNESCO tentative list in 2004.

Since the early 1990s, various proposals to the restoration were made. In 1992, Henadz Lauretsky suggested to restore the church as it may have looked at the time when it was built, while Vadzim Hlinnik proposed to recreate the church according to the 1852 technical drawings made right before the church collapse. At a later stage, Lauretsky proposed a modern brick construction which would have followed the lost outlines in a contrasting texture.

The first two proposals gained the biggest support from the government, the parishioners, the general public, and a number of heritage activists and architects (*as was observed by the article author in the 2000s and 2010s public discussions about the church fate*). However, these popular proposals contradict the 1964 Venice charter (still a crucial guideline for the monuments from UNESCO tentative list). Based on these considerations, the architect Alena Schasnaya, appointed with making the conservation project in 2013, held a professional belief that the reconstruction of the wall should be done in the spirit of the Venice Charter. She observed that the 1935 renovation may be considered a cultural heritage object in its own right, being an early monument of scientifically-based and attentive conservation that preserved the integrity of the remaining elements (*from the personal interview with the architect*). In the architect's view, the proper approach would have been to recreate the missing walls out of light wood in the spirit of the 1935 restoration. Rather than forcing her vision upon all the invested parties that favoured a full recreation of the missing elements, A. Schasnaya decided to present the alternatives in a very delicate and unassuming manner.

Under A. Schasnaya's suggestion, the priest in charge of the church (Andrej Balonnikau) with the parish organized scientific conferences in 2015 and 2016, which brought together the heritage preservation and ICOMOS experts, architects, art and architecture historians from Ukraine, Poland, Belarus, and Russia (all of which were highly-engaged people who took the church's fate to heart but had polarized opinions on the preferable conservation approaches), local activists, city council members, policymakers, members of the clergy, and the government press. The parishioners actively participated in the conference from preparing the venue and the meals to taking part in the discussions.

Thanks to the chosen format, the clergy, the local administration, and the parishioners saw the experts reach a consensus in heated discussions rather than listen to a top-down lecture. The motivations and reasonings behind the conflicting proposals were made clear to the local attendees. The conferences produced roadmaps and guidelines for the upcoming conservation works. The whole process was covered by the state newspapers. As the public was made aware of the pro and contra of different

proposals, the public opinion eventually shifted to A. Schasnaya's proposal. The resulting 2017 design was a wooden construction reminiscent of the initial 1935 conservation project but with pilasters mirroring those of the original brick wall (Figure 1).

Figure 1. The St. Boris and Gleb church after the 2017 restoration and conservation

CONCLUSION

The Kalozha church case demonstrates the importance of equal ground in the conversation between the architects and the public. The experts may provide the necessary data, inform the local community in a respectful and open manner about the inner logic of various design solutions, and explain the responsibility that comes with each decision. The open discussions with experts of conflicting visions allow the stakeholder groups to make an informed decision on their heritage site. The horizontal conference format facilitated a shift in the power balance. It was not the community that was invited by the architects or the city administration as one of the discussion participants, but the other way round: the parish invited the experts to a conference it organized. This shift allowed the parish community to retain its agency and strengthened its emotional engagement in the monument preservation.

NOTES

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URBAN DESIGN FOR SMALL TOWNS IN LOUISIANA

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INTRODUCTION

The Community Design Workshop (CDW) is an Institute within the School of Architecture and Design at the University of Louisiana at Lafayette in Lafayette, Louisiana. The CDW has been involved with community urban design projects in architecture and planning for over twenty-eight years. During this time, the CDW has been involved with small town projects that promoted the revival of their downtown areas and neighborhoods. Small towns have been particularly vulnerable to twentieth and twenty-first century development. The expansion of suburban areas, characterized by the proliferation of American strip developments and suburban housing, has often led to the deterioration and underdevelopment of core areas within these small towns. “Suburban sprawl, now the standard North American pattern of growth, ignores historical precedent and human experience. It is an invention conceived by architects, engineers, and planners, and promoted by developers in the great *sweeping aside of the old* that occurred after the Second World War.”[1] The CDW has undertaken various urban design initiatives aimed at revitalizing small towns across 14 parishes in Louisiana.

The CDW has collaborated with Main Street organizations, the Louisiana Department of Transportation and Development, and various grant agencies to secure funding for small-town redevelopment projects. This paper highlights two recent examples of small-town redevelopment projects focusing on the methodologies and approach employed by the CDW to build stakeholder engagement through direct interaction with small town-residents, local businesses, and municipal leaders. The use of charrettes and public meetings is central to this process, enabling the CDW to develop urban design proposals that reflect the needs and aspirations of the community. “This citizen involvement is most effectively done when there is a clear and consistent means of incorporating public opinion on an ongoing basis into the development process.”[2] The collaborative nature of these efforts involves a multidisciplinary team, including architects, planners, and engineers, working collaboratively to produce comprehensive, relevant urban design proposals.

THE COMMUNITY DESIGN WORKSHOP

The CDW represents one of six design research initiatives in the School of Architecture and Design at the University of Louisiana at Lafayette. Over the past twenty-eight years, the CDW has produced over 120 projects that have focused on planning for small towns, regenerating neighborhoods, participating in university master planning, designing linear parks along transportation networks, and restoring hurricane-devastated communities in southwest Louisiana. The CDW’s mission is to serve as an outreach institute, engaging with the community on urban design issues and providing

undergraduate and graduate architecture students with practical experience in addressing real-world design challenges.
The CDW operates out of an office in Lafayette and maintains an "on-location" design studio within the communities it serves. This approach, often referred to as "squatting," enhances community involvement by providing local residents with direct access to the design process through meetings, charrettes, and ongoing interactions. The small-town projects that have been undertaken by the CDW illustrate the benefits of public engagement in the design process, demonstrate how student learning is enriched through practical experience, and contribute to the advancement of urban design within both urban cores and traditional neighborhoods.

Approach

The CDW's approach embodies four distinct methods for engaging the public. These include 1) conducting transparent public meetings, 2) deploying mobile sidewalk studios within the study area, 3) organizing and conducting public charrettes, and 4) establishing an office in the study area, a practice referred to as "squatting." This collaborative strategy emphasizes stakeholder involvement by giving them a voice with the process. This approach strategically categorizes different engagement methods according to target audiences, varied venues, and anticipated outcomes. The practice of public meetings was borrowed from other established precedents. Mobile sidewalk studios were conceived as a solution to facilitate public participation in a more informal setting when conventional approaches were deemed insufficient. Public charrettes were modified to adapt to the skill sets of the undergraduate and graduate architecture students. Squatting was adopted from architectural design practices popularized in the 1970s. Notably, many of these approaches were established prior to the adoption of Context Sensitive Solutions (CSS) by the Federal Highway Administration.

Public Meetings

The CDW Team begins each project with a public meeting aimed at introducing the project's goals and processes to stakeholders and developing initial interactions between the Team and the community. Typically held in local venues such as churches or community centers, these meetings attract a diverse audience, including residents, professionals, property owners, business owners, and city officials. Stakeholder diversity is useful at this juncture in the process because it allows the CDW Team to consider a wide range of perspectives which inform and shape the project's development. The frequency and number of subsequent meetings are determined based on stakeholder input, ensuring ongoing responsiveness to community needs. The initial public meeting primarily is identified as a kick-off event with numerous meetings to follow while culminating with the public final presentation.

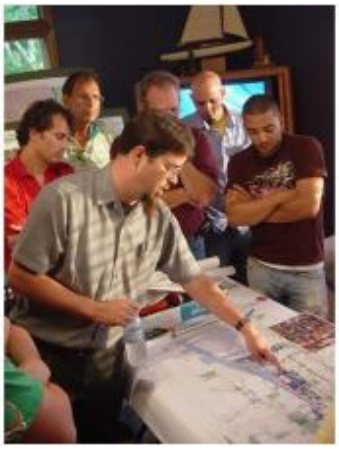

Figure 1. Public Meeting discussions and exchange of ideas with stakeholders

Sidewalk Studios

The mobile sidewalk studio, the most informal and improvisational approach, is conducted in neighborhoods and/or downtowns, and allows the CDW Team to meet people on the street. CDW Team members visually survey and record the context, conduct interviews and distribute questionnaires and comment cards. The informal venues, typically held on the stakeholders' own turf, are often conducted with a one-on-one format which facilitates candid communication between the CDW Team and community members. This setting allows team members to gain a deeper understanding of the personal significance the project holds for stakeholders. Multiple sidewalk studios may occur throughout the project in response to stakeholder feedback and input.

Charrettes

A useful method for conducting focused feedback sessions is the design charrette. Charrettes are short, intensive design workshops where stakeholders, including members of the community and academic participants, engage in exchange of ideas and problem-solving exercises. “Most people are not familiar with the word “charrette.” A charrette is a design activity where the participants are assigned a very complicated design project and are expected to bring it as close to completion as possible within a very short time. Members of the School of Architecture at the Ecole des Beaux-arts in Paris…”[3] Like the public meetings, charrettes are usually held in a venue within the stakeholder’s neighborhood. Recognizing that a resident will likely have a different perspective than a city official, the CDW may organize multiple charrettes aimed to address differing issues and /or to target different stakeholder groups. The goal of the charrette is to generate positive strategies for dealing with complex planning issues, create illustrative and evocative visualizations – such as vignettes or perspective drawings – that are easily assessable to stakeholders, and to demonstrate to stakeholders that their ideas are heard and considered to be important by the CDW Team.

“Urbanism is a special condition of cities and towns independent of their size or density, and results when buildings touch and are not free standing. Attached buildings combine into common urban walls, which are necessary to both define exterior space and subdivide it.” [4]

Squatting

The CDW has always strived to open offices with the community to welcome and allow public access to the design process. Examples of previous office space have included space within planning organizations, city hall, downtown commercial buildings and even in vacant single-family homes. Each space embedded within the study area contributed to the open and informal exchange of ideas.

Figure 2. Background buildings defining square with church as dominant set-piece

QUALITIES OF SMALL SOUTHWEST LOUISIANA TOWNS

Small towns in southwest Louisiana are characterized by their distinct architectural and spatial organization, which reflects both historical and environmental influences. Typically composed of one- to two-story buildings, these towns exhibit a coherent relationship between structures, facilitated by a tradition of self-zoning and a clear distinction between public and private spaces. These small towns have a clear, established and readable center. The town centers are often marked by significant landmarks such as courthouses, churches, or main streets, which serve as focal points of community activity and public spaces with definable boundaries. “Public squares dispersed through the city help interconnect street patterns and short cuts into the web. They also have a civic spatial attribute. When successful, they can represent the city they helped form.”[5] The overall structure or morphology of these towns is closely linked to major topographic features like bayous, bays, or canals, which guide the town's orientation and development. This layout was influenced by the French Long Lot cadastral system, where narrow plots of land front on the bayou or river which facilitated the transportation of goods during the colonial period and 18th century development. Typical lot sizes ranged from 20 to 40 arpents along the waterway, extending 40 to 80 arpents in depth, a pattern observable in French colonial developments across various water routes, including the Bayous of Louisiana and the Mississippi River.

Figure 3. Southwest Louisiana land pattern structured on French Long Lot[6]

Traditional architecture for southwest Louisiana adapted to the semi-tropical environment with commercial buildings designed to incorporate covered walkways and housing with wrap around porches. While the predominant building scale remains modest, larger structures were reserved for use as significant civic and religious buildings. The landscape of these small towns is enriched by dense foliage, including live oak, crepe myrtle and bald cypress trees along with other flowering plants all contributing to a distinct sense of place. Despite their historical charm, many small towns have evolved to include modern developments such as big-box stores, car dealerships, and suburban housing, reflecting the broader trends of 20th and 21st-century urban expansion.

SMALL TOWN CASE STUDIES

Delcambre, Louisiana

The small town of Delcambre, situated in southwestern Louisiana along Highway 14, is divided between Vermilion and Iberia Parishes. Long celebrated for its thriving shrimping and fishing industries, Delcambre fronts the Delcambre Canal (also known as Bayou Carlin) and has direct access to the Gulf of Mexico. Positioned south of Lafayette and approximately twelve miles east of

Abbeville, Delcambre is host to an annual Shrimp Festival, a major Louisiana tourist attraction. On September 24, 2005, Hurricane Rita's landfall caused the Delcambre Canal to flow north, reversing its natural course and leading to severe flooding that devastated the town. In response, the CDW was tasked with developing a model for the town's recovery and revitalization. The CDW engaged itself with studies and produced proposals generating options for the town's revitalization by creating workable settings for business and leisure while keeping the spirit of the small shrimping town alive. "In a good city, the public realm offers many activities, celebrations, festivals that bring all of its inhabitants together, events that bring opportunities for its citizens to be together, not in the specialized roles and functions that they usually occupy, but as full human begins!"[7]

Figure 4. Boardwalk, Delcambre Canal creating a sense of place and character

The project included raising new and existing buildings to meet FEMA's mandate of a minimum elevation of 10 feet above the flood line, which often necessitated elevating structures by at least 8 feet. This design consideration not only addressed flood risk but also integrated features such as screened porches and dining facilities, ensuring functionality while embracing the local culture. Delcambre's strategic location along Highways LA 14 and LA 89, places it in a position as a regional center and acts as a connector between Abbeville, New Iberia and Lafayette. The CDW's goal for the Delcambre project focused on stimulating economic growth and rejuvenating the town, while restoring its role as a central player in Louisiana's shrimping industry and cultural landscape.

Proposal for Waterfront Development

This plan involved creating a retail waterfront with a raised boardwalk along the canal offering a series of plazas to serve as boat launches, fishing spots and other gathering spaces. The bottom floor of these areas are open air structures (in accordance with the new flood restrictions) could accommodate space for restaurant seating, other boat launches and extensions of ground level plazas that would also provide visual access to the festival grounds, the canal and the marina. "This plan involves creating a retail waterfront with a raised boardwalk along the canal offering a series of plazas to serve as boat launches, fishing spots and other gathering spaces."[8] The new marina inlet from the canal featured a civic area, including a monumental town hall building at its end. A large pedestrian patio at the corner of the marina provides an outlook over the canal, while banners, trees, and lights around the boardwalk provide pedestrians with a sense of place. A new grand hotel was proposed to be built to the south of the bayou area.

Land Development

A system of water inlets was proposed to branch off from the canal and cut into the rear of residential properties, raising land values. These inlets run parallel to the system of existing roads to create two systems of transportation for each residential unit. By allowing boat parking directly under homes, owners would have convenient access, fostering a recreational boating community and helping reduce street traffic. Houses were positioned to front the street edge, providing a larger backyard gathering space along the water. All canals would have bulkheads; culverts would connect all dead ends allowing for the continuous flow of water. The elevation of canals should slope down from the furthest canal towards the river to avoid dead zones within the waterway system.

Structures along the canal that have unique character and/or historical significance to the town were preserved and commercially renovated to allow visitors to experience these contexts in new ways, while maintaining the spirit of the community.

A new Shrimp Festival building on the grounds would double as a public park to connect with the marina and also would serve as an urban billboard to advertise upcoming activities and events.

Washington, Louisiana

Dating back to 1720, the historic town of Washington is one of the oldest settlements in Louisiana. Its location on Bayou Courtableau established the city as a steamboat port, with shipments of cotton, cattle and sugar. With many of the city's homes and buildings listed on the National Register of Historic Places, Washington offers antebellum homes, bed and breakfast facilities, and many antique markets.

"The CDW's goal for Washington was to establish its Main Street as a rich space for the community to work, shop and play through the introduction of landscape architecture, courtyards, pedestrian friendly walkways while preserving its existing architectural artifacts."[9]

The project's aim was to provide residents with a renewed sense of identity and culture through architecture, and to develop streetscapes in an effort to preserve and improve the quality of life for the residents of Washington.

