SOCIETY. SPACES. SCREENS

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Mediated Cities Series

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INTRODUCTION

SOCIETY. SPACES. SCREENS

Mediated Cities Series

Today, the spaces and societies in which we live are infused with media and technology. Smart cities, digital sociology, Industry 4.0 and augmented realities are just a few of its examples. Simultaneously, there are places and practices untouched and unaltered by the effects of technology – whether due to a lack of resources or a reactionary response to change. The questions this raises are boundless and interlinked. They are relevant across spaces, times and disciplines: architecture, urbanism, heritage, sociology, transport, business, education, politics and more. In this context, when we discuss new medias or technologies in any field, we are obliged to think equally about traditional practices, theories and concepts.

In response, the papers collected in this publication ask you to critique contemporary practice in your own discipline. It asks whether it has, or has not, been altered by advances in technologies and medias. For example, CAD involves new modes of design in architecture, while architects champion participatory planning. Urban data informs the management of cities, while the phenomenological experience of space is central to its use. Spatial computing brings disruptive change to public engagement and the 'democratic process'. At the same time, there are political forces rejecting a future of remote and absentee voting. Social media alters how we interact in spatial settings, yet reports daily on acts in physical space. In every discipline then, technological advances find their analogue parallels.

In exploring the interconnected questions we face today when critiquing the society and spaces in which we live, these papers are open to various questions. They are interested in architecture and urbanism. They ask if data, BIM and intelligent infrastructure have modified our understanding of planning? Equally, they question does design practice continue without it? With regard to the social sciences, they critique whether technology has altered community connections to place, and how have they evolved without it? In the arts and design, they ask how traditional practices continue to thrive in parallel with the digital realm? For cultural theorists they question what happens to identity and tradition in an online world, and what do these mean in 'unconnected' parts of the globe? In the field of teaching and learning, they enquire into whether remote pedagogy has altered what happens in the physical classroom?

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INFLATABLES AT WORK: REDEFINING POST-PANDEMIC OFFICE SPACES

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INTRODUCTION

The traditional understanding of workplace dynamics has undergone a radical transformation in recent years. The emergence of the hybrid office model, characterized by flexible work arrangements and location independence, represents more than a temporary adaptation to the COVID-19 pandemic—it marks a fundamental shift in workplace organization.[1] While flexible work arrangements can be traced to pre-World War II industrial shift work, the contemporary hybrid model emerged through distinct technological and social phases: the initial push of the 1970s and 1980s driven by rising commuting costs and the advent of personal computing; the digital revolution of the 2000s enabled by cloud computing and mobile devices;[2] and the regulatory framework established by the Americans with Disabilities Act of 1990 and subsequent employment policies.[3]

The architectural implications of this transition are particularly significant when examined through the lens of office design evolution. The open office layout, which gained prominence in the 1990s as an antidote to isolated cubicle systems, promised enhanced collaboration and economic efficiency.[4] However, the superimposition of hybrid work patterns onto this static architectural framework has exposed critical limitations. Contemporary workplaces now face a complex set of challenges: fluctuating occupancy patterns creating "ghost offices" during low-attendance periods and overcrowded spaces during peak times,[5] compromised acoustic privacy affecting both in-person and virtual interactions, and insufficient infrastructure for the increasing demand for impromptu meetings.[6] Recent studies indicate that these ad hoc collaborations, when properly supported, significantly contribute to organizational innovation and productivity.[7]

The intersection of hybrid work with traditional office architecture demands a fundamental rethinking of spatial design. According to McKinsey & Company,[8] 52% of workers prefer more flexible working arrangements, yet existing office infrastructure remains largely rigid and unresponsive to these changing needs. Gallup's latest workplace research further emphasizes this disconnect,[9] revealing that successful hybrid workplaces require not just policy changes but physical adaptability to support varying work modes and occupancy patterns. This architectural challenge presents an opportunity to develop innovative solutions that integrate flexibility at the building scale.

This paper proposes that the solution lies in the development of responsive architectural systems capable of real-time adaptation to occupancy patterns and collaboration needs. Specifically, it explores the potential of dynamic inflatable structures as a novel approach to supporting ad hoc collaboration while optimizing space utilization. This intervention represents one facet of a broader

need for intelligent workplace design that can enhance both immediate functionality and long-term sustainability through adaptable architecture. By addressing the specific challenge of meeting space flexibility, this research contributes to the larger discourse on creating resilient, future-ready workplaces that can accommodate evolving work patterns while maintaining operational efficiency.

Figure 1. Meeting taking place inside the inflatable structure by Philip Arnold

Background

The birth of inflatables is often attributed to the US military with Cornell aeronautical lab engineer Walter Bird. Bird first built, radome, an inflatable fiberglass fabric enclosure for the radio antennae in 1948.[10] Soon NASA picked up the concept before Soon after, NASA adopted these structures, leveraging their lightweight and flexible properties. This pioneering technology later entered civilian use, finding applications in greenhouses, storage sheds, and pool enclosures. Visionary architect Buckminster Fuller proposed a massive inflatable dome over Manhattan, while Frei Otto imagined a vast shelter for 40,000 people in the Arctic Circle. The era embraced lighter materials and innovative construction techniques as alternatives to traditional forms.

In the 1960s and 70s, inflatable architecture reached its experimental zenith, fueled by techno-optimism, countercultural ideals as well as the arrival of cheap, mass-produced plastic. Plastic became widely available and young, radical architecture groups embraced the creative potential of inflatable technology. Groups like Ant Farm published the Inflatacookbook, a DIY guide to creating inexpensive, disposable inflatable structures from plastic. Radical architectural groups like Archigram and Archizoom pushed the boundaries of inflatable architecture. Archigram's visionary projects, the “Cushicle” (1964) and “Suitaloon” (1967), reimagined the relationship between individuals and urban environments, allowing people to carry a self-contained habitat directly on their bodies through inflatable suits. In the early 1970s, Ant Farm addressed ecological concerns with their “Clean Air Pod,” a portable, cost-effective, and quickly deployable structure. Around the same time, Spatial Effects explored innovative uses for inflatables through their “Waterwalk” series, creating buoyant, mobile structures, still with the use of plastic. One of the most notable manifestations of inflatable architecture was Yutaka Murata’s Fuji Pavilion at Expo 1970 in Osaka, a large-scale modular design constructed from interconnected inflatable tubes.

However, the 1970s oil crisis and growing concerns over environmental sustainability curtailed the widespread use of inflatable plastics. In recent years, advances in high-tech materials have renewed interest in inflatables.[11] Kengo Kuma’s TEC house, built with Gore Tenara fabric, and Herzog & de

Meuron's Allianz Arena, clad in illuminated ETFE panels, exemplify modern applications that marry innovation with sustainability.

The success of inflatable structures can be attributed to their reliance on plastic, a material that is inexpensive and widely available. However, plastic's lack of sustainability and the high cost of advanced materials make it challenging to scale these structures for mass use. This paper proposes an alternative: cellophane—a fully biodegradable, cost-effective, and widely accessible material—as a means to construct airtight structures. During the seminar, students and I explored the potential of cellophane by designing and building pop-up meeting rooms (Figure 1). These experiments tested the material's viability while embracing the spirit of 1960s architectural experimentation. This work aims to reimagine inflatables through a sustainable lens, blending innovation with ecological responsibility.

METHODOLOGY

The methodology for the seminar consisted of a two-step process involving material research and student experimentation. First, I conducted material and tooling research to prepare for the seminar and establish parameters for student experimentation. Second, the students applied the selected materials and tools to develop their design concepts. The primary goals of the project were to identify the most suitable material for creating inflatables, develop tools that effectively worked with the material, and allow students to test its suitability for their concepts.

Materials and Tools Research

The initial research and preparation for the seminar focused on three key objectives: material selection, the development of welding tools, and preliminary testing. The criteria for evaluating materials included both technical and feasibility requirements. Technically, the material needed to be airtight, extremely lightweight, and capable of forming strong seals. From a feasibility perspective, sustainability, availability, and cost-efficiency were critical considerations. Additionally, the material needed to be aesthetically pleasing and allow light transmission to minimize claustrophobic effects in enclosed spaces (Figure 2).

Figure 2. Materials comparison and research

Materials

Three materials were initially investigated: 200D Nylon Oxford with TPU Coating, Cellophane Wrap, and 10-Gauge Polyvinyl Chloride (PVC), a material commonly used in inflatables (Figure 3). The findings revealed that while nylon satisfied some technical requirements, it lacked the extreme lightweight quality needed. PVC performed poorly in terms of sustainability, cost, and heat resistance,

often melting during testing. In contrast, cellophane emerged as the most suitable material. It met all technical criteria—being airtight, extremely lightweight, and sealable—while also excelling in feasibility. Widely used in the floral and packaging industries, cellophane is cost-effective and biodegradable. Although some industrial processes involved in its production are not entirely sustainable, the material itself aligns well with environmental goals. Moreover, cellophane's availability in various colors and its transparency made it ideal for creating visually appealing microenvironments.

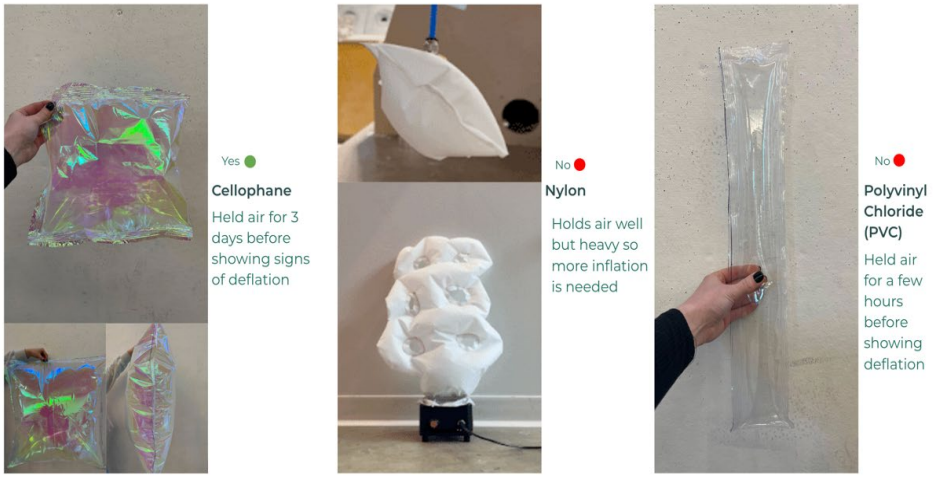

Figure 3. Materials comparison and testing with inflation and welding.

Sealing Techniques

The next phase involved exploring sealing techniques to bond the cellophane material into airtight structures. The primary methods tested included: 1) Adhesive Bonding: Using hot glue and all-purpose cement and 2) Heat Sealing: Using custom-built tools (Figure 4).

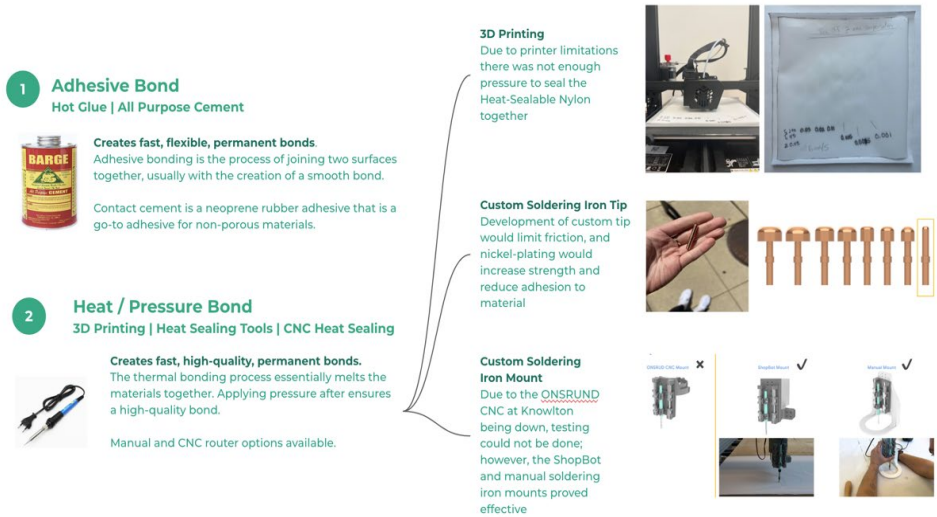

Figure 4. Welding custom tools and techniques

Adhesive bonding with all-purpose cement proved ineffective, as the sheets frequently separated, even when applied to different materials. Conversely, hot glue performed well, creating strong and flexible bonds. An unexpected benefit of hot glue was its reversibility—it allowed bonded areas to be separated upon reheating.

Custom tools played a significant role in heat sealing. A 3D printer with a heated tip was initially tested for creating precise seams, but its size limitations and inconsistent temperature control restricted its usability. To address this, I developed a custom soldering iron for manual use and integration with a CNC machine. This tool featured a heated tip and a spring-loaded attachment, enabling precise pressure control. Capable of reaching temperatures up to 500°F, the soldering iron allowed the identification of optimal bonding temperatures for each material. Additionally, an edge sealant tool, commonly used in the packaging industry, was tested and found effective for creating airtight seals.

Each material was then tested against the available tools to evaluate performance. PVC was challenging to work with due to its tendency to burn at high temperatures, making it difficult to find an optimal bonding point. Nylon performed well, especially with the soldering iron, thanks to its textured surface. Cellophane exhibited the best results, responding particularly well to hot glue and the edge-sealing tool. Based on these findings, I selected cellophane for the seminar, as it fulfilled both technical and feasibility requirements. However, its extreme lightweight nature required careful handling. To enhance the aesthetic value, I chose iridescent rolls of cellophane for the students' projects.

Student Application

Limitations and Goals of the Seminar

At the start of the seminar, students were tasked with designing a microenvironment for workspace use, utilizing inflatables as the primary construction method. The students were divided into three groups of five. Each group was required to design a structure that demonstrated flexibility or adaptability in the workplace and remained within a maximum size of 12 feet. The designs could cater to either individual users or small groups.

The material provided for the seminar was cellophane, and the students were introduced to various welding tools to test their efficacy. A consistent method of inflation was established: each group was limited to using industrial fans with metal blades, capable of delivering 1,500–2,000 CFM (cubic feet per minute) of airflow, ensuring uniformity across projects.

Concept Development

Each group developed unique concepts: 1) Phone Booth: A private space for individuals to make calls, 2) Dual Bubbles: A design aimed at isolating polluted air in offices while supporting clean air for collaborative work in small groups and 3) Meeting Room in a Backpack: A portable solution featuring expandable chambers to accommodate meetings of varying sizes.

The students began by designing their concepts in Rhino 7, 3D modeling software. They quickly discovered that their designs often involved double-curvature forms, necessitating a process of discretization. By breaking the forms into single-curved, developable elements, the groups were able to produce shapes that could be flattened without deformation. After creating 2D templates from the discretized elements, additional offsets were added to account for overlapping parts during assembly.

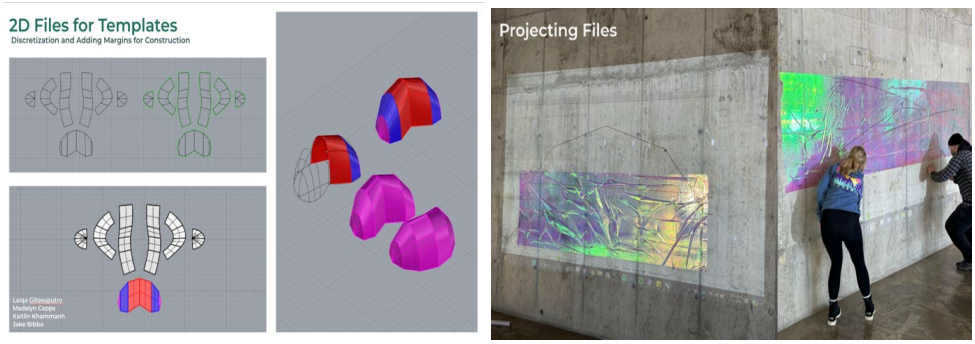

Figure 5. Students learning discretization methods and fabrication at full scale

Full-Scale Fabrication

To fabricate the designs at full scale, the 2D templates were transferred to panels of cellophane. The limited roll width of the material required an efficient technique for scaling and tracing. The groups used a projector to project the templates onto a wall, which surprisingly held the cellophane in place without additional attachments. The projector was calibrated to match the desired scale, and students traced the templates onto the cellophane using markers (Figure 5). After tracing, the panels were cut to shape and prepared for sealing. Each group employed different sealing methods to assemble their designs, testing various techniques presented during the seminar.

Inflation and Final Adjustments

Once the panels were sealed, the structures were inflated. The groups worked to determine the optimal air pressure required for their designs to maintain structural integrity. This process often involved strategic adjustments, such as creating additional airflow and pressure.

RESULTS

Ultimately, all three student groups successfully constructed their inflatable structures, each showcasing unique and innovative ideas.

Figure 6. Pop up phone booth- work by students, group 1.

Group 1: The Phone Booth

The first group designed an inflatable phone booth, a private, enclosed space for an individual to sit and take a quiet call. The structure featured an entryway, a roof, and two windows, offering a sense of privacy as the interior was not visible from the outside. This concept was particularly valuable in the context of the university, which lacks private spaces for individual use. Such a structure is especially beneficial in architecture schools, where students often work together in open studio spaces with little opportunity for solitude. The phone booth was bright and cozy, with cellophane walls allowing light to filter through while still creating an environment conducive to focus. The students constructed the booth at a 1:1 scale, using templates generated in Rhino and transferring the designs to large sheets of material. They meticulously sealed the seams, ensuring that the structure could maintain its shape and stand independently once inflated.

Figure 7. Pop up meeting room. Room in a Backpack- work by students, group 2.

Group 2: Room in a Backpack

The second group developed the "Room in a Backpack," a concept allowing a collapsible inflatable room to be folded into a compact bundle and carried in a backpack. This portable structure could be deployed in various settings, such as open spaces, hallways, or outdoor areas, providing a flexible and temporary space as needed. The room was designed to accommodate different group sizes—ranging from two to six people—by incorporating multiple zippers. These zippers allowed the main chamber to expand as additional chambers inflated, creating an adjustable, modular design. The students faced the challenge of discretizing the complex double-curved geometry into developable surfaces. Using Rhino, they created precise templates, which they transferred to sheets of cellophane, then cut and welded together. Finally, they integrated zippers to enable the modular functionality.

Figure 8. Inside one of the Lungs, pop up room with good oxygen- work by students, group 3.

Group 3: The Lungs

The third group's project, The Lungs, addressed the concept of office air quality through two interconnected inflatable bubbles. One bubble was designated for "bad air," intended to isolate pollutants, such as smoke or airborne germs, effectively separating sick individuals or smokers from the rest of the office. The second bubble, focused on "good air," contained plants to enhance oxygen production, providing a tranquil space for rest or meetings. Although the two bubbles functioned independently, they could be set up or dismantled in minutes. The students designed the forms as double-curved surfaces, requiring careful discretization and template creation. The "bad air" bubble was intentionally crumpled during fabrication to create a textured appearance. This design choice, paired with the iridescent quality of the material, resulted in a visually striking effect that reflected light beautifully.

Each project demonstrated the students' ability to translate complex digital designs into physical structures, showcasing creativity and technical skill in addressing real-world challenges.

Figure 9. Inside the inflatable phone booth.

CONCLUSION

This study highlights the potential of new materials and adaptable design strategies to address the evolving needs of hybrid workplaces. Through the use of cellophane as a sustainable and versatile material, coupled with advanced digital modeling and fabrication techniques, the student projects exemplified how inflatables can provide flexible, cost-effective, and aesthetically pleasing solutions for contemporary work environments.

The three concepts developed—Phone Booth, Room in a Backpack, and The Lungs—demonstrate the versatility of inflatables in creating functional spaces that cater to privacy, portability, and air quality needs. These designs reimagine traditional workplace features, offering alternatives that are both responsive to human needs and adaptable to changing contexts.

The successful translation of digital designs into full-scale prototypes underscores the value of hands-on experimentation in architectural education. The seminar not only tested the viability of cellophane as a material for temporary structures but also challenged students to navigate the complexities of geometry, fabrication, and real-world application.

Overall, the findings contribute to the growing discourse on adaptable architecture, advocating for the integration of sustainable materials and flexible design principles in addressing the challenges of hybrid workspaces. By embracing such innovative approaches, architects and designers can help shape workplaces that are resilient, user-centric, and sustainable.

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FROM METAVERSE TO HYPERREALITY: THE ROLE OF IMMERSIVE TECHNOLOGIES IN SHAPING VIRTUAL ARCHITECTURE

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INTRODUCTION

The advent of immersive technologies, particularly Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR), is poised to revolutionize the concept of virtual architecture, propelling virtual worlds and the current state of the "metaverse" toward a state of hyperreality. This research explores how these technologies enable the seamless integration of virtual spaces and objects with the physical world, leading to a blended reality where digital and real distinctions become increasingly imperceptible. The study begins by examining the foundational principles of VR, AR, and MR, highlighting their roles in creating immersive environments. Through a comprehensive review of current technological advancements and practical applications, we analyze the potential of these tools to extend beyond isolated virtual experiences, facilitating interactions that overlay and augment our physical surroundings.

A key focus is the concept of hyperreality, where the virtual and the real converge to a point of indistinguishability. This merger is anticipated to redefine spatial interactions, architectural design, and user experiences in unprecedented ways. The study suggests scenarios on how virtual objects can be projected onto physical spaces, creating a combined and unified environment. This paper argues that as immersive technologies advance, they will drive the evolution of virtual spaces, transforming them into a hyperreal domain where virtual and real coexist seamlessly. The findings underscore the need for a multidisciplinary approach to harness the full potential of these technologies, ensuring ethical and sustainable integration into our daily lives. This research contributes to the ongoing discourse on digital and physical world convergence, providing insights into the future trajectory of virtual architecture stepping outside the metaverse and creating a new reality, a hyperreality existence.

THEORETICAL FRAMEWORK OF IMMERSIVE TECHNOLOGIES

One of the earliest attempts that aimed at providing an immersive experience was of Morton Heilig's Sensorama. The booth-like device was intended to fully immerse the individual in the film and synchronize sight, sound, smell, and movement to create for the user a multisensorial immersive experience.[1] While Heilig's work was halted due to financial limitations, many other attempts, and experimentations took place in the time span that lasted 55 years before HTC released its HTC VIVE SteamVR headset in 2016. This is considered to be the first commercial release of a headset with

sensor-based tracking that allowed users to move freely in a space.[2] Many argue that since 2019 COVID many leading technology companies decided to seriously invest in immersive technology devices which has led to the current variety of Head Mounted Displays (HMD) that provided a wide range of immersive experiences from totally isolated from the physical world to the more engaging virtual experience overlayed on top of the real world.

The Continuum of Extended Reality (XR)[3] explained by the US Government Accountability Office along with the Reality-Virtuality Continuum[4] framework, adapted by Milgram and Kishino, still serve as comprehensive definitions and updates on how immersive technologies, VR, AR, and MR are becoming significant development in advancing not only virtual architecture but the field of architecture in general. Once constrained by the physicality of materials and spatial limitations, architecture now extends into digital immersive realms where boundaries dissolve, and new possibilities emerge. Accordingly, through immersive technologies, virtual architecture transcends conventional design principles and user experience by leveraging digital environments to create dynamic, interactive, experimental, and experiential spaces. Certainly, virtual architecture cannot be dissociated from the physical infrastructure that comprises the developed technologies, and whether encompassing purely digital assets within virtual worlds, or augmented overlays on top of physical environments (Figure 1), immersive technologies have provided the possibilities to not only rethink the design process[5] but also to venture into spaces that can challenge traditional architectural constraints.

Figure 1. Mixed reality experience overlaying the digital onto the physical space at the CRID

In line with this direction, these technologies, through their immersive capacities, are assisting in dissolving the boundaries between physical and virtual spaces, and by that facilitating an architectural experience that is simultaneously real and simulated. An experience that converges with the notion of hyperreality[6] that mirrors Jean Baudrillard's vision in his Simulacra and Simulation, of a world where both simulation and reality merge to create a space that is neither purely real nor purely imaginary rather a new reality that is neither digital nor physical, but an endless interplay of both aspects. In other term, a world according to Baudrillard, that is sheltered from the imaginary, and from any distinction between the real and the imaginary.

Metaverse or Hyperreality?

By extending the above-mentioned framework to include the transformative outcomes emerging from immersive technologies applications that are currently in development, such as but not limited to ORION,[7] a trajectory aligns with the vision articulated by Dr. Louis Rosenberg and Alvin Wang

Graylin in their recently published book *Our Next Reality: How the AI-Powered Metaverse Will Reshape the World*. While their work does not explicitly use the term hyperreality, it presents a conceptually parallel perspective that points in the same direction. For both authors Artificial Intelligence (AI) will lead the way to create what they referred to as AI-powered Metaverse that will be accessed using XR devices.[8] Unlike the traditional definition of the metaverse being a massively-scaled and interoperable network of real-time-rendered 3D virtual worlds,[9] where Mathew Ball in his book *The Metaverse: And How It Will Revolutionize Everything*, often imply a separation between virtual and real spaces, the AI-powered Metaverse will be a mixed reality that ultimately will accelerate the collapse of virtual and digital boundaries, and will mirror Baudrillard's vision of a world where the simulated and the real become indistinguishable. In this evolving paradigm shift, virtual architecture plays a pivotal role by leveraging XR to create spaces that transcend material limitations and exist on top of the real physical world, ultimately bringing us closer to an architectural experience that is neither purely physical nor purely virtual but a hybrid one that embodies the essence of hyperreality.

While neither the metaverse nor hyperreality are fully realized today, they are steadily taking shape and both XR technologies with AI advancement, are not only accelerating their development, but are also essential to their eventual happening. And whether it is mixed reality, the AI-powered Metaverse, or spatial computing, all these concepts converge toward a shared vision: a richly layered virtual existence seamlessly integrated with the physical world. In this envisioned reality, the distinction between simulations and tangible experiences become imperceptible and lead back to the original notion of a hyperreal experience.

THE IMPACT OF IMMERSIVE TECHNOLOGIES ON ARCHITECTURAL EDUCATION

The integration of XR technologies into architectural education at the American University in Dubai (AUD) highlights the transformative potential of immersive design learning. The state-of-the-art workstations that comprise XR technologies at the Center for Research, Innovation, and Design (CRID) has facilitated the creation of fully immersive courses dedicated for virtual environments, virtual designs, and virtual art. These courses were ideal for students looking to specialize in extended reality (XR) applications in architecture, design, and art equipping them with the skills necessary to innovate within the rapidly evolving VR landscape.

The Case of Virtual Environments

DDFT 474 – Virtual Environments is an advanced professional elective under Digital Design and Fabrication Technology, offering a three-credit course with 5 contact hours, focused on VR modeling and design. This course, delivered at the CRID, introduces students to cutting-edge VR-based 3D design methodologies, enabling them to create virtual architecture directly within immersive environments while developing both passive and active learning techniques. Each semester, the course tackled a different design brief, allowing students to explore distinct themes through fully immersive digital experiences. In Summer 2021, students engaged in FREESPACE / NEWSPACE: An Homage to Lebbeus Woods, while Fall 2021 focused on Virtual Phenomenology: Five Senses Five Spaces where students explored how their sense perception can be expressed virtually within immersive environments.[10] In Summer 2022, MetaHAUS challenged students to design a virtual home in the metaverse,[11] and in Spring 2023, GAMIFITECTURE: The Virtual Space of Playfulness explored spatial design through game-like interactivity.[12] Throughout all courses, students were fully immersed in digitally created spaces, working exclusively in VR for over 50 hours across a full semester, isolating themselves from physical reality to develop and refine their virtual architecture. VR Sketch was the main application used in this course due to its capacity to focus on the creation of

architectural spaces as illustrated in Figure 2. After the completion of building the digital model, students used Twinmotion, a real-time visualization application, in order to represent their final design using renders and video production.

Figure 2. Students at the CRID working in VR utilizing VR Sketch Application

With more than 40 different virtual environments across all different sections and semesters, students across the board felt that VR has empowered them to be more creative and explore design approaches with spatial experiences that were not available for them without these tools. For example, *Awake?* by Dana Kharsa, draws inspiration from *Mind Path to Thalamus*, transporting users into a surreal dreamscape where portals guide them through vivid representations of the four seasons. Similarly, *Seven Deadly Realms* by Shahab Pasandeh reimagines the narrative landscape of the *God of War* franchise through the lens of the seven deadly sins, with each realm meticulously designed to reflect a distinct sin using an intricate interplay of color, thematic elements, and spatial composition. Another example, *Chamber of Secrets* by Mehak Minocha, inspired by *Hogwarts Legacy*, invites users to engage with an interactive virtual environment that reconstructs different realms of the wizarding world (Figure 3). These projects underscore the profound impact of VR in fostering innovative design thinking, allowing students to experiment with immersive storytelling, dynamic environments, and unconventional spatial narratives that extend beyond traditional architectural constraints.

The Case of Virtual Designs

Another fully immersive course delivered at the CRID titled *DDFT 373 – Virtual Designs* has both a VR and an AR component, and teaches students how to design inside virtual reality with a focus on product design and industrial design. In addition, some students were able to use the available see-through technology in order to evaluate their designs in AR that provided them the opportunity to explore their products overlayed on top of real physical space.

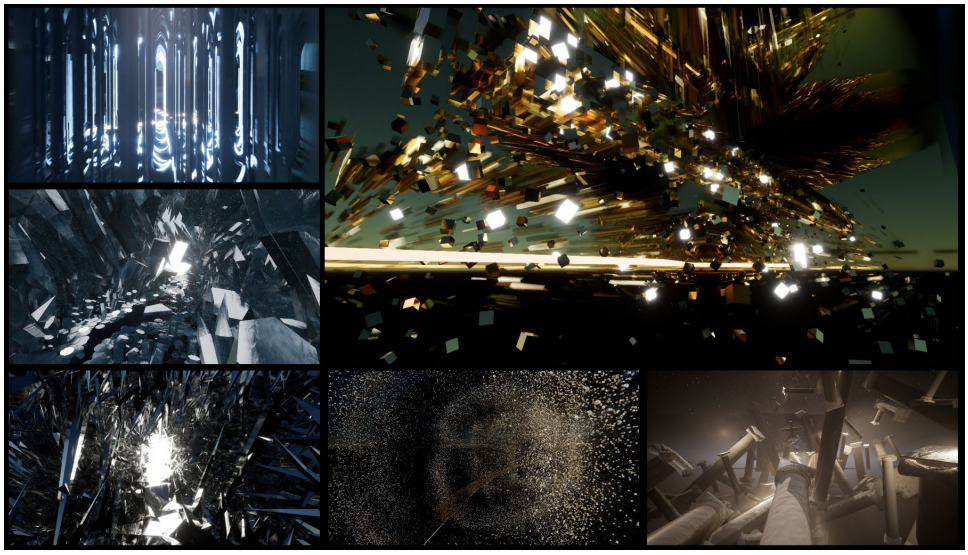

Figure 3. Samples of Virtual Architecture Created by Students for the GAMIFITECTURE Design Brief

The design brief of this course was part of a competition in collaboration with the Dubai police and one of the biggest developers in the UAE (Majid Al Futtaim) that tasked students to design the future flying vehicles. In this full semester course students as well spent 50 hours inside VR to create their designs where they utilized Gavity Sketch as the main application for design process and creation (Figure 4). students adeptly transformed two-dimensional concepts into complex three-dimensional models, mastering scaling, manipulation, and the application of materials, colors, and lighting to elevate their creations to a professional standard.[13]

Figure 4. Students at the CRID working in VR utilizing Gravity Sketch Application

The design proposals covered a large variety of topics that allowed students to not only refined their virtual reality modeling skills but also contributed meaningfully to the discourse on sustainable and futuristic design solutions. For instance, *SkyScape* by Sahar Nami, offers tourists an immersive journey beneath Dubai's futuristic skyline and presents panoramic views that capture the city's essence. This design combines advanced technologies and aerodynamic systems, drawing inspiration from contemporary automotive aesthetics to enhance national tourism. *Aerodrop Patrol* designed by Hanin Daryanavard draws inspiration from the aerodynamic teardrop shape. One of the main aspects is to prioritize speed and stealth. The design features a continuous curve and a new type of propellers

that do not have any blade but work using wind instead, enabling smooth and silent movement. This flying vehicle aims to address security issues promptly, revolutionizing officer navigation and setting a new standard for futuristic policing. (Figure 5).

Figure 5. Samples of Virtual Designs Created by Students for the ELEVATE 2024 Design Brief

The interactions that occur between the real and the virtual as if the virtual is part of the room. Scale change, color adjustments, and modifications that can occur while seeing the digitally overlapped cars on the table. Also, one can see how each user was able to see and interact with the same asset from their own point of view. These are few advantages of what was able to be done with these technologies.

Students Feedback of the Usage of Immersive Technologies Inside the Courses

An ongoing accumulative open-ended survey, distributed to all students who usually take these courses, has revealed overwhelmingly positive feedback on the integration of immersive technologies in the design process. More than 90% of students either strongly agreed or agreed that immersive design significantly enhanced their creativity compared to traditional 2D and 3D design methods. They also reported a deeper understanding of design proportions when working in VR, as opposed to conventional digital formats. The ability to change scale and perspectives within VR heightened their awareness of the impact of their designs, reinforcing the advantages of immersive spatial exploration. Furthermore, students found designing in VR to be more experiential and intuitive, providing a sense of engagement that exceeded that of traditional methods. Across the board, there was a strong consensus that digital models created in an immersive environment will likely replace physical models due to the ease of modifying scale, refining concepts, adjusting drawings, and experimenting with spatial experiences at a true 1:1 scale. This shift underscores the transformative potential of VR in architectural and design education, positioning it as an essential tool for the future of creative and spatial innovation.

Students also expressed strong appreciation for the course and its impact on their design thinking. Many highlighted how the course not only enhanced their creativity but also deepened their understanding of architectural spaces, recognizing it as a uniquely valuable offering within architectural education. Others emphasized the unparalleled creative freedom provided by VR,

appreciating the ability to explore and develop ideas without the constraints typically imposed by traditional architectural software. One student reflected on the broader implications of the course, stating that it represents the future of architecture and design, expressing gratitude for the opportunity to learn and integrate Virtual Reality into their creative process. Their feedback collectively reinforces the significance of immersive technologies in shaping the next generation of architects and designers, empowering them with innovative tools that transcend conventional limitations.

EXPLORATION OF PLAUSIBLE PATHWAYS FROM VR DESIGN TO 3D FABRICATION

The integration of immersive technologies is paving the way for a seamless transition from virtual design to physical fabrication, offering unprecedented opportunities in architectural and product design. A notable development in this trajectory has been the ability of students to conceptualize and fabricate complex designs without the need for traditional physical modeling. Within the immersive environment, students successfully designed a virtual chair, which was then directly sent for 3D printing, demonstrating the efficiency and precision of VR-driven digital fabrication. This process eliminates the constraints of conventional prototyping, allowing for rapid iterations and refinements in real-time before physical production (Figure 6).

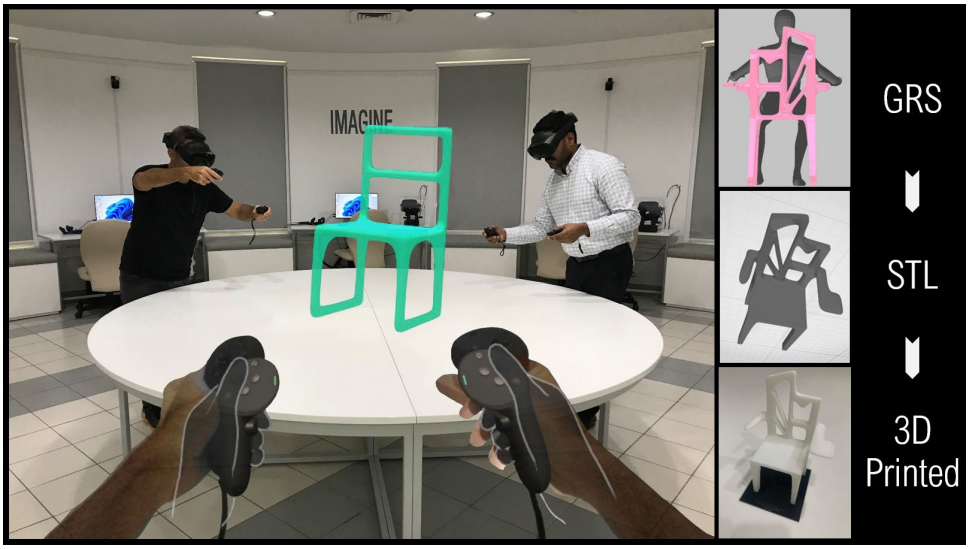

Figure 6. Sample of a Virtual Chair overlayed onto the physical space at the CRID

Furthermore, Augmented Reality (AR) has played a pivotal role in enhancing the workflow by enabling designers to visualize their creations within real-world contexts before committing to fabrication. By overlaying digital models onto actual environments, students could assess proportions, details, and spatial relationships with accuracy, ensuring that their designs are fully optimized for functionality and aesthetics prior to 3D printing. This synergy between VR, AR, and 3D fabrication signifies a transformative shift in design methodologies, bridging the gap between conceptualization and realization. As immersive technologies continue to evolve, they will not only streamline production processes but also redefine material exploration, customization, and fabrication strategies, marking a new era in digital craftsmanship and architectural innovation.

CONCLUSION

As immersive technologies continue to evolve, their impact extends beyond architectural pedagogy and professional practice, fundamentally redefining the way humans perceive and interact with architectural spaces. This paper has demonstrated that the transition from the metaverse to

hyperreality represents a paradigm shift that moves from isolated virtual experiences to an integrated spatial continuum where digital and physical environments seamlessly coexist. By leveraging VR, AR, and MR, architects and designers can transcend traditional material constraints, fostering an era of spatial experiences that challenge conventional notions of presence and reality.

The findings underscore the transformative role of XR technologies in both design methodology and education, offering an unparalleled level of creative fluidity and interactivity. Case studies from the Center for Research, Innovation, and Design (CRID) at AUD illustrate how immersive environments empower students to conceptualize and experience architecture in ways previously unattainable. The integration of XR-driven design with 3D fabrication further bridges the gap between digital conceptualization and material realization, and opens new frontiers in architectural innovation.

Moreover, the trajectory from the AI-powered metaverse to hyperreality suggests that the dissolution of digital and physical boundaries is accelerating. While Baudrillard's notion of hyperreality originally envisioned a world where simulations and reality become indistinguishable, contemporary advancements in AI-driven spatial computing, mixed reality, and adaptive environments are making this vision increasingly tangible. Future research should explore the ethical implications, cognitive effects, and societal transformations that may emerge from this convergence, ensuring that these technologies augment human experience rather than break it.

Ultimately, this paper affirms that immersive technologies are not merely tools for representation but catalysts for a new era of spatial experience where one in which digital and physical realities no longer compete but instead merge into a new dynamic, hyperreal existence. As architects and designers embrace this shift, the challenge ahead lies in shaping these virtual-physical spaces in ways that prioritize innovation, sustainability, and human experience.

NOTES

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THE GAZE: AN ARCHITECTURAL FICTION RECONCEIVING SIGHT IN ARCHITECTURE

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INTRODUCTION

Vision has long been central to architectural theory, yet it is often treated as a stable, objective faculty rather than a cognitive and interpretative process. This study explores how optical illusions, perspective, and visual perception have shaped architecture, questioning the dominance of objectivity in design methodology. By engaging with historical perspectives, critical theories, and speculative fiction, this research examines alternative ways of perceiving space. Through the concept of the "Eyes of Epoché", it proposes a method of architectural fiction to challenge conventional vision, inviting a reconsideration of how architects engage with subjectivity and perception in spatial design.

The Legacy of Ancient Egypt and Greece

Auguste Choisy, in his seminal work Histoire de l'architecture,[1] highlighted the deliberate use of optical illusions in ancient Egyptian and Greek architecture to enhance spatial perception and aesthetic experience. In ancient Egypt, architects employed visual corrections to maintain the grandeur and harmony of massive structures. For example, the tapering of obelisks and the subtle inward inclination of temple pylons created an illusion of heightened verticality, reinforcing their monumentality. The alignment of columns and axial perspectives in ancient temples also manipulated visual depth, guiding the observer's gaze toward sacred inner chambers.[2]

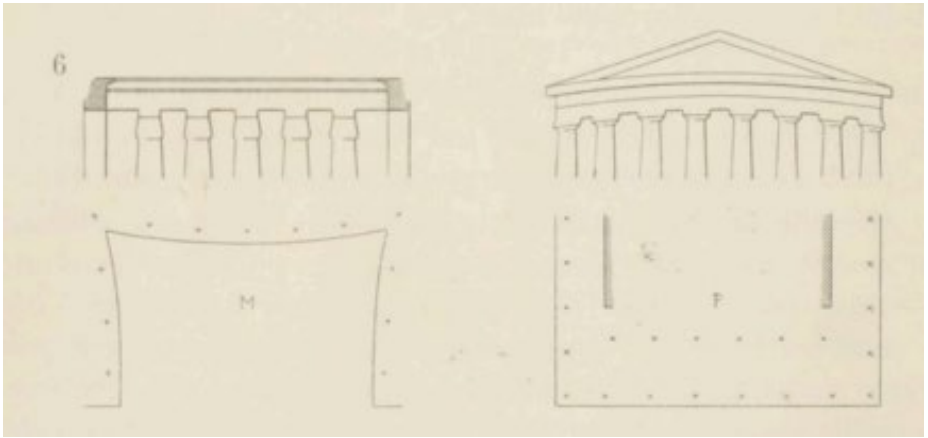


Figure 1. Compensation for Optical Distortion in Greek Temples[3].

Greek architects, particularly in the design of the Parthenon, refined these techniques to a remarkable degree. Choisy detailed how the Parthenon's columns exhibit entasis, a slight convex curvature that counteracts the optical illusion of concavity when viewed from a distance[4] (Figure 1). The stylobate and entablature are also subtly curved, ensuring that the temple appears perfectly straight to the human eye. These deliberate distortions corrected the limitations of human vision, allowing architecture to achieve an idealized form rather than an optically flawed one. Through these examples, Choisy demonstrated how ancient builders used optical illusions not as mere aesthetic tricks but as essential design tools to shape spatial experience and perception.

The Development of Perspective and Optical Illusions in Renaissance and Baroque Architecture

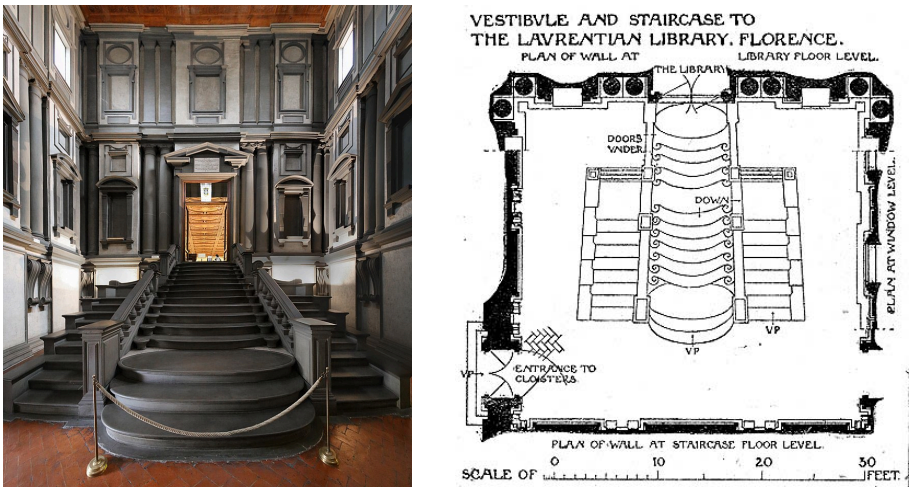


Figure 2. Laurentian Library staircase, 1571

The study of perspective, which began with Alhazen's optical theories,[5] flourished in Renaissance Europe, leading to new architectural experiments in optical illusion. Architects and artists sought to manipulate spatial perception through forced perspective, trompe-l'œil, and deliberate distortions, fundamentally altering how space was perceived and experienced.

One of the earliest examples is Santa Maria presso San Satiro (1482), where Donato Bramante designed a painted apse that uses trompe-l'œil to simulate depth in an extremely shallow space. This innovative solution allowed the church to maintain the illusion of a traditional Latin cross layout despite spatial constraints.

Later, Michelangelo experimented with perception in his Laurentian Library staircase (1571), where the steps are not parallel to the walls, subtly destabilizing spatial expectations. This architectural intervention challenged the conventional relationship between structure and movement, creating an unsettling yet dynamic experience for visitors (figure 2.).

In the Baroque period, Francesco Borromini's Galleria Spada (1632) refined the use of forced perspective, where a diminishing colonnade and sloping floor create the illusion of a much longer passageway than its actual dimensions. The calculated distortion of space demonstrates how perspective techniques were not merely decorative but essential tools for expanding architectural perception. These works illustrate how Renaissance and Baroque architects pushed the boundaries of vision and spatial illusion, transforming the built environment into an active participant in human perception.

Perspective and the Evolution of Theatrical Scenography

Figure 3. Stage Design by Joseph Furttenbach (1591 – 1667)

The application of perspective in Renaissance architecture was not limited to buildings but extended into the realm of theatrical scenography, fundamentally transforming the design of stage spaces. With the rise of court theatre, the need to create the illusion of vast depth within confined spaces led to the development of contracted scenic boxes, where spatial distortions were carefully calculated to align with a single, privileged viewpoint.[6]

One of the most significant examples of this technique is found in Andrea Palladio's Teatro Olimpico (1580), later completed by Vincenzo Scamozzi, as well as the Teatro all'Antica in Sabbioneta. These theatres employed an anisotropic perspective, manipulating spatial proportions to create a relief perspective—a technique that compressed and expanded space to enhance the illusion of depth. Guidobaldo del Monte (1600) further formalized these methods in Perspectivae Libri Sex, demonstrating how the punctum concursus (vanishing points) could be used to precisely control the contraction of the scenic space.

This theatrical use of perspective was not merely a decorative trick but a methodological innovation, bridging architecture, optics, and performance. By transforming real space into an illusionistic projection, Renaissance scenography expanded the potential of perspective beyond fixed architectural frameworks, influencing both urban planning and later developments in visual culture.

Anamorphosis and the Mathematical Evolution of Perspective

The development of anamorphosis emerged as a natural extension of linear perspective, evolving from the geometric studies of Alhazen and reaching its full complexity in Renaissance and Baroque Europe. In Anamorphoses,[7] Jurgis Baltrušaitis explores how this technique, initially considered an intellectual curiosity, became a crucial artistic and scientific tool.

Anamorphosis distorts an image so that it appears intelligible only from a specific vantage point or through a reflective device, challenging conventional perception. As perspective was mathematically formalized, artists and scientists experimented with ways to manipulate the rules of vision. By the 16th and 17th centuries, the method became widely documented, particularly in the works of Jean-François Niceron and Salomon de Caus, who integrated mathematical precision into these illusions.

A well-known early example is Hans Holbein's The Ambassadors (1533), where a seemingly abstract shape at the bottom of the painting reveals itself as a skull when viewed from an oblique angle. This

principle was applied not only in painting but also in architectural spaces. Baroque churches and palaces often featured catoptric anamorphosis, in which curved mirrors reconstructed distorted images, enhancing the interplay between vision and space.

Through these experiments, anamorphosis highlighted the illusory nature of perspective itself, reinforcing that what we see is dictated by the mechanisms through which we view it. This exploration of alternative visual structures opened new possibilities in architecture, as designers sought ways to engage perception beyond fixed, linear perspectives.

The Spectacle of Vision: The Suppression of Optical Experimentation in Architectural Methodology

Throughout history, the study of vision has opened vast possibilities for redefining spatial perception. However, rather than fostering radical architectural methodologies, optical experimentation was increasingly absorbed into mechanisms of spectacle and social control. Jonathan Crary, in Techniques of the Observer,[8] examines how the evolution of visual technologies gradually shifted from exploratory investigations into perception to instruments that standardized and regulated vision.

During the 19th century, various attractions such as the panorama, diorama, and stereoscope redirected optical research from experimental and participatory modes of seeing toward passive consumption. These devices, while initially rooted in perspective studies, functioned to condition the observer rather than challenge perception. Unlike earlier optical experiments—such as anamorphosis or forced perspective—which required movement and interaction, these spectacles reinforced a fixed, authoritarian mode of looking.

This transformation significantly impacted architectural design. Rather than embracing the fluidity of vision and its destabilizing effects, architecture aligned itself with structured visual control. The urban environments of the 19th and early 20th centuries—characterized by grand boulevards, shopping arcades, and exhibition halls—were designed to orchestrate perception, ensuring that spatial experience adhered to predefined frameworks. The potential for dynamic, perception-based design methodologies was largely neglected in favor of controlled, immersive environments that catered to the emerging consumer culture.

By analyzing these historical trajectories, it becomes evident that while vision was once a domain of radical inquiry, its experimental potential was systematically suppressed. This raises fundamental questions about how architecture might reclaim the lost possibilities of optical experimentation, reintroducing vision as an active, participatory force in the design process rather than a tool of passive observation and control.

Objectivity vs. Subjectivity: The Transformation of Vision in the 19th and 20th Centuries

Two significant events in the 19th century fundamentally reshaped the understanding of vision. The first was Hermann von Helmholtz's scientific discovery that human vision does not function like a camera obscura, passively transmitting external images to the brain. Instead, vision is an active cognitive process, in which the brain unconsciously interprets sensory data, often introducing distortions. This overturned the notion of purely objective vision, revealing that perception is not determined by the eye alone but by the reasoning mechanisms of the mind. The second major event was the invention of photography by Niépce and Daguerre, which introduced an external mechanical apparatus capable of recording images with an unprecedented claim to objectivity.

The divergence between how fine art and architecture responded to these discoveries is particularly revealing. In fine art, the realization that objective vision was an illusion led artists to abandon the pursuit of optical realism and immerse themselves in subjectivity. As photography assumed the role of

documenting reality, modernist art movements—Impressionism, Expressionism, and Surrealism—began rejecting linear perspective and turned toward the representation of personal perception and inner realities.

In contrast, modernist architecture embraced the rhetoric of objectivity and functionality as guiding principles. While painting moved toward subjective interpretations of reality, architecture aligned itself with scientific rationalism and technological progress, seeking to optimize efficiency and practicality. However, this pursuit of objectivity contained an inherent contradiction: the very principles that modernist architects claimed as "universal" and "objective" were, in fact, based on subjective ideological choices shaped by historical, economic, and technological conditions.

Guido Hauck challenged the idea that perspective was merely a mathematically precise system, instead proposing subjective perspective, which accounted for human perception rather than purely geometric constructions. Erwin Panofsky later adopted Hauck's insights in Perspective as Symbolic Form, arguing that perspective is not a neutral tool but a culturally and historically constructed system of representation. He introduced the concept of "objectification of the subjective", emphasizing that even the most rigorously structured perspectives encode subjective assumptions about space and reality.[9]

This contradiction was particularly evident in modernist architecture. While claiming to be rooted in universal objectivity, modernist design principles were in fact highly selective and ideological, reflecting the needs of an industrializing society rather than an absolute truth about form or function. Reyner Banham, in Theory and Design in the First Machine Age, critiques this tendency, arguing that modernist architecture's so-called rationalism was deeply shaped by technological determinism and the desire to aestheticize the values of the machine age.[10] Similarly, Manfredo Tafuri in Architecture and Utopia contends that modernism's obsession with objectivity and efficiency was not a neutral design logic but a response to the socio-economic demands of capitalism. He asserts that modernist architecture's claim to scientific rationalism was, in reality, a strategic adaptation to the ideological pressures of the time.[11]

Thus, modernist architecture's rhetoric of objectivity was built upon aesthetic, economic, and philosophical choices that were anything but neutral. By privileging efficiency, standardization, and abstraction, architects framed these values as "objective truths" rather than acknowledging their contingency on historical and ideological factors. This paradox exposes a critical flaw in the modernist project: while seeking to eliminate ambiguity through rigid universal principles, modernism unwittingly encoded subjective decisions about what should be considered rational, functional, and efficient.

Ultimately, the tension between objectivity and subjectivity in visual perception has left a lasting impact on architecture. While modernist architects sought to eliminate ambiguity by adopting rigid, universal principles, contemporary discourse increasingly acknowledges that architecture cannot be divorced from perception, interpretation, and human subjectivity. As vision is not a direct transmission of reality but a cognitive process shaped by the brain, architectural design must reconsider its reliance on strict objectivity and explore new methodologies that engage with the perceptual and psychological dimensions of space.

How to Emphasize Subjectivity in Architecture: Phenomenology and Its Limits

In response to modernist architecture's pursuit of objectivity, theorists have explored ways to restore subjective experience in design. One of the most well-known attempts is phenomenology, particularly in Juhani Pallasmaa's The Eyes of the Skin. Pallasmaa critiques the dominance of vision in architectural discourse, arguing that architecture should engage the full range of human senses. His

work emphasizes haptic perception, materiality, and embodied experience, advocating for an architecture that resonates with human presence rather than relying on purely visual aesthetics.[12]
However, Pallasmaa's approach has its limitations. While he effectively highlights the neglect of sensory experience, his critique of vision remains superficial, treating it as an obstacle rather than critically reexamining its role in architectural perception. Instead of offering a nuanced understanding of vision, he replaces it with a vague notion of "sensory architecture," which, while compelling, lacks a clear methodological framework for design practice. This shift from vision to an abstract sensory experience ultimately fails to address the deeper complexities of architectural perception, leaving phenomenology as an incomplete response to the challenge of integrating subjectivity into architecture.

Rethinking Vision and Sensation: Diderot, Condillac, and the Role of Fiction

In contrast to phenomenology's limitations in addressing the complexity of vision, Diderot's Letter on the Blind[13] and Condillac's Treatise on Sensations[14] offer alternative perspectives on how sensation and perception are formed. Both thinkers reject the idea that sight is an innate and transparent means of understanding the world, instead emphasizing how perception is shaped by experience, cognition, and social conditioning.
Diderot, in his Letter on the Blind, presents a philosophical argument inspired by real cases of blind individuals, particularly Nicholas Saunderson, a blind mathematician who navigated the world through touch and reasoning rather than sight. Through this, Diderot questions the primacy of vision, suggesting that knowledge is not exclusively visual but instead multisensory and interpretative. Similarly, Condillac's thought experiment of a statue acquiring its senses one by one in his Treatise on Sensations illustrates that perception is not immediate but rather a process of learning and association, where experience conditions our spatial understanding.
The relevance of these works to architecture lies in their reconceptualization of perception. Instead of treating vision as a passive tool of representation, they highlight the active construction of space through sensory experience and cognitive adaptation. Furthermore, both thinkers employ fictionalized scenarios not as mere literary devices but as critical methodological tools, enabling a speculative approach to perception. By incorporating fiction as a design methodology, architecture can move beyond the constraints of conventional vision-based spatial logic, opening possibilities for alternative ways of constructing and experiencing space.

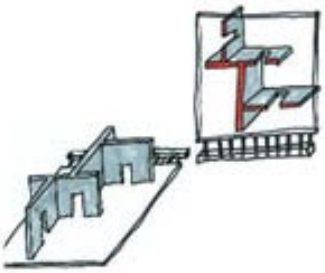
Architectural Fiction as an Experimental Methodology: The Gaze

The Gaze is a fictional experiment that explores the relationship between vision, perception, and space, challenging conventional architectural assumptions. Rather than treating vision as a stable, objective faculty, this project examines what it means not to see, shifting the focus from visual perception to the absence of visual knowledge.
The accompanying fictional narrative, The Gaze, illustrates this concept through the story of a woman raised in extreme sensory deprivation, whose only connection to the external world is through vision. Without prior exposure to learned visual structures, she does not recognize fundamental spatial relationships—depth, perspective, and scale remain incomprehensible. Her world consists only of fragmented visual stimuli, unanchored by meaning or experience. The movement of objects does not imply distance, overlapping forms do not suggest spatial hierarchy, and light and shadow fail to define volume. When she is eventually introduced to movement and spatial interaction, she undergoes a disorienting transformation, revealing the limits of conventional vision and forcing a reevaluation of how architecture is perceived, represented, and constructed.

This is the story of a woman marked by ONE image.

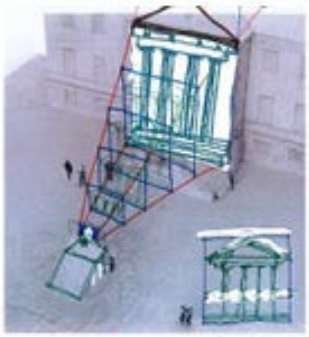
A languageless woman gazes endlessly.

She is in a state of tetraplegia, unable to feel any sensation below her neck as she has been artificially turned into a Cervical Spinal Cord Injury Patient from birth. The tragedy doesn't end here. In 'the room,' which lacks any kind of artificial lighting but where temperature, humidity, and soundproofing are perfectly controlled, she has lived her entire life fixed to a chair, completely excluded from contact and interaction with others. She receives nutrition through a tube and eliminates waste in the same manner, and her hygiene and health are managed by a caretaker while she sleeps. In such a situation, there isn't much information she can gather to form an existential consciousness.



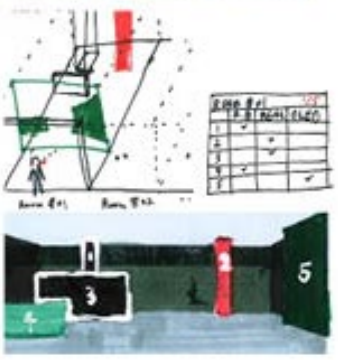
He was a failed architect. Like the other experts in the group of cognitive scientists, none of his attempts to treat her were successful. First, the architect made her walk along the surface of a wall, brushing it with her hand, and then asked her to draw the plan of that wall. She couldn't understand the architect's request to draw the footprint of the enormous wall on a small piece of paper that was dozens of times smaller than the wall itself.

The architect built a mechanical wall for her that rotates 90 degrees. She traced the footprint of the wall onto a transparent acrylic board attached to the base of the wall, thus completing her first 1:1 scale plan.



Next, the architect asked her to draw the elevation of a very simple geometric building. This time, to help her become more familiar with the concept of scale, he installed multiple layers of acrylic boards between her line of sight and the building's façade, each board depicting a progressively smaller elevation.

She could simulate something resembling an elevation on the acrylic board positioned right in front of her eyes while sitting in a chair, fixing her gaze as if she were in 'the room'. However, this didn't mean she understood the individual elements that made up the façade. The request to draw the same elevation on a piece of paper on the table instead of the fixed acrylic board was completely incomprehensible to her.



The device looked like a massive box with 10 pairs of peepholes. Inside the box, it was subdivided into 10 distinct chambers, all showing an identical scene composed of a floor, a ceiling, four walls, and two columns, with each element in a different color. The distinction among each room resided in the nature of its elements: they could either be real physical objects, images of the elements on a layer of acrylic board, or displayed on OLED screens.

Yet the issue lay in the flawless operation of the device, leaving the architect himself bewildered by the physicality of each element within the room, glimpsed through the apertures. To assist the architect in comprehending her way of perceiving through her eyes, she conceived a device with a similar format.

Figure 5. Excerpt from The Gaze.

Inspired by Diderot's Letter on the Blind and Condillac's Treatise on Sensations, this research follows their inquiries into how perception is formed rather than merely received. Condillac's thought experiment, in which a statue gradually acquires its senses, highlights that perception is not given but constructed over time. Similarly, Diderot's reflections on blindness demonstrate how knowledge is shaped through experience and interpretation rather than passive observation. These perspectives suggest that architectural vision, too, is not an innate faculty but a learned system, shaped by conventions that can be questioned and reimagined.

This question is explored through the concept of the "Eyes of Epoché", a theoretical construct that imagines a perceptual state stripped of learned visual assumptions. Unlike standard blindness, the Eyes of Epoché retain the physiological ability to see but lack the cognitive framework to process visual information. In this state, objects do not possess inherent meanings; spatial depth, materials, and light exist without preconditioned associations. The project seeks to simulate this condition through architectural fiction, testing whether an alternative form of architectural perception can emerge.

Ultimately, this architectural fiction serves as a methodological tool, using speculative narrative to investigate perception beyond conventional frameworks. By embracing fiction as an experimental space, this research does not merely theorize about vision—it attempts to destabilize its assumed objectivity, opening new possibilities for how architects engage with space, representation, and experience.

CONCLUSION

Rather than treating fiction as an abstract conceptual exercise, The Gaze explores its potential as a design methodology. By constructing a world in which vision operates under unfamiliar conditions, it provides a testing ground for new spatial devices—ones that challenge existing assumptions about form, perception, and experience.

This research does not merely analyze historical visual techniques but seeks to expand the architect's toolkit, proposing fiction as a means to redefine how space is perceived and constructed. The next step is to develop architectural devices that materialize these speculative inquiries, integrating them into contemporary design practices.

NOTES

[1] Auguste Choisy, *Histoire de l'architecture* (Paris: Librairie Générale de l'Architecture et des Travaux Publics, 1899).
[2] Choisy, *Histoire de l'architecture*, 51.
[3] Choisy, *Histoire de l'architecture*, 58.
[4] Choisy, *Histoire de l'architecture*, 58.
[5] A. Mark Smith, *Alhacen's Theory of Visual Perception, Volume 2: English Translation* (Philadelphia: American Philosophical Society, 2001).
[6] Leonardo Baglioni and Marta Salvatore, *Images of the Scenic Space between Reality and Illusion: Projective Transformations of the Scene in the Renaissance Theatre*, Proceedings 2017, 1, 943 (Basel: MDPI, 2017).
[7] Jurgis Baltrušaitis, *Anamorphoses: Les perspectives dépravées* (Paris: Olivier Perrin, 1955).
[8] Jonathan Crary, *Techniques of the Observer: On Vision and Modernity in the Nineteenth Century* (Cambridge, MA: MIT Press, 1990).
[9] Erwin Panofsky, *Perspective as Symbolic Form*, trans. Christopher S. Wood (New York: Zone Books, 1991)., 65
[10] Reyner Banham, *Theory and Design in the First Machine Age* (London: Architectural Press, 1960).
[11] Manfredo Tafuri, *Architecture and Utopia: Design and Capitalist Development* (Cambridge, MA: MIT Press, 1976).
[12] Juhani Pallasmaa, *The Eyes of the Skin: Architecture and the Senses* (Chichester: Wiley, 2005).
[13] Denis Diderot, *Letter on the Blind for the Use of Those Who Can See*, trans. Margaret Mauldon (London: Penguin Classics, 2011).
[14] Étienne Bonnot de Condillac, *Treatise on Sensations*, trans. Geraldine Carr (London: Routledge, 1930).

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REIMAGING THE PAST: UTILISING AI FOR VISUAL PRESERVATION OF LOST ARCHITECTURAL HERITAGE

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INTRODUCTION

The preservation and visualization of lost architectural heritage have long posed significant challenges within the domains of history, architecture, and cultural studies. Urban landscapes are in a constant state of flux, with historical buildings and structures often falling victim to redevelopment, neglect, or natural decay. As these edifices disappear, the cultural and historical narratives they embody risk being lost forever. Consequently, there is an increasing urgency to develop innovative methods to capture, reconstruct, and disseminate the essence of these vanished spaces.

Digital reconstruction has emerged as a pivotal tool in the field of heritage preservation. Through the use of computer-generated imagery (CGI) and virtual reality (VR), it is possible to recreate historical buildings and sites with a high degree of accuracy. These digital models allow for detailed visualizations that can be used for educational purposes, public engagement, and scholarly research. However, traditional digital reconstruction methods often have limitations, such as the inability to fully capture the materiality and sensory experience of the original structures and architectural spaces.[1]

The rapid advancement of artificial intelligence (AI) technologies offers new possibilities for addressing these limitations. AI has the potential to revolutionize the way we approach digital heritage preservation by providing tools that can analyze and interpret vast amounts of historical data with unprecedented accuracy and speed. Techniques such as machine learning and computer vision can enhance the fidelity of digital reconstruction, enabling more precise and immersive visualizations of lost architectural heritage.[2]

In this paper we explore the potential of GenAI tools in revolutionizing digital heritage preservation through the specific case study of the Dennys Lascelles Woolstore in Geelong, Australia. The Dennys Lascelles Woolstore, once a significant industrial building, has been demolished, and its historical and cultural significance risks being forgotten. By leveraging AI-assisted architectural design tools, we propose a novel framework for digitally preserving and visualizing this lost industrial heritage.

The primary objective of this paper is to demonstrate how AI can be harnessed to enhance the digital preservation of architectural heritage. This approach not only aims to conserve the rich narratives of the past but also to enhance digital placemaking practices, fostering a more immersive engagement with lost architectural heritage. Digital placemaking refers to the creation of meaningful virtual spaces that reflect the cultural and historical context of physical places. By integrating AI into this process, we can create more dynamic and interactive digital environments that allow users to explore and experience historical sites in a new and more engaging ways.

The theoretical framework for this study draws on concepts from digital heritage, AI technology, and architectural visualization. Digital heritage involves the use of digital technologies to document, preserve, and disseminate cultural heritage. This field encompasses a wide range of practices, including digital archiving, 3D modeling, and virtualization. AI technology, particularly machine learning and computer vision, offers powerful tools for analyzing historical data and generating accurate digital reconstructions.[3] Digital architectural modelling and visualization provide insights into the principles of design and construction that inform the digital reconstruction process.

To explore the potential of AI in digital heritage preservation, we adopt a multi-method approach that includes data collection, digital reconstruction, and digital visualization. The data collection phase involves gathering historical photographs, architectural drawings, and textual descriptions of the Dennys Lascelles Woolstore. This data is then used to initiate the digital reconstruction that is derived by the analyzed and interpreted historical information. Machine learning algorithms, such as convolutional neural networks (CNNs), are employed to identify and visualize architectural elements from historical data.[4]

The digital reconstruction phase involves using the AI-generated tools to create detailed 3D visualizations of the Woolstore. These visualizations are enhanced with realistic textures and lighting effects to capture the materiality and sensory experience of the original structure.

The integration of AI into digital heritage preservation has the potential to transform the field in several ways. First, it can improve the accuracy and fidelity of digital reconstructions, ensuring that they more closely resemble the original structures. This is particularly important for educational and research purposes, where the authenticity of digital models is crucial. Second, AI can streamline the reconstruction process by automating the analysis and interpretation of historical data, saving time and resources. Finally, AI-enhanced digital reconstructions can provide more engaging and immersive experiences for the public, fostering a deeper connection to cultural heritage.

Despite its potential, the use of AI in digital heritage preservation also presents several challenges. One of the main challenges is the quality and availability of historical data. AI visualizations require large amounts of high-quality data to generate accurate reconstructions, and this data is not always available for historical sites. Additionally, there are ethical considerations related to the use of AI in heritage preservation. For example, there is a risk that AI-generated reconstructions could be used to manipulate or distort historical narratives.[5]

The preservation and visualization of lost architectural heritage are critical for maintaining cultural and historical continuity in rapidly changing urban landscapes. The rapid advancement of AI technologies offers new possibilities for revolutionizing digital heritage preservation, providing tools that can enhance the accuracy and immersive quality of digital reconstructions. Through the study of the Dennys Lascelles Woolstore, this paper demonstrates how AI can be harnessed to create detailed and engaging digital representations and visualizations that capture the essence of lost architectural heritage with limited resources and information. By integrating AI into digital placemaking practices, we can foster a deeper connection to cultural heritage and ensure that the rich narratives of the past are preserved for future generations.

BACKGROUND AND LITERATURE REVIEW

Digital heritage preservation

Digital heritage preservation has gained significant attention in recent years as a means of documenting and disseminating cultural heritage information.[6] Traditional methods of digital preservation often rely on 3D modeling, photogrammetry, and virtual reality technologies to recreate lost or endangered heritage sites.[7] However, these approaches can be limited by the availability of historical data and the expertise required to create accurate reconstructions.

AI in Architecture and heritage

The application of AI in architecture and heritage studies is a rapidly evolving field. Recent studies have demonstrated the potential of AI in various aspects of architectural design and analysis, including style recognition, structural assessment, and generative design. In the context of heritage preservation, AI has shown promise in areas such as image recognition for artifact classification and predictive visualization for conservation efforts.[8]

Industrial heritage and place identity

Industrial heritage such as the Dennys Lascelles Woolstore, play a crucial role in shaping Geelong and Victoria identities. These structures often embody the economic, social, and technological histories of their regions.[9] Although it is demolished and replaced with the current Transport Accident Commission (TAC) building in 2009, the digital reconstruction and preservation for this lost heritage can lead to a connection from the past and recall the place identity.[10] Therefore, innovative approaches such AI technology to preserving and presenting lost industrial heritage are essential for maintaining cultural continuity and fostering community engagement with local history.