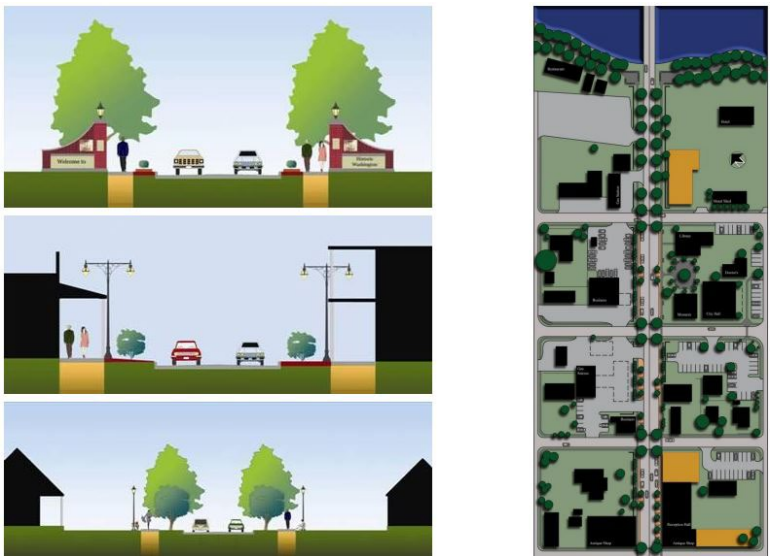

Figure 5. (L-R) – Main Street, street section; Master plan for streetscape

Streetscape

Streetscapes were viewed as important environments for automobiles as well as pedestrians. People feel more comfortable driving or walking along streets that hold their interest. Streets can provide a comfortable feeling of belonging and identity, as well as a strong sense of enclosure, when a tree-lined boulevard provides separation from an uninterrupted urban wall.

Trees help buffer the pedestrian from the road and provide shade. Street furniture, lighting fixtures and sensitive signage all contribute to creating an interesting streetscape with a strong sense of identity. Sidewalks were defined and separated from the asphalt roads with paving materials. Handicap accessible sidewalks were integrated into the downtown streetscape, providing improved access for the community at large. Paving materials were changed to enhance the character as well as to define pedestrian walkways and intersections. The landscape proposal offered a mixture of trees including cypress, evergreens, and crepe myrtles along with a variety of flowering bushes.

Streetscapes encourage social and business activity by creating and framing points of interest, a concern for the town's citizens. Ultimately, the streetscape proposal helped restore and repair the downtown fabric.

Parking

Reconstructing parking conditions improved access to downtown businesses. This was achieved with a combination of on-street parking and organized parking courts in the center of the block, offering access to businesses and capturing the overflow parking from downtown.

Infill

Fragmentation of the existing downtown block was addressed with positive infill buildings that addressed the streetscape and activated the street at a human scale. Vacant properties were revitalized by infilling with new architecture into the once empty void. "Building facades must maintain a consistent street edge, except to provide pedestrian passageways to rear parking areas. Ground-floor space shall be reserved for pedestrian-oriented retailing and services, with offices and housing above."[10] These urban buildings were aligned with the sidewalk, granting access to commercial properties while providing office space and housing on the upper floors. Continuity of the architecture was achieved with code guidelines regulating setback, scale, proportions, materials and style for new buildings. This helped ensure an aesthetic and harmonious connection within Washington and provided a solid urban edge.

CONCLUSION

The Community Design Workshop (CDW) has been a cornerstone of design research and outreach at the School of Architecture and Design at the University of Louisiana at Lafayette, demonstrating a commitment to addressing real-world urban design challenges. Over its twenty-eight-year history, the CDW has engaged in a diverse array of projects, from revitalizing hurricane-damaged towns to enhancing small-town character through thoughtful design. Its innovative approach, which includes public meetings, sidewalk studios, public charrettes, and the practice of "squatting," illustrates a model of participatory design that prioritizes community engagement and practical learning.

Through its work in towns like Delcambre and Washington, the CDW has shown how tailored design solutions utilizing local history, culture, and environmental conditions can enhance the built environment. In Delcambre, the CDW's strategies not only addressed flood risks but also revitalized the town's economic and cultural landscape, reinforcing its role as a vibrant center for the shrimping industry. In Washington, the emphasis on streetscapes and historic preservation rejuvenated Main Street, thereby enhancing the quality of life for residents and visitors alike.

The CDW's methods have always strived to reflect the understanding that exists with the practical and experiential aspects for creating urban design. As it continues to bridge academic research with community needs, the CDW demonstrates the collaborative practice of being engaged to produce responsive design practices. Its ongoing projects promise to further enrich the communities it serves, embodying a commitment to sustainable, inclusive, and context-sensitive design.

NOTES

[1] Andres Duany, Elizabeth Plater-Zyberk, and Jeff Speck. *Suburban Nation.* (New York, North Point Press, 2000) 4.
[2] International City/County Management Association (ICMA), the US Environmental Protection Agency (EPA), and Smart Growth Network. *Getting to Smart Growth 100 Policies for Implementation.* (Published by the International City/County Management Association (ICMA) and the Smart Growth Network with EPA's support, International City/County ICMA Management Association, 2002) 81.
[3] Patrick M. Condon. *Sustainable Urban Landscapes.* (Vancouver, British Columbia, the University of British Columbia, 1996) 11.
[4] Michael Dennis. *Temples & Towns.* (Oro Editions, Gordon Goff: Publisher, 2022) xi.
[5] Nahoum Cohen. *Urban Conservation*. (Cambridge, Massachusetts, The MIT Press, 1999) 195.
[6] Google Maps. "St. Matinville, Louisiana" Manipulated image. Accessed June 2024.
[7] Suzanne H. Crowhurst Lennard, Sven von Ungern-Sternberg, and Henry L. Lennard. *Making Cities Livable.* (Carmel, California, A Gondolier Press Book, 1997) 15.
[8] Community Design Workshop. *Waterfront Development*. (Lafayette, Louisiana, University of Louisiana at Lafayette School of Architecture and Design, 2008) 7.
[9] Community Design Workshop. *Washington Streetscape Proposal*. (Lafayette, Louisiana, University of Louisiana at Lafayette School of Architecture and Design, 2010) 2.
[10] Randall Arendt with Elizabeth A. Brabee, Harry L. Dodson, Christine Reid, and Robert D. Yaro. *Rural by Design: Maintaining Small Town Character*. (Chicago, Illinois and Washington D.C., American Planners Association, 1994) 119.

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COLLABORATIVE PLANNING TOOLS FOR URBAN COMMONS FOR TACKLING SOCIAL AND CLIMATE VULNERABILITY -THE CASE OF GLASGOW

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INTRODUCTION

Making Glasgow a sustainable city; policies and strategies

Glasgow is a city that has navigated a significant experience of transition from an industrial to a post-industrial city, featuring currently a diverse creative, knowledge and service economy. Yet, significant challenges like deprivation also prevail: much of the deprivation in the whole of Scotland, is concentrated in the post-industrialisation areas like Glasgow City (as well as the surrounding towns in the Central Belt and in the West of Scotland). These areas suffered high levels of unemployment as light and heavy industries and mining declined in the prevailing socio-economic conditions during 1970s and 1980s. The city has featured significant changes since then with quality of life increasing while it embarked on a Green and Netzero innovation journey, aiming to achieve a fair transition within a decarbonized city region. This paper analyses Glasgow's sustainable city strategy and relevant work around the development of its District regeneration frameworks on the basis of strategic commitments for the city like the Glasgow Green Deal from the lens and perspective of urban commons. It seeks to identify how social, next to climate vulnerability are included in those frameworks and how participatory approaches are deployed in the urban planning processes to enable better governance of 'urban commons'.

The paper seeks to examine practices and 'tools' under collaboratively planning as defined by its front runners, John Forester and Patsy Healey. The *development plan or any other policy document* prepared under the condition of collaborative planning would contain discourses and related `systems of meanings' of the stakeholders.[1]

Here we seek to assess methods of engagement or partnership in such plans first and secondly how this may be informing considerations of socio-environmental vulnerabilities around urban commons that inform spatial planning. Faehnlea and Tyrväinenb[2] propose an approach to evaluating collaborative planning looking into integration of citizen experience and integration in decision making. They identify three key aspects to evaluate the extend of collaborative planning process in the development of plans; *knowledge integration, meaningful involvement and functioning governance* and we focus more on involvement and a bit less on knowledge integration due to the nature of evidence we analyse.

Urban commons as an analytical lens for studying collaborative planning

The concept of ***urban commons*** has gained prominence as a means of fostering community engagement, enhancing social cohesion, and ensuring equitable access to shared resources. Feinberg et al[3] provide a structured framework with key parameters for considering the socio-economic and ecosystem services benefits from urban commons, next to the challenges from their governance and management.

They also provide an initial *taxonomy of urban commons* which is vast and expands to global and typologies like cultural or traditional commons (where they include parks and green) next to traditional commons (forests, agriculture and land tenure) which is useful for our study, as our focus is on collaborative planning tools and approaches to spatial decision making at the city level. In Feinberg et al, the benefits from 'urban commoning' in urban gardens for example brings benefits that include cultural practices, land availability and reduced privatization next to environmental sustainability.

Social vulnerability through deprivation and inequalities metrics

There are many conceptualisations of social vulnerability and ways to consider who is vulnerable and why.[4] In urban settings, poor health, income deprivation, high levels of social and private renting, lack of local knowledge and limited mobility are all important contributors to social vulnerability.

There is, however, general agreement that the most important characteristics relate to five domains: Susceptibility to harm, ability to prepare, ability to respond, ability to recover but also Service access and community support (which may typically not be viewed as component of vulnerability as we will see below). Social vulnerability via the prism of harm or risk exposure and inequality (financial or social that describes the base difference in resources and services access) has been measured via multiple deprivation indexes (health, socio-economic etc).[5] Glasgow remains the most deprived city and local authority area in Scotland. The following specific statistics for Glasgow depict the situation of the city: almost half (44%) of Glasgow's residents, 281,000 people, reside in the 20% of most deprived areas in Scotland. In contrast, nearly 37,000 people (6% of the population) live in the 10% of least deprived areas in Scotland (based on 2020 population estimates).

Climate vulnerability

A focus on deprivation alone does not necessarily reflect a community's vulnerability to a climate risks, like flood (although flood vulnerability is significantly influenced by income deprivation, as clearly demonstrated by Tapsell et al. [6]).

Risks emerging from changing climate conditions could be 'catholic' in cases of pollution (eg. air quality affecting all or urban core residents across a whole city) or place-specific like in the effects of catastrophic flooding in prone neighbourhoods or spatial 'pockets' of a city.

The combination of social and climate vulnerability has been recently used to indicate the hardest hit segments of the population in such events and can inform emergency/reactive planning solutions. A recent study by ClimateXchange for all Scotland identified the most socially vulnerable neighbourhoods in 'large urban areas' are three times more likely to be exposed to high temperatures than others, and 50% more likely to be exposed to poor air quality.[7]

Planning official documents for the Glasgow City centre alone, refer to key climate risks like flood risk level assessments provided by SEPA (with flooding being a key climate vulnerability for Glasgow). Collaborative planning practices may support both in the process of engaging the most vulnerable households with the risk awareness but also wider citizens with adaptation and mitigation planning interventions.

METHODOLOGY

In order to describe and assess the collaborative planning tools in the case of Glasgow and tis integration of socio-environmental vulnerability we follow the next steps;

-Firstly, we map the urban development guidance and frameworks for regeneration across levels in Glasgow through specific documents (looking at Strategic Development plan and Framework, placemaking framework at district level through DRFs/ District regeneration frameworks)-

-Then we analyse presence of collaborative planning through mapping participatory and engagement approaches applied in the development of those documents,

-Briefly review and assess integration of vulnerability components (social and climate) for communities across the districts of the city. at the level of Strategic development plan (for the city centre) and within the Glasgow Green Deal technical document.[8] This is used as a strategic document and indicative of city-wide approach to resilient living, environment al sustainability and justice.

-Finally, we critically assess success factors regarding inclusion and equality especially for vulnerable communities (of the placemaking strategy) again with specific reference to the role of planning with participatory tools.

These central challenges of space, affordability and sustainability are all critical to new housing design and they are intrinsically linked. The cost of building a dwelling is related to its size – and both relate to the environmental impact that it will have – as illustrated in Figure 1.

District regeneration Frameworks and the Glasgow districts as commons

Glasgow City Council appointed multi-disciplinary teams to develop District Regeneration Frameworks (DRFs) for the City Centre's 9 Districts in 3 phases.[9] Those plans will be delivered over the next decade through the DRFs while consultation for their development saw over 4,300 people participating and helping to shape these. Participation and consultations, fed into a detailed placemaking guidance (and subsequently practice that we use as our primary sources for this analysis. Using a pioneering, innovative and interactive process of (described by the team as 'sustainable urban planning') the DRF approach was seeking to be 'community-led' with 'co-design and participatory planning' principles but also enable evidence-based urban data analysis. The ideas and projects proposed within those framework documents are described as a 'Shared Action Plan' for all stakeholders with an interest in or responsibility for each District.[10] Combined North-East 'handbook for regeneration'[11] were also co-produced to accompany those and share a multi-district approach in that area which is highly affected by segregation, social and spatial.

Strategic Development Framework and its components -inclusion and vulnerability considerations

As the DRF plans do not contain a clearly written set of measures in relation to social or climate risk and vulnerability across districts or as a methodological approach, for the scope of the analysis here the Strategic Development Framework (SDF)[12] is also used for the review, almost acting 'in lieu of' priorities for performance across the city centre districts. At Strategic level the Strategic Development Framework (SDF) sets out a vision for the future evolution of Glasgow City Centre over the next 30 years (to 2050). Within that lies the spatial strategy, which identifies four key components for the city centre: (1) Vibrant, (2) sustainable, (3) connected, (4) green/resilient. The City Centre is currently home to around 20,000 people or 3.5% of the City's population having a relatively low density compared to other cities and is in the epicentre of changes around lifestyle, demography and use of historic environment spaces while green in its periphery (around M8 ring road) are in focus[13.]

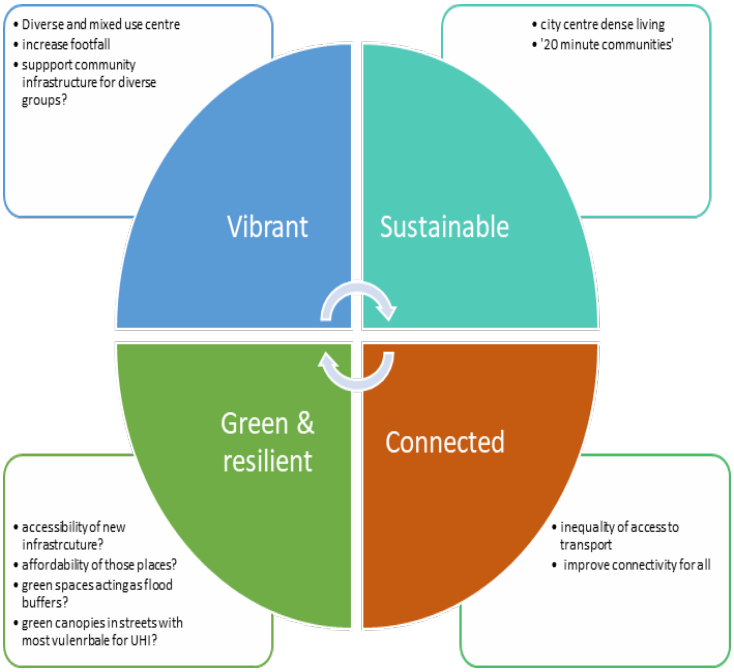

Figure 1. Four key components of the city centre strategy-reflections on relevant inclusion and social vulnerability considerations in the outer quadrants by each priority (Source: author)

The community consultations required the city planners to take a fresh approach to deliver lasting change in districts like Cowcaddens, Townhead, the Learning Quarter and the Merchant City.

In that sense the sustainability component (2) is, in the guidance, interlinked with the other three. Within the sustainability aspect, the aims of the city is to promote city centre living, looking into supporting the development of 20 minute communities[14] but also enhance the historic townscape of the City Centre by facilitating repairs that can support the densification aspects of the strategy. Without doubt, the densification ambitions of the city centre ('doubling the residential population, to reach up to 40,000 by 2035') include multiple challenges due to new (price and residential) pressures and change in character in the city centre upon their implementation. Those are proposed together with the ambition to sustain a dense and diverse population, with a vibrant mix of ages and cultures in the city centre.