Figure 1. Left: Old archived ariel photo. Right: the digital reconstruction as the model of the Dennys Lascelles Woolstore that referenced and derived from the old, archived photo.

METHODOLOGY

Our research methodology combines traditional architectural research methods with current AI technologies to create an initial framework for digital heritage preservation. The process involves several key steps:

Data collection and analysis

We initiated our study by gathering all available historical data related to the Dennys Lascelles Woolstore. The data collection process included sourcing archival photographs and drawings, which provided visual documentation of the building's original and evolving structures. In addition to visual records, we examined historical documents and records that offered insights into the building’s usage, ownership, and significance over time. To complement this, we also reviewed existing digital models and reconstructions, which allowed us to understand previous interpretations and restorations of the structure.

The data collected was then subjected to a thorough analysis. This analysis was aimed at identifying key architectural features that are emblematic of the Woolstore’s historical design. We focused on understanding spatial relationships within the building, which are crucial for preserving its integrity and historical context. Additionally, we examined the broader historical contexts to ensure that our interpretations and future interventions would respect and enhance the Woolstore's heritage significance.

Digital reconstruction

Using the contemporary CAD modeler, Rhinoceros 3D, we generated a series of digital reconstructions of the Dennys Lascelles Woolstore. These reconstructions included detailed interior and exterior views, allowing us to visualize the building's design from multiple perspectives (Figure 1). By simulating variations in lighting and atmospheric conditions, we were able to explore how different environmental factors influenced the appearance and ambiance of the Woolstore at various times of day and throughout different seasons. These digital reconstructions were instrumental in our analysis, offering a comprehensive and flexible tool for examining the Woolstore's historical significance and architectural experience.

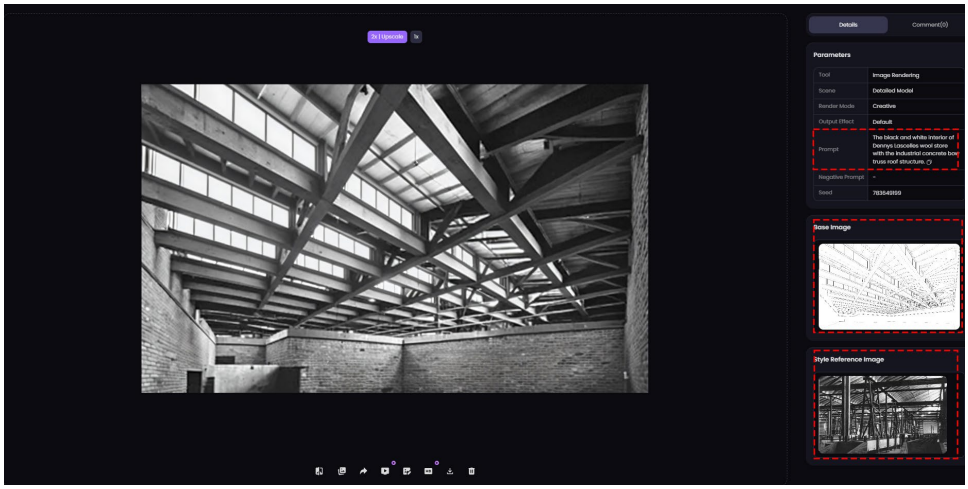

Figure 2. Interior AI-generated images derived from the narrative prompt, line drawing base image of the reconstructed digital model and old archived photo (indicated in red dotted lines) via LookX AI Cloud platform.

AI visualization and development

Based on the collected data and digital reconstructed model, we generate the AI visualization and representation using the available GenAI tool, LookX AI Cloud, which is part of the Generative Adversarial Networks (GANs). This advanced technology allowed us to create highly detailed and realistic visualizations by leveraging a diverse dataset. The visualizations were generated using a dataset of historical industrial buildings from the same era and region, which provided a contextual foundation for accurately representing the architectural style and features typical of that period.

In addition to the broader dataset, we specifically utilized archived photos as style reference images of the Dennys Lascelles Woolstore to ensure that the visualizations were closely aligned with the actual historical appearance of the building. These photos, along with the base image of the reconstructed model and a simple narrative prompt, were essential in refining the AI's output to accurately capture the unique characteristics of the Woolstore (Figure 2). Furthermore, we incorporated variations in exterior and interior viewpoints of the digitally reconstructed model, allowing us to explore the Woolstore from different angles and perspectives (Figure 4). This approach allowed us to develop visualizations that preserved the Woolstore's historical integrity while offering valuable insights into its architectural evolution and significance.

Figure 3. Left: the initial stage of the AI-generated visualization for the interior of the Dennys Lascelles Woolstore. Right: the updated version of the interior visualization with refined understanding of materials, lighting and atmosphere.

VISUAL PRESERVATION OF THE LOST DENNYS LASCELLES WOOLSTORE

AI-generated visualizations

The AI-generated visualizations of the Dennys Lascelles Woolstore demonstrate a remarkable level of detail and authenticity. As illustrated in Figure 3, the AI visualization successfully captured key architectural elements that define the Woolstore's historical character. One of the most striking features is the complex truss system of the roof structure, which the AI accurately rendered, showcasing the intricate design and engineering that supported the building's expansive roof.

Additionally, the visualizations highlight the spatial relationships between columns, beams, and floor spaces, providing a clear understanding of how these elements interact to create the building's interior layout. The AI also skillfully replicated the play of light through the windows and skylights, offering an authentic representation of how natural light would have influenced the ambiance within the Woolstore. Furthermore, the textural details of materials such as wood, metal, and concrete were meticulously recreated, adding another layer of realism to the visualizations.

The framework of these AI-generated images offers a range of perspectives and lighting conditions, allowing for a comprehensive visual and spatial experience of the lost building. This variety is crucial for gaining a nuanced understanding of the Woolstore's spatial qualities and atmospheric characteristics, bringing to life a structure that no longer exists in its original form (Figure 3).

Enhanced spatial understanding

Compared to the reconstructed digital model and the old, archived photos, the AI-generated images offer a significantly enhanced spatial understanding of the Woolstore. The AI visualization's ability to interpret and extrapolate from limited data has resulted in images that convey a sense of scale, depth, and atmosphere that was previously difficult to achieve.

Material and tactile qualities

The AI visualizations demonstrate a remarkable ability to render the material and tactile qualities of the Dennys Lascelles Woolstore with appropriate accuracy. The visualizations capture the roughness of the timber floors, highlighting the texture and wear that would have developed over years of use. This level of detail brings the space to life, allowing viewers to imagine the solid, gritty surface underfoot.

The grain and weathering of the wooden columns are also meticulously rendered, showcasing the natural variations in the wood and the effects of time and exposure on these structural elements. The AI image's attention to these subtle details helps to convey the history embedded in the building materials, reflecting the passage of time and the building's enduring presence.

Moreover, Figure 3 shows the properties of metal fixtures are captured with relevant precision, revealing how light interacts with these surfaces, whether polished or corroded. This attention to

tactile detail significantly enhances the immersive quality of the visualizations, allowing viewers to almost "feel" the textures of the lost building. By faithfully recreating these material qualities, the AI visualizations offer not just a visual experience, but a sensory one, deepening our connection to the Woolstore's historical fabric.

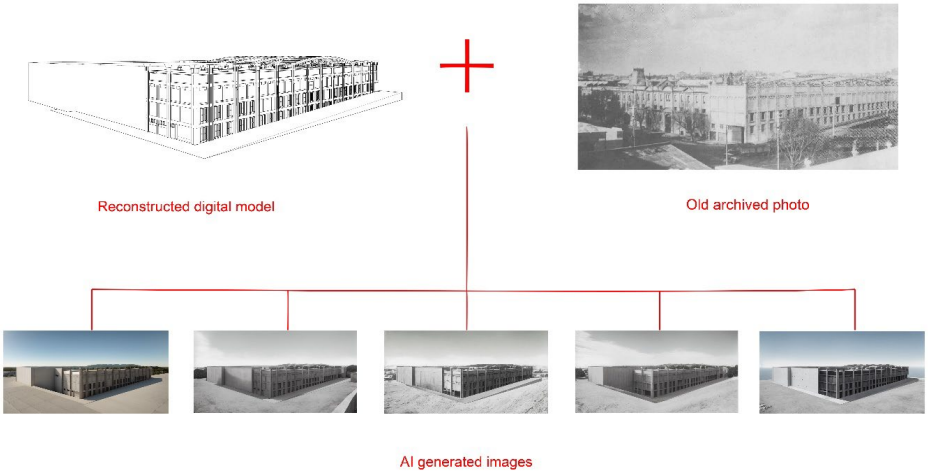

Figure 4. The framework to generate the exterior AI-generated images derived from the integration of line drawing images of the reconstructed digital model and old archived photo with the considerations of potential material, lighting and atmosphere.

Lighting and atmosphere

The AI-generated images excel in capturing the atmospheric qualities of the Woolstore. The AI's interpretation of lighting conditions creates a sense of mood and ambiance that brings the lost space to life.

This includes the play of natural light through windows and skylights, which bathes the interior in a soft, diffused glow. The interplay of shadows cast by the structural elements adds depth and dimension to the space, highlighting the architectural features and creating intriguing patterns across the floor and walls (Figure 3).

Additionally, the exterior view images suggest different times of day and weather conditions, further enhancing the realism and immersive quality of the recreated environment. These subtle variations in lighting and atmosphere allow viewers to experience the Woolstore under various circumstances, providing a more comprehensive understanding of how the space might have looked and felt throughout the day and in different seasons (Figure 4).

IMPLICATIONS FOR DIGITAL PRESERVATION

There are potential implications that derived from the study of the digital visual preservation of the lost Denny Lascelles Woolstore provide a comparative summary (Table 1) of how AI-generated visualizations impact different aspects of digital preservation and engagement with heritage sites:

Enhancing historical narratives

The AI-generated visualizations offer a powerful tool for enhancing historical narratives. By providing vivid, immersive representations of lost buildings and structures, they allow historians and educators to create more engaging presentations of historical visual information. These visualizations can effectively illustrate changes in architectural and industrial practices over time, giving viewers a

tangible sense of how buildings and construction technologies evolved. Furthermore, they can highlight the social and economic contexts of industrial heritage sites, helping to paint a more comprehensive picture of the lives and experiences of those who worked in these environments.

Fostering community engagement

The richness and accessibility of AI-generated visualizations have the potential to greatly enhance community engagement with local lost or forgotten heritage. This approach can stimulate interest in local history among younger generations, who are generally more receptive to digital and interactive forms of learning. These visualizations can provide a focal point for community discussions about heritage and urban development, encouraging dialogue about the importance of preserving historical sites and their significance to local identity. Additionally, they can support efforts to preserve and repurpose remaining industrial heritage sites by demonstrating their potential value and historical importance.

Informing conservation and restoration efforts

For partially preserved buildings and structures or those undergoing restoration, AI-generated visualizations can serve as valuable references. They can guide restoration efforts by providing detailed visual information, offering insights into how the building might have originally appeared. This can be particularly useful in decision-making processes regarding the preservation of industrial heritage, helping conservators and preservation architects make informed choices about how to approach restoration projects. Moreover, these visualizations can offer insights into original design intentions and construction methods, potentially uncovering forgotten techniques or architectural details.

Expanding digital placemaking practices

The integration of AI-generated visualizations into digital placemaking practices opens new possibilities for engaging with heritage sites with minimum and limited information. This technology can be used to create virtual heritage trails and tours, allowing people to explore historical sites from anywhere in the world. It also enables the development of augmented reality applications for on-site heritage experiences, overlaying digital reconstructions onto existing structures or ruins. Finally, these visualizations can potentially enhance museum exhibits with immersive digital content, providing visitors with a more interactive and engaging way to learn about historical sites and contexts.

Table 1 outlines the impacts and potentials of AI-generated visualizations to enhance historical narratives by creating immersive representations of lost buildings, helping researchers and publics grasp architectural and industrial evolutions while adding social and economic context. They foster community engagement by presenting heritage in interactive formats, sparking interest and dialogue about architectural preservation. For conservation and restoration, AI representations offer visual references to original structures and uncover forgotten design techniques, aiding decision-making. Finally, AI will eventually enhance digital placemaking practices through virtual tours, augmented reality overlays, and interactive museum exhibits, expanding global access to heritage sites and creating more engaging, immersive learning experiences for global audiences.

Implication	Description	Impact and potential
Enhancing historical narratives	AI-generated visualizations provide immersive depictions of lost buildings, making architectural and industrial evolutions tangible while contextualizing industrial heritage within its social and economic background.	- Engages audiences with visual, dynamic historical reconstructions. - Helps illustrate architectural and industrial changes over time. - Provides deeper social and economic context.
Fostering community engagement	AI visualizations can ignite local interest, particularly among younger generations, by presenting heritage in interactive formats and serving as focal points for community discussions on digital historical preservation and urban development.	- Enhances interest in local heritage. - Stimulates community dialogue about preservation. - Encourages the recognition of historical sites' cultural and social significance.
Informing conservation and restoration	AI-generated visualizations aid restoration efforts by providing visual references to original structures and materials, along with insights into design intentions, construction methods, and forgotten architectural details.	- Aids in decision-making for restoration projects. - Reveals original design techniques and intentions. - Supports conservation efforts with accurate visual references.
Expanding digital placemaking practices	AI visualizations expand access to heritage sites by enabling virtual tours, VR overlays, and interactive exhibits, creating virtual heritage trails and enhancing museum experiences with immersive technology.	- Expands global accessibility to heritage sites through virtual tours. - Enhances on-site experiences with AR overlays. - Enriches museum displays with interactive digital content.

Table 1. The comparative potential implications of the impact and potential for AI-aided digital preservation.

CONCLUSION

The use of AI in digitally preserving and visualizing lost industrial architectural heritage, as exemplified by the Dennys Lascelles Woolstore study, presents a promising approach to engaging with built heritage.

By combining limited historical records, relevant architectural knowledge, and advanced AI technologies, we can create rich, detailed, and evocative representations of lost architectural heritages that enhance our understanding of the past and strengthen our connection to place.

This approach preserves lost heritage narratives while expanding opportunities for engagement, education, and conservation in architectural heritage.

As AI technologies continue to evolve, their integration into heritage preservation practices promises to revolutionize how we interact with, understand, and preserve our architectural past.

In future research we will further explore the AI-generated reconstructions using a three-step validation process: comparing with historical records, expert review, and community feedback. This

iterative refinement enhances accuracy and authenticity, ensuring faithful representation of lost historical buildings based on available information.

Future research should also focus on refining AI visualizations, developing succinct practices for ensuring accuracy and ethical use, and exploring new ways to integrate AI-enhanced visualizations into broader architectural heritage education and preservation efforts. By doing so, we can create a more sustainable, engaging, and comprehensive approach to digital heritage conservation that bridges the gap between past and present, technology and tradition.

NOTES

[1] Erik Champion, *Critical Gaming: Interactive History and Virtual Heritage* (New York: Routledge, 2015), 5-20. https://doi.org/10.4324/9781315574981

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[3] Oliver Bimber and Ramesh Raskar, *Spatial Augmented Reality: Merging Real and Virtual Worlds* (MA: A K Peters, 2005), 93-97.

[4] Ian Goodfellow, Yoshua Bengio and Aaron Courville, *Deep Learning*. Cambridge (MA: MIT Press, 2016), 321-359.

[5] Luciano Floridi, *The Ethics of Artificial Intelligence: Principles, Challenges, and Opportunities* (Oxford: Oxford University Press, 2023), https://doi.org/10.1093/oso/9780198883098.001.0001

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[8] Matteo Fiorucci et al. "Machine Learning for Cultural Heritage: A Survey," Pattern Recognition Letters 133 (2020): 102–08, https://doi.org/10.1016/j.patrec.2020.02.017

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DESIGNING DESIGN PRACTICE

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INTRODUCTION: IMAGING DESIGN PRACTICE

Since 2010, photographer Marc Goodwin has documented architects' working spaces worldwide in city-by-city chronicles. Much can be learned from analyzing these collections—insights into a city's prevailing aesthetics or signs of changes to the profession's racial and gender diversity.[1] [Figure 1] However, there are also broader lessons in Goodwin's images, not about particular offices but about underlying, often unremarked aspects of contemporary architecture practice. The first is the near-universal presence of computer screens. Even when used for what are conventionally called drawings, these screens show that architecture today is as much about information management as formal delineation.[2] The second is that architects' workspaces are themselves objects of design, even if not always treated consciously as such or given the same attention as client projects.

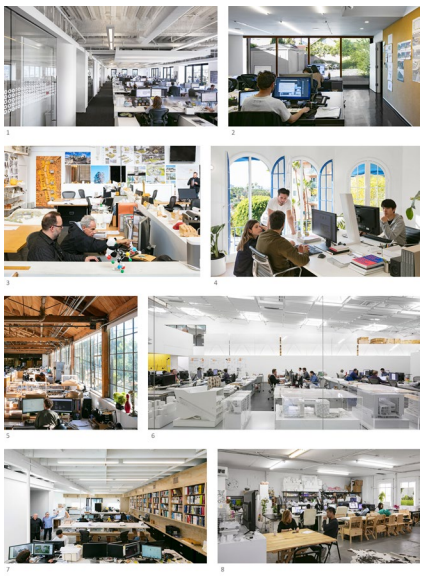

Figure 1. Interiors of Los Angeles area architecture offices showing computer use across firms ranging in scale, building typology focus, and aesthetic agenda. 1) CO Architects; 2) Standard Architecture/Design; 3) Eric Owen Moss; 4) Charlap Hyman & Herrero; 5) Marmol Radziner; 6) Morphosis; 7) Brooks Scarpa; 8) Bureau Spectacular.
Source: Marc Goodwin, Eric Baldwin, "Discover Los Angeles Architecture Studios Through the Lens of Marc Goodwin," ArchDaily, January 24, 2019, https://www.archdaily.com/910088/discover-los-angeles-architecture-studios-through-the-lens-of-marc-goodwin
Photos by Marc Goodwin.

Differences in attention aside, architects' offices are sites where they negotiate pressures and values shaped by local contexts, technologies, and disciplinary mores. In organizing their workspaces, architects design how they socially and technically structure their practice and tailor their presentations to those they identify as their audiences.[3] Even seemingly minor choices, like where to place a computer screen, shape architectural practice. These decisions don't occur in isolation. Architects operate within a complex of disciplinary histories, legal requirements, technical standards, social norms, business cultures, managerial strategies, labor markets, political shifts, economic trends, and aesthetic movements, all of which they respond to and influence. This complex is stitched together by intertwined concerns: how to divide the labor of design and how this work, along with its products, is perceived and valued—the image of the architect, shaped by evolving social and technical conditions.[4] Put another way, the proliferation of personal computer screens linked to global information communication networks on the desks of designers in centralized offices today along with the potential post-Pandemic dissolution or intensification of such offices are where the histories and futures of architectural practice are being brought together both materially and imaginatively.

THE ARCHITECTURAL OFFICE AS DESIGN PROBLEM

Practical and perceptual concerns regarding the manner and spaces in which architects should conduct their affairs are not new. In several renaissance treatises foundational to the modern architectural profession in the West, guidance is provided by way of direct instruction or analogy to other social roles such as mechanics, mathematicians, and painters as to the work and working conditions appropriate to the standing the treatise authors hoped would be accorded to designers as distinct from builders.[5] Given the patronage-centered structure of architectural commissioning in which these treatises were written and which they projected forward, they primarily offered instructions for social comportment and effective communication of the singular designer's intentions to patron or builder via drawings/models, and an outlining of the accoutrements of science (books) and art (dividers and other creative tools) that the architect should have at hand. The architect was to be situated between science and art, study and workshop, but crucially was to take care that their labor not be usurped by masons or painters and that their authority in one setting be reinforced by their associations with the other. The resulting figure of the gentleman architect was thus defined by their tools and social presentation in the form of their place of residence, not by a workspace that was designated as specifically architectural.[6]

The tension between associations with science or art, study or workshop remained only tentatively resolved through much of the industrial revolution, when new production technologies, building demands, labor divisions, and class structures disrupted the gentleman architect model's dominance. [7] Tools and workspaces associated both to stately parlors, painting ateliers, and emerging multi-person bureaus are all visible in a series of early twentieth century periodical profiles of American architects, with individual architects such as H.H. Richardson or Carrere & Hastings privileging the gentlemanly and bureaucratic respectively to best align with their clientele, their design work, and their self-image as either upstart businessman or learned patrician.[8] [Figures 2 and 3]

Figure 2. Office of H.H. Richardson, Brookline, MA
American Architect and Building News, December 27, 1884
Unlisted Photographer

Figure 3. Carrere & Hastings Office, New York, NY
The Architectural Record, October 1900, p.14
Unlisted Photographer

Much like Goodwin's photographs, the profiles themselves are notable for registering a concern with the place and status of the architect in the United States during this period. Alongside drafting manuals and office guides published at the time, they mark an investment in consolidating the practices and image of architects by American designers in the midst of efforts to codify their professional status through recognition from state governments, respect from other participants in an emerging building industry, and patronage from a growing number of corporations commissioning buildings.[9] They record the beginnings of the concept and reality of a distinct space in which architectural work should take place. [Figure 4]

Figure 4. Left: "How Architect's Work: I. Offices of Noted Architects," The Brickbuilder, December, 1911, p.294; Middle: "Where Our Architects Work No.3: Ernest Flagg's Workshop," The Architectural Record, December, 1900, p.240; Right: "The Offices of Albert Kahn, Architect, Detroit, Michigan," Architectural Forum, November 1918, p.129

As the turn toward combining gentlemanly and bureaucratic tropes in subsequent office profiles shows, architects began using office design to triangulate themselves and their work within emerging industrial systems that retained vestiges of social stratification.[10] This initially involved strict separation of spaces for engaging clients, contractors, or design labor and later through the increasing display of managerial tools for administering increasingly large buildings projects spread among multiple draftspersons alongside books, paintings, and drafting implements. In both cases though, the office, as the number of architects who designed purpose-built spaces within commissioned projects through the 1930s attests, had been made into a design object.[11] By the mid-twentieth century, bureaucratic practices and spaces of architectural production had been foregrounded through the growth of architectural organizations alongside the burgeoning military industrial complex emphasizing managerial systems, operational controls, and large-scale building projects.[12] In a renewed series of office profiles in *Architectural Record*, organization charts and detailed descriptions of working methods replaced photographs of office spaces or works-in-progress.[13] Even for smaller design organizations the effects of this shift were palpable as qualification requirements and regulatory environments intensified, while groups like the AIA positioned firm expansion as the natural trajectory for architectural organizations.[14] [Figure 5]

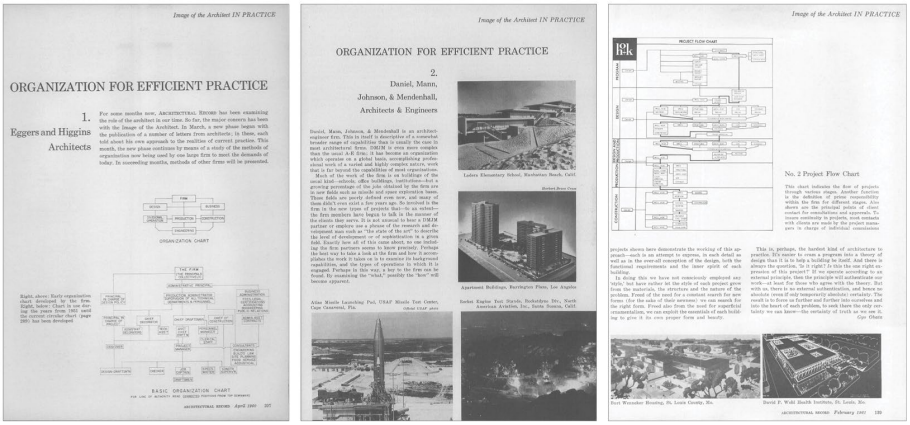

Figure 5. "Organization for Efficient Practice," Architectural Record Left: Eggers and Higgins Architects, April 1960, p.207; Middle: DMJM, June 1960, p.189; Right: Hellmuth, Obata, Kassabaum, February 1961, p.139

In terms of the design, both the reality and aesthetic of efficient operations became driving forces for the layout of architect's offices to support the coordination of work done on a single project by multiple draftspersons following a common unifying (often gridded) method or pattern which historian Arthur Drexler noted connected curtain wall and businessman's jacket, connoting responsibility.[15] Further, through these patterns, offices also served as sites for experimental integrations of various modularized building systems, showcasing architects' control over the "total design process" – the entire system of production, from vision through supervision and imagination through realization.[16] Elements of the gentlemanly approach persisted but were often reduced to stylizations or decorative touches in organizational leaders' offices. Still, investments in decoration that strayed significantly from prevailing business culture were frequently met with ridicule of pretensions to prima donna status on the part of the offending party. The tools and structure of practice remained largely the same, only with a shift in emphasis.[17] [Figure 6]

Figure 6. Office of Skidmore, Owings & Merrill, Inland Steel Building, Chicago, IL
Photographs by Ezra Stoller, 1957

WHERE DO THE COMPUTERS GO?

The widespread adoption of electronic computing devices by clients and governments whom these new large professional image-, practice-, and agenda-setting architectural organizations aligned themselves with during the 1960s, however presented new challenges to architects who sought to adapt themselves in practice and appearance to changing business methods. Computers of the time were large, inscrutable machines whose functioning required dedicated spaces as well as tending by dedicated staffs of programmers who could translate the problems of business or design into computer functions.[18]

For architects such as Ellerbe & Associates; Daniel, Mann, Johnson, and Mendenhall; Caudill, Rowlett, Scott (CRS); Welton Becket & Associates; and Skidmore, Owings, and Merrill (SOM), who acquired computers during this period for accounting, structures, and project sequencing purposes, the problem was where to put the computer, both physically and functionally: Should computer services be a separate, largely unseen support function like an organization's library or specification-writing employees as was among the initial proposals at SOM, or should it be an object of attention used to position a design organization at the vanguard of professional (read business-like) practice as was the case at Gensler & Associates in San Francisco where a display room near the entry to the organization's offices was constructed to house its computer equipment and workers?[19] With this question also came questions about divisions of labor: Should those operating computers be architects working in project studios or should they be dedicated specialized employees, and if the latter, should they have architectural training? Would physical, social, and technical distance restrict the kinds of design problems to which computers might be put?[20]

Questions about how to spatially, technologically, and socially organize architects' workspaces intensified in the 1970s with the incorporation of graphic interfaces, digitization, and printing technologies into the tools architects were expected to use for large projects. If in the 1950s low-cost, small-scale desktop whiteprinting of drawing under/overlays performed directly by architects supplanted earlier duplicating, and cross-profession drawing coordination efforts by less-skilled drafting labor of greater gender-diversity, in the 1970s the question posed alongside the adoption of graphic interfaces and computer-produced drawings was whether computer work was design or drafting.[21] In the case of the former, computer work involved decisions about the trajectory of a project and contributed to the development of an information database description of a building from which documents could be derived. Computer work, as design, it was agued by several partners at SOM, thus should be performed by skilled architects in studio spaces using mainframe-connected terminal devices.[22] [Figure 7] In the case of the latter, computer work, as drafting, was merely the execution of decisions made by designers and thus could be performed by a centralized pool of technical workers using mainframe-integrated hardware while also providing operational efficiencies such as the multi-shift 24/7 production operations employed at CRS to better amortize the expensive machines involved.[23] [Figure 8]

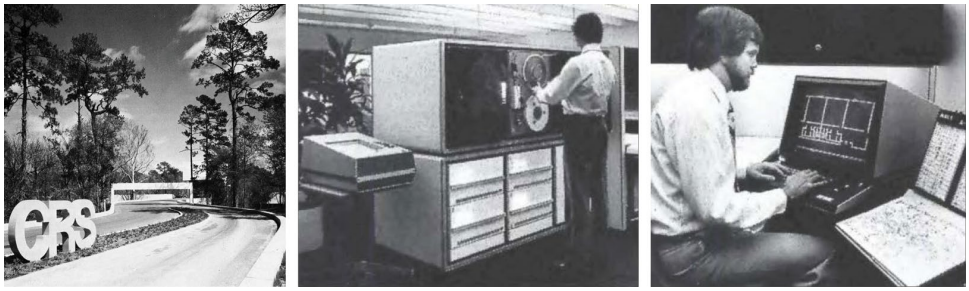

Figure 7. Offices of CRS Design Associates featuring Computer Services Division, Houston, TX
Unlisted Photographer, Architectural Record, April 1978

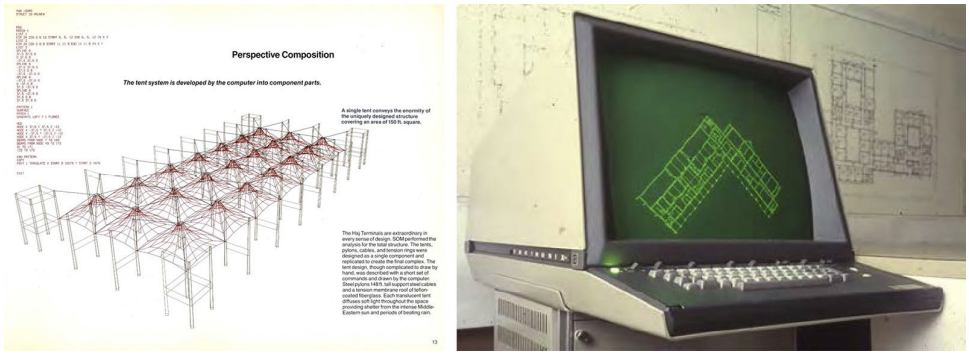

Figure 8. Excerpt from Model for Hajj Terminal Roof, Jeddah, Saudi Arabia and Tektronix 4014 Terminal showing Makkah Campus Project
"SOM Computer Capability," 1980 SOM Chicago Archives

It wasn't until the 1980s that a status quo of personalized desktop machines in studio spaces began to coalesce, again reflecting broader trends in business and organization design which architects helped to shape. [24] Captured under terms such as "reengineering" and "officing," these trends saw companies leverage less expensive personal computers and new networking technologies as vehicles for re-imagining core business processes around service delivery. [25] The aim of this reimaginging was to achieve continual improvements in operation and in turn in company value by tasking multi-skilled

knowledge workers with managing information to solve complex integrated problems while outsourcing more specialized work to consultants.[26]

Enacting this reimagining spatially meant reconceptualizing workspaces as technologized, dynamic matrices supporting rapid organizational changes, like employee groupings or rebrandings, while maintaining continuity through less-changeable elements like façade architecture.[27] For large architectural organizations, many of which created "officing" labs as workspaces and venues for researching and showcasing reengineered office approaches, this reimagination involved shifting from a project-based studio model to collections of expert groups focused on specific project genres (airports, stadiums, office buildings, educational facilities, etc.) subject to ongoing evaluation and redesign.[28] Among the aims of such shifts was allowing knowledge and stored computer data to be used across projects or to underwrite competitive expansion into new service areas such as facilities management while also making this knowledge directly accessible to specialized groups or members of project consortia through digital information sharing networks that could support common data models of existing/proposed buildings.[29] Especially as the widespread use of computer graphics applications was popularized in the early 1990s, the underlaying premise that was promoted through magazine-sponsored roundtables and advice columns about office organization and computer use was that architects, regardless of scale or design focus were primarily managers of information and that the design process itself should be a perpetual focus of internal design efforts.[30] Personal computers that supported dynamic network restructurings as well as raster display screens that supported the integration of multiple informational forms were, as a consequence, made into a permanent fixture of architect's offices. [Figure 9] Spaces for collaborative meetings with growing consultant teams were also expanded, while spatial distinctions between top-level managers and entry-level designers or technicians diminished as skills and responsibilities converged.[31] The stage was in effect set for form itself to be framed in informational terms in what has commonly been called the "digital turn" in the 1990s and subsequently in the elaboration of "parametric" architecture, but also more broadly in now standard building information modeling software suites.[32]

Figure 9. SOM Office, Chicago, IL, Architecture, May 1996, 222
Photo by Ralf-Finn Hestoft

POST-PANDEMIC ARCHITECTS / POST-PANDEMIC OFFICES

The core of the status quo of office organization that emerged in the later-1980s has remained relatively fixed over three decades despite several surface-level aesthetic or software changes.[33] New technological and social conditions, particularly following the COVD-19 Pandemic, however, have challenged this status quo and placed new stakes on the design of architect's offices and design processes as architects and their clients navigate what the future of work might look like.[34] As ever,

the designs architects propose for their own offices and the ways they organize work as well as employ technology is a space of negotiation and influence, with designers drawing from their day-to-day experience to shape the workspaces of others while clients, in turn, take cues from how their hired designers operate.

In a recent studio course at the Rhode Island School of Design, I asked students to consider this dynamic and propose designs for how future architectural organizations might operationally, spatially, and technologically structure themselves. Across the proposals which ranged from a university-affiliated residential apprenticeship to a design-build collective and a traveling caravan of specialized working modules, several framing observations recurred. Perhaps most salient was a reversal of the question that had driven office design into the 1980s of "where to put the computer." [Figure 10] Instead, the question the students repeatedly asked was, given the ubiquity of multi-functional wirelessly networked computers of various sizes, "where and when is the office?" A new, if not wholly positive blurring of working and leisure space, time, and technology in both built and screen environments drove all of the groups towards more multipurpose spaces whose architecture was either more deeply rooted to or ambivalent to its site but was in each case defined primarily by a relatively loose shell housing more specific furnishings.[35] This blurring was also identified as holding the seeds of potential responses to the glut of sparsely occupied post-pandemic office spaces in the form of looser zoning, rental/ownership, and occupation models.

Figure 10. "Taking Care of Business" Student Work from Bryn Stuppler, Mo Lin, Tom Hu, Yuchen Li, Yana Tsyvis, Jay Hwang, Yucheng Che, Sabrina Eisenberg, and Betty Ng
Rhode Island School of Design, Spring 2024

The second repeated framing observation was the role played by real-time views and editing access to common/shared documents from personal devices complemented by screen-sharing capabilities. On one hand these shared documents reinforced questions about where precisely an office might be located, or what constituted an office in the first place (a file repository?). On the other it revealed an underlying ideological structure of work related to a sense of ownership over work activities, products, and technologies (the personal computer, "my documents," etc.) that lingers even as these are shared.[36] This, according to several of the groups, suggested that designers interested in collaboration, especially with community partners, might need to seek techno-social solutions that extend beyond present instantiations of computing technologies in the form of common spaces and

common practices. Overall, workspace aesthetics took a back seat to efforts to construct the flatter hierarchies implied if not realized by open-plan office design, while acknowledging that designers and those engaging their services are rarely coming from common backgrounds or with the same resources.[37] Matching these workspaces, the proposed design organizations were also smaller, more nimble, and predicated more on association than on growth, with considerations of the appropriate temporality/longevity of their operational models, technologies, and working spaces becoming foundational considerations.

CONCLUSION: FROM REACTIONARY TO PROJECTIVE DESIGNING OF DESIGN PRACTICE

Returning to Goodwin's photographs with this combined historical and practical perspective, it is possible to see in them the ongoing design of the design process itself that architects are engaged in as they negotiate disciplinary and professional histories, present business or aesthetic trends, and projections of the future of architects and the built environment writ-large. At the same time, the limitations of Goodwin's subject matter also become apparent in light of both longer durée histories of architectural production and its seemingly immanent techno-social futures. The dedicated office/bureau has been an ongoing historical construction as have the technologies and other accoutrements with which these working spaces have been appointed, it is not fixed or a given. The work of architectural production necessarily extends beyond the boundaries of these spaces, perhaps even more so today than ever.

As such, Goodwin's photographs might be understood as capturing only the identifiable component of architectural production relevant to the continued construction of the professional standing of architects in a comfortably familiar capitalist social structure where work and business are clearly defined (seated, at a desk, in front of a screen), leaving out the increasing complexities in as well as challenges to the nature, location, and temporality of work. In the opposing direction, Goodwin's photographs might also be interpreted as too broad, focusing too much on the metaphorical forest at the expense of the unique species of practice that might be revealed by deeper investigations into the movement of the computer screens, or in a previous era the physical documentary materials employed by architects from location to location along with the movements of images/files across these screens, file structures and organizational networks. These too are part of the vocabulary architects employ as they design their design practices and through these practices help to shape the broader world of work.

Acknowledging the spaces, organizations, and protocols of design practice as objects of design is not new. It has been used by architects across time to articulate their identities and social positions. This articulation, however, has frequently been as much if not more reactionary as it has been projective or has been used to protectively circumscribe a specifically "architectural" area of knowledge/competency. Recognizing the design of the spaces, protocols, and organization of design processes as a habit as much as a competency again today, at a moment of considerable change in the technologies, locations, and patterns of work, is an invitation to take advantage of this moment; to imagine and include rather than react and exclude. It is an invitation for architects to propose the futures for technology, practice, collaboration, and built environment that they would like to see in order to begin building the mechanisms for their realization.

NOTES

[1] Dima Stouhi, “Explore Architecture Studios from Around the World Through the Lens of Marc Goodwin,” *ArchDaily*, March 9, 2022, accessed November 21, 2024, https://www.archdaily.com/978173/explore-architecture-studios-from-around-the-world-through-the-lens-of-marc-goodwin

[2] Architectural theorist John May points out both the breakdown of the distinction between graphic and other forms of information used in architectural production as well as a parallel transformation of architectural production over the course of the twentieth century according to “managerial logics.”
John May, “Everything is Already an Image,” *Log* 40 (2017): 12-13, 17; John May, “Logic of the Managerial Surface,” *Praxis: Journal of Writing + Building* no. 13 (2011): 116-124; Katie Meyer, “Technology in Architectural Practice: Transforming Work with Information, 1960s-1990s,” *Information and Culture* 51, No.2 (2016): 250, 252-263.

[3] Kjeld Schmidt and Ina Wagner, “Ordering Systems: Coordinative Practices and Artifacts in Architectural Design & Planning,” *Computer Supported Collaborative Work* 13 (2004): 364.

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[7] Mary N. Woods, *From Craft to Profession: The Practice of Architecture in Nineteenth-Century America* (Berkeley, University of California Press, 1999), 107-108, 167, 170; Andrew Saint, *The Image of the Architect* (New Haven: Yale University Press, 1983), 73-91, 160.

[8] In January 1890, *Engineering and Building Record* published the first in a series of articles entitled “The Organization of an Architect’s Office,” which was a profile of the spaces and routines comprising the Chicago partnership of Daniel Burnham and John Wellborn Root located in the pair’s Rookery Building. Aimed at readers who “have more than once intimated… that a description of the organization and methods of work in some leading architectural offices would be of much interest and in many cases of value to others in the profession,”
"The Organization of An Architect's Office No. *1.," The Engineering & Building Record* (January 11, 1890): 84-85.

[9] George Barnett Johnston, *Assembling the Architect: The History and Theory of Professional Practice* (London: Bloomsbury Visual Arts, 2020); David Brain, “Practical Knowledge and Occupational Control: The Professionalization of Architecture in the United States,” *Sociological Forum* 6 No. 2 (June 1991): 241

[10] Beginning in 1911 under the title “How Architects Work,” *Brickbuilder* began publishing its own office profile series by New York architect D. Everett Waid. Waid’s articles closely followed the style of those from the *Engineering and Building Record* as well as the content of *Architectural Record*’s photo documentary series, “Where Our Architects Work,” (1900-1901), the *American Architect and Building News*’ practical advice column on the minutiae of “The Management of an Architect’s Office” (1891-1893), and Waid’s own previous general advice column on “The Business Side of an Architect’s Office” in *Brickbuilder* (1902-1904). The new series, however, marked an important shift from these earlier publications. As Waid’s choice to reprise his previous column’s title when he renamed the series in 1913 belies, this shift corresponded with the increasingly commercial imagination of architecture and the business of cultural performance for and by clients, contractors, competitors, or colleagues. The business side, as it were, was becoming less an aspect, and more the dominant trope of the spatial and organizational enactment of architectural practices. *Architecture Forum* in turn offered a series of articles on office administration as well as profiles on the offices of leading architecture firms which catalogued best practices and provide examples of forms and office arrangements that others might emulate.
Waid, "The Business Side of an Architect's Office," *The Brickbuilder, I.* (April 1902): 69-70; II. (May 1902): 91-93; III. (August 1902): 157-160; IV (September 1902): 191-195; V. (February 1903): 37-39; VI. (November 1903): 232-233; VII. (December 1903): 254-256; VIII. (January 1904): 13-15; VII. [sic] (August 1904): 168; Waid, "How Architects Work," *The Brickbuilder,* I.-Offices of Noted Architects [H. J. Hardenbergh, Cass Gilbert, La Farge & Morris, Maynicke & Franke, Donn Barber] (December 1911): 249-252; II.-Offices of Noted Architects [York & Sawyer, Charles A. Platt, Carrere & Hastings, Grosvenor Atterbury] (January 1912): 7-10; III.-Offices of Noted Architects [J. H. Freedlander, H. Van Burn Magonigle, Delano & Aldrich, Trowbridge & Livingston] (February 1912): 35-38; Waid, "The Business Side of an Architect's Office," *The Brickbuilder,* "With A Description of the

Architects' Building, New York" (August 1913): 179-181; "The Office of Mr. Donn Barber" (September 1913): 197-200; "Description of the Offices of Messrs. Henry Bacon; Ford, Butler & Oliver; Ludlow & Peabody; H. Van Buren Magonigle and Kenneth Murchison" (November 1913): 251-254; "The Office of Messrs. McKim, Mead & White" (December 1913): 267-270; "The Office of George B. Post & Sons" (February 1914): 47-49; "The Offices of Mr. Howard Greenley and Messrs. Taylor & Levi" (March 1914): 62-64; "The Office of Messrs. Mann & MacNeille" (May 1914): 103-105. “Office Administration,” *Architecture Forum* 29 No. 2 (August 1918): 27-40; George C. Baldwin, "The Offices of Albert Kahn, Architect, Detroit, Michigan," Architectural Forum (October 1918): 125-130.

[11] Wickersham, “Learning from Burnham: The Origins of Modern Architectural Practice,” *Harvard Design Magazine* 32 (Spring/Summer 2010): 25; Michael Osman, *Modernism’s Visible Hand: Architecture and Regulation in America* (Minneapolis: University of Minnesota Press, 2018), 172.

[12] A 1959 article in *Newsweek* as well as one in the January 1958 issue of *Fortune* and a 1954 issue of *Business Week* all linked these approaches to “total design” with ongoing shifts in the business models/practices of US corporations in which visions in the form of corporate goals were to be achieved through increasingly fine grained and computer-assisted supervision.

"Designers For a Busy World: Mood For Working," *Newsweek* (May 4, 1959): 100; "The Architects From Skid's Row," *Fortune* (January 1958): 137-40, 210, 212, 215; "2-Billion Worth of Design by Conference," *Business Week* (December 4, 1954): 96-104; Henry-Russell Hitchcock, “The Architecture of Bureaucracy and the Architecture of Genius,” *Architectural Review*, No. 101 (January 1947), 3.

[13]The firm profiles were "1. Eggers and Higgins Architects" (April 1960): 207- 212; "2. Daniel, Mann, Johnson, & Mendenhall, Architects & Engineers" (June 1960): 187-194; "3. Smith, Hinchman and Grylls Associates, Inc. Architects & Engineers" (August 1960): 165-170; "4. Caudill, Rowlett and Scott, Architects- Planners-Engineers" (November 1960): 179-184; "5. Hellmuth, Obata and Kassabaum, Inc., Architects" (February 1961): 137-144; "6. Gruen Associates" (October 1961): 133-134; "7. Nolen-Swinburne & Associates" (February 1963): 155-158; "8. Eliot Noyes & Associates" (March 1963): 163-170; Michael Kubo, “Architecture Incorporated: Authorship, Anonymity, and Collaboration in Postwar Modernism,” Ph.D. diss (Cambridge, MA: Massachusetts Institute of Technology, 2018).

[14] The AIA voiced this view and proposed a means for its achievement by way of self-reflexive attention to the design of design processes to serve the profession, large industrial corporations, and the mainstream of US society alike in a two-volume programmatic survey entitled *The Architect at Mid-Century*

The Architect at Mid-Century: Evolution and Achievement, Volume I, ed. Turpin Bannister (New York: Reinhold Publishing, 1954), 17.

[15] Arthur Drexler, “Introduction,” Arthur Drexler and Axel Menges, *Architecture of Skidmore, Owings & Merrill, 1963–1973* (New York: Architectural Book Publishing Co., 1974), 12; W. Sinclair Gauldie and Arthur F.S. Wright, “Practice: Architectural Management: A Method Study 1,” *The Architects Journal*, January 8, 1959, 52.

[16] For architectural organizations that grew or were set up with the aim of becoming large enterprises following the second world war, efforts were made not just to conscript these disciplinary actors brought together around/through drawings, but to internalize them into integrated processes of “total design” which updated appeals to notions of total works of art and total architecture with legacies in German modernism to the postwar US industrial production/labor landscape. Such processes, as the one reading of the Welton Becket & Associates motto indicated, were to extend from “Vision through Supervision” – from conceptualization through to eventual building occupancy, or from masterplan to ashtray in addition to landscape architecture and electrical engineering as the leaders of SOM framed what they called “Total Design Services.”

Welton Becket & Associates, “Vision Through Supervision,” 1954, Getty Center, MacDonald Becket Papers, Box 2; “Imposing New Projects Demand Expanded Services,” *Building Design and Construction*, March 1972, 44; William Dudley Hunt, *Total Design: Architecture of Welton Becket & Associates* (New York: McGraw Hill, 1971); William Hartman, “Big Buildings from Big Offices,” *The Voice of America: Forum Lecture 6*, No. 7 (1961): 6.

[17] “CRS Design Office Building,” *Texas Architect*, February 1971, 3-5; Olga Gueft, “Welton Becket & Associates,” *Interiors*, September 1959, 2.

[18] John Harwood, *The Interface: IBM and the Transformation of Corporate Design 1945-1976* (Minneapolis: University of Minnesota Press, 2011), 7.

[19] Herbert Wheeler, *Emerging Techniques of Architectural Practice* (Washington D.C.: The American Institute of Architects, 1966), 78.; David Campion, *Computers in Architectural Design* (New York: Elsevier, 1968), 21, 29; Thomas Farr Ellerbe, *The Ellerbe Tradition: Seventy Years of Architecture and Engineering*, ed. Bonnie Richter (Minneapolis: Ellerbe Inc., 1980), 170; Nicholas Adams, “Creating the Future (1964-1986): How a Passionate Group of SOM Architects and Engineers Came Together to Envision Their Profession through the Lens of Technology,” *SOM Journal* 8 (2013): 121; Art Gensler as quoted in: Martin Meeker, *Art Gensler: Building a Global*

Architecture and Design Firm: Interviews by Martin Meeker (Berkeley, CA: Bancroft Library Regional Oral History Office, 2015), 227-228; "Architect of the Future," *Building Design & Construction*, April 1970, 43.

[20] Jonathan Barnett, "Computer-Aided Design and Automated Working Drawings," *Architectural Record*, October 1965, 92; Jonathan Barnett, "Will the Computer Change the Practice of Architecture," *Architectural Record*, January 1965, 143; Christopher Alexander, "A Much Asked Question about Computers and Design," in *Architecture and the Computer: Proceedings of the First Boston Architectural Center Conference* (Boston: Boston Architectural Center, December 5, 1964), 52-54.

[21] Murray Milne, "From Pencil Points to Computer Graphics," *Progressive Architecture*, June 1970, 168-177; *Reflections on Computer Aids to Design and Architecture,* ed. Nicholas Negroponte (New York: Petrocelli/Charter, 1975), 165; Aaron Tobey, "Database Architecture," *Harvard Design Magazine* 52 (Winter 2024: Instruments of Service).

[22] "SOM's Computer Approach," *Architectural Record: Engineering for Architecture*, Mid-August 1980, 88; Kristine Fallon (SOM), phone conversation with author, December 4, 2020; Nick Weingarten (SOM) in conversation with author, August 30, 2021. Doug Stoker (SOM), in conversation with author, January 20, 2021

[23] "CRS Invests in Computer-Aided Drafting to Streamline Production," *Architectural Record*, April 1978, 65; Chuck Thomsen (CRS) in discussion with the author, November 30, 2021.

[24] "The Information Technology Revolution," *Information Technology and the Corporation of the 1990s*, ed. Thomas J. Allen and Michael S. Scott Morton (New York: Oxford University Press, 1994), 3; CRSS and Matsushita Electric Works, *Officing: Bringing Amenity and Intelligence to Knowledge Work* (Houston, CRSS, 1988).

[25] "The Information Technology Revolution," *Information Technology and the Corporation of the 1990s*, ed. Thomas J. Allen and Michael S. Scott Morton (New York: Oxford University Press, 1994), 3; CRSS and Matsushita Electric Works, *Officing: Bringing Amenity and Intelligence to Knowledge Work* (Houston, CRSS, 1988).

[26] Michael Hammer and James Champy, *Reengineering the Corporation: A Manifesto for Business Revolution* (New York: Harper Collins, 2002), 21.

[27] Francis Duffy, "Office Design," 39-40; Francis Duffy," "Organizations, Buildings, and Information Technology (1983)," *Architectural Knowledge: The Idea of a Profession*, ed. Francis Duffy and Les Hutton (New York: E&FN SPON, 1998), 81-82; Francis Duffy, "The Changing Role of the Architect (1984)," *Architectural Knowledge: The Idea of a Profession*, ed. Francis Duffy and Les Hutton (New York: E&FN SPON, 1998), 87; Francis Duffy, "A Case for More Collaboration (1986)," *Architectural Knowledge: The Idea of a Profession*, ed. Francis Duffy and Les Hutton (New York: E&FN SPON, 1998), 98; Sonia R. Chao and Trevor D. Abramson, "Intentions," *Kohn Pedersen Fox: Buildings and Projects 1976-1986*, ed. Sonia R. Chao and Trevor D. Abramson (New York: Rizzoli, 1987), 303, 305-306; Michael Wagner, "A New Generation of Leadership at Gensler and Associates/Architects, New York, Will Help Lead the Firm into the 21st Century," *Interiors*, December 1988, 91-97.

[28] Charles K. Hoyt, "Office Shakeup," *Architectural Record*, July 1991, 182; Robert Young, "A Third Wave of Practice," *Progressive Architecture*, November 1992, 106, 108; Andrea Oppenheimer Dean, "Profile: SOM, a Legend in Transition," *Architecture*, February 1989, 56; Karen D. Stein, "Against All Odds," *Architectural Record*, April 1989, 92.

[29] Douglas E. Gordon and M. Stephanie Stubbs, "Practice in the 80's," *Architecture*, December 1989, 81-83; "Greater Diversification Seen from Computer Use, *Architectural Record*, November 1984, 35; John Stokdyk, "The Sky's the Limit," *Building,* September 2, 1988, 55.

[30] Ken Sanders, "Computers: Practice: Emerging Trends in Architectural CAD Software," *Architectural Record*, March 1989, 130; Mitchell B. Rouda, "Technology & Practice," *Architecture*, February 1987, 77; Oliver R. Witte, "Affordable CADD: 1987 Update," *Architecture*, February 1987, 94-95; Nicholas H. Weingarten, "Computers: A Few Simple Tests," *Progressive Architecture*, June 1987, 59.

[31] Deborah K. Dietsch, "Workplaces of Change," *Architecture*, October 1993, 13; Edward Gunts, "Offices in Flux," *Architecture*, October 1993, 41-42; Bradford McKee, "SOM Retrenches," *Architecture*, May 1996, 238

[32] Ken Sanders, *The Digital Architect: A Common-Sense Guide to Using Computer Technology in Design Practice* (New York: John Wiley & Sons, 1996,) 1; Youngjin Yoo, Richard J. Boland, Jr., and Kalle Lyytinen, "From Organization Design to Organization Designing," *Organization Science* 17, No.2 (March-April 2006): 221

[33] Yehuda E. Kalay, "The Impact of Information Technology on Design Methods, Products, and Practices," *Design Studies* 27 (2006): 362; John May, "Afterword: Architecture in Real Time," *Design Technics: Archaeologies of Architectural Practice*, ed. Zeynep Celik Alexander and John May (Minneapolis: University of

Minnesota Press, 2020); Phil Bernstein, “Why Architecture Needs a New Business Model,” *Architectural Record*, June 1, 2018.

[34] Pranav Tyagi, “The Next Gen Workspace: The Intersection of AI and Human Intelligence,” *Work Design Magazine*, September 19, 2019, accessed November 11, 2024, https://www.workdesign.com/2019/09/the-next-gen-workspace-the-intersection-of-ai-and-human-intelligence/; Ronda Kaysen, “The Post Pandemic Office,” *Architectural Record*, May 1, 2022, accessed November 11, 2024, https://www.architecturalrecord.com/articles/15632-the-post-pandemic-office.

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ENHANCING SANITATION EDUCATION WITH ONLINE LEARNING PACKAGES

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INTRODUCTION

Sanitation is a major issue worldwide, particularly in the case of mobile populations with limited resources. This paper discusses the online learning packages created for a research project on the design and testing of a portable latrine for mobile populations in Jordan, funded by the Royal Academy of Engineering in the UK. Aiming to tackle sanitation problems in Jordan's Southern Ghor District, the research project included analysing stakeholders, gathering data via interviews and surveys, and creating a mobile latrine for water-scarce areas. While the target of the project was a low-income area in Jordan, the paper presents more widely the use of technology in sanitation projects broadly in the Global South. It initially presents the creation of the mobile latrine, but then moves on to an overview of the development literature and screen applications and implementation in the Global South. Drawing from observations identified in the literature, we describe the learning packages, as designed by the research team in Jordan and the UK. The online content created for this project was aimed at sharing information on sanitation solutions and the implementation of mobile latrines. Our paper concludes by discussing how technology and community involvement can promote lasting sanitation improvements in disadvantaged areas across the globe.

Globally, sanitation crises contribute to approximately 1.6 million preventable deaths annually due to unhygienic conditions, and 2.4 billion people lack basic sanitation facilities.[1] Mobile groups such as refugees and displaced individuals are at higher risk due to inadequate infrastructure. The issue is particularly pressing for women and children since they are disproportionately affected: inadequate sanitation compromises their safety, dignity, and access to schools. The application of screen-based learning has been shown in development studies to bring about ameliorations in the lives of communities that face extreme challenges. Our research project considered the use of digital tools and mobile-friendly platforms as a way of upskilling local engineering professionals and improving sanitation access.

The Southern Ghor District

Jordan is a middle- to low-income country with a population of approximately 11 million.[2] The area of our project focus, the Southern Ghor District in Karak Governorate, has a total population 65,000 residents over 350 square kilometers of land.[3] The region faces significant water scarcity issues and

socioeconomic challenges: the poverty rate exceeds 40% in the area, and in some pockets, it reaches as high as 60%.[4] These difficult economic conditions in Jordan, particularly in low-income areas, highlight the urgent need for effective alleviation strategies, as evidenced by the high unemployment rates and the prevalence of informal employment within the labor market.[5] Water scarcity in the Southern Ghor District further exacerbates existing sanitation challenges. Most residents living below the poverty line are not connected to sewer systems and lack safe water access and storage facilities.[6] This situation is indicative of broader issues faced by low- and middle-income countries, where inadequate infrastructure and limited resources hinder the provision of essential services.[7] The lack of access to clean water and sanitation facilities does not only affects public health. It contributes to the cycle of poverty, as poor sanitation can lead to health issues associated with costs and reduced economic productivity.[8] Given these conditions, there is an urgent need for innovative and sustainable sanitation solutions that can be adapted to resource-constrained environments.

METHODOLOGY

To ensure an effective and targeted intervention, the first aim of the project was to conduct a stakeholder analysis to identify key actors in addressing sanitation issues in the region. This became important in considering the e-learning packages discussed in the next section, because this analysis helped us identify who the target audience should be. Our analysis, adapted from Mendelow's matrix,[9] ranked stakeholders based on their influence and interest, prioritizing three primary groups: local authorities, skilled labor, and the broader community of users. Identifying the level of stakeholder engagement is crucial for ensuring that community needs and perspectives are adequately represented in decision-making processes.

Using a matrix to define stakeholders

The matrix below provides the framework used for categorizing stakeholders into four distinct levels, depending on their influence and interest. By identifying these two parameters, we were able to assess their engagement and identify their involvement to map on the matrix: Collaborate, Involve, Consult, and Inform. Each of the separate sections on the graph below, reflect varying degrees of stakeholder influence and interest, ranging from low to high. The results are illustrated in the graph in figure 1 below:

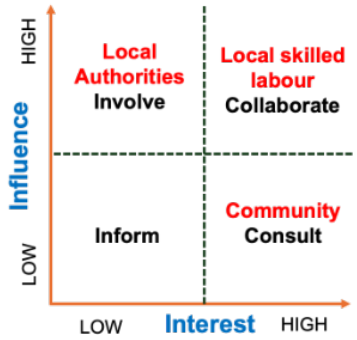

Figure 1. Mapping stakeholder engagement, Adapted from Mendelow, 1991

Collaborate (Local skilled labour/ high interest – high influence)

At this level, we have placed on the graph stakeholders actively engaged in decision-making and contributing their knowledge and expertise. In this section, we identified local skilled labor, which has both high interest and high influence on project results. Previous studies have shown that collaboration with stakeholders can lead to more effective and locally appropriate solutions because they bring relevant local knowledge and skills.[10] The participatory approach brings a sense of ownership to stakeholders, which has the potential to improve the sustainability of projects.[11] Evidence shows that stakeholder involvement at this scale has the ability to greatly improve the outcome of projects by guaranteeing that solutions formulated are addressed to the specific requirements of the community. [12]

Involve (Local Authorities/ low interest – high influence)

Local authorities, as influential as they are on policy and regulation, have lesser interest in individual projects. Nevertheless, is necessary to engage these stakeholders to achieve local law compliance as well as gain required approvals. Their engagement can also assist in the facilitation of resource allocation and sponsorship for initiatives, even when their short-term interest is minimal.[13] Effective engagement strategies in this phase can include regular communication and consultations to ensure that the local authorities are briefed and involved so that their level of ownership increases.[14]

Consult (Community/ high interest – low influence)

Community members often have a high interest, but do not necessarily have the authority to make decisions. Involving them in consultation is critical so that the project remains attuned to their needs and concerns, which can then be utilized to plan and implement interventions.[15] It has been shown that consultation with communities leads to greater satisfaction with outputs and has the potential to increase the overall impact of interventions.[16]

Inform (low interest – low influence)

This category includes stakeholders possessing low interest as well as low influence. Such stakeholders may or may not participate directly in making the decisions but still must be communicated with to ensure transparency and to remain accountable to them.[17]

APPLICATIONS OF TECHNOLOGY IN DEVELOPING CONTEXTS

The potential of technology to transform lives in low-income communities has been extensively documented in literature: applications of technology have been used to bridge inequalities in health care, economic development, and education. For example, mobile health (mHealth) projects have improved health provision in resource-constrained settings.[18] Similarly, online platforms have contributed significantly towards disseminating knowledge and gaining skills, while mobile financial services have enhanced economic stability. This current study builds on earlier findings by employing technology to create awareness on sanitation and support the development of skills relevant to the issue.

In the case of development studies, technology has played a pivotal role in enhancing access to information and resources that have the potential to positively impact communities. Online platforms have emerged as vital tools for disseminating knowledge and facilitating skill acquisition. Various education technologies and e-learning platforms, for example, have enabled quality education to reach a multitude of individuals, enabling those from low-income communities to acquire new skills and become more employable.[19] One such application has been particularly significant during the COVID-19 pandemic, where traditional education was halted and online education became a primary

mode of learning.[20] Additionally, technology integration in economic development has been seen to stimulate local economies by allowing small enterprises to penetrate bigger markets through e-commerce websites. This not only enhances income-generating opportunities for individuals but also fosters community resilience.[21]

However, the effectiveness of such technologies often hinges on equal access. There is evidence to suggest that while digital health technologies have the potential to address healthcare disparities, they may further increase the prevailing inequalities if access is not equitably distributed. The concept of a "digital divide" highlights that disadvantaged populations not only face barriers in accessing technology but also in its meaningful utilization. This calls for targeted interventions for the delivery of equitable access to digital health resources, especially to vulnerable populations.[22] This is why it is essential to recognize that the benefits of these technological advancements can be unevenly distributed, often favoring those with pre-existing advantages in education and resources.[23]

So, while technology holds immense potential to transform lives in low-income communities, it is important to consider in its application potential inequalities in access and utilization. Enabling access to a wider audience is crucial for achieving equitable outcomes. [24] The concept of a "digital divide" highlights that disadvantaged groups often face barriers not only in accessing technology but also in utilizing it effectively.

Creating the learning packages on the online platform

Based on the observations on technology implementation stated above, the team developed as part of this project an online platform to serve as an educational tool for stakeholders involved in improving sanitation infrastructure in Jordan (figure 2). The platform is aimed toward anyone interested generally in the topic of sanitation and particularly to those interested in sanitation implementation in a particular area and the potential of the latrine designed, alongside guidelines for their construction. It consists of 4 modules all accessible publicly (complete module map seen in figure 3). The user has the option to log into the platform by setting up an account with their own credentials or use the platform as a guest. Registered access does not have any different features to guest access, but accessing with an account allows a user to track their progress in undertaking the modules and their online tests completed.

Module 1: Introduction to Sanitation Challenges in Poverty Pockets.

The learning package begins with an overview of sanitation’s critical role in public health and community well-being, emphasising its direct impact on disease prevention and quality of life, It explores how poor sanitation contributes to the spread of diseases disproportionately affecting vulnerable populations. Beyond health implications, the module also examines the broader social and environmental consequences of inadequate sanitation. To provide context, the package outlines the specific sanitation challenges faced in Jordan. The module highlights the urgent need for scalable and sustainable solutions tailored to the local environment, such as mobile latrines that can be quickly deployed in emergency settings or remote locations. The online presentation is followed by an assessment (online quiz) framing sanitation as both a health and social equity issue to instil the importance of integrating engineering solutions with public awareness and policy initiatives to create long-term, impactful change.

Module 2: Design and Construction of Mobile Latrines

The second module focuses on educating users on mobile latrines, outlining their key features, benefits, and limitations. The package presents various types of mobile latrines, recognized by WASH (Water, Sanitation, and Hygiene) and the United Nations, including composting latrines, container-

based solutions, and chemical toilets. Each type is analyzed in terms of its construction, functionality, structural design and waste management process. The module also highlights their suitability for different settings, such as refugee camps, construction sites, and disaster-stricken areas, where rapid deployment and adaptability are essential. A key take-home message for users is maintenance requirements including the importance of proper waste disposal, hygiene management, and durability. To enhance user engagement, the learning package incorporates visuals, enabling learners to compare different latrine models and understand best practices for their effective deployment. The module quiz at the end of this module ensures that users have gained knowledge on the implementation of sustainable sanitation solutions tailored to specific contexts. (Figure 3)

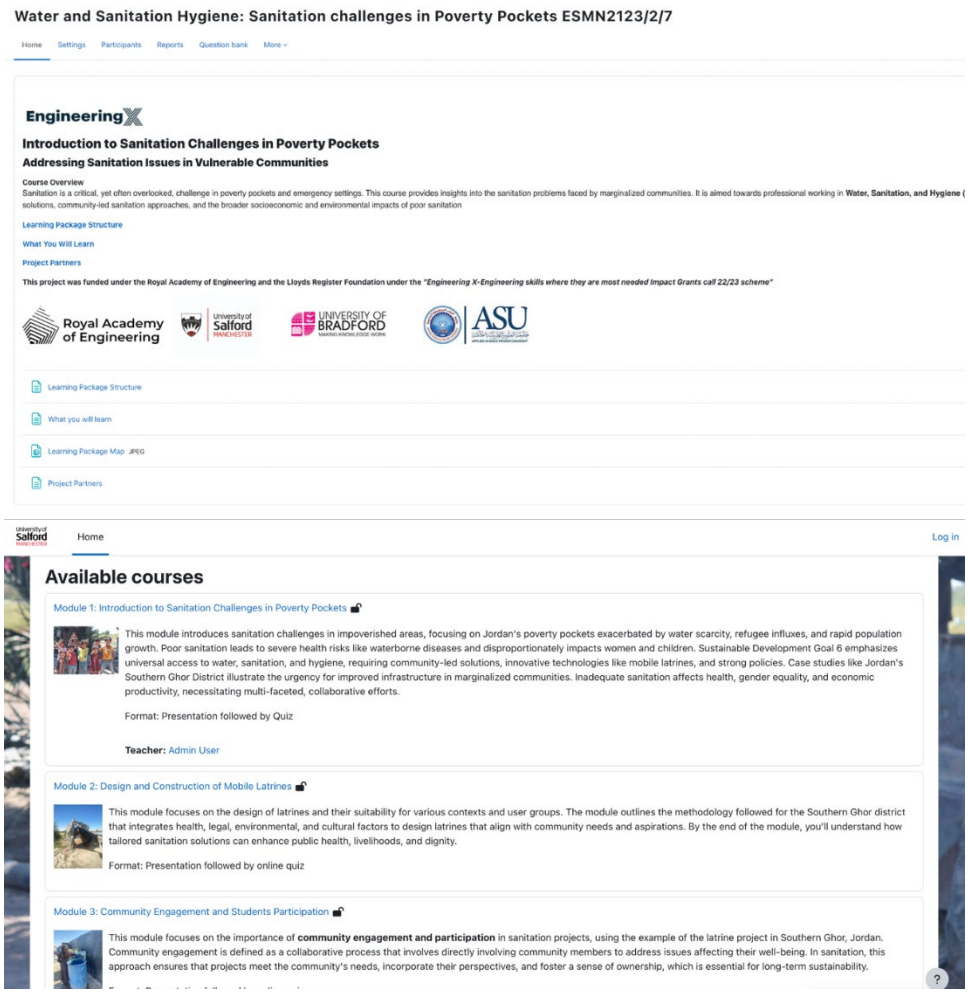

Figure 2. The landing pages of the learning platform, available at https://wash.thinklab-salford.org/

Module 3: Community Engagement

This module focuses on the vital role of community engagement in ensuring the success and sustainability of sanitation initiatives. It begins by highlighting the importance of understanding local needs, cultural norms, and environmental factors and following the steps followed by our team to conduct community assessments, demonstrates the methodology used for stakeholder engagement and discusses the way the team ensured that the mobile latrines were designed and implemented in a way that is socially acceptable to the local norms. By presenting this real-world example, this module demonstrates how inclusive, community-driven approaches can improve public health outcomes, enhance sanitation adoption, and build local resilience.

Module 4: Sustainability and scalability of sanitation

The final module explores the **long-term sustainability and scalability** of sanitation solutions. How does one ensure that such interventions remain effective and adaptable over time? It examines strategies for **upscaling sanitation projects,** allowing small-scale interventions to be expanded and replicated in different contexts. To provide real-world insights, the module includes **case studies from Kenya and Bangladesh**, showcasing the scalability of successful sanitation models in similar socio-economic and environmental conditions. Users can learn from these global examples, **how to develop, implement, and expand sanitation solutions**.

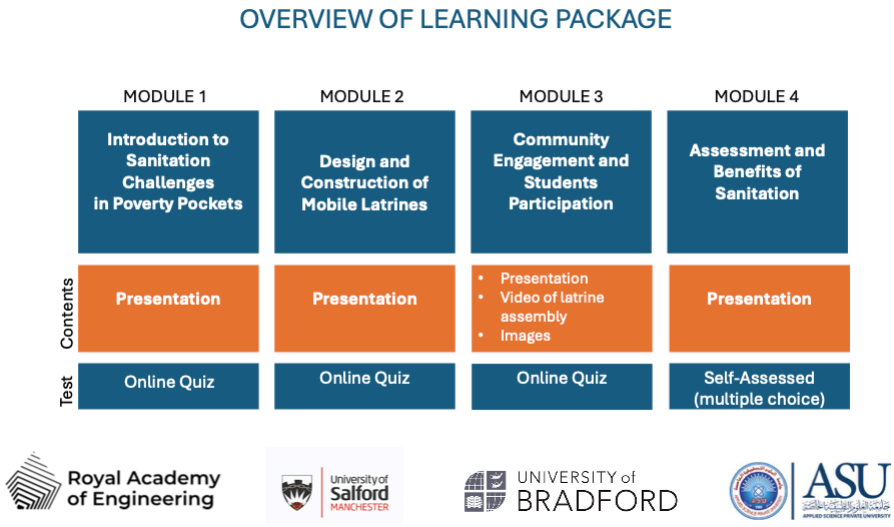

Figure 3. Overview of learning package, available at https://wash.thinklab-salford.org/

The importance of interactive features

As already mentioned, in order to ensure engagement and effective knowledge transfer, the package includes multiple-choice quizzes and educational videos that guide users through key concepts and hands-on processes.

Interactive Multiple-Choice Questions

To reinforce learning and assess comprehension, the application includes multiple-choice quizzes at the end of each module to reinforce the understanding of key concepts, including waste disposal methods, hygiene standards, and the structural components of mobile latrines. Questions are designed to cover both theoretical and practical aspects, ensuring that learners grasp not only the importance of sanitation but also the technical details involved in implementing effective solutions. Some of the questions provide instant feedback: there is an explanation that follows, clarifying the correct response. Other questions rely on self-reflection, helping the user identify areas where they may need further review. If an incorrect answer is chosen, learners are encouraged to revisit relevant sections of the module to reinforce their knowledge.

Educational Video on Latrine Construction

A crucial component of the learning package is the instructional video demonstrating the step-by-step construction of the mobile latrine constructed for the purposes of the project. The video is presented in Arabic with English and Arabic subtitles and covers the selection of materials, assembling structural components, and maintaining hygiene standards. By visually demonstrating these processes, the

package enhances comprehension and provides a practical guide for stakeholders looking to implement sanitation solutions.

Visual Informational Material

To support the deployment and proper use of mobile latrines, the learning package includes **visual instruction leaflets,** available in both **English and Arabic**. These leaflets are included in the online learning package and serve as a reference for users, providing step-by-step guidance on assembling, maintaining, and safely using the latrines. Designed to be clear and accessible, they incorporate **illustrations, with minimal text** to ensure comprehension across diverse literacy levels and linguistic backgrounds. The inclusion of this visual material was of crucial importance for the project and was developed with the day-to-day users in mind: these **communities have a low literacy rate.** Hence, diagrams allow users to follow instructions easily without relying solely on written explanations. It is worth noting, that this material was originally drafted in Arabic. For wider dissemination purposes, the learning package also includes the English version to support **humanitarian aid organisations** in understanding and implementing sanitation solutions more effectively (as seen in figures 4 and 5).

Figures 4 and 5. The English manual of mantling the latrine, and the same visual representation on-site, next to the mobile latrine (on the left).

CONCLUSION

Designing and implementing mobile latrines for vulnerable populations requires a nuanced approach that involves innovation and community empowerment. Though technology has been crucial in enhancing sanitation systems and hygiene practices, it is worth reflecting that the use of these units can come with issues that require careful management of their use. A technology of sanitation can inadvertently (or not) create certain dynamics by those constructing, designing managing and using them. The question that therefore arises is: what can be done to prevent unintentionally creating power structures in this context. If access and control of such facilities remain concentrated within certain groups, stakeholders or users, there is a risk that they could be used as tools for exclusion instead of catalysts for equitable development. As such, proper rollout of mobile latrines requires that structures to democratize access, ensure equitable distribution, and allow communities to manage and maintain these interventions independently are put in place. This is where technology can also play a role.

To prevent such issues and ensure long-term sustainability, technology can extend to accountability. The digital divide itself remains central to the discussion of technological implementation since the majority of disadvantaged areas lack access to regular internet or the digital literacy necessary to utilize digital platforms effectively. Going forward, steps in the direction of greater

accessibility in the form of offline resources, community workshops, and printed instructional materials will be essential for making digital interventions available to those who most need them. Another key factor in the success of the project is the ongoing involvement of key stakeholders at all levels. As noted in the stakeholder analysis, various groups need varying levels of involvement, which can range from active involvement to consultation and information sharing. Local expertise, characterized by high interest and influence, is paramount to guarantee the successful roll-out of sanitation projects. It is necessary to access this knowledge through participatory strategies that foster skill-transfer and local ownership, thus ultimately increasing the sustainability of the projects.

Additionally, community mobilization is key for any successful sanitation intervention. While community members may lack formal decision-making power, their high level of interest and direct impact from sanitation solutions necessitate meaningful consultation. By incorporating their feedback and ensuring culturally sensitive implementations, the project can achieve long-term adoption and maintenance. This observation aligns with global best practices, as demonstrated by previous studies included in the learning package and where stakeholder involvement has significantly improved project outcomes by ensuring solutions are specifically tailored to the needs and cultural characteristics of the population.

Ultimately, the success of this project and similar sanitation interventions is more likely when combined with technology for the users for their education, implementation and management. Such solutions need not only be technical, but also socially inclusive, culturally sensitive and community-led. Technology in this case has the ability to prioritize equitable access, fostering collaboration among stakeholders, and continuously refining implementation strategies, sanitation initiatives can evolve into sustainable, long-term solutions that genuinely improve quality of life for vulnerable populations worldwide.

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CITIZEN EMPOWERMENT IN URBAN PLANNING AND DESIGN: A COMPARATIVE STUDY OF DIGITAL APPLICATIONS

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INTRODUCTION

The widespread and increasing adoption of digital applications and online social media has transformed how we interact with urban space within communities and society at large. Several studies explore how user-generated data combined with advanced data analytics, collaborative platforms and applications, can make urban planning and design more open, participatory and engaging in diversity towards positive transformative change.

This paper explores how citizen participation can be empowered through digital applications through the lens of *social innovation (SI)*. Based on the dimensions of SI as defined in the literature, we develop an analysis framework, aiming to answer the following research questions: RQ1. What are the main characteristics of the existing digital applications for participatory urban planning and design? RQ2. What clusters of digital applications can we distinguish and what are their key features? RQ3. How is participation affected by the different characteristics of the digital applications, and particularly by the role of digital technologies?

Social Innovation

Social innovation (SI) is perceived to be grounded in territory and contributing to multi-scalar socio-political and ecological change.[1] In urban studies and planning, SI is regarded as a catalyst for reimagining the political dimensions within the planning process.[2] Despite the wide range of definitions and the development of the concept in various disciplinary perspectives, its core characteristic is that SI aims to address a social issue, while at the same time, the process of delivery is a vital outcome of the innovation itself.[3] In other words, social innovations not only benefit society, but also enhance its capacity to act.[4]

This research builds upon an exploratory framework of social innovation for sustainable urban development,[5] expanding it in the field of urban planning and design. This framework is based on the three basic dimensions of social innovation, as defined by the literature: 1) content, 2) process, and 3) empowerment.[6] 'Content' refers to the social purpose of SI, inherently aimed at addressing social challenges and needs, such as inclusion, quality of life, well-being, sustainability, etc. 'Process' refers to social process, implying a change of relationships among humans and between humans and governmental factors, and in the way that services are produced and offered to individuals and

specific population groups. 'Empowerment' comes as the social outcome of SI and refers to extending the operational capacity of citizens and organizations to act, respond and be heard, therefore strengthening their role and position in the state of play. Based on the relevant literature of SI, we further analyze these dimensions into more specific characteristics, creating a framework that enables the comparative analysis of digital applications for participatory urban planning and design.

Empowerment through participation

Citizen participation in urban planning and design is considered as a means of empowerment, enabling citizens to become actively involved in decisions affecting their cities, and therefore, their lives.[7] The benefits of citizen participation in urban planning and design are widely accepted and documented in literature, and involve increased citizens education and awareness,[8] civic engagement, and government responsiveness.[9] In this context, understanding how to strengthen citizen voices in the urban realm has been a longstanding concern of both professional planners and scholars through the communicative and collaborative planning theories,[10] leading to the development of diverse methods and tools for participatory planning.[11]

Critical approaches on citizen participation have also been formulated; among the most often cited is that of Sherry Arnstein who argued that "participation without redistribution of power is an empty and frustrating process for the powerless".[12] She also introduced the "ladder of citizen participation", a typology that has been widely used and adapted by scholars and professionals, with the IAP2's Spectrum of Public Participation, being the most relevant and used internationally,[13] also used in the exploratory framework proposed in this paper to define the expected level of citizen participation.

Digitally enabled participation

Digital technologies create an opportunity to rethink participation in the planning process through their potential to empower people and reinforce their active role in decision-making processes.[14] Today, the increasing complexity of tackling urban problems requires more flexible and dynamic processes of urban planning and design. Diverse collaboration tools become widely accessible, and, together with technological breakthroughs in representation and design (3D modelling, simulation and computation algorithms, AR/VR, etc.), they make interaction and information exchange among urban planners, citizens and other stakeholders easier than ever.[15]

Over the last decade, there has been recognition of the potential for more citizens to become engaged in the planning system by embracing technology.[16] However, there are also critical voices supporting that digital platforms developed for participatory planning often mirror traditional methods rather than leveraging the opportunities technology offers, limiting their function to one-way provision of information.[17] Another critical view to the design of digital technologies for citizen participation regards the difficulty of 'translating' the citizen voices into information that is easily understood and actionable for decision-makers.[18] In this paper, we aim at exploring how digital technologies are used for increased citizen participation, what their role and function is in the design process, and, finally, how participation is affected by their use.

DATA AND METHODS

To address the research questions, a comparative analysis of 60 applications addressing the lack of participation in urban planning and design has been conducted. The analysis framework is extended to capture additional characteristics that are relevant to urban planning and design, including the stage of design, and the level of participation targeted by the application, summarized in *Figure 1*. Following the design thinking approach,[19] there are seven stages of design, starting from researching and then defining users' needs, to ideation, evaluation of alternatives, prototyping, to monitoring the progress,

results and impact of a project. The level of participation, based on the IAP2'public participation spectrum ranges from 1 – Inform, 2 – Consult, 3 – Involve, 4 – Collaborate, and 5 – Empower. Most characteristics are categorical variables, while some of them (including degree of innovation, role of technology, design stage and level of participation) are considered ordinal, as they have a specific, ordered relationship to one another, but the exact distance between consecutive categories is not necessarily uniform or measurable.

The data collection took place from May 2018 to May 2022, and one of the key criteria for selection, was the availability of data about all the characteristics in the Greek, English or Spanish language. Additional criteria have been, on the one hand, the existence of a digital element supporting the application, such as a digital platform or other online media, and, on the other hand, having citizen participation among the key target objectives of the application. Different qualitative (thematic analysis) and quantitative (descriptive, network analysis, spectral clustering and linear regression) methods are applied to explore the questions stated at the beginning of this research.

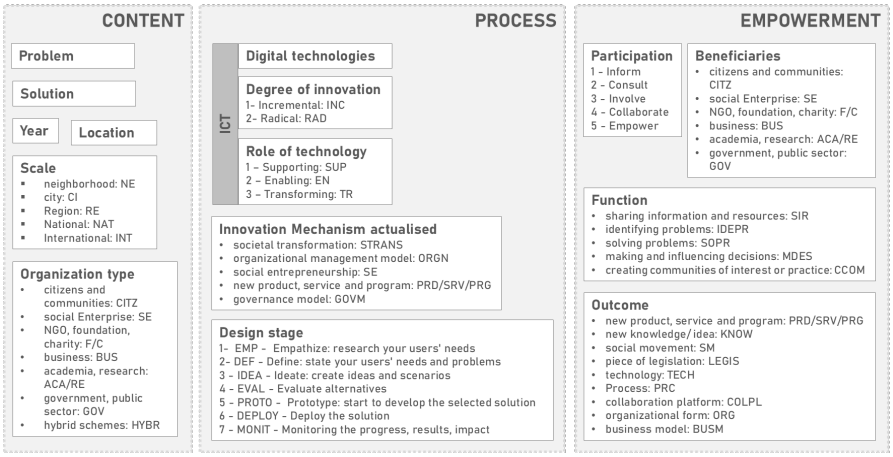

Figure 1. Analysis framework for digital applications for urban planning and design.

RESULTS

Through thematic analysis, we have extracted the most common themes arising in terms of the problems addressed, and the solutions provided. More specifically, the main problem, as expected, being one of the criteria for selection, is the lack of citizen participation and engagement in urban planning and design, while there are some additional common themes that are identified, including:

- Social exclusion, inequality and participation barriers
- Inefficient and outdated planning processes and tools
- Ineffective participation methods and tools
- Complexity of urban problems and stakeholder management
- Political distrust and disengagement in decision-making processes
- Technology and data issues

Figure 2 visualizes the results of the co-occurrence network of the words most commonly appearing together in the problems addressed. We can see that the terms 'participation' and 'engagement', connected to 'citizens' and 'public' respectively, are both connected to the terms 'lack', 'urban', 'planning' and 'design'. We can also see that 'barriers' are linked with 'planning' as well as with 'underprivileged' and 'communities', indicating social exclusion as a major problem addressed. At the same time, we can see that 'planning' is connected to 'consent', 'difficult', and 'reach', while 'conflicting', 'viewpoints' and 'stakeholders' are also connected, implying the complex nature of urban planning and stakeholder management, as reported above.

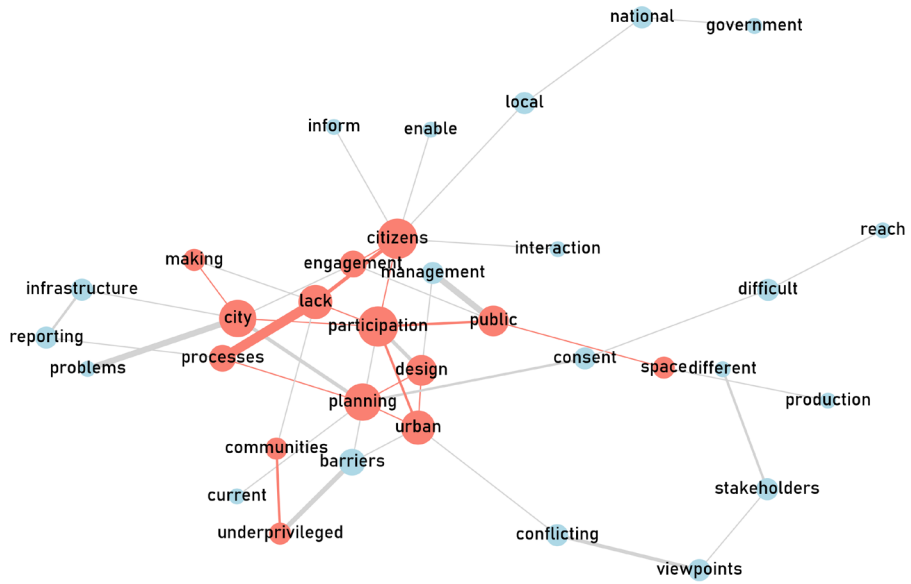

Figure 2. Word co-occurrence network for problems addressed. Nodes with less than 2 edges have been removed. The most common terms are highlighted with salmon along with their connecting edges. The size of the nodes follows their degree of networking.

Regarding the solutions provided, the main theme detected is digital platforms for citizen engagement in urban planning and design. Additional themes that are often found are the following:

- XR applications for enhanced citizen engagement in urban planning and design
- Mobile applications for data collection and citizen feedback
- Collaborative tools for crowd creativity and urban design
- Map-based participatory applications for urban management
- Open data platforms and advanced analysis and visualization tools
- Games and gamification in urban planning & design
- Participatory budgeting and crowdfunding platforms

Figure 3 illustrates the results of the co-occurrence network of the words most commonly appearing together in the proposed solutions of the digital applications. We can see that the term ‘platform’ is connected to the terms ‘online’, ‘digital’, ‘participatory’ and ‘engagement’. We can also see ‘mobile’ linked to ‘application’, which are then linked with ‘collecting’, ‘feedback’ with ‘opinions’ and ‘citizens’. At the same time, we observe a close link between the terms ‘augmented’, ‘reality’, and ‘mixed’, indicating the existence of XR applications in our sample, as well as between the terms ‘improve’, ‘communication’ and ‘facilitating’, and between ‘public’, ‘spaces’ and ‘community’.

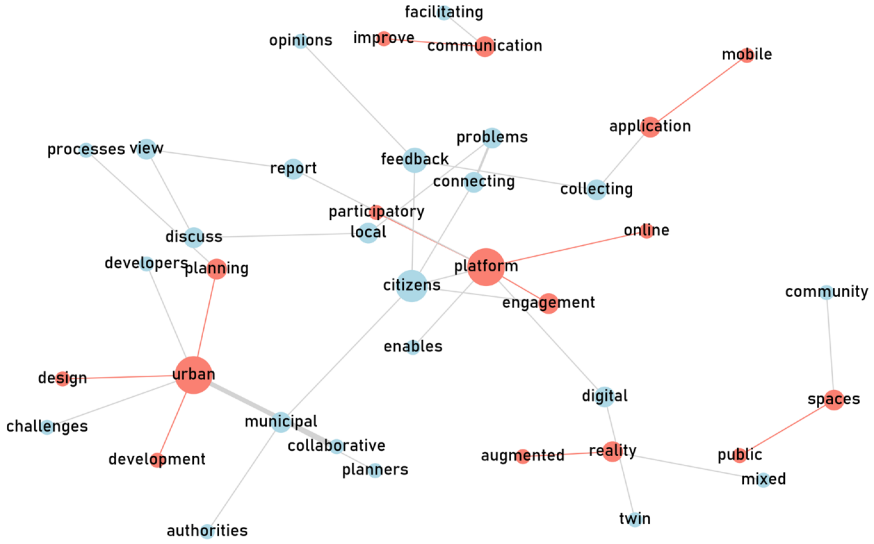

Figure 3. Word co-occurrence network for solutions of digital applications. Nodes with less than 2 edges have been removed. The most common terms are highlighted with salmon along with their connecting edges. The size of the nodes follows their degree of networking.

As far as the geographical distribution of the digital applications is concerned, most of them are based in western countries, with a large part (35%) coming from the United States (n=13) and the United Kingdom (n=8). Individual cases come from Australia, New Zealand, Hong Kong, Kenya and Brazil. Figure 4 presents the evolution of the number of applications related to the type of organization that initiated them throughout the period under investigation. As we can see, most applications come from the academic and research community, while more than 70% of them were initiated between 2010 and 2017. Proprietary applications coming from the private sector are ranked second, followed by the third sector (NGOs, foundations, charities, etc.) whereas there is only one case coming from citizens communities.

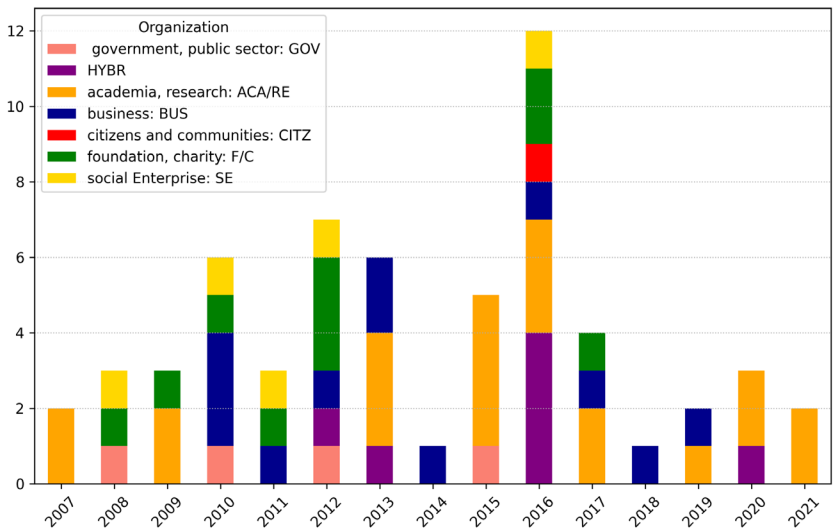

Figure 4. Number of digital applications per year and per organization type.

Figure 5a shows the technologies most used in the selected cases. As we can see, web and mobile applications are the most widely used technologies, with crowdsourcing and interactive mapping capabilities being also quite common. Among other key technologies that are highly relevant for

urban planning and design are 3D modelling, GIS, interactive dashboards and analytics. Figure 5b shows the most common programming languages (JavaScript, HTML, CSS, Python, PHP) from the open-source applications where this information was available (17 out of 60).

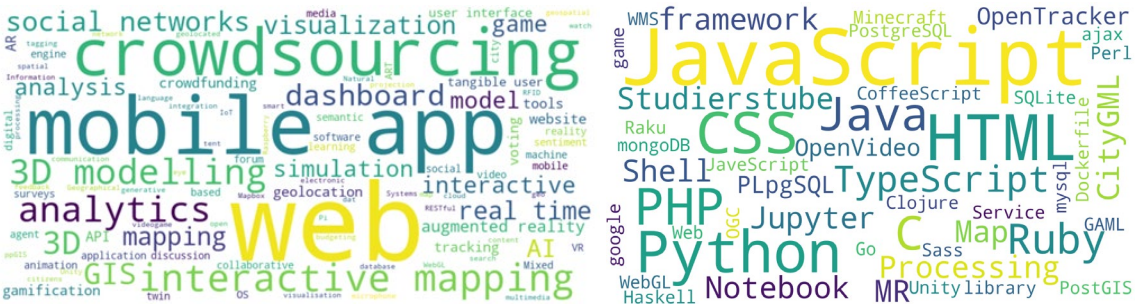

Figure 5a (left) and 5b(right). Technologies used in the set of digital applications, and (right) the programming languages used in the open-source applications (17 out of 60). The bigger size of the text indicates a higher frequency of terms.

Figure 6 illustrates the level of participation in relation to the design stage where the application is focused. We can see that most of the applications target design stages 2 to 4, which correspond to *2. Define, 3. Ideate,* and *4. Evaluate*. At the same time, the goal for most cases is to involve (participation level 3 – Involve) citizens in the design process, ensuring their concerns and aspirations are understood and considered. We can also observe that there are some cases focusing on stage *7-Monitoring*, but their level of participation is quite low, as their function is purely informative. It is interesting to also note that applications that target an empowering level of participation for citizens (level 5) are mainly led by the third/civil sector (green color).

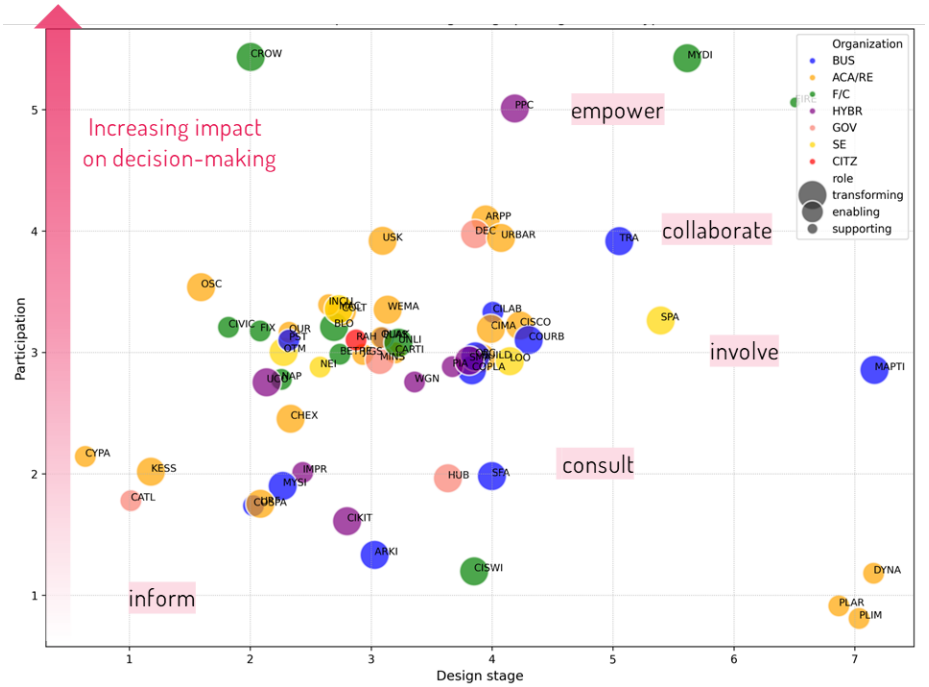

Figure 6. Level of participation and relevant design stage. The color represents the type of organization that developed the application, while the size of the circle represents the role of technology (1-supporting, 2-enabling, 3-transforming).

Figure 7 presents the evolution of the participation level throughout the period under investigation related to the type of organization that initiated them (color) and the participation level (y-axis). Similar to the previous figure, technology seems to play an important role in most applications, either by enabling or transforming them, and this does not seem to change over time. Recent cases are mostly stemming from academic and research communities, while participation levels seem to remain independent of time and technology.

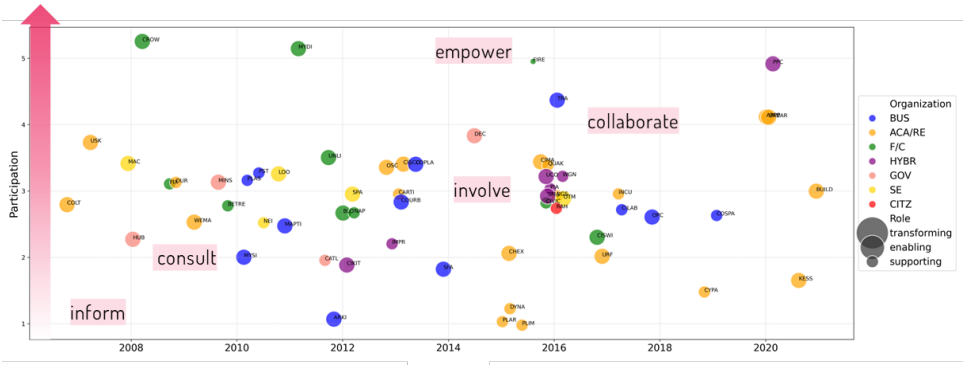

Figure 7. Evolution of participation level. The color represents the type of organization that developed the application, while the size of the circle represents the role of technology (1-supporting, 2-enabling, 3-transforming).

To identify meaningful patterns among the digital applications, a spectral clustering algorithm was applied using *nearest_neighbors* as the distance metric, particularly suitable for datasets containing categorical and ordinal values. After testing a range from n=3 to n=10 for the number of clusters, we selected n=7 as the most number based on the highest silhouette score combined with clearer interpretability. The clustering incorporated a set of variables reflecting key attributes of the applications (as presented in *Figure 1*); specifically *Design stage, Degree of Innovation, Role, Participation, Scale, Organization, Innovation Mechanism, Beneficiaries, Outcome* and *Function.* To facilitate visualization, the t-SNE technique was used for dimensionality reduction and the plots are presented in *Figure 8*. The analysis produced the following clusters:

1. **Cluster 1 (14 cases)**: **Radical innovations** with **transformative** technology, driven by **hybrid schemes** (involving businesses, academia, and the public sector), focusing on the stage of **evaluation of alternatives,** and featuring **medium participation** levels.
2. **Cluster 2 (14 cases)**: Research projects with **incremental innovations** targeting different design stages (1-7) and supporting **low to medium participation**.
3. **Cluster 3 (4 cases)**: **City management software** to be used by public authorities interested in involving citizens in **identifying and solving problems** of the public infrastructure.
4. **Cluster 4 (8 cases)**: International collaboration platforms focusing on **societal transformation**, led by the **civil sector**, employing **technology** with a **transformative role**, emphasizing on communities and decision-making, and targeting **high participation**.
5. **Cluster 5 (9 cases)**: **Civic engagement** solutions, typically **business products and services** for **government** contexts, featuring a **transforming role** of technology, oriented toward **the evaluation of alternative scenarios**, and targeting **medium participation** levels.
6. **Cluster 6 (7 cases)**: **Research projects** in **initial design stages**, adopting **radical innovation** with a **transformative** technological role, ranging from **low** to **medium** participation levels.
7. **Cluster 7 (4 cases)**: Collaborative platforms for **urban design** at the **neighborhood level**, focusing on **creating ideas and evaluating alternatives**, through **radical technological innovation** with a **transformative** role, and exhibiting **medium to high participation**.

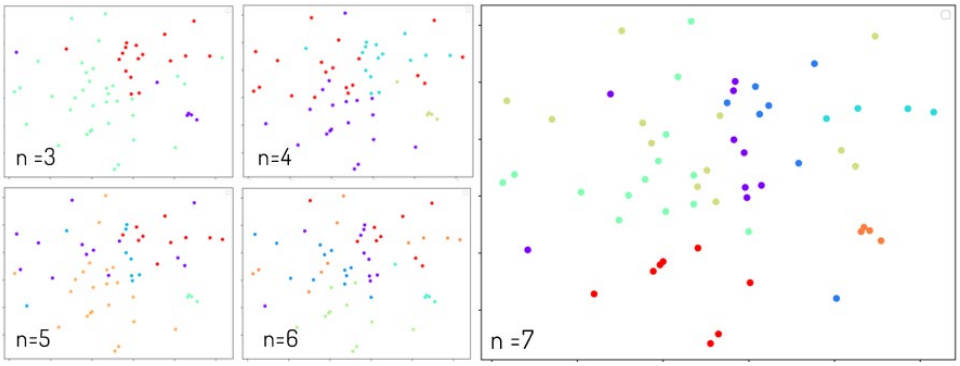

Figure 8. Visualizations for spectral clustering with different numbers (n) of clusters. Each cluster is represented by a different color.

To better understand how participation is affected by the different characteristics of the digital applications, a series of regression analysis were conducted, using the least squares method. The dependent variable in the analysis was 'Participation', while the independent variables for all models were 'Design stage', 'Degree of innovation' and 'Role', plus one additional variable for each model among 'Scale', 'Organization', 'Innovation mechanism', 'Beneficiaries', 'Outcome' and 'Function' (see *Table 1*). The results reveal that several characteristics significantly influence participation, while others exhibit negligible effects. In particular, applications led by third sector seem to drive higher participation levels (M2), together with applications that their innovation mechanism is societal transformation (M3). Although the degree of technological innovation and its role do not seem to be statistically significant, the way citizens are empowered has a strong positive relationship with participation: higher participation is achieved when citizens are empowered to make decisions and create communities through the digital applications.

Model /Coef, p-value	M1	M2	M3	M4	M5	M6
Design stage	0.065, 0.481	0.049, 0.576	-0.001, 0.994	0.0295, 0.757	0.0526, 0.494	-0.0201, 0.812
Degree of Innovation	0.265, 0.350	0.143, 0.601	0.082, 0.753	0.0105, 0.972	0.0377, 0.875	0.1796, 0.497
Role of technology	0.09, 0.736	0.148, 0.577	0.1897, 0.448	0.2035, 0.454	0.1081, 0.632	0.0003, 0.999
Var. 4	-0.034, 0.917	-0.038, 0.886	0.2254, 0.584	0.0398, 0.917	1.2373, ***	0.1810, 0.479
Var. 5	1.134, **	0.099, 0.757	0.3187, 0.182	-0.017, 0.962	0.8336, 0.197	0.7302, **
Var. 6	0.113, 0.866	0.469, 0.585	1.3175, ***	0.0999, 0.811	0.0124, 0.979	0.1612, 0.66
Var. 7	0.435, 0.604	0.838, **	-	-0.0199, 0.952	0.5049, 0.099	0.2859, 0.515
Var. 8	0.112, 0.716	0.036, 0.938	-	2.2127, **	0.1142, 0.711	0.6181, *
Var. 9	0.167, 0.746	0.296, 0.428	-	-	2.1161, **	-
Var. 10	-	0.245, 0.576	-	-	0.943, *	-

Table 1. Regression analysis results

Given the inherent limitations of this research, these findings should be taken as primarily indicative insights, offering ground for further reflection rather than normative.

CONCLUSION

This study examined 60 digital applications designed to enhance citizen participation in urban planning and design, revealing their diverse technological and organizational characteristics. The analysis underscores the potential of digital applications to empower citizens in urban planning and design by fostering crowd creativity and mass participation, while also addressing social exclusion and complexity of planning processes, thereby challenging traditional top-down and outdated planning processes. Driven by academia, private and civil sector, digital platforms employ diverse technologies and approaches to facilitate more inclusive and democratic city-making processes, enabling citizens to be actively involved at different stages of design of their urban environments. Our findings support Seltzer and Mahmoudi,[20] and Hasler et al.,[21] emphasizing the necessity of employing multiple and diverse digital tools to drive evidence-based and citizen-centric planning processes. Finally, our findings imply more transformative technologies do not necessarily drive higher participation levels; rather, higher participation appears contingent upon existing social structures and institutions.

Further research could focus on expanding the analysis framework or the data sample, broadening also the geographical scope. Moreover, another research direction could be to incorporate in-depth qualitative analyses to better understand the role of specific urban, institutional and socio-cultural contexts.

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DIGITAL FABRICATION AND MAKING IN EDUCATION: EXPANDING PEDAGOGY TOWARDS DESIGN AND REFLECTIVE PRACTICES

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INTRODUCTION

The integration of handmade craftsmanship and digital fabrication within design education represents an evolving yet underexplored domain. The Fourth Industrial Revolution has ushered in a new era of technological advancement, profoundly influencing spatial design practices. Digital tools such as Computer-Aided Design (CAD), parametric modelling, and computational fabrication have transformed the way designers conceptualise and execute their ideas.[1] However, despite these advancements, the role of traditional craft techniques remains essential in fostering material literacy, spatial awareness, and hands-on problem-solving skills.[2] Interior design, as a discipline that bridges architecture and human experience, is particularly well-positioned to explore the synthesis of digital and handmade methodologies.

This paper investigates the pedagogical implications of integrating digital handmade techniques, including advanced manufacturing technologies such as 3D printing and laser cutting, within interior design curricula. It examines how this integration fosters a balanced understanding of technology and materiality, preparing students to navigate contemporary design challenges. By focusing on a third-year interdisciplinary interior design project, this study explores how students conceptualise, develop, and fabricate a multifunctional structure that merges traditional craftsmanship with digital fabrication. The project encourages an iterative design process, enabling students to engage with digital fabrication techniques while maintaining a hands-on approach through craft-based methodologies such as origami and macramé.

The theme of the *Society. Spaces. Screens.* conference underscores the complex relationship between technology and traditional practices across disciplines. This study critically examines how interior design education is evolving in response to technological advances while maintaining a connection to craft-based traditions. As smart cities, digital sociologies, and emerging fabrication methods redefine spatial interactions, the digital handmade approach ensures that students develop not only technical proficiency but also a deeper understanding of materiality and spatial dynamics.[3] This paper aligns with the conference theme by demonstrating how digital technologies coexist with analogue traditions, shaping the evolution of contemporary spatial practice.

Engaging in these dual methodologies cultivates critical thinking, problem-solving, and material experimentation, skills essential for the future of design practice. The outcomes of this approach demonstrate the potential of the digital handmade to not only enhance interior design pedagogy but

also reshape spatial practice. As digital technologies continue to evolve, fostering a curriculum that bridges traditional making with emerging fabrication techniques ensures that students remain adaptable and innovative. This paper argues that the digital handmade is not merely an aesthetic or technical approach but a fundamental shift in the way design education prepares students for the dynamic intersection of craft, technology, and spatial design, resonating with broader discussions on the integration of digital and physical spaces in contemporary society.

THEORETICAL FRAMEWORK: THE DIGITAL HANDMADE IN DESIGN PRACTICE

The term 'digital handmade' describes the convergence between traditional craftsmanship and digital technologies, fostering innovation in design production while maintaining a tangible connection to materiality and process.[4] This concept emerges from the broader discourse on the evolving relationship between technology and craft in design education and practice. Scholars such as Lisa Iwamoto[5] and Thomas Heatherwick[6] emphasise that despite the increasing reliance on digital tools, making remains an essential aspect of design thinking, as it facilitates deeper engagement with material properties, construction methods, and spatial articulation.

Heatherwick[7] critiques the detachment of designers from the act of making, advocating for a renewed engagement with materiality and process to preserve the richness of tactile knowledge in an era of digital dominance. Similarly, Johnston,[8] in Digital Handmade: Craftsmanship and the New Industrial Revolution, argues that the infusion of digital technologies into craft practice does not replace the human touch but rather enhances it, allowing for novel explorations in form, structure, and function. This aligns with the pedagogical shift in interior design education, where digital fabrication techniques such as 3D printing, laser cutting, and CNC milling are increasingly integrated with craft methodologies, enhancing spatial understanding and technical proficiency.

The digital handmade approach within interior design practice resonates with broader academic discussions on hybrid making, where traditional and contemporary modes of production coexist. McCullough,[9] in Abstracting Craft: The Practiced Digital Hand, explores how digital tools augment, rather than diminish, human craftsmanship by introducing precision, scalability, and iterative adaptability. This notion is further supported by Pye,[10] who differentiates between 'workmanship of risk', where the maker's skill directly affects the outcome, and 'workmanship of certainty', where automated processes predetermine results. Digital handmade approaches negotiate this binary by allowing designers to manipulate digital precision while retaining the organic unpredictability of handcrafted techniques.

Moreover, scholars such as Sennett,[11] in The Craftsman, and Dormer,[12] in The Culture of Craft, advocate for the continued relevance of hand skills in an increasingly digital landscape. They argue that craftsmanship involves a deep understanding of material behaviour and process, which is often lost when designers rely solely on virtual modelling. In interior design education, fostering a digital handmade approach ensures that students engage in an embodied design process, where knowledge of materials and fabrication methods informs spatial solutions.

Another key theoretical underpinning of the digital handmade is its relationship to material agency. Ingold,[13] in Making: Anthropology, Archaeology, Art and Architecture, emphasises that materials are not passive elements but active participants in the design process. This perspective aligns with the work of Oxman,[14] in Age of Entanglement: When Architecture Becomes Ecology, which examines how computational design and fabrication technologies enable a more symbiotic relationship between designers and materials. By integrating digital and handcrafted techniques, interior design students cultivate a deeper understanding of material behaviour, structural performance, and fabrication constraints.

The integration of digital fabrication with handmade methodologies also aligns with principles of experiential learning and constructivist pedagogy. Kolb,[15] in Experiential Learning: Experience as the Source of Learning and Development, argues that hands-on engagement enhances cognitive development by allowing students to test ideas in real-time and respond to the affordances of materials and tools. Schön,[16] in The Reflective Practitioner, further supports this notion, emphasising that iterative-making processes enable designers to refine their ideas through direct interaction with materials and fabrication technologies. This is particularly relevant in interior design education, where the ability to prototype, test, and refine spatial interventions is critical to developing functional and aesthetically compelling environments.

Furthermore, the digital handmade intersects with sustainability discourses in design. Manzini,[17] in Design, When Everybody Designs, highlights the potential of localised, small-scale digital fabrication in reducing material waste and promoting resource-conscious making. By incorporating recyclable materials and modular construction strategies, interior design students can explore environmentally responsible approaches to fabrication while maintaining high levels of craft and aesthetic refinement. This is echoed by Gardetti and Coste-Manière,[18] in Sustainable Luxury and Craftsmanship, who advocate for the role of craft in fostering sustainable production models that balance technological innovation with artisanal expertise.

In summary, the digital handmade represents a critical paradigm shift in design education, bridging traditional craft sensibilities with advanced fabrication technologies. By integrating literature from craftsmanship studies, digital fabrication research, material agency theories, and pedagogical frameworks, this paper situates the digital handmade as a transformative approach within interior design practice. As interior spaces become increasingly responsive to digital innovations, maintaining a connection to materiality, making, and human engagement ensures that design education remains holistic, adaptive, and future-oriented.

PROJECT FRAMEWORK AND METHODOLOGY

This study employs a case study methodology to examine the integration of digital and handmade techniques in interior design education. The case study focuses on a third-year interior design project conducted at the University of Johannesburg's Faculty of Art, Design, and Architecture (FADA). The project brief required students to design and fabricate a freestanding room divider that incorporated both digital and handmade techniques, emphasising innovation, material efficiency, and structural integrity. The methodological framework was structured around several key phases, each reinforcing an iterative and reflective design process.

Concept Development

The project commenced with an in-depth research phase, where students explored biomimicry, material properties, and spatial interaction through precedent studies. Biomimicry served as a core conceptual foundation, drawing inspiration from nature’s structures and adaptive mechanisms. Students analysed organic forms, geometric patterns, and self-supporting structures found in natural systems, applying these principles to inform their design strategies– as illustrated in Figure 1.

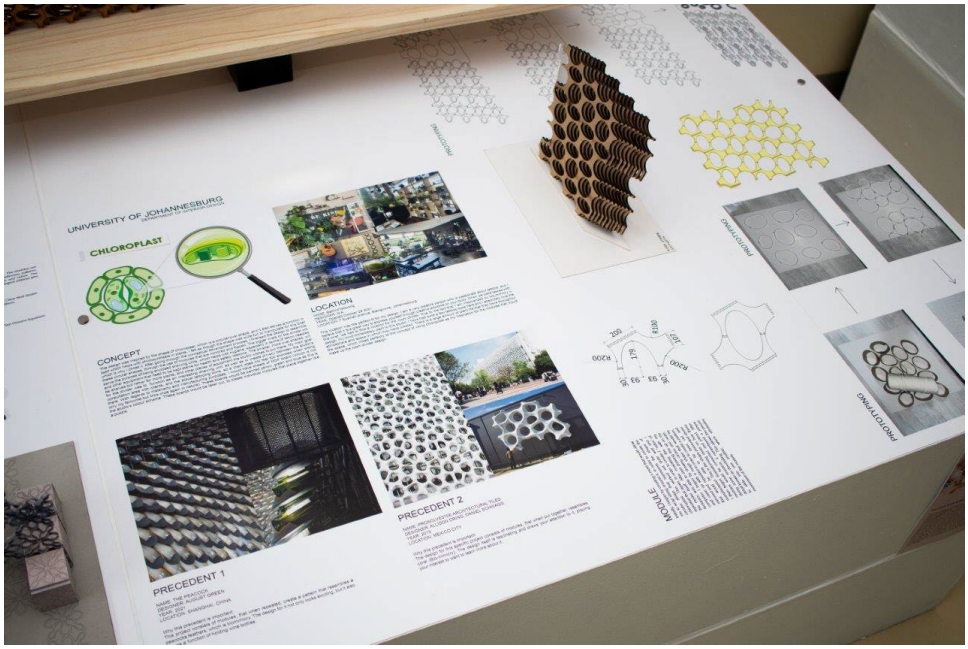

Figure 1. Biomimicry-inspired design strategies and structural adaptations.

Additionally, material research played a crucial role in the early stages of concept development. Students engaged in tactile explorations of various materials, examining their flexibility, strength, and textural qualities. Traditional craft methods were studied in parallel with digital fabrication possibilities, allowing students to understand the nuances of different production techniques– as illustrated in Figure 2. Precedent studies included an analysis of historical and contemporary approaches to partitioning spaces, ranging from traditional handcrafted screens to digitally fabricated parametric structures.

During this phase, students engaged in sketching exercises, digital modelling, and conceptual presentations to articulate their design ideas. Collaborative discussions with faculty members facilitated critical engagement with key design considerations such as modularity, functionality, and sustainability.

Figure 2. Material exploration and comparative analysis of craft and digital fabrication.

Iterative Prototyping

A fundamental aspect of the project was the iterative prototyping process. Rather than working toward a singular final product, students developed multiple scaled models, each iteration refining their understanding of structural integrity, fabrication constraints, and spatial articulation. This stage emphasised an exploratory approach, where failures and material inconsistencies were treated as learning opportunities.

Students began with small-scale physical models constructed from paper, cardboard, and foam board to quickly test formal ideas and joinery techniques. These initial prototypes provided insight into the behaviour of folded and tessellated structures. Following this, more refined scaled models incorporated diverse materials such as plywood, acrylic sheets, and fabric composites, each chosen for their structural and aesthetic properties– as illustrated in Figure 3.

Figure 3. Iterative prototyping and material testing in scale models.

Throughout the iterative process, students were encouraged to document their progress meticulously. Photographic records, annotated sketches, and fabrication notes provided a comprehensive understanding of how each design evolved. Digital simulations using software such as Rhino and Grasshopper allowed for parametric adjustments, ensuring precise material optimisation before full-scale fabrication.

Digital Fabrication

The project incorporated advanced manufacturing techniques, including laser cutting, 3D printing, and CNC milling. Each of these digital fabrication methods played a distinct role in refining the structural and aesthetic aspects of the room divider.

Laser Cutting

Laser-cut components facilitated intricate detailing, modular assembly, and precision cutting of lightweight yet durable materials. Students experimented with interlocking joints, perforated panels, and parametric engraving to enhance the visual and functional aspects of their designs.

3D Printing

Additive manufacturing was employed to create complex three-dimensional forms that would have been challenging to produce through traditional means. The ability to fabricate customised connectors, organic geometries, and intricate lattice structures allowed for greater formal experimentation.

CNC Milling

For students exploring larger structural components, CNC milling provided an opportunity to shape plywood and MDF with high accuracy. This technique enabled the production of customised curved panels, ribbed frameworks, and tessellated modules that contributed to the spatial dynamics of the room divider.

A key objective of this phase was to balance digital precision with an understanding of material constraints– as illustrated in Figure 4. The students engaged in hands-on troubleshooting, adjusting their digital files based on material tolerances and fabrication outcomes. The intersection of digital precision and manual refinement became a defining characteristic of the project's approach to making.

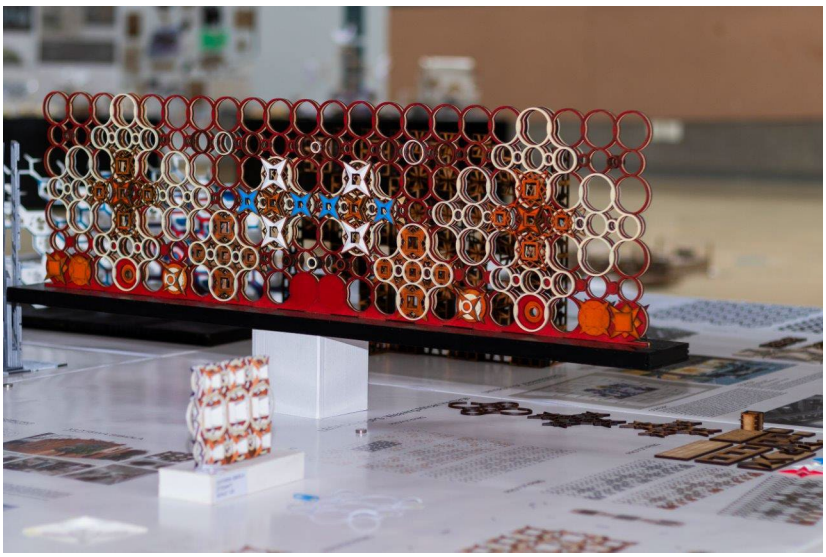

Figure 4. Digital fabrication techniques and material precision in design development.

Handmade Craft Techniques

Parallel to digital fabrication, the project emphasised the importance of traditional craft techniques, reinforcing the value of tactility and human engagement in the making process. Students explored macramé, origami, and tessellation as methods of form-making and structural efficiency.

Macramé

The use of textile-based techniques introduced flexibility and organic movement into the otherwise rigid digital components. Knotted rope structures allowed for innovative partitioning solutions that integrated texture and translucency.

Origami

Inspired by the Japanese paper-folding art, origami techniques were applied to generate foldable, collapsible, and lightweight modules. This method facilitated adaptable and reconfigurable spatial elements– as illustrated in Figure 5.

Tessellation

The repetition of geometric modules provided an opportunity to explore self-supporting structures. Laser-cut tessellated panels offered structural integrity while minimising material waste.

Sectioning

By slicing 3D forms into planar components, students optimised material use and assembly techniques.

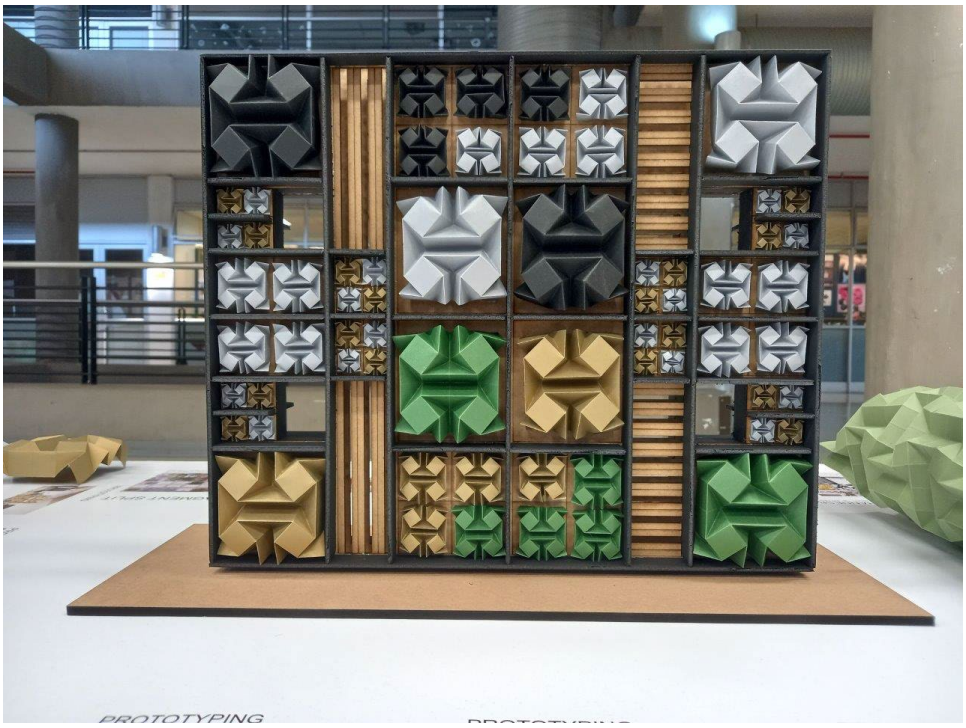

Figure 5. Exploration of handmade craft techniques in structural design.

By juxtaposing digital fabrication with handmade craft, students developed a comprehensive understanding of both mechanised precision and the subtle irregularities of human touch. This dual approach underscored the pedagogical aim of cultivating adaptability, problem-solving, and innovation in interior design education.

Critical Reflection and Design Refinement

Throughout the iterative process, students engaged in continuous critical reflection, refining their designs based on material behaviours, fabrication limitations, and user experience considerations. Faculty-led critiques played a pivotal role in helping students identify strengths and weaknesses in their designs, fostering a culture of constructive feedback and iterative improvement.

As part of the reflective process, students documented their design evolution through process journals, capturing insights from material experiments, fabrication challenges, and structural testing. These journals served as a vital tool for self-assessment, reinforcing the learning objectives of the project and allowing students to track their progress comprehensively.

In addition, the final prototypes were evaluated against key assessment criteria, including structural stability, material efficiency, aesthetic innovation, and the seamless integration of digital and handmade techniques. This phase encouraged students to critically engage with their own work, bridging conceptual ideas with practical execution. By emphasising process-oriented learning, this

approach not only enhanced students' technical capabilities but also cultivated their ability to think holistically about design and fabrication in interior environments.

CONCLUSION

The structured methodology employed in this project, which integrates research, iterative prototyping, digital fabrication, and craft techniques, demonstrates a comprehensive approach to design education. The framework provides students with a hands-on, experiential learning opportunity that deepens their understanding of material behaviours, fabrication processes, and spatial problem-solving. By engaging in an iterative process that emphasises experimentation and refinement, students cultivate a mindset that values adaptability and continuous improvement in design practice.

This project underscores the importance of integrating both digital and handmade methodologies to create spatial solutions that are innovative, structurally sound, and contextually responsive. Through this approach, students develop an awareness of the evolving role of materiality in interior design, equipping them with the ability to navigate complex design challenges with confidence. The balance of computational precision and hands-on making not only enhances technical proficiency but also fosters a deeper appreciation for craft, reinforcing its continued relevance within contemporary spatial practice.

OUTCOMES AND PEDAGOGICAL INSIGHTS

The project yielded several critical insights that underscore the significance of integrating digital and handmade methodologies within interior design education. By engaging in an iterative design process that combined advanced manufacturing technologies with traditional craftsmanship, students developed a deeper understanding of materials, spatial design innovation, technical proficiency, and sustainability. These insights reveal the pedagogical value of digital handmade approaches in preparing students for contemporary design challenges and industry expectations.

Material Understanding

One of the most significant learning outcomes was the development of a nuanced comprehension of materials. Students engaged in extensive material exploration, analysing the tactile, structural, and aesthetic properties of various substrates, including plywood, acrylic, fabric, and recyclable composites. The hands-on experience of working with both digital and handmade techniques enabled them to understand the strengths and limitations of different materials, particularly in relation to digital fabrication constraints such as cutting tolerances, assembly tolerances, and material stress points.

Furthermore, students were encouraged to experiment with material manipulation, folding, tessellation, and modular construction, allowing them to test how digital precision could be complemented by craft-based adaptability. This dual approach fostered an appreciation for how materials respond to different fabrication methods, emphasising the importance of flexibility in design thinking and execution– as illustrated in Figure 6.

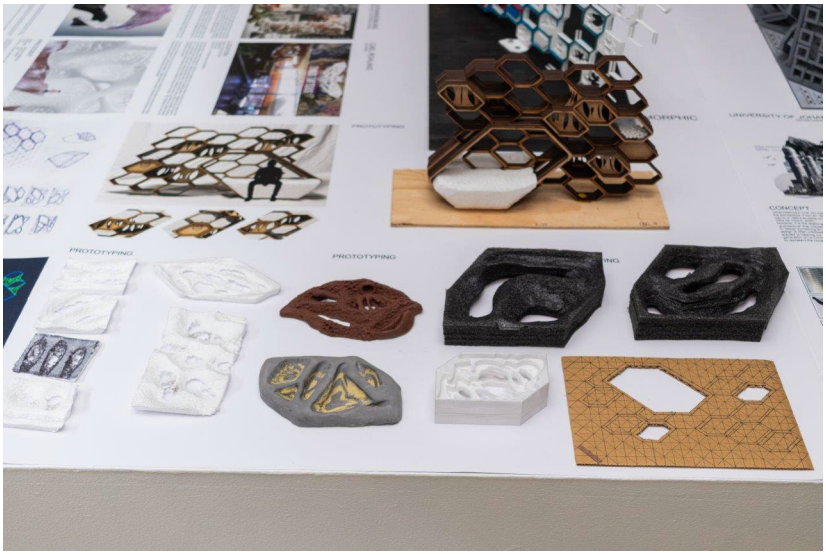

Figure 6. Comparative analysis of material properties and fabrication techniques.

Innovation in Spatial Design

The integration of digital and handmade techniques led to the development of innovative spatial interventions, pushing the boundaries of traditional interior design methodologies. By combining computational design with handcrafted elements, students explored new possibilities for adaptive, interactive, and multifunctional interior spaces. Many of the room dividers produced exhibited complex geometric forms, kinetic structures, and modular adaptability, demonstrating a sophisticated understanding of space-making through hybrid techniques.

Moreover, the project encouraged students to critically examine how digital fabrication can inform spatial experiences beyond mere aesthetics. By considering the dynamic interplay between light, shadow, material transparency, and spatial fluidity, students were able to create design solutions that responded to environmental and human factors. This approach aligns with contemporary trends in interior design, where technological integration is not only about efficiency but also about enhancing the experiential quality of spaces.[19]

Technical Proficiency

Engagement with advanced manufacturing technologies played a crucial role in enhancing students' technical competencies. Throughout the project, students developed proficiency in various digital fabrication processes, including:

Laser Cutting

Mastery of laser cutting techniques allowed students to explore intricate detailing, modular construction, and pattern-making for both structural and decorative purposes– as illustrated in Figure 7.

3D Printing

Exposure to additive manufacturing enabled students to experiment with complex, organic forms that would have been challenging to achieve using traditional fabrication methods.

CNC Milling

Understanding subtractive manufacturing techniques helped students refine their designs, particularly in terms of large-scale structural components and joinery techniques.

Additionally, students honed their skills in computational design software such as Rhino, Grasshopper, and Fusion 360, enabling them to translate conceptual ideas into precise digital models for fabrication. This technical expertise aligns with industry demands, ensuring that graduates are well-equipped with the necessary skills to navigate the evolving technological landscape of contemporary design practice.

Figure 7. Technical skill development in digital fabrication processes.

Sustainability Considerations

Sustainability emerged as a central theme throughout the project, prompting discussions on responsible material use, circular design, and waste reduction. Students were encouraged to adopt environmentally conscious approaches in their fabrication processes, considering factors such as:

Material Efficiency

Optimising material use to minimise offcuts and waste, particularly when using laser cutting and CNC milling.

Recyclability

Experimenting with recyclable and biodegradable materials, such as compressed cardboard, fabric remnants, and bioplastics– as illustrated in Figure 8.

Modular Design

Creating adaptable and reconfigurable structures that could be repurposed or reassembled to extend product lifespan– as illustrated in Figure 8.

By incorporating sustainable principles into their projects, students developed a heightened awareness of the environmental impact of design and fabrication. This emphasis on sustainability aligns with global shifts toward eco-conscious design practices, reinforcing the importance of responsible making in the future of interior design.[20]

Figure 8. Sustainable design strategies in material selection and modular construction.

Critical Reflection and Learning Integration

A key component of the project was the emphasis on critical reflection, enabling students to assess the evolution of their designs through iterative feedback and self-analysis. Maintaining detailed process journals allowed students to document their learning trajectory, capturing design iterations, fabrication successes, and challenges encountered along the way. This reflective practice reinforced the importance of adaptive problem-solving and continuous refinement, essential skills in professional interior design practice.

Faculty-led critiques provided structured opportunities for students to articulate their design decisions, defend their methodologies, and receive constructive feedback. This process encouraged a deeper engagement with the principles of spatial design, material behaviour, and fabrication logic. Additionally, peer evaluations facilitated collaborative learning, allowing students to exchange insights, troubleshoot challenges collectively, and refine their work through dialogue and critique.

By fostering an iterative learning environment, this approach ensured that students were not merely executing digital and handmade techniques in isolation but were actively engaged in an evolving design discourse. This reflective process instilled a sense of intellectual rigour, preparing students to navigate the complexities of contemporary interior design with confidence and critical awareness.

Conclusion

The findings from this project highlight how digital handmade methodologies serve as a bridge between tradition and innovation in interior design education. By integrating digital fabrication with traditional craft techniques, students engage in a process that extends beyond skill acquisition to encompass critical engagement with materiality, technology, and spatial design. This hybrid approach fosters an environment where students can test, iterate, and refine their ideas, ensuring that they are prepared to address contemporary design challenges with both technical expertise and creative adaptability.

Moreover, the project emphasises that spatial design is not solely about the adoption of emerging technologies but about how these technologies interact with traditional methods to create meaningful, functional, and sustainable interior environments. The exploration of sustainability, modularity, and interactive spatial experiences within the project serves as a model for future curriculum development in interior design education. By reinforcing the interplay between digital precision and tactile intuition, this approach equips students with the skills necessary to innovate while maintaining a strong foundation in craftsmanship and material understanding.

CONCLUSION: REIMAGINING INTERIOR DESIGN PEDAGOGY

As smart cities and digital technologies reshape contemporary environments, interior design education must evolve to prepare students for this changing landscape. The integration of digital fabrication with craft-based approaches fosters a pedagogical framework that balances technological innovation with material intuition. This paper advocates for a reimagined curriculum that positions the digital handmade as a central tenet of design education, ensuring that students remain at the forefront of spatial innovation.

The *Society. Spaces. Screens.* conference theme underscores the dynamic interplay between digital and physical realms, raising critical questions about how design education adapts to technological advancements while maintaining a connection to traditional practices. By bridging the gap between digital precision and handcrafted methodologies, this approach aligns with broader discussions on the evolving role of technology in shaping spatial experiences. The digital handmade serves as a model for how interior design can navigate the intersection of emerging digital tools and timeless craft traditions, reinforcing the discipline's relevance in an increasingly digital society.

Future research should explore interdisciplinary collaborations and the potential for emerging technologies such as AI and AR in further enhancing the digital handmade paradigm in design pedagogy. As digital fabrication continues to advance, integrating these tools with hands-on making will ensure that students develop the adaptability and creative fluency needed to innovate within both technologically driven and materially grounded design contexts.

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SCREENING SPACES: CINEMATIC URBAN LANDSCAPES AS A TOOL FOR SPATIAL PLANNING

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INTRODUCTION

One of the challenges in spatial planning is to reconcile abstract, conceptual and theoretical analysis and design with the lived realities of everyday life, even more to bring these ideas into execution in the practical realms of lived space. When a disconnect emerges between planning discourses and lived experiences, spatial plans mainly remain unexecuted, which might eventually result in a failure to bring about the intended transformations and to move towards an envisioned, more sustainable future. The Flemish urbanized landscape serves as a particular example of such issue, where perceptions on this landscape are widely divergent. On the one hand, experts such as spatial planners, urban designers, and policymakers struggle to manage the urbanization and fragmentation of this Northern region of Belgium. Their focus is mainly on demographic, economic, and ecological issues arising from the dispersed settlement structure in Flanders. Plans and reports like the *Spatial Structure Plan for Flanders,*[1] *Spatial Policy Plan,*[2] *Spatial Report,*[3] and others emphasize the urgent need for densification of city centres combined with a building stop and/or shift. On the other hand, the remaining open space is still taken up by residential or industrial development.[4] Despite the adverse effects of sprawl, such as ongoing traffic jams, impact on climate change, heightened energy consumption and landscape transformation, the Flemish inhabitants in general persist in their dispersed settlement behaviour; thus suburbanization unimpededly continues. The urban planning discourse and corresponding plans of recent decades seem to have little effect on everyday life. In other words, there is a discrepancy between the discourse, theories, and concepts within professional planning practices and the everyday culture and reality of residents. The dominant discourse in planning is mainly based on an instrumental, rational, strategic approach, where conventional research methods and instruments such as plans, Geographic Information Systems (GIS), statistics, and so on, barely capture the specific nuances of daily life. The social and cultural context, the intrinsic characteristics, meaning, value, and experience of this urbanized landscape are often missing in the abstract, technocratic frameworks that determine policy.

In order to bridge this gap and understand space, its meaning and how it is used, it is essential to consider alternative ways of interpreting and understanding space with methods that go beyond abstract frameworks. Since art plays a crucial role in reflecting and interpreting social and cultural contexts, and Flanders has a rich tradition in artistic representations, this research focuses on utilizing art to gain a more integrated and nuanced understanding of the Flemish urbanized landscape. In this context, film distinguishes itself from other art forms like literature, photography, and painting by its

widely accessible and multidimensional nature. Cinematic perceptions, especially their depiction of spatial environments, have the capacity to represent (as a visual medium), reflect (as a spatio-temporal and narrative medium), and interact (as an influential medium). Especially in our modern-day super-mediatized society, the impact of audiovisual media cannot be underestimated. By portraying spaces in evocative ways, cinematic perceptions express and influence our ideas and vision on the actual world. In that way, film, as a product originating in the everyday, can instigate planners to move beyond conceived theories and systematic knowledge. Based on film's unique ability to portray and manipulate time and space creating a distinctive, dynamic perspective on spatial complexities, this research explores film as a tool for spatial planning. Specifically considering the Flemish urbanized landscape, film might contribute to a new approach in spatial planning that could bridge the gap between theoretical concepts and everyday ways of living.

Understanding the everyday through cinematic imagination

Film as a mediator for spatial planning

In choosing film as the focus of this research, the intention is to engage with the everyday in a way that other forms of art might not fully achieve. Film's ability to dynamically represent urban environments, capturing the temporal and spatial dimensions of the human experience, makes it an ideal medium for exploring the social and cultural meanings embedded in everyday spaces. Furthermore, the cinematic imagination of cities in movies has been investigated in international academic studies highlighting various topics such as mapping urban spaces, identity, tourism, architecture, etc.[5] The focus of this study is on the mediating role between reality and theoretical discourses on contemporary landscapes, particularly for spatial planning purposes. Cinema's ability to represent, reflect, and interact with evolving spaces structures the exploration of its role for spatial planning.

First of all, film is a representational medium; by combining visual, spatial, and temporal elements, the moving image provides information about space. Cinema's capabilities to evoke the dynamics of space is a topic reaching back to an entire tradition in film and architecture theory. Amongst these, the architectural historian Siegfried Giedion recognized cinema's potential to covey the dynamism of space and movement. In his seminal work, *Mechanization Takes Command*[6], Giedion explored the impact of mechanization on everyday life and its relationship with film. Giedion noted that film's ability to capture movement and integrate sound and sight represents the culmination of full mechanization. His historiographical approach situates cinema within the broader evolution of mechanized representation, linking it to industrial rationalization and the alienation of human experience. Next to the depiction and representation of movement, the use of montage also enables to reflect the dynamism of space. The arrangement of sequencing of shots create a certain rhythm and equally enables to show different viewpoints and evoke complex meanings. Montage allows filmmakers to connect disparate spaces and moments, creating a dynamic experience of space that transcends linear time. Sergei Eisenstein, Soviet filmmaker and theorist, conceptualizes montage as a dialectical tool that generates meaning through the collision of images, thereby shaping the viewer's spatial and temporal understanding.[7]

Secondly, films are social constructs that reflect particular perspectives on the 'real' world. The narratives embedded in films shape and structure our understanding of space, framing the ways in which people experience and interact with their environment. Drawing on Henri Lefebvre's concept of lived space in *The Production of Space*,[8] this research acknowledges that space is not only defined by its physical form (perceived space) and its conceptualization by planners and architects (conceived space), but also by the lived experiences and expectations (lived space). While urbanists and architects focus on rationalizing space, lived space often remains outside their direct gaze. Thus,

understanding spatial environments through cinema requires going beyond mere representation to engage with the underlying imaginaries and everyday experiences that shape urban life.
Finally, film also has the power to shape public discourse on spatial issues. As AlSayyad[9] argues, cinema influences not only how we construct images of the world but also how we interact within it. Due to its accessibility and widespread reach, film can influence public opinion and behavior regarding urban environments. In understanding the role of film in the complex dynamics at play in this (co-)evolution of space and society, Latour's actor-network theory (ANT)[10] offers a relational perspective on to study the social as a hybrid of systems and the everyday. The manipulation of time and space through cinematic techniques - such as framing, editing, and montage - creates a complex narrative that engages viewers on multiple levels. This interplay between time, space, and narrative contributes to a more engaged and nuanced understanding of space as a relational construct, rather than a mere physical location. Cinematic perceptions, in particular the depiction of spatial environments in films, might represent, reflect and influence the evolutions of spaces as hybrids of the cinematic system (such as directing, celluloid, producing etc.) and the cinematic lifeworld (of the filmmaker, actors, contexts etc.). These perceptions then determine not only ideas about space, but also affect in return those who live and work in it. It becomes in fact an ongoing story of (cinematic) actant-networking about how we perceive, conceive and live space, paraphrasing Lefebvre. But even more, as much as film influences space, film itself is shaped by space and cannot exist without it; the interaction between film and space, actants and networks, becomes hybrid in itself.

Cinematic approach

Grounded on the notion of film as a representation, reflection of social constructs, and mediator between system and the everyday lived space, and building on recent research,[11] the investigation of cinematic perceptions of the Flemish urbanized landscape analyzed the representation of the everyday (reading space), the strategical reflection on visual and temporal imaginaries of space (socially constructing space) and the interactive dimension (mediating space) in a selection of six contemporary fiction films. The first part involved an in-depth spatio-morphological film analysis (using the video annotation software ELAN[12]) to discover the prevailing cinematic representations of the Flemish urbanized landscape. This was done by indicating different spaces, the way they are portrayed and the relation to the storyline of the movies, and resulted in schematic representations that can be defined as the spatial inventory of each movie. Based on this analysis of spatial representations, the next step examined the (inter)subjective expressions of spatial-sociocultural themes in relation to the stylistic effects evoked by the use of editing, light, color, sound, optics, and so on. Through semi-structured bilateral interviews with the directors of the selected films, the intentions and reflections on these imagined spaces became clear. In the final part, moderated film sessions with stakeholders investigated the role of film in spatial planning. Discussions with the panel and audience were used to understand how these films shape our perceptions, influence our sense of place, and mediate our relationship with depicted environments. This was done based on a grounded theory approach[13] that adopted a systematic process of open and selective coding on the recorded and transcribed discussions.
Six contemporary Flemish fiction films, so-called 'film d'auteur', were selected in this first investigation of film's possible mediating role in spatial planning. *Steve+Sky,*[14] *Carlo,*[15] *Fucking Suburbia,*[16] *Kid,*[17] *Violet,*[18] and *Home*[19] stood out in their contemporary and contextual view of specific spatial themes in the Flemish urbanized landscape; namely ribbon development along arterial roads and low-density residential areas in suburban regions. These spatial topics define Flemish dispersed settlement and the accompanying challenges and thus served as a substantive selection criterium. Next to that, more formal criteria, including the release date after 2000 and the focus on

fictional feature films, had to preserve the contemporaneity of the images and the artistic reflection on the topics.

SCREENING THE FLEMISCH URBANIZED LANDSCAPE

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.

Motorway spaces

The first topic focuses on motorway spaces, more specific on the typical Flemish roadside ribbon landscape of housing and commercial functions that developed along these arterial traffic connections between cities. These environments face issues such as high utility costs, ribbon development, traffic jams, pollution, and so on, making them problematic for planners. Nevertheless the films *Steve+Sky*, *Carlo* and *Home* highlight the significance of the roadside ribbon landscape, where brothels, gas stations, and big stores populate the built environment along the road.