The green and resilient component (4) of the guidance covers more aspects relevant to capacity for climate resilience and shaping 'a net-zero carbon place', both of which have implications for the accessibility and affordability of those places and subsequent pressures they may put on vulnerable populations across the 9 districts. Glasgow has significantly high ration of green spaces per capita for the UK (25.53 sqm for city centre as per Green Space index data[15]), yet Glasgow city centre was found to have one of the lowest UK normalised difference vegetation index (NDVI).[16] Also accessibility of those 'on foot or within 10min walk' is not necessarily well distributed across residential areas in or around the city centre. The strategic plan identifies some place-specific activation of existing or creation of new 'urban green commons' like in the cases of Blythswood Hill - a residential neighbourhood that could accommodate a new child friendly 'urban park' in space reclaimed from the street and that of Vacant development sites (including Broomielaw Riverside, Candleriggs, High street sites) – with potential to provide new public spaces to 'serve their (local) communities'.

The DRFs analysis of opportunities for local green space creation at neighbourhood and district levels will feed to the preparation of the Green-Blue Integrated Infrastructure Strategy and support the Glasgow Open Space Strategy Delivery Plan.

The connected component (3), similarly, covers links to inequality of access to transport of amenities and aims to improve connectivity for all through a focus on public transport routes and active travel solutions.

Those components offer significant complexity and signify priorities for the city planning directions and feeding into district level management and action plans. Little inclusion of social connectivity or socio-spatial segregation aspects[17] are noted at this level. Such factors that may affect population level dynamics and individual choices in terms of mobility and perceived accessibility.

Climate Planning for urban commons: Green and cultural infrastructure projects and vulnerability

Due to the placemaking focus of the district documents of DRFs and the scale of the SDF, there is little coverage of specific urban commons 'projects' in greater detail. We seek to include key activities /cases from 'The Green deal' technical document, a key commitment in Glasgow's Climate Action Plan .

We look for examples of collaborative planning around urban green and cultural commons (i.e. collectively managed parks, community gardens, and allotment areas or similar spaces[18]).

Cultural and media organisations are mainly cited in the 'role of culture for supporting the Net Zero goals for the city', but very little mention of historic or public cultural spaces is included, or their role for poverty alleviation or their function as vital social infrastructure hand in hand with green infrastructure.

Case studies on use of such green commons or green infrastructure that showcase a very ambitious and innovative approach by Glasgow city, aiming to increase green coverage and proofing the city from climate risk/vulnerability, include the *Trees AI project or Clyde forest* (the planting of 18 million trees across the region in the next decade) which both contribute to emission reduction and indirectly to health risks for city-dwellers with vulnerable health. None of those, from their nature, refer to development of *new* publicly used defined space or involvement of users in longer run maintenance for example. Previous recent applications of Trees AI did integrate and considered smart technology and big data to 'care for' mixed vulnerability components (health and climate risk) like in the recent Stuttgart application of this approach ([19]). Such approaches though may not seek prioritise needs of spatially segregated groups or see to 'softer to map' access needs for those residing far from 'action' areas.

PARTICIPATORY APPROACHES AND TOOLS TO INCREASE ENGAGEMENT

A development strategy connecting communities, stakeholders and funding offered a lot of connecting opportunities. Community-engagement policy and plan-making fostering a sense of ownership by the residents and set out the agenda of all relevant stakeholders that may need to be engaged for the future developments.

Some tools and approaches that can enhance participation observed through the process of shaping the DRFs include:

1.Adoption of a Living Lab approach (with Community Hubs[20] and/ or Urban Rooms) employed in NE Districts to bring together local communities, and expert individuals / organisations / Higher and further education, businesses active in the area to test ideas, innovate, apply research into practice.

2. Tools like the '(Y)our City Centre Performance Monitor' proposed to assist monitor and refine DRF implementation at local level and refine actions within stated climate-related ambitions (in Climate Emergency Implementation Plan and Circular Economy Route-Map[21).] Those include establishing metrics and ensure 'public access', (or some levels of cross-cutting considerations that include access and equity).

3. Aligned with the DRFs, the Open Space Strategy Vision[22] sets out that by 2050, there will be network of good quality, well-distributed, multi-functional open spaces, and connecting infrastructure, that contributes positively to the City's livability, the health and wellbeing of the City's population and of its flora and fauna; and the long-term resilience of the City in relation to the climate change. The Connecting Nature Project,[23] developed CO-IMPACT is relevant, decision-support tool for this, allowing officers to create impact assessment plans for their NBS projects and this way consider adverse effects to populations or amelioration of living conditions thanks to NBS project development.

5. Horgan and Dimitrijevic[24] discussed before the capabilities of Place Standard tool, a tool used across Scotland for collaborative planning. Currently used by Adaptation Scotland in great extent and expanded to a Climate-lens version[25] it allows for resilience considerations that span decarbonization to nature and inclusion aspects. Place Standard and SP=EED (a practical guide to undertaking effective community engagement in planning)[26] are included in best practice guidance for local plan development engagement by the council.

Meaningful involvement of communities in DRFs

Participation in urban planning for the DRF development spans at least a 5-year period with the first part of the work undertaken in 2016 and 2017 and co-designed with more than 4,000 estimated contributions from Glaswegians, sought to lock in best practice in sustainable urbanism. They utilised a range of online participatory planning techniques devised to engage with hard to reach and under-represented groups in each District. This has resulted in over 4,000 contributions via over 200 meetings, 54 workshops, 44 online community events and webinars, 20 no. 1 to 1 interviews, 3 Freephone line sessions (to minimise digital exclusion) and 2 dedicated project websites capturing issues, ideas and solutions from Glaswegians.[27] A website has been launched inviting contributors to share comments and ideas about how to improve these four districts in future.

Citizen engagement in local level is invited through mechanisms like the Local Place Plans. The Community Empowerment (Scotland) Act 2015 defines who can submit plans and ensures control by the communities that represent the areas of those plans.[28]

Two initiatives with key significance for engagement with urban commons and enabling bottom-up action are described below:

-*Build (y)our neighbourhood*: was a key initiative in terms of shaping community -driven work and ideas for the future of the districts. A hands-on invitation to citizens to engage in ideas for how to improve their immediate neighborhoods' with inclusion of local skills and expertise and custom-build projects that support sense of ownership and empowerment (eg. where community activity was not present).[29]

-*Short-term place activation strategy and the role of community hubs*: Involving, activating, and empowering communities from 'day 1' required a short-term place activation strategy in parallel to the preparation of complex long-term projects. Responding to community needs through direct interventions and as part of activation, the inclusion of a community manager for each area and space for new public programmes to act as community hubs for socialising and discussion. This last element is crucial for the 'activation' part as physical spaces were suggested for playing this role across the districts enabling gathering of local residents around them.

Success factors for socio-environmental vulnerability integration in city (centre) planning

Three elements intersect and can define the success of the strategy for placemaking for Glasgow urban centre, regarding the inclusion of socio-environmental justice components:

-densification policies implementation tools that consider inclusion: Tools that ensure participatory approaches in shaping those, regulatory[30] and 'quality control' planning tools that support control of affordability and financial vulnerability stressors (eg. planning guidance that provides comprehensive guidance on how to achieve high quality placemaking, including guiding the development of tall buildings or securing the preserving of rental housing in the city centre,[31] quality viability assessments within planning frameworks that focus on identifying priority areas of those changes.

-heritage regeneration support tools and consideration of role of culture as infrastructure in the context of the city: planning tools applied at urban tissue level and not only consideration of individual historic assets/landmarks functions. This can support the success of the 'mixed uses approach' for the city centre in support of diversification proposed, ensure lower risks of isolated communities around historic buildings at risk of demolition, or reduced negative outputs like socially unsafe places that may expose residents and users to violence or other negative impacts.

-housing regeneration and 'greening processes' (within Carbon Neutral by 2030 /Zero Emissions by 2045 targets for Glasgow): citizen and housing-sector stakeholder participation tools & community training mechanisms are necessary to enable the transition to green infrastructure within post-industrial residential districts, where social housing prevails. This, for Glasgow, is crucial for ensuring non displacement, affordability and training/community capacity building to adapt and endorse changes and fight disruptions [32] (in lifestyle but also in the use of semi-public space).

Overall, from the revied of the DRFs and other strategic documents we observe that social vulnerability remains separate from climate vulnerability. The word vulnerability or deprivation is notably absent from most of the district level DRFs, even the ones in areas with population facing significant levels of multiple deprivation [33.] The city through a system of actors significantly advances its use of data-driven approaches to socio-spatial mapping of social deprivation and climate risk mapping which can still aid towards localised interventions or decision making.

CONCLUSION

The paper aims to contribute to the study of collaborative planning tools by looking at actual practice and types of engagement in the revision and shaping of urban commons in the case of Glasgow's DRFs development and city centre's strategic vision for the future. From a theoretical perspective it also aspires to establish a dialogue between studies in environmental justice, health inequalities and urban planning and governance research fields as per recognition ([34] to name some) recognised that remain separate fields of enquiry:

While a focus on data and evidence to understand drivers of vulnerability (Factors that increase the impact exposure to a hazard has on a household or an individual) may be important for planners and decision makers, yet, equally so is the actual engagement with collaborative tools that open up opportunities for those groups facing compound socio-environmental hazards to be supported as priority groups in planning and placemaking processes and to build their own responses. This will enable urban commons at neighbourhood level to act as 'buffers' for community vulnerability not only as an activation but a longer-term approach. The Glasgow city as a case identified significant innovations in picking strategic planning interventions and tools to enable future-proofing of place, yet a striking division between the social and climate vulnerability priorities for spatial interventions, which mainly remain in different spheres, Lessons from Healey's work on effective spatial planning

(see also) may bring suggestions for more socially inclusive approaches in planning practice and emphasis on the connecting component of the city centre strategy, also from a social perspective.

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IS THERE A FUTURE FOR PARTICIPATORY DESIGN IN TURKEY? A DISCUSSION ON THE DESIGN PROCESS OF DÜZCE HOPE HOMES

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INTRODUCTION

Participatory design is a widely recognized approach that has been the subject of extensive research and practical experience. The objective of participatory design is to empower communities to become active decision-makers, thereby enabling them to play a role in shaping the spaces in which they live. Nevertheless, there is a relatively narrow scope for discussion and application of participatory design in Turkey. Conversely, the country is incapable of providing solutions that address the needs of communities in the context of contemporary challenges, including rapid urbanization and natural disasters such as earthquakes. This study will examine the potential of participatory design in the context of the Düzce Hope Homes project, which represents a rare and significant example of such an approach in Turkey. The data for this study were gathered via participatory action research conducted throughout the project. All stages of the project were recorded with comprehensive documentation, including detailed notes, photographs, interviews, and archival material.

Participatory Design and Power Relations

Participatory design represents a significant transformative impact on the production of housing, as well as a radical transformation in the field of architecture. Till, however, argues that mainstream architectural practice is denying the concept of participation, viewing it as a potential threat to the established norms and values of the architectural profession. For him, once the threat is identified, it is possible to overcome it and view participation not as an obstacle to architecture, but as an opportunity to reformulate architectural practice. However, before undertaking this task, it is essential to define the term "participation".[1]

This study takes the concept of participation from the perspective of power relations as theorized by Arnstein. In her 1969 publication, *A Ladder of Citizen Participation*, Arnstein presents a framework for understanding the different forms of citizen participation, which she divides into three subcategories: nonparticipation, degrees of tokenism, and degrees of citizen power. She argues that the crucial point is that "participation without redistribution of power is an empty and frustrating process for the powerless." This approach allows the powerholders to argue that all perspectives were taken into account. However, it also allows for the possibility that only some of those perspectives will benefit. The status quo is thus maintained.[2]

In accordance with the arguments proposed by Till and Arnstein, this study addresses the concept of participatory design from a political perspective, rather than from a purely technical standpoint. It

views participation as a process rather than an outcome, taking into account the heterogeneous nature of the actors involved. The objective is to displace the architects from their role as subjects in participatory design experiences, positioning them instead as objects of discussion.

Participatory Design in Turkey

In the 1970s, as urban movements began to emerge in Turkey, discussions about the participation of local communities in the planning and design of urban development projects became a topic of interest. The Izmit New Settlements Project, initiated by the Izmit Municipality in 1974, aimed to address housing concerns through the active involvement of residents. This was the first documented instance of participatory planning and design being implemented in Turkey, with a particular emphasis on achieving equality and ensuring the active involvement of all stakeholders. Despite the objective of constructing 30,000 housing units through a comprehensive and inclusive participatory process, the project ultimately proved unsuccessful due to the emergence of conflicts between local and central governmental authorities.[3] Moreover, there have been few completed examples of participation in planning and design in Turkey. One noteworthy example is the Ankara Batıkent project, which was initiated in the 1970s by the local government in collaboration with the civil society organization Kent-Koop. The project, developed to address the housing problems of middle and lower-income groups, produced 50,000 houses. The Batıkent model is regarded as participatory in nature, as it is a cooperative organisation that works closely with municipal authorities.[4] Additionally, the project received the World Habitat Award in 1986.[5] It is unfortunate that the discussions and experiences in this field were brought to an end by the military coup that occurred in 1980.

In the 2000s, there was a notable increase in interest in the concept of participation in the fields of local government and civil society, as well as in planning and architecture in the country. Simultaneously, however, the notion of participation in architecture is regarded with a certain degree of skepticism. It is argued that the transformation of the individual act of designing into a multi-actor participatory process may result in the creation of a conflict[6]. Conversely, the field of planning is more likely to adopt participatory approaches than the field of architecture in Turkey. However, Tekeli[7] argues that, in the present context, participation in planning has become subject to widely accepted but de facto practices.

Following this brief overview, the question of whether participatory design has a future in Turkey will be addressed through an analysis of the participatory design process of the Düzce Hope Homes.

DÜZCE HOPE HOMES PROJECT

Düzce Hope Homes is a cooperative housing project with a primary focus on post-disaster reconstruction efforts in the Beyköy district of the Düzce province in Northern Turkey. [Figure 1] The project includes the construction of 234 housing units and the development of a community center, urban gardens, a women's cooperative kitchen, and common spaces for low-income tenants, all of whom were affected by the 1999 earthquake in Turkey. After years of advocacy by tenant earthquake victims for adequate housing, the Düzce Hope Homes project was developed between 2013 and 2023 through a participatory and community-driven process from design to construction. The project's primary actors were the Düzce Solidarity Housing Cooperative for Homeless and Tenant Earthquake Victims and the Düzce Hope Studio. Düzce Hope Homes has been selected as a finalist for the World Habitat Awards 2017, in recognition of its unique design and construction process.[8]

Figure 1. Location and 2023 view of Düzce Hope Homes

1999 Earthquakes

The origins of the Düzce Hope Homes project can be traced back to a significant event that occurred in the region. In 1999, two earthquakes struck the Marmara region of Turkey. The epicenter of the second earthquake was located in the province of Düzce. The earthquakes had a catastrophic impact, resulting in the loss of over 17,000 lives, the damage or destruction of over 300,000 homes, and the displacement of over 600,000 people, who were left with no alternative accommodation except prefabricated emergency shelters.[9] [Figure 2] The majority of reconstruction efforts in Turkey in the aftermath of the earthquakes were developed for the owners of the affected properties. Adequate solutions for providing housing for tenant victims of the earthquake were not developed. In response, tenants began to advocate for their right to housing. However, it proved challenging for them to effectively communicate their concerns to the government. As a result, the struggle of the tenants continued for many years.[10]

Figure 2. The devastation of the 1999 earthquakes

Cooperative and Studio

The primary demand of the tenants affected by the 1999 earthquakes was for governmental assistance in the construction of habitable and secure dwellings. However, it must be noted that the governments have failed to provide the necessary support at any stage of the Düzce Hope Homes project. Consequently, in response to these circumstances, tenants collectively established The Düzce Solidarity Housing Cooperative for Homeless and Tenant Earthquake Victims in 2003. The principles of the cooperative's membership are as follows: the member is required to have been resident in Düzce at the time of the 1999 earthquake and continue to live in the area; the member must also be on a low income and have no existing ownership of property. In addition, each member is required to work one day per week at the construction site and to participate in the design and management of the project.