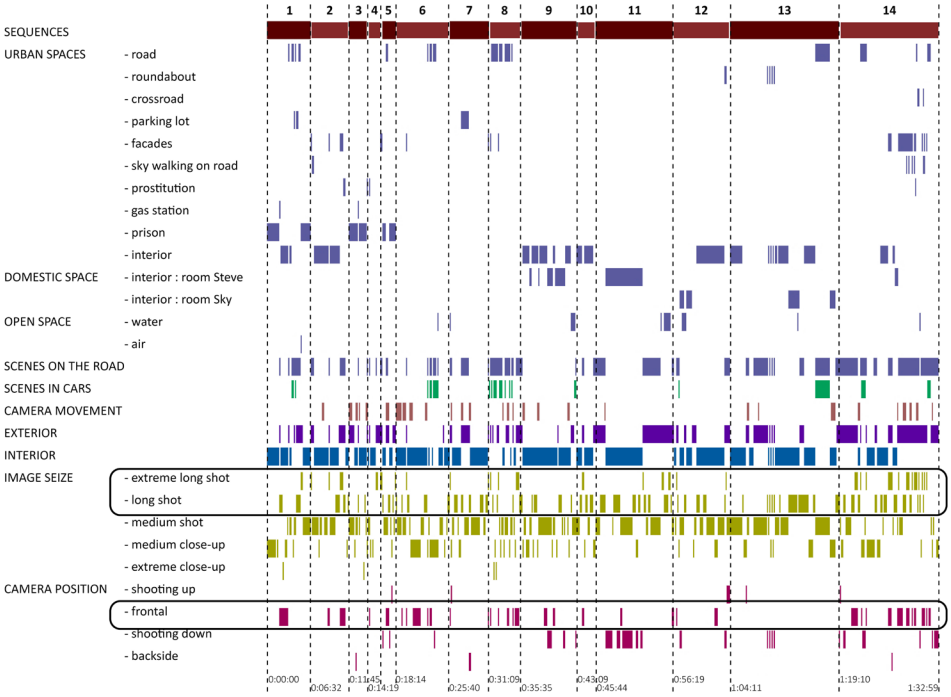

Figure 1. visualization of the spatial structures (top) and camera-settings (bottom) in relation to the sequences and storyline in Steve+Sky – ELAN

A detailed analysis of the cinematic portrayal revealed these spaces as generic environments that, despite lacking a distinct identity, define specific subcultures and characters. Figure 1, the spatial inventory of the movie *Steve+Sky* shows, amongst others, a recurring structure of static, frontal long shots and extreme long shots in *Steve+Sky* that captures the isolated buildings along the road. The image seize, a long shot captures the subject in its entirety and an extreme long shot shows a vast expanse of the setting from a considerable distance, contributes to the prominence of these buildings. In this movie, the gas station and brothel emerge as defining environments, revealing the connection between theses spaces and the protagonists. (Figure 2)

Figure 2. Steve+Sky – still 0:06:39 – still 0:10:50 – still 0:25:43 – still 0:34:52

The cinematic social construct reflects a dual narrative of no-man's land and connection. The motorway spaces are portrayed as liminal areas where protagonists find themselves stuck, evident in *Steve+Sky*, and to a certain extend also in *Carlo*. The deliberate framing of these spaces emphasizes their interconnected nature, both formally and symbolically. In the portrayal of the (arterial) road, *Steve+Sky* stands out as a film where the motorway serves as a central space, connecting characters and places. The opposition between the slow, deliberate movements of Sky and the fast-paced activities of Steve adds depth to the narrative, reaching an apotheosis in the final scene. The roundabout becomes a symbolic element, emphasizing the cyclical nature of Steve's life. (Figure 3) Director Felix Van Groeningen's attention for these spaces illuminates the characters' inner states and amplifies their experiences. The seemingly ordinary locations along the arterial road become meaningful elements in the narrative, contributing to character development and storytelling.

The representation of arterial roads also unravels a narrative of connection. Van Groeningen employs the motorway in *Steve+Sky* both formally and symbolically, physically knitting characters and spaces together and uniting the protagonists in a tender love story. The music soundtrack, particularly the song *Beats of Love*, reinforces this theme of connection. In *Carlo*, the road serves as a crucial, connecting element both physically and symbolically, defining the characters' interactions and shaping their destinies.

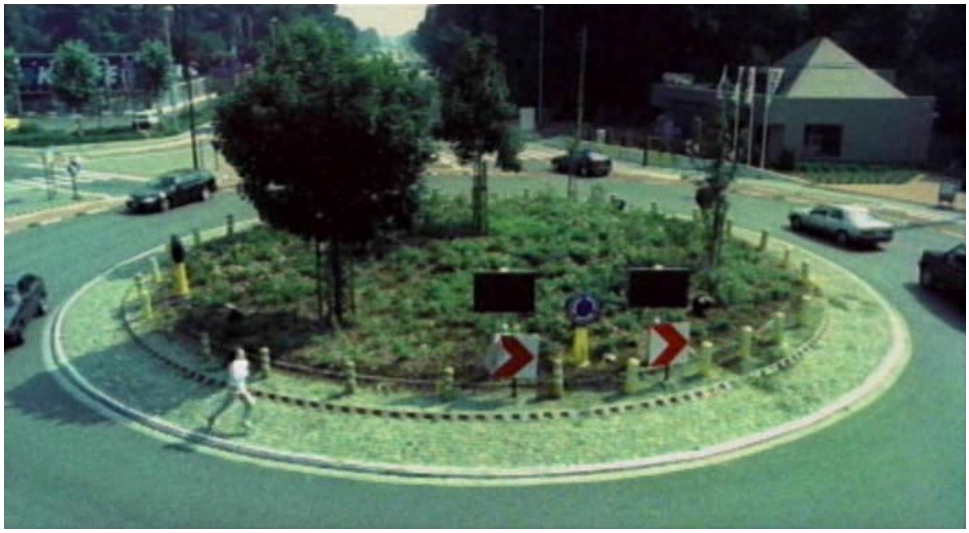

Figure 3. Steve+Sky – still 1:03:49

Suburban spaces

Typical low-density suburban neighborhoods, composed of detached single-family houses, became the dominant form of urbanization in Flanders. As mentioned in the introduction, this dispersed, space-consuming building pattern does not stroke with current densification efforts and the envisaged building shift.

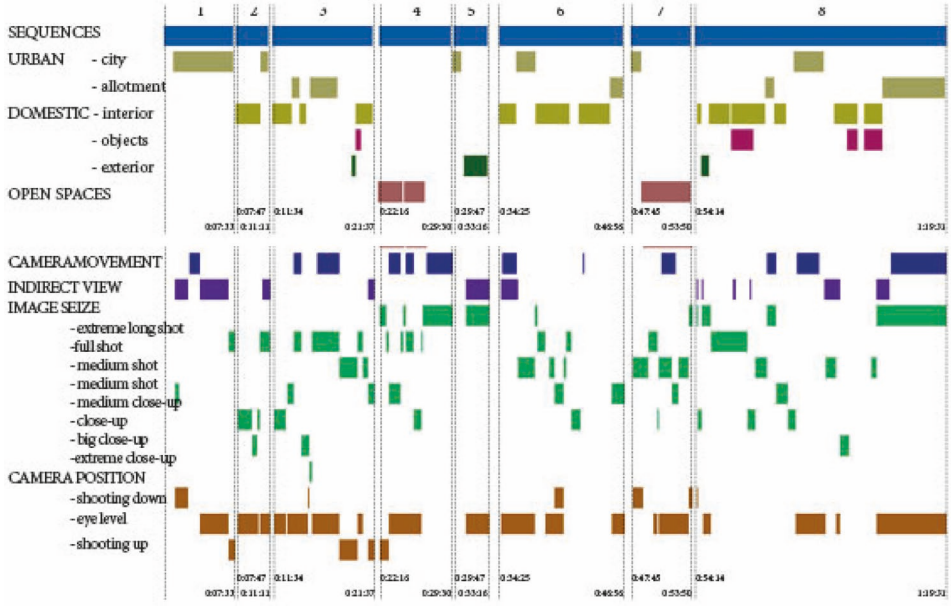

Figure 4. visualization of the spatial structures (top) and camera-settings (bottom) in relation to the sequences and storyline in Violet – ELAN

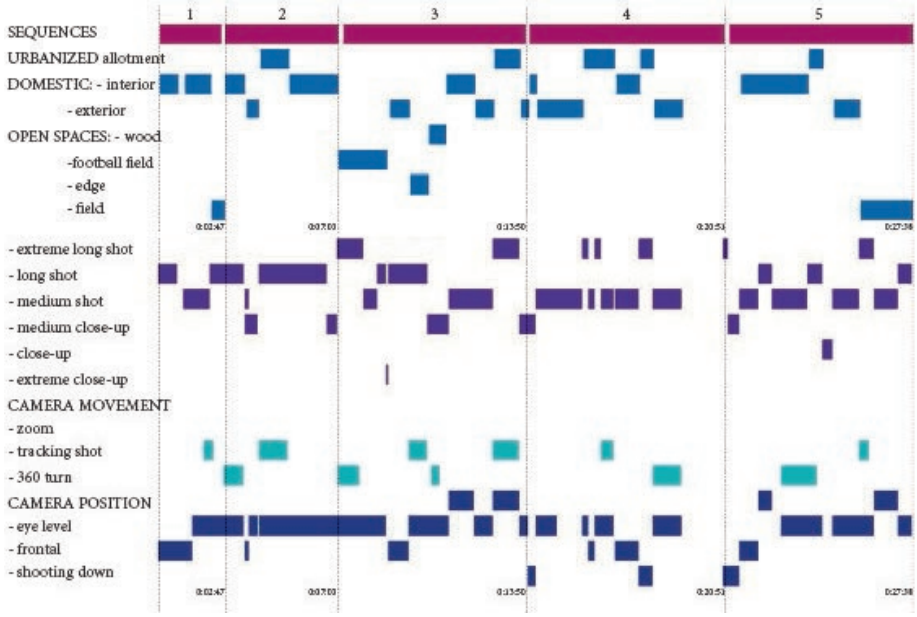

Figure 5. visualization of the spatial structures (top) and camera-settings (bottom) in relation to the sequences and storyline in Fucking Suburbia – ELAN

In contrast, the cinematic exploration of suburban spaces offered an aesthetically styled view on the streets, individual houses and interiors of these neighborhoods. Through the extensive use of long takes - shots that have a long duration, indicated by the bigger colored blocks on the schematic representations - predominantly empty streets are presented in *Violet* (Figure 4) and *Fucking Suburbia* (Figure 5). Next to that, the frontal images of facades with front yards, as displayed in Kid, emphasize the individuality of single-family houses. (Figure 6) Moreover, the schematic representation of *Violet* also reveals a specific structure in the movie that is connected or associated with specific places. The opening sequence, for instance, takes place in a random shopping mall, not indicate the city. This environment is portrayed as unsafe since the protagonist's friend, a harmless teenager, is randomly stabbed in this scene. The rest of the film is mainly set in a suburban residential neighborhood, depicted as quiet, safe space for this youngster trying to deal with his grief. (Figure 7) The overall static camerawork is replaced with a handheld camera in *Home* (Figure 8), a movie that relies on interior shots to portray a suburban lifestyle. Teenagers are represented on these deserted streets but also in relation to the hybrid outdoor spaces on the outskirts of suburbia, like the forest, the skate-park or the parking lot of the supermarket.

Figure 6. Kid – still 0:48:55

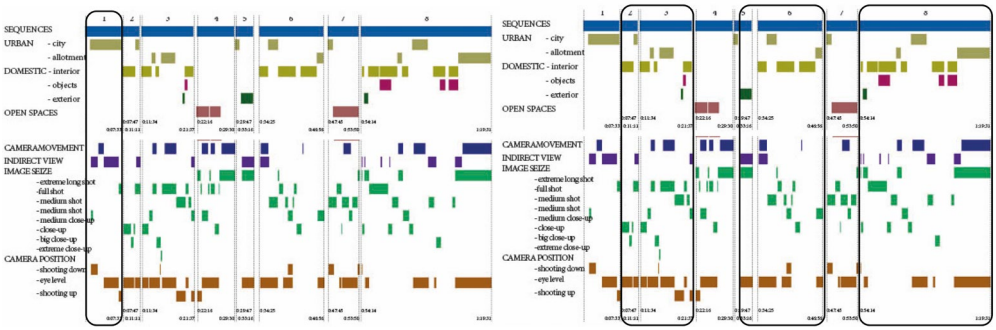

Figure 7. Violet – opening sequence in the city – sequences in the suburban neighborhood

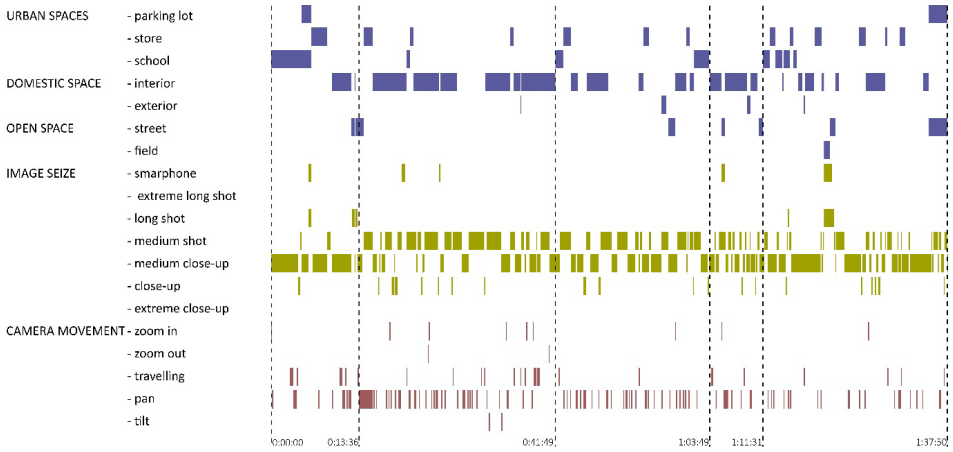

Figure 8. visualization of the spatial structures (top) and camera-settings (bottom) in relation to the sequences and storyline in Home – ELAN

In terms of social construct, the selection of films consistently depicts suburban spaces as enclosed, safe worlds. In *Violet*'s depiction of suburbia, the neighborhood is foremost portrayed as the main character's safety net. *Fucking Suburbia* even indicates suburbia as an idealized location for children and undisturbed families. The well-maintained appearance symbolizes stability, also in *Kid* and *Violet*. However, this stability evokes also feelings of boredom and stagnation.

The cinematic mediation, as demonstrated through the filmic debate evening, highlighted the experience of suburbia. Debates on the quality of life were linked with a perceived tranquility through silence and empty streets in the fragments. Furthermore, the reflections illuminated a central age-related experience, especially considering the different positions of teenagers and adults regarding their environment. Apparently teenagers don't find their place within the confines of suburban neighborhoods. The impact of individualization on suburban dynamics emerged as another factor in the atmosphere of the fragments.

CONCLUSION

This study of six fiction films demonstrates how cinema can broaden our view of urban landscapes by shedding new light on typical Flemish themes such as motorway spaces and suburban neighborhoods. Films draw attention to everyday spaces and their use by specific groups, challenging mainstream perceptions of these spaces. The cinematic images highlight what is valued in these landscapes and reveal the versatility of the urbanized landscape.

More specifically, the way these motorway spaces appear in the films showcases the power of cinema in shaping our perception of these spaces. By situating these stories along these motorways, in combination with their portrayal as symbolic landscapes that contribute significantly to the narrative depth and character development, these spaces are acknowledged and even appreciated as important and valuable places. Moreover, this cinematic perspective demands attention for these specific spaces and the (marginalized) groups that inhabit them, also spatial planners need to recognize, acknowledge and include not only these places but also the marginalized subcultures. The prevailing discourse often fixates on the negative repercussions of car dominance and sprawled developments along these roads, focusing on issues such as environmental degradation, safety concerns, and public health impacts. Yet, amidst this dialogue, the non-urban lifestyle that thrives along arterial roads is frequently overlooked. The films made clear that these spaces represent more than mere conduits for transportation; they serve as habitats and social hubs for marginalized groups often relegated to the peripheries of societal consciousness. As we confront the planning challenges posed by motorway landscapes, it becomes evident that a narrow technocratic approach is insufficient. While these spaces demand organization and infrastructure, they also necessitate a recognition of the diverse human experiences they encompass. The commonplaces and cultures that flourish along motorway corridors are integral to the fabric of our society, deserving of inclusion and consideration in the planning process. In essence, the cinematic portrayal of motorway spaces serves as a catalyst for reevaluating our perceptions and priorities in urban planning. It prompts us to expand our conceptualization of public spaces, embracing the multiplicity of experiences and identities that intersect within them.

Moreover, also the observations on the suburban neighborhoods in the selected movies underscore the importance of understanding how people relate to their surroundings, especially considering their residential place. The cinematic narratives made clear how suburban environments are perceived and experienced differently by different age groups. While suburban areas may be regarded as secure spaces that offer stability, especially for families with children growing up, other age-groups may not appreciate these qualities as much. For instance, in this selection of movies, teenagers seek places away from their families, while the perspective of the elderly age-group is and their experience of suburban environments is not represented. Furthermore, the cinematic portrayal of suburban life highlights how the everyday meaning of these places goes beyond issues of density, car-dependency, or energy consumption. Instead, it delves into more subjective and dramaturgic aspects, influenced by individuals' age and personal experiences. This underscores the importance for spatial planners to incorporate age-related perspectives into their decision-making processes, ensuring that residential environments are inclusive and responsive to the diverse needs of their inhabitants.

These insights make it clear that film can offer a new approach to spatial planning practice, they are an excellent tool at the analytical stage in a planning process providing an accelerated understanding of complex situations. In the social constructions of films, multilayered interpretations emerge that offer new planning insights. Moreover, films serve as mediators that contribute to cultural awareness, spark discussions, and inspire planners to create innovative approaches and concepts. As such, the moving image serves as a platform for interdisciplinary dialogue between planners, policymakers, architects, and other stakeholders.

Film not only facilitates an understanding of everyday urban life (reading space) but also enables critical reflection on spatial imaginaries (socially constructing space). Moreover, through its narrative and visual dimensions, cinema has the potential to shape planning actions, integrating lived experiences into systematic approaches (mediating space). These three cinematic functions—representation, reflection, and mediation—offer a methodological framework for understanding where, when, and how the cinematic gaze can contribute to spatial planning. By incorporating cinematic perspectives, planners can adopt a more engaged, dynamic, and responsive approach to the complexities of urban and suburban landscapes.

NOTES

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[2] Vlaanderen, Omgeving. *Beleidsplan Ruimte Vlaanderen: Strategische Visie*.(2018).
[3] Ann Pisman, et al. *Ruimterapport Vlaanderen (RURA)*. (2019); Ann Pisman, et al. *Ruimterapport Vlaanderen 2021*. (2021).
[4] such as in 2019 at a speed of 6,4 hectares a day, RuimteRapport 2019
[5] See, among others, Nezar AlSayyad, *Cinematic Urbanism: A History of the Modern from Reel to Real* (London: Routledge, 2006); Iain Borden, *Drive: Journeys Through Film, Cities and Landscapes* (London: Reaktion Books, 2013); Tony Fitzmaurice and Marc Shiel, *Cinema and the City: Film and Urban Societies in a Global Context* (Oxford: Blackwell, 2001); Julia Hallam, "Film, Space and Place: Researching a City in Film," *New Review of Film and Television Studies* 8, no. 3 (2010): 277-296; Richard Koeck and Les Roberts, *The City and the Moving Image: Urban Projections* (Springer, 2010); Chris Lukinbeal and Elisabeth Sommerlad, "Doing Film Geography," *GeoJournal* 87, no. 1 (2022): 1-9; François Penz, *Cinematic Aided Design: An Everyday Life Approach to Architecture* (Routledge, 2017).
[6] Sigfried Giedion, *Mechanization Takes Command: A Contribution to Anonymous History* (New York: Oxford University Press, 1948).
[7] Sergei Eisenstein, *Film Form: Essays in Film Theory* (Boston: Houghton Mifflin Harcourt, 2014).
[8] Henri Lefebvre, *The Social Production of Space* [La production de l'espace] (Oxford: Blackwell, 1974).
[9] Nezar AlSayyad, 2006. *Cinematic urbanism : a history of the modern from reel to real*. (London: Routledge, 2006),1.
[10] Bruno Latour, *Reassembling the Social: An Introduction to Actor-Network-Theory* (Oxford: Oxford University Press, 2005).
[11] Annelies Staessen, Antonio José Salvador, and Ingfrid Lyngstad, "An Exploration of Artistic Expressions of Everyday Peri-Urban Landscapes as a Method of Socio-Spatial Analysis in Spatial Planning," *Architecture* 4, no. 1 (2024): 124-147; and Annelies Staessen, and Luuk Boelens, "Framing Daily Life in Sprawl: Flanders Urbanized Space from a Cinematic Perspective," *European Planning Studies* 31, no. 3 (2023): 621-640; and Annelies Staessen, and Luuk Boelens, "Once Upon a Time in Open Space: Cinematic Spatial Narratives of Flemish Urban Landscapes," *disP-The Planning Review* 60, no. 2 (2024): 6-22.
[12] As a professional tool, the computer software ELAN allows to manually and semi-automatically annotate and transcribe audio or video recordings. For more additional information on the software see https://archive.mpi.nl/tla/elan. For this research, version 5.9 was used to segment the films in tiers according to thematic subjects and add descriptions.
[13] Anselm Strauss and Juliet Corbin, *Basics of Qualitative Research Techniques* (Thousand Oaks, CA: Sage, 1998).
[14] *Steve + Sky* (Film, directed by Felix Van Groeningen, Belgium: Kinepolis Film Distribution, 2004).
[15] *Carlo* (Film, directed by Michaël R. Roskam, Belgium, 2004).
[16] *Fucking Suburbia* (Film, directed by Jeff Otte, Belgium, 2012).
[17] *Kid* (Film, directed by Fien Troch, Belgium, Netherlands, Germany, 2012).
[18] *Violet* (Film, directed by Bas Devos, Belgium, 2014).
[19] *Home* (Film, directed by Fien Troch, Belgium, 2016).

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INTEGRATING EYE-TRACKING AND IMMERSIVE VIRTUAL ENVIRONMENTS FOR INFORMED CO-URBAN DESIGN DECISION-MAKING PROCESS THROUGH ENHANCING PEDESTRIAN COMFORT, SAFETY, AND PERCEPTUAL QUALITY

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INTRODUCTION

In the evolving discourse on urban design and planning, the integration of human-centred technologies has emerged as a critical area of exploration, particularly in the context of the post-digital era. Urban built environments are dynamic spaces shaped by human perception, interaction, and lived experience. Architects and urban designers strive to develop a built environment that not only meets functional requirements but also resonate with users on an emotional and perceptual level.[1] However, a persistent challenge in urban planning is the difficulty of quantifying and incorporating the subtle, subjective experiences of individuals into practical evaluations of urban spaces. This challenge becomes particularly significant when employing methodologies such as eye-tracking and immersive virtual environments, where interpreting real-time visual engagement and behavioural responses is crucial for obtaining accurate and actionable insights.

For practical planning decisions, the conclusions drawn from the qualitative feedback may not always be sufficiently detailed. Moreover, non-expert users often lack the appropriate professional vocabulary to articulate what they find interesting or disturbing in the structure and elements of the urban environment.[2] To address the communication gap in urban planning, we apply technology used in landscape planning to capture human perceptions of the built environment. This provides detailed insights from non-experts, crucial for practical planning. Eye-tracking offers objective data on visual attention, bridging subjective experience and quantitative needs. Considering both environment and user context, we compared how professionals and residents view urban plans, identifying perceptual differences to tailor design solutions for all. This clarifies what attracts attention, guiding urban interventions.

Attractiveness is key to perceived livability. Traditional qualitative methods lack detail for planning. Eye-tracking provides objective insights into attention patterns, revealing what defines urban design quality from non-experts' perspectives. Urban physical characteristics (complexity, differentiation, visibility) influence wayfinding. Visibility is crucial for pedestrian navigation, and visual space perception is central to spatial experience, with design impacting perceived quality.[3]

This research seeks to leverage eye-tracking data and immersive VEs to enhance our understanding of pedestrian preferences and improve urban design decision-making. The study is guided by the following key research questions:
Which elements of urban streetscapes influence pedestrian users to choose a route based on attention data?
Based on the route choice decisions, what elements are missing in the alternate routes that influenced participants to avoid other ways?
How much change occurs in the attention data based on specific modifications in urban design elements in VE?

Perceptual and behavioral understanding

Individuals possess internal mental models, or schemas, derived from past experiences, which shape their interactions with the present environment. When encountering a familiar urban setting, individuals draw upon these schemas to guide their behavior and perceptions.[4] Through the eye tracking method, we tend to investigate the behavior and perception of individuals into the following measures.

Measuring walkability

Some important insights related to measuring walkability through perceptual and behavioral analysis have been incorporated in previous research.[5] It finds that Pedestrians engage more with ground floors, with visual focus differing between street types. Well-designed pedestrian environments enhance visual interaction and walkability.
Walkability is influenced by pedestrian/vehicular space ratios, greenery, and street furniture. Greenspace correlates with perceived visual quality and encourages outdoor activity. Eye-tracking shows pedestrians focus on visually engaging elements, suggesting attention-catching urban design for walkability.[6]

Measuring Attraction

There is a difference between active and reactive behaviors in movement, suggesting that pedestrians exhibit a mix of inherent exploratory tendencies (active motion) and responses to environmental stimuli (reactive motion). The presence of attraction points—defined as locations or stands that capture attention—plays a crucial role in guiding pedestrian flow.[7] Through eye tracking in this research, we tend to measure the environmental stimulus that attracts pedestrians and influence their route choices.

Environmental Preference

Pedestrian environmental preferences vary by neighborhood type. In pedestrian-oriented areas, walkability, transit access, and outdoor opportunities are prioritized for utilitarian walking. In automobile-oriented areas, walkway continuity, shade, and scenery are valued, with walking often for exercise or socialization. Personal conditions (safety, energy, desire to be outside) are crucial for all walkers, suggesting combined environmental and personal influences.[8]

CASE STUDY

The empirical study was conducted in Downtown Greensboro, North Carolina, United States of America, selected for its diverse environmental composition, active pedestrian corridors, and accessible streetscapes. Since the early ‘90s downtown Greensboro has been supporting the city’s brand, innovation and tax base. The City of Greensboro authority’s vision is to make the streetscapes

of Downtown Greensboro safe, comfortable, and well-connected; an integrated network of multi-modal streets stitches together a diverse mix of destinations that contribute to vibrant street life for a wide range of users and fosters a unique sense of place that celebrates Greensboro's history and culture.[9] The aim of this study is to analyze people's attention and visual connectivity of the streetscapes of downtown Greensboro. To perform the research, we selected a location in the downtown Greensboro area which can be used by most pedestrian activity.

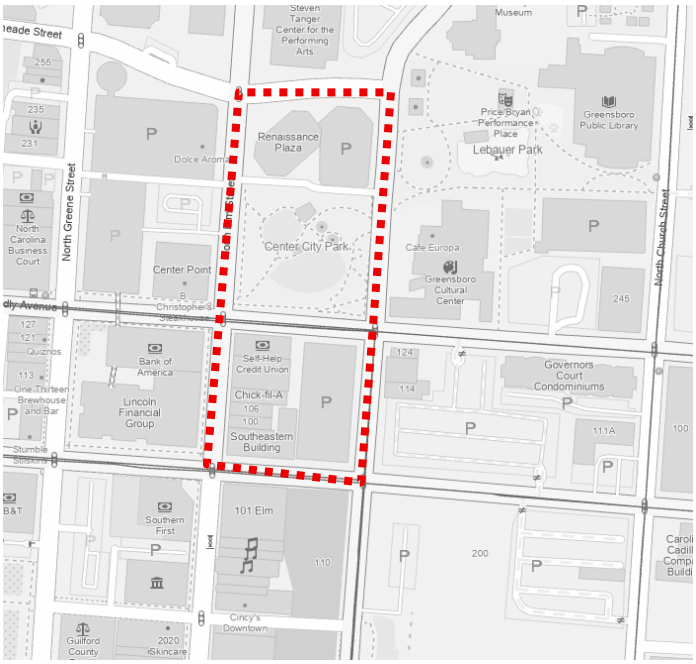

Figure 9. Location map of the study area used

This study analyzes visual attention and connectivity in downtown streetscapes using eye-tracking. Examining pedestrian engagement in this mixed-use area aims to identify elements of engaging and functional urban environments, understanding how design impacts perception and behavior.

RESEARCH METHOD

This multi-phase framework explores the relationship between urban environments, pedestrian cognition, and walkability, integrating real-world observation and virtual environment evaluation to inform urban design.

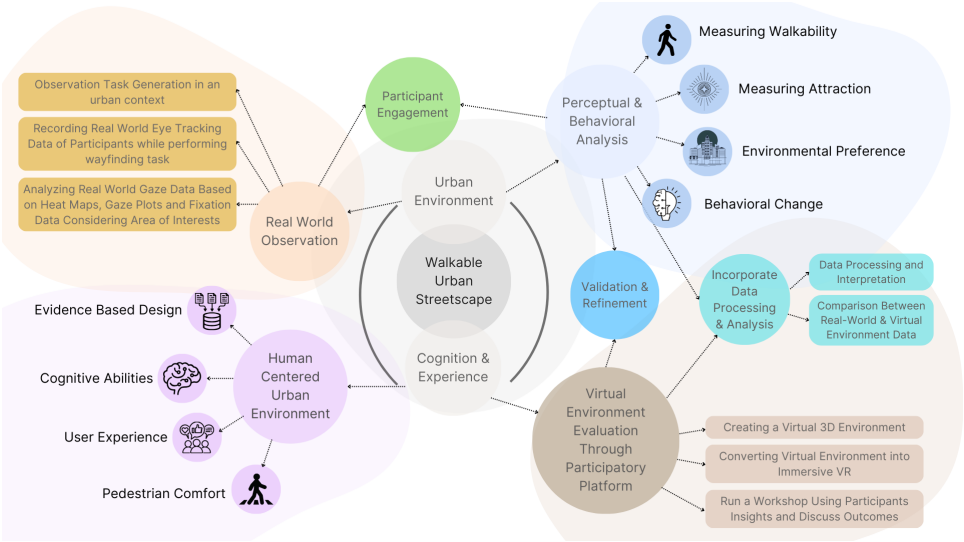

Figure 10. Research Framework

Phase One: Real-World Observation

The Real-World Observation phase forms the foundation of the research by studying pedestrian behaviour and cognitive responses in urban environments. This phase focuses on collecting and analyzing real-world data to understand how participants navigate, perceive and interact with their surroundings. The insights gained here serve as the baseline for design interventions in subsequent phases.

The methodology for this phase includes task design, participant recruitment (10 person) and data collection followed by data analysis.

Observation Task & Data Collection

The observation task simulated real-world urban navigation and wayfinding in a mixed-use area, exploring pedestrian behavior at intersections, crosswalks, sidewalks, and open streetscapes. Participants from diverse demographics walked a route, and their behavior and eye-tracking data were recorded.

Demographic & Behavioral Data

Before the navigation task, the demographic information of each participant was collected. The major demographic data that has been considered are age, gender, and height. Each participant has been observed from a distance to record their navigation route especially the decision they are making in the critical points like crossing the streets and passing other vehicle or pedestrian. Environmental factors such as weather conditions were also recorded to understand their impact on participant's behaviour.

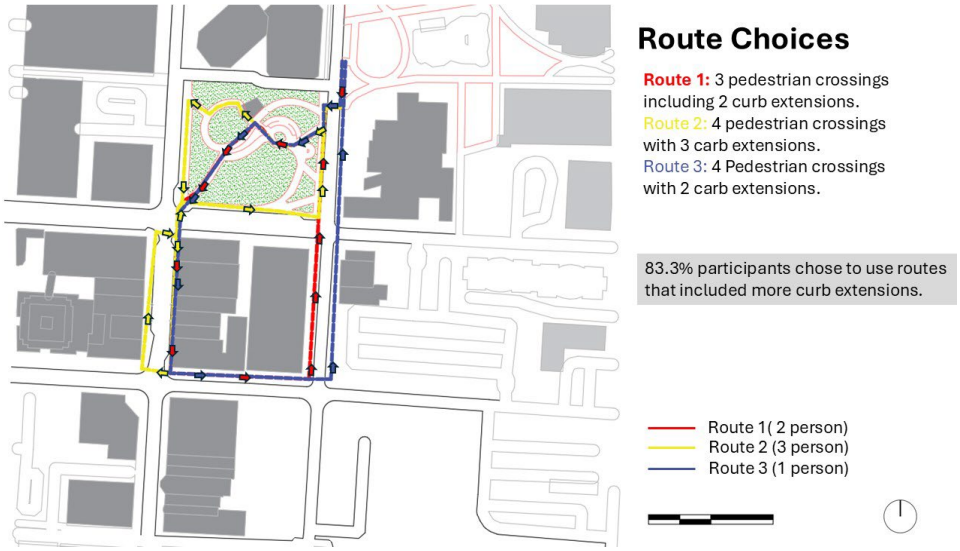

Figure 11. Route choices

Eye-Tracking Data

Participants were provided wearable eye trackers (Tobii glasses3) to record their gaze data. Their gaze has been recorded throughout their travel time.

Data Analysis

Data from the real-world observation phase is extracted in analytical format using the Tobii pro lab. Different patterns and insights are examined from the data.

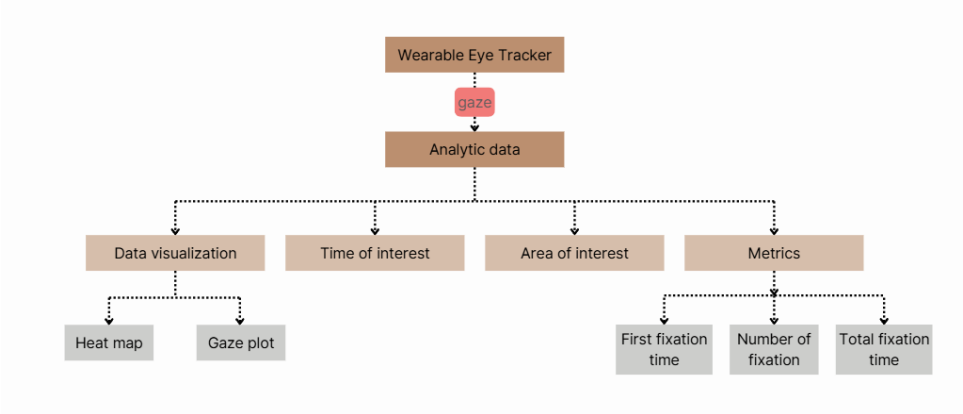

Figure 12. Data Segmentations

From the analytic data, the major insights are data visualization, Time of Interest (TOI), Area of Interest (AOI), and Metrics. Data visualization is examined in the format of heat maps and gaze plots, whereas the metrics data are explored in different formats like first fixation time, number of fixations, and total fixation time. The collected data were classified into 7 different data classes and the AOI has been generated accordingly.

Areas of Interest (AOIs) are classified into seven categories:

Group	Classes
Flat	Road, sidewalks, parking, rail track
Human	Person, rider
Vehicle	Car, truck, bus, motorcycle, bicycle
Construction	Building, wall, fence, guard rail
Object	Pole, traffic sign, traffic light
Nature	Vegetation, terrain
Sky	Sky

Table 2. Data Classes

AOI-based analysis compares gaze data across these categories to extract insights on visual attention and navigation behaviour.

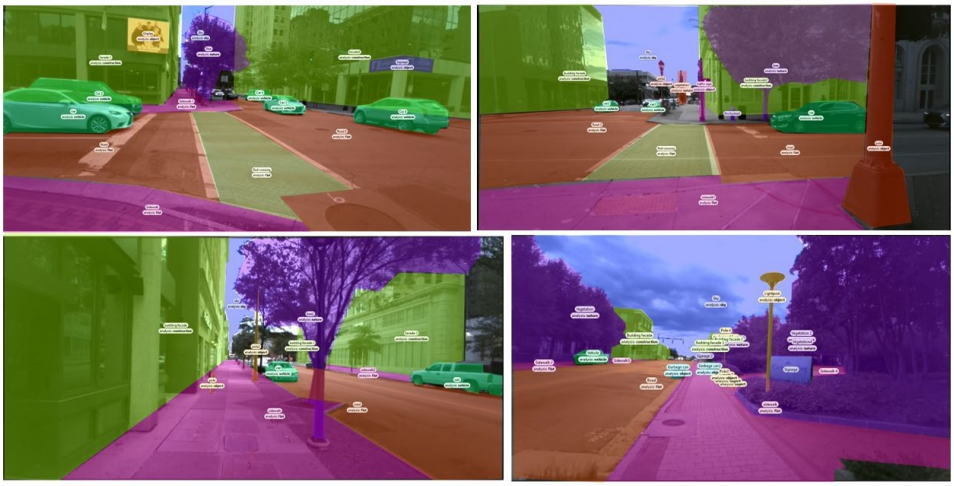

Figure 13. AOI segmentation in different locations.

Phase Two: Measuring the Key Parameters

This phase serves as a bridge between the real-world observation and the virtual design evaluation. The focus was to quantify the key indicators of pedestrian experience, behaviour and environmental quality in walkable urban streetscapes. To evaluate attraction factors, measuring how effectively urban features (e.g. landmarks, green spaces, or signage) draw attention and contribute to wayfinding.

Phase Three: Virtual Design Evaluation

In this phase, an immersive virtual environment (VE) was used to analyze how pedestrians interact with different urban design interventions. The goal is to assess how changes in the built environment influence visual attention, spatial perception, and overall pedestrian comfort and safety. In this phase, real-world data collected in earlier phases are used and integrated into a controlled, interactive virtual setting.

Development of the Virtual Environment

Satellite imagery was converted into 3D meshes using Blender and Unity, and the virtual model was integrated into Spatial.io to create an interactive metaverse space. The streetscape includes key pedestrian infrastructure, street elements, and environmental conditions observed in the real-world study.

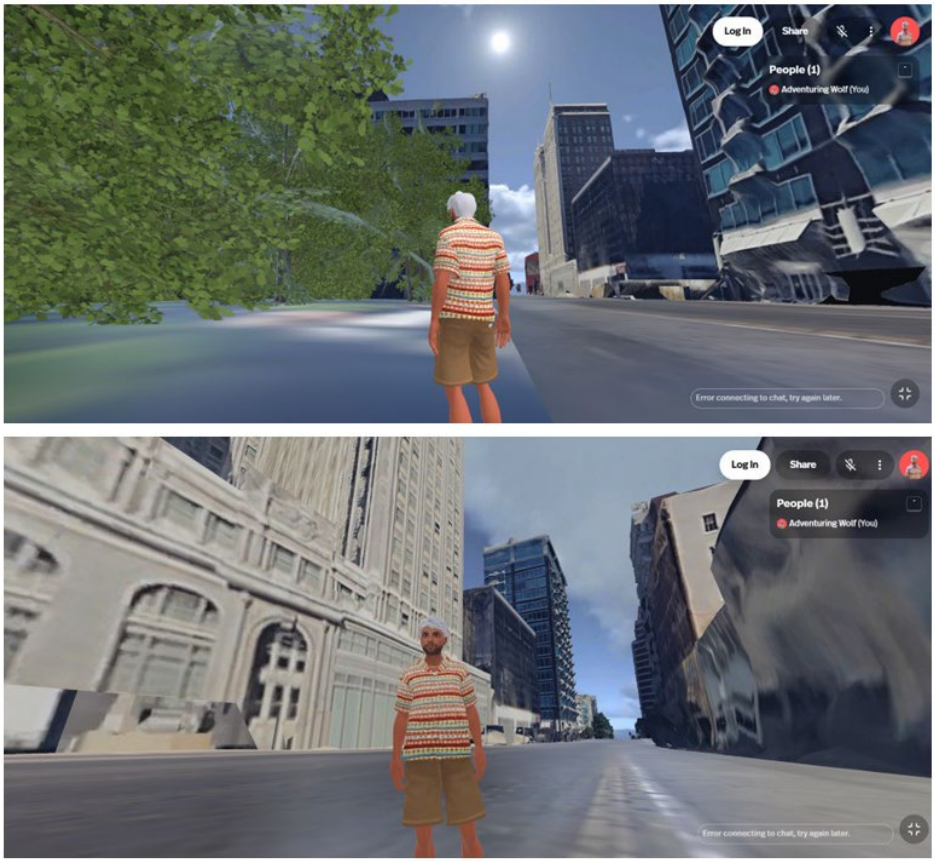

Figure 14. Virtual Environment in a Metaverse Space

Participant Engagement in the VE

Participants used Meta Quest Pro VR headsets to navigate the virtual streetscape while enabling eye tracking to record gaze behavior. The task replicates real-world pedestrian movement, allowing for a direct comparison between physical and virtual interactions.

Comparative Evaluation and Perceptual Quality Matrix

Real-world and virtual data were analyzed to validate perceptual differences. A Perceptual Quality Matrix was developed based on fixation metrics, categorizing urban elements by their impact on pedestrian safety, comfort, and visual appeal.

RESULTS OF THE EYE TRACKING

Focus Heat Map

A focus heat map is an effective method for presenting eye-tracking results in a clear and concise manner, as it uses color shading to indicate the level of attention and fixation received by different elements within the scene. Darker areas, particularly those highlighted in red and orange, represent higher levels of attention from participants.[10] In this study, each focus heat map was generated by collecting eye movement fixation data over a duration of 7s for each streetscape scenario. The calibration and computation were performed using Tobii Pro Lab to ensure accurate measurement of the gaze distribution across different urban design elements.

Figure 15. Focus heat maps.

Heat maps showed high fixations on crosswalks, curbs, vegetation, and buildings. In crossings, attention focused on curbs and markings, with curb presence altering gaze (more traffic focus without curbs). Vegetation and shade also drew attention, supporting the positive impact of green infrastructure.[11] However, vegetation placement and density may also play a role in determining its effectiveness in influencing pedestrian behaviour.

AOI Based Results

The eye-tracking data collected during this study provides a quantitative understanding of pedestrian visual attention in different urban design scenarios. The key parameters analyzed include duration of fixations (DF), number of fixations, number of glances and average pupil diameter, each of which offers insights into how pedestrians engage with various streetscape elements.

AOI Class	Avg. duration of fixations (ms)	Min duration of fixations (ms)	Max duration of fixations (ms)	Number of Glances	Number of fixations	Number of Visits	Avg Pupil diameter (mm)
construction	10,617	6,189	18,936	132	207	132	125.06
Flat	13,518	9,969	19,251	248	443	248	164.50
nature	11,289	7,266	16,713	79	108	79	112.77
object	4,590	4,269	4,932	32	33	32	35.42
sky	1,626	1,020	2,523	20	39	20	31.24
vehicle	3,846	2,463	5,169	35	39	35	50.52

Table 3. Results of AOI-based eye tracking indicators

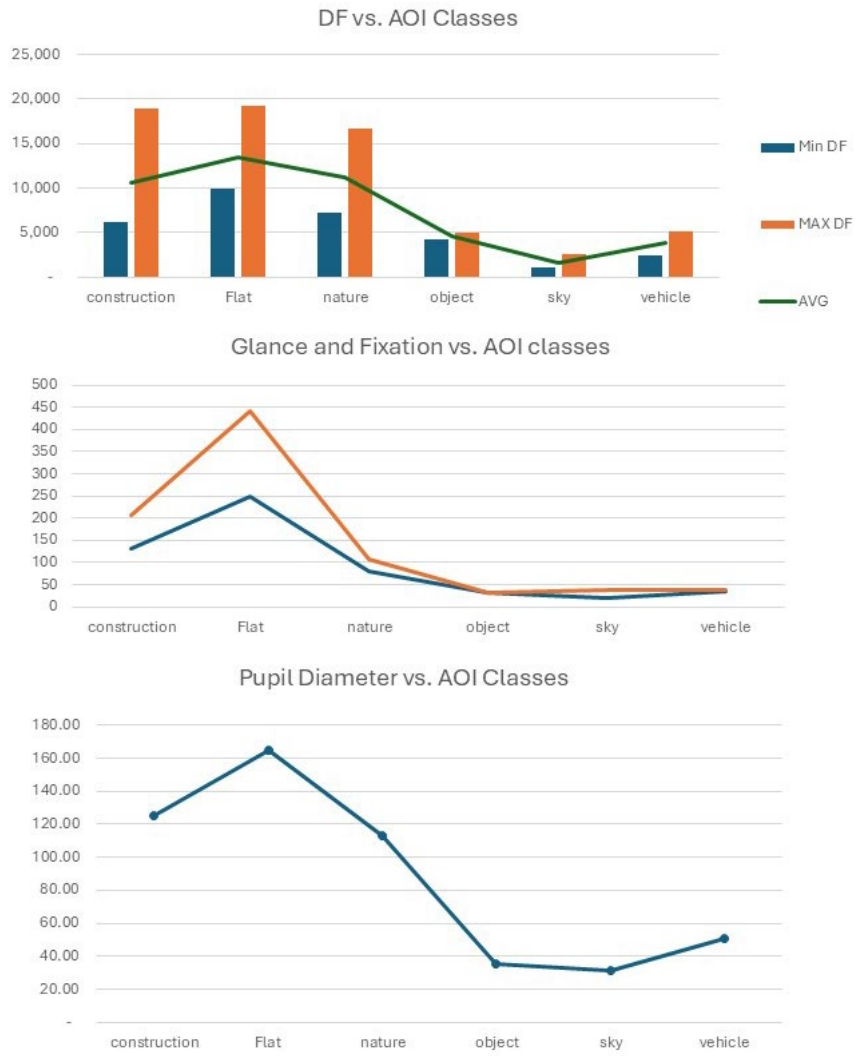

Figure 16. AOI Based Results

"Flat" and "construction" AOIs had the longest fixations, most glances/fixations, and highest visit frequency, suggesting greater visual engagement and cognitive processing. Visits decreased from "flat/construction" to "nature," "object," "vehicle," and lastly, "sky," indicating a hierarchical pattern of interest.

Gender-Based Results

The data is visualized using a stacked histogram with kernel density estimate (KDE) curves overlaid, allowing for comparison of both the frequency and distribution shape of first glance times between the two genders.

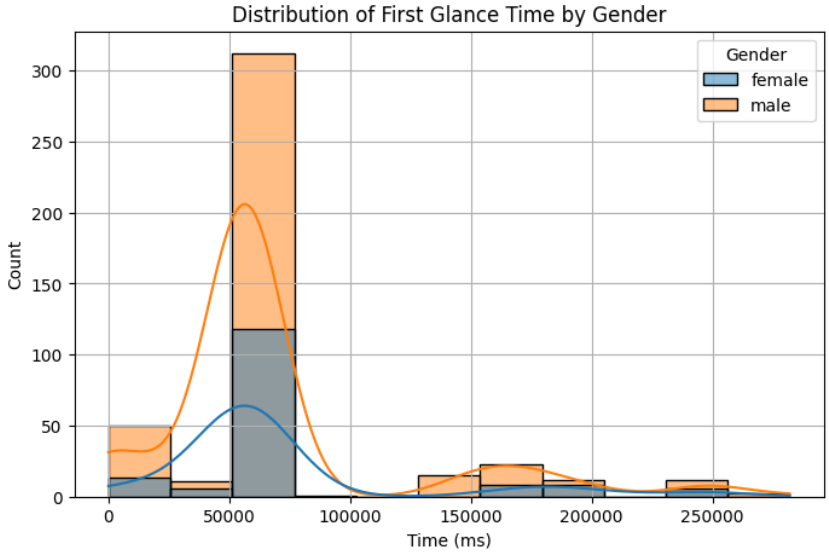

Figure 17. Gender Based Distribution of First Glance

The histogram reveals a bimodal distribution of first glance times, suggesting two distinct patterns of initial visual attention. This bimodality is noticeable for both genders, although it is more pronounced in males. This could indicate that participants either responded very quickly to a stimulus or required a significantly longer time for their first fixation.

FUTURE RESEARCH

This study lays the groundwork for a deeper understanding of human cognition and perception within urban environments, specifically focusing on the influence of visual attention. However, several avenues remain unexplored and offer exciting possibilities for future research. The primary direction involves extending this investigation into immersive virtual environments (VEs). Comparing responses across VEs with varying degrees of fidelity will help determine the critical factors for creating ecologically valid virtual environments for perception research.[12] Furthermore, this research will contribute to the validation and refinement of using VEs as powerful tools for investigating complex perceptual phenomena, paving the way for more innovative and impactful research in the fields of urban planning, architecture, and environmental psychology.

DISCUSSION

Using eye-tracking in real and virtual environments, this study investigated pedestrian perception and behavior, revealing how design elements influence visual attention, route choice, and overall experience.

The heat maps (Figure 6) revealed distinct areas of focus within the streetscape scenarios. As anticipated, key pedestrian infrastructure elements such as crosswalks, curbs, and sidewalks attracted significant visual attention, indicating their crucial role in guiding pedestrian movement and safety perception.[13] The increased attention to curbs in traditional crossings underscores their function as both physical and visual boundaries, influencing pedestrian navigation[14]. Curbs significantly altered pedestrian gaze, highlighting the importance of nuanced design for safety and comfort. Increased attention to vegetation supports the positive impact of green infrastructure on well-being.[15] These findings reinforce the need for incorporating natural elements into urban design to create more appealing and comfortable pedestrian environments.

AOI analysis (Table 2) showed longer fixations and more glances/fixations on "flat" (walkways) and "construction" (buildings) AOIs, suggesting greater cognitive processing due to navigation demands and architectural features.[16] The lower attention directed towards "sky," "object," and "vehicle" AOIs aligns with expectations, as these elements typically require less detailed visual processing.

Gender analysis (Figure 7) showed bimodal first glance times, with males exhibiting more rapid initial fixations, potentially indicating a reactive style, while females showed more delayed fixations, possibly reflecting a deliberate search.[17] These findings contribute to the growing body of research exploring gender differences in visual attention and spatial cognition.[18] Limitations include small sample size and specific location. Preliminary real-world/virtual comparisons suggest VEs' potential for urban design research.[19] While replicating real-world scenarios, future research should explore VEs' potential with dynamic elements, advanced VR, and personalized experiences.

CONCLUSION

This research explored pedestrian behaviour and perception using eye-tracking in real and virtual urban environments. Findings highlight the impact of design elements on visual attention and route choice, emphasizing the importance of infrastructure and green spaces. Gender differences in initial attention suggest varied visual strategies. Preliminary real-world/virtual comparisons offer promising avenues for future research exploring advanced VR, multimodal integration, and transferability. Ultimately, this study contributes to understanding human-environment interaction, providing a framework for evidence-based urban design.

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TEXTILE ARCHITECTURE. INNOVATIVE BUILDING COMPONENTS FOR SMART ENVELOPES

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INTRODUCTION

This work illustrates the first results of a research by the Department of Civil Engineering and Architecture of the University of Catania, on the enhancement and protection of fragile environments, with particular attention to historic squares. The research explores innovative technological solutions, with a focus on lightweight and reversible structures, such as geodesic domes, to ensure effective protection without compromising usability of the place. Advanced methodologies and a case study will be presented that demonstrates the integration between parametric modeling, innovative materials and smart technologies for the protection and sustainable use of these contexts.

Historic squares as fragile environments

Historic squares are not only places of aggregation, but constitute a unique cultural heritage, defined by the presence of buildings of architectural value that frame them and, as such, are fragile environments to be safeguarded. However, these areas are frequently used to host cultural, social, or exhibition events that often require temporary facilities such as pavilions or roofs to provide services to users. These structures must be designed with extreme care, respecting the context and minimizing the impact on the surrounding environment.

A significant example is St. Peter's Square in Rome, where a lightweight cover is used during celebrations, to protect the Pope. This example is emblematic of the characteristics that such structures must have lightness, reversibility, absence of foundations, use of dry technologies and an autonomous architectural style.

These characteristics are adequately represented the potential offered by textile architecture. In fact, this technology makes it possible to obtain lightweight solutions made with dry technologies. An admirable example is the two megalithic temples of Ħaġar Qim in Malta, where two textile structures protect the archaeological site without altering its visual and functional integrity. Textile structures such as these demonstrate how it is possible to create lightweight covers, respecting the surrounding environment and ensuring adequate functionality for the public.

In the context of the climate change, temporary structures must be designed to dynamically adapt to environmental conditions. For example, in the event of strong solar radiation, the envelope must be able to provide shade and mitigate overheating. On the contrary, in conditions of insufficient ventilation, the structure should favor air circulation. Therefore, the possibility of having an envelope with moving parts (which open and close) is strategic in a Mediterranean climate.

A representative example of this responsiveness is the large umbrellas of the Nabawi mosque in Medina, which open and close according to climatic needs. The complexity of geometries and the use of kinematics require advanced design, based on parametric methodologies that allow to optimize shapes and predict the behavior of structures in different conditions. This operational flexibility allows for improved user comfort while reducing environmental impact. The integration of sensors and automated systems is critical to ensuring that these facilities respond in real time to climate changes and the functional demands of public spaces.

a) b) c)

Figure 1. a) St. Peter's Square (Rome); b) Ħaġar Qim temples (Malta); c). Nabawi Mosque (Medina)

RESEARCH METHODOLOGY

The research was developed through an approach articulated in seven phases which are as follows.

1. Analysis of the state of the art: analysis of existing solutions for light and temporary structures, with particular attention to textile architecture and reversible structures. This phase made it possible to define the design criteria and to validate the structural, technological and environmental performance through preliminary tests.
2. Geometric and construction characteristics: the geodesic dome has been identified as the optimal solution for its ability to evenly distribute loads, ensuring lightness and resistance. The most suitable geometric and construction configurations for an efficient and non-invasive installation were analyzed.
3. Parametric modeling and optimization: development of an advanced digital model of a geodesic dome with responsive textile envelope through the definition of parametric algorithms. This phase included the analysis of multiple scenarios to test the robustness and flexibility of the design.
4. Definition of components: design of the individual construction elements, with particular emphasis on structural nodes.
5. Choice of the case study: identification of a real context to test the proposed design solutions through the creation of an architectural simulation.
6. Prototyping: creation of prototypes both in small scale and in full size. Creating physical models is a strategic step in verifying the functionality of the proposed technology.

STATE OF THE ART

History and evolution of geodesic domes

Origin of geodesic domes dates back to the first experiments in designing lightweight and strong structures such as the dome for the Zeiss Planetarium in Jena, Germany, built by Walther Bauersfeld in the 20s of the twentieth century.[1] However, it was Richard Buckminster Fuller, in the 50s, who perfected the geodesic design, making it synonymous with structural innovation. He conceived geodesic domes as structures capable of covering large spaces with minimal use of materials, thanks to their spherical shape and uniform distribution of stresses. One of the most iconic achievements is the Montreal dome, designed for Expo 1967, which remains a symbol of structural efficiency and futuristic design.[2] Subsequently, geodesic domes have been applied in numerous contexts, such as the

creation of innovative greenhouses (e.g. the Eden Project in Cornwall[3]), or temporary structures for events and emergency situations. Their versatility has made them an ideal solution not only for experimental architecture, but also for practical projects[4] in the environmental and humanitarian fields.[5] Technological evolution has further improved the performance of geodesic domes. The introduction of advanced materials, such as reinforced polymers and light alloys, has made it possible to increase structural strength and reduce overall weight. At the same time, the use of parametric software has made it possible to optimize geometries and customize configurations to fit specific design needs. Today, geodesic domes represent a benchmark for sustainable architecture. Thanks to their energy efficiency, the possibility of integrating smart technologies and their ability to adapt to different climatic contexts, they continue to be a privileged solution to face the challenges of contemporary architecture.

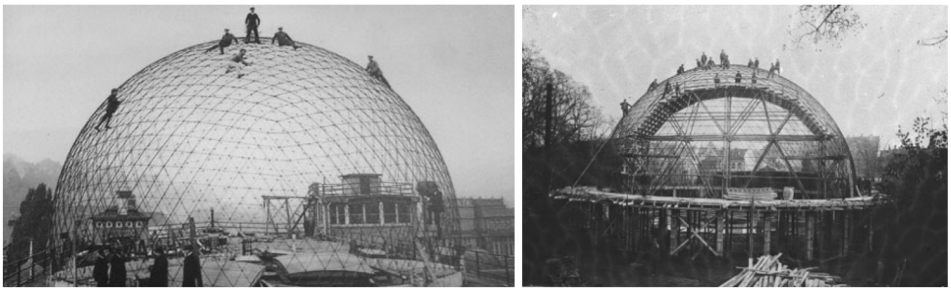

Figure 2. Construction of the Zeiss-Planetarium Jena (Germany), on the left the first (1923) and on the right the second (1925)

Figure 3. Eden Project geodesic domes, Grimshaw Architects, 2001

The geodesic dome: geometric and construction characteristics

Geodesic domes represent one of the most advanced solutions for the construction of light and resilient temporary structures. Their design is based on the icosahedron, a regular polyhedron with 20 triangular faces, which is projected onto a spherical surface to generate the basic network. This configuration ensures an even distribution of stresses and considerable structural strength.

Geometric parameters

There are two main parameters that define the geometry of the dome:

1. frequency is the number of subdivisions of the triangular faces of the icosahedron, a higher frequency corresponds to a denser and more regular network;
2. the class determines the rotation of the mesh relative to the original face of the icosahedron, affecting the arrangement of the triangles in the dome; the different classes allow the structure to be

adapted to specific load and shape requirements.[6]

Main components of geodesic domes

Geodesic domes are composed of four main elements, each of which plays a critical role in the stability and functionality of the structure.

3. The members connect the nodes and form the geometric network of the dome. These elements can be made of lightweight and durable materials such as aluminum alloys, steel, composite materials, or wood. The choice of material depends on the context of use and structural requirements. The length and arrangement of the rods vary according to the frequency and subdivision chosen for the dome.[7]
4. The nodes represent the connection points of the rods and are designed to ensure structural stability and ease of assembly. Through the nodes, forces are transferred and redistributed in the structure.[8] There are different types of knots and the main ones are clamp knots, ring knots and plate knots.[9]
5. The cladding represents the external surface of the dome and has the task of protecting the interior from atmospheric agents and regulating environmental conditions. Among the most widely used materials are innovative fabrics such as ethylene tetrafluoroethylene (ETFE) or photovoltaic fabrics, which combine lightness, transparency and the ability to generate energy. Coatings can also include responsive elements that adapt to climatic conditions.[10]
6. The foundations are a fundamental element that acts as ballast for the geodesic dome, necessary to counteract the stresses due to the wind, which represents one of the main loads to which the structure is subjected.

Figure 4. Main components of geodesic domes

Materials and construction techniques

The choice of materials and construction techniques is guided by criteria of lightness, sustainability and ease of assembly. Among the main materials used are:

• steel, used for its strength and durability;

• aluminum alloys, which offer an excellent ratio between lightness and strength, making them ideal for temporary structures;

• composite materials, such as carbon, which guarantee high structural performance with reduced weight;

• wood, for applications in traditional or ecologically sensitive contexts, where a reduced environmental impact is required.

The construction techniques mainly adopted for geodesic domes include:

• the rods and knots, a traditional method that allows great design flexibility;

• the prefabricated panels, used to create the taselli, speed up assembly times;

• space modules, ideal for small structures, which can be assembled entirely off-site and subsequently transported and installed.

The modular approach allows for quick and easy assembly and disassembly and high adaptability, making geodesic domes an ideal solution for temporary architecture in fragile environments.

a) b) c)

Figure 5. Main construction techniques: a) rods and nodes, b) prefabricated panels, c) spatial modules

Responsiveness and sustainability

A key aspect of geodesic domes is their ability to integrate with their surroundings. Thanks to the use of responsive components, such as integrated solar panels and automated ventilation systems, these structures can dynamically adapt to climatic conditions. Photovoltaic fabrics, for example, generate renewable energy allowing the creation of an off-grid roof. These aspects make geodesic domes a versatile and environmentally friendly solution, particularly suitable for protecting and enhancing fragile environments[11].

PARAMETRIC MODELING AND OPTIMIZATION

The research group's attention was focused on geodesic domes, as they lend themselves to dry construction processes, with light elements and can be composed of modular elements. In addition, these architectures are able to cover large spans, while maintaining the characteristics of light, temporary architecture and without the need for special foundation works.

Parametric modeling is an essential approach to geodesic dome design, allowing you to explore complex and optimized configurations quickly and accurately. Using advanced digital tools such as Grasshopper, integrated into the Rhinoceros software, it was possible to develop a parametric algorithm that controls every aspect of the geometry and components of the structure.

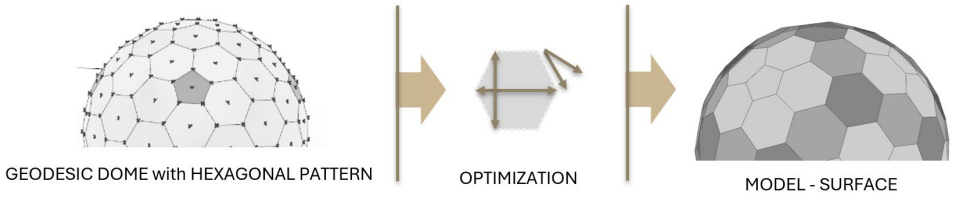

Figure 6. Parametric design strategy adopted

Creating the Geometric Network

The process of parametric generation of the geodetic structure began with the definition of an icosahedron, a regular polyhedron composed of twenty triangular faces. This basic volume was divided into smaller sub-elements, generating a triangular network. The subdivision determines the frequency of the dome, influencing the density of the network and, consequently, the distribution of loads. The generated points were then projected onto a spherical surface, thus creating a coherent three-dimensional geometry.

A key aspect of the development of the parametric algorithm was the creation of hexagonal meshes. It was considered more appropriate to work with hexagonal faces rather than triangular ones, as the latter provide more space for the insertion of responsive elements, such as smart components that can open and close.
This was achieved through an algorithm that selects groups of four points and combines them to create lines that define the hexagons. However, the arrangement of the hexagonal links was found to be irregular. To optimize the shape of the geodesic dome and regularize these geometric elements, a plug-in called Kangaroo was used to simulate the forces within the structure and control their stresses.

Geometry Optimization

By inserting virtual forces into the simulation, it was possible to deform the geometric network in order to obtain:
• similar or equal angles;
• uniform rod lengths;
• flatness and regular points.
Thanks to this optimization process, it was possible to create a network of regular hexagonal elements, improving both the functionality and aesthetics of the geodesic dome.

Nodes

A fundamental aspect of the design is the realization of the components of the dome. The first focus was dedicated to the nodes, since the solution devised must be reversible and allow the assembly of the dome in a very short time. For this reason, a snap-on knot has been designed, equipped with spring elements that allow the rods to be quickly fixed and removed just as easily when necessary. Once the dome is complete, the nodes can be locked to ensure stability to the structure.

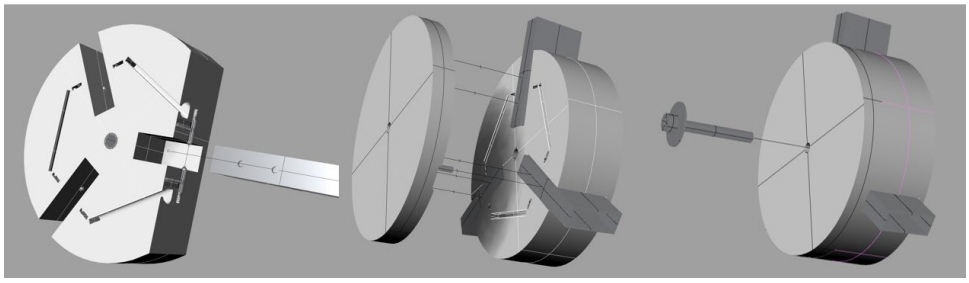

Figure 7. Node and phases of assembly and hooking of the elements

Smart envelope and technology integration

To create a responsive envelope, capable of opening and closing as needed, the integration of commercial components, such as smart roller blinds, was envisaged. These elements reduce overall costs and optimize construction time, while ensuring sustainability during installation and maintenance.
The integration of advanced technologies has also been studied, such as:
• environmental sensors, which monitor parameters such as temperature, humidity and light intensity and whose data can be used to manage the behavior of the structure;
• thin-film photovoltaic modules, which integrated into the fabric or on the frame, allow energy to be generated to power the smart systems integrated into the dome, reducing dependence on external energy sources and making the energy dome sustainable;

• automated opening systems, which dynamically adjust ventilation and shading according to the climatic conditions detected by the sensors, improving indoor comfort and optimising direct solar input for energy savings.
The integration of these technologies makes the dome a responsive and completely self-sufficient structure from an energy point of view, capable of adapting quickly to different environmental conditions and ensuring adequate levels of internal comfort.

CASE STUDY: OTTOBRATA ZAFFERANESE

To verify the functionality of the defined technology, it was considered appropriate to carry out an architectural simulation. For this reason, a study case located on the slopes of Mount Etna, in the town of Zafferana Etnea, was chosen. Mount Etna is the highest active volcano in Europe and is included in the UNESCO list thanks to its extraordinary biodiversity. In addition, the area is protected by the establishment of the Etna Park in 1987, which protects its ecosystem and natural heritage.
The choice of Zafferana as a case study was motivated by the presence of a festival known as *Ottobrata*, which takes place every year during the month of October with the aim of enhancing local agri-food products, with stands dedicated to sales and tasting. However, the current tasting spaces are limited and often offer quite low levels of comfort.

Project objectives

The main objective was to design a geodesic dome that would serve as a multifunctional pavilion for the *Ottobrata*. The pavilion has been designed to host:
• tasting and catering areas, divided into spaces for large groups, areas for quick consumption and more intimate spaces for couples or small groups;
• modular kitchens, for the preparation of typical dishes;
• a responsive envelope that can be opened and closed according to needs and external climatic conditions.

Digital survey and context analysis

One of the first phases was the creation of a digital survey through the use of a drone equipped with a scanner. Thanks to this technology, it was possible to obtain a detailed 3D mapping of the area. The survey was further investigated using specific tools and software to improve the accuracy of the model. Subsequently, an architectural simulation was carried out based on the digital survey data. This simulation made it possible to identify the optimal position for the dome, located near the mother church, in Piazza Cardinale Pappalardo.

Figure 8. Model of the geodesic dome and digital survey of the intervention area

Flow analysis

To verify the effectiveness of the chosen location, an analysis of pedestrian flows was conducted during two different conditions (Fig. 9):

• weekdays (Monday-Friday), during which the main flows focus on access to surrounding buildings, represented by red arrows;

• on weekends (Saturday-Sunday), during the *Ottobrata*, pedestrian flows intensify and have been simulated through blue lines representing the movements of visitors coming from the upper level of the square, the parking area and the stands.

The analysis confirmed that the presence of the dome does not interfere with existing flows, but represents an optimal solution to improve the use of spaces during the event.

Figure 9. Analysis of pedestrian flows in the intervention area

Design and construction phases

The geodesic dome is a modular and lightweight structure, designed for quick assembly and reduced invasiveness. The lattice of rods with reversible nodes ensures stability and ease of assembly, while the enclosure combines fixed and mobile panels for optimal ventilation and shading control. The use of sustainable materials ensures resistance and flexibility of use.

For the case study, the assembly phases of the structure were defined, which include:

• preparation of the base, made of triangular steel modules, ballasted with concrete blocks of 50 kg each to ensure stability;

• assembly of the structure, including the main arches and the network of members that make up the dome;

• the installation of the cladding, consisting of two types of panels, some fixed and others mobile; the movable envelope can be opened or closed according to functional and climatic requirements.