The Cooperative has assumed a pivotal role in this project. Since 2003, the cooperative has organized a series of mass demonstrations in Düzce and in the capital city of Ankara, demanding the implementation of state-subsidized loans and the provision of land. [Figure 3] The demand for suitable and affordable land from the state was continued by the cooperative until 2012 and finally, they took three plots of land.

Figure 3. Demonstrations in Düzce and Ankara

Following an open call from the cooperative, Düzce Hope Studio was established as a temporary, collaborative, multidisciplinary studio. The call emphasizes a collective, self-build, and participatory design process for those affected by the earthquake. Following the open call, a number of professionals and students from a variety of disciplines, including architecture, engineering, urban planning, social science, attended a meeting in Istanbul. [Figure 4]

Figure 4. Düzce Hope Studio meeting

Many of the studio members had limited experience of working in direct collaboration with local communities. In the initial meeting, alternative roadmaps were prepared and discussed with the objective of organizing a participatory design process. Following deliberations at the studio, participatory approaches were adopted at the design stage, structured around a game format.

LAYOUT AND HOUSE PLAN GAMES

The primary workshop for cooperative members is the "Layout Plan Game". In order to gain insight into their preferences regarding layout plan, members of the cooperative were invited to participate in a game that posed the question, "What kind of neighborhood do you want to live in?". The members were required to place their homes on a scaled model of the land, in accordance with a set of defined rules. The rules included parameters such as the equalization of the size of housing units and the consideration of common spaces, as well as housing units themselves. Additionally, a simplified

version of the game was designed for children. [Figure 5] During the game sessions, the role of the Düzce Hope Studio members was limited to responding to questions, reminding participants of the rules, and taking notes and photographs. They did not intervene in the decisions made by the cooperative members. Subsequent to the game sessions, focus group meetings were conducted with representatives from various sectors of the community, including the elderly and women.

Figure 5. Layout Plan Game sessions

Following the conclusion of the workshop, the Studio proceeded to analyze the findings of the game sessions and focus group meetings. The collective requirements of cooperative members can be categorised as follows: They have expressed a desire to live in low-rise houses due to concerns about the earthquakes. Many have also expressed a preference for larger houses, citing their experience of living in small, prefabricated houses for an extended period. Additionally, there is a demand for living spaces that incorporate low-density and more green areas. In addition, there were instances of disagreement and conflict between the members. For some members, ensuring the safety of the community was of primary importance, which entailed constructing defensive barriers around buildings. Some members advanced the position that the cooperative should prioritize the provision of housing units, rather than allocating financial resources to the development of common spaces. By analyzing the findings, five layout plan alternatives were designed by the Studio, according to the specified parameters. [Figure 6] The shared needs of members, the conditions of the land, building regulations, and low-cost construction were taken into account.

Figure 6. Spatial analyses of layout game sessions

One month later, the Studio conducted a second workshop with cooperative members. In the initial phase of the workshop, the cooperative members were presented alternative layout plan designs in

poster format and 3D visualizations. They were then invited to prioritize their preferences regarding these alternatives. Following the initial session, the second game was conducted by the Studio with the objective of gaining insight into the needs and expectations of members with regard to their homes. On this occasion, the members requested that the rooms, kitchen, bathroom, and balcony be placed on a grid. [Figure 7] The game was conducted as one-to-one sessions with each participating household. The decisions made during the game were documented through the use of surveys, photographs, and field notes. These findings were instrumental in defining the design criteria. The game demonstrated to the cooperative members which spaces and sizes were required. Conversely, the members of the cooperative were empowered to challenge the socially constructed notions of "home" that were not aligned with their needs.

Figure 7. House Plan Game sessions

Reflections on Design

The reflections of the two participatory workshops with the cooperative members can be summarized as follows: The design alternatives were restricted by the limitations of the land, the requirements of the building regulations, and the costs of construction. In the current context, the construction of buildings with two or three stores would result in an increase in building density, accompanied by a reduction in both the size of residential units and that of common spaces. For this reason, the majority of the buildings were designed with three floors, with a few exceptions that included four floors. Furthermore, L-shaped buildings with semi-public spaces could address safety concerns. Additionally, a central courtyard system and community spaces were integrated into the design to facilitate interaction and encourage a strong sense of community. In accordance with the agreed parameters, the studio designed a variety of house plan alternatives, which were then presented to the members.

The architectural design project of Düzce Hope Homes was developed according to the decisions derived from the findings of the participatory workshops and community meetings. [Figure 8]

Figure 8. Reflections on layout plan

The architectural project includes five different housing unit alternatives, each designed to meet the specific needs of different family sizes or types, as opposed to the conventional standard-sized units. The housing units vary in size, with the smallest units measuring 75 square meters and the largest units measuring 100 square meters. The location of each housing unit and each room has been carefully designed with consideration of various factors, including daylight, view, and noise. The design also took into account smaller but crucial features, such as the incorporation of a second balcony, a pantry, and a separate toilet facility. [Figure 9]

Figure 9. Reflections on floor plan

Design Together, Build Together

The architectural project of Düzce Hope Homes was completed in about a year, following a series of participatory workshops, research and analyses, discussion meetings, and the finalisation of technical drawings. The participatory activities have been continued even after the finalization of the architectural project. The cooperative members have been engaged in a range of activities at the construction site, including basic construction work, cleaning, and the cooking. Düzce Hope Studio provided ongoing assistance to cooperative members, sharing its expertise and technical knowledge.

The construction site for Düzce Hope Homes was characterized by numerous collective activities, which contributed to the strengthening of community and social ties. [Figure 10] and community oven have been constructed. The facilities have been utilized for the production and sale of a variety of products, including bread, bottled or dried foods. Members of the cooperative have acquired knowledge regarding the production of compost from organic waste and recycling. The compost generated from the community kitchen's waste is utilized in the community garden. Moreover, a women's production cooperative has been established for the purpose of generating income.

Figure 10. Collective activities on the construction site

The construction was financed through the combined efforts of cooperative membership fees and, when necessary, bank loans. In order to reduce costs, materials were purchased directly from local producers. The construction of the community center was completed using wood that was locally sourced. The soil required for ground-level construction was extracted directly from a landfill site neighboring the construction site itself, thereby reducing the necessity for transportation. The construction of the houses was completed in 2023, due to the combined impact of economic challenges and the global pandemic. The construction of common spaces is still in progress.

CONCLUSION

The Düzce Hope Homes project has a significant impact on the production of affordable housing in Turkey. The project is transforming the perception of housing cooperatives in the country, challenging the negative reputation they have held since the 1980s due to issues such as corruption. This transformation is pivotal in the context of the contemporary housing crisis in Turkey, where housing is frequently regarded as an investment rather than a fundamental right. Moreover, the project's significance for this research is that it is one of the few affordable housing projects in the country to

be designed with the active participation of its residents. The participatory design process has resulted in a shift in perceptions among both the cooperative members and the volunteer designers with regard to housing and living in a shared environment. Additionally, this project facilitated the dissemination of participatory design practices within the broader architectural community in Turkey.

Conversely, the design process of the Düzce Hope Homes may be subject to critique with regard to the power relations inherent to the participatory design process. As previously mentioned, the government was a primary actor in few participatory design experiences in Turkey. Consequently, discussions and critiques concentrate on these actors, yet the stance of designers remains inadequately examined. In the case of the Düzce Hope Homes project, it can be stated that the Düzce Hope Studio faced difficulties in achieving a participatory design that would result in a transformation of power relations, as was critiqued by Till and Arnstein. Many studio members were unfamiliar with the practice of working directly with a community. The most significant challenge was for architects to alter their fundamental approach to decision-making within the design process. The studio's assumption that cooperative structures inherently facilitate participation resulted in a failure to address the underlying power dynamics. As a result, the objective of equality in the design process was not fully achieved, with cooperative members frequently perceiving the workshop experts as authoritative figures. The primary objective remained the completion of homes for those facing long-term housing issues, rather than ensuring equitable participation and transformed power relationships.

Düzce Hope Homes represents a pioneering approach to affordable housing in Turkey, wherein the project was designed and completed through a bottom-up organizing and participatory process. It has the potential to serve as an important model for addressing the affordable, healthy, and safe housing in the country. This experience demonstrates the necessity for architects to transform their mindsets in order to adopt participatory design approaches that aim to transform social power relations in Turkey.

NOTES

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[3] Tuncay Çavdar, “Toplum Bilinçlenmesinde Araç Olarak Katılımsal Tasarım: İzmit Yenilikçi Yerleşmeler Projesi,” Mimarlık Dergisi 154 (1978): 55.
[4] Deniz İncedayı, *Mimari Tasarım Sürecine Katılımcı Yaklaşım: Demokrasi Kültüründe Mesleki Boyutun İrdelenmesi* (İstanbul: Mimar Sinan Üniversitesi Yayınları, 2002), 114-118.
[5] “Batikent Project, Ankara,” World Habitat Awards, accessed August 12, 2024, https://world-habitat.org/world-habitat-awards/winners-and-finalists/batikent-project-ankara/
[6] Ferhat Hacıalibeyoğlu, “Mimari Tasarım Sürecinde Katılım Sorunu ve Yaklaşımlar,” Mimarlık Dergisi, no. 376 (2014): http://www.mimarlikdergisi.com/index.cfm?sayfa=mimarlik&DergiSayi=393&RecID=3477
[7] İlhan Tekeli, “Kentlerin Planlanmasındaki Katılımcılığı Siyasetin Katılımcılığından Nasıl Farklılaştırabiliriz?” Mimarlık Dergisi, no. 419 (2021): http://www.mimarlikdergisi.com/index.cfm?sayfa=mimarlik&DergiSayi=434&RecID=5306
[8] “Düzce Hope Homes,” World Habitat Awards, accessed August 12, 2024, https://world-habitat.org/world-habitat-awards/winners-and-finalists/duzce-hope-homes/
[9] “Türkiye’de Deprem Gerçeği ve TMMOB Makina Mühendisleri Odası’nın Önerileri,” TMMOB Makina Mühendisleri Odası, accessed August 12, 2024, https://www.mmo.org.tr/sites/default/files/d4419b4a44bde5f_ek_0.pdf
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VISUAL METHODS FOR CO-DESIGNING SAFE PUBLIC OPEN SPACES FOR WOMEN

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INTRODUCTION

Public spaces are integral to urban life, offering platforms for social interaction, cultural expression, and a sense of belonging. The design and accessibility of these spaces significantly impact community well-being, social cohesion, and mental health.[1] However, access to these spaces is often limited by various socio-spatial hierarchies, particularly those related to gender, ethnicity, and socio-economic status.[2] Recent studies highlight the unique barriers women face in accessing public spaces, driven primarily by concerns over safety and insecurity, which contribute to spatial exclusion.[3]

In Leeds, a city-wide survey revealed that 64% of women feel unsafe walking alone at night, citing poor lighting, lack of visible security, and threatening behaviour as key issues.[4] These findings align with global trends indicating that fear of harassment and violence severely limits women's participation in public life. The disproportionate impact of these fears on marginalised women underscores the need for urban planning strategies that prioritise inclusivity and address these socio-spatial inequalities.[5]

This paper explores how participatory visual methods, such as mapping exercises, visual narratives, and co-design workshops, can be employed to engage women in the design process of public spaces, focusing on enhancing their safety. This bottom-up approach enables marginalised groups to voice their needs and aligns with global initiatives, such as the United Nations Sustainable Development Goals (SDGs), aimed at fostering safe, resilient, and inclusive urban environments. Through a case study in Leeds, this research contributes to the ongoing discourse on gender-sensitive urban planning, advocating for practices that foreground the lived experiences of women.

The Gendered Experience of Public Spaces

The theoretical foundation for understanding the gendered nature of public spaces draws from critical urbanism and feminist geography. Scholars like Jane Jacobs and Henri Lefebvre have long argued that public spaces are arenas where power dynamics and social relations are enacted and contested.[6] Lefebvre's notion of the "right to the city" advocates for inclusive environments that support equitable access for all citizens.[7] However, feminist critiques highlight that access remains unevenly distributed, with women's participation constrained by both physical and psychological factors, such as fear of violence and harassment.[8]

Spatial exclusion is not merely the result of individual experiences but is embedded within broader socio-spatial structures that perpetuate inequality.[9] The design and governance of public spaces often

reinforce patriarchal norms, limiting women's agency and reinforcing existing power hierarchies.[10] These dynamics are evident when urban design overlooks gender-specific needs, creating environments that are either hostile or unwelcoming to women.

The exclusion of women from public spaces is increasingly recognised as a social justice issue, as it restricts their right to fully participate in urban life. Spatial justice frameworks, which advocate for the fair distribution of public space, provide a useful lens for addressing these disparities.[11] These frameworks align with the global movement toward inclusive urban development, as articulated in the Sustainable Development Goals (SDG 11) and the New Urban Agenda, which emphasise the importance of designing cities that are safe and accessible for all.[12]

Visual Methods as Tools for Participatory Urban Planning

Participatory visual methods have gained traction as effective tools in urban planning, particularly for engaging marginalised communities who may face barriers to participating in conventional processes. These methods, which include participatory mapping, photovoice, and co-design workshops, allow participants to visually articulate their experiences and concerns, offering deeper insights into the socio-spatial dynamics of urban environments.[13] Such approaches are rooted in participatory action research (PAR), which democratises knowledge production by involving community members in research and decision-making.[14]

Visual methods are particularly valuable in addressing issues of spatial justice for women. By enabling participants to map out areas where they feel unsafe or uncomfortable, urban planners can identify and address the environmental factors that contribute to these feelings of exclusion. For example, research in Leeds shows that specific locations with poor lighting, lack of visibility, and inadequate policing are consistently associated with heightened perceptions of insecurity among women.[15] These insights are critical for informing urban interventions that are responsive to the lived realities of women, particularly those from disadvantaged backgrounds.

One effective example of visual methods in action is the "Safer Cities for Girls" program, implemented across cities in Asia, Africa, and Latin America by Plan International.[16] Through participatory mapping and community-led audits, girls identify dangerous areas in their neighbourhoods and collaborate with local authorities to improve safety. Similarly, photovoice in urban design projects in Nairobi allowed women to capture images of public spaces that felt threatening or uncomfortable.[17] These visual outputs informed design modifications, such as better street lighting and the addition of community spaces, which ultimately improved safety and inclusivity.

In Europe, the EU-funded project "Cities-4-People" employed visual storytelling and co-design workshops to enhance mobility and safety in urban areas through community-led initiatives. Participants, particularly from marginalised groups, used visual narratives and interactive maps to propose solutions that addressed their daily mobility challenges and enhanced safety.[18] Such examples highlight the scalability and adaptability of visual methods in diverse urban contexts, demonstrating their potential to drive more inclusive and equitable urban planning practices.

The alignment of these methods with global initiatives like the SDGs underscores their relevance in contemporary urban planning discourse. SDGs 5 and 10 emphasise gender equality and reducing inequalities, while SDG 11 focuses on making cities inclusive, safe, resilient, and sustainable.[19] Integrating visual methods into planning processes allows cities to design public spaces that meet the needs of all community members.

GLOBAL INITIATIVES AND LOCAL PRACTICES

The growing recognition of the need for gender-sensitive urban planning is reflected in initiatives like UN Women's Safe Cities and Safe Public Spaces programme, which promotes the prevention of sexual harassment and violence through participatory design and community engagement.[20] These global frameworks advocate for integrated approaches combining policy, service delivery, and grassroots participation, reflecting a holistic understanding of urban safety. The "Global Public Space Programme" by UN-Habitat has been instrumental in providing guidelines and support to cities worldwide, encouraging the adoption of inclusive design principles that address the needs of vulnerable groups, including women and children.[21]

Locally, cities like Leeds have adopted similar approaches by aligning their urban policies with these global initiatives. The Women Friendly Leeds initiative is a key example of this alignment. Through surveys, focus groups, and visual engagement activities, the project identified critical areas of concern for women and proposed targeted interventions, including improved lighting, increased community warden presence, and creating safe zones in key public areas.[22] Such practices not only improve local conditions but also contribute to the broader global dialogue on urban inclusivity.