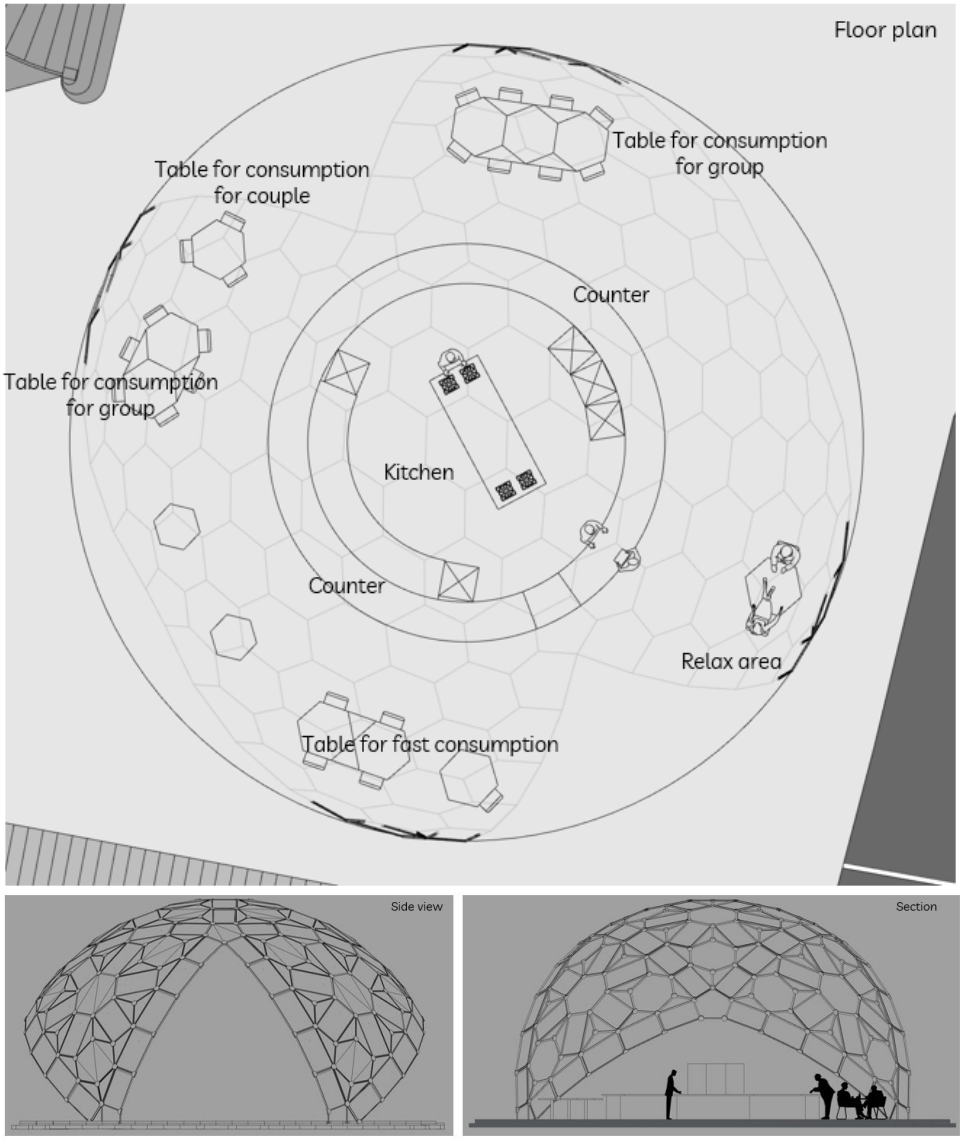

Figure 10. Geodesic dome, plan, section and elevation.

FUTURE DEVELOPMENTS

The next step of the research involves the creation of a full-scale prototype of a part of the studied artifact. The research team has selected each component and is proceeding to test the technology through a prototyping phase both on a small scale and on a full scale. This phase is considered necessary to explore different solutions for the assembly of the components and the dome. Thanks to the reversibility of the nodes, the idea is to configure different shapes of the dome over time. In fact, the nodes can be produced by 3D printing and this allows the modules to be reassembled into different shapes, producing new nodes independently and using the other components themselves.

CONCLUSION

The technology developed has proven to be particularly suitable for the construction of architectures for the enhancement and protection of fragile environments. Thanks to their lightness, reversibility and ability not to alter the context in which it is applied, geodesic domes offer a functional and sustainable solution. In addition, the integration of existing commercial components allows for reduced costs and improved overall sustainability.

These developments pave the way for a wide range of future applications, making this technology replicable in different contexts and providing concrete answers to the challenges of contemporary architecture.

NOTES

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[2] Dalvesco Rebecca. “R. Buckminster Fuller, the Expo ’67 Pavilion and the Atoms for Peace Program.” Leonardo 50 (2017): 486
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[6] Lendave Komal.B et. al. “Class I and Class II Subdivision of the 20-Meter Geodesic Dome Behavior and Analysis Using Breakdown Methods 1 and 2 for Various Dome Frequencies.” Nanotechnology Perceptions 20, no. S1 (2024): 12–28. doi: 10.62441/nano-ntp.v20iS1.2.
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FORM INTERPRETS AGENCY: PARC DE LA CITÉ

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INTRODUCTION

'The city' provides in immersive canvas of histories, societies, and changes from which we can derive meaning. Rooted in the palimpsestic relationship of the distant past, the *zeitgeist*, and the contemporary future, the city represents a synthesis of form and agency in its excavated layers. The iatrogenesis of societal evolutions presents an opportunity to catalyze new design derived from the diverse screens or lenses of the urban past.

This paper examines the city, its histories, associations, and latencies, as an instrument for teaching iterative processes for beginning architectural designers. The Parc de le Cité project, theoretically grounded in the *Parc de la Villette* Paris Competition*,* introduces cities that have experienced significant changes over time as a subject for parti diagramming that emphasizes agency over aesthetic. Asking students to translate and critique a world city through new conceptual design, the project interrogates the age-old "Form Follows Function," instead employing a strategy of *"Form Follows Understanding,"* followed by *"Form Interprets Agency."*

The learning outcomes symbiose with expanded course outcomes to transition beginning designers from their foundational curriculum to architecture-specific skillsets. Centered on abstraction and iterative ideation, Parc de le Cité layers academic research, parti diagramming, design software fluency, and model craft as part of the conceptual exploration. As student creative repetition and failure tolerance becomes more challenging in light of their secondary education, Parc de la Cité teaches passive and active criticism as integral to design iteration, while confronting the historical societal past as inspiration for new, conceptual design.

THE CITY AS PALIMPSEST

World history is illustrated through the spatial/aesthetic juxtapositions of historic cities. Often, additional latent histories can be discerned from the social, economical, religious, ethnic, and other population shifts over time. The resulting layers of meaning inherent within "the city" propose a palimpsest that can be interpreted in infinite ways through design exploration. This process is exemplified through the Paris *Parc de la Villette Paris Competition* (1976-83), which asked contemporary designers to reimagine the former abattoir and meat market district in Paris as a public recreation space as part of President Mitterand's city beautification agenda. Over 470 entries were submitted, with Bernard Tschumi's proposal accepted as the winner for the "urban park for the 21st century." Competition entrants included high-profile as well as emerging architects such as Zaha Hadid, Peter Eisenman, Jean Nouvel, OMA, Cedric Price, Jean Aubert, Team Zoo, and Kisho Kurokawa among others.

The competition forced the theoretical examination of a beloved European city featuring architectural monuments from a variety of inspiring histories. Paris visually bore the signs of revolution, gentrification, rebuilding, religious reformation, poverty, industrialization, pollution, and other moments of extreme change, challenging designers to apply new architecture to a complex, and at times confusing, legacy. Urban/architectural theorist Richard Dagenhart attributes this confusion in part to the emergence of the "decontextualized city," following World War II, suggesting that "[t]he physical artifacts of the city (including architecture and the landscape), the social and human activities of the city, and the remaining structure of the city no longer correspond. The contextual weaving of the city has become unwoven."[1] Citing "disjointed" American urban examples such as Los Angeles, Houston, Phoenix, and Atlanta, Dagenhart tasks architects through the competition with mediating the contemporary morphology of the city beyond its history and supposes that Tschumi and Koolhaas (via OMA), unlike many architects, are participatory in this process.

The weaving proposed by Dagenhart assumes that the park and the city are not mutually exclusive, but instead have a symbiotic relationship. Both are identifiable and acknowledged by the other instead of isolated through their own aesthetics. As Tschumi writes about the historical position of park, "in the park, the city is not supposed to exist."[2] Tschumi's statement references the theory of landscape architect Frederick Law Olmsted, whose immersive natural experiences were intended as a retreat from the less-savory parts of the 19th century industrialized city, a necessity for evolving civilization.[3] The Paris abattoir district [Figure 1] could be considered an exemplar of the unhealthy living conditions of the city, but by the mid-20th century city planning strategies and application of the public park had changed, prompting a more integrated and contextual approach, which Tschumi translated through his entry.

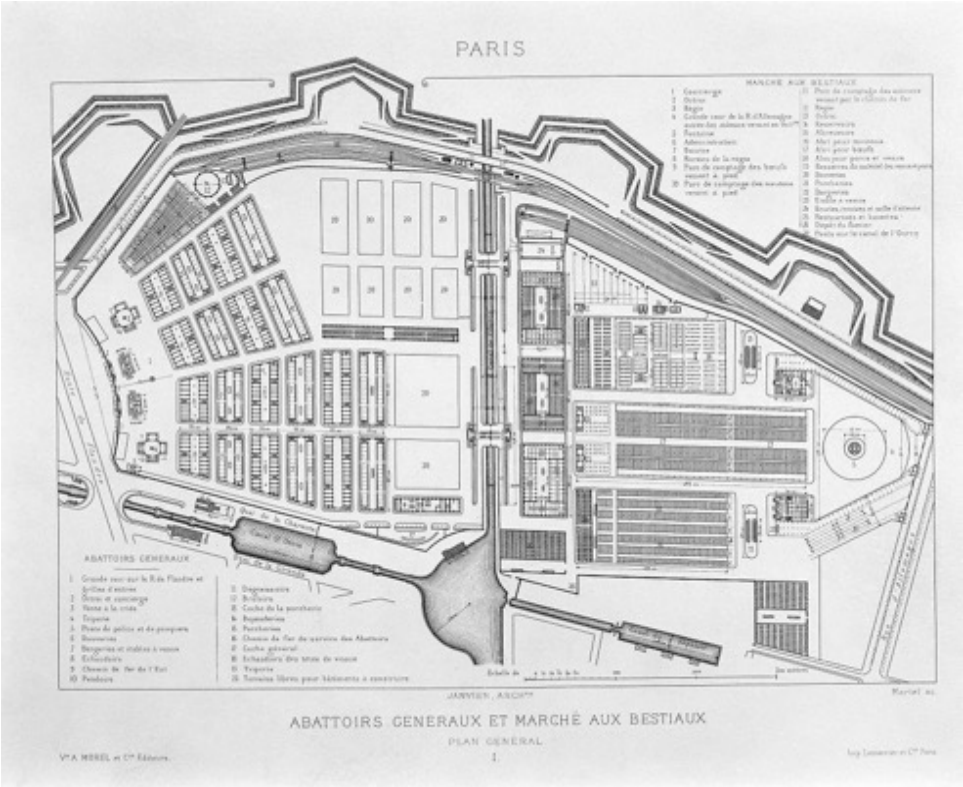

Figure 1. Paris Abattoir and Meat Market plan in 1867.

Tschumi's proposal examines the former abattoir/meat market district through design trends of the last four centuries. The resulting illustrations [Figure 2] elucidate landscape architecture parti diagrams that are both specific to Paris, but also universal schematic representations of historical movements in design, representing the change in the area through epochal design lessons. These investigations are framed through social/aesthetic history:

1. The18th century is represented through the geometric *allées* and *ronds-points* of the French Baroque
2. The 19th century is represented through the "artificial informality" of the Romantic English-style garden[4]
3. The 20th century is represented through the *pilotis*-elevated mass housing boxes of modernist Europe
4. The "future" 21st century park is the superimposition of the previous three principles simplified into diagrammatic elements of points, lines, and planes [Figure 3]

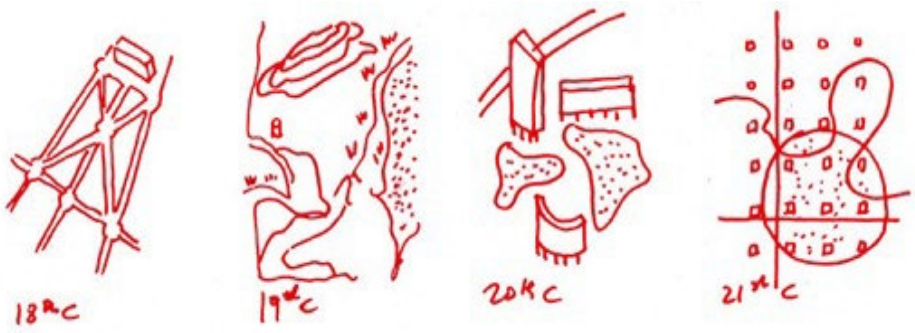

Figure 2. Bernard Tschumi's historical analysis diagramming of the city of Paris from the 18th century to the "future" 21st century, 1982.

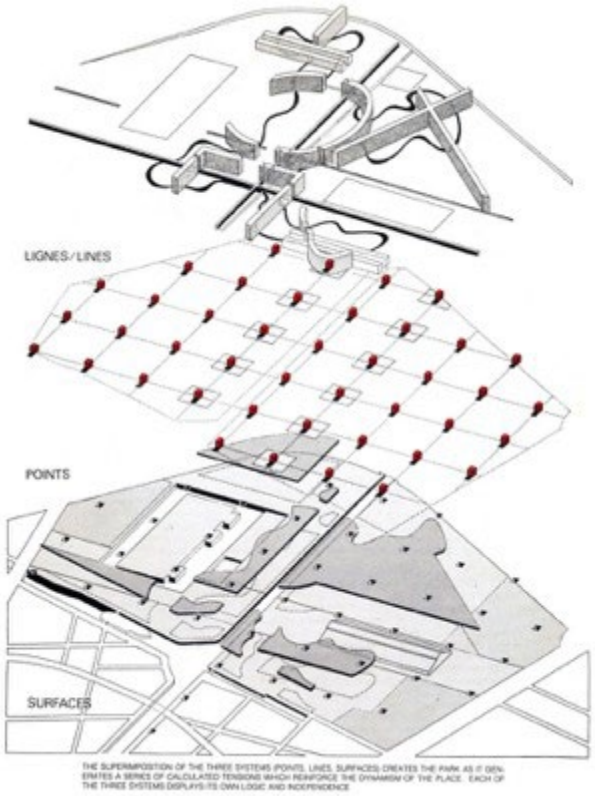

Figure 3. Bernard Tschumi's Parc de la Villette diagram overlay, 1982.

Tschumi's solution essentializes each period and creates an intersecting layout featuring programmatic pavilions within a greater landscape.

While Tschumi's winning proposal provides a precedent of built work from which to understand the palimpsest principles inherent in Paris, several other submissions also saw the competition as an opportunity to layer historical meaning within their proposals. OMA/Koolhaas's submission, titled *Congestion Without Matter*, took the city layout and represented it through a series of gestures [Figure 4], each of which described a significant aesthetic of the city at a certain moment in time. These were overlaid on top of the site plan for the new park and then layered together to purposefully interact through x, y, and z axes. Peter Eisenman's interpretation (in concert with Jacques Derrida) [Figure 5] is a study in time that looks at the city from the past, present, and future. He represents these by diagramming three key components in interpretation—the wall (Medieval Paris), the abattoir/butcher (Victorian Paris), and the grid (Baroque Paris). Overlaying them, he similarly develops a 3-dimensional conceptual framework for the interaction of the city and site.

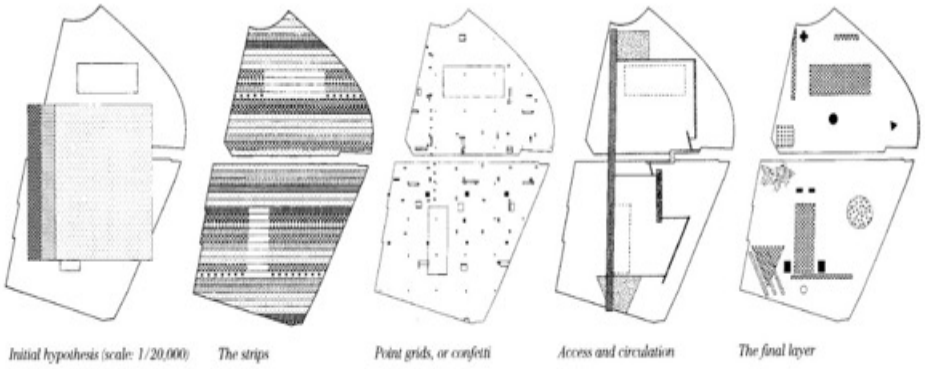

Figure 4. Parc de la Villette Competition Submission Diagram by OMA, 1982

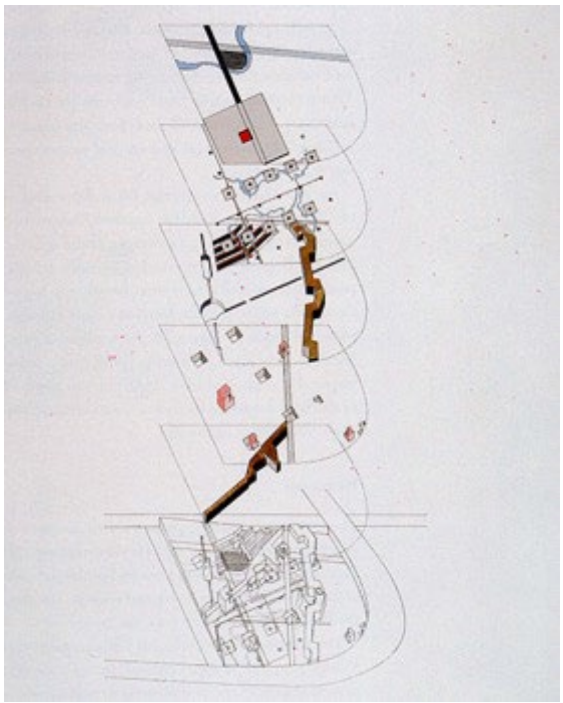

Figure 5. Peter Eisenman's diagram submission for La Villette, 1987

Each of the solutions addressed presents an opportunity to explore the palimpsests inherent in Paris's disparate forms within a greater context, using conceptual theory to drive overall design. This practice parallels the ideas of Deconstruction, a theory to which Tschumi, Eisenman, and Koolhaas all subscribe, that advocates for the breaking down (deconstructing) of known forms/ideas/elements and their related narratives to allow for the reconstruction of these fragments in innovative ways. Each design applies agency to the latent, deconstructed forms and associated meanings behind historical development from a contemporary perspective and restructures "history" through the palimpsest. In a study of formal development, Paris is largely irrational as a result of its aesthetic epochs (such as those identified by Tschumi and Eisenman). This allows Tschumi, Eisenman, and Koolhaas/OMA to deconstruct these layers into simple form, followed by reassigning them a new contextual rationale. In contrast to Louis Sullivan's "form follows function," the proposals for La Villette by Deconstructionist use form to create context and illustrate meaning.

FORM FOLLOWS UNDERSTANDING

The Deconstructionist approach provides an interesting roadmap to lead students through a design process related to complex aesthetic space, particularly in beginning design education (the first 1-2 years of education). Rather than starting with a blank canvas and asking students to fill it, asking students to reconstruct a variety of design processes helps to build a toolkit for them to reference as they develop their own iterative process. In the fall semester of the Ball State University Bachelor of Architecture program, students take their first architecture studio, which is intended to transition them from the conceptual foundational education of their first year into discipline-specific architectural content. To help with this transition, the author presented students with the *Parc de la Villette* competition as a precedent for deconstructing complex existing design into understandable parti diagrams and reconstructing the meaning behind these into new design, uniting enclosure and scape. The project, titled Parc de le Cité, featured several steps to not only pedagogically transition students into an architectural curriculum, but also build associated technical skillsets, specific software, and concept development using the following objectives and strategies:

1. Objective: Introduce primary and secondary source research and precedent into the beginning architectural design studio as a method for concept development

a. Strategy: Integrate the architectural librarian into the studio faculty

b. Strategy: Assign students research presentations for collaborative learning

c. Strategy: Require design/diagramming as part of the research presentation

d. Associated skills/concepts/values: Research, Written Communication, Oral Communication, Graphic Composition, Analysis

2. Objective: Transition from first year foundational skillsets into second year architectural skillsets

a. Strategy: Initiate short charrette to assess drawing skills, observation, Adobe Creative Cloud

b. Strategy: Implement progress checks with diagramming, software, and model-making machines

c. Strategy: Layer/Step skills as part of the process, moving from hand-drawing in 2D, to Adobe 2D, and then Rhino 3D

d. Associated skills/concepts/values: Hand-drawing, Diagramming, Adobe Illustrator, Rhino, Lasercutting, 3D printing, Craft

3. Objective: Encourage abstract/conceptual thinking as primary this iterative design process

a. Strategy: Conduct analytical diagramming of cities through change and transition as motivation for concept

b. Strategy: Encourage hierarchical distribution of concepts via importance to inform Boolean and other operations in Rhino

c. Associated skills/concepts/values: Schematic Design, Personal process, Rigor/Resilience/Failure Tolerance, Software fluency

The first part of the project had students select a city from a given list developed by the author. Cities included on the list exhibit noticeable changes over time, often related to societal shifts in the population for a variety of reasons.[5] Once selected, students conducted primary and secondary source research the history of the city and its planning, landscape, and architectural influences to create a series of analytical parti diagrams describing these changes. The diagrams were produced by hand, then translated into Adobe Illustrator, followed by 3-dimensional drawing/rendering/models of the partis in Rhino [Figure 6]. The primary goal of this iteration was to translate meaning through these diagram—in other words, form follows an understanding of the history.

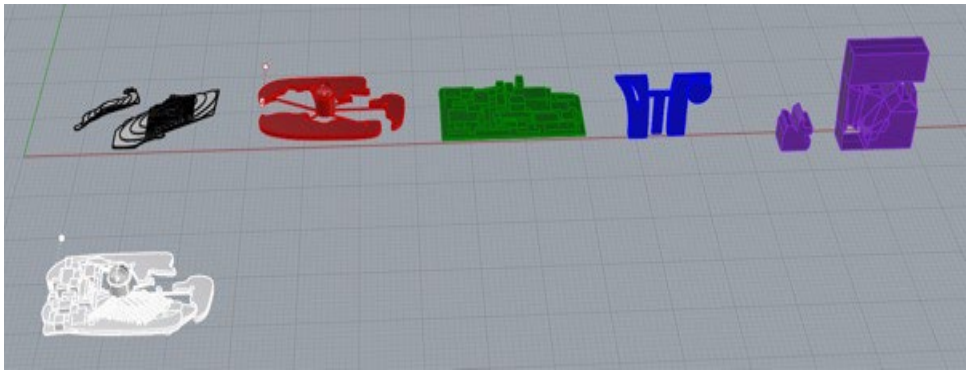

Figure 6. Rhino progress check with parti diagrams of Alexandria, Egypt, by Alexandria Purdue, 2024

The first stage asked students to discern 8-10 parti diagrams based on the history of the city. These were narrowed to 5-6 diagrams of the most "critical" or "important" histories. This second step required students to make hierarchical judgements based on research. Students were asked to consider what sources they were using to identify significance, as well as how their hierarchies were developed. This model of participatory decision-making encourages students to critically assess information for relevance using the Analytical Hierarchy Process (AHP) as defined by Saaty.[6] AHP suggests that sociologically, humans are decision thinkers, and that using an analytical model to making more interpretive/subjective decisions helps to formalize the decision-making process. While Saaty uses this more as a comparison model through which priorities might be defined, when applied to a beginning design architectural framework, it helps to formalize an iterative process beyond formal/aesthetic "likes" and "dislikes." Cities provide an ideal subject for this because there are so many factors from which students can gather "meaning" or intention in their design process, particularly when asked to think hierarchically about concepts.

FORM INTERPRETS AGENCY

Once students identified their critical concept partis, they were asked to layer these together into a 3-dimensional palimpsest in Rhino. Following the *Parc de la Villette* methodology, students were required to translate form from meaning derived from research and represent the historical and contemporary complexities of urban space through this complex 3D diagram. Initially, students were not given a program for design, but instead asked to initiate a scaleless 3D diagram that represented their conceptual palimpsest hierarchy [Figure 7]. This step mandated that students learn and apply simple operations to manipulate forms and apply key operations that they were learning in a parallel digital design course. Critically, they were asked to think about how the manipulation of their form communicated or interpreted the agency of the city concepts/partis. Inherent in their final 3D

palimpsest should be significant meaning behind the final formal language, through the interaction of their layers. The diagram should represent the individual influence or importance of certain elements, periods of change, design revisions, or any other characteristics that that the student discerned from the historical research into the city over time, encouraging the abandonment of purely aesthetic meaning in favor of conceptual agency.

Figure 7. Final Rhino palimpsest of Naples, Italy, by Yamilet Martinez, 2024

Another important consideration for the project was that students were learning new skillsets and tools iteration within a design process. This included learning new methods of model craft and their efficiencies, including lasercutters, 3D printers, and hand crafting. Students were asked to produce an approximate 18”x24” model of their parti palimpsest diagram [Figure 8], with conceptual meaning or intention applied to the materiality and construction methods. Materiality could be applied by layer, or through another hierarchical system developed through AHP. As the final step, students applied scale and simple program (through scale figures) to the model and simple Rhino renderings [Figure 9]. These constraints were purposefully given as the last step to reinforce conceptual iteration above function as a method for transitioning from the first-year foundational curriculum to discipline-specific design. The methodology reverses the iterative process that students have been largely taught before arriving in architecture school—that the primary driver of design is function. Instead, this supposes that design can be driven by a variety of ideas before function is applied.

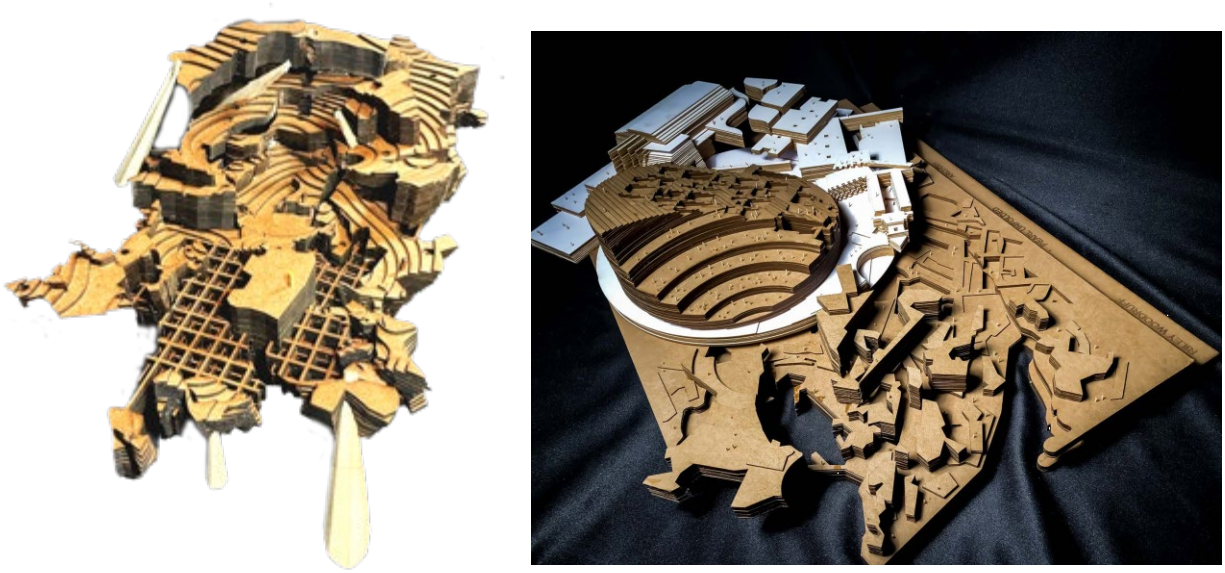

Figure 8. (Left) Final crafted palimpsest of Kyoto, Japan by Ethan Orion, 2024; (Right) Final crafted palimpsest of Alexandria, Egypt by Riley Woodruff, 2021

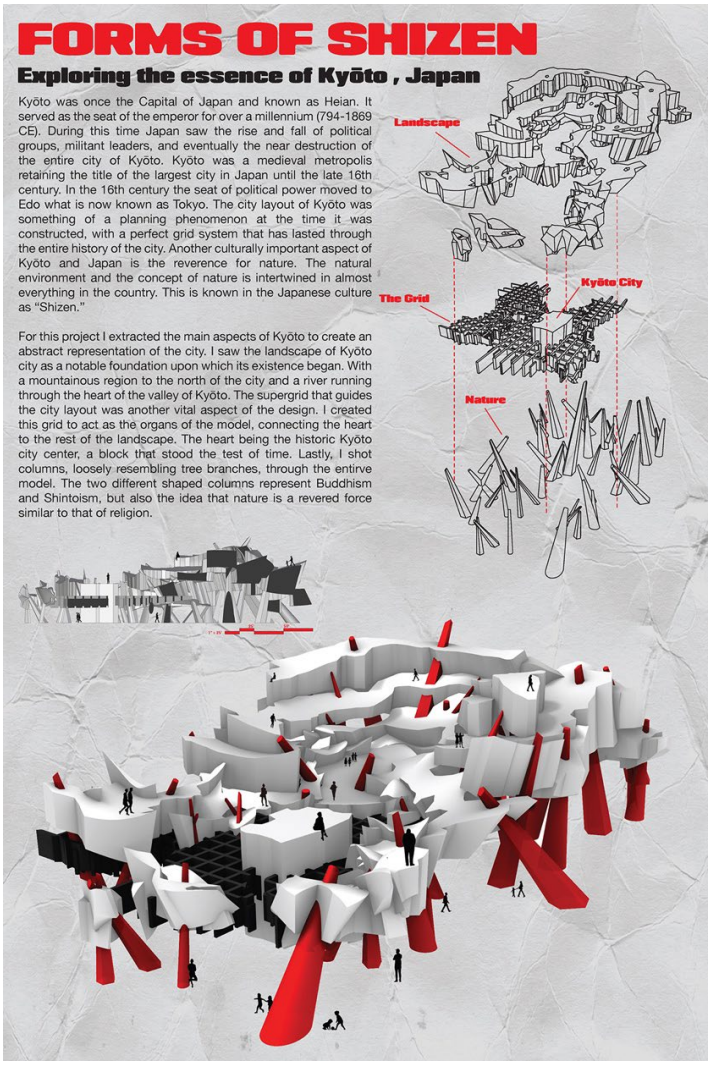

Figure 9. Final digital board with programmed parti palimpsest for Kyoto, Japan by Ethan Orion, 2024

REFLECTION AND CHALLENGES

Important to note is that this design project is in the first half of the semester and a later project takes students through a more "traditional" design process with an established program from the onset. Students are often taken aback by the project, as they have arrived in the second-year studio ready to design "actual buildings," which are made up of a variety of definitions and typologies. Therefore, faculty must mediate student expectations, fears, and anxieties. A method employed following each project was a prompted reflection regarding the learning objectives for the project alongside guided questions related to student performance. Students were asked what was challenging about the project, how it related to learning objectives, and what they did well. Reflection is a high impact practice[7] that encourages students to process information in an informative way—much like an iterative design process. Student reflections on the project largely addressed the challenging new skillsets, as well as the expected conceptual thinking that the project offered [Figure 10]. Reflection also provides for a continuation of the learning process after a formal critique at the end of a project. The Parc de le Cité project had a gallery review for the final designs, but the studio employed a resubmission policy for all projects, meaning that students were encouraged to edit and resubmit all work based on feedback, allowing them to refocus some attention on any work that they were not satisfied with throughout the semester.

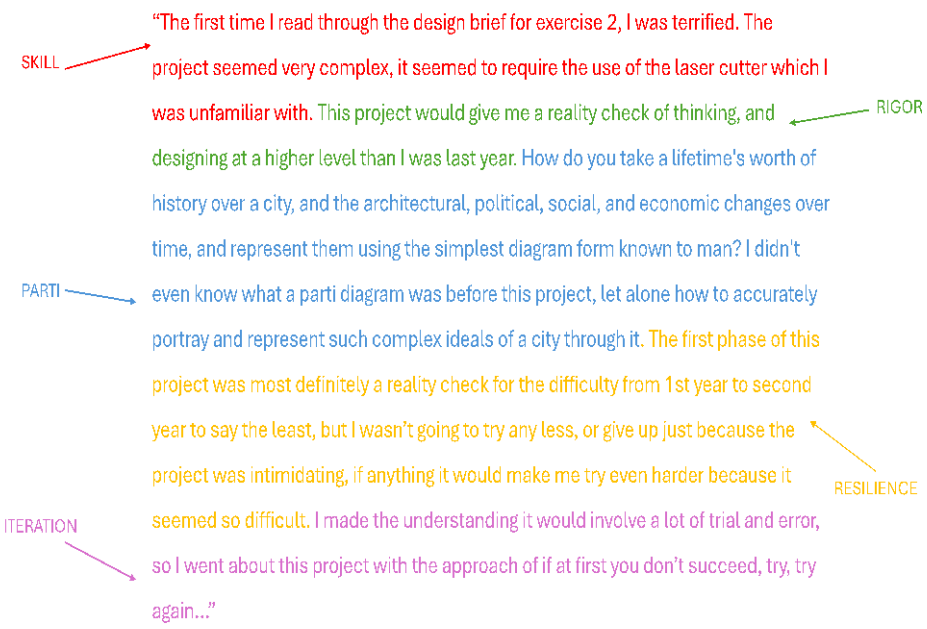

Figure 10. Highlighted reflection by Nick Adams, 2024

Despite the intentions and objectives/strategies of the project, there were some challenges addressed through assessment that required mediation in the moment. The following were challenges and modifications made for the most recent iteration of the project (fall 2024):

1. CHALLENGE: Rhino taught in different sequence than previously in support course

a. MODIFICATION: Instructor brought in former students and faculty to consult and teach necessary tools

2. CHALLENGE: 75% of students in class (11/14) reported diagnosed neurodivergence, or received university accommodation through university disability services. Some neurodivergence impacted conceptual and abstract thinking.

a. MODIFICATION: Decoding of expectations and processes; charrette workshops in small groups and pairs; clear instruction, definition, and language
3. CHALLENGE: Perfectionism, expectation creep, overwhelm, anxiety
a. MODIFICATION: Flexibility with submission type, written practical support, one-on-one attention, student-led rescheduling
4. CHALLENGE: Concept fatigue, remedial skill development
a. MODIFICATION: Design Thinking session with full studio to replan projects and semester timing, ensuring that there was sufficient time to achieve mastery of skills and concepts
5. CHALLENGE: Heavy outside coursework and early end of semester
a. MODIFICATION: Replanning review dates for prior to Thanksgiving Break and reserving two weeks after for revision and resubmission of projects
When attempting to teach an agency/concept-driven process in beginning design, it is imperative that students see purpose and meaning in a project to move beyond aesthetic choices to a more intentional iteration. The Parc de le Cité project uses the city as an inspiration for this agency, providing an expressive palimpsest from which students may discern partis. Using AHP as a method, alongside the *Parc de la Villette* competition as a precedent, students are able to see the variety of concepts available to explore in architectural design while engaging in active learning, reflective thinking, and skillset development. The project theoretically models a process for students while pedagogically grounding concept agency as formal inspiration. Critiquing the chronicle of the city as part of this process allows students to participate in the creation of new urban history, and reinforces the critical role of design in interpretating or illustrating meaning.

NOTES

[1] Richard Dagenhart, "Urban architectural theory and the contemporary city: Tschumi and Koolhaas at the Parc de la Villette," *Ekistics* (1989): 84-92.
[2] Bernard Tschumi, “Parc De La Villette,” *Architectuual* (August 30th, 2019). Accessed at: https://architectuul.com/architecture/parc-de-la-villette.
[3] Witold Rybczynski, "Why we need Olmsted again," *The Wilson Quarterly* 23, no. 3 (1999): 15-22.
[4] Peter Blundell Jones, "Parc de La Villette in Paris, France by Bernard Tschumi," *Architectural Review* 7 (2012).
[5] The cities list included: Beijing, China; Istanbul, Turkey; Athens, Greece; Belfast, Northern Ireland; Mumbai/Bombay, India; Alexandria, Egypt; Lima, Peru; Naples, Italy; Izamal, Mexico; Timbuktu, Mali; Tunis, Tunisia; Kyoto, Japan; Isfahan/Esfahan, Iran; Cape Town, South Africa; Dubai, United Arab Emirates; Singapore, Republic of Singapore; London, England; Rio de Janeiro, Brazil; Montreal, Canada; Kuala Lumpur, Malaysia
[6] Thomas L. Saaty, "Decision making with the analytic hierarchy process," *International journal of services sciences* 1, no. 1 (2008): 83-98.
[7] Sarah E. Summers, Heather Chenette, Ella L. Ingram, Jay P. McCormack, and Patrick J. Cunningham, "Cross-Disciplinary Exploration and Application of Reflection as a High Impact Pedagogy," *Insight: A journal of scholarly teaching* 11 (2016): 29-47.

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THE SPACESHIP ZIGGURAT AND THE RIPPED CONCRETE

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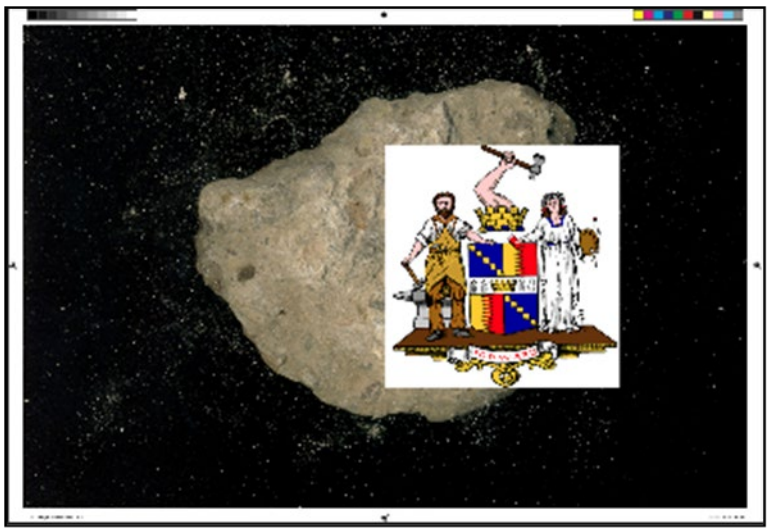

Figure 1. Assemblage_01 (concrete fragment and Birmingham council coat of arms)

INTRODUCTION

The Office For Speculative Landscapes[1] (TOFSL) formed in 2015 and has operated as a nomadic interdisciplinary design studio since then; occasionally situating itself within cultural institutions for brief periods as part of various artist residencies. In an attempt at explaining TOFSL, The Illustrator had resorted to describing the organisation as speculative archivists, ritual copyists and common un-specialists operating on behalf of the future. Whilst acknowledging that there remains a level of ambiguity in each of these descriptors, it hopefully provides enough of an entry point into the thinking and the making.

What follows is a post-project report, written by The Illustrator on behalf of The Office For Speculative Landscapes:

TOFSL INVESTIGATION-1 THE SPACESHIP ZIGGURAT

The investigation has focussed on a single brutalist building, the Birmingham Central Library, engaging in what could be called a speculative documentary practice. In this investigation documentary making has been understood in an expanded sense, as an action performed, with the documentarian as an actor. By approaching the documentary as a performed action, the Illustrator attempted to speak to the site in a way that was reflective of it, embodying the site, developing

specific strategies that could only make sense within the unique context of the given site as isomorphic gestures. The intention was to collapse the distance normally required to observe with any sense of perceived impartiality. The documentary subject transitions from the observed to a conspirator.[2] It is in this messy space that I have looked to enter into a dialogue with the Birmingham Central Library, with a time and place. There has been no attempt at constructing a singular historic narrative, instead an embrace of what failed to materialise and that which haunts the Birmingham Central Library on behalf of the future. This approach is in response to Mark Fisher when he wrote, "the past has to be continually re-narrated, and the political point of reactionary narratives is to suppress the potentials which still await, ready to be re-awakened, in older moments…so to recall these multiple forms of collectivity is less an act of remembering than of unforgetting, a counter exorcism of the spectre of a world which could be free."[3]

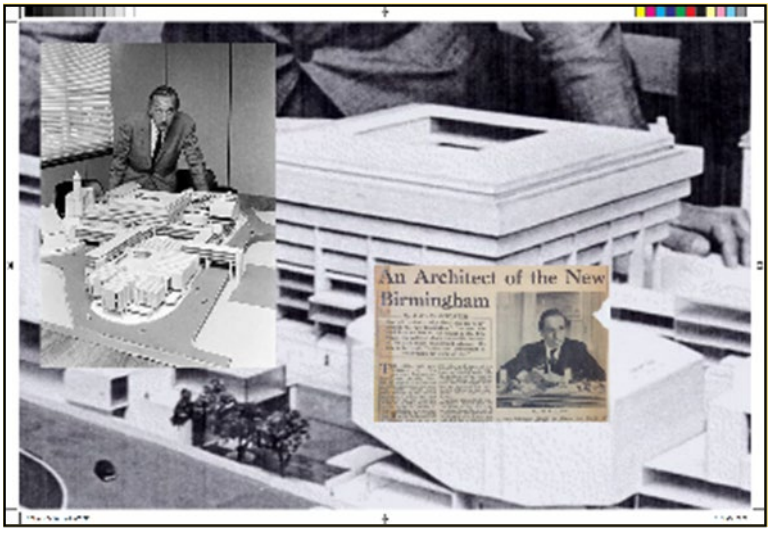

Figure 2. Assemblage_02 (John Madin with architectural models and archival news paper cutting)

Brutalism is understood as once being the embodiment of technological progress, defined by Reyner Banham in 1954 as having "clear exhibition of structure" and "valuation of materials as found".[4] In 1958 Banham would expand his definition of brutalism, rejecting the tendency to see brutalism as a style and "… its replacement by the concept of 'the style for the job'. This abandonment opens the way for a more viable integration of design with practicalities of machine age existence."[5] In this investigation, I have looked to develop Banham's concept of 'the style for the job', developing an fugitive documentary vocabulary that speaks to the site on its own terms. Drawing on contemporary technological tools as a way of speaking both to this past and to the reality of the present, the intention has been to create a feedback loop where one can tap into the echoes of an unrealised future.

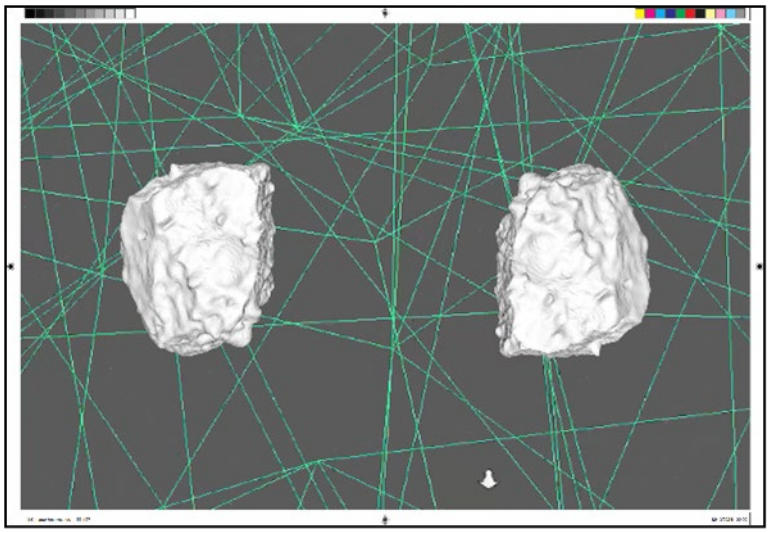

Figure 3. Assemblage_03 (3D scans of concrete fragments)

Through writing and making I have engaged with brutalism as method; as a starting point for imagining messy and fragmented worlds outside and beyond capitalism. Building on the work of Ben Highmore to consider how a brutalist methodology might work today, in this scenario the Birmingham Central Library is transformed into a tool through which to reanimate the utopian ambition of past gestures. In an essay for *Architectural Design* in 1957, Peter and Alison Smithson described brutalism's "essence as ethical" and that "any discussion of Brutalism will miss the point if it does not take into account Brutalism's attempt to be objective about reality - the cultural objectives of society, its urges, its techniques and so on. Brutalism tries to face up to a mass produced society, and drag a rough poetry out of the confused and powerful forces which are at work."[6] Through this project I have come to think of the library as something akin to a lucid hallucination, as a proposition sent from the future to rescue "optimism from the jaws of oblivion… so as to build a future that could somehow come to terms with history."[7] The library is not a relic of the past, in this study it is not even a building, instead it is a vital catalyst in enabling brutalism to move beyond its own concreteness and into a 'rough poetry' of hope.

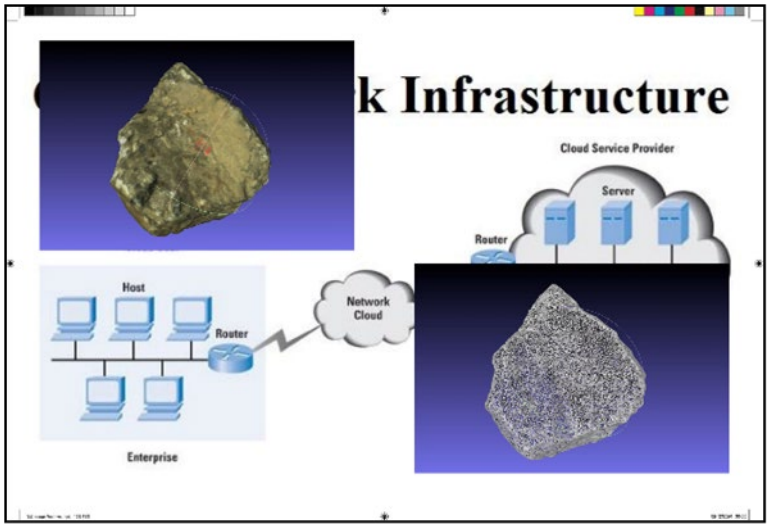

Figure 4. Assemblage_04 (3D scans of concrete fragments and infographic for cloud computing)

Technological screens have acted as gateways through which a brutalist library - or whats left of it - has flowed both into and out of. This post-digital regurgitation (of the library) is comparable to birds that feed their young by vomiting into their mouth. Preserving the future of their species. An act of survival rooted in the puke of semi-digested matter. In this project, a practice of reciprocity has evolved where the library evolves as it transitions between online and offline worlds. A rejection of the simple material binary (real/unreal, online/offline, materialise/dematerialise), slippage'ing towards a state of porosity. Images are no longer merely representing the real, images are now agents in a system of reproduction and dissemination. The internet is understood as a material landscape within which to perform acts of both burying and digging; where the extraction of a demolished building - as a poor image[8] - generates a temporal and spatial rupture, unshackling it from its own historic baggage and the hegemonic narratives around a "puritanical politics of shame—which fetishise oppression as if it were a blessing."[9] A reminder that there might be an alternative to what we might call the rampant individualism of neoliberalism.[10]

The internet is a landscape with its own material reality, it is fibre optic cables, server farms, technological devices and lithium mines to name but a few of the physical forms required to make this digital landscape real. This investigation acknowledges this complex reality, developing a promiscuous relationship with the internet and whilst some aspects of my practice are web-based they are rooted in an attempt to make offline. Concrete.rip is a website but it is designed for people to download fragments of digitised concrete so that they might 3D print their own copies. In this instance the use of a web-based platform is as a call to action, allowing me to share a resource, inviting willing participants into the project as co-conspirators. By downloading a fragment of concrete the audience become active participants in the project, enabling the buildings temporal and spatial dislocation. The emphasis on material manifestations across all phases of production is not intended as a privileging of the offline world or seeking the authentic, I acknowledge the futility in any attempt to designate what is and what isn't 'real'. The decision to make material is to consider the impact of a building being vomited back into the world and to see what such a mutation tells us about the way we might construct a "rough poetry" for remembering sites at risk of being lost or forgotten. This is an attempt at documenting a building but as a way of considering the technological systems that are fundamental to our experience of space, both seen and unseen. The seemingly analog nature of various parts of the practice - such as the use of 35mm slides or cake making - is not a nostalgic turn but, to quote James Bridle in his essay *The New Aesthetic and its Politics*, "…this unwillingness to codify is a reproduction of the network's own refusal to be pinned down, controlled, routed and channelled, which must be considered one of its core, inherent values. But is also born of a serious desire not to foreclose discussion…"[11]

The overriding historical narrative around brutalism is still one of an architecture synonymous with failure and ruin. For a general public, brutalist buildings remain oddities in the landscape, and their overwhelming weirdness has never felt so out of step with the UK's current political, social and cultural landscape. However, if - as Fredric Jameson says - "the best utopias are those that fail the most comprehensively"[12] then perhaps all is not lost. The intention of this investigation has never been to preserve a nostalgia for brutalism where it is stripped of its radicalism and remade within a neoliberal heritage project. Better to knock it down and start again; embrace the failure. Let it mutate. The intention has been to explore how a documentary practice might reclaim brutalism, transforming a building into a vessel for building future worlds. If as Timothy Morton has suggested, that the world has already ended[13] and we are living in the dying embers of late-stage capitalism, perhaps the hope needed to rebuild can be found in the performative possibilities of engaging with brutalism as a tool, a device for dreaming, speculating and reimagining.

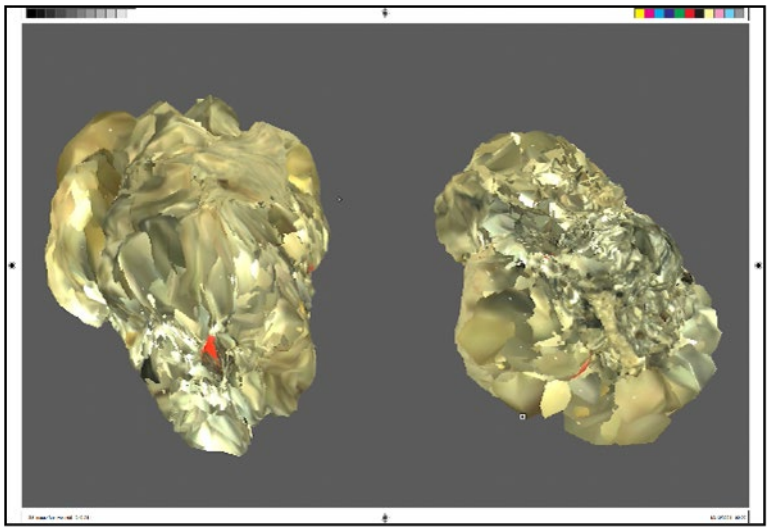

Figure 5. Assemblage_05 (Concrete fragments manipulated in Blender)

The concrete debris of the Birmingham Central Library is situated within a framework of Object Oriented Ontology and New Materialist modes of thinking. This frames the debris within a world that is more than human and as an object that is made up of "a dynamic and shifting entanglement of relations"[14]. Calling into question the concrete's reliability as a witness to the historical, where the historical is understood as a human narrativisation of power. From this position of instability, the concrete offers a space of resistance through its application as site from which counter-histories can be extracted. The concrete is salvaged as a relic of future significance and understood as a weird object. Weird in this context functions as a technical category, in relation to Mark Fisher who said that the weird has a "preoccupation with the strange." For Fisher, the strange is, quite simply, "a fascination for … that which lies beyond standard perception, cognition and experience." Fisher defines the weird as "constituted by a presence – the presence of that which does not belong."[15] The weird is something that is out of place - such as the Birmingham Central Library and Brutalism more broadly, an architectural vernacular that has always felt weirdly out of time and out of place.

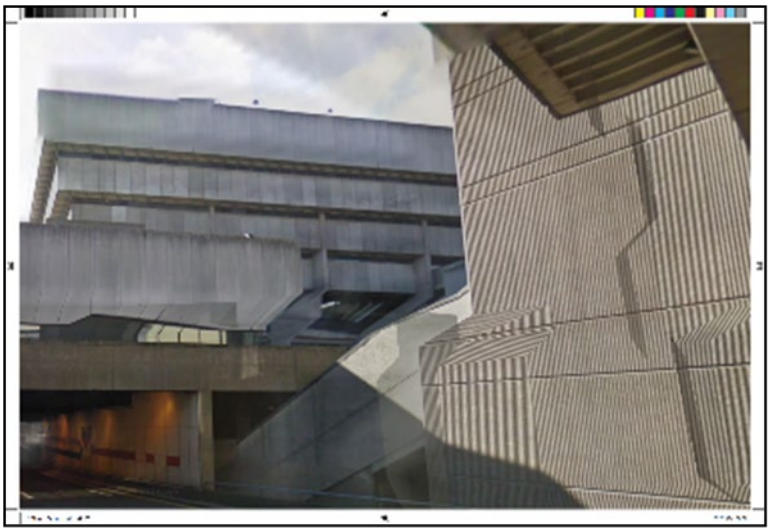

Figure 6. Assemblage_06 (Install images from 'On The Subject of Precarity' at Grand Union in 2019)

Figure 7. Assemblage_07 (Distorted image of Birmingham Central Library in Google Street View)

3D scanning has transformed the way archeologists are able to preserve fragile artefacts and reconstruct ancient architecture of historical significance. In this research project, technological tools such as 3D scanning and printing are used to establish a feedback loop where Brutalism is remade as image, echoing the ruinous status of the original concrete fragment. This echoing facilitating what Jane Bennett calls "…a staged rupture in the trajectory of movement… so that new structures can appear in the now empty space of the present."[16] As a digital image (or object) it enters into a complex system of duplications that distort and destabilise the original, transforming into a speculative device for future world building scenarios. The concrete is revealed as a multi-temporal object, relocated within a website that allows users to download it at an unspecified moment in the future.

The concrete debris has become a tool, able to re-materialise through technological devices anywhere in the world with a wifi connection. But this dematerialisation is not without its own material reality, it relies on the extraction of raw materials - such as lithium and cobalt - materials forged in geological time. This is time outside of human computation. The digital concrete is now trapped in the capitalist supply chain, downloaded onto machines that eventually make their way to unregulated electronic recycling plants where they are either burnt or buried. Returning to the soil and to a temporality outside of the human. The intention here is to illustrate the material entanglement inherent within contemporary conceptions of space and place. In both its IRL and URL versions, the concrete is encountered at different scales, connecting into competing and converging histories. The oscillation between the micro and macro is crucial in shifting the object to a space beyond the human, enabling the dislocation and disorientation of the object (and then the viewer). A rupture that enables the object to break free of the past and to become a companion of the future.

A ghost hunt has been performed from within Google Street View. Ghosts in the sense that they are buildings that have been demolished but that are still accessible through the technology, haunting the present, but only if they were still standing IRL when Google Street View launched in the UK in 2009. In Google Street View time is layered, past versions are stacked on top of one another, time registers do not follow one another sequentially, they overlap continuously. As Professor Susan Buck-Morss 'describes in *Seeing <—> Making: Room for Thought,* "history is layered. But the layers are not stacked neatly. The disrupting force of the present puts pressure on the past, scattering pieces of it forward into unanticipated locations."[17] My encounter with the Leeds International Swimming Pool in Google Street View reflects this thinking. By revealing a gap in the normally seamless of stitched

panoramas I opened up a portal to another time where the building was no longer demolished. It is a ghost resurrected. Borrowing from Mark Fisher once again, this "…haunting… can be construed as a failed mourning. It is about refusing to give up the ghost or… the refusal of the ghost to give up on us. The spectre will not allow us to settle into/for the mediocre satisfactions one can glean in a world governed by capitalist realism"[18]

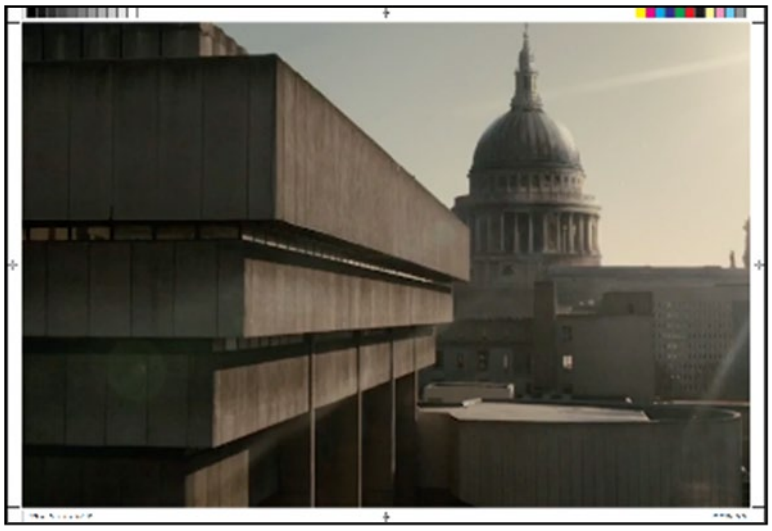

Figure 8. Assemblage_08 (Screenshot from 'The Game')

To return to Reyner Banham's definition of brutalism, he identifies the "…Memorability as an Image"[19] as the first principle in his 1955 definition. Whilst originally intended as an acknowledgement of the spectacular within brutalism, this now appears as a prophetic statement, predicting the demolition and destruction of brutalist buildings and their afterlife as images. Increasingly hidden in the time-layers or lurking in-between the panoramas, lost to the prevailing trajectory of the neoliberal city that seeks to wipe out any glimpse of an alternative future. For now, Google Street View provides a temporary territory in which brutalist buildings survive as an image.

A practice of pirating has been established, running across all phases of production. By pirating I mean the act of unauthorised copying, a disobedient gesture that refutes the authority of originality. Informed by Hito Steyerl's concept of the 'poor image' which she describes as "…a copy in motion. Its quality is bad, its resolution substandard. As it accelerates, it deteriorates. It is a ghost of an image, a preview, a thumbnail, an errant idea, an itinerant image distributed for free, squeezed through slow digital connections, compressed, reproduced, ripped, remixed, as well as copied and pasted into other channels of distribution."[20] I have copied; I have remixed; I have replicated; I have re-appropriated; I have ripped; I have reenacted. Crucially I have dispersed, uploading and downloading fragmented copies into existing infrastructural architectures.

The use of the Birmingham Central Library in 'The Game' provides a catalyst for a series of works that attempt to remake the library - not as it was but as it might be. As a lecture-performance the library is reconstructed as an autonomous self-moving building, the lecture functioning as its own site of becoming, another portal through which another world is conjured. As a cake the library is reconstructed as a tool for speculating on other political possibilities. It was shared with students and staff at Birmingham City University as a gesture of generosity, of solidarity and of kinship. Finally as a science-fiction narrative the library is reconstructed in an entirely mutant form, as fragments of audio dispersed into the exhibition space. The text takes the chapter titles from Buckminster Fuller's *Operating Manual For Spaceship Earth* (1969) as a narrative structure for a story about a concrete

fragment becoming a mushroom. The version of the work in the exhibition reconstructs the book, with two large metal spatial dividers zig-zagging through the space to create a sequence of double-page spreads. Within each project from phase three the library enters into a process of reconstruction but with no attempt at fidelity to the hegemonic historical narratives that position Brutalism as ruin. The act of reconstructing in the present - but also the possible future reenactments - enable the library to be accessed as a speculative tool. The documentary lens points toward the future - crucially this is a 'future' understood through the lens of Franco 'Bifo' Berardi who defines the future not in terms of the direction of time but as an idea that shapes the present.[21]

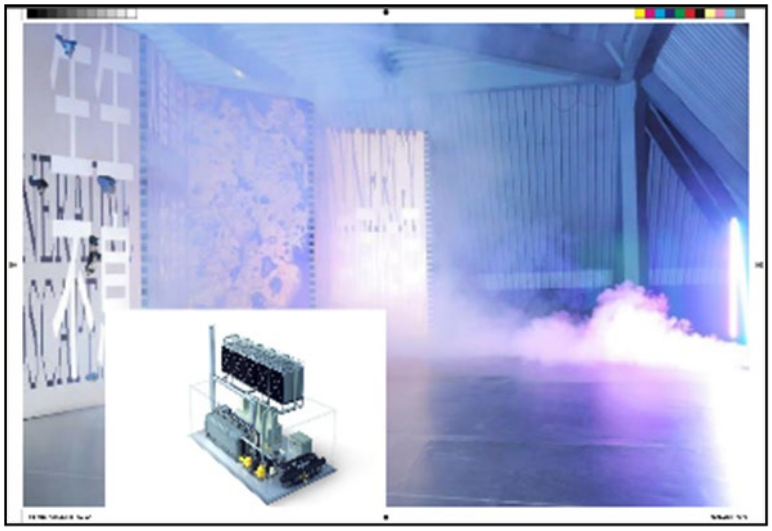

Figure 9. Assemblage_09 (Installation image from By The City at the Museum of Waste in Changsha, China and image of air conditioning unit)

Oscillating between the micro and the macro, the physical and the virtual, I have attempted to excavate a building that now exists only as an unreal site. The erasure of the Birmingham Central Library from its original geographical site raises a compelling proposition, not that the building has disappeared but that the building became, or is in the process of becoming, a fiction, and it is in this transformation that an alternative narrative can be constructed. In *Communists Anonymous*, Ingo Niermann explores the need for Communism to return to the world of fiction, he says that "great fiction immerses you in any possible scenario with just a few words. Great fiction does not replicate - it creates realities in the simplest, most efficient fashion."[22] Applying this logic to Birmingham Central Library and its civic ambitions, this project approached the building not as a relic to the past or as a site of historic significance, but as a device for storytelling and speculation.

Figure 10. Assemblage_10 (image of Tainan Public Library and archival image of Birmingham Central Library)

Birmingham's inverted ziggurat library now resides as a lost monument, enshrined in digital images that resurface in online forums and image feeds. It rematerialises as the setting in a TV drama, teleporting to a new city before disappearing once again. Where once its presence haunted Birmingham, it is now its absence that haunts the city. The internet facilitates an excavation, re-interpretation and re-presentation of lost, buried and demolished landscapes which forces us to consider the way in which sites become visible, as well as how they are seen and what they might see. It might also allow for a space in which we can consider how we might communicate with a place and to question how unexpected solutions might be found in imaginary worlds and fictions where humans are not at the centre. The Birmingham Central Library was already an attempt at 'world making', it was already a fiction and so it should come as no surprise that if we are to enter into a dialogue with this site that we must approach it in this manner.

"It is a strange realism, but it is a strange reality."[23]

NOTES

[1] The Office For Speculative Landscapes is a fictional organisation invented for the purpose of writing a PhD thesis. TOFSL employs a single worker - The Illustrator - a version of myself. The Illustrator assumes multiple roles within the organisation, operating as researcher, designer, educator, performer and documentarian. Additional employees (not versions of myself) are brought in on a ad-hoc basis when required. The intention was to avoid a straight forward distinction between the writing and the making and to introduce a narrative framework through which to explore the symbiotic nature of practice-led research. My approach to writing within the PhD has been to focus on descriptions of what I have made. Zooming into and lingering on the act of making within each phase of production as a way to articulate - in writing - this practice-led research project.

[2] This should not be seen as counter to the documentary discipline but instead, in full acknowledgment of it. As Hito Steyerl says in Documentary Uncertainty, “The closer to reality we get, the less intelligible it becomes. Let us call this 'the uncertainty principle of modern documentarism’”
Hito Steyerl, “Documentary Uncertainty” for A Prior Magazine 15 (June, 2007)
http://www.aprior.org/apm15_steyerl_docu.htm

[3] Mark Fisher, “Acid Communism (Unfinished Introduction)” in *K Punk: Mark Fisher* ed. Darren Ambrose (London: Repeater Books, 2018), 756

[4] Reyner Banham, “The New Brutalism” in *The Architectural Review*, July 2010, https://www.architectural-review.com/archive/the-new-brutalism-by-reyner-banham

[5] Reyner Banham, “Machine Aesthetics, New Statesman, August 1958,” *A Critic Writes Essays by Reyner Banham,* ed, Mary Banham, (Berkeley: University of California Press. 1999), 28

[6] Peter and Alison Smithson, “Thoughts in Progress,” in *Architectural Design 27*, (April 1957), 113

[7] Ben Highmore, “The Art of Brutalism,” (New Haven and London: Yale University Press, 2017), 27

[8] In reference to Hito Steyerl’s conceptualisation of the poor image, as “…a copy in motion. Its quality is bad, its resolution substandard. As it accelerates, it deteriorates. It is a ghost of an image, a preview, a thumbnail, an errant idea, an itinerant image distributed for free, squeezed through slow digital connections, compressed, reproduced, ripped, remixed, as well as copied and pasted into other channels of distribution.”
Hito Steyerl, “In Defense of the Poor Image” in *e-flux Journal #10,* (November 2009) https://www.e-flux.com/journal/10/61362/in-defense-of-the-poor-image/

[9] Laboria Cubonik, “The Xenofeminist Manifesto,” (London: Verso, 2018), 47

[10] “Hypernormalisation,” directed by Adam Curtis, (BBC, 2016) 2 hr 46min

[11] James Bridle, “The New Aesthetic and Its Politics,” in *You Are Here: Art After the Internet*, ed Omar Kholeif (Manchester: Cornerhouse, 2014), 27

[12] Fredric Jameson, “Archaeologies of the Future: The Desire Called Utopia and Other Science Fictions,” (London: Verso 2007), 13

[13] Timothy Morton argues not that the world is ending but that it has already ended. He is not referring to an invisible apocalypse but but because we are unable to understand the word “world” what we call “the world”—a place that revolves around human beings and is defined by what we can see and feel—is simply too small to cope with reality anymore. Faced with massive forces whose impacts defy our physical perceptions, from global warming and extinction events to the Covid-19 pandemic, our parochial idea of the world falls away like the set of a movie being torn down.

[14] Karen Barad, "Meeting The Universe Halfway” (Durham, North Carolina: Duke University Press, 2007), 224

[15] Mark Fisher, “The Weird and the Eerie” (London: Repeater Books, 2016) 8-9

[16] Cassandra Collective, “How To Break Free of the Ghosts of the Future,” 264

[17] Susan Buck-Morss, “Seeing <—> Making | Room for Thought” ed. Susan Buck-Morss, Kevin McCaughey, Adam Michaels (Los Angeles: Inventory Press, 2024), 202

[18] Mark Fisher, “Ghost Of My Life: Writings on Depression, Hauntology and Lost Futures,” (Winchester: Zer0 Books, 2014), 22

[19] Reyner Banham, Machine Aesthetics, New Statesman, August 1958 (A Critic Writes Essays by Reyner Banham, ed Mary Banham, Berkeley: University of California Press, 1999), 28

[20] Hito Steyerl, “In Defense of the Poor Image,” in *e-flux journal #10* (November, 2009) https://www.e-flux.com/journal/10/61362/in-defense-of-the-poor-image/

[21] “I am not referring to the direction of time. I am thinking rather of the psychological perception, which emerged in the cultural situation of progressive modernity, the cultural expectations that were fabricated during the long period of modern civilisation, reaching a peak after the Second World War. These expectations were shaped in

the conceptual frameworks of an ever progressing development, albeit though different methodologies: The Hegel-Marxist mythology of *Aufhebung* and founding of the new totality of Communism; the bourgeois mythology of a linear development of welfare and democracy; the technocratic mythology of the all-encompassing power of scientific knowledge; and so on."
Franco 'Bifo' Berardi, "After The Future," (Chicago: AK Books, 2011) 18
[22] Ingo Niermann, "Communists Anonymous" in *Communists Anonymous,* ed. Ingo Niermann and Joshu Simon *(London: Sternberg Press,* 2017) 14
[23] Ursula K. Le Guin, *"The Carrier Bag Theory of Fiction,"* (London: Ignota, 2019), 36

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THE TECHNO-SUBLIME OF MEDIA SPECTACLE: FROM SCREEN-INTERFACE TO SCREEN-SCAPE IN SEOUL'S DDP

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INTRODUCTION: SCREEN AND SPACE IN THE COMMUNICATIVE CITY

The contemporary city increasingly manifests as an urbanscape where digital screen and architectural space converge to create new forms of cultural experience. Seoul, with its high degree of media saturation, exemplifies a city interwoven with advanced information and communication technology (ICT) that articulates distinct combinations of corporeal, emotional, and spatial perceptions. Within the context of the convergence of ICT and urban space, referred to as "the media city" or "the communicative city,"[1] the Dongdaemun Design Plaza (DDP), designed by the late Zaha Hadid, stands out as a notable example of what Colangelo describes "massive media,"[2] presenting monumental and iconic architectural expressions through large-scale projection and high-resolution media façades. Focusing on the recent two site-specific projection installations at DDP, Yiyun Kang's *Geofuture* (2022) and Je Baak's *Lucid Dream* (2021), this paper explores how these works of media art contribute to constructing a distinctive form of media spectacle that negotiates between global architectural aesthetics and local cultural narratives while articulating a new form of Seoul's urban identity. In doing so, the paper argues that the DDP's media spectacle exposes the shift from conventional screen-interfaces to immersive screen-scapes, thereby establishing the material conditions for the synthesis of a new collective perception, that is, the techno-sublime.

DDP AND LOCALIZED OCCIDENTALISM

The historical and cultural contexts of DDP are deeply rooted in Seoul's colonial memory from the early twentieth century. Originally constructed as a stadium in 1925 during the Japanese colonial period to commemorate Crown Prince Hirohito's wedding, the site marked a significant milestone in Seoul's architectural history as the city's first modern sports arena. Following liberation in 1945, it evolved beyond its colonial origins to become a vibrant center of Korean sporting culture, particularly during the industrialization and urbanization phase of the 1960s through 1970s. The dual stadia for baseball and football witnessed a number of memorable matches that helped forge Korea's national identity, celebrating the healthy, strong, vibrant, collective, and disciplined bodies of a modern state.