This research aligns with global approaches by emphasising the importance of community-driven, participatory design processes. By involving women directly in the co-design of public spaces, this study addresses their specific safety concerns and contributes to broader efforts to create more inclusive and equitable urban environments. Moreover, using visual methods in this research highlights the importance of accessible and inclusive tools for engaging marginalised communities in the urban planning process. The Leeds study demonstrates how local initiatives can be part of a global movement toward safer and more inclusive cities, contributing to broader goals of social equity and justice.

METHODOLOGY

This research adopts a mixed-methods approach grounded in participatory action research (PAR), designed to examine women's experiences of public spaces and their involvement in co-design processes. PAR, as articulated by Freire (1970)[23] and extended in urban studies by Selim (2021),[24] emphasises community-driven research that empowers participants, ensuring their perspectives directly inform urban design solutions. Leeds serves as the case study, reflecting its diverse socio-spatial context and significant urban challenges.

Research Design and Participant Recruitment

The study involved purposive sampling to recruit 45 participants from different ethnic backgrounds, age groups, and socio-economic statuses. Participants were selected in collaboration with local community organisations, ensuring broad representation of women across marginalised communities in Leeds. The demographic composition reflected the city's diversity, including young women aged 18-24, older women over 65, and participants from ethnic minorities, including Bangladeshi, Pakistani, Caribbean, and Eastern European communities.

Participants were recruited through local community centres, women's groups, and social networks and were compensated for their time. Facilitators with relevant language skills and cultural competencies were employed to foster an inclusive environment for data collection. This approach allowed for rich, nuanced data collection that would not have been possible using traditional survey methods alone.

Visual Methods Employed

The research employed three primary visual methods: participatory mapping, visual narratives, and the clothesline method. These techniques align with feminist and spatial justice theories, emphasising the importance of integrating women's lived experiences into urban design processes.

1. **Participatory Mapping:** Participants annotated large-scale maps of their neighbourhoods, identifying areas where they felt safe or unsafe (figure 1). Color-coded markers and stickers highlighted key sites, such as poorly lit streets, busy transport hubs, or secluded pathways. The mapping sessions revealed spatial patterns of fear and safety, uncovering intersections between environmental design and gendered experiences in public spaces.

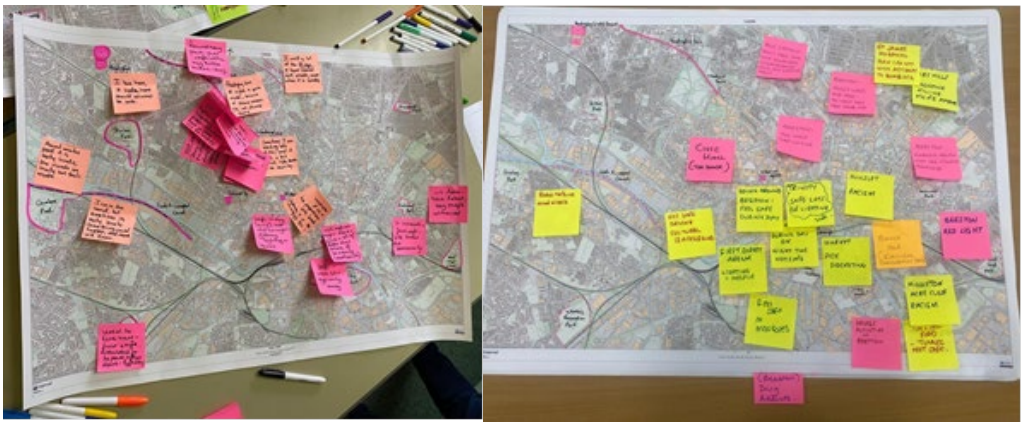

Figure 1. Participatory mapping done by the participants (researcher, 2023)[25]

2. **Visual Narratives:** Building on participatory mapping, participants created visual stories through drawings and collages (figure 2), depicting their daily interactions with public spaces. This method provided insights into the emotional and psychological dimensions of their experiences. One participant noted, "I always take a longer route home to avoid the park at night because the lighting is poor and it feels isolated."[26]

Figure 2. Visual narratives of women's experiences in public open spaces (researcher, 2023)[27]

3. **Clothesline Method:** Inspired by feminist research methodologies, the clothesline method involved participants anonymously writing their concerns (figure 3), suggestions, and experiences on pieces of paper, which were then displayed on a clothesline. This approach encouraged candid reflections and highlighted themes such as the fear of harassment, distrust in local governance, and the lack of community ownership of public spaces. One participant shared, "Walking by the canal in the evening makes me anxious—there's no one around, and it's too dark."[28]

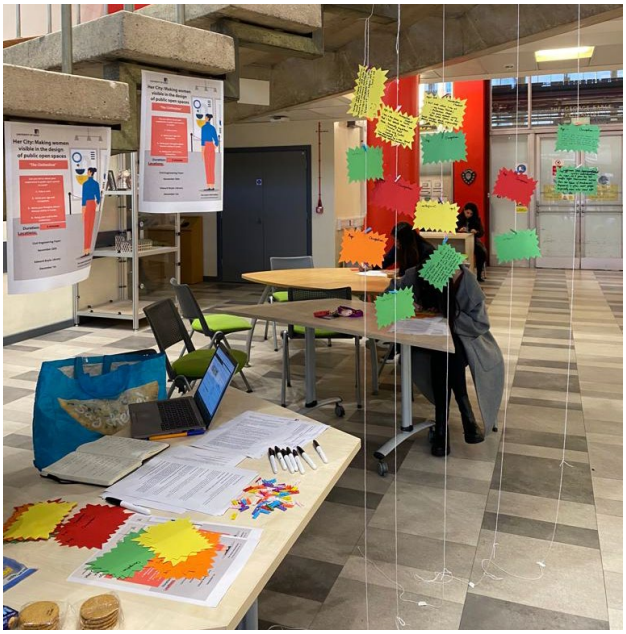

Figure 3. Clothesline method (Researcher, 2023)[29]

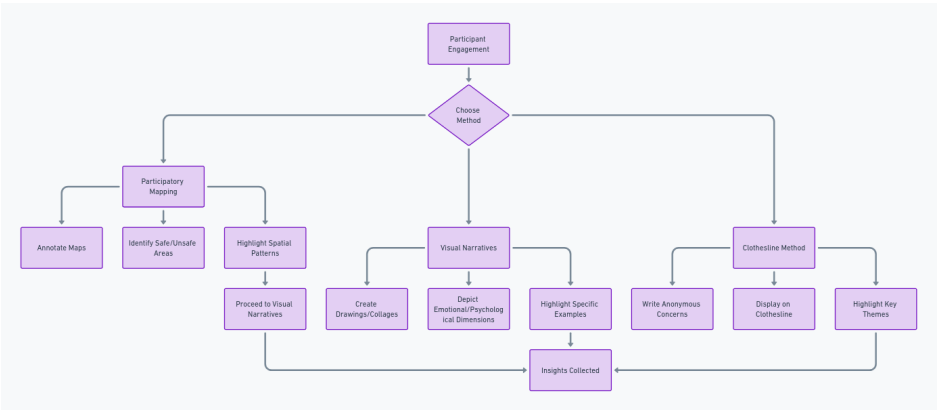

Figure 4. This diagram illustrates the process of engaging participants in various research methods including participatory mapping, visual narratives, and the clothesline method. It highlights the steps involved in each method and how they contribute to collecting insights on community experiences (Researcher, 2024)[30].

Data Analysis

Data from the visual methods and surveys were analysed thematically, with spatial justice and feminist geography providing the theoretical framework. Thematic coding identified recurring motifs such as lighting, accessibility, visibility, and social presence. These themes were triangulated with survey data, revealing how socio-spatial inequalities and gendered experiences converge in urban environments.

Ethical Considerations

Ethical considerations were prioritised throughout the study. Informed consent was obtained from all participants, who were assured of their anonymity. Special attention was given to ensuring a supportive environment, recognising that discussions about fear, harassment, and insecurity could be distressing. This was particularly important for participants who had experienced trauma. Regular debrief sessions and access to mental health resources were provided to ensure the well-being of participants.

Aligning Methodology with Global Initiatives

The methodology aligns with global initiatives like the UN's Safe Cities and Safe Public Spaces programme, which emphasises participatory approaches in designing urban environments that prevent violence and promote inclusivity. By directly involving marginalised women in the co-design process, this research addresses SDG 11's goal of making cities inclusive and safe while contributing to SDG 5 (Gender Equality) and SDG 10 (Reduced Inequalities) by ensuring that women's voices are integral to urban planning.[31]

FINDINGS

The findings reveal significant insights into how women perceive safety in public spaces and how these perceptions can inform urban design. The analysis of the participatory mapping, visual narratives, and clothesline method uncovered key themes reflecting spatial and social factors influencing women's sense of safety (figure 5).

Spatial Factors

1. **Lighting and Visibility:** Across all methods, participants consistently identified lighting as a crucial determinant of safety. Well-lit areas were marked as safe zones, while poorly lit or shadowy locations were consistently flagged as places of fear. As one participant noted, "When there are good lights, I feel like I can walk confidently, but in the dark, I'm constantly on edge." [32] This aligns with Ceccato's (2020)[33] findings that visibility—both in terms of lighting and sightlines—is fundamental to perceptions of safety in urban environments. The maps revealed concentrated "no-go zones" in areas lacking sufficient lighting or where visibility was obstructed by poorly placed infrastructure, such as high walls and dense foliage.

2. Accessibility and Activity: The visual narratives and mapping exercises emphasised the importance of accessibility and consistent activity. Spaces that are easily navigable and regularly frequented by a diverse range of users were perceived as safer. "If there are people around, I feel safer, even if they're strangers," remarked one participant.[34] This theme echoes findings from similar studies in cities like Barcelona and Bogotá, where participatory research shows that well-maintained and busy public spaces naturally deter anti-social behavior.[35] The Leeds study highlighted specific areas, such as underpasses and pedestrianised zones, where improved maintenance and design could significantly enhance accessibility and safety.

3. Community Presence and Amenities: Spaces with community amenities—such as seating areas, markets, and cafés—were identified as safer due to their capacity to attract a steady flow of people. This finding is consistent with Jacobs' (1961) concept of "eyes on the street," which argues that well-used public spaces deter criminal activity through passive surveillance.[36] The clothesline method specifically revealed how neglected or underutilised spaces foster feelings of alienation and fear, suggesting the need for urban interventions that prioritise active, communal use.

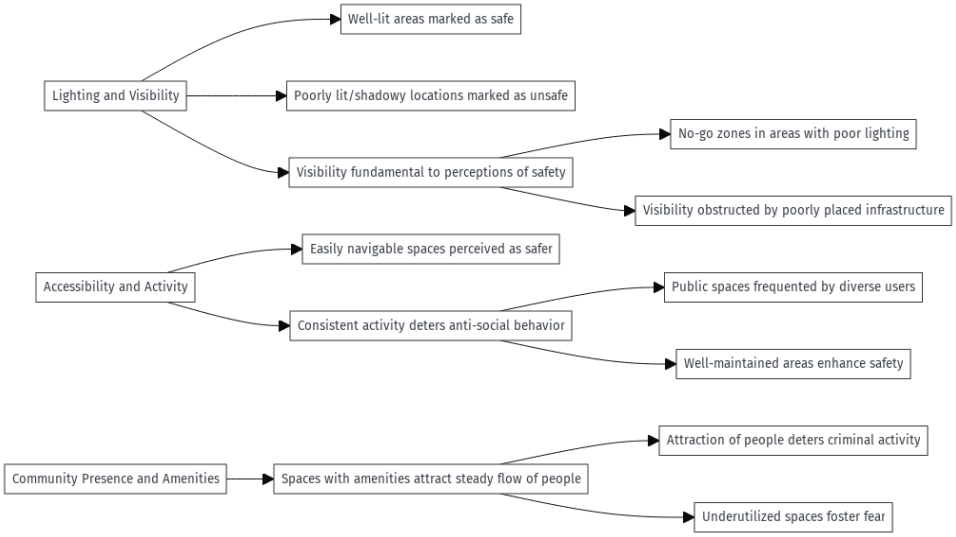

Figure 5. illustrates key elements such as lighting, accessibility, and community presence, highlighting their impact on safety perceptions in public spaces (Researcher, 2023)[37]

DISCUSSION

The findings highlight the multifaceted nature of safety in public spaces and underscore the importance of visual methods in capturing the complex interplay of spatial, social, and psychological factors that influence women's experiences. Drawing on theories of spatial justice, feminist geography, and the "right to the city," the study advances the argument that safety is not merely a matter of physical infrastructure but is deeply intertwined with broader socio-political dynamics.

The Significance of Visual Methods in Marginalised Communities

Visual methods such as participatory mapping, visual narratives, and the clothesline method offer distinct advantages in engaging marginalised communities. These approaches enable participants to articulate their experiences in ways that transcend the limitations of traditional planning tools. The use of mapping and narratives in Leeds revealed spatial patterns and emotional responses that might otherwise have remained hidden, offering valuable insights for urban design. For instance, participants highlighted how poor lighting in certain areas made them avoid otherwise convenient routes home, leading to further isolation of those spaces.

Similar approaches have been successfully implemented in cities like Malmö and Nairobi, where participatory visual methods have informed interventions that prioritise inclusivity and community ownership.[38] In these cases, visual methods provided a platform for marginalised voices to be integrated into urban planning, leading to more socially responsive design solutions.

Theoretical Analysis and Emerging Themes

The integration of Lefebvre's[39] theory of spatial justice and Soja's[40] conceptualisation of spatiality provided a robust analytical framework for understanding the themes that emerged from the data. The recurring motifs of visibility, accessibility, and community presence align with Lefebvre's assertion that the production of space is inherently political. By foregrounding these elements, the research highlights the need for design strategies that dismantle exclusionary practices and promote equitable access to public spaces.

Theories of feminist urbanism also played a key role in identifying the gendered dimensions of public space, revealing how everyday interactions are shaped by broader power dynamics. Participants'

experiences of harassment and discomfort illustrate how public spaces can become sites of oppression rather than empowerment, particularly for marginalised women. This reinforces the importance of integrating gender-sensitive approaches into urban planning, not only as a matter of safety but also as a fundamental right to equitable participation in public life.

Implications for Urban Planning and Policy

The research offers several practical implications for urban planners and policymakers. First, it underscores the importance of integrating participatory visual methods early in the planning process to ensure that public spaces are responsive to the needs of all users, particularly those from marginalised backgrounds. Second, it highlights the need for ongoing community engagement initiatives that foster a sense of ownership and shared responsibility for public spaces. For example, initiatives that involve local residents in maintaining and monitoring public areas can contribute to long-term safety and cohesion.

Finally, the study demonstrates that safety must be understood holistically, requiring coordinated efforts across urban governance, law enforcement, and community networks. The insights gained from this study are directly applicable to cities beyond Leeds, offering a framework for implementing participatory design processes in diverse urban contexts. By integrating visual methods into urban planning, cities can move closer to achieving the Sustainable Development Goals (SDGs) and the broader objectives of the New Urban Agenda, ultimately contributing to the creation of safer, more inclusive, and more resilient public spaces.

CONCLUSION

This study examined the use of visual methods in co-designing safe public spaces for women in Leeds, focusing on marginalised communities. The findings underscore that safety in public spaces is not merely a function of physical infrastructure but is deeply intertwined with social dynamics, such as trust, belonging, and the pervasive fear of harassment. Through participatory mapping, visual narratives, and the clothesline method, critical spatial factors such as lighting, accessibility, and community presence emerged as key determinants of safety. These insights align with the work of Ceccato[41] and Jacobs,[42] affirming the importance of well-lit, accessible, and actively used spaces in fostering a sense of security.

The theoretical analysis, informed by Lefebvre's[43] spatial justice and feminist urbanism frameworks, revealed that safety is inherently political, shaped by broader socio-spatial inequalities. The research highlighted how exclusionary practices manifest in the built environment and how community-led initiatives can counteract these trends by promoting spatial ownership and collective responsibility. This aligns with global urban agendas that advocate for inclusive, safe, and resilient cities, as articulated in the Sustainable Development Goals and the New Urban Agenda.

The visual methods employed in this study proved effective in capturing nuanced experiences and engaging participants who might otherwise be excluded from traditional urban planning processes. The co-design approach demonstrated that involving marginalised groups in the planning process not only enhances the relevance and responsiveness of design interventions but also fosters greater community trust and engagement. Similar participatory frameworks have been successfully implemented in cities like Malmö and Nairobi, indicating the scalability of this approach.

The study's practical recommendations for urban planners and policymakers include prioritising the integration of visual methods early in the design process, ensuring sustained community engagement, and aligning governance strategies with community needs. By embedding these practices into urban planning, cities can create safer, more inclusive public spaces that are resilient to socio-spatial

inequalities. The Leeds case study offers a model that can be adapted to other urban contexts, ultimately contributing to more equitable and just urban environments.

NOTES

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[25] Participant Interview, conducted by Researcher, March 2023.
[26] Participant Interview, conducted by Researcher, March 2023.
[27] Participant Interview, conducted by Researcher, March 2023.
[28] Participant Interview, conducted by Researcher, March 2023.
[29] Participant Interview, conducted by Researcher, March 2023.
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CO-PRODUCTION AND THE KEY ASPECTS OF COMMUNITY INVOLVEMENT IN FLOOD RISK MANAGEMENT (FRM)

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INTRODUCTION

Flood risk management (FRM) has shifted towards more decentralised and people-centred approaches. This increase in community involvement has become conceptually linked with 'co-production,' used in other societal domains by both academics and professionals over the past decade. The two main principles of co-production are fair, equitable distribution of power and community empowerment. Mees et al.[1] have set out typologies of citizen co-production in one of the most relevant frameworks for understanding the forms of co-production within the domain of FRM. Yet some of the Mees et al.[2] categories arguably do not fully adhere or embrace the core principles of equitable power distribution and empowerment.

This paper discusses how the potential limitations in these categories could inadvertently reinforce power imbalances and restrain opportunity for community empowerment. Drawing on wider research, a scoping literature review (across bibliographic databases Scopus, Web of Science and Google Scholar), the paper argues that five key aspects of community involvement—mutual learning, early and long-term involvement, inclusivity, clear objectives, and capacity building—would enable adherence to the core principles of co-production in FRM. These key aspects integrated with the Mees' framework would enable the evaluation of not only the 'form' of co-production, but also if and how communities have been empowered in the process.

Shift in Governance – to FRM and Co-Production

Flood Risk Management (FRM) is understood as the strategies undertaken by government and non-governmental actors with the aim of averting and/or lessening the impact of flood damage.[3] Many researchers have reported a shift in governance from traditional 'flood defence', characterized by centralised top-down decision-making and structural hard engineered flood defences, to 'flood risk management' with the adoption of multiple, integrated and holistic measures. FRM includes hard engineering solutions, but also softer options such as nature-based solutions, property flood resilience measures, flood forecasting and warnings, which typically necessitate the involvement of multiple actors, stakeholders, and people-centred approaches.[4]

This shift can be attributed to a number of factors, that have been identified in the literature. Climate change impacts, with the increasing frequency and intensity of flood risks, means that the physical limitations of flood defences to fully protect against flood events have been recognised.[5] There are higher costs associated with defences, more recently compounded by government austerity.[6] International and national policy drives the shift, such as the UN's Sendai Framework for Disaster Risk Reduction (2015–2030), the EU's Flood's directive (2007/60/EC),[7] England (UK)'s 'Big Society' agenda[8] and 'Making Space for Water' strategy[9] and the 'Participation Society' and 'Room for the River' programme in the Netherlands.[10]

With this shift, communities are expected to be more involved in FRM, and some researchers have evidenced increased community participation.[11] Communities are contributing their knowledge, ideas, time, resources, values within the entire FRM cycle (from risk prevention through to recovery from flooding).[12] This increase in community involvement has become closely linked with the term 'co-production,' which has gained popularity, arguably becoming a 'buzzword' used by both academics and professionals over the past decade.[13]

Rationale and challenges of co-production

Several researchers have also advocated for community co-production efforts in FRM. Some suggesting it has an intrinsic or inherent value,[14] others suggesting that co-production provides a platform to share social concerns in the decision making and implementation stages of FRM alleviation projects.[15] It also highlighted that it enables integration of diverse local knowledge in FRM.[16] Co production has also been suggested to enhance development of social capital which also enhances community resilience to flooding.[17]

Yet there are concerns about the time and resources required for effective collaboration efforts, which can be prohibitive.[18] At times, co-production is misused to legitimize already agreed decisions.[19] Co-production initiatives have also been reported to lead to 'environmental racism'.[20] These challenges around collaboration and co production initiatives in FRM highlight the need for an ongoing evaluation of co-production frameworks to further facilitate reflexive practice.

Principles of co-production

Beyond its buzzword status, co-production aims to represent a shift in how collaborative efforts are approached.[21] Elinor Ostrom is widely credited as the original instigator of the term 'co-production' in the 1970s.[22] Ostrom's research showed that aspects of public safety can improve when communities work together with police officers instead of just being passive recipients of public safety.[23] The concept gained traction through the following decades in various fields including healthcare, public administration, policy, planning and now more latterly within the FRM domain.[24] Therefore, as co-production evolved from its conceptual origins to practical application across various fields and policies, certain core principles emerged that define its essence. These principles reflect the lessons learned from decades of implementation and research, encapsulating the fundamental values and goals that drive co-productive approaches. While the specific articulation of these principles may vary depending on the context and discipline (for example, see McEwen[25]), two key principles or ideals consistently stand out as central to the concept of co-production.

Firstly; the goal for a fairly equitable distribution and sharing of power in decision making.[26] This principle emphasizes the importance of distribution of power, enabling all participants to actively shape decisions. It is suggested that understanding the mechanisms through which decisions are made can shed light on how power is shared within a given context.[27]

Secondly, the goal for community empowerment, which may involve community members gaining skills and knowledge to actively participate and or lead as well in collaborations. Fostering these

interactions and processes that lead to growth and development enables community to take more ownership of their initiatives.[28] Community empowerment could be seen as the one overarching core principle of co-production with power sharing viewed as one of the ways to empower communities.[29] Twigger-Ross[30] do define community empowerment as 'rebalancing of power' between actors such as government and community.

These fundamental principles of co-production, while well-established in fields such as healthcare, hold significant implications for the analysis of co-production in FRM. By applying these principles, community involvement in FRM can transition towards a community-empowerment model approach to managing flood risks.

CO-PRODUCTION IN FLOOD RISK MANAGEMENT

A literature search using the keywords 'co-production' AND 'flood risk management' reveals Mees et al.[31] paper consistently appearing among the top five results in Web of Science, Scopus and Google Scholar when sorted by relevance. It stands out in offering a typology or framework for understanding co-production in the field of FRM. Therefore, this paper considers Mees' framework as one of the most relevant frameworks for understanding co-production within the domain of FRM.

Table 1 presents Mees' framework of co-production typologies. For a comprehensive explanation of each category, please refer to the full paper.

Typology	Categories
Type of interaction	• Hierarchical • Incentivised • Deliberative
Role and Type of citizen input	• Substitutive (Role) • Complementary (Role) • Co-funding/Co-investment (Type) • Co-delivery (Type) • Co-creation of knowledge (Type)
Distribution of contribution and benefits	• Private individual • Private collective • Philanthropic individual • Philanthropic collective

Table 17. Mees' framework for typologies of co-production in FRM

The typologies provide a useful and comprehensive framework for understanding the forms of co-production in FRM. However, it is important to evaluate how well these categories under these typologies potentially align and adhere to the core co-production principles.

Evaluating FRM Co-Production Categories for Adherence to Core Principles

Hierarchical co-production acknowledges the reality of government-mandated community involvement, but it also raises concerns about power imbalances. The current emphasis on FRM regulations and sanctions suggests a top-down approach where community members have limited agency and autonomy in decision-making, undermining the principle of fair and equitable power sharing. Additionally, the category may lack the element of voluntary participation, valuable in any collaboration initiative.[32] Therefore, the extent to which it truly embodies the co-production principles, as opposed to mere compliance, is debatable.

Incentivised co production, where the government incentivises citizen participation, can be viewed as a more collaborative approach than hierarchical co-production. However, it may still place the government in a more controlling position than the community by offering incentives for specific community or individual behaviours. While incentives can encourage participation and could support community empowerment to an extent, they may not necessarily foster or allow for equitable decision-making. For example, the examples by Mees'[33] primarily involve subsidies or tax breaks for implementing property flood resilience. These examples suggest that while the community was encouraged to participate, the scope of their involvement might be limited to actions predetermined by the government, leaving little room for community-led decision-making or alternative solutions. Therefore, more detail is needed, such as which decisions community contributed to and how.

Similar arguments can be made for complementary co-production whereby in some cases, complementary co-production only allows the community to supplement government activities without having the power to influence decision-making. If the community's role is limited to supporting pre-decided government actions, without having a say in how those actions are planned or delivered, then we should question if this represents true community empowerment and whether the community has shared power in the process.

For substitutive co-production, community efforts replace government actions. This raises concerns about the shifting of costs to community and exploitation of community resources as well as the erosion of public services. If communities are taking on responsibilities that were previously the responsibility of the government, it could lead to an unfair burden on them, particularly for marginalized communities with limited social, human, cultural capacities.[34] This would undermine the empowering aspect of co-production and perpetuate existing inequalities. (Such cases have been reported [35]).

Private individual and collective co-production categories focus on private benefits accruing to individuals or specific groups within the community. While it can be empowering for those individuals/groups involved, an emphasis on only private gains could potentially create disparities between those who can contribute and those who cannot, leading to unequal benefits and detraction from the broader community-wide goals of FRM. If co-production efforts are primarily or solely driven by private interests, those with more resources may have more influence or better outcomes than others. This might lead to fragmented initiatives and also to neglect of marginalised vulnerable populations, hindering the goal of equitable outcomes and community-wide empowerment.

These examples highlight potential limitations in how the Mees' categories, as they stand, might inadvertently reinforce power imbalances, limit influence in decision making in the process restraining the opportunity for community empowerment. Mees et al.[36] have acknowledged these concerns for negative consequences. To address these concerns, this paper suggests an additional conceptual lens, supplementing the Mees' 'forms' of co-production typology to enable a more detailed analysis of 'how' the community are involved, and if they are truly empowered within FRM initiatives.

KEY ASPECTS OF COMMUNITY INVOLVEMENT

The following section identifies key aspects to foster meaningful and collaborative community involvement from the literature, in order to promote a more balanced distribution of power and enable community empowerment.

Mutual learning, benefits and two-way communication

To foster effective and collaborative community engagement, it is important to strive towards mutual learning, respect, and benefits for both community members and state actors.[37] Mutual learning and benefits align with the attribute of reciprocity, ensuring that both community participants and government actors gain value from their involvement.[38] This concept of reciprocity sets the foundation for building collaborative relationships[39] and sharing of power.[40] Collaboration is suggested to foster the development of shared knowledge and shared decision making.[41]

This key aspect also recognizes the importance of the diverse knowledge and perspectives of community members and encourages a two-way exchange of information between them and the project implementers.[42] Incorporating traditional local knowledge in the engagement process is one way to express community viewpoints, suggested to lead to a more comprehensive and effective decision-making process in FRM.[43]

It is also important for communities to feel empowered to be able to voice their perspectives and influence decision-making processes.[44] This empowerment is fostered by this iterative two-way learning process and as the community also stands to benefit.[45]

Early and long-term involvement of community members

Many researchers underscore the significance of sustained community engagement throughout the entire project or program lifecycle, from inception to completion.[46] This enables establishment of a sense of ownership and promotes sustainability of community involvement.[47] Early and consistent involvement of community members helps build effective relationships and trust,[48] enabling them to contribute and also enhance the acceptability and legitimacy of engagement recommendations.[49] Involving the community in decision-making from the outset ensures that the knowledge generated is locally relevant and the project is sustainable in the long-term.[50] It is suggested that early and long-term involvement allows for relationship building and frequent interactions with relationship building viewed as key in the sharing power and community empowerment.[51]

Inclusivity

Inclusivity is argued to be a key aspect of collaborative community engagement.[52] Inclusivity ensures that all members of the community are represented, have an equal opportunity to participate in the process and that this includes aspects of fairness. Inclusivity also ensures that the needs and aspirations of all members of the community are considered, particularly those who may be marginalized in society.[53] This includes groups of individuals from different backgrounds, such as different races, social economic backgrounds, faiths, sexual orientations, and abilities.[54] Different groups may require different types of engagement.[55] For example, methods that require reading or writing should be avoided when working with groups in communities that may include individuals who are illiterate.[56] It is important to be flexible and adjust the approach as needed to address new challenges that may arise, and the different approaches employed should equalise and share power between participants to avoid marginalizing the voices of less powerful members of the community. This leads to overall community empowerment without re-enforcing any existing inequalities within a community.[57]

Clear goals, objectives, roles and responsibilities

Establishing clear objectives, roles, and responsibilities for stakeholders and participants in a community engagement process is proposed to be important to managing expectations, cultivating trust, and avoiding dissatisfaction.[58] By clarifying the expectations and responsibilities of all parties involved, stakeholders are better equipped to participate effectively.[59] This also ensures that the

process is transparent.[60] Thoradeniya and Maheshwari[61] contend that transparency and accountability cultivate fairness and trust in the engagement process. Furthermore, clear communication can help to prevent misunderstandings and conflicts between stakeholders.[62] Having clear understanding of the objectives, the nature of involvement, the timeline, and the purpose of the engagement is also important for the success of community engagement,[63] whereas unclear goals and responsibilities can lead to decreased involvement and undermine trust, leading to a failure of the engagement process. Trust building is associated with relationship building which sets the foundation for collaboration and community empowerment.[64]

Capacity building

Reed[65] and Carr et al.[66] emphasize that merely providing opportunities for community involvement in decision-making and implementation is insufficient for effective participation. Therefore, community members should possess the actual capacity and skills to be involved meaningfully. This concept, referred to as competence by Carr et al.[67] can necessitate educating participants and fostering the knowledge and confidence required for their active involvement. The need for capacity building may also arise because some project implementers may undervalue or distrust experiential or indigenous local knowledge from communities.[68] Puzyreva et al.[69] also corroborates this, highlighting the need of knowledge attainment through trainings and suggest that capacity building enables collaborative community involvement. Puzyreva et al.[70] contends that capacity building enables community members to develop more knowledge and skills to allow them to effectively contribute to discussions with technical experts. The importance of capacity building has been emphasized by various other researchers.[71] Nguyen[72] contends that capacity building empowers communities to have more equitable power or more roles in decision making.

Although aware that these are not exhaustive, integrating these key aspects (Table 2) —mutual learning, early and sustained engagement, inclusivity, clear objectives, and capacity building— into a framework of co-production leads towards a more holistic understanding of co-production in FRM. These aspects can be used to analyse whether community involvement fosters empowerment and shared decision-making, considered as fundamental values for co-production.

Key Aspect	Values, actions and norms involved
Mutual learning and benefits	• Two-way dialogue • Reciprocity • Use of local knowledge
Early and long-term involvement	• Relationship building • Creation of community ownership • Sustainability structures
Inclusivity	• Fairness • Accessibility • Emphasis on marginalised groups of society
Clear goals, responsibilities, objectives	• Clear tasks • Transparency • Accountability
Capacity building	• Trainings • Sensitization efforts • Awareness raising

Table 18. Key Aspects of community involvement

CONCLUSION

The shift in FRM towards more decentralised and people centred approaches has led to the popularity of co-production as a concept.[73] The two main principles of co-production are fair and equitable distribution of power[74] and community empowerment.[75] This paper has introduced five key aspects of community involvement that can lead towards the adherence of these core principles. Mees[76] comprehensive co-production framework is important to analyse and evaluate the form of community involvement in FRM. However, this paper argues that some categories within the framework arguably do not fully adhere to these core principles of co-production. An integrated framework, of Mees co-production typologies and this paper's key aspects, is proposed to evaluate the forms of how communities are involved in FRM, but also if and how they have been empowered in the process. This is crucial for any co-production efforts by government and other authorities.