Figure 1. Dongdaemun Stadium. Photograph taken by Seoul 2025 Urban Form and Landscape, Seoul Metropolitan Government 2005, Dongdaemun Stadium Aerial View, August 2005, Wikimedia Commons. Accessed 11 February 2025 https://commons.wikimedia.org/wiki/File:Dongdaemun_Stadium_2005_01.jpg.

Figure 2. Dongdaemun Design Plaza. Photograph taken by Eugene Lim, Dongdaemun Design Plaza at night, Seoul, Korea, April 17, 2014, Wikipedia. Accessed 11 February 2025 https://en.wikipedia.org/w/index.php?curid=68358278.

In 2008, the Seoul Metropolitan Government (SMG)'s initiative to convert this historical monument into a contemporary landmark exemplified Seoul's approach to reconciling its post-colonial and modernization legacy while forging a novel mode of global, cosmopolitan, and post-industrial character. This transition prompts major questions about the place identity regarding the redefinition of historical legacy and the reconstruction of collective memories amid political and memory conflicts among diverse stakeholders.[3] A crucial challenge pertains to the degree to which newly generated visual representations and narratives shape the identity of the particular locale of the Dongdaemun area.

Zaha Hadid's proposal that actively employs a metonymic landscape approach to DDP won the global design competition in 2007 and the construction was completed in 2014. Creating an indirect interplay between the DDP's central position and its adjacent district, Hadid's metonymic design seeks to facilitate the relational integration of historical, cultural, and urban elements as an organic yet indeterminate amalgamation. This metonymic entity manifests as the world's largest three-

dimensional amorphous structure that intentionally juxtaposes the porous trait of public space with traditional Korean ramparts through bold slopes and sweeping arcs. The building's exterior, characterized by a curvilinear design, comprises 45,133 distinctive panels, facilitating an equilibrium of natural and built environments. Spanning 86,574 square meters across three underground and four above-ground levels, the utilization of mega-truss methods, space frame systems, advanced BIM (Building Information Modelling), and exposed concrete demonstrates a high level of contemporary engineering capabilities and achievement. The key principles of Hadid's design—transparency, porosity, and durability—were implemented in alignment with SMG's strategy to convert historically intricate sites into vibrant cultural hubs that preserve collective memory and simultaneously embrace urban globalization.

The reconstruction of DDP might be viewed as an embodiment of 'localized Occidentalism,'[4] signifying the localization of the imagined future city while resulting in the decontextualization of the place. Globally recognizable yet locally unrecognizable, DDP confronts the challenge of reconfiguring historically rich and intricate cultural sites while maintaining a futuristic architectural aesthetic. This tension between global and local identity serves as the backdrop for the active employment and utilization of innovative media art. Since its inaugural exhibition in 2019, DDP Seoul Light, an annual media art showcase organized by the Seoul Design Foundation, has substantially contributed to representing, redefining, and reshaping DDP's identity as a central cultural nexus within the creative industrial complex, particularly in design, architecture, and fashion by hosting events such as the DDP Design Fair, Seoul Fashion Week, and the Seoul Biennale of Architecture and Urbanism.

DDP Seoul Light shows that the social and cultural issues of localized Occidentalism concerning DDP's futuristic spectacle are inseparable from complex aesthetic inquiries of media art, notably regarding the intersection of ICT and architectural space. When projected onto the vast 222 m façade, how do DDP's curvilinear surfaces and amorphous form contest the traditional role of media façade as a screen-interface? How does the new fusion of multiple projections and spatial configurations of the structure align with DDP's distinctive architectural style and monumentality? In what manner does DDP, as a massive media, affect public perception of the historical and cultural meanings of public space? I analyze a case involving two media arts at DDP to answer these questions.

GEOFUTURE AND ATMOSPHERIC SCREENING

Yiyun Kang's *Geofuture*, a 3D mapping project developed in partnership with Dassault Systèmes, which specializes in software for 3D product design and interactive applications such as CATIA solution. As a response to Dassault Systèmes's project, <The Only Progress is Human / Act 4: The City>, Kang's work focuses on the sustainable coexistence of humanity, nature, and technology, exploring the human-nature connection through the lens of the Anthropocenic crisis. This work builds on her previous installations, including *Casting*, the site-specific installation at the Victoria and Albert Museum (2016), and her large-screen media façade works *0.4* and *Vanishing* at COEX K-Pop Square COEX in Seoul (2022), which have consistently interrogated the relationship between visual and spatial elements through the mediation of digital screen and projection.

Figure 3. Yiyun Kang, Geofuture, 2022. DDP, Seoul, South Korea. Courtesy of the artist.

The narrative framework of *Geofuture* unfolds in three sections, each contributing to a comprehensive exploration of urban geography. The first section, focusing on macro to micro changes within the city, illustrates the interdependence of urban systems. Through dynamic visual transformations between aerial city views and microscopic structures, the work employs particle systems and fluid dynamics simulations to represent urban flows. The integration of data visualization of Seoul's environmental metrics demonstrates the intricate interconnections between urban infrastructure and natural systems. In the second section, depicting landscape evolution, *Geofuture* transforms static urban forms into dynamic biodiverse ecosystems through generative algorithms simulating natural growth patterns. Fluid animations morph geometric forms into organic systems while utilizing color gradients to represent ecological transitions, creating a bridge between local cultural heritage and global environmental concerns. The third section emphasizes animate transformation through evolving patterns that suggest biological growth. The implementation of reactive elements responding to environmental conditions creates visual metaphors for urban-natural symbiosis. The integration of sound design enhances the sense of living presence, while temporal rhythms mimicking natural cycles complete the transformation from static architecture to living system.

The experiments undertaken by *Geofuture* constitute both an aesthetical and ethical response to the environmental crisis, as well as a technological adaptation to the evolving role of urban screen. The technical difficulty arises from the inadequacy and limitations of existing mapping approaches to DDP's complex curvilinear surface. Kang actively utilizes Dassault Systèmes's Virtual Twin program, a cognitive augmented design tool that facilitates extensive projections on an uncertain surface. By accommodating the numerous curves and angles of the building, *Geofuture* generates seamless projections through its 45,133 panels. The technical achievement of *Geofuture* represents a distinctive method by which digital screen technologies not only overlay but fundamentally reshape our experiences of the urban space. As Slaatta observes, screen technology in itself is evolving into a

landscape, blurring the distinction between 'natural' and 'electronic'—or 'digital'—landscape.[5] Kang integrates optical projection with the environmental area, merging modeling and simulation to convert DDP's myriad panel surfaces into a large-scale screen that serves as both a container and a content for digital projection. The surface of DDP functions both as a projected screen and as a spectacle in its own right. DDP has become a massive media that generates a meta-commentary on the interplay between digital design instruments and tangible urban environments. The massive media function of *Geofuture* shows that contemporary screens function not as an interface of display but as a screen-scape, a multilayered technological space when the technological and architectural infrastructure constitutes the "optical-environmental compound."[6] *Geofuture* as a screen-scape is articulated not only by the representation of the spectacle—a key function of screen-interface—but also, more crucially, by "the atmospheric screening,"[7] a spatial projection practice that facilitates the permeable fusion of the visual and the spatial and thereby blurs the boundary between physical architecture and imaginary projection. Herein lies the distinctive aspects of Kang's work as a media spectacle. *Geofuture* turns DDP into an environment where the viewing experience becomes inherently spatial and embodied. *Geofuture*'s digital surface reshapes DDP as a multifaceted mixture of pictorial imagination and spatial materiality. As Bruno argues, the atmospheric screening itself becomes an "actual environment."[8] Through their experiences of *Geofuture*, the spectators are immersed in DDP's environment not through their visual shock displayed by the massive media but through their multisensorial immersive perception. *Geofuture*'s atmospheric screening converts DDP into a massive media and transforms its physical site into an urban environment where the visual, the spatial, and the corporeal are fused, shattered, and constantly reconfigured.

LUCID DREAM AND THE MEMBRANE SCREEN

A South Korean contemporary multimedia artist, Je Baak created *Lucid Dream: Five Colors*, a 12-minute multi-projection installation for the 2021 Seoul Light show, reflecting his ongoing investigation into post-humanist aesthetic perspectives on the increasingly intertwined relationship between human beings and technology. Baak's multimedia works specifically examine the convergence of reality, perception, and spirituality, juxtaposing Eastern Philosophy and Buddhist ideas with Western aesthetics, illustrating the growing integration of the human body into an expanding machine. In his recent piece, *Poetry of Time* exhibited at DDP Seoul Light in 2024, Baak examines how AI interprets the poetic language of the artist's inner ideas, exemplifying a collaborative creative method between humans and machines. The artist draws an abstract painting from memory and subsequently composes a poem to articulate his emotions regarding the image. The generative AI program analyzes the emotional aspects of the poem and reflects them with the production of a new image. in his series, *Colors of Memory*, Baak's work prominently features an exploration of the technological imagination of memory through color. *Lucid Dream* embodies his endeavors to amalgamate color imagery with spatial reality by employing DDP's surface as an organic screen, a venture he designates as meta-bio art, signifying a fusion of metaverse, biological, and media art.

Figure 4. Je Baak, Poetry of Time, 2024. DDP, Seoul, South Korea. Courtesy of the artist.

Lucid Dream is structured around five distinct themes—emotion, skin, void, act, and time—which correspond to traditional Korean color theory, Obangsaek, a term that literally denotes five color modalities: black, green, white, red, and blue. The installation creates rhythmic temporal progression, presenting a substantial organism as a 'metaverse' of the building's surface, which challenges the conventional way of visual perception of color and memory. The first meta-emotion segment utilizes dynamic color algorithms derived from emotional mapping, producing fluid transitions between affective states. The emotional aspects of color are presented through abstract patterns that undulate across DDP's surface, generating what Bruno refers to as "the surface tensions of media,"[9] which enable the interaction between the color's imagination and the viewers' emotional reactions. The second section, meta-skin, explicitly turns the building's panels into cellular structures that appear to breathe and react to ambient conditions, implying a living, responsive architecture imposed by light patterns. The implementation of reactive surfaces that adapt to environmental conditions enhances the texturality of the panels, leading to organic spatiality. In the third section, the meta-void generates areas of emptiness and existence through the deliberate application of light and shadow. Baak's application of color transparency intensifies surface permeability, enabling a dynamic interaction between architectural rigidity and biological fluidity. The fourth meta-act segment produces dynamic movement patterns that suggest deliberate agency, obscuring the distinctions between architectural materiality and the organic movement of image flows. The fifth section, meta-time, modulates temporal perception via rhythmic color alterations, emphasizing the hue of memory that encompasses both the spatial and the temporal.

Figure 5. Je Baak, Lucid Dream, 2021. DDP, Seoul, South Korea. Courtesy of the artist.

The five chapters of *Lucid Dream* illustrate how Baak's meta-bio art constructs an organic media spectacle, wherein the boundary between representation and reality becomes increasingly permeable and indistinct. The audience views DDP's colorful panels as diminutive cells that transform across various layers, generating an augmented environment, a tangible area superimposed with dynamically shifting color-images. However, Lucid Dream elucidates an additional layer of screen-space, alluded to as 'a screen-membrane' by Bruno.[10] The numerous panels, resembling small cells, coalesce with the colored images, separating and ultimately merging like a living organism. DDP's panels function as 'connective tissue' in the metamorphosis of architectural space into 'pliant planes of moving images.'[11] The membrane surface of DDP transforms into a screen-scape, immersing in a blend of color visuals with its expansive space. Baak's bio-art, *Lucid Dream*, transforms DDP into a massive—yet animate—media, creating a 'phantasmagoric' screen-scape of 'urban spectacle'.[12]

THE PHANTASMAGORIA OF URBAN SPECTACLE

The metamorphosis of DDP via the two media installations illustrates overarching theoretical issues in urban, visual, and media studies. Both works demonstrate how DDP, as a screen-scape, navigates intricate relationships between global architectural aesthetics and local cultural narratives, forming a hybrid visual lexicon that resonates with both international and Korean audiences. These installations demonstrate how the gigantic spectacle of massive media may shape distinct cultural expressions and articulate a form of screen-scape. Mitchell asserts, "the screening of nature has revealed the nature of the screen."[13] True. The transformation from screen-interface to screen-scape at DDP signifies not merely technological advancement, but a profound change in the interaction between the dynamics of human perception and environmental media. The vast magnitudes of digital projections engender significant psychological and perceptual implications that profoundly alter urban spectators' cultural and aesthetic experiences. Kang and Baak's works pose cognitive challenges as spectators engage with intricate environmental media that surpass Occularcentric perceptual frameworks of attention and concentration, resulting in novel forms of spatial awareness marked by shock, awe, and distraction. The DDP spectacle represents a 'phantasmagoric' space, as Benjamin describes, where technological spectacle fosters novel forms of multi-sensorial perceptions.[14]

The communal urban experience articulated by the convergence of atmospheric screening and membrane screens at DDP may be regarded as a manifestation of the 'technological sublime' proposed by Leo Marx, which outlines the nuanced yet essential distinctions in the elevated perspective of the spectacle.[15] The Romantic sublime emerged from encounters with natural phenomena, eliciting feelings of awe, terror, and danger (Edmund Burke) or embodying a principle of disorder or purposelessness (Immanuel Kant). In contrast, the technological sublime arises from the experience of the engineered spectacle, specifically "the uncanny feeling" when one faces "the machine in the garden."[16] However, Kang and Baak's works depict the DDP spectacle as the nature of the machine, wherein the uncanny feeling arises from the interaction within the screen-scape. The paradoxical character of the technological sublime in the DDP resides in the spectacle's capacity to evoke dual aspects of collective perception, characterized as "delight tinged with horror," as articulated by Bourriaud,[17] this entails a simultaneous attraction and repulsion towards the technological spectacle of nature. As metropolitan areas increasingly implement multimedia projection installations in public spaces, the DDP exemplifies innovative perspectives on urban space as both a medium and a message in McLuhan's terminology.[18] Although there are similarities in both approaches to media art, Yiyun Kang's work emphasizes the de-anthropomorphizing of nature in the Anthropocene, whereas Je Baak's work centers on the technologization of human beings in the age of AI. The spectacle of the DDP screen-scape configured by these installations not only aids in shaping

Seoul's urban identity but also signifies the symptomatic rise of phantasmagoric public spaces where technology, nature, and human experience foster novel modes of public imagination within the increasingly technologized metropolis.

NOTES

[1] Scott McQuire, *The Media City: Media, Architecture and Urban Space* (London: Sage, 2008).; Scott McQuire, "Architecture, Media and Spaces of Urban Communication," in *Communicative Cities and Urban Space*, ed. Scott McQuire and Sun Wei (London and New York: Routledge, 2021), 28-44.
[2] Dave Colangelo, *The Building as Screen: A History, Theory, and Practice of Massive Media* (Amsterdam: Amsterdam University Press, 2019).
[3] Hyun Kyung Lee, "Recreating Dongdaemun Stadium in South Korea: Beyond Japanese Colonial Memories and towards a Global City," *Seoul Journal of Korean Studies* 31, no. 1 (June 2018): 99-128, doi: 10.1353/seo.2018.0005.
[4] Arif Dirlik, "Architectures of Global Modernity, Colonialism and Places," *Modern Chinese Literature and Culture* 17, no. 1 (Spring 2005): 33-61, doi: https://www.jstor.org/stable/41490932.
[5] Tore Slaatta, "Urban Screens: Towards the Convergence of Architecture and Audiovisual Media," *First Monday* 11, no. 2 (2006), doi: https://firstmonday.org/ojs/index.php/fm/article/download/1549/1464.
[6] Francesco Casetti, "The Optical and the Environmental: From Screens to Screenscapes," *Critical Inquiry* 49, no. 3 (Spring 2023): 325, doi: https://doi.org/10.1086/723720.
[7] Giuliana Bruno, *Atmospheres of Projection: Environmentality in Art and Screen Media* (Chicago: The University of Chicago Press, 2022).
[8] Bruno, *Atmospheres of Projection,* 160.
[9] Giuliana Bruno, *Surface: Matters of Aesthetics, Materiality, and Media* (Chicago: The University of Chicago Press, 2014), 73.
[10] Bruno, *Surface,* 5.
[11] Bruno, Surface, 5.
[12] Jaeho Kang, *Walter Benjamin and the Media: The Spectacle of Modernity* (Cambridge: Polity Press, 2014).
[13] W.J.T. Mitchell, "Screening Nature (And the Nature of the Screen)," *New Review of Film and Television Studies* 13, no. 3 (2015): 231-246. doi: https://doi.org/10.1080/17400309.2015.1058141
[14] Walter Benjamin, "Paris, Capital of the Nineteenth Century," in *The Arcades Project* (Cambridge, MA: Belknap Press of Harvard University Press, 1999), 14-26.
[15] Leo Marx, *The Machine in the Garden: Technology and the Pastoral Ideal in America* (New York: Oxford University Press, 1964).
[16] Marx, *The Machine in the Garden*.
[17] Nicola Bourriaud, *Planet B: Climate Change and the New Sublime*, trans. Denyce Beaulieu (Paris: Radicants, 2022).
[18] Marshall McLuhan, "The Medium is the Message," in *Understanding Media: The Extensions of Man* (Cambridge, MA: MIT Press, 1994[1964]), 7-21.

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CAN VIRTUAL NATURE REPLACE REAL NATURE? THE IMPACT OF LIVING PLANTS AND IMAGES OF NATURE ON RESTORATION, CUSTOMER SATISFACTION, AND BEHAVIORAL INTENTIONS IN CAFÉS

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INTRODUCTION

With the rapid pace of urbanization and modernization, urban dwellers are increasingly exposed to high levels of mental stress, making psychological well-being a critical public concern.[1] In response, various industries, including the food service sector, have adopted strategies to create restorative environments that promote relaxation and stress relief. Among these strategies, healing marketing has emerged as an effective approach for attracting and retaining customers by enhancing their overall well-being.[2] One promising method for fostering a restorative atmosphere is biophilic design, which integrates natural elements into built environments to support human health and psychological recovery.

As a representative type of third place, cafés have come to play a particularly important role in urban life. Beyond offering spaces for dining, relaxation, and social interaction, they increasingly function as everyday environments where individuals seek emotional comfort, psychological restoration, and a sense of well-being.[3] In this context, biophilic design becomes not merely a decorative choice but a strategic intervention to support psychological and physiological restoration, enhance customer experience, and promote positive behavioral outcomes.

Previous studies have highlighted the benefits of natural elements in promoting psychological restoration, particularly the positive effects of living plants in reducing stress, improving mood, and enhancing mental health.[4] Simulated or constructed representations of nature—such as digital displays, nature-themed prints, or videos—are significantly more beneficial than the complete absence of visual contact with nature. For interior environments where incorporating real nature is difficult due to spatial limitations or maintenance concerns, such indirect applications of nature offer substantial value.[5]

Biophilic design has been widely applied in cafés, where the presence of living plants and images of nature has become a common practice. However, while the benefits of biophilic elements have been well-documented in healthcare and hospitality settings, the specific effectiveness of biophilic design—particularly images of nature—in café environments remains relatively underexplored. Attention Restoration Theory (ART) provides a theoretical foundation for understanding how natural elements facilitate psychological restoration. The theory posits that prolonged mental fatigue resulting

from urban living and cognitive overload can be alleviated through exposure to restorative environments. According to Kaplan and Kaplan, such environments support recovery by engaging the mind effortlessly and fostering the core restorative experiences of being away, fascination, coherence, compatibility, and legibility.[6]

This study aims to bridge this gap by examining how living plants and images of nature contribute to restoration, customer satisfaction, and behavioral intentions in café environments. Specifically, this study has two key objectives: (1)Grounded in Attention Restoration Theory (ART), this study aims to evaluate the effects of living plants and images of nature on the five key dimensions of restoration—being away, fascination, coherence, compatibility, and legibility. (2)To assess the influence of living plants and images of nature on customer satisfaction and behavioral intentions. By addressing these objectives, this research provides valuable insights into the role of biophilic design in enhancing the well-being and experiences of café customers.

LITERATURE REVIEW

Living Plants

As a crucial component of the direct experience of nature in biophilic design, living plants—such as potted and flowering plants—are among the most commonly employed strategies to integrate nature into built environments.[7] Numerous prior studies have demonstrated the various physiological and psychological benefits of incorporating plants into architectural spaces.

In the healthcare sector, research by Brogan and Wise has shown that exposure to environments with green plants effectively lowers heart rate, reduces blood pressure, increases serotonin levels, restores gut microbiota, and mitigates inflammation.[8] Furthermore, introducing living plants into indoor spaces has been found to enhance pain tolerance, reduce fatigue and overall discomfort, and promote cardiovascular health.[9] Additionally, in hospitality settings, the presence of plants has been proven to enhance guests' well-being, improve psychological health perceptions, and significantly increase satisfaction and revisit intentions.[10] Indoor greenery has also been shown to have a positive impact on mental health in a coffee shop settings.[11]

Images of Nature

In environments where direct contact with plants and vegetation is not feasible, images of nature serve as an essential aspect of the indirect experience of nature in biophilic design, offering a connection to the natural world.[12] Previous studies have confirmed that nature imagery—depicting plants, animals, water bodies, oceans, expansive landscapes, mountains, and geological features—can provide benefits comparable to those of direct encounters with nature.[13] Such images, presented through various media, including videos, photographs, and paintings, can facilitate human interaction with nature within built environments.[14]

Extensive research has explored the positive impact of nature images on human well-being, particularly in healthcare settings. Artistic depictions of nature, such as paintings of plants and video footage of natural landscapes, have been shown to effectively reduce patient stress levels.[15] Furthermore, studies indicate that hospitalized patients who are exposed to nature imagery during their recovery process experience faster recuperation and lower stress levels.[16] Research by McMahan & Estes found that viewing photographs of natural environments alleviates mental fatigue and fosters greater emotional well-being and cognitive health.[17] A study by Untaru et al. further corroborated these findings, demonstrating that the emotional well-being induced by nature images enhances satisfaction with healthcare facilities. Moreover, the improvements in emotional well-being and cognitive health can strengthen patients' attachment to healthcare environments.[18]

Attention Restoration Theory

Attention Restoration Theory (ART), proposed by Kaplan and Kaplan, suggests that prolonged engagement in cognitively demanding tasks can lead to mental fatigue, which can be alleviated through exposure to restorative environments. [19]

Biophilic design plays a crucial role in fostering restorative environments by integrating natural elements into built spaces. By providing a sense of connection to nature, biophilic design enhances the restorative potential of spaces, making them more conducive to mental rejuvenation.

The restorative perception of an environment is measured through five dimensions: being away, which refers to the sense of psychological and physical escape from everyday stressors; fascination, which captures the effortless attention evoked by intriguing and aesthetically pleasing natural elements; coherence, which describes the environmental organization and its ability to create a harmonious experience; compatibility, which assesses how well the environment supports an individual's needs and preferences, and legibility pertains to the ease of navigating and understanding the space. These dimensions collectively determine the extent to which an environment can facilitate attentional recovery and psychological restoration.[20]

Existing studies have demonstrated the positive effects of biophilic elements, such as plants and water features, in promoting restoration. However, despite the widespread incorporation of living plants and images of nature in café environments, research examining their specific restorative potential remains limited. Given the increasing application of biophilic design in commercial settings, it is essential to investigate how these elements contribute to psychological restoration and customer experience in cafés.

Customer Satisfaction and Behavioral Intentions

Customer satisfaction refers to an individual's assessment of a product or service based on their expectations and needs.[21] Satisfaction occurs when the perceived service performance surpasses expectations, making it a key factor in business success.[22] Since satisfaction directly influences post-purchase behavior,[23] it holds significant importance for customer retention.

Behavioral intentions generally involve repurchase likelihood, product returns, and word-of-mouth (WOM) recommendations,[24] all of which are closely tied to business performance. Consequently, these factors have been widely studied in the tourism, retail, and service industries.

While prior research has explored the role of café environments in shaping customer satisfaction and behavior, highlighting the positive effects of natural elements,[25] studies specifically examining the impact of living plants and images of nature remain limited. As biophilic design becomes more prevalent in commercial spaces, further investigation is needed to clarify its influence on consumer experiences and business outcomes.

METHODOLOGY

Data collection was conducted from July 29 to August 13, 2024, using the online survey platform Creadamo. A total of 300 café customers aged 20 and above participated in the study. Prior to participation, all respondents provided informed consent via the platform. Participants were asked to evaluate the café's biophilic design, restorative environmental perception, customer satisfaction, and behavioral intentions based on their most recent café experience. These evaluations were measured using a five-point Likert scale, with survey items adapted from previous studies.[26]

After eliminating inconsistent or unreliable responses (e.g., contradictory answer patterns), a final sample of 251 valid responses was used for analysis. The collected data were coded in Excel, and internal consistency was assessed using Cronbach's alpha. To examine the relationships between the independent variables (living plants and images of nature) and the dependent variables (restorative

environmental perception, customer satisfaction, and behavioral intentions), linear regression analysis was performed. All statistical analyses were conducted using IBM SPSS Statistics 23.

RESULTS

Composite reliability (CR) values confirmed internal consistency across factors, demonstrating that the measurement scales were reliable. The CR values for each construct were as follows: Living Plants (0.848), Images of Nature (0.747), Being Away (0.768), Fascination (0.759), Coherence (0.721), Compatibility (0.800), Legibility (0.791), Satisfaction (0.706), and Behavioral Intentions (0.726). These values indicate that all constructs met the commonly accepted threshold for composite reliability (0.70), ensuring the robustness of the measurement model.

To further examine the relationships among the key variables, linear regression models (Figure 1) were employed to assess the impact of biophilic design elements (living plants and images of nature) on the perceived restoration dimensions (being away, fascination, coherence, compatibility, and legibility), customer satisfaction, and behavioral intentions.

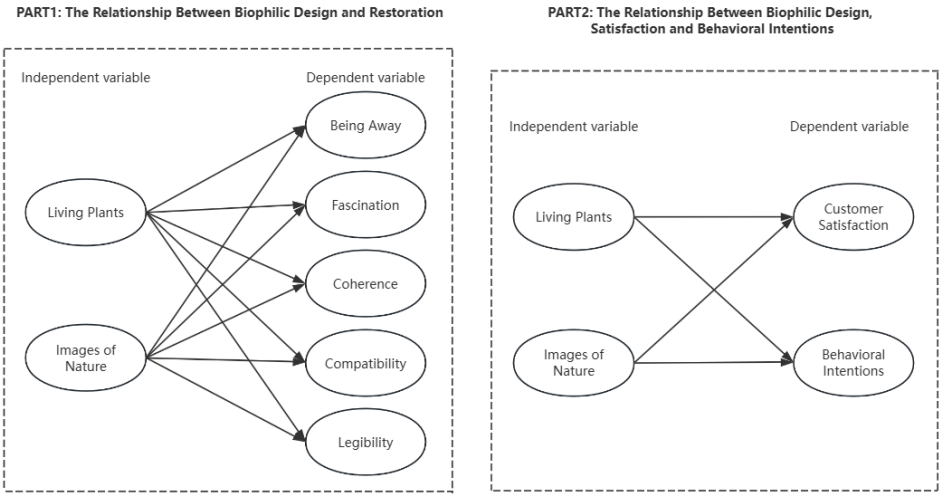

Figure 1. Linear regression models.

The Relationship Between Biophilic Design and Restoration

A significant regression model predicted being away ($F = 29.088$, $p < .001$, adjusted $R^2 = 0.184$). Both living plants ($\beta = 0.376$, $p < .001$) and images of nature ($\beta = 0.179$, $p = .002$) had significant positive effects. Fascination was also significantly predicted ($F = 41.231$, $p < .001$, adjusted $R^2 = 0.244$), with both living plants ($\beta = 0.348$, $p < .001$) and images of nature ($\beta = 0.318$, $p < .001$) showing significant contributions. For coherence, the model was significant ($F = 4.538$, $p = .012$, adjusted $R^2 = 0.028$), though only images of nature had a significant effect ($\beta = 0.179$, $p = .005$), whereas living plants did not ($\beta = 0.039$, $p = .540$). Compatibility was significantly predicted ($F = 36.571$, $p < .001$, adjusted $R^2 = 0.222$), with both living plants ($\beta = 0.252$, $p < .001$) and images of nature ($\beta = 0.375$, $p < .001$) exhibiting significant effects. Legibility was also significant ($F = 16.687$, $p < .001$, adjusted $R^2 = 0.112$), with living plants ($\beta = 0.127$, $p = .036$) and images of nature ($\beta = 0.305$, $p < .001$) both having positive effects.

These findings underscore the crucial role of biophilic design in enhancing multiple dimensions of restoration, including being away, fascination, compatibility, coherence, and legibility (Figure 2). While both living plants and images of nature contributed positively, the relative strength of their effects varied across different psychological constructs.

Living plants had a stronger impact on being away, reinforcing their effectiveness in facilitating psychological escape and mental relaxation. Both elements significantly influenced fascination and compatibility, demonstrating their shared ability to create engaging and supportive environments that promote psychological well-being. Images of nature played a dominant role in coherence, likely due to their curated aesthetic appeal and structured composition. The non-significant effect of living plants on coherence suggests that while they enhance restoration, they do not necessarily contribute to perceptions of environmental organization and order. Legibility was positively influenced by both living plants and images of nature, suggesting that natural elements enhance spatial comprehension and environmental clarity. However, images of nature had a stronger effect, possibly because they provide visual landmarks and contribute to a more structured perception of the space.

Overall, the results highlight the effectiveness of biophilic design elements in fostering a restorative environment. Moreover, they underscore the complementary roles of real and visual nature, emphasizing the importance of integrating both elements in biophilic design to maximize psychological and perceptual benefits.

The Relationship Between Biophilic Design, Satisfaction and Behavioral Intentions

The multiple regression analysis revealed that both living plants and images of nature significantly influenced customer satisfaction and behavioral intentions. The model predicting customer satisfaction showed an R^2 of 0.134, indicating that 13.4% of the variance in customer satisfaction could be explained by the predictors ($F = 19.181$, $p < .001$). Both living plants ($\beta = 0.256$, $p < .001$) and images of nature ($\beta = 0.232$, $p < .001$) were significant predictors, suggesting that the presence of biophilic design elements contributes positively to customer satisfaction.

Similarly, the model predicting behavioral intentions exhibited a higher R^2 of 0.211, explaining 21.1% of the variance in behavioral intentions ($F = 33.101$, $p < .001$). Again, both living plants ($\beta = 0.311$, $p < .001$) and images of nature ($\beta = 0.301$, $p < .001$) significantly impacted behavioral intentions. These results indicate that incorporating biophilic design elements not only enhances customer satisfaction but also fosters stronger behavioral intentions.

Notably, the effect size of living plants was slightly higher than that of images of nature in both models (Figure 2), implying that direct exposure to real plants may have a more profound impact on customer satisfaction and behavioral intentions. This could be attributed to the multisensory engagement offered by living plants, including their tactile, olfactory, and dynamic visual qualities, which enhance the overall immersive experience.

From a practical perspective, these results emphasize the strategic value of incorporating both living plants and images of nature in commercial environments such as cafés. While real plants provide a heightened sense of connection to nature and may yield stronger effects, images of nature offer a feasible alternative where maintaining live greenery is impractical due to spatial, financial, or maintenance constraints. The combination of both elements can create a more holistic and accessible biophilic environment, maximizing user satisfaction and reinforcing positive behavioral intentions.

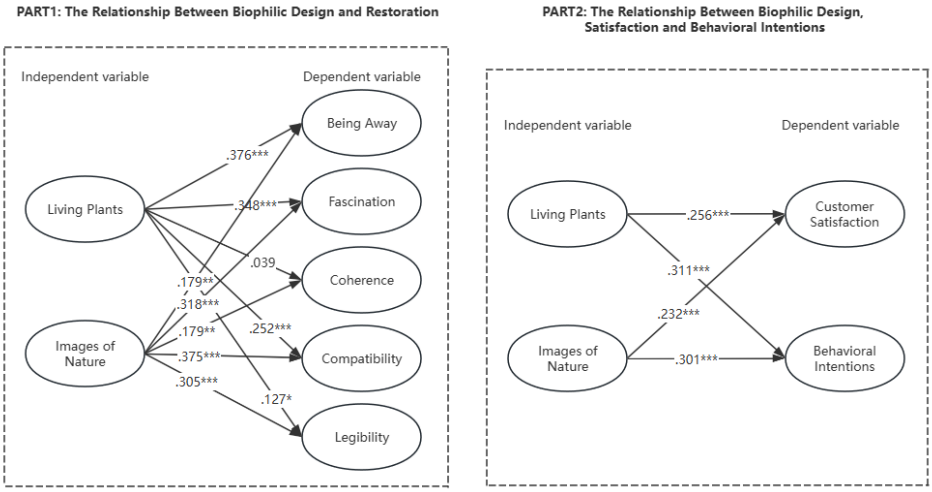

Figure 2. Result of Linear regression models.

CONCLUSION

This study demonstrates the significant impact of biophilic design—specifically, the presence of living plants and images of nature—on psychological restoration, customer satisfaction, and behavioral intentions in café environments. Grounded in Attention Restoration Theory (ART), the results validate that natural elements enhance key dimensions of perceived environmental restorativeness, namely being away, fascination, coherence, compatibility, and legibility. Importantly, the findings reveal that while both living plants and images of nature significantly contribute to restoration, the strength and significance of their effects vary across dimensions. Living plants exerted a stronger effect on being away, indicating their notable role in facilitating psychological escape. In contrast, images of nature had a significant impact on coherence, while the effect of living plants on this dimension was not statistically significant. Meanwhile, both elements significantly influenced fascination, compatibility, and legibility, highlighting their complementary potential in promoting multiple aspects of environmental restorativeness.

Furthermore, the positive influence of both living plants and nature imagery on customer satisfaction and behavioral intentions confirms the value of biophilic design in commercial contexts. Notably, living plants exhibited a slightly stronger effect on both satisfaction and behavioral intentions compared to images of nature, suggesting that direct exposure to real plants may have a more pronounced influence on customer attitudes and future behaviors. These results suggest that integrating both real and representational nature elements can maximize psychological and perceptual benefits, particularly in environments where maintaining live plants is difficult due to spatial or operational constraints.

Theoretically, this study contributes to the growing body of research that applies Attention Restoration Theory beyond healthcare and residential environments to hospitality and service settings. By empirically validating the psychological mechanisms of biophilic design in cafés—a widely frequented type of third place—this research expands the scope of restorative environment studies and provides a nuanced understanding of how different natural modalities influence users' restorative perceptions and behavioral responses. Practically, these findings provide actionable design guidance for café owners, interior architects, and brand strategists seeking to enhance psychological restoration, customer satisfaction, and behavioral intentions through nature-inspired interventions.

In sum, this study underscores the psychological and behavioral significance of biophilic design in everyday environments, highlighting its potential to foster more human-centered, restorative, and experientially rich commercial spaces or third places that actively support mental well-being and customer engagement.

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SPECTATOR AS SPECULATOR: MEDIATED ARCHITECTURE AND IGNORANCE

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INTRODUCTION

In this paper I explore representations of buildings that purport to enclose knowledge and its production. Having assembled a typology of architectural images leased, owned or commissioned by the Big 4 consultancy/accountancy firms, I present some preliminary observations of the typology as a whole, and three salient examples. Delimiting and commodifying knowledge and its opposites, an architecture emerges which appears to shift away from any prior idea of a transparent 'knowledge commons' towards something more recursive, paradoxical and cognizant of the value of non-knowledge.

One of the key insights gained from exploring the collection of images is that the simultaneous operation of functions of *auditing* and *consultancy* – the key activities of the Big 4 - can be traced in the operation of the networked architectural image itself. Photorealistic, the image appears to be traced off an immanent and contingent reality, however given its role as an economic actor, it projects a desired future: the trace is simultaneously a projection into a future that it attempts to produce. This is consistent with the performative economics which Esposito[1] describes as endemic under late Capitalism, based on binding the future via present speculation, producing realities by speaking them into being.

My interrogation of these diverse architectural images attempts to locate the trace of non-knowledge. Significant of the financialised economy, according to Davies and McGoey is the productive power of strategic ignorance.[2] The auditing/consulting industry was instrumental in the global economic crash of 2008: an audit of Lehman Bros in 2007 by EY revealed none of the evasive practices which were later uncovered. Reflecting on these events, McGoey writes:

Here… is where the value of ignorance becomes most visible. After the system stabilized, collective ignorance – believable because of its sheer magnitude – has been a useful alibi, helping to deflect accountability for those who precipitated the crash. It has proved remarkably difficult to hold particular financial actors liable for systematic risks that few have admitted to understanding or perceiving. Ignorance has a double usefulness. First, widespread social silence enabled the perpetuation of highly profitable, however ultimately destructive, activities. Second, earlier silences were exploited in order to exonerate the actions of individuals claiming risks were impossible to detect. It was logical to claim ignorance both before and after the collapse. [3]

Ignorance (in many forms) can be seen as productive of a reality from which images can present themselves as having been traced.

The Logic Equilibrium of the Image

Since the financial crisis of 2008 the Big 4 accountancy and consulting firms – EY, PwC, Deloitte and KPMG – have gained in influence, economic heft, territorial reach, and ownership or control of real estate. A sector worth 212 billion USD in 2024[4] servicing state and private clients, the ostensible function of actors in this sector is to mitigate market risk through both analysis (audits and accountancy) and prediction (consultancy). Since the global financial crash of 2008, with states and pan-national bodies proposing and imposing regulations in order to prevent a recurrence, the sector has sought to capitalise on manifesting an equilibrium between risk and security for its clients – including the very 'regulatory landscapes' designed to ensure market stability following 2008. This strategy has led to exponential growth in the sector, reaching 103% in 2022.

For Dunne et al[5] the Big 4 balance internal contradictions in their business model by maintaining what they term 'logic equilibrium:'

Logic equilibrium refers to the state of balance between the contradictory forces of the professional and commercial logics that allows organizational field actors to simultaneously leverage aspects of both logics. [6]

A 'manifest tension between audit and non-audit work' is sustained by 'institutional maintenance,' a large part of which consists of sustaining a mythologising spectacle to market, regulator and public, thereby presenting an appearance of institutional coherence which covers up layers of complexity and potential conflicts which have led to lawsuits, state regulation and public mistrust.[7] One function of the sector's preoccupation with construction and real estate is to serve this process of spectacular mythologising by bodying forth and signalling tangibility, permanence and accumulation.

My typology therefore contains a series of mappings and framings of the relationship between knowledge and non-knowledge. Visually heterogeneous, though bodying forth some fairly recognisable generic corporate tropes, this paper is not so much an analysis of style but rather various *gestures*: how the image is *played* in the context of a game which must be played endlessly.

Performance

For Barthes, the contemporary architectural image - digitally rendered, networked and *operative* - represents 'what has been'[8] while simultaneously constructing the world discursively.[9] It recently emerges as a functional actor in construction due to its integration into technologies that materially link visualisation and construction via automation and data processing, such as Building Information Management (BIM). Architectural critic K Michael Hays' speculation on architecture potentially becoming 'a total fusion of media, in terms of both form and content'[10] – is enabled by technologies within which the image is functionally deployed to facilitate both measurement (via photometric scanning) and marketing (via the translation of construction data into legible perspectival representations). The image in such a system faces both forward and back.

According to economist Elena Esposito, the trading of complex financial instruments produces a *'risk society,'*[11] which negotiates value by trading complex instruments in the present in order to bind the future - and is characterised by performativity:

…the future can be produced by the very operations that try to anticipate it. This is something financial markets do continuously. They sell derivatives that set the conditions for the future in the present, and look forward to how things will continue once the future is accomplished.[12]

This is graspable when dealing with traditional commodities – minerals, foodstuffs etc. However, the creative and productive perpetuation of 'asymmetric information'[13] implies speculative trading on the perpetuation of ignorance, whereby *'operators do not exchange goods, but uncertainty (in the sense of 'the mutual unconsciousness of what the future holds').* (ibid) Some of the buildings in my typology deploy a finite and bounded form of representational schema ('photography' and its analogues) to

present spectacular proof of the sheer productive potential of 'mutual unconsciousness.' Such productive uncertainty could not function without a corresponding signifier of fixity, tangibility and certainty. The function of the photographic was always precisely to frame the unpredictable immanent in order to overwrite contingency in the service of discourse,[14] however convergent technologies now make certainty and uncertainty, knowledge and ignorance, *productive* on the same platform.
Under conditions of financialised economics one does not really know whether one is looking at a building that contains future knowledge, present intelligence, or an archive – if the image is speculative, the projection of future knowledge into an architectural container based on *present* technologies and knowledges blocks out future insights or discoveries by framing them within present modes of understanding.

TEL AVIV – A SIGNAL GLITCH

To take a first example/sample, the Tel Aviv offices of EY, pitched as a combination of data centre, organisational hub and watchtower, showcase surveillance infrastructure at scale:
'On the 16 floors, 14 OPEN 810 EMS controllers integrate a total of 9,000 data points via 560 FCU controllers. OPENview, the DEOS HTML 5 user interface hosted on the OPEN 810's internal web server, provides system graphics, trending, alarming and commissioning tools.'[15]
The building gathers and represents *quantity*: mass and duration - a kind of 'audit.' In my typology we encounter many representations of change via projections of immanence and fixity: maybe the first form of ignorance to contend with is that the representations in question do not show the activity of construction which is the true signifier of economic activity: the endless mechanised 'churn' of a city undergoing an infrastructure upgrade: such a city resembles a building site, its signifiers are cranes, and thoroughfares impassible due to excavations.
We can deduce from this that the being (or representation) of the audit is very different from the process of auditing. The edifice bodies forth the power of auditing, its presence, in a sense, by the very immobility of architecture, representing vast accumulations of material and in this case also data. For 'masses' to 'play in light' they must first be accumulated, however the linearity of this structure is a key signal that such a process must have taken place – a rational process, rather than anything in which non-knowledge plays a productive role. This is ignorance of ignorance.

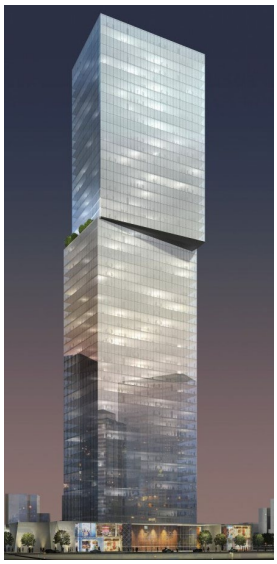

Figure 1. EY Headquarters, Tel Aviv, Moshe Zur Architects 2021

EY's Tel Aviv HQ also encodes risk and power. For De Certeau, height is dominance enabled by the elevated view,[16] and the structure introduces the signal glitch of a 'twist' which functions as a banner advertising the presence of 'risk.' Such a glitch is performative, like a film stunt – a balance between the appearance of instability, and the complex engineering that renders it utterly safe. The analogy – both visual and gestural - is a form of *hedging* – a practice that attenuates investors' exposure to risk depending on their differential access to capital. Structurally the armature is absolutely stress tested, but the appearance of a flaw, or an element of 'danger,' signals uncertainty under complete control. Absence of risk would be unprofitable – risk is both desired and undesired.

Binding the future, the rendering of the tower represents omniscience-as-commodity, in the process signalling the presence of risk: the existence of the building (in rendering or reality) *produces the environment as risky*: whether it is or not depends on how convinced one is by the representation: it is uncommon to accept a building as gestural, performative – as ephemeral as an advertising pitch - however, as technology such as BIM accelerates construction, it addresses a market need for *impressive structures built quick,* which simultaneously convince with their mass, while emerging (and disappearing) rapidly.

Seen speculatively, such a structure signals the potential of dominance and its other, the possibility of powerlessness, the dark matter of risk: that which is *not accounted for.* Architecture, for Benjamin, is primarily received by masses in a state of distraction,[17] and in this project, the image also. What is happening in the background?

All that is *not here* - outside the frame of the building and its image - is framed as risk.

ANXIETY IN ELYSIUM: THE WINGS

Figure 2. Rendering of The Wings (Diagem, Belgium) (Assar Architects, for Ghelamco, 2024)

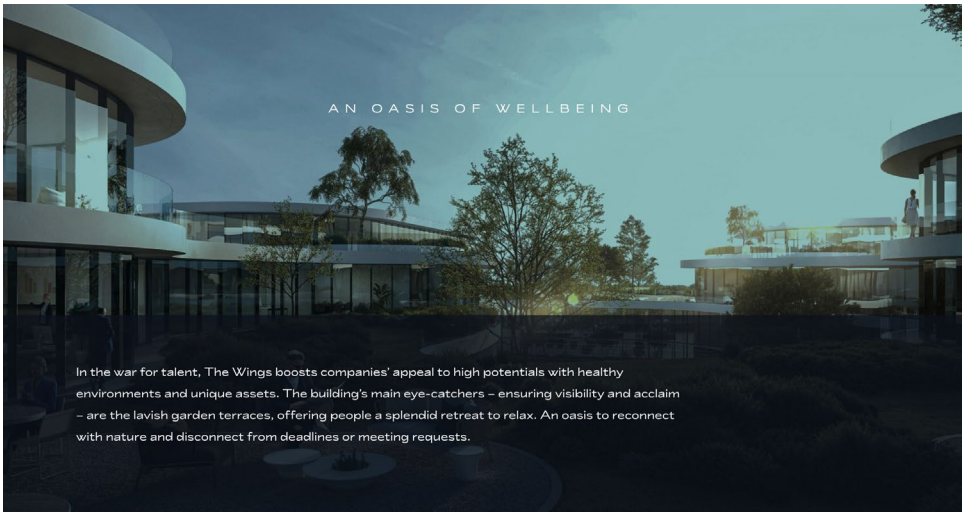

Figure 3. Promotional images and text for The Wings (Diagem, Belgium)

It would be impossible to foreground everything here, so I present a signal example of the notion of 'manufactured anxiety,' EY's HQ in Diegem, Belgium, The Wings. (Assar Architects, for Ghelamco, 2024) Presented as 'an oasis of wellbeing,' and boasting three sustainability certifications, the development's promotional copy runs thus:

'In the war for talent, the Wings boost companies' appeal to high potentials with healthy environments and unique assets. The building's main eye-catchers – ensuring visibility and acclaim – are the lavish garden terraces, offering people a splendid retreat to relax. An oasis to reconnect with nature and disconnect from deadlines or meeting requests.'[18]

This is a direct appeal from the developer intended to attract high profile occupants. Beginning with the metaphor of a 'war' for talent, the world beyond the frame is produced as one of conflict and stress. The contradiction between an appeal to 'high potentials' – referring to 'high potential earners' – and the image of workplace-as-downtime is essentially temporal: is the 'war' for talent merely to give these subjects time to relax? The war in question is 'for' a certain kind of subjectivity – either to be recruited, or to be performatively produced. There is even a double meaning here: a 'war for talent' might also be taken in the same sense as a 'war for freedom,' implying a conflict between talent and its opposites. The rendering implies an effort to raise capital in the present based on the production of the opposite of talent in the future – maybe ignorance - by speaking it into being, performatively.

The building is one of many in the typology which focus on signs of sustainability: architectural greening such as garden walls, the integration of vegetation and overt signifiers appealing to a contemporary visual tropes of 'sustainability.' However, in this context this points to an Elysian vision. Bucolic, Arcadian, picturesque, the website presents the images in the context of a gathering darkness.

MORE LONDON

The More London Estate houses three significant buildings: the offices of PwC at 7 More London, EY's London HQ at 1, and the now vacant County Hall at the Eastern end of the estate, the famous egg-shaped structure designed to house London's parliament. The estate itself, topped out in 2001, was conceptualised and laid out by Foster and Partners, and the landowner is St Martins Property Group – a pseudonym for the Sovereign Wealth Fund of Kuwait.

Since 2001, much has changed: though the two competing accounting/consultancy firms remain, the State was forced to decamp in 2020 to the London Borough of Newham: in order to cut costs

London's governing body now occupies the Crystal building in the Royal Docks area, formerly London base for industrial giant Siemens. Despite all its efforts to promote 'growth' and marketing London as 'open to business,'[19] the state simply failed to compete on market terms since the most significant 'black swan' event of recent years, the Covid-19 pandemic of 2020.

Figure 4. Rendering of 7 More London (Foster and Partners, 2001)

PwC's block, at Number 7, is dark and dynamically angular, forbidding and clad in pigmented glass which renders vision unidirectional. It looks out onto a world of risk, and though it might resemble an oceangoing vessel - a catamaran, its twin 'hulls' facing the Thames – it has other aquatic resonances. It could also be considered to represent a 'Black Swan,' with wings outstretched, taking flight.
The building faces onto its competitors – immediately to the left, Ernst and Young, and to the right City Hall, the Regulatory State. However, considering that the Sovereign Wealth Fund of Kuwait own the entire campus, this gathering of competing organisations is manifestly not the site of a collectivity based on solidarity and shared interests, but a game, like a pitch or a card table, explicitly anticipating the exclusion of any losing player. EY's current marketing slogan is 'All In,'[20] conflating Artificial Intelligence and gambling in one neat phrase. In this case, the losing player turned out to be the State.

Figure 5. Left: 1 More London (EY), Right: 7 More London (PwC), image: the author

To reference a Foucauldian concept, each building, in its ability to contain entire worlds in terms of information gathering and modelling, is ostensibly a heterotopia, the definition of which is 'a kind of effectively enacted utopia in which the real sites, all the other real sites that can be found within the culture, are simultaneously represented, contested, and inverted.' [21]

However, here are two heterotopias facing off against each other, PwC versus EY, each one projecting omniscience, occupying the same site. One must necessarily contain a representation of the other. One is the curtain twitching neighbour of the other, a representation of which must necessarily be contained within, and so on ad infinitum. One imagines a market for each self-contained standpoint which cannot see beyond itself, thereby delimiting the conditions for its own visibility, but also its ability to observe any *thing* at all. The limit of visibility against which all is measured is a *loss* such as that experienced by London's governing authority, or the contract not proceeding, the money running dry, etc. The horizon is the closing of a deal: nothing lies beyond, everything leading up to that is contingency. We need to look at the rendering of More London and be able to see the possibility of the State losing as a condition of the existence of the image, an indexical trace, as real in its productive capacity as the fake trees.

As Esposito notes, this is a space of orientation, not knowledge or fixity but manouverability:

Operators, who do not know everything, observe other operators in order to decide what to do. This circular observation produces what is called the prevailing inclination, market feeling or perceived trend, which does not reflect what people actually think, but only what people think that people think. This constitutes the shared reference to which everyone orients themselves. One does not know how things actually are; one knows only what to do.[22]

What stares across the void between EY and PwC is the trace of risk – the other - that guarantees the perpetuation of a high stakes game, which remains in play with the state relegated to the East, downriver, downwind. Regulation is priced out precisely because of the success of the business model: greater risk necessitates more anticipatory management, more hedging, the accumulation of more capital and territory. Regulation cannot be afforded, however because the actors trade on navigation of regulatory conditions, both risk and the threat of regulation must be performatively

created. The view from each building is of the absolute other, the presence of which ensures the viability of the game.

CONCLUSION

The photographic returns as a kind of 'zombie.' Despite all attempts to proclaim its death[23], it returns stronger than ever. It appears that, despite the rise of a financialised, performative economy, without the truth function there is nothing to trade, regardless of orientation, manoeuvring, the scission of sign and referent. Each image in my messy typology embeds itself in a discursive context which plays it as a card, as chips in a casino, or in the case of the State and More London, the illusory promise of a prosperity secured by forms of certainty. This constant oscillation between knowledge and non-knowledge engineers the closing out of other possible futures. As Étienne Balibar notes, neoliberalism is utterly dependent upon the infrastructure of the social state which it performatively opposes: the provision of public infrastructure and good governance is a significant subsidy.[24] Its loss signals the approaching end of this business model, as the entities in question come to take their own representations for reality, in the process forgetting the role of ignorance in their success.

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BEYOND SMART: INCLUSIVITY THROUGH GRASSROOT INITIATIVES IN URBAN BARCELONA

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INTRODUCTION

Smart city initiatives are being recognized as viable responses to modern urban challenges with the potential to enhance collective capacity for urban planning. Central to the operational framework of smart cities are the concepts of multi-level governance and co-creation among diverse stakeholders, including local communities, governmental entities, non-governmental organizations, and private enterprises. This inclusive approach increases the likelihood of successful implementation while promoting long-term sustainability through shared ownership and mutual benefits.

However, recent studies have identified significant limitations in existing engagement models, with criticisms focusing on the exclusion of citizen voices and the marginalization of vulnerable and underrepresented groups. These concerns raise important questions about the inclusivity of smart cities and challenge their capacity to ensure equitable access to the benefits of smart technologies and applications

This paper critically examines existing engagement tools in terms of inclusivity, with a focus on the role of grassroots initiatives in promoting social inclusion and environmental justice within smart cities. Using specific case studies from Barcelona's smart city initiatives, we challenge the conventional understanding of "smart citizenship," arguing that the concept of being "smart" should not be confined solely to technological advancements.

Inclusiveness through Co-Creation in Smart Cities

In the 21st century cities have become crucial mechanisms for human development, relying on community interdependence and improvements in resource efficiency to ensure long-term sustainability. However, these urban centers face significant challenges, associated with rapid urbanization, increased density, uncertainties and extreme hazards linked to climate change and deepening socio-economic inequalities.

Smart city initiatives are emerging as potential solutions to these contemporary urban issues, by enhancing our collective ability to plan and respond. Central to the smart city's processes are the principles of multi-level governance and co-creation. This collaborative approach ensures that diverse perspectives and needs are addressed, fostering innovation, resilience and inclusive transformation .[1] By integrating inclusive co-creation mechanisms, smart cities can not only harness the collective intelligence of their populations but also promote equity, accessibility, and a sense of belonging.[2]

The concept of co-creation points to a shift in how public participation is understood. Whereas from the 1970s onwards the discussions surrounding participation centered on rights and power,

participation conceptualized as co-creation instead focuses on including diverse forms of knowledge in urban processes to create innovative solutions to complex problems. Co-creation in Smart Cities refers mainly to innovation and value creation taking place as a collaborative process involving different types of actors. In this framing public institutions enable citizens to actively engage themselves in social policymaking and service provision, and it is as much about harnessing resources as about empowering the deprived.[3]

The vision of an inclusive smart city (ISC), which identifies and meets the needs of everyone, especially marginalized groups, seems to be the main issue of modern urban governance facing constant challenges in different sectors.[4] According to de Oliveira and Neto, the main characteristic of the ISC is the "ability of identifying places and objects (or things) and making this information digitally available".[5]

Whilst there is an implicit value to smart cities being imagined as inclusive, some researchers argue that though ISC are necessary and desirable, the term "inclusive" has often been misinterpreted as being inclusive of every segment of the population, without considering people's choices or having become aligned with the concepts of scale, economic growth and expansion. Instead, they argue that ISC should be evaluated as whether they are equal and liveable.[6] In this context, the term "smart citizenship", i.e. civic engagement via technology, is being put into question as it serves practices that are addressed to the "urban elite". The technologically illiterate and the poor risk being marginalized, and the digital spaces that emerge from smart citizenship act as aunctional separation between 'sealed-off technological enclaves and leftover marginalized spaces.[7] Thus, the 'digital divide'[8] becomes a central concern.

Given the need for more citizen-focused and inclusive smart cities this study investigates the inclusivity of smart city engagement tools and the challenges they encounter. Using Barcelona as a case study, the research also examines the potential of community-led initiatives to advance environmental justice and social inclusion.

The research questions are listed as follows:

a.Which are the key co-creation mechanisms for smart city solutions, and which are the barriers against civic engagement?

b.How can community-led initiatives contribute to enhancing social inclusion in urban environments?

A descriptive case study approach was adopted, supported by a literature review to identify smart city characteristics, engagement models, and strategic frameworks. Secondary data were used including policy documents, reports, and materials from various organizations. Barcelona was selected as a case study for its long-standing smart city strategies and diverse engagement models. However, inclusivity gaps persist, particularly among its culturally diverse population. This ongoing research will incorporate empirical studies in the future, including semi-structured interviews, to provide a more comprehensive understanding of inclusive smart cities.

Citizen engagement models in urban innovation

According to Simonofski et al.,[9] urban innovation has traditionally been driven by urban planners making centralized decisions aligned with the municipality's vision for the city. However, in smart cities, a more inclusive approach has emerged, leveraging the participation of all stakeholders to address social sustainability goals.

The European innovation system utilizes the quadruple helix model to foster open urban innovation, enabling seamless collaboration and idea exchange among its stakeholders: citizens, academia, government, and industry, fostering an innovative urban ecosystem.[10] The participation of different stakeholders occurs in three stages: planning, development and implementation of digital tools/applications and actions and is part of the so-called "bottom-up" approaches. The employ of

different tools aims to support creativity and the diversity of ideas, lead to more effective and inclusive solutions.

Figure 1. Smart City Engagement Tools

According both to literature and city documents, smart cities adopt various engagement models that draw on best practices established within the framework of urban development (Fig.1). Sustainable urban innovation in smart cities relies on active stakeholder engagement and the strategic use of data. Information collected from sensors, mobile apps, and other sources throughout the city is analyzed to identify patterns, trends, and areas for improvement. This analysis helps city officials and urban planners better understand the needs and preferences of citizens. Based on these insights diverse stakeholders collaborate in co-creation workshops to develop innovative urban solutions. Following the co-creation workshops, prototypes of the proposed solutions are developed and tested in real-world scenarios. Citizens are actively involved in testing and providing feedback on these protypes ensuring that the final solutions meet their needs and expectations. Once the prototypes have been refined based on citizen feedback, they are implemented on a larger scale. Continuous monitoring and evaluation help ensure that the solutions remain effective and responsive to the evolving needs of the community (Fig.2).

Figure 2. Smart City Innovation Flow

Barcelona's official smart city strategy initiated in 2015[11] and it is structured around 3 pillars. (1) Digital Transformation (2) Digital empowerment (3) Digital Innovation. Digital Transformation addresses issues related to digital infrastructure, 5G networks, data management and social innovation. The term "social innovation" refers to identifying and addressing social challenges using data. A key component of this pillar is the use of Open-Source Software and Open Data, which enables stakeholders to collaborate and interact through platforms like GitHub. Digital Empowerment refers to initiatives that are related with digital education and training, digital inclusion, democracy and digital rights. Communities are engaged in co-creation activities related to green initiatives through platforms such as "Decidim" ("We decide" in Catalan). Decidim is an open-source digital platform that provides residents with access to open-data sets such as transportation, housing, environment and public services. Using the platforms, residents can submit proposals for projects and initiatives that they believe can benefit the community. The proposals once submitted are reviewed and discussed with other community members who can vote on which project they support. Digital Innovation refers to initiatives related to digital entrepreneurship, start-up programs, Innovation Districts and Living Labs. 22@Barcelona, known as the 'Makers District,' is an internationally

recognized innovation and technology district, surrounded by cutting-edge companies, research centers, and training facilities. Various types of labs operate in the city focused on the development and implementation of urban solutions (Fig. 3) typically managed by municipal authorities or operate through public-private partnerships.

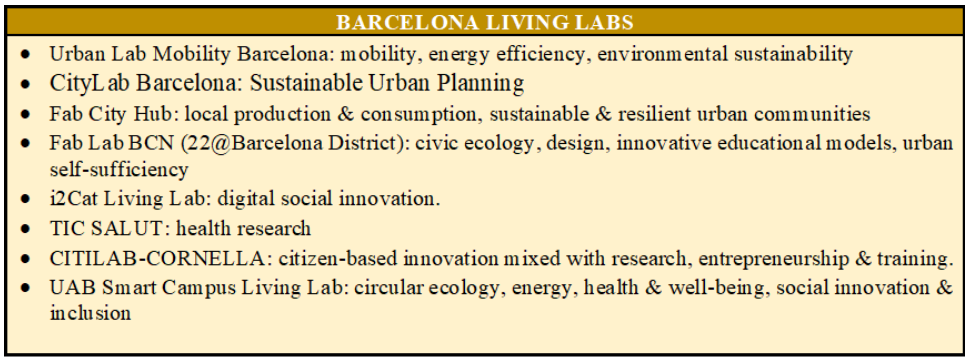

Figure 3. Barcelona Living Labs

Although the key co-creation mechanisms seem to promote inclusivity, the ways in which these collaborative ideas have been put into practice have been criticized for being "public support machines"[12] that exclude marginalized citizens. It has been argued that other forms and other conceptualizations of participation are needed.

The implementation of engagement models is influenced by various factors.[13] One significant challenge is technological barriers, including unequal access to digital infrastructure caused by geographic, economic, or social disparities, which restrict participation in co-creation efforts. While low-cost ICT solutions have emerged, challenges like digital literacy, language, and technical aptitude still exclude many citizens, with initiatives like hackathons often targeting tech-savvy individuals. Additionally, security concerns, including potential misuse of data by third-party users, further complicate engagement efforts.[14]

Social and institutional factors are also crucial. Successful community engagement relies on citizens' willingness to participate[15] and their confidence in the effectiveness of their involvement.[16] Traditional approaches often exclude certain demographics (younger/older citizens, culturally diverse groups)[17] and require significant time investment alongside family commitments, work, and social events.[18] Institutional challenges include distrust of government-led initiatives, insufficient funding, and physical or social barriers that hinder the participation of marginalized groups.

Addressing these challenges requires rethinking existing urban models, which often fall short in tackling these critical issues. Citizen-led initiatives can bridge these gaps by promoting meaningful and inclusive grassroots innovation beyond technological advancements.

Community-led activism for sustainable societies

According to the Theory of Community Empowerment, propagated by Paulo Freire in the 1970's, true societal change can only be achieved through the empowerment of marginalized communities. This theory posits that empowering individuals and communities with knowledge, skills and decision-making authority enables them to actively participate in shaping their own futures. In the context of smart cities environmental initiatives underscore the importance of enabling community members to take ownership of environmental issues and decision-making processes. By fostering a sense of agency, building capacity and promoting inclusive participation, grassroot initiatives have the

potential to empower individuals and communities to become stewards of their local environment and effect positive change[19] beyond the technological driven smart city concept.

Grassroot movements refer to collective actions driven by community members aiming to address local issues or advocate for broader social, political, or environmental change. These movements originate at the local level and rely on the active participation and mobilization of ordinary people, rather than top-down directives from larger organizations or political entities. Projects backed by local organizations can quickly gain momentum on the local level because they are generally enacted by local actors. Individuals' interactions in their immediate neighborhoods have the potential to give rise to strong community-wide patterns and these patterns may lead to broader interactions.[20] These groups are the first responders to the crises and critical witnesses to which solutions are a better fit to context.

Known for its progressive urban planning measures including the widely celebrated car-free Superblocks model, Barcelona continues to consolidate its trajectory by making neighborhood revitalization, climate adaptation and the creation of green, public spaces a priority.[21] Although this new urban model sounds ideal, a closer look reveals some problematic trends. Various typologies of nature-based solutions are implemented in the city, from city-planned large-scale projects to community-driven, informal interventions. Infrastructure-intensive greening projects by municipal authority despite their important ecological features, whether intentionally or not, can end up serving the interests of new real estate developments. At the same time smart city engagement models often fail to include marginalized community members in decision making processes due to the challenges mentioned above. These stand in stark contrast with community-led urban gardens that promote community cohesion, inclusivity and engagement with nature while facing temporality and precariousness. Grassroots groups are fighting to stay in their neighborhoods as gentrification and urbanistic pressures are mostly set to transform formerly industrial lots into service and IT sector areas.[22]

The neighborhood of Poblenou, as part of the 22@Barcelona project, has undergone radical transformations, with less emphasis on community-building and more focus on a service-sector, office-based economy. The area was designated for "productive activities," particularly in technology, media, energy, design, and medical industries, attracting startups, multinational companies, and research centers. It also serves as a testing ground for smart city technologies, including IoT systems, energy-efficient buildings, and urban mobility solutions. While the project has revitalized the area, it has also led to rising property prices and the displacement of long-time residents and small businesses, sparking debates about social equity. These rapid changes have challenged Poblenou's traditional identity, although efforts have been made to preserve its industrial heritage through cultural initiatives like the Palo Alto creative space. In terms of community engagement and inclusivity there have been attempts to involve local communities in planning, but some argue that the process prioritizes economic goals over social inclusivity. While 22@Barcelona emphasizes innovation, there are concerns about whether all residents benefit equally from the smart city technologies and infrastructure. Concerning its environmental goals, the project includes sustainability measures, such as green buildings and renewable energy, but balancing growth with environmental preservation remains an ongoing challenge. Although the gentrification pressures do not paint a promising picture for equity, the social movements and mobilizations advocating for community-oriented spaces offer a beacon of hope for achieving social and environmental justice.

ConnectHort is a community-driven urban gardening project in Barcelona that exemplifies grassroots environmental initiatives. Located in the Poblenou district, ConnectHort transforms unused urban spaces into vibrant community gardens, promoting sustainability, community engagement, and environmental education. The project adapts a collaborative decision-making process regarding the

garden's development and activities, with input from all participants. Specific projects focus on supporting marginalized groups, such as refugees, low-income families, and people with disabilities providing targeted assistance and opportunities to engage with the community and the environment.
Similarly, La Vanguardia was one of the largest community gardens in Poblenou transformed by residents. With it, residents not only reclaimed public unused land to transform it into a green and diverse space for gardening activities but introduced a new place for residents of the area to gather and socialize. Unfortunately, this community garden was bulldozed in 2020 to serve as the front lawn of a hotel situated nearby.
In the case of Barcelona, a contradiction emerges within the context of the smart city. While climate change is a key focus in smart city planning, leading to numerous environmental initiatives involving diverse stakeholders in areas like smart mobility and waste management, the expansion of tech areas like Poblenou, designed to create inclusive urban solutions, paradoxically contributed to gentrification. This, along with the significant barriers often encountered in implementing engagement models, has shifted focus away from the primary goal of leveraging technology to build an inclusive smart city.
Communities play a crucial role in driving lasting change through urban green solutions. The idea behind grassroot environmental initiatives is that the effect will be more significant if more people have the same goal and change their behavior. The more people collaborate, the faster small actions can evolve into a global phenomenon. When engagement models fail to address residents' needs and inadequately involve them in co-creation processes, grassroots movements can foster inclusivity through co-creation. Despite their potential, grassroot movements face their own problems. Community groups work on a voluntary basis, suffer from limited capacity and struggle to reach a larger audience. Universities and local councils can help, providing specific expertise and funding where needed. External organizations can facilitate exchanges between different communities, including ethnic minorities and those of lower income.[23] Sharing local knowledge and making small differences to help sustain the environment and its inhabitants can invoke action and inspire other communities and organizations to follow in their footsteps.

CONCLUSION

This study aimed to investigate smart city engagement models from the perspective of inclusiveness. Though the limitations of the research based on secondary data are acknowledged, the findings point out that smart cities build their engagement strategies based on open-data sources, digital environments/applications and co-creation mechanisms involving diverse stakeholders. Although the importance of engagement is highlighted, technological, social and institutional factors challenge the effectiveness of engagement models. Community-led initiatives aim to fill the gap created by the inefficiency of the methods by leveraging local knowledge and enhancing inclusivity. Especially concerning environmental issues, the impact of grassroot initiatives seems to be important as they address directly to local problems, require a degree of self-organization and can achieve direct interventions in urban environment.
Community engagement through co-creation for smart sustainable cities is beneficial as it can lead to developing services based on real needs of citizens and strengthening residents' interest in urban development. Though smart cities are easily considered as a technological phenomenon, in the last decade the need for a multi-level co-creation and a human centric city has become the focus of the notion "smartness". In the light of social inclusion and environmental justice, the notion of smartness moves beyond the narrow frames of technological oriented initiatives and is connected to the utilization of local knowledge and diverse cultural backgrounds. The adaptation of both formal and informal practices carried out in public space within the city and/or within a digital environment could

be proven beneficial for more inclusive smart cities. Physical public space, digital platforms and community-led initiatives can reduce the danger of social exclusion and lead to a more holistic outcome that is necessary to address urban challenges.

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THE INTERSECTION OF SPACE AND IDENTITY IN MEMPHIS' LATINX COMMUNITIES

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INTRODUCTION

It is essential to recognize that Hispanics and Latinos are not the same. While they share substantial similarities, they are distinct from one another. Therefore, it is crucial not to group them together but to treat them separately, acknowledging their unique identities and needs. In this research, the Latino community will be the primary focus of the investigation.

Being Latino encompasses resilience, adaptability, and community. The Latino community adapts to new environments while facing challenges related to identity in a different culture. The United States, a melting pot of cultures, promotes an idealistic American Dream that often fails to provide equal opportunities due to deep-rooted systemic racism, leaving the dream unattainable for people of color. Individuals immigrate seeking better opportunities or escaping persecution. This creates a dichotomy as they embrace their culture through material symbols and traditions.