Incorporating this extra layer of understanding community involvement in contentious contexts such as FRM is likely to introduce further complexities in practice. However, these complexities are arguably worth navigating to ensure meaningful engagement and empowerment. This approach will be tested in the next stage of this PhD research, analysing FRM government-led projects with communities in England (UK) and Uganda.

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TRANSLOCAL IMAGINARIES AND SENSE OF BELONGING: NARRATIVES AND MYTHOLOGIES IN THE DESIGN OF THE MIGRANT URBAN COMMONS

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INTRODUCTION

Landscapes constantly evolve, shaped by the movement of people, cultures, and ideas across borders. These landscapes are physical spaces with cultural and emotional terrains infused with their inhabitants' memories, practices, and aspirations. As migration increasingly influences urban environments, traditional notions of locality and belonging are being redefined. Locality, multilocality, and translocality become relevant to understanding how individuals and communities navigate their identities in diverse, interconnected contexts. Considering this, public spaces are significant arenas for cultural negotiation, adaptation, and transformation. Blending memories with present experiences and future aspirations creates a dynamic and sometimes paradoxical sense of belonging, which public spaces both shape and are shaped of.

This article explores translocal placemaking through the lenses of amalgamation and juxtaposition. These concepts emerged through initial explorations of visualizing selected prompts from participants in held workshops[1] with Image-Generative Artificial Intelligence (IGAI). Motivated by the first findings of the research, we discuss two distinct approaches to urban space development shaped by the cultural and spatial negotiations of immigrant communities: Seattle's Chinatown-International District and Copenhagen's Superkilen. In parallel, we speculate on the questions prompted by our case study, a third public space taking shape in Los Angeles- the regeneration of a former landfill into a multicultural regional park in the Puente Hills.[2]

This exploration questions what value we can gain from case studies by dissecting their published participatory methods and scholarly critique and discussing the resulting design through prerogatives of translocal placemaking. Two main research questions have shaped the methods: are juxtaposition and amalgamation the only ways to trace translocality[3]? And how is urban heritage affected by shifting dynamics of immigrant communities?

Traditional concepts of heritage often focus on preserving historical artifacts, sites, and practices rooted in specific cultural and geographic contexts. By applying critical lenses such as amalgamation, juxtaposition, and paradox, this article explores the intricate processes of public space design that aim to include and reflect upon the often hybrid identities of migrant communities. Urban heritage here is reconceptualized as a dynamic construct,[4] continually reshaped through the mobility of people, ideas, affect, and cultural exchanges. In this view, public spaces are repositories of cultural memory and active grounds for ongoing conflicts and negotiations.

The article offers a critical perspective on the multifaceted nature of belonging in cosmopolitan urban environments and the tools decision-makers and designers use. Through the lens of translocal placemaking, it advocates for a broader awareness of cultural plurality and resilience in public spaces to accommodate the fluid, hybrid, and often contradictory identities that define contemporary multicultural urban environments.[5]

LOCAL- MULTILOCAL - INTERLOCAL – TRANSLOCAL

Public Spaces and Sense of Belonging

Public spaces are often integral to the identity of a locality, serving as venues for communal activities and cultural expressions.[6] They provide a sense of belonging, anchoring communities within their historical and geographical contexts.[7] However, migrants' experiences and identities are shaped by their ongoing connections to multiple places, challenging static notions of home and belonging.[8] Multilocality, interlocality, and translocality are distinct but interconnected concepts that help understand how spatial dynamics and relationships with places are affected by immigrants' intergenerational knowledge and everyday practices. This knowledge is interwoven with memories, shaping behavioral patterns and material traces. It contributes to the emotional bonds and sense of security immigrants have toward specific places and influences preferences, identity, well-being,[9] and sense of belonging.[10]

Immigrants and Urban Networks of Affect

Migrant individuals and communities navigate their identities and experiences across different locales, recognizing that their sense of self and belonging is shaped by interactions with multiple places and the cultural, social, and political influences they encounter.[11] Their sense of belonging encompasses feelings of otherness, difference, multiplicity, paradoxes, and contradictions, forming a dynamic constituency of ever-changing and shapeshifting parts. Migrants and other mobile populations maintain connections to multiple places, resulting in hybrid identities and practices that blend elements from various cultural and social contexts.[12]

These connections allow migrants to integrate into new environments while maintaining ties to their places of origin, creating hybrid identities and practices[13] framed as translocal subjectivities.[14] These interconnected relationships between individuals, communities, and environments form “networks of affect,” where emotions circulate within and across social networks, shaping experiences, interactions, and identities within and across private and public spaces, influencing decision-making, coping strategies, and experiences of belonging.

Information and Communication Technologies (ICT), such as social media and mobile communication, facilitate extending affective networks beyond physical boundaries, influencing cultural expressions and identity formations among migrants, fostering hybrid identities, and resilience amidst cultural transitions.[15]

In sum, a translocal sense of belonging could be defined as affective processes generating spaces that are influenced by memories, present preferences, and visions of the future, constantly engaging in processes of translation and negotiation between different sets of cultural and spatial values.

TRANSLOCAL PLACEMAKING

Multicultural cities emerge as crucial nodes in affect networks by virtue of hosting diverse immigrant populations.[16] Urban environments support/allow cultural exchanges, generating social and cultural hybrids that shape them.[17]

We first analyze two cases of public space developed with participatory processes involving immigrant communities in Seattle, US, and Copenhagen, Denmark. Both projects deal with symbolic

artifacts, while natural elements are marginal. We discuss how translocality materialized through design in both cases, although their participatory processes differed.

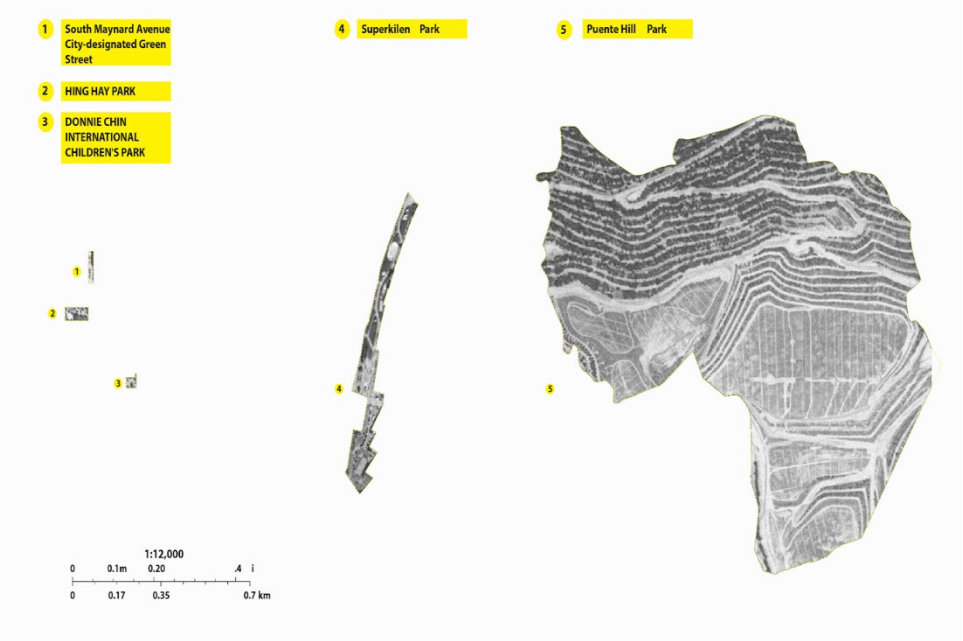

Figure 1. Seattle CID, Superkilen, and Puente Hills Landfill Park. image by Jordi Prieto

First, each project is described, then a reflection through the critical lenses of concepts such as amalgamation/ hybridization and juxtaposition/paradox continues.

a. Chinatown/International District, Seattle, USA

Seattle's Chinatown International District (CID) originated in the late 19th century and represents a culturally rich and historically significant neighborhood, reflecting the diverse Asian-American heritage of the Pacific Northwest.[18]

Figure 2. Features and elements in the different public spaces in Seattle CID. Image by Jordi Prieto

South Maynard Avenue City-designated Green Street (2004-2005)

Plans included adding signage, public art, resting spots for older people, widened sidewalks, and improved lighting. Community engagement methods included photovoice and design charrettes. The outcomes include improved parking and safety (more sidewalk space and visibility), culturally resonant (familiar) materials with tiles and gravels for permeable sidewalks, and cascading water elements inspired by East Asian terraced fields, doubling as seating.

Donnie Chin International Children's Park Redesign (2007-2012)

The original International Children's Park, developed in the 1970s through community activism, was designed by architect Joey Ing and featured notable elements such as a neon pavilion, a dragon sculpture, a rock mountain, and a Ying-Yang sand pit. However, over time, the park's usage has declined due to its poor visibility and limited flexibility in programming,[19] leading to its underutilization.[20]

Community engagement and public participation methods included Photovoice Interviews, Intergenerational Workshop, Design Buffet, and Children's Design Workshop held at the Denise Louie Education Center. Following these workshops, three design concepts by Karen Kiest were presented for community review and comment. The final design incorporated artistic elements by Stuart Nakamura and involved the relocation and addition of various park features.

The participatory process underscores the role of community activism and advocacy in shaping a neighborhood's development. It highlights how residents, business owners, and community organizations collaborate to preserve cultural heritage while accommodating new waves of immigrants and businesses.[21] However, the neighborhood's multiple and sometimes conflicting identities create challenges,[22] resulting in contestation over space, inter-ethnic conflicts, and class divisions. The project faced challenges in articulating and preserving cultural identity.[23] We ask whether materializations of symbolic elements are a fruitful outcome or if more open-ended expressions of translocality would better support a sense of belonging.

b. Superkilen, Copenhagen, Denmark

Superkilen is a kilometer-long urban park, one of several public spaces developed in Nørrebro's neighborhood over the past two decades, aiming to "expand social spaces and integrate the neighborhood more seamlessly into the urban fabric of Copenhagen."[24] Designed through a collaboration between architectural firm BIG,[25] artist collective Superflex, and landscape architects TOPOTEK 1, the park also involved input from the predominantly Muslim local community. Superkilen draws on the historical themes of the "universal garden" and the amusement park, reinterpreting them within a contemporary urban context to celebrate cultural diversity and invite people to intergenerational playful interactions. The project represents a bold experiment in participatory urban design[26] intended to foster co-management and inclusion of the community, providing a space that reflects the area's cultural diversity. Superkilen was intended to reflect the local community's diversity by integrating cultural artifacts from over 60 countries into its design. However, the project has sparked debates about the true nature of participation and representation, raising questions about the extent to which marginalized communities were genuinely included in the design process. The park's juxtaposition of disparate cultural symbols also brings to light the paradoxes of celebrating diversity in a way that risks reducing complex cultural identities to aestheticized, superficial representations.

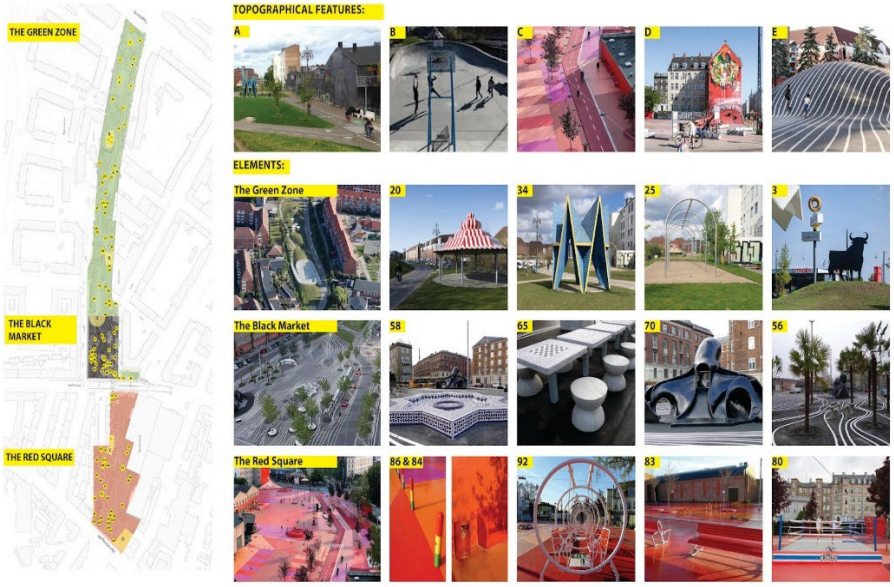

Figure 3. Features and elements in the different public spaces in Copenhagen's Superkilen. Image by Jordi Prieto

Despite this framing, the process is obscured by a lack of transparency and detailed information about how participation was facilitated. Representation remains a central issue at Superkilen,[27] even though the park was conceived as a space for integration and multiculturalism. The use of picturesque park narratives, invoking the idea of a Universal Park, and its imported architectural elements and cinephile references have been controversial,[28] particularly concerning the implications for authentic participatory design and the potential activism embedded in the process.[29]

Superkilen is attempting to install, as an experiment perhaps, a dynamic cosmopolitanism, an "indexic" translocality that we can call a paradoxical juxtaposition of triggers. The elements chosen do not claim to be a collective representation as in the former project. The objects are situated on the urban surface, aiming to express urban dynamics, and a sense of belonging is pursued by accepting the imaginaries of others and embracing or accepting them.[30] It is not about critiquing the qualities of the urban space delivered by the designers but asking ourselves how a multiplicity of shapes exemplifies translocality as a vehicle of a sense of belonging for all.

c. Puente Hills Landfill Park, Los Angeles, USA

The Implementation Plan[31] of Puente Hills Landfill Park in Los Angeles, led by Studio - MLA, offers a unique perspective on translocal placemaking.[32] Situated on one of the largest former landfills in the United States,[33] the park is being designed with a focus on sustainability and environmental justice. The master plan, established in 2015-2016, emphasizes sustainable practices[34] while promoting environmental stewardship by addressing the post-industrial site's complex ongoing monitoring of refuse settlement and landfill gas emissions. The current design phase implemented a community-centered planning approach that included extensive, multi-pronged outreach efforts.[35] This project exemplifies urban regeneration by transforming an industrial site into a cultural, recreational, and ecological asset. Emplacement[36] is central to transforming this site into a space for flexible, multicultural park program and ecological restoration, fostering a sense of place and belonging for diverse communities that articulated a shared value in bolstering site ecology and healthy open space environments that integrate spaces for gathering and ceremonial practice.

Figure 4. Puente Hills Landfill Park implementation plan. Image by Studio-MLA

Geographically located in the San Gabriel Valley, the Puente Hills Landfill has historically functioned as part of a broader waste management network that extends beyond the local context. This landfill was the endpoint for waste generated by the migratory flows of people, animals, plants, and goods across Los Angeles County and beyond, embodying the displacement of materials from diverse contexts to a single, concentrated site.

The site represents a complex stratification of layers resulting from the amalgamation of diverse materials and objects, the juxtaposition of techno-legal frameworks with environmental contexts, and the challenges posed by the convergence of temporal, spatial, territorial, and geographic dimensions. This layered process forms a consolidated yet multifaceted interplay between ecological processes, regulatory frameworks, and sociocultural factors.

Translocal Imaginaries - generative AI tools to translate and mediate immigrants' preferences and memories

Amalgamation, juxtaposition, and paradox apply to using Image-Generative Artificial Intelligence (IGAI) as a tool for translation and mediation between constituents and designers in participatory processes in the design of public spaces. When investigating the impact of IGAI through interviews with immigrants and subsequent AI-generated visualizations, we explored how these novel tools can mediate and translate preferences and memories into possible design probes and elements.[37] The initial AI-generated images tended to reproduce stereotypes, sometimes as an amalgamation of objects, artifacts, colors, or even ethnic features, and present visual composites that juxtapose disparate, often paradoxical realities. The images showcased environments that can co-exist as imaginaries but do not relay truth when addressing Puente Hills's conditions. For example, one of the translated imaginaries depicted cherry trees and horses by a water body, suggesting a pairing oblivious to the site's *genius loci* and specificities of environmental and ecological conditions.

Figure 5. AI simulations of memories and preferences from interviews with young adult immigrants. Image Project "The Sound of Silence" using dreamstudio

Simulations of this kind can be very evocative and helpful when opening up the possibilities of belonging (by the participants) and creating divergent pathways supporting diversifying perspectives. However, incorporating safe and responsible IGAI in participatory design and AI-mediated conversations must continually reflect on questions of inclusion, bias, and conviviality while mitigating the technology's limitations to improve efficiency and effectiveness.

NARRATIVE ENVIRONMENTS[38]

In urban public spaces, the coexistence of diverse cultural influences is common. IGAI has the potential to simulate spatial interactions, where social practices and their material expressions intersect and evolve through amalgamation and juxtaposition. These processes, by allowing differences to exist or by creating a dynamic visual effect or meaning, create hybrid spaces where traditional and contemporary, local, elsewhere, and global elements intersect and interact, although not without paradoxes and spatial ambiguities, tensions, conflicts, and anxieties, sometimes intentionally introduced in the design[39] or as consequences of the design itself.[40]

The concept of amalgamation, where different cultural elements are blended, presents a tension between creating a unified space and maintaining the authenticity of each represented culture. In projects like Seattle CID, this tension is palpable. While the park's design aims to create a cohesive space that reflects the community's diversity, there is also a risk of diluting or misrepresenting individual cultural identities of other ethnicities.

Questions remain about whether true cultural amalgamation is possible or desirable in public spaces. Placing disparate elements side by side, like in Superkilen, is a powerful tool in design, but it also carries risks. In the context of public spaces, juxtaposition can highlight the richness of cultural diversity. Still, it can also lead its aestheticization to a mere visual spectacle.

Wherever and/or whenever cultural identities blend and intersect, they generate hybrid places. However, hybridity is inherently paradoxical: it involves both the merging of cultures and the preservation of cultural distinctiveness. This paradox can lead to tensions in public spaces, where hybrid identities may be celebrated in some contexts but marginalized or misunderstood in others, generating friction and tensions, exposed and hidden, and different degrees of resistance.

Concerns often arise about which cultures are included or excluded in public spaces and whether the representation offered genuinely reflects the diversity of the local population. There is a risk that cultural identities may be reduced to superficial symbols.[41] However, these spaces also provide

opportunities for individuals to engage with diverse cultures, facilitating experiences of "otherness" through active interaction and participation.

The long-term sustainability of translocal placemaking projects hinges on several factors, including community stewardship, funding for maintenance, and programming that sustains community engagement. There is also the need for adaptability to changing urban dynamics.[42]

Finally, there is the question of how these public spaces contribute to social cohesion, cultural understanding, and community well-being over the long term. While the initial design and construction phases may successfully bring people together, the challenge lies in ensuring that these spaces foster social connections and cultural exchange as the community and city evolve.[43]

DESIGNING THE [IM]MIGRANT COMMONS

Designers must navigate large-scale, complex environments that encompass physical, social, and regulatory dimensions while addressing the multifaceted needs of diverse stakeholders. This process requires a nuanced understanding of varying preferences and expectations and the ability to integrate multifunctional requirements into cohesive design formulations. In translocal placemaking, particularly in spaces that cater to migrant communities, the challenge is to navigate these processes of differentiation in ways that acknowledge, incorporate, and synthesize the diverse heritages of stakeholders.

Heritage[44] practices often privilege certain narratives while marginalizing others, contributing to selective processes of memory, remembrance, and forgetting that shape cultural identities over time. Consequently, heritage is a repository of cultural memory and a dynamic arena where societal struggles over identity, power, and spatial justice intersect.

Applying a translocal lens involves exploring how heritage and its institutions are shaped, reconstructed, and transformed through the movement of people, ideas, artifacts, technologies, and discourses. This approach reconsiders translocality as integral to the heritage of localities as more commonly recognized elements.[45]

Can we reimagine heritage as vectors of diversity and change over time and public space as sites of contestation with the potential for alternative futures in the design of the migrant commons? Location, history (narratives), and geography (place) all influence how a designer approaches a yet-to-be-realized space like Puente Hills. Identifying and balancing these translocal subjectivities in the design of urban commons requires careful consideration and continuous engagement with communities, challenging us to revisit protocols, policies, methods, and practices.

Migrant communities often experience instability and transience, challenging participatory processes. Formal and informal mixed methods and the responsible integration of nascent technology, particularly AI and data analytics, can enhance participation. For example, Image-Generative Artificial Intelligence (IGAI) can generate visual representations facilitating communication and understanding between designers and migrant community members. Still, it risks producing results biased toward dominant cultures, harming the same marginalized communities it was intended to support.[46]

If we are to advocate for an idea of migrants' heritage in urban public spaces, we have to acknowledge the importance of affect and emotion, as well as temporal and spatial multiplicity. Such an approach not only accommodates the diverse and evolving identities of migrant communities but also fosters environments that are responsive to the complex, interconnected realities of contemporary urban life.

This leads us to consider the need for true versatility in space that offers opportunities to overcome issues of static representation through symbols. Such a space could (and should) foster a sense of belonging through accumulating (shared) memories over time without excluding prior references.

Additionally, it could provide a flexible platform for distinct collectives to celebrate their differences together towards a more inclusive and dynamic urban environment.

NOTES

[1] As part of a broader research initiative [Project “The Sound of Silence: Mapping immigrants’ preferences and use of public space through social media toward an inclusive design and management of the urban commons”, 2022-2024, Cornell Migrations Grand Global Challenge / Mellon Foundation Just Futures Initiative Grant] and in collaboration with a landscape architecture design advocacy practice Studio-MLA, we explored the use of advanced digital tools, including generative AI, to translate the memories and preferences of young adult immigrants into visual representations. These synthetic representations of memories and imaginaries reflect hybrid identities and future aspirations. While this approach demonstrates the potential of technology to influence and enhance participatory design processes, it also raises critical ethical questions about the nascent ability of such tools to accurately capture and represent the complex lived experiences of diverse communities. We explored the use of AI as a mediator in translating the memory and preferences of young adult immigrants as a pilot study adjacent to a public engagement process for the first phase of the regeneration of a former landfill into a multicultural regional park in Los Angeles

[2] Seattle’s Chinatown-International District exemplifies rich Asian-American heritage while highlighting the tensions between cultural preservation and modernization. Copenhagen’s Superkilen, integrates cultural artifacts from over 60 countries, sparking debate about authentic participation and representation. These spaces illustrate the tensions, challenges, and opportunities of translocal placemaking in contemporary urban settings. In Los Angeles, the development of Puente Hills Landfill Park emphasizes sustainability and environmental justice while incorporating the cultural and emotional histories of surrounding (immigrant) communities.

[3] Amalgamation and Juxtaposition are significant methods for examining translocality—how diverse cultural elements intersect and coexist within urban spaces. Amalgamation is the process of blending or combining different elements or components (into a unified whole) and juxtaposition the act of placing contrasting or dissimilar elements or parts side by side. However, these frameworks alone may not fully capture the complexities of how translocality manifests in urban environments. The role of immigrants and their evolving identities in such spaces prompts a re-evaluation of urban heritage. Immigrant communities contribute to and reshape urban commons through diverse cultural practices, memories, and aspirations. This ongoing interaction challenges static notions of heritage and calls for a more nuanced understanding of how urban spaces can accommodate and reflect dynamic, multifaceted identities.

[4] Influenced by dominant discourses, structures, and practices

[5] Urban heritage is increasingly influenced by the contributions of immigrant communities, who reshape these shared spaces with their unique cultural practices and aspirations. This ongoing negotiation between traditional heritage and evolving identities calls for a more nuanced approach.

[6] Stephen Carr, Mark Francis, Leanne G. Rivlin, and Andrew M. Stone, *Public Space*, (Cambridge: Cambridge University Press), 1992; Neil Smith and Setha Low. Introduction: The imperative of public space to *The politics of public space*, (Routledge, 2013), 1-16.

[7] Doreen Massey. *Space, Place, and Gender*. Minneapolis, (University of Minnesota Press), 1994

[8] Avtar Brah, *Cartographies of Diaspora: Contesting Identities*, (London: Routledge), 1996; Alison Blunt and Robyn Dowling. "Home, Migration, and Diaspora." In *Home*, (Routledge, 2022), 247-308; Nina Glick Schiller and Noel B. Salazar. "Regimes of mobility across the globe." Journal of ethnic and migration studies 39, no. 2 (2013), 183-200;

[9] Lynne Manzo and Patrick Devine-Wright, *Place attachment: Advances in theory, methods and applications*. (Routledge, 2013)

[10] Concepts like Yi-Fu Tuan’s topophilia (1974) and Norberg Schulz’s genius loci (1979) provide complementary frameworks for understanding the deep connections between people, place, and the sense of locality. These concepts inform an understanding of locality, where both the subjective, human-centered experience (topophilia) and the objective, context-based qualities (genius loci) are crucial in shaping resonant places. Consequently, notions of heritage became embedded in urban praxis. They informed many of the approaches to landscapes and public spaces later in the 20th century, becoming intertwined with urban design and urbanism discourses and practices, particularly in Europe.

[11] David Conradson and Deirdre McKay. "Translocal subjectivities: Mobility, connection, emotion." *Mobilities 2*, no. 2 (2007): 167-174; David Ralph and Lynn A. Staeheli. "Home and migration: Mobilities, belongings and identities." *Geography compass* 5, no. 7 (2011): 517-530.

[12] Conradson and McKay, 167-174; Ralph and Staeheli, 517-530; Erin Cory, Maria Hellström Reimer, and Per Möller. "Translocality and Translocal Subjectivities: A Research Overview Across the Fields of Migration, Culture,

and Urban Studies." *Mistra Urban Futures Report*. 2020; Suketu Mehta, “Being Interlocal” in *Shaping Cities in an Urban Age*, ed. Ricky Burdett and Philipp Rode, (Phaidon Press, 2018), 78-85

[13] Ruben Gielis. "A global sense of migrant places: towards a place perspective in the study of migrant transnationalism." *Global Networks* 9, no. 2 (2009): 271-287.

[14] Conradson and McKay, 167-174.

[15] Mimi Sheller and John Urry. "The New Mobilities Paradigm." *Environment and Planning A* 38, no. 2 (2006), 207-226; Dana Diminescu. "The Connected Migrant: An Epistemological Manifesto." *Social Science Information* 47, no. 4 (2008), 565–579; Lee Komito. "Social media and migration: Virtual community 2.0." *Journal of the American society for information science and technology* 62, no. 6 (2011), 1075-1086; Mirca Madianou and Daniel Miller, Migration and new media: Transnational families and polymedia. Routledge, 2013

[16] Steven Vertovec. "Super-diversity and its implications." *Ethnic and racial studies* 30, no. 6 (2007): 1024-1054.

[17] Homi K Bhabha. The location of culture. Routledge, 2012; Ien Ang. "Together-in-difference: beyond diaspora, into hybridity." *Asian studies review* 27, no. 2 (2003): 141-154.

[18] It encompasses distinct areas such as Chinatown, Japantown, and Little Saigon, each contributing unique cultural elements and historical narratives. The district, with its origins in the late 19th century, is characterized by its historic architecture, markets, traditional dining establishments, and various festivals that celebrate the cultural traditions of diverse Asian communities: Chinese, Japanese, Vietnamese, Filipino, and other. This neighborhood functions as both a commercial hub and a cultural epicenter, where (immigrant) heritage is actively preserved through the efforts of community organizations, cultural centers, and public art installations.

[19] hindering the adaptive use of a space for a wide variety of community needs and activities

[20] Hou, Jeffrey, and Amy Tanner, "Constructed identities and contested space in Seattle’s Chinatown-International District." *CELA 2002: GroundWork* 33 (2002).

[21] Dan Abramson, Lynne Manzo, and Jeffrey Hou. "From ethnic enclave to multi-ethnic translocal community: contested identities and urban design in Seattle's Chinatown-International District." *Journal of Architectural and Planning Research* (2006), 341-360.

[22] Different ethnic groups and stakeholders hold varying visions for the district's future, leading to contested narratives about its cultural and economic development.

[23] Debates over proposals, such as installing Chinese-style gates in the core Chinatown area, reveal disagreements on how best to express and represent cultural heritage.

[24] from the architect’s statement on Superkilen, BIG. Accessed September 1, 2024. www.big.dk

[25] Bjarke Ingels Group

[26] Branded as a “participatory park extreme”. BIG. Accessed September 1, 2024. www.big.dk

[27] Elizabeth Stanfield and Micheline Van Riemsdijk, "Creating public space, creating ‘the public’: Immigration politics and representation in two Copenhagen parks." *Urban Geography* 40, no. 9 (2019), 1356-1374.

[28] Bloom, Brett. 2013. “Superkilen: Participatory Park Extreme!” Mythological Quarter. Accessed September 8, 2024. https://www.mythologicalquarter.net/s/SUPERKILEN_Brett_Bloom_2013.pdf

[29] The literature on participatory processes reveals a spectrum of engagement, from non-participation and tokenism to genuine citizen empowerment The effectiveness of participation is contingent on how power is distributed and the extent to which citizens can influence decision-making (see Arnstein,1969; Pretty, 1995; White, 1996; Cornwall, 2004; Fung, 2006).

[30] Even the palm trees, criticized as alien to Copenhagen, are protected during cold winters, playfully engaging with the imaginaries of translocality

[31] in development from 2022 to 2027

[32] design advocacy through "the power of coalition building and collective action to affect meaningful change." The project benefitted from having a substantial grouping of project partners, some of which were direct links to the immigrant communities

[33] in operation from 1957 until 2013

[34] such as habitat restoration and biodiversity enhancement through the incorporation of native species and wildlife corridors

[35] Such as public workshops, surveys, and meetings conducted in four languages—English, Chinese, Korean, and Spanish—to ensure that the diverse population of the relevant neighborhoods is adequately represented. The success of this transformation relies heavily on public perception, with educational programs, community events, and communication playing key roles in reshaping the site’s identity from a symbol of waste to a communal public space, aptly termed "A park for all."

[36] the process of creating a sense of place or belonging by embedding cultural, social, and environmental narratives within a specific geographic location. It involves the physical and symbolic integration of diverse

histories, identities, and memories into a space, transforming it from a mere site into a meaningful place that resonates with the experiences and aspirations of its communities.

[37] Although IGAI can enhance the translation of verbal input into visual representations, influencing stakeholder engagement, we also identified potential risks, such as the exacerbation of power imbalances and biases, mainly when dealing with non-Western subjects, cultural references and contexts

[38] physical and conceptual spaces designed to tell stories, convey meanings, and evoke experiences through the interaction of space, objects, and users. These environments intertwine spatial design, storytelling, and sensory elements to create immersive experiences that reflect cultural, historical, or personal narratives

[39] as in the case of Superkilen project, Copenhagen, Denmark.

[40] as in the case of Chinatown/International District projects, Seattle, USA

[41] Critics argue that curating cultural artifacts in public spaces can lead to the commodification of culture (aestheticization), where cultural elements are showcased for their visual appeal without addressing the more profound socio-economic inequalities and power dynamics that shape cultural representation. This process risks stripping culture of its context and meaning, reducing it to a mere aesthetic experience, leading to tokenistic displays of multiculturalism that fail to capture the complexities of lived experiences. Questions often arise about whether local communities were genuinely engaged in the design and planning phases, if their voices were adequately represented, and if the initial participation of community members is sustained throughout the park's operation and maintenance stages. Continuous community input is crucial for ensuring that the park's evolution remains aligned with the needs and aspirations of the local population (see Sandercock, 2003; Rishbeth and Rogaly 2018; Hou, 2020)

[42] Elinor Ostrom, *Governing the commons: The evolution of institutions for collective action*, (Cambridge university press), 1990

[43] Jeffrey Hou. "Public space as a space of resistance and democratic resilience." In *Companion to public space*, (Routledge, 2020), 335-345.

[44] traditionally understood as the preservation and valorization of historical artifacts, sites, and practices rooted in a specific cultural and geographic context,

[45] such as architecture, crafts, cuisine, music, etc,

[46] Jose A. Guridi, Cristobal Cheyre, Maria Goula, Duarte Santo, Lee Humphreys, Aishwarya Shankar, and Achilleas Souras. "Image Generative AI to Design Public Spaces: a Reflection of how AI Could Improve Co-Design of Public Parks." *Digital Government: Research and Practice* (2024).

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