The racialization system confines individuals to societal norms, stripping away individuality and fostering divisive rhetoric that limits cultural expression and impacts future generations. Systemic racism has historically influenced urban spaces, leading to ethnic enclaves and marginalizing the Latinx community. As they adapt to less desirable spaces originally designed for white Americans, they creatively redefine these environments.

Despite these challenges, the community highlights the importance of customs, traditions, and innovative use of spaces to foster belonging. Schools, churches, and non-profits serve as anchors for community-making.

The community has further demonstrated the benefits of having spaces that are unstructured play. Structured and unstructured play refers to the spaces meticulously created for a particular activity, often used within the American culture, while unstructured play refers to spontaneous spaces, with various programs occurring without a sequential or meticulous thought process, often present in Latino culture.

LITERATURE REVIEW

The United States has a complex DNA made up of many races, ethnicities, and cultures. For centuries, the country has referred to itself as a melting pot, suggesting a place where everyone is welcome. Throughout the years, the United States has embodied the allure of the' American Dream, ' leading to a significant influx of immigrants from various backgrounds. The strong promotion of the 'American Dream' creates a symbiotic relationship that contributes to the melting pot. When moving

to the United States, Hispanics and Latinx individuals face both internal and external challenges of being part of the melting pot while still holding on to their culture. As explained by authors of *Racial Formations in the United States*, Michael Omi and Howard Winant, the deeply rooted racial and cultural ideologies, along with the outcomes of the historical redlining and segregation of cities, have left a rippling effect on the emergence of American cities,[1] affecting the arrangement of ethnographic neighborhoods – enclaves. Because of the high numbers of migrants within and into the country, the societal demographics of the country have become an everchanging mosaic of cultures and ethnicities.[2]

In the racial frameworks, Latinos have always been in a state of limbo, as throughout history, they were never categorized as either black or white but rather were sometimes treated as one and sometimes as the latter.[3] Therefore, during the period of segregation and redlining cities, Latinos were placed in a gray area. Because of this, Latinos began to 'occupy' the vacant spaces left as a result of 'white flight,'[4] usually being the spaces that are the least desirable by others and the neighborhoods between the black and white races, becoming "physical buffers between predominantly Black neighborhoods, and the "better" White neighborhoods."[5]

As defined by Jesus J. Lara, "Placemaking can be defined as the transformation of physical space into areas that support human interaction."[6] Placemaking can occur in many settings through different instances. While the senses – sight, smell, touch, and hearing – are critical components of identifying a space with placemaking character, the built environment catalyzes the starting process.[7] Sensory experiences, as explained by psychologists Setha Low and Irvin Altman, begin to create a rooted attachment of individuals to a space. Moreover, the physical alterations and the placemaking process deepen the attachment and build community.[8]

The culture and traditions of the Latino community have acted as driving factors for the reprogramming and rearranging of the built environment. As explained by the author of *Latino Urbanism: Placemaking in 21st-century American Cities*, Jesus J. Lara, the community is located in spaces initially designed for others, and the community has had to adapt the space to fit their cultural needs.[9] Latinx communities are influential as they are responsible for revitalizing decaying, lifeless neighborhoods in American cities.[10] Because of their high impact, neighborhoods are taking on a new life, "transforming and retrofitting" spaces, causing the flourishing of "pedestrian-oriented places filled with urban activities" that promote social activities, consequently contributing to the creation of third spaces.[11] Although the space adapts to the needs, the available space lacks cultural identity and character because hostile rhetoric instills fear into the community, leading individuals and communities to hide in plain sight.

One of the most significant aspects of Latinx community culture is the collective mindset that fosters community-making. This communal ideology cultivates a sense of belonging within the neighborhood, challenges the boundaries between the public and private spheres, and embraces the concept of unstructured play. Consequently, the domestic space begins to serve as a catalyst for community-making.

In Latinx neighborhoods, domestic space serves as a fundamental spatial and programmatic organizer for the community. By adapting the space, the community has pushed and challenged the existing social norms of the domestic environment, transforming them to fit "their traditional vernacular forms."[12] Within the Latinx domestic space, the front yard of a house holds great significance, becoming "personal vignettes of [the] owners' lives."[13] The threshold between private and public space is blurred, located at the edge of the perforated fence, allowing a view into the front yard. This visual connection creates a grey area for the community, preventing full access to the private. These front yards foster new, unprogrammed, quasi-private, and quasi-public activities, reaffirming community-making among neighbors and creating opportunities for unstructured activities.[14] Within

the American culture, the activities performed by individuals often exist within the framework of a "structured play," meaning that specific activities happen at specific times and locations. However, within the Latinx culture, spontaneity is often a driving factor for multiple activities, creating instances of unstructured play, and causing unsystematically and informal activities to flourish.

Domestic spaces often further their utility by functioning as commercial spaces. Due to the spatial adaptation and the lack of infrastructure supporting the community's needs, domestic spaces are transformed into commercial spaces for residents, redefining their home concepts.[15] The front yard blurs domestic and commercial boundaries, creating a dynamic and non-fixated public space. The absence of sustainable infrastructure also shapes the neighborhood's vernacular landscape.[16] Community members have repurposed unconventional spaces for various programmatic activities, turning parking lots and streets into unstructured, non-fixed informal commercial corridors and plazas. [17] In the text, *Viewpoint: Latino Vernaculars and the Emerging National Landscape*, the author, Andrew K. Sandoval-Strausz, cites the quote, "Hay un supermercado en el semáforo," alluding to the idea that unconventional spaces are temporarily transformed into unpredictable spaces. This reflects the spontaneity of the culture, using its resources of adaptation and making spaces work with what they have, creating moments of informal public space that challenge the American social norm. This unstructured play makes space morphing possible, which can be seen as crude and inappropriate in the context of American structured spaces. Comparing the potential spaces of community making, such as parking lots, the act of existing in a parking lot for an extended period is deemed illegal; it is loitering. There is a difference in culture and attitudes towards mannerisms and activities because when immigrants migrate to the country, no one teaches them the socially "appropriate" mannerisms and ways of doing things.

The retrofitting of spaces allows the creation of placemaking for neighborhoods, consequently creating a sense of belonging for individuals. It creates a safe space for individuals to follow their cultural expression. However, because of the hostile rhetoric that exists, these enclaves are warned against claiming these spaces to be dangerous and full of gangs and drugs. In addition, the absence of appropriate supporting infrastructure that allows a safe space for full expression of culture and ethnicity causes a limitation on the community. However, if spaces that provided the celebration of culture and allowed for the hybridization of culture to the neighborhood existed, the attitude towards the neighborhood would change, and the benefits provided by immigrants would be recognized.[18] Resulting in the neighborhood would influence the place-keeping of the space to maintain the present ethnographical community and enhance the existing character and identity of the space.

Making the corridor pedestrian-friendly has significantly contributed to placemaking. Importantly, the space is not identified as a Latino enclave; rather, its cultural identity emerges through subtle cues like retail signage and offered products. The Latinx community of the area is "giving a new meaning to abandoned, unmaintained urban infrastructure." [19] If city officials had taken charge of placemaking for the corridor, the neighborhood would likely not have the appropriate character and identity desired by the neighborhood community.

CASE STUDIES

District of Fruitvale: Oakland, California

The District of Fruitvale in Oakland, California, is one of the most diverse areas, with a high density of minorities, including Latinos, Asians, and Blacks.[20] City officials chose a top-down approach, tasking planners with revitalizing the neighborhood to reflect the Latinx community's cultural identity. They gathered data through observations, cultural mapping, and resident interviews. Ultimately, the project created a "corridor-like plaza" connecting neighborhoods and fostering commercial activity, featuring tiles, arches, and a central fountain that echoed 'Mediterranean' and

'Mexican' influences.[21] However, while the projects had good intentions of creating a safe space with cultural identity, the outcomes were unsuccessful, creating social divisiveness and questioning the "politics of character and its use in planning and urban design."[22] The project's design failed to identify the differences between Latinos, as they are different.[23] Secondly, it created a bland and superficial design by creating details in the design based on generic ideologies of the Latino style.[24] Finally, it failed to acknowledge the presence of other culturally diverse minorities and only acknowledged the Latino presence, creating social divisiveness in the community. While the involvement of city officials in creating a top-down approach can have positive and impactful results, it is a challenging endeavor as it needs to gain a deep understanding of the existing community. The dangers of a top-down approach can catastrophically impact a community by completely dissipating the existing value of the neighborhood, sometimes even creating a fake, touristic experience for visitors.[25]

The West Vernor-Bagley Street Corridor: Detroit, Michigan

The West Vernor-Bagley Street Corridor, located in Detroit, Michigan, is locked in by the surrounding highways, interstates, and a river.[26] The corridor is located 1.5 miles from downtown Detroit, accessible by both cars and public transit, is considered a pedestrian-oriented neighborhood, and has a high density of Latinx commercial spaces.[27] The neighborhood has taken a bottom-up, grassroots approach, creating a community of character and identity and a lively, thriving, and safe space. The neighborhood is exceptionally different from the surrounding neighborhoods because of the revitalization given to the space by the Latinx immigrants. The surrounding neighborhoods are "largely characterized by vacant lots, abandoned buildings, a declining urban population, chronically high unemployment, and high crime rates." [28] The bottom-up approach to the revitalization of the neighborhood and the making of the community has aided the fast-growing Latinx population of the area.

MEMPHIS: DISTRICT 5

The Latinx community in the Shelby County area requires improved infrastructure that can serve as a third space to support their cultural needs and foster community-making. The limitations of the existing infrastructure undermine the concept of placemaking and community-making for the community' s cultural requirements.

The geographic position of Shelby County presents challenging situations for the Latinx community. In the neighboring states of Mississippi and Alabama, prevailing racial attitudes often limit opportunities for Latinos due to insufficient support from the local population and government. Memphis, located in the southern region, has a long history and strong ties to the segregation and Civil Rights Movements. However, the Mississippi River's position and its direct link to Louisiana have made Memphis a pivotal point for migration out of the Deep South, altering the city's demographics and dynamics over time. As a result of these evolving dynamics, Memphis, despite being situated in the South and bordering states like Alabama and Mississippi, has formed its own bubble, differentiating itself from the systemic South and evolving into its own interpretation of the “South. " The historical shifts in demographics continue to unfold, and Memphis now faces a new demographic landscape, leading to a transformed dynamic.

Shelby County comprises thirteen districts, including the Memphis metropolitan area and the suburbs of Germantown, Collierville, Cordova, and Bartlett. Each district features a distinct sociological and demographic profile. The analysis examined Shelby County using various methodologies to gain a deeper understanding of its current demographics, challenges faced by the Latinx community, and

available opportunities within the urban environment. For this research, both quantitative and qualitative data—cultural mapping and observation—were used to compile the data results.

Quantitative data from the Census Data Bureau noted that the United States has a total population of 331,449,281. Latinos are the fastest-growing minority group in the United States,[29] making it the largest minority group in the country, making up 26.82 percent of the total population, with a total of 62,080,044. The community has surpassed the Black and African American population, as they document to be 17.26 percent, with a population of 39,940,338. Amongst the fifty states, California has the largest population of Hispanics and Latinos at 15,579,652, followed by Texas at 11,441,717, Florida at 5,697,240, and New York at 3,948,032. The language spoken at home showed Spanish as the country's second most spoken language domestically, presenting 13.7 percent. Tennessee has a total population of 6,910,840. The state is on the lower spectrum of the Hispanic and Latinx populations, having a total population of 479,187, making up 6.93 percent.

Shelby County, located in the Memphis area, has a population of 929,744 distributed among thirteen districts and consisting of five main areas: Memphis City, Germantown, Collierville, Bartlett, and Cordova. The Hispanic and Latinx population within the county is 8.357%, totaling 77,707 individuals. Two central districts were highlighted and analyzed: Five and Twelve. District Five has a population of 72,341, with Hispanics and Latinos making up 18.989%, totaling 13,737. Spanish is spoken in 14.50% of households, not accounting for various dialects. Interviews with a Knoxville Latino organization revealed about 70 dialects in the area. Although Spanish usage isn't at its peak, dialects are prevalent in homes. District Five includes two contrasting neighborhoods: Bearclair, near Summer Avenue, and East Memphis, near Sam Cooper. These neighborhoods differ in racial composition and associated stereotypes; Bearclair is often viewed as dangerous, while East Memphis is considered highly desirable.

Through the qualitative lens, two principal methodologies, cultural mapping, and observation, were used to dissect the data. Cultural mapping is the action of analyzing a specific area in depth with the intent of gaining a sense of the existing sociological demographics of the space. This methodology "can help to develop a profile of how communities operate in places and to explain the functional links between commercial, artistic, and cultural expression."[30] The research compared the United States and Shelby County to understand the existing conditions. The research site analyzed the two districts and began looking at the current infrastructure conditions to begin calling out the current opportunities. As the research observed the surroundings, individuals in the community, as stated by the literature review, have adapted spaces to fit their needs because of the need for proper infrastructure.

An example is retrofitting parking lots into flexible spaces with simple objects like tables and tarps. Observers witness community building as people interact as if indoors, engaging with pedestrians and vehicles. The second major shift was converting front yards into commercial areas, vital for community connection through transparent thresholds. These front yards serve as miniature plazas where people sell goods and advertise informally, transforming into temporary stores and restaurants for pedestrians and drivers.

CONCLUSION

The existing challenge of lacking appropriate infrastructure to support the community's cultural needs has prompted individuals to adapt their spaces in interesting ways. This new adaptation of spatial qualities aligns with the spontaneity of the culture and the existing unstructured play. The prevailing negative discourse surrounding the community has hindered individuals from fully expressing their cultural identity. Although the adaptation of the space has addressed some needs, it has yet to fully reflect the neighborhood's character and identity. However, the potential for enhanced placemaking,

rich in character and identity, is attainable if space is provided through a mixture of top-down and bottom-up approaches, offering a secure environment for the community to fully express its cultural identity.

To engage the community in the process, the proposed approach must combine top-down and bottom-up strategies to address all of the community's needs. Given the neighborhood's large size and the negative stereotypes associated with it, an acupuncture design method would be most beneficial. This approach would encompass the entire neighborhood, creating hub spaces throughout. Additionally, it would reduce the feeling of a targetable area that induces fear among individuals. While this is the recommended approach, it is not the only one; however, it is believed to be the most effective, fostering confidence in its potential to bring about positive change.

Creating spaces that meet the needs of immigrants can help showcase the community's offerings, dismantling stereotypes. These new spaces can serve as catalysts for other neighborhoods and communities, fostering a ripple effect throughout the area and allowing for discussions about the social injustices faced by other groups.

NOTES

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RENEWING URBAN NARRATIVES: A CASE OF PUBLIC TOILETS AS INTERACTIVE URBAN SCULPTURES

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INTRODUCTION

The city of Ahmedabad is a living entity constantly evolving in response to socio-cultural shifts, technological advancements, and growing needs. The elements of urban infrastructure, such as public transportation, road networks, public parks, and healthcare facilities, have constantly embraced change. However, certain facilities, such as public toilets, remain neglected functionally and in perception. Public toilets are the most overlooked yet basic components of the urban fabric. Public toilets in India, specifically in the city of Ahmedabad, have suffered from social stigma, infrastructural lapses, lack of maintenance, and inadequate accessibility. Since it is perceived as a private and utilitarian space, it is disregarded as an integral entity of urban life. As a result, toilets are trapped in a vicious circle of poor maintenance, avoidance, and neglect that further reinforces their poor functionality and negative perception. This neglect of the public toilets is a cause of issues like open urination, reduced public hygiene, and a lack of inclusivity in the urban realm. This condition of public toilets restricts women, the elderly, and the differently-abled from accessing this basic facility in Ahmedabad.[1]

Figure 1. Locating the site

This research experiments with a scenario where public toilets are not just utilitarian units but vital and engaging urban elements. Using the potential of interactive and sensory designs, the study also explores strategies that transform public toilets into spaces that attract rather than repel. Here, public toilets in urban spaces are reimagined with space-tech interventions through lighting, soundscapes, projection mapping, and behavioural nudges in both visual and functional aspects.[2] This approach of space-making for public toilets is projected to increase user engagement, enhance safety, challenge social stigma, and improve functionality. Precedent study of existing toilets in the city and proposing

alternatives using space-tech interventions and urban design principles, the study seeks to shift the perception of public toilets from neglect and avoidance to innovation and engagement.

UNDERSTANDING CHALLENGES WITH PUBLIC TOILETS

Lapses in public toilets across India range from accessibility to maintenance. Most public toilets are smaller than the minimum cubicle size, degrading usability. The lack of maintenance, ramps, and features like a dedicated space for childcare facilities leads to issues of hygiene, accessibility, and inclusivity. Due to these reasons, public toilets remain an eyesore in the urban fabric with minimum utilitarian engagement and no aesthetic relevance in the Indian urban contexts.

Figure 2. Existing lapses in public toilets across India [3]

Analysing a Public Toilet

A public toilet in a busy marketplace at Municipal Market, CG Road, Ahmedabad, was documented and analysed to understand its shortcomings. With the male and female toilets well separated at about 10 meters, the female toilet was observed to be locked during the study. In the areas where the male public toilet was functional, spit marks on the corners and edges of the walls were observed. Lack of ventilation resulted in the retention of foul odour that degraded the user experience. Structural and non-structural cracks were evidence of infrastructural lapses. Along with functional lapses, the location of the public toilet at Municipal Market furthers the idea of shame and neglect.

Further, to understand the frequency of the facility on important public roads of the city, public toilets along the major roads of Ashram Road, SG Highway, and CG Road in Ahmedabad were studied. Public toilets in Ashram Road were observed at an average interval of 500 meters. The government mandate of having a public toilet at every petrol pump could be the reason for it. Most of the public toilets in Ashram Road were observed to be older structures. The SG Highway is a state highway passing through the city. Being an actively developed and maintained road, it has multiple toilets that were recently installed. They were observed to be in a better condition. CG Road, the site selected for the experiment, is an active commercial street. This road stretch accommodates a mix of old and newly built public toilets.

User Research

To understand user pain points, online surveys and on-site interviews of 80 individuals were conducted. Out of 80, 75% of the respondents had rarely or never used a public toilet. Only 10% of them use a public toilet regularly. 83% of the female respondents had rarely or never used a public toilet in Ahmedabad. Over 90% of the respondents prefer alternative options to public toilets.

Further, the questionnaire was divided based on whether they had never or rarely used a public toilet or had used it frequently or regularly. Of respondents who have rarely or never used a public toilet, 88% struggled to locate one in public spaces. All interviewed participants expressed concerns about hygiene and maintenance while using a public toilet. A majority of them were worried about safety in some of the other ways. When asked about alternatives to public toilets, 63% of respondents preferred restaurants or malls, while 27% of them rushed to home or office in urgent situations. The overall comfort level with technology in public toilets was rated 4 out of 5.

For respondents who frequently or regularly used public toilets, the average experience rating was 2.75 out of 5. Even in this group, respondents remained concerned about hygiene and maintenance. 71.5% of the respondents were not always able to find a public toilet easily. 66.5% of them felt unsafe while using a public toilet. Three out of every five often came across cases of open urination in Ahmedabad.

To conclude the survey, the respondents were asked if they were able to recognise these structures (Figure 3). Most of them were unable to recognise these as public toilets! Further, they were asked whether they would prefer using public toilets over alternatives if they were given a choice. 84% of the respondents who have rarely or never used a public toilet would use presented examples over the alternative options. 94.5% of the respondents think public toilets like these may reduce the cases of open urination.

Figure 3.[4] *Asking respondents if they can recognize these structures*

CG ROAD: SPATIAL AND CONTEXTUAL STUDY

CG Road evolved as a commercial hub in Ahmedabad around the year 1980. The increase in traffic and lack of parking facilities in the late 1980s made CG Road unsafe for pedestrians, vendors, and shoppers. In 1995, CG Road was redesigned to increase its efficiency and to make it safer and aesthetically pleasing while accommodating the conflicting demands on the street. Twenty years later, in 2019, its redevelopment accommodates the rising densification, footfall, and traffic congestion.

CG Road, a major commercial hub in Ahmedabad, was identified as the site for intervention and experimentation. The recently developed streetscape and presence of street furniture encouraged pedestrians to pause, further supported by commercial shops and snacking vendors. A designated parking area kept walkways vehicle-free, ensuring they remained accessible to pedestrians.[5]

Figure 4. Photographs of the site, CG Road

To assess the need for toilet facilities, estimate the number of users and design for maximum usage, the pedestrian footfall on CG Road was recorded. On a Sunday, at 5 pm, a maximum number of pedestrians were observed on CG Road. At a node with high pauses, commercial activities, and pedestrian flow, an approximate count was taken as follows:

1700 hours to 1715 hours – 219 pedestrians
1715 hours to 1730 hours – 243 pedestrians
1730 hours to 1745 hours – 208 pedestrians
1745 hours to 1800 hours – 276 pedestrians

Along with the pedestrian count, some common trends were observed on the site. A majority of pedestrians observed were commuters, street food vendors, and shoppers. Most of them walk on footpaths. Pedestrians frequently used benches to pause while walking. No direct sunlight at the time of study seemed to affect the study seemed to affect pedestrian movement or activities on the site.

Urban Characteristics of CG Road

With the recent development, the presence of planters, bollards, street lights, and layered planning made the road stretch organised and safe for pedestrians. Concrete benches and placed at regular intervals allow a pause.

The buildings along CG Road are primarily commercial and mixed-use buildings. Food stalls and vendors, which create a pause, were observed at key nodes and in front of shopping complexes with high pedestrian footfall. Dense pedestrian movement was noted at nodes, junctions, and commercial complexes. Currently, two public toilets and toilet facilities at two petrol pumps are functional on the site.

INTEGRATING SPACE-TECH AND BEHAVIOURAL NUDGES

Nudge is a theory coined by Richard H. Thaler and Cass R. Sunstein. The theory explores the possibilities and subtle ways that can influence people's behaviour in predictable ways without restricting their choices. The theory of nudges can further be explored, considering how technology, integrated with spatial elements, influences user behaviour.[6]

The theory suggests that small and seemingly insignificant details can have major impacts on people's behaviour. In South Korea, people using their phones while crossing the road often led to accidents. Installing pedestrian lights below their eye level is an example of behavioural change achieved by integrating technology into the space. However, these nudges are not mandated but serve as gentle prompts to encourage desired user behaviour.[7] They are easy and also economically sustainable. For instance, although a musical staircase by Volkswagen Fun Theory nudges the users to take the stairs, the presence of escalators alongside provides an effortless alternative to bypass it. Social incentives, such as peer pressure and people's thoughts influencing our actions,[8] also serve as examples of nudges. Japanese transparent toilets in Tokyo designed by architect Shigeru Ban, which turn opaque when in use and transparent when vacant, encourage users to leave the facility clean before exiting. A bus stop in Umea, Sweden alerts passengers about an approaching bus through light and sound. The seamless integration of space and technology enhances the waiting experience for people using public transport. Impatient road crossings provide another example of how the fusion of space and technology enhances urban life. Dancing figures on pedestrian traffic lights in Lisbon sparked curiosity. At the same time, waiting for the signal to turn green, pedestrians engaged by mimicking the dance.

The theory of nudge, along with examples of space-tech integration from around the world, demonstrates how improving user behaviour and functionality can be made more effective and seamless.

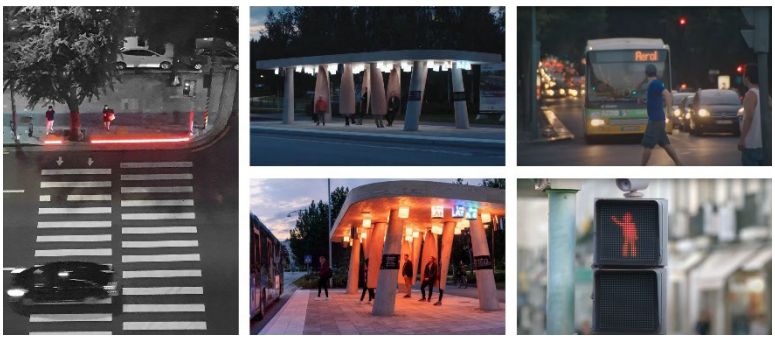

Figure 5.[9] *Space-tech examples*

PUBLIC TOILETS AS URBAN CATALYSTS

The research discusses how public toilets have the potential to foster public engagement and add value to the urban landscape. It also examines how interactive and sensory design, with space-tech interventions, can transform public toilets into sculptural pause points, challenging their stigma.

For each site along the stretch of CG Road, the placement and experimental design of the public toilets were guided through the factors of urban response, safety, engagement, and hygiene standards. Considering the factors of distance, pedestrian footfall, and urban fabric, the public toilets were planned to be at Parimal Garden, Mardia Plaza, Supermall, and Municipal Market. Each location presented unique challenges, resulting in distinct toilet designs tailored to their specific context.

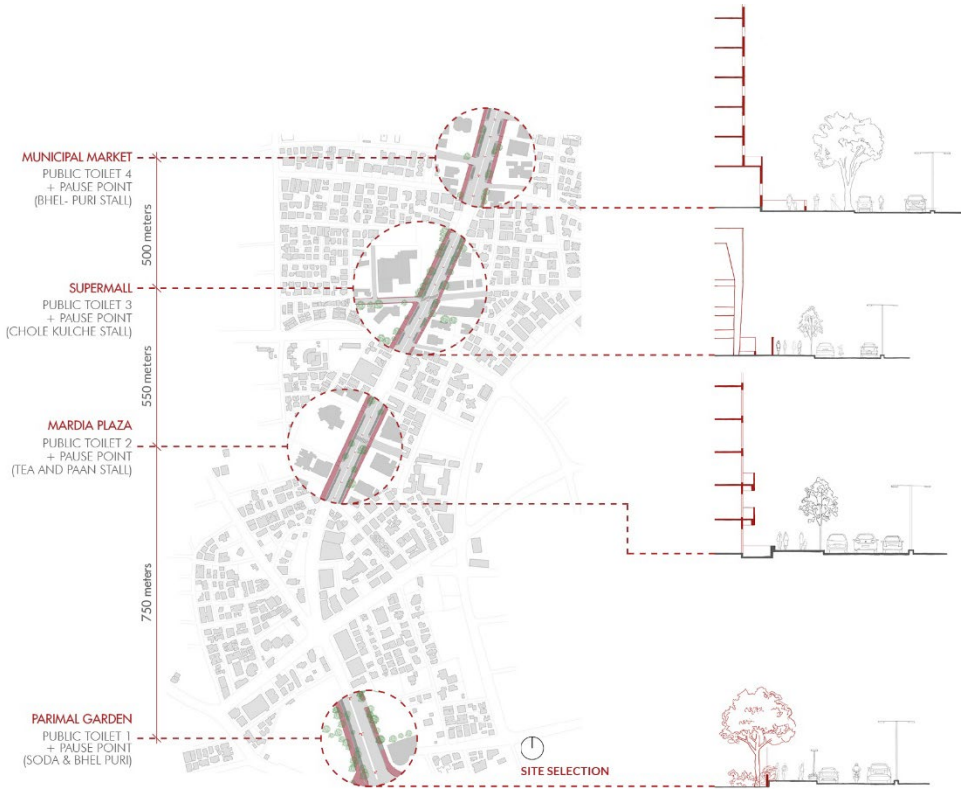

Figure 6. Locating public toilets on CG Road, Ahmedabad, India

Public Toilet at Parimal Garden

Located between the vibrant edge of a busy street and the greenery of Parimal Garden, the public toilet responds to its urban context with a light wall for safety, shaded seating as a pause point, and a MyByk[10] stand for enhanced connectivity. The public toilet complements the existing pause at the site facilitated by street food vendors. Situated at a bustling road junction, the public toilet stands out as a bold and vibrant sculptural element, seamlessly blending functionality with urban aesthetics. This not only ensures visibility but also challenges conventional perceptions of public sanitation facilities. Spit marks on corners and wall edges were a common issue observed in public toilets across Ahmedabad, compromising both hygiene and aesthetics. To address this, interventions like an interactive spittoon can spark curiosity and subtly encourage users to utilise the designed facility instead of spitting in the toilet space. A person observes spit on the graphical wall and is nudged to mirror the behaviour if required. The sensor detects the spit on the wall, and water is sprinkled from the top of the spittoon. After being in contact with water, hydroponic ink reveals the graphic of a clean space. As a result, this transforms the act of using a spittoon as engaging and fun.

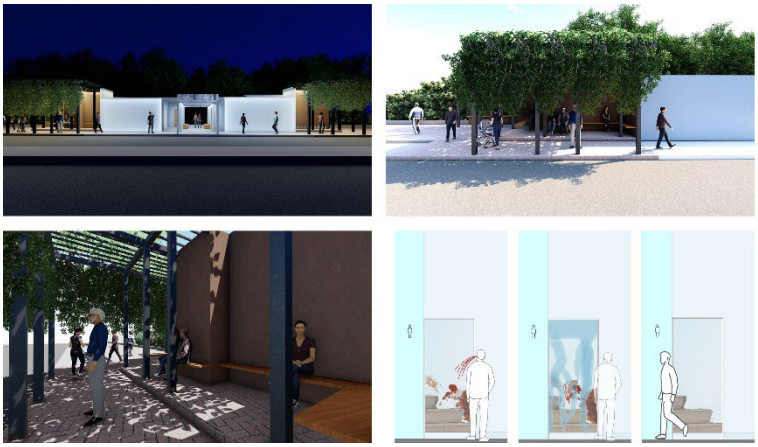

Figure 7. Public Toilet at Parimal Garden and Spittoon

Public Toilet at Mardia Plaza

The roadside space around Mardia Plaza is surrounded by shopping complexes. With commercial shops at eye level, constructing a public toilet at ground level would obstruct visibility and obstruct business activities. To address this, the public toilet at Mardia Plaza was strategically placed below ground level, ensuring minimal disruption while maintaining accessibility. Safety was a setback when the public toilet was taken underground. To address this issue, ventilation ducts above ground were designed as lightboxes, serving a dual purpose. These lightboxes not only provide illumination but also function as safety indicators, turning red in case of an emergency in the underground public toilet. Additionally, skylights allowed natural sunlight to enter the space, enhancing visibility and improving overall safety. Handrails, taking the users to the public toilet, are designed from wood, giving a warm and inviting texture. To further enhance safety, motion-sensing lights integrated into the railings illuminate the path, demonstrating the seamless blend of technology and spatial design. The urban space above the public toilet serves as a place for pause and engagement. Currently facilitated by snack vendors, it is also designed to feature musical lines embedded in the floor, creating a playful and interactive experience as pedestrians step on them! These innovations not only bring the urban fabric to life but also aim to reshape the existing perception of public toilets.

Figure 8. Public toilet at Mardia Plaza

Public Toilet at Supermall

A solid wall on the site, separating the mall from the footpath, serves as a backdrop for the public toilet. The corner of the node, currently used as a pause point under the shade of trees, is preserved in the design. The public toilet is strategically placed next to it, ensuring functionality while maintaining the existing space for pause and interaction. This public toilet was envisioned as a metaphorical 'Temple of Hygiene.' Designed with empathy for toilet cleaning workers, it utilises nudges to subtly influence user behaviour, fostering respect for sanitation and encouraging responsible usage. Right beside the entrance of the public toilet, moving holograms of toilet cleaning workers are displayed. This nudge ensures that users witness the effort required to maintain cleanliness, foster awareness, and encourage responsible use. After using the public toilet, interactive feedback celebrates responsible usage, nudging users to promote their actions. The user flips worker faces from sad to happy, encouraging better user behaviour. This example of a public toilet explores how space-tech integration fosters empathy and explores positive behavioural change.

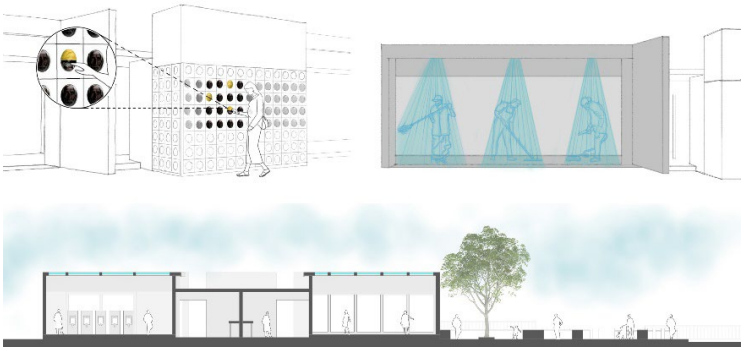

Figure 9. Public toilet at Supermall

Public Toilet at Municipal Market

Amidst the bustling marketplace, the public toilet at Municipal Market addresses the hygiene needs of shoppers from across the city. With an existing bus stop on-site, the public toilet is integrated into the context by combining both facilities. While the bus stop faces the road, the public toilet remains accessible from the footpath. Vibrant and bright colours make the public toilet an eye-catching urban sculpture. It also extends the marketplace, offering a pause point amid the bustling environment. The back wall of the public toilet creates an alley along the walkway. To enhance safety and prevent the space from feeling dull, motion sensors activate 'glowing fireflies', making the alley interactive and safe. Projection mapping beside the public toilet makes it an active element on the street. It is envisioned to add the quality of engagement and make it lively. The blend of safety, engagement, and pause points transforms the public toilet into a well-integrated and appreciated urban sculpture within the marketplace.

Figure 10. Public toilet at Municipal Market

CONCLUSION

On-site user feedback was collected to validate the design experiments, allowing individuals to experience the designed public toilets through VR headsets. People of different age groups and genders provided insights on functionality, safety, aesthetics, and accessibility. The user feedback highlights that thoughtful integration of space and technology can reshape public perception, making public toilets more inviting and accepted in urban spaces. Features like automatic faucets and interactive elements were appreciated, making public toilets more inviting and accepted in urban spaces. However, concerns regarding privacy, clear gender separation, and the need for signage were raised by some respondents. These responses helped assess the effectiveness of space-tech integration in enhancing user experience and acceptance.

Each public toilet, designed in response to its unique site context, addresses challenges related to safety, hygiene, perception, aesthetics, and accessibility in distinct ways. These interventions not only make public toilets accepted but also contribute to a more engaging and dynamic urban experience. The public toilet at Parimal Garden stands out as a bright and interactive lightbox sculpture, seamlessly integrating safety features with inviting pause points. The underground public toilet at Mardia Plaza transforms the urban space through engaging musical strips and integrated safety features. A sense of empathy is created at the public toilet at Supermall as an attempt to nudge user behaviour for the better. Within the lively marketplace, the public toilet at Municipal Market stands as a street sculpture with vibrant colours, projection mapping for engagement, and a bus stop as an urban response. Public toilets, through human-computer interaction, can become vital components of urban

infrastructure. This approach also elevates basic facilities like a public toilet beyond functionality. Such design interventions, revive and enhance urban spaces and help minimise the stigma associated with public toilets in the Indian scenario. They add life to the urban landscape and promote sustainable integration of facilities into public settings.

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INTERACTIVE MEDIA IN URBAN REDEVELOPMENT: A TOOLKIT FOR COMPLETE COMMUNITIES

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INTRODUCTION

This research introduces an interactive media toolkit designed to support urban planners and their stakeholders in developing a complete community.

We offer an updated and flexible definition of a complete community, resulting from our extensive secondary research and the application of strategic foresight. We expand the domains of transit-oriented mixed-use to include health, environmental and economic resilience; affordability; diversity, equity; Indigenous reconciliation; and shared governance.

The interactive, holistic toolkit combines five integrated components:

1. GIS mapping of the development site and surrounding area in support of catchment and void analysis of amenities and other complete community factors.
2. Case studies of similar scope that are visualized and compared with the planned development by applying AI and GIS tools.
3. Digital data-driven personas representing different demographic and stakeholder needs, whose requirements are assessed, and grouped, allowing placement within procedural visualizations.
4. Procedural visualizations that draw from the GIS maps, integrate complete community best practices, and respond to the needs of personas, allowing designers to create highly visual, interactive, dynamic 3D models of alternative scenarios.
5. An interactive scorecard that measures the development against case studies, regional best practices, and complete community guidelines.

The toolkit provides effective mediation between physical site planning and data-driven design, offering the ability to dynamically test and adjust scenarios. This is an innovation in the ways that planning traditionally occurs ensuring that urban planning decisions are grounded in empirical data and adaptable to stakeholder needs.

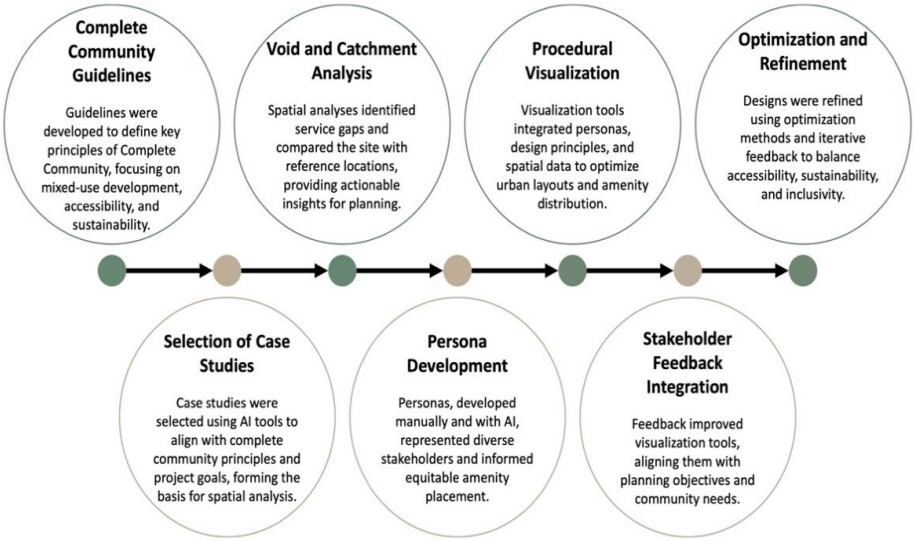

Figure 18. Integrated stages of toolkit methodology. Image created by Prashant Matta.

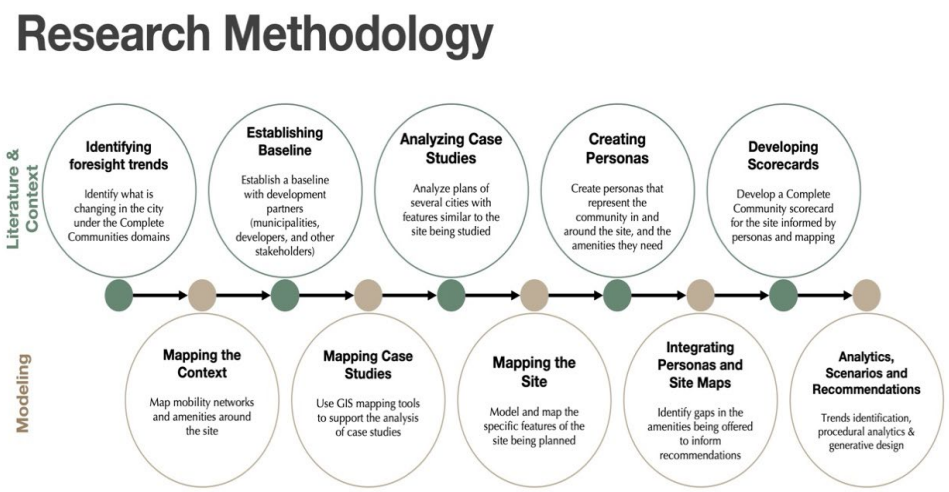

Figure 19. Detailed research methodology for the applied toolkit. Image created by Samah Kamalmaz.

We undertake validations with real-world test beds that offer differing scales.

RESEARCH CONTEXT – TWO TEST BEDS

Two research partnerships provide test beds for the interactive media toolkit through its development phases. We meet regularly with stakeholder teams, attend community consultation meetings, access consultation data, and are provided with extensive planning reports, consultants' advice and plans, site plans, city policy, and planning requirements.

YZD Northcrest Developments Downsview

The YZD development is a 30-year transformation of the Downsview site in Toronto, Canada, led by Northcrest Developments and Canada Lands Company.[1] It is the scale of a small city. The development will accommodate approximately 110,000 new residents and 47,000 workers over the next 30 years. It is driven by responsible development principles.

The research team was asked to:

1. Provide a strategic foresight trend analysis and scenarios to inform future planning over the current and future phases of YZD.
2. Use our toolkit to undertake a comprehensive analysis and plan for amenities that met contemporary complete community needs appropriate to YZD, beginning with the Hangar District, an area zoned for mixed-use, and residential, and then extending to the Wilson District that is primarily mixed-use and residential.
3. Contribute to a complete community scorecard using case studies as benchmarks.

Brightwater – Mississauga, DiamondCorp

The Brightwater development led by DiamondCorp in Mississauga, Canada, is a mixed-use, primarily residential site with a neighbourhood facing a large waterfront park.[2] Brightwater comprises of 3893 housing units, 35 stories maximum height, over 18 acres of Public Parks, Open Space, and Privately Owned Publicly Accessible Spaces (POPS).
The research team was asked to:
1. Use our toolkit to undertake advice for an amenity plan for Block U, a neighbourhood within the Brightwater development that acts as a catalyst for waterfront activity and open parklike design, including a community centre.
2. Design a complete community scorecard appropriate for development priorities.

REFINING COMPLETE COMMUNITY DESIGN

We conducted secondary research, stakeholder consultation, and applied strategic foresight methods to identify emerging trends in complete community design. Traditional definitions of the complete community are compact, mixed-use developments that ensure transit accessibility and walkability and reduce dependency on automobiles.[3] These frameworks focus on physical infrastructure, housing mix, commercial real estate, transit networks, and public spaces - yet often treat communities as static rather than evolving ecosystems. This approach overlooks critical issues of governance, inclusivity, and long-term adaptability.
By applying scenario-based strategic foresight analysis and trend monitoring, we refined complete community development frameworks to incorporate resilience-building and adaptability. Strategic foresight is a methodology for anticipating and preparing for future trends, uncertainties, and transformative forces.[4] It involves analyzing social, technological, economic, environmental, political, values and culture-based (STEEP+VC) drivers to guide proactive decision-making.[5] In urban planning, foresight is critical for ensuring that communities and their planners remain resilient and responsive to evolving challenges such as climate change, migration, demographic shifts, and economic disruptions.
Our framework positions the complete community as a dynamic model responsive to emerging trends and social needs that users adapt for each specific context. The increasing density and intensification central to complete community planning must be accompanied by proactive measures that address infrastructure capacity, public space, culture, health and wellness, accessibility, climate resilience, the overarching integration of digital infrastructure in the urban public and private realms, overall livability, and social cohesion.[6] Factors such as walkability, mixed-use, employment, access to active and public transportation and safety remain relevant factors.[7] As Brooks and Ohland emphasized, power imbalances can distort planning priorities, permitting accessibility and inclusivity to erode over time.[8] Hence, sustainability, affordability, governance, Indigenous reconciliation, diversity, and inclusion are core values.
In their study of self-organized complete communities, Donaldson notes that community stewardship and participatory governance are essential components for success.[9] Case studies of self-organized

communities and residents' space interventions highlight shared models that empower residents to co-design public spaces, local economies, and cultural hubs.[10] By integrating social infrastructure and adaptive governance, complete community planning can better address evolving challenges while maintaining equity and accessibility.

The diagram below provides our overview of relevant domain factors that define a 21st century complete community and have been applied to both YZD and Brightwater.

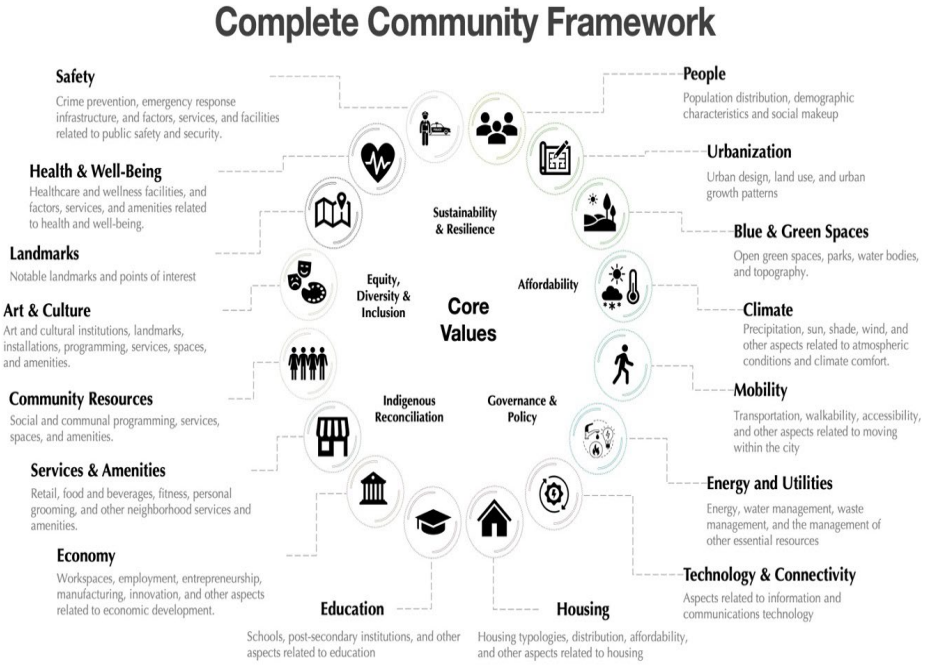

Figure 20. Complete community framework incorporating core values and major trends. Image created by Samah Kamalmaz.

TOOLS TO ACHIEVE COMPLETE COMMUNITIES

Our toolkit, described in detail below, builds on these observations to support equitable, complete community design.

Catchment and Void Analysis

Catchment and void analysis are two methods that can be used sympathetically to evaluate the density, placement, and diversity of amenities surrounding a site, as well as any service gaps, compared to a relevant reference area. These methods can support planners in designing amenity placement that adheres to complete community principles while complementing existing conditions. We implemented ArcGIS, including ArcGIS Pro and ArcGIS Business Analysis, because they are well equipped to spatialize and analyze large geo-referenced data sets, such as amenities within a broad catchment area.

Catchment analysis first identifies the amenities chosen for an area. It then applies distance-based assessment of accessible service areas for specific amenities of interest. Void analysis is most frequently used in the retail industry to identify "voids" or gaps in certain types of businesses in an area compared to a reference area. To support both YZD and Brightwater, we mapped existing amenities and then conducted a network analysis to create catchment areas within reasonable walking distances for specific amenities. These analyses complemented the void analysis in supporting

persona development and procedural visualization by indicating the required types of amenities and gaps in service areas.

Comparative Case Studies

Case study research is an empirical, qualitative methodology used to analyze and compare complex social phenomena and urban development. This method employs multiple converging data sources to derive findings and respond to specific research questions within a real-world context. We developed a multi-step approach to conducting comparative case study analysis that includes systematic literature reviews and geospatial analysis. We sought examples of successful complete community precedents based on a standardized set of criteria and to derive recommendations from the evaluation of these sites. Case studies could be used for comparative voice analysis.

We implemented LLM ChatGPT4 as a search engine to source potentially relevant case study sites. Our AI prompts could include walkability, inclusivity, well-being, adaptability, environmental sustainability, and social cohesion. From the AI-generated list, the most relevant case studies were selected and systematically evaluated.

A few key case studies were selected for geospatial analysis using ArcGIS Pro. We applied the void analysis tool to evaluate our sites against other development case studies. A map that spatializes amenity clusters in relation to residential land use was produced for each site and compared with the planned development. For example, the Wharf neighbourhood in Washington D.C. was selected as an appropriate reference site because it fares well on measures of sustainability, mobility, and social vibrance through pedestrian-friendly place-making with mixed-use development and year-round programming.

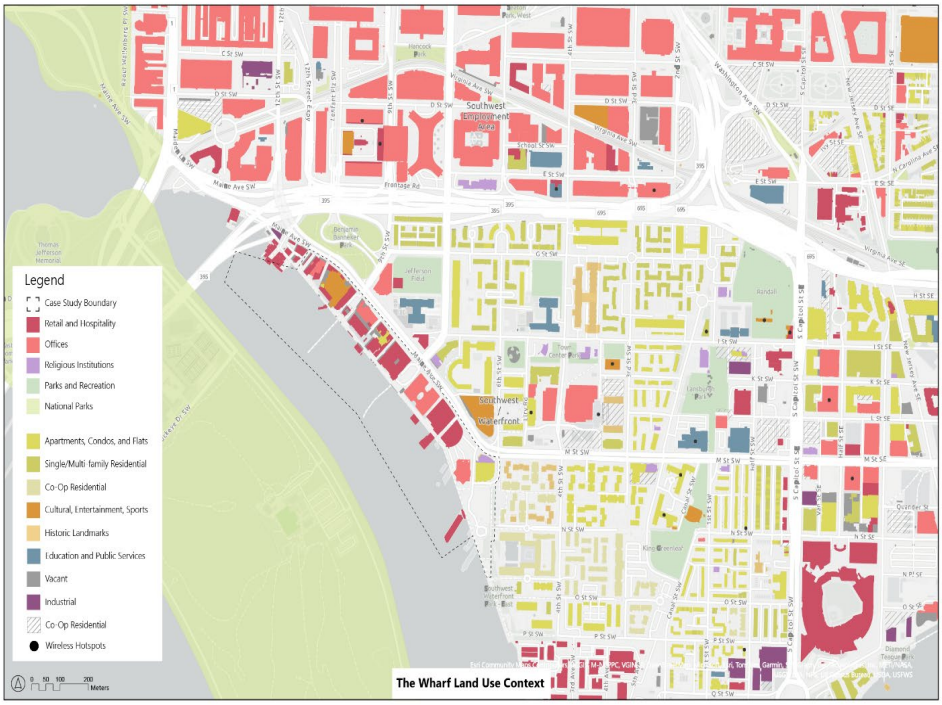

Figure 21. Amenity clusters in relation to residential land use in and around The Wharf, Washington, D.C. Shown on ArcGIS Online, generated using ArcGIS Pro. Image created by Rebecca Martin and Kendra Munn.

Digital Data-Driven Personas

Urban planning can view communities as static, emphasizing physical infrastructure over evolving social dynamics. Incorporating personas into procedural visualization embeds nuanced demographic data into tools for urban planners, enabling the use of complete community design to respond to changing demographics, governance structures, and inclusivity needs.[11] Personas' requirements include economic opportunities, such as on-site employment, appropriate social services, and retail and amenities specifically suited to site users.

Personas are fictional representations that encapsulate the diverse needs and goals of a given population. Their definitions and development processes draw from research by Nielsen on refined narratives,[12] Dam on role-based applications,[13] and Jansen on balancing rational and effective traits.[14] Stakeholders conceptualized as 'interested parties'[15] are categorized by amenity influence to reflect power dynamics.[16]

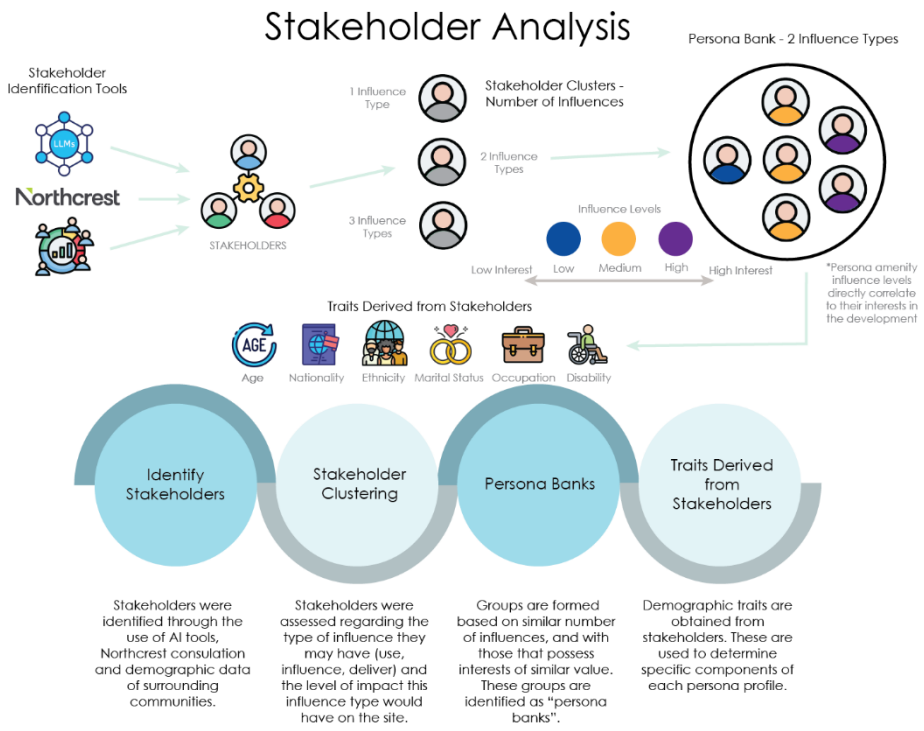

Figure 22. Breakdown of the process of stakeholder analysis, detailing how stakeholders are grouped based on influence and used to determine persona traits. Image created by Fiona Mawuenyegah.

In our work with YZD a manual persona development process began with a stakeholder analysis, categorizing stakeholders by influence and interest levels to align with the client project's context. We referenced data from extensive community consultations, Statistics Canada, the Government of Canada and the City of Toronto demographic surveys, employment, and education patterns.[17] As shown in Figure 5, stakeholders were mapped using Gregory's clustering principles into 'Persona Banks' for low, medium, and high influence.[18] XY charts identified those most impacted and impactful. Persona traits were derived from stakeholder combinations with highly influential stakeholders as primary references. We then applied LLM automation to scale persona creation to generate diverse sub-populations to address a set of different scenarios supplied by the YZD team. Figure 6 indicates that automated personas were based on amenity scenarios, client data, additional open data sets, and industry research. Prompts guided narratives, demographics, and interests and

served to evaluate each persona's priority amenity requirements. Over several iterations, we corrected LLM biases (including gender and education taxonomies) by feeding additional datasets and undertaking manual adjustments.[19]

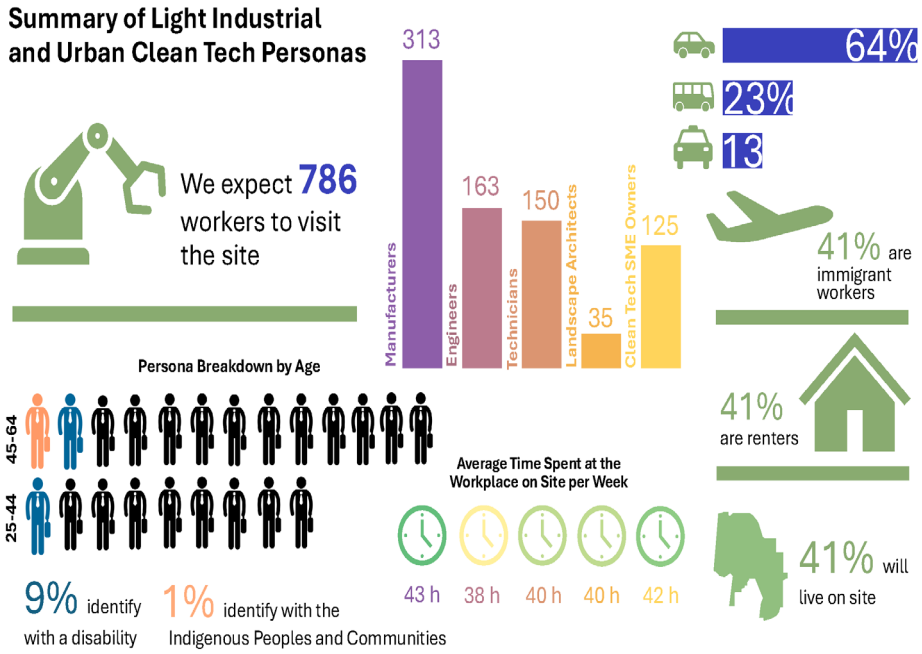

Figure 23. Example of Light Industrial and Urban Clean Tech persona characteristics. Image created by Catherine Xayabanha.

Procedural Visualization for Complete Community Design

Procedural visualization is an interactive method to support the analysis of often large urban datasets, making data comprehensible and actionable for planners and stakeholders.[20] As Jiang et al. and Ewing et al. demonstrate, by leveraging digital tools and algorithms, procedural visualization allows urban planners to generate, simulate, analyze, and optimize urban layouts and design scenarios.[21] Our method applies GIS-driven spatial analytics and parametric modelling via Grasshopper3D and Rhino to structure urban planning as a generative, performance-driven process. By embedding rule-based spatial logic, the system dynamically adjusts amenity allocations, land-use distributions, and pedestrian accessibility in response to quantified design criteria.

At the core of this process is multi-objective evolutionary optimization, which evaluates amenity clustering, accessibility, and socio-demographic needs. The algorithm assigns programmatic elements to maximize community benefit while respecting urban constraints. Each iteration refines spatial outcomes by balancing catchment-based service distribution, ensuring walkable access to essential urban functions; mixed-use density calibration, optimizing land-use distribution across retail, housing, and cultural spaces.[22] Social infrastructure integration aligns public amenities with user-driven needs based on digital personas.[23]

Procedural visualization provides a negotiation platform for developers, policymakers, and community members to interact with alternative design scenarios. Through real-time simulation tools, stakeholders can adjust key parameters (e.g., green space coverage, retail density, and transit accessibility), compare multiple development scenarios side by side, and validate design choices against interactive scorecard metrics, ensuring alignment with sustainability and livability benchmarks.

Unlike traditional planning methods, which rely on static assumptions and top-down decision-making, procedural visualization provides a collaborative, data-driven approach that integrates stakeholder input at multiple stages of the design process. The model supports assumption testing and validation, providing transparency and measurable results. It allows clients, developers, and municipalities to define key urban performance metrics (e.g., walkability thresholds, employment density targets, green space ratios, amenity clustering, and cultural and social service requirements). These priorities can be weighted and adjusted dynamically, ensuring that policy, economic, and social considerations remain flexible throughout development. As Walmsley and Villaggi emphasize, the ability to adjust weightings and constraints in real time makes the tool a negotiation platform where competing urban priorities can be resolved through evidence-based trade-offs.[24] By benchmarking proposals against best-practice case studies and policy frameworks, our stakeholders were able to gain quantifiable insights into how design choices impact long-term urban resilience.

At YZD, procedural visualization was used to allocate ground-floor retail and public amenities, ensuring a contextually responsive, complete community and economically viable distribution that integrated and then addressed the needs of automated personas. The tool synthesized earlier void analysis results to propose strategic interventions where urban services were lacking and further suggestions of clustering.[25]

At Brightwater, the model was adapted to a high-density waterfront context, balancing public space activation and community and cultural amenities with residential needs. This allowed planners to generate adaptive amenity configurations, responding dynamically to developer constraints and municipal policy frameworks.[26]

Figure 24. Procedural visualization output depicting optimized amenities distributed on the YZD Hangar District site ground floor as a diagrammatic plan. Image created by Richard Schutte.

Building an Interactive Scorecard

Urban planning scorecards serve as structured evaluation tools that measure the success of development projects against established sustainability, livability, and resilience goals. The scorecard operates as a dynamic and adaptable framework that stakeholders can strategically modify to align with their evolving objectives and priorities.[27] Scorecards also promote accountability, enabling municipalities, developers, and stakeholders to track progress and adjust strategies in response to evolving urban needs.[28] Scorecards help cities meet global and local sustainability targets by

embedding measurable sustainability and resilience principles within urban design and infrastructure decisions. For instance, frameworks like LEED for Neighborhood Development (LEED-ND) and the Sustainability Tools for Assessing & Rating Communities (STAR Community Rating System) help guide developments toward reducing carbon footprints, enhancing mobility, and fostering economic diversity.[29] Scorecards such as Mercer's Quality of Living City Ranking can also support comparison within and across developments in one or many municipalities.[30] These tools enhance decision-making by offering a transparent and standardized framework for assessing projects at various stages - from initial planning to implementation and post-occupancy performance.

We are developing interactive scorecards for Brightwater and YZD Northcrest. Only metrics that allow longitudinal data collection or where data is available are appropriate. Dimensions in our scorecards include:

1. Complete community standards derived from our research.
2. Specific metropolitan standards derived from a city's goals and data (demographic surveys, open data platforms; urban, parks and culture plans; social media data).
3. Comparative case studies chosen by the research team and developer.
4. The specific development driven by the development's goals and data.[31]

Northcrest and Brightwater scorecards will stand out for their holistic, equity-driven approach, aligning with modern urban planning principles and providing a scalable evaluation model. A comparative matrix below outlines the key focus areas of different scorecard methodologies.

Criteria	Focus Area	Northcrest & Brightwater	LEED-ND	EPA Smart Growth Scorecard	STAR Community Rating System
Sustainability &Resilience	Environmental Impact & Climate Adaptation	●	●	●	●
Affordability	Housing Cost	●	●	●	●
Governance & Policy	Policy Integration	●	●	●	●
Indigenous Reconciliation	Cultural Inclusion	●	●	●	●
Equity, Diversity & Inclusion	Social Impact	●	●	●	●

Table 1: Comparative Matrix of Urban Planning Scorecards

Legend: ● High Importance ● Moderate Importance ● Low Importance

Figure 25. Comparative analysis of scorecard principles: Northcrest, Brightwater, LEED-ND, EPA Smart Growth, and STAR Community Rating System. Image created by Sanya Mathur. [32]

An example of Green-blue spaces and the Accessibility criteria is provided below.

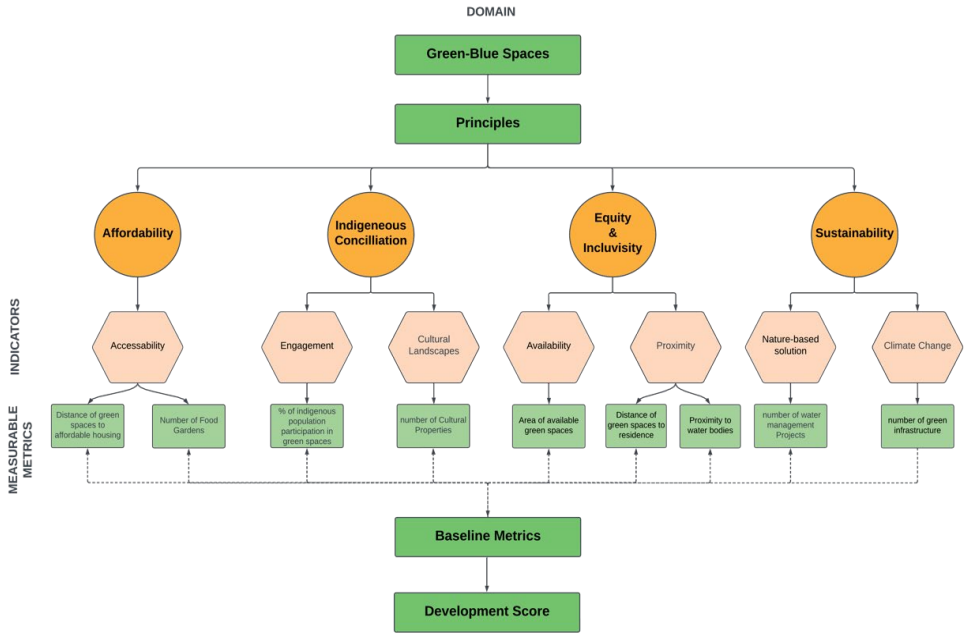

Figure 26. Scorecard Metrics Development Methodology: Green-blue Spaces. Image created by Sanya Mathur.

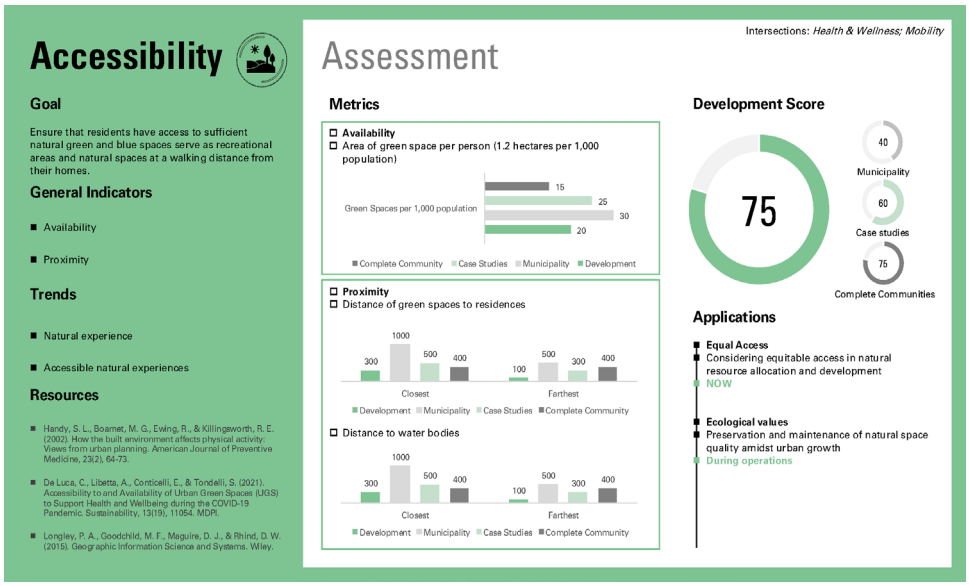

Figure 27. Scorecard factor example: Green-blue Spaces > Accessibility. Image created by Ava Xia.

CONCLUSION

Integrating GIS mapping, comparative case studies, digital personas, procedural visualization, and an interactive scorecard provides a holistic and multidisciplinary approach to urban planning. Our approach shifts the role of the architect and urban designer from master planner to curator of evolving spatial intelligence, fostering a more responsive and resilient built environment. This framework shifts away from static, top-down urban development models, creating a more inclusive and resilient approach to complete community design.

The interactive media toolkit applies AI-driven urban planning tools. These are promising, but human experts and stakeholders must respond to the analysis to fact-check and address biases in data sets that

LLMs models draw on and outputs. Qualitative insights from urban planners, policymakers, and community groups are fundamental in choosing priorities and accuracy of predictions.

Future Research

While AI tools such as LLMs (Large Language Models) have been used for persona generation and case study selection, they also hold the potential for automating urban scenario testing. By integrating generative design algorithms, procedural visualization could automate pattern recognition in land-use planning, allowing planners to identify optimal site layouts based on historic precedents and case study data. Amenity gaps and infrastructure stress points can be tested within different development scenarios and incorporate machine learning-driven optimizations, refining urban plans based on evolving socio-economic conditions. Future research will explore the ways that participatory AI-enhanced procedural visualization can scale across diverse urban contexts and be replicated across multiple regions with varied socioeconomic and geographical conditions.

The interactive scorecard will offer a means to measure impact, providing a structured way to evaluate and benchmark urban developments, reinforcing the toolkit's evidence-based nature. We will refine and automate the scorecards to include qualitative charts such as sentiment analysis and spatialized data.

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A CRITICAL ANALYSIS OF BIM THROUGH THE LENS OF OBJECT-ORIENTED ONTOLOGY

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INTRODUCTION

From an Object Oriented Ontology (OOO) perspective, this paper critically analyzes the emerging design technology of Building Information Modeling (BIM). While BIM is a comprehensive concept, architects engage with it in their everyday work mainly through the use of integrated modeling software such as Revit and ArchiCAD, which have caused dramatic changes in the way architects work over the past decade. BIM tools bring efficiency and seamless cooperation to the industry, but at the main time, they also exert subtle influence on how we think about architectural design. This study aims to investigate how BIM has shifted the way architects think of and work with architecture in their daily working process, with an emphasis on how the various products of architectural design (digital/physical models, drawing, etc.) interact with each other in the past and at present. By contrasting the design process before and after the application of BIM, we aim to find out what we have lost and gained in this technological shift.

ARCHITECTURE ONTOLOGY

Historically, architectural theorists hold two different stances about the ontology of architecture. The first stance "undermines" architecture as it tries to reduce architecture to its fundamental components or underlying processes.[1] This stance believes that architecture itself is too shallow or superficial to be the primary focus of metaphysical inquiry. On the other hand, the second stance attempts to "overmine" by regarding architecture as nothing more than its appearances, effects, or relations.[2] Those who overmine argue that objects are too mysterious or abstract to be real, focusing instead on their observable attributes or interactions. All these ontological explanations of architecture have made significant impact in history, but people never stop asking the question: "what is architecture?"
In response, Object Oriented Ontology (OOO) rejects both overmining and undermining, claiming that architecture should be recognized as itself and itself only, as a unique individual object that cannot be simply reduced to something else.[3] The OOO theory critiques undermining for destroying the individuality and autonomy of architectural objects.[4] Meanwhile, it critiques overmining for denying the deeper reality of architectural objects that exists beyond their surface attributes or external relationships.[5]

ARCHITECTURE PBJECTS: REPRESENTATIONAL AND MATERIAL

Two Major Objects in Architecture

Object is a multifaceted concept that goes beyond the typical notion of physical or tangible things.[6] An object exists as a cohesive, unified existence that cannot be seen as a mere collection of parts or qualities or dependent on its relationships with other objects.[7] Both a physical tree and a fictional character are qualified as objects. From the representational product to the final product of a physical building, a typical process of architectural design involves mainly two objects.

The first one is "***representational architecture***", which corresponds to various physical and digital representations, nowadays including BIM models. Representational architecture is the development process of architectural design, aiming to provide descriptive information and imagery of the actual building that is yet to be built. The second architectural object is the "***material architecture***", which is the material realization of architectural design. It mainly involves what we refer to as the construction management phase.

The Four-Fold

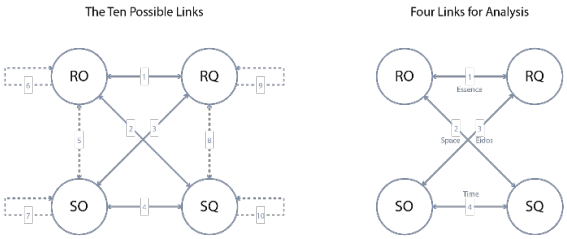

Figure 1. The Fourfold Framework-10 links
Figure 2. The Fourfold Framework-4 links discussed in this paper

The fourfold framework, as shown in the diagram, is a core concept of OOO. It reimagines the nature of objects and their relationships. This approach draws heavily from the phenomenology tradition.[8] From Husserl, OOO adopts the idea that objects are never fully accessible in experience, only appearing as partial "profiles" in perception.[9] Heidegger's concept of "withdrawal" —— where objects, like tools, recede from conscious attention unless they break — inspires OOO's idea that objects always withdraw from full access, not only from humans but from each other.[10]

According to OOO, the ontology of objects is described through the four poles and how they interact with each other and themselves.[11] A ***real object*** is an entity that withdraws from all experience. Real objects exist independently of any perceiving subject or interaction.[12] They are autonomous units that are not reducible to their appearances, qualities, or interactions with other objects. ***Real qualities*** are features or traits that belong to a real object but are not accessible through perception.[13] They are essential, internal features of an object, and while they shape the identity of the object, they remain hidden from direct access.

On the lower side of the diagram, a ***sensual object*** is an object that exists only in experience, meaning it is present in consciousness or perception.[14] It is not autonomous but depends on the perceiving subject. It is a stable core that persists despite the constant change in its surface appearance. ***Sensual qualities*** are the perceptible features or attributes of a sensual object. They are linked to the experience of the sensual object but do not define it.[15] These qualities can be seen as superficial or accidental aspects that are always present with the sensual object in perception. Unlike real qualities, sensual qualities are directly available to experience.

As objects, the aforementioned two types of architectural objects each consist of real objects, real qualities, sensual objects and sensual qualities, all of which are bound to each other by a series of tensions and relations.

Inner Dynamics of the Four-Fold

While we have a total of 10 different links (fig 1) between the four poles, we will focus only on four of them (fig 2). They are the most important links that construct the fundamental structure of an object. ***Essence*** is the tension between a real object and its real qualities.[16] For example, a specific chair has its own essence, which is not reducible to its shape, size, or material, but is a deeper quality that defines it as "this particular chair" and not another. ***Space*** is the tension between a real object and its sensual qualities.[17] A real object, like a city, exists independently of any one experience of it. When you visit it, you see certain sensual qualities of it, but you never encounter the full real city. It is a tension between the distant, concealed real object and the fragmented sensual qualities that we encounter in perception.[18] ***Eidos*** is the tension between a sensual object and its real qualities. Borrowing from Husserl's concept of eidetic intuition, OOO describes eidos as the process of stripping away all accidental features of an object to reveal its essential form.[19] ***Time*** is the tension between a sensual object and its sensual qualities.[20] If we imagine a situation where a tree looks different as you walk around it. The tree as a sensual object stays the same, but its surface features like color, angle and shadow are always shifting effect of time.

THE ARCHITECTURE PROCESS AS OBJECTS

We analyze the two architectural objects by unfolding them into the fourfold to find out what changes during the BIM process. For each link, we assign a design process that best describes this relation between the two poles.

The Architectural Process before BIM

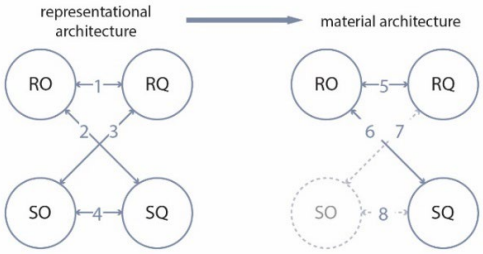

Figure 3. Fourfold Diagram of Architectural Objects pre-BIM
1, Materiality of Digital Model (Rhino, CAD)
2, Structural Logic, tectonic
3, Formal Development
4, Coordination and Communication
5, Architectural Principle
6, Craftsmanship
7, Labor force
8, Construction process

Firstly, we analyze how the architectural objects are formed before BIM is applied. Representational architecture as an object is analyzed using the fourfold framework. Between RO and RQ lies the ***materiality of representation*** (line No. 1). In the context of representational architecture, the "object" is the digital model itself— the .3dm, .dwg files stored in software like Rhino or AutoCAD. The real qualities are the inherent characteristics of this model, such as algorithmic logic and parametric constraints. These qualities are not immediately perceivable, but they define the internal, hidden structure of the digital object.

What connects RO and SQ is ***structural logic, or tectonics*** (line 2). describes how the real object (the stored model with embedded geometry and logic) is made visible through the perceptible qualities of structure and material articulation. Tectonics is the visible and aesthetic expression of structure and construction: how a building's form conveys, dramatizes, or "makes legible" the interplay of forces.[21] An architect has a digital model (RO) that contains hidden structural rules—it might be a parametric truss system or a shell structure with embedded curvature logic. Through the articulation of tectonics, the hidden structure of model is transformed into sensible forms and objects.

The link between RQ and SO captures how essential traits shape the perceived whole. This is best named as ***formal development*** (line 3), where the hidden generative principles result in the form of the building as perceived in drawings, models, and renders.

SO and SQ meet to create the physical product of representational architecture, and this process is ***coordination and communication*** (line 4), the dynamic process of sharing drawings, discussing revisions, and coordinating design intent. As drawings are shared, annotated, and updated, the visual qualities of the sensual object change, while the overall architectural object is still perceived as a whole.

Next, in material architecture, we see how these elements continue to play their roles. The essence that binds RO and RQ, from the perspective of designer and builder, is the ***nature and principle of architecture*** (line 5). This link represents the essential, defining qualities of the building that exist within its real object and are tied to its real qualities. The architectural principle refers to the conceptual core of the building's design — its fundamental logic, purpose, and aesthetic identity. This essence exists in the realm of withdrawal, always beyond our full grasp, but it defines what the building *is* at its core.[22]

Then, through the link between RQ and SO, which is ***craftsmanship*** (line 6), the deeper, hidden essence of the building manifests in visible, tangible forms. Craftsmanship refers to the precise techniques, materials, and methods used to make the building "appear" in the world. While the real object (the building's essence) withdraws from view, its craftsmanship becomes visible in the form of the building's shape, texture, materials, and detailing.

Labor force (line 7) represents the human energy, effort, and activity that turns a potential quality into an actual form. The real qualities of the building only become sensually manifest through the actions of the labor force. Without laborers, the essential logic of the building would remain abstract. The link between SO and SQ describes the way in which the building as a perceivable object evolves through shifting surface appearances.

Construction process (line 8) represents the dynamic transformation of the building as it is being built. At different stages, the building appears in different forms — a skeleton of scaffolding, a bare concrete frame, a partially completed facade. The sensual object (the "building-in-progress") changes its sensual qualities (its appearance, shape, color, etc.) throughout the construction process. This transformation over time reflects the flux of sensual qualities that are never stable until the building is completed.

The Architectural Process After BIM

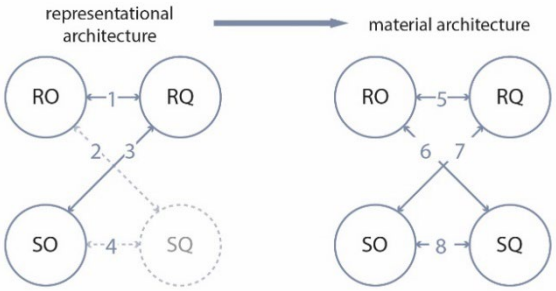

Figure 4. Fourfold Diagram of Architectural Objects post- BIM
1, Materiality of BIM
2, The Existing Structural logic of BIM
3, Formal Development
4, Interactive Interface
5, Architectural principle
6, Materialization of Digital Craftsmanship
7, Labor force
8, Feedback loop

Building Information Modeling (BIM) represents a paradigm shift in architectural design, transitioning from traditional 2D drafting to an integrated, data-rich 3D model-based process. It supports design, construction, and operational management phases by incorporating geometric, spatial, and informational data into a collaborative platform. After the introduction of BIM, we find that the diagrams present a slight change.

The most significant change takes place in the first diagram, where the inner process of representational architecture is heavily influenced by BIM. The essence, which used to be the materiality of digital models, is now replaced by the ***materiality of BIM*** (line 1). The materiality of BIM refers to its essential traits that make it different from other design tools, which is its foundational working logic. In the lower part of the diagram, the BIM model as an integrated model has eliminated the need for a multiplicity of representations of sensual quality to exist. This means that the sensual quality pole is taken out of the diagram. As a result, we should delete two other lines from the diagram, leaving only line 1 and line 3. This is not to say that line 2, which refers to ***structure logic, tectonics***, and line 4, which refers to ***coordination and communication***, are missing from representational architecture with the intervention of BIM. On the contrary, both of them have been incorporated into ***materiality of BIM***. Here, we are essentially arguing that the sensual dimension is absorbed into the hidden, operational logic of BIM. BIM is less focused on what is seen (like visual renderings) and more focused on what is known, controlled, and shared (like datasets, parametric constraints, and structural rules). As a result, the links between SO-SQ and RO-SQ are removed. BIM absorbs the role of tectonics and surface-level appearance into the internal rules and constraints of the model itself. The BIM model becomes the "withdrawn" reality, and its rules and

processes are housed within the logic of the model rather than appearing as surface-level visual qualities.

However, sensual quality can never be truly "eliminated".[23] Instead, it might be better to say that the sensual quality is concealed or subordinated to the real quality. BIM shifts the architectural process from perceiving objects (like drawings, visualizations, and tectonic details) to controlling real, hidden qualities (like material properties, load paths, and fabrication logic). BIM processes become "invisible" in their operation, but they are still there. Therefore, if we are still going to name these two links, the link between RO and SQ is the ***existing structural logic of BIM*** (line 2). Although tectonics are "absorbed" into the hidden logic of the BIM model, certain ***visual*** cues for joints, connections, and construction details can once again be made available as part of drawings and renderings produced from the BIM model. And the link between SO and SQ is the ***interactive interface*** (line 4). BIM model is no longer an abstract, static model, but a dynamic, interactive interface. In a BIM environment, the interface serves as the "interactive front-end" for the user. It allows architects, engineers, and contractors to view, annotate, modify, and manipulate the BIM model in real-time. This interaction creates an ever-changing set of visual qualities.

In the second diagram, what remains unchanged are the innate architectural principle and the labor force put into the construction. But instead of focusing solely on craftsmanship, we now shift to digital craftsmanship as materialization. In modern construction, BIM allows for prefabrication of components and automation of fabrication[24] through CNC machines and 3D printing.[25] These processes turn digital models into physical objects. What is also different is that previously, the link between sensual object and sensual quality focused on the idea that the construction process changes the appearance of the building over time. With BIM, this process is enhanced by a dynamic ***feedback loop*** (line 8). Using tools like drones, IoT sensors and even AR tracking,[26] the BIM system tracks real-world progress.[27] This creates a feedback loop where physical changes to the building update the BIM model, and changes in the BIM model influence construction in the field.[28]From here we can see why BIM is such an efficient tool in the construction process. All design, material, and scheduling data are stored in one model, eliminating the need for multiple, fragmented documents.[29] Design changes automatically update all associated drawings, schedules, and specifications, reducing rework and miscommunication.[30]

In summary, the critical change brought by BIM is that the tectonics is packed into the basic logic of BIM tools, in which all architectural parts are sorted into certain categories and are obliged to follow a set of given roles that dictate how they relate to each other. BIM tools constantly notify that a column that is placed on the ground floor should be connected to the floor of upper levels, otherwise it is a mistake. It is a fact that as a versatile modelling tool, BIM is capable of modelling unconventional tectonics, but those who follow the default logic of BIM may risk falling into a trap where they think architectural tectonics is something given in advance, therefore there no longer exists any chance for innovative strategies to take place at this stage. Despite that people tend to think of form and function as the most important elements in the creative process, the structural logic of architecture should not be taken for granted by the designer.

BEYONG LIMITATION OF BIM

BIM tools model a building as an aggregation of parametric objects with attributes such as dimensions and materials. In conventional design workflows, elements like walls or doors are depicted as mere lines or symbols on paper. BIM elevates these elements to ontologically “richer” entities—fully parameterized objects that “know” how they connect to one another. On the surface, this seems to align with OOO’s emphasis on the individuality of objects: in BIM, a door is no longer just a notational mark but an interactive, self-contained digital entity with defined properties. However, the

risk is that architects start to rely on the software as a "black box," where sophisticated simulations produce results without the architect thoroughly understanding or shaping the underlying tectonic concerns. BIM tools do little to foster a deeper connection with materials or the actual building process if not used critically.

During the initial transition to the digital era, scholars have identified similar problem: most digital software excels at refining detailed geometry or rapidly testing standard structural solutions[31]—but still lags in enabling new technological substances. For genuinely innovative tectonics that unites new materials, new building methods, and a new architectural vision, the available programs typically offer limited help. They might standardize and expedite a known approach, but they do not automatically foster a closer dialogue between architectural concept and engineering knowledge.[32]

Technology alone rarely guarantees a tectonic approach. The negative impacts of BIM tools on innovative tectonics often stem from relying too heavily on software's ready-made outputs. If the BIM software only supports geometry that limits the kind of physical and structural logic that is in tandem with the architect's intent, it can undermine the project's tectonic ambitions.

CONCLUSION

In this paper, we analysis how architectural design as objects, from the representational phase to the construction phase, has changed after employing BIM from an OOO perspective. BIM is a significant technological advancement of the architecture industry. We are not against the use of BIM as a tool to enhance design efficiency, but we find it necessary to evaluate and articulate the profound impact of BIM on the way we think about architecture. Comparing traditional architectural design with BIM-driven design highlights the need to bridge the gaps created by technological biases. Furthermore, we propose architects continue to consider tectonic and structural logic, apart from forms and functions, as part of the creative design process.

NOTES

[1] Graham Harman, *The Quadruple Object* (UK: Zero Books, 2011), 7-9. Graham Harman, *Architecture and Objects* (Minneapolis: University of Minnesota Press, 2022), 2-3.
[2] Tristan Garcia, *Form and Object: A Treatise on Things*, trans. Mark Allan Ohm and Jon Cogburn (Edinburgh: Edinburgh University Press, 2014), 21. Ian Bogost, *Alien Phenomenology* (Minneapolis, University of Minnesota Press, 2012), 33.
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MEDIATING URBAN LIFE: INTERIORITY AND DIGITAL-PHYSICAL EXPERIENCE

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INTRODUCTION

Digital technologies and screen-based interactions have reshaped how people inhabit and experience places. These transformations raise important questions about the interplay between physical surroundings, digital engagement, and experiences of interiority. Interiority can be thought of as a psychological and spatial condition of comfort, refuge, and personalization, which has long been tied to the design of physical places. This paper suggests that screens offer a form of interiority that is both physical and digital, mediating the relationship between individuals and their environments to provide experiences of respite and connectivity that extend or enhance the comfort and utility of existing spaces.

Drawing on research that documents digital and physical experiences, this paper explores how screen-based interactions shape spatial activities and redefine boundaries between public and private realms. The findings highlight how screens offer users a form of digital interiority that can mimic or mediate the psychological functions of conventional urban spaces.

INTERIORITY AS A RESPONSE TO URBAN ALIENATION

A variety of urban theorists have examined the psychological toll of urban modernity, emphasizing the isolating effects of mobility and anonymity in public spaces. Georg Simmel argues that urbanites develop a "blasé attitude" as a defense against the sensory overload of chaotic urban environments.[1] Similarly, Henri Lefebvre underscores the alienation intrinsic to capitalist urbanism, where individuals are increasingly disconnected from the social and material fabric of their surroundings.[2] More recently, Richard Sennett critiques the ways in which contemporary urban development prioritizes efficiency and spectacle over social interaction, leading to increasingly fragmented and privatized forms of urban experience.[3]

In response to these challenges, interior spaces often serve as psychological sanctuaries, mitigating the harshness of urban life through sensory control and material comfort. In the context of early urban modernity, Walter Benjamin describes experiences of interiority as a retreat from the alienating forces of industrial capitalism. Benjamin's observations highlight how interiors are both physical constructs and social and psychological responses to external pressures, offering a haven from the chaos and impersonality of the city.[4] Gaston Bachelard describes interiors as spaces of refuge and imagination, essential to well-being. Bachelard emphasizes the intimate relationship between physical spaces and sense of self, suggesting that interiority shapes how a person perceives their place in the world.[5]

Contemporary theories further recognize how interior environments mediate between personal identity and broader socio-political forces. Interiority, by supporting human comfort and well-being, helps people negotiate dynamic social, psychological, and material conditions.[6]

In terms of physical comfort, features such as seating, lighting, and climate control are employed to create spaces that respond to both physical and psychological needs. John Pile emphasizes how spatial arrangement, material selection, and lighting design shape user experience, noting that soft lighting and tactile materials foster a sense of intimacy and warmth, while modular furnishings enhance flexibility and adaptability.[7] Reyner Banham considers how technological interventions such as heating, ventilation, and air conditioning systems have redefined the relationship between humans and their built environments, enabling spaces to be finely tuned for optimal comfort.[8]

Design for comfort and convenience has extended beyond traditional interiors to shape urban spaces, blurring the boundaries between "inside" and "outside" or “private” and “public.” Urban environments increasingly provide covered areas, seating, electrical outlets, and amenities that prioritize user convenience and control. Places such as transit stations, shopping malls, and urban plazas often include features like soft seating, refined lighting, and climate control designed for comfort and respite. The concept of "interior urbanism" highlights how interiority has come to define many urban spaces, and how enclosed and semi-enclosed spaces—quintessential places like cafes and hotel lobbies, as well as informal in-between spaces like corporate lobbies and sidewalk awnings—typify urban experience.[9] These environments function as social and psychological buffers, providing conditions that support everyday activities and interactions. In many places these spatial configurations are nearly continuous; or if not, digital devices help close gaps, creating a sense of seamless comfort and control within the urban environment as people maintain their digital milieu while moving through various physical milieus.

THEORIZING SCREEN-MEDIATED SPATIAL EXPERIENCE

Marshall McLuhan’s notion of media as “extensions of man” provides a foundational framework for understanding how screens augment human capabilities and extend sensory experience. For McLuhan, media reshape human interaction with the world by amplifying certain capacities while simultaneously diminishing others.[10] In the context of screen-based interactions, this dynamic becomes especially apparent: screens act as both tools for engagement with distant realities and as barriers to immediate, physical surroundings. Sherry Turkle further develops this idea, illustrating how technology-mediated relationships transform social dynamics, creating spaces for connection that are simultaneously isolating. Turkle notes that screens offer the illusion of intimacy while modifying traditional modes of physical presence, creating a dual reality where users are both "here" and "not here."[11]

By engaging users in digital environments, screens allow individuals to retreat from their immediate surroundings into customizable, immersive spaces. This phenomenon extends the concept of interiority into the digital realm, where screens provide psychological comfort and agency, replicating or enhancing the functions of physical interiors. Francesco Casetti describes screens as portals that reconfigure spatial relationships, enabling escape, connection, and agency.[12] Social media platforms, video streaming services, and gaming environments exemplify this experience of digital escape, offering virtual refuges that parallel the comfort, personalization, and control found in physical interiors. These platforms allow users to construct digital experiences that mitigate the sensory and social demands of the external environment, creating an interior-like quality that is both individual and portable.

Other frameworks, such as Bruno Latour’s Actor-Network Theory, offer insights into the mediating role of screens in human-environment interactions.[13] Latour emphasizes that objects, like screens, are

not passive tools but active participants in shaping networks of interaction, influencing human behavior and perceptions of space. Screens do more than display content—they mediate relationships between individuals and their surroundings, reconfiguring the dynamics of space and presence. For example, in transit settings, a commuter engrossed in their device might perceive the bus or train not as a shared public environment, but as a semi-private space facilitated by their screen. This reconfiguration of presence diminishes social engagement with fellow passengers and the physical surroundings of transit but enhances the user's sense of connection to distant or digital networks.

Screens thus act as a bridge between digital and physical realms, modifying how users perceive and interact with their environments. They collapse spatial boundaries, allowing users to access distant or virtual spaces while remaining physically rooted in another (often urban/public) place. This dual function—anchoring users in one context while simultaneously transporting them to another—transforms traditional notions of space, interiority, and presence. Additionally, screens challenge the materiality of interiors, suggesting that comfort, refuge, and personalization can be achieved not only through physical design but also through digital experiences.

Scholars such as Donna Haraway[14] and Rosi Braidotti[15] add a critical lens to this discussion, highlighting the ways in which screen-based technologies challenge human-centric views of space and experience. Screens, as part of this posthuman paradigm, not only reshape physical and digital environments but also redefine human experience within them, challenging traditional understandings of identity, agency, and spatial belonging. The point is that screens are more than passive devices; they are active mediators that extend interiority into digital spaces, providing immersive, customizable environments that parallel the psychological functions of physical interiors. By bridging digital and physical realms, screens redefine the ways people engage with urban spaces, creating a sense of interiority and suggesting a significant shift in how we understand and design environments for human experience.

METHODOLOGY AND OBSERVATIONS: TRACKING DIGITAL-PHYSICAL EXPERIENCE

Seeking to better understand the physical-digital milieu, this study employed a mixed-methods approach to document and analyze participants' everyday experiences. Phase one of the study included information self-recorded by 40 undergraduate students about their daily digital and physical activities. Participants tracked their screen usage over a series of days, recording details about both what they were doing in the digital environment and the physical environment, including location, posture, and activity type. These observations were translated into time charts and sectional drawings to visualize patterns of digital-physical engagement (as shown in Figures 1 and 2).

Figure 1. Example of digital-physical milieu tracking.

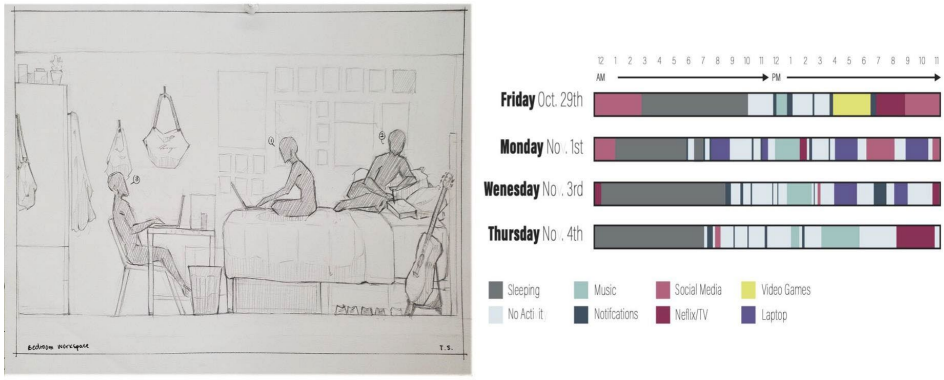

Figure 2. Example of digital-physical milieu tracking.

Phase two looked more closely at urban settings, and involved observational research of physical activity and device usage. Student-researchers used place analysis techniques to observe and document behaviors and activities in common urban settings, including public parks, cafes, train stations, and lobbies. They documented the physical environment and how people were engaged with digital devices.

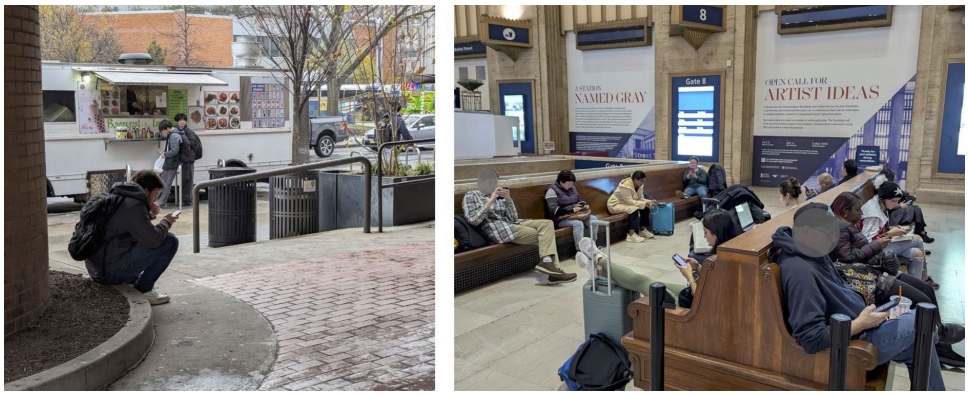

Figure 3. Screen-based activities in common urban settings: food trucks (left), train station (right).

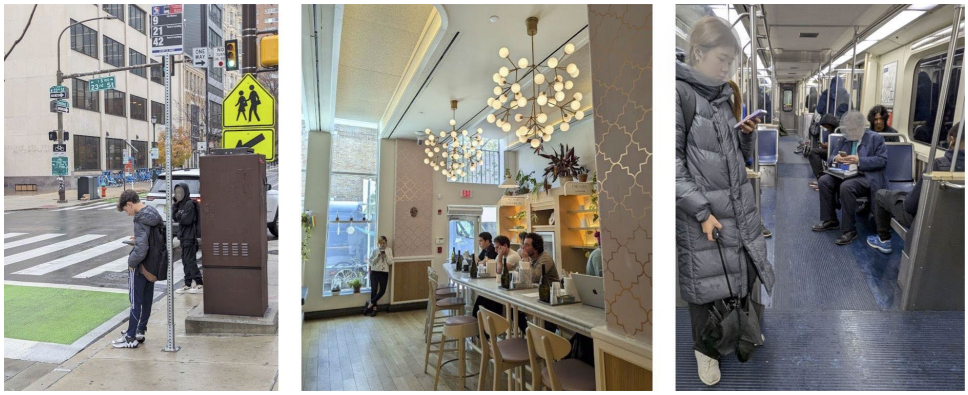

Figure 4. Screen-based activities in common urban settings: bus stop (left), café (center), subway (right).

The data revealed a number of broad categories of activity that people were involved in:
Small task-oriented activities - participants were on devices (typically smartphones) to send or check messages (text, email, phone, etc.), or use apps for other short-term and focused activity

Large task-oriented activities - participants were on devices (typically laptops) engaged in deeper productivity activities such as writing, reading, or other types of work
Escapist activities - participants were on devices, engaged in activities in which their attention was directed elsewhere; sometimes immersed in a movie, game, or social media; other times only partially disconnected from their physical milieu such as in listening to music or podcast while doing other physical (walking) or digital (work) activities
Connected activities - participants were on devices, engaged in active communication with another person in a different place, often through phone, video chat, or messaging apps
Transition activities - participants were on devices (typically smartphones) to coordinate or navigate from one location or activity to another (such as arranging an Uber)
These digital activity patterns were observed in all phases of the research and across participants; however, there were differences in digital activities depending on the location and type of physical place occupied. Looking at how different types of spaces correlated to digital activity patterns, there were a few things that were observed:
Urban streetscapes - People occupying sidewalks, benches, and building entries (both exterior and interior) tend to use smartphones and be involved in transition, connected, or small task-oriented activities.
Transit spaces - People on public transit (buses and trains) tend to use smartphones and be involved in escapist or small task activities.
Public parks - People in parks and other public recreation settings used a variety of devices and were involved in the widest range of activities, including all of the activities listed above.
Semi-public places - People in cafes, coffee shops, and hotel lobbies tend to use laptops and be involved in connected or large task-oriented activities
These observations highlight how the physical characteristics of spaces influence digital engagement. Urban streetscapes and transit systems, often transient and utilitarian, encourage brief, focused interactions, while semi-public interiors like cafes and parks provide the amenities and ambiance needed for more sustained or immersive digital activity. This variation suggests that the interaction between digital and physical spaces is contextual, shaped by the affordances of the built environment and the psychological needs of users. Whether providing tools for productivity, opportunities for social connection, or avenues for escape, screens mediate a complex interplay between digital and physical realms, underscoring their role as agents of both spatial and psychological interiority.

Figure 5. Screen-based activities in common urban settings: streetscape (left), public park (center), airport waiting area (right).

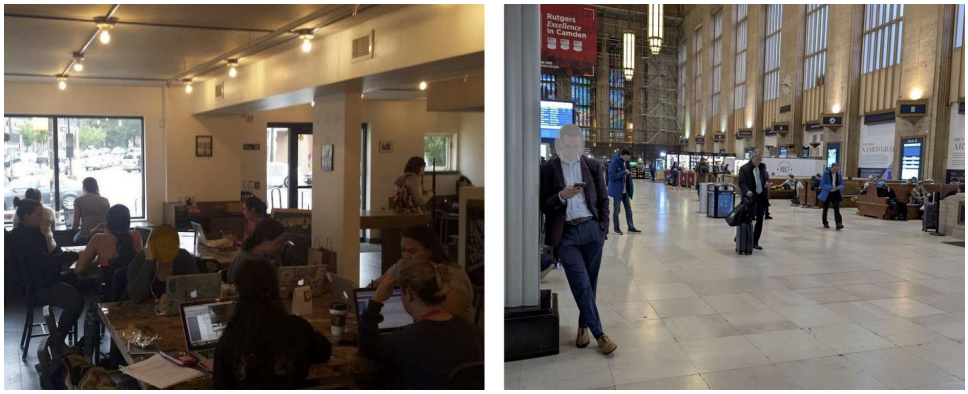

Figure 6. Screen-based activities in common urban settings: café (left), train station (right).

FINDINGS: SCREEN-MEDIATED INTERIORITY IN URBAN SPACES

This study reveals how screens act as mediators of interiority in diverse settings, creating conditions of comfort, control, and connectivity in environments ranging from urban streetscapes to semi-public interior spaces. These findings illuminate how screens shape spatial activity, bridging the digital and physical realms in ways that both complement and transform traditional notions of space. Diving further into the broader implications of these patterns, there are a few common ways screen-mediated interiority influences human behavior and spatial dynamics.

Screens provide personalized, portable interiority, enabling users to curate their experiences within spaces that have not traditionally supported this type of privatized interiority. For example, individuals using screens in parks or on public transit were able to create pockets of personalized engagement—such as listening to music, scrolling social media, or watching videos—effectively transforming these shared spaces into private, self-directed experiences. Social media and streaming platforms, in particular, allowed users to immerse themselves in alternate realities, replicating the sensory and emotional functions of private interior spaces.

Screen use redefines spatial and temporal perception and bodily engagement. Participants frequently reported spending more time in digital environments than they were aware of, highlighting the temporal distortion screens can create through sustained immersion. Physiologically, prolonged screen use was associated with inward-facing postures such as slouching or craning the neck, which not only disengages users from their immediate surroundings but also contributes to physical strain.[16] These postures further reinforce the sense of withdrawal from physical space, creating a cocoon-like state of digital immersion.

Psychologically, screens foster a duality of presence: users are physically located in one environment but mentally and emotionally engaged elsewhere. This duality can enhance feelings of connection to distant individuals or digital communities while simultaneously amplifying disconnection from the physical and social environments around them. Participants described screens as tools for emotional regulation, using digital content to manage stress, boredom, or overstimulation in urban contexts. Screens can provide a sense of psychological privacy and comfort that isn't afforded in the physical space a person may be occupying.

Socially, screen use transforms interactions within shared environments. Participants engaging in connected activities, such as video chats or messaging, prioritized remote relationships over potential interactions with co-present individuals. This prioritization disrupts traditional social dynamics, reducing opportunities for spontaneous socialization in public settings like cafes or parks. The presence of screens can subtly influence group dynamics; for instance, individuals in social settings

often defer to their devices during lulls in conversation, altering the rhythm of face-to-face interactions and contributing to a sense of fragmentation in shared experiences.

These findings suggest that screens are not merely tools for engagement but active participants in reshaping spatial and social dynamics. They enable new forms of privatized engagement in public settings, blur the boundaries between physical and digital spaces, and redefine how time, space, and social presence are experienced. As digital environments increasingly mediate human activity, their physiological, psychological, and social impacts warrant deeper exploration, particularly as digital engagement transforms urban spaces into extensions of personal interiors.

DISCUSSION: BLURRING BOUNDARIES BETWEEN DIGITAL AND PHYSICAL REALMS

Urban spaces are increasingly interwoven with digital environments that provide tailored, controlled experiences of interiority. Screen interfaces both soften the alienation of urban life by offering curated forms of engagement and connection, and amplify isolation by diverting attention away from social and physical surroundings. This study shows how screens mediate this duality, offering users a sense of psychological refuge and while simultaneously diminishing their engagement with their immediate milieu. For example, participants using smartphones for work or conversation in cafes and lobbies were insulated from the noise and unpredictability of urban life. This extends Simmel's concept of the urban "blasé attitude," wherein individuals seek mechanisms to cope with sensory overload, as screens intensify this withdrawal by replacing physical sociality with digital engagements. At the same time, the ability to find connection and personal satisfaction through digital devices mirrors functions of interior spaces, creating a portable sense of belonging. These findings highlight the ambivalent role of screens as both facilitators of engagement and agents of disconnection, reframing the relationship between public spaces, interiority, and social experience in urban environments.

Another finding considers how digital interiority parallels physical interiority in its provision of comfort, agency, and control. Observations from participants highlight how personalized digital environments offer a sense of refuge and autonomy, akin to the effects achieved by traditional interior spaces through material and sensory design. For instance, digital platforms like social media or streaming services allow users to curate experiences tailored to their preferences, replicating the psychological functions of spaces designed for relaxation or focus. This echoes Bachelard's notion of interiors as sites of imagination and agency, while extending these ideas into the virtual realm. Unlike physical interiors, however, digital spaces are inherently portable, enabling individuals to carry their customized environments into diverse urban contexts, from parks to airports. This phenomenon raises critical questions about how digital interiority redefines traditional boundaries between public and private spaces, challenging designers to consider the interplay of physical and digital elements in creating environments that support human well-being and agency.

It is also worth considering how screens mediate human engagement with urban environments by altering physical, phenomenological, and social experiences. Observations reveal that screen use in public spaces often shifts attention away from the immediate physical environment, creating a layered experience where digital and physical realms coexist. This aligns with McLuhan's idea of media as extensions of human perception, as screens reconfigure how individuals navigate and interpret urban spaces. In some cases, physical environments become secondary to immersive digital experiences, transforming contemporary places into hybrid digital-physical settings. Designers face the challenge of adapting and enhancing these spaces in ways that accommodate virtual engagement without sacrificing the social and sensory potential of physical environments.

CONCLUSION: RETHINKING SPATIAL EXPERIENCE IN THE DIGITAL AGE

This paper highlights the transformative role of screens in mediating human experiences within urban and interior environments, revealing how digital technologies bridge the realms of physical and virtual space. Screens afford a sense of interiority, providing users with tailored experiences of comfort, control, and connectivity that parallel the psychological and sensory functions of traditional physical interiors. These findings demonstrate that screens reshape spatial and temporal perceptions, enabling users to create privatized and immersive engagements within shared everyday places.

As screens increasingly mediate interactions in diverse urban contexts—from parks and transit systems to cafes and lobbies—they challenge conventional boundaries between public and private realms. Designers must consider how spaces are configured to accommodate evolving modes of digital-physical interaction. The implications of this study suggest that as screens continue to redefine the human relationship with space, future research and design must explore how these technologies can enhance well-being while addressing the potential for social fragmentation and physical disengagement. That screens foster both connection and isolation, refuge and alienation, prompts critical questions about their role in shaping social and spatial dynamics. By understanding the nuanced interplay of digital and physical realms, we can enhance human wellbeing and design places that support the complexities of contemporary human life.

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SAFEGUARDING THE INTANGIBLE CULTURAL HERITAGE OF THE RUMSU VILLAGE IN HIMACHAL PRADESH, INDIA

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INTRODUCTION

The UNESCO Convention for the Safeguarding of Intangible Cultural Heritage (2003) conceptualizes ICH as encompassing "practices, representations, expressions, knowledge, skills" and their associated cultural manifestations that communities identify as their heritage.[1] Through this definitional lens, Rumsu's cultural patrimony emerges as a complex tapestry of agricultural wisdom, pastoral knowledge, artisanal craftsmanship, and communal traditions. As indigenous communities navigate the interface between tradition and modernity, the preservation of such intangible cultural heritage presents formidable challenges in contemporary conservation discourse.[2] As indigenous communities navigate the complex terrain of development and globalization, their traditional knowledge systems and cultural practices face unprecedented pressures.[3] This research examines these dynamics through an ethnographic investigation of Rumsu's evolving cultural landscape, proposing a methodological framework that reconciles heritage preservation with sustainable development imperatives.

Safeguarding the Intangible Heritage

The UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage (2003) marked a paradigmatic shift from tangible preservation towards recognizing living cultural systems [4]. Intangible cultural heritage (ICH) encompasses the dynamic manifestations of communal knowledge, practices, and representations that constitute cultural identity,[5] representing sophisticated systems of transgenerational knowledge transmission and ecological adaptation.[6] Contemporary discourse conceptualizes ICH as a fluid process rather than a static artifact, necessitating adaptive preservation methodologies that privilege community agency.[7] The multifaceted challenges to ICH—driven by globalization, technological disruption, and demographic shifts—disproportionately affect indigenous communities.[8] Theoretical frameworks have evolved toward interdisciplinary approaches synthesizing anthropological, sociological, and conservation paradigms.[9] Empirical evidence demonstrates ICH's pivotal role in maintaining sociocultural cohesion and ecological adaptation,[10] often embodying sophisticated environmental knowledge systems crucial for contemporary sustainability challenges.[11] This evolution in preservation methodology reflects an ethical imperative to center community voices in heritage conservation efforts.

METHODOLOGY

Exploring the living heritage of a community requires a multi-layered approach integrating ethnographic fieldwork, semi-structured interviews, and phenomenological analysis to capture cultural experiences and meaning-making processes [Figure 1]. Ethnographic fieldwork, a qualitative method involving immersive observation within a community, provides localized perspectives on cultural practices and social dynamics.[12] In Rumsu village, two months of fieldwork documented intangible heritage amidst socio-economic change through participant observation of terrace farming, pastoral routines, craftsmanship, and rituals. Community mapping highlighted spatial relationships between cultural landmarks and communal spaces, while oral histories from elders provided insights into the historical and spiritual significance of these practices. Photographic and video documentation of rituals and artisanal processes further enriched the data. Despite challenges such as language barriers and seasonal variations, building trust with the community revealed how shared labor fosters ties, rituals transmit values, and artisanal skills reflect local identity. Semi-structured interviews, guided by a flexible framework, facilitated in-depth exploration of participants' perspectives.[13] Interviews with 20 participants, including families, women, farmers, artisans, youth, elders, and community leaders, examined evolving traditional practices and socio-economic transitions like tourism and modernization. Farmers discussed adapting traditional techniques to modern demands, while artisans expressed concerns about craft continuity, preferring new opportunities. Youth highlighted lifestyle changes and shifting occupational preferences, whereas elders recounted the origins and transformations of communal rituals. Community leaders elaborated on balancing development with cultural conservation. The interview format encouraged open dialogue, revealing shared concerns about heritage preservation alongside the need for sustainable adaptation. Phenomenological analysis, focusing on lived experiences, uncovered the essence of cultural practices by prioritizing meaning-making and individual perception.[14] Narrative interviews, participant observation, and collaborative meaning-making illuminated deeply embedded values within Rumsu's heritage. Through phenomenological reduction, essential meanings were systematically extracted from participants' narratives, bracketing researcher preconceptions. Hermeneutic interpretation explored how community members construct and transmit cultural knowledge across generations. Personal memories, emotions, and sensory experiences interwove to create a rich cultural identity, revealing how traditions are experienced and transformed. By prioritizing participants' voices, the study presented an authentic portrayal of Rumsu's dynamic and deeply personal cultural preservation practices.

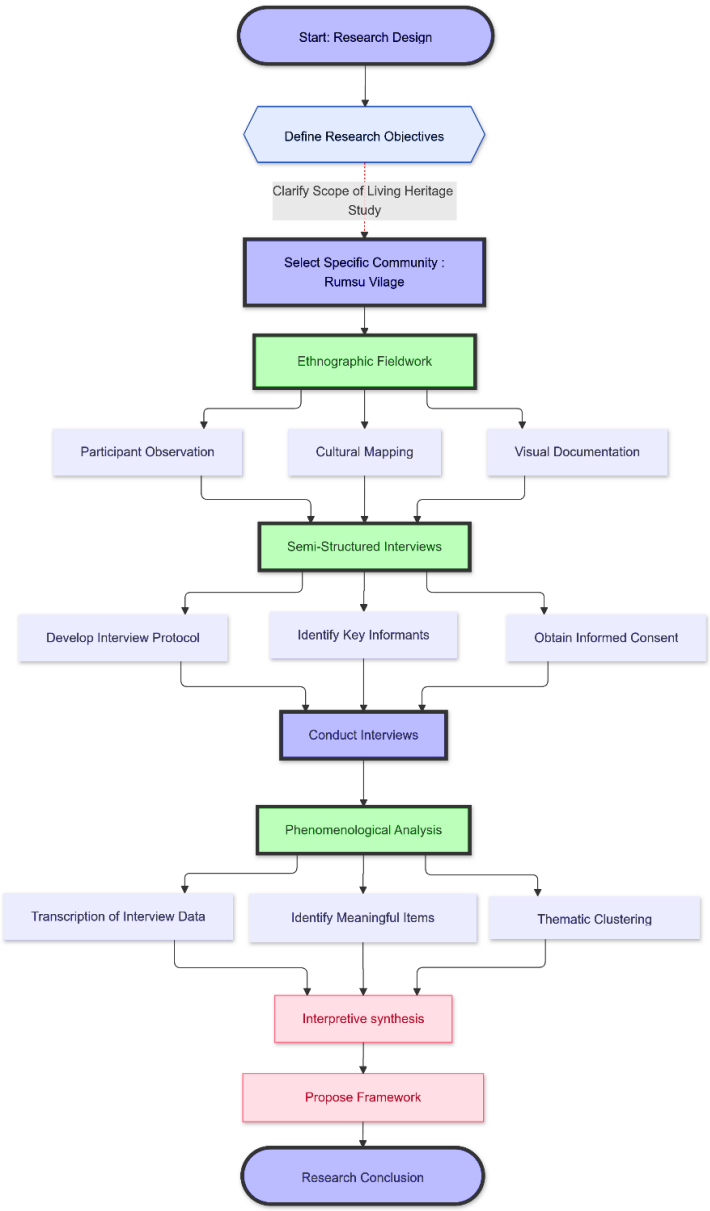

Figure 1. Research Methodology

RUMSU: A TRADITIONAL HIMALAYAN VILLAGE AT THE CROSSROADS OF CHANGE

Rumsu is a picturesque, traditional village strategically located in the verdant foothills of Himachal Pradesh, India, representing a microcosm of Himalayan Mountain culture [Figure 2]. Situated within the culturally rich landscape of Naggar, the village embodies a unique ecological and social ecosystem that has evolved over centuries. With a modest population of approximately 500 inhabitants, Rumsu represents a tightly knit community that has preserved its traditional way of life against the backdrop of rapid modernization. The village's architectural landscape is particularly noteworthy, comprising around 100 buildings, with an impressive 60%-75% maintaining their original traditional architectural design. These structures are not merely buildings but living repositories of indigenous architectural wisdom, constructed using locally sourced materials like wood and stone. The village's architectural signature is defined by the sophisticated Kath Kuni construction technique, an ingenious dry-stone building method that exemplifies the community's

profound understanding of local environmental conditions. This traditional construction approach is a testament to the villagers' adaptive engineering skills, creating structures that are inherently earthquake-resistant and thermally optimized. The Kath Kuni technique involves interlocking wooden beams and stones without using mortar, allowing buildings to flex during seismic activities while providing excellent insulation against the harsh mountain climate. Each structure tells a story of ecological adaptation, technological innovation, and cultural resilience, reflecting the deep connection between the built environment and the natural landscape.

Figure 2. Aerial view of Rumsu settlement

Intangible Cultural Heritage and the Interplay with the Built Environment

Rumsu's intangible cultural heritage embodies a rich tapestry of collective knowledge, practices, and social memories that have sustained the village's ecological and social systems for centuries [Figure 3]. Agricultural techniques, pastoral practices, craftsmanship, and social customs have been transmitted through oral traditions and community interactions. These practices, including wool weaving, rice-straw mat-making, and communal rituals, served as social technologies that ensured both community survival and cultural continuity. Traditional homes in Rumsu are key manifestations of this intangible heritage. Constructed using locally sourced materials like wood and stone, these homes are minimalist yet functionally sophisticated, reflecting a deep understanding of the local climate and ecological context. The houses typically feature essential elements such as wooden storage trunks (*kotli*), rice-straw mats (*mandri*) for insulation, and open ovens (*tandoor*) that double as heating systems [Figure 4]. These architectural features are not merely utilitarian but serve as living narratives of the community's adaptation to its environment. The integration of livestock shelters and beekeeping spaces within homes further highlights the community's symbiotic relationship with nature. The village's communal spaces and temples play pivotal roles in maintaining social cohesion. Festivals, communal gatherings, and traditional ceremonies revolve around these spaces, reinforcing the village's collective identity. Social interactions, such as women gathering to search for grass for cattle or older men playing board games near local shops, have historically defined the rhythm of daily life in Rumsu. Weddings and celebrations, marked by traditional *Pahadi* songs, dances, and local cuisine, provide a glimpse into the village's enduring cultural practices. Despite the cultural richness embedded in these traditions, Rumsu faces significant challenges in preserving its intangible heritage. The increasing influence of modernization and the allure of urban lifestyles are causing younger generations to disconnect from these traditional practices. The demand for modern amenities and contemporary housing styles has diminished the value placed on traditional architectural forms.

Figure 3. Intangible cultural heritage aspects of Rumsu

Figure 4. Kotli (top-left), Mandri (top-right), Kanse ki thali (bottom-left), Tandoor (bottom-right)

Traditional craftsmanship, once a vital part of the village's social fabric, is now on the verge of extinction. The skills required to weave woolen garments, spin wool, and craft rice-straw mats are no longer being passed down, resulting in a loss of cultural knowledge. During winters, when agricultural activities slow down, weaving and wool spinning were integral to daily life, with both men and women weaving woolen garments such as *pattu* (traditional women's wear) and *kotti* (men's woolen wear) and spinning wool for *sille* (goat wool blankets) [Figure 5]. Wool was spun into threads and woven into khadi garments using local looms. With each household producing one or two pieces of clothing per year, traditional wear lasted for up to six years, making this community an excellent model for sustainable clothing. The knowledge of crafting intricate khadi garments and traditional wear like *pattu, sille* and *kotti* is fading, as younger generations show little interest in these labor-intensive processes. The scarcity of resources like rice straw and wool, a consequence of changing agricultural priorities, has further contributed to the decline of traditional crafts, for instance, the substitution of crafted baskets by plastic ones [Figure 6].

Figure 5. Sille (top-left), Khaddi (top-right), Phoola (bottom-left,right)

Figure 6. Pattu traditional wear carried in crafted baskets; replaced by plastic baskets

The built environment and daily practices in Rumsu are intricately linked, reflecting the community's historical relationship with its natural surroundings. However, as socio-economic changes reshape the village's priorities, the cultural significance of these practices is diminishing. The transition from subsistence farming to apple orchards has altered not only the landscape but also the social structures and cultural expressions that have defined Rumsu for generations. While the village's traditional homes and crafts embody centuries of ecological wisdom and cultural memory, their relevance is increasingly questioned in the context of modern aspirations. Preserving this heritage requires a renewed recognition of its value and a conscious effort to integrate traditional knowledge with contemporary livelihoods, ensuring that Rumsu's rich cultural legacy continues to thrive amid changing times.

Economic Transformation and Cultural Dynamics

Rumsu's historical economic framework was deeply rooted in a self-sufficient model that thrived on subsistence farming, pastoralism, and artisanal craftsmanship. This traditional economy functioned as a holistic ecosystem, where agricultural practices, animal husbandry—particularly sheep rearing—and textile production were interwoven into the community's survival strategies. Wool-based textile production, along with artifact creation, was more than an economic activity; it was an essential

cultural practice embodying generations of accumulated knowledge and skill transmission. However, in recent decades, this economic landscape has undergone a dramatic metamorphosis. Traditional agricultural practices, such as paddy farming, have been systematically replaced by apple orchards, which have emerged as the village's primary economic driver [Figure 7]. While apple cultivation has brought considerable financial gains, it has also initiated a complex cascade of socio-cultural, ecological, and economic transformations. This shift represents more than a pragmatic economic adaptation; it symbolizes a profound restructuring of the community's relationship with land, labor, and traditional knowledge systems. The transition to apple farming has disrupted the local craft economy. With the decline of agricultural by-products that supported wool weaving, rice-straw mat-making, and wood carving, traditional crafts have lost their practical relevance. As the community's dependency on external markets grows, Rumsu's historical self-sufficiency has given way to consumerism. The allure of modern amenities and the construction of "pucca" houses have further contributed to the erosion of traditional architectural practices. While traditional homes built with local materials like wood and stone are inherently sustainable and earthquake-resistant, many villagers now perceive these "kuchha" homes as outdated [Figure 8]. The architectural shift reflects broader socio-economic changes that prioritize convenience and modernity over heritage and sustainability. Tourism has added another layer of complexity to Rumsu's transformation. The village's proximity to Naggar, a popular tourist destination, has brought occasional visitors, but Rumsu itself remains relatively inaccessible. Attempts to convert traditional homes into homestays have largely been unsuccessful due to inadequate infrastructure and limited community awareness. While tourism offers potential economic benefits, it also poses challenges to the preservation of the village's cultural integrity. Younger generations, influenced by urban opportunities and modern lifestyles, are increasingly migrating to cities, further detaching themselves from traditional knowledge systems and practices. This exodus contributes to the gradual disappearance of communal rituals, such as weaving, wool spinning, and the crafting of rice-straw mats, which were once integral to Rumsu's cultural fabric. The socio-economic changes in Rumsu reflect a broader narrative of cultural erosion. Traditional crafts, once markers of social identity and ecological wisdom, are now seen as obsolete. The community's relationship with land and resources has fundamentally changed, shifting from sustainable living practices to profit-driven agricultural methods. The apple boom, while economically lucrative, has led to a loss of biodiversity and a disconnection from ancestral agricultural practices. Paddy fields, once central to the village's economy, have been replaced, and with them, the crafts associated with rice-straw products have vanished. The cultural knowledge embedded in these crafts is at risk of being lost, as younger generations show little interest in learning or preserving these traditional skills.

Figure 7. Apple orchards around the house (Source: Walking wanderer)

Figure 8. Traditional houses and modern houses built next to each other (Source: Harshit Tiwari)

PROPOSED METHODOLOGICAL FRAMEWORK

The proposed framework for ICH conservation outlines a structured approach to preserving and managing the community's intangible cultural elements. The various steps of the proposed framework illustrated in Figure 9. The identification of ICH elements is a critical first step in preservation efforts. UNESCO's 2003 Convention provides a comprehensive framework for recognizing diverse cultural expressions, including oral traditions, performing arts, rituals, and knowledge systems.[15] Researchers

must employ holistic methodologies that capture the dynamic nature of cultural practices through interdisciplinary approaches combining anthropological, ethnographic, and participatory research techniques.[16] Documentation serves as both archival and interpretative, creating meaning and value while preserving cultural knowledge.[17] Comprehensive strategies should include audio-visual recordings, oral histories, ethnographic descriptions, and collaborative narratives to capture lived experiences and cultural nuances.[18] The goal is to create rich, contextual representations that capture the lived experiences and intricate nuances of cultural practices. Engaging the local community fosters a sense of ownership and ensures that interventions align with their aspirations.[19] Bottom-up approaches prioritize local agency and self-representation, emphasizing participatory research methods that actively involve community members in decision-making and cultural preservation.[20] Understanding the socio-economic dimensions of ICH is crucial for sustainable preservation, as cultural practices intersect with livelihoods.[21] Researchers must assess the economic value of cultural practices, identify sustainable income-generation strategies, and examine social transformations linked to heritage preservation.[22] Adaptive integration of traditional and contemporary practices ensures cultural vitality, allowing expressions to evolve while maintaining authenticity.[23] Supporting innovative expressions and balancing preservation with contemporary relevance is essential for cultural resilience.[24] Policy development for ICH safeguarding requires culturally sensitive, flexible approaches aligned with international guidelines.[25] Regulatory frameworks should recognize cultural diversity, provide legal protections, support community-led initiatives, and facilitate intergenerational knowledge transmission. Community-driven initiatives ensure local ownership and continuity, addressing specific needs, supporting cultural education, and creating platforms for knowledge sharing.[26] Continuous assessment and adaptive management are essential for long-term ICH preservation. Strategies must be flexible and responsive to changing cultural dynamics through regular consultations, impact evaluations, and ongoing documentation.[27] Developing community-led tourism models that prioritize authenticity and minimize commodification can provide economic benefits while preserving cultural integrity.[28] Tourism models must respect cultural identity, offer economic benefits to local communities, and promote authentic cultural experiences.[29]

Figure 9. Proposed methodological framework

The framework emphasizes that cultural conservation in Rumsu must extend beyond physical structures to intangible practices defining community identity. Traditional agricultural practices such as paddy farming, agro-pastoralism, and crop diversification should be integrated with sustainable techniques like organic farming and water management to restore ecological balance. Promoting smaller, community-based apple orchards alongside diversified crops can maintain traditional farming practices while leveraging apple cultivation's economic benefits. Revitalizing traditional crafts, including wool spinning and weaving, requires documentation, education, and market promotion. Workshops and school partnerships can facilitate intergenerational skill transfer, ensuring crafts remain relevant by integrating innovative materials and techniques. Preservation of traditional architecture should focus on restoring existing structures using local materials, retaining ecological benefits. Hybrid models incorporating traditional designs with modern energy-efficient technologies can bridge heritage and progress. Community-driven cultural conservation efforts are essential, with active local involvement ensuring alignment with community needs. Intergenerational knowledge sharing is crucial for continuity, and establishing a cultural conservation committee can facilitate this process. The proposed framework positions the community as the primary architect of cultural preservation, marking a shift from top-down heritage management models. Conceptualizing ICH as a living, evolving system, the framework offers a holistic, adaptive strategy for cultural continuity. By integrating traditional knowledge with sustainable practices, it fosters adaptive tourism development and ensures cultural preservation initiatives remain responsive to local contexts and aspirations.

CONCLUSION

The intangible cultural heritage of Rumsu manifests as a complex tapestry of interconnected dimensions, reflecting the community's profound symbiosis with its environment and social frameworks. Traditional agricultural practices, exemplified through terrace farming and indigenous crop cultivation, demonstrate sophisticated ecological intelligence and generational knowledge of the local terrain. This agricultural acumen is complemented by refined pastoral practices, characterized by nuanced seasonal grazing patterns that reflect centuries of accumulated environmental wisdom. The community's material culture, particularly evident in vernacular artifacts like wooden carvings and traditional textiles, transcends mere functionality to embody cultural narratives and inherited aesthetic sensibilities. These tangible expressions are intrinsically linked to communal traditions—a sophisticated network of rituals, festivals, and oral narratives that serve as mechanisms for social cohesion and cultural transmission. Rumsu emerges as a microcosm of the broader challenges facing rural cultural heritage preservation in an era of rapid transformation. The village exemplifies the tension between tradition and modernization characteristic of rural India, highlighting the necessity for nuanced conservation approaches that recognize heritage not as a static entity but as a dynamic, evolving system. Through the integration of traditional ecological knowledge with contemporary sustainable practices, this research illuminates pathways for cultural resilience that align preservation with community aspirations. This study contributes significantly to heritage conservation discourse by demonstrating the efficacy of participatory methodologies and adaptive frameworks in ensuring cultural continuity. The findings suggest that successful heritage preservation requires a hybrid approach that honors traditional knowledge systems while accommodating inevitable social change, ultimately fostering a model of cultural sustainability that maintains authenticity while embracing measured transformation.

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FROM “COLD” CALCULATIONS TO “HOT” INTERACTION: HOW DEMOCRATIZED BUILDING TECHNOLOGY SIMULATION SOFTWARE AND AFFORDANCE THEORY CAN TRANSFORM STRUCTURAL LEARNING IN ARCHITECTURAL DESIGN EDUCATION

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INTRODUCTION

The traditional split between design and structural learning experiences in university architecture education is polarized. On the one hand, Studio is typically a sensorially immersive, frenetic environment—layered with sculptural forms, vibrant colors, and rich textures—referring to a myriad of poetic concepts regarding space, place, and phenomenal experience. On the other hand, Structures classes are typically characterized by a legion of students sitting with proper decorum at desks facing forward, with attention drawn toward an instructor who deliberates lecture and test pedagogies where learning comprehension is assessed by students' ability to solve formulaic static equilibrium equations in time-limited testing scenarios.[1]

This segregated learning of Studio and Structures results in an unreconciled cognitive divide, further exacerbated by course credit hour discrepancy and time demands for students between both classes respectively.[2] As a result, students typically invest most of their time and focus in Studio, while Structures classes—often perceived as a necessary hurdle for students to jump over to achieve their degrees—are frequently neglected. Consequently, structural principles are rarely substantively integrated into design thinking, leading to a perception among architecture students that they lack practical applicability.[3]

This disconnect continues along career trajectories when, as architects, former students are subsequently faced with a corollary disciplinary split where each domain, design and structures, respectively, continue to be siloed, further reinforced by reified contractual and legal liability models, with structural engineers acting in consulting roles to remediate the schematics created by designers who have usually retained very little applicable structural engineering knowledge in their formative years. This pedagogical divide in school leads to long-term consequences in the profession, where these traditional patterns persist, resulting too often in engineering as an afterthought and the loss of greater agency for architects, architecture, and the built environment at large.

Emerging democratized technologies are shifting these disciplinary boundaries. Similar to the ways Apple's GarageBand allows non-musicians to compose complex music and Unity enables users to create 3D worlds without extensive programming knowledge, Autodesk's Fusion 360 extends

accessibility to structural analysis and engineering tools that were once exclusive to highly trained specialists.[4]

Free for educational use, Fusion 360 allows designers to create schematics that integrate structural engineering workflows, simulating feedback and validation that once required contractual relationships with highly paid consultants.[5] Although software like Fusion 360 does not fully replace the role of highly skilled structural engineers, it offers a profound extension of the capacities architectural designers have historically possessed, allowing them to create and technically evaluate their ideas as they are taking shape.[6] By leveraging these tools, this study charts a path forward for an integrated approach that merges design, prototyping, and structural learning.

In pursuit of ameliorating the disconnect between design learning and structural learning, this study leverages Embodied Cognition and Material-Driven Design concepts to frame design in Studio as a series of Exploratory Procedures that uphold physical engagement, human intuition, iterative discovery, and structured problem-solving actively situating materials, tools, and environments in ways that reveal latent potentials for integrated, structurally informed design through dynamic interaction.

This study provides qualitative insights into how students develop spatial-structural reasoning through embodied, iterative processes but also establishes a foundation for extended assessment in future course iterations with planned quantitative analyses to measure the long-term efficacy of this pedagogical approach, ensuring its progressive refinement and adaptation. This research aims to further ameliorate the traditional polarity of design ideation and structural reasoning, championing an educational model that seeks to fully integrate hands-on prototyping, computational analysis, and environmental performance evaluation.

THEORETICAL FRAMEWORK: EMBODIED COGNITION THEORY AND MATERIAL DRIVEN DESIGN AS COMPOSITE LEARNING MATRIX

Embodied Cognition Theory positions knowledge as being primarily acquired through the body's sensorimotor interactions with its environment.[7] Built upon 20th-century philosophical foundations of Phenomenology, which argued that perception is inherently a manifestation of bodily experiences,[8] Embodied Cognition stands in direct opposition to Cartesian Dualism, which historically positioned the mind as separate from the body and privileged abstract disembodied reasoning over phenomenal experience.[9]

In the context of architecture studios that seek to interrelate design learning and structural learning, this study posits that aspects of Embodied Cognition theory, specifically Affordances, Enaction, and Exploratory Procedures, can function as 'reinforcement fibers' in a robust 'composite learning matrix.'

In Embodied Cognition Theory, Affordances describe what is possible in an environment, and Enaction describes how designers engage with those possibilities to construct meaning and knowledge. Affordance Environments, in the context of Studio, consist of the studio space itself, as well as the speculative building site that is being designed for, and Exploratory Procedures consist of experimental action with the range of materials, tools, and processes [stocked within the Affordance Environment] that designers actively implement in pursuit of enacting their architectural schemes.

Figure 1. Affordance Environment 1 -The Project Site and Vicinity Landscapes.

Figure 2. Affordance Environment 2: The Architectural School and Studio

Two formative pedagogical motivations are significant here, positioned as the imperative drivers for the composition of this learning matrix. The first is in response to the rise in the hyper-virtualization of design education in recent years—particularly as an effect of pandemic-era quarantines, which exacerbated the already prevalent cultural trend of image predominance—manifesting too frequently in architecture education as an overreliance on representational visual depictions that risk subjugating physical making, tangibility, materiality, and buildability in schematic ideation processes.[10] The second is in response to the deterministic tendencies of structural engineering-based design processes that too often forge building concepts from linear, analytically privileged modes of thinking, leaving behind the indeterminate, intuitive, experiential, subjective, and poetic aspects of designing for space, place, and corporeal inhabitation.[11]

Material-Driven Design (MDD) catalyzes this Composite Learning Matrix, accelerating the integration of design learning and structural learning.[12] Within this pedagogic system, intuitive ideation and structural evaluation function as interdependent elements in an iterative digital-physical feedback loop—one that recursively layers intuitive hands-on trial-and-error experimentation with materials, tools, and processes on the one hand, and analytic, cerebral, and virtualized modes of thinking on the other.[13] Rather than treating design and engineering as separate disciplines—opposing the prevalence of Cartesian Dualism in traditional architecture curricula—MDD activates their interaction, binding the development of embodied insight with computational analysis throughout the design process.[14]

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STUDIO CASE STUDY METHODOLOGY

Within the context of the design school's curriculum, the course at the center of this case study is the second to last upper-level design studio required for students' NAAB-accredited degrees. Conceptually, this studio called for building proposals conceived as both an 'Earthwork' and a 'Spanning Spatial Structure' integrated into the local landscape's natural topographic, infrastructural,

and cultural conditions. Programmatically, the studio brief called for a multimodal transit station—combining automobile, Vertical Take and Landing aircraft [VTOL], train, pedestrian, and bicycle flows and relationships. The station is situated below a Spanning Spatial Structure that doubles as a recreational landscape integrated with pathways within, below, and extending beyond for biking, hiking, and walking. Contextually—guided by Embodied Cognition theories—the studio actively immersed in the following Affordance Environments.

Affordance Environment 1: The Project Site and Vicinity Landscapes.

This affordance environment centers on the speculative building site, an exurban location outside the outer ring of a mid-western United States city with a population of 700,000. The landscape can be described as one of grassy meadows over rolling hills with scattered rock outcroppings, bifurcated by roadway interstates and railway track systems – set within a climate characterized as having hot, humid subtropical summers and cool winters with occasional snowstorms.

Affordance Environment 2: The Architectural School and Studio

This studio's affordance environment, initially set up by the instructor, included computers equipped with Autodesk's Fusion 360, Bambu Lab's X1C multi-material 3D printers, and Hand Sketching 'kits' including various pens, pencils, and transparent trace paper. As a result of ongoing, iterative design activity, the studio Affordance Environment is progressively layered with new visualizations, including photo and sketch essays of Affordance Environment 1 [the project site and vicinity landscapes], and physical prototypes at various scales, materiality, and complexity - all contributing to a dynamically changing atmosphere conducive for the ongoing Enactive design process though Exploratory Procedures.

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Studio Process Through Exploratory Procedures

The design and prototyping process oscillated between exploratory procedures derived from the two Affordance environments—the local landscape and the studio—to stimulate ongoing cognitive synergy throughout the semester. Students initially hiked, photographed, and sketched the local landscape with the objective of translating their embodied slope and spatial terrain conceptualizations into designs for materialized structural form, habitable enclosure, and recreational landscapes. Returning to the studio, students began translating their insights into digital landforms using Autodesk's Fusion 360 and its intuitive T-spline modeling tools, which afford the sculpting of organic, topographically inspired geometries. These T-spline digital landforms were then translated into Spatial Spanning Structures, modularly composed of individual panel-frames with structural ribs connected to thickened surface membranes.

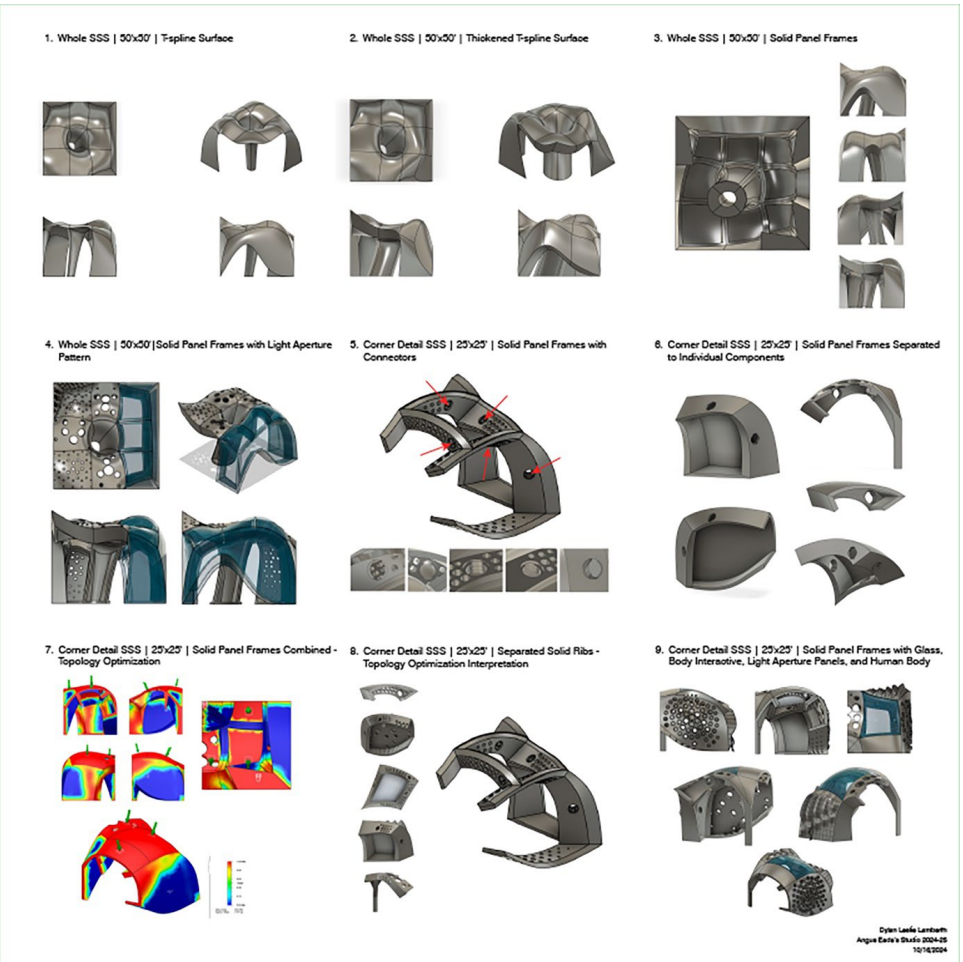

Figure 3. Autodesk Fusion 360 Exploratory Procedures.

Using Topology Optimization with materials assignments for steel and concrete, areas of excess structural mass were identified for strategic removal from the modular panel-frames. Exploratory procedures involved hand-sketch interpretations on trace paper over color-coded heatmaps representing structural performance zones. Through these sketches, students began to develop structural-material efficiency and spatial porosity for daylighting and programmatic integrations simultaneously as well as optimal mechanical connection locations to link each panel frame sequentially in anticipation of the physical prototyping process.

Figure 4. Exploratory Procedures, Sketch Interpretations of Topology Optimization Heatmaps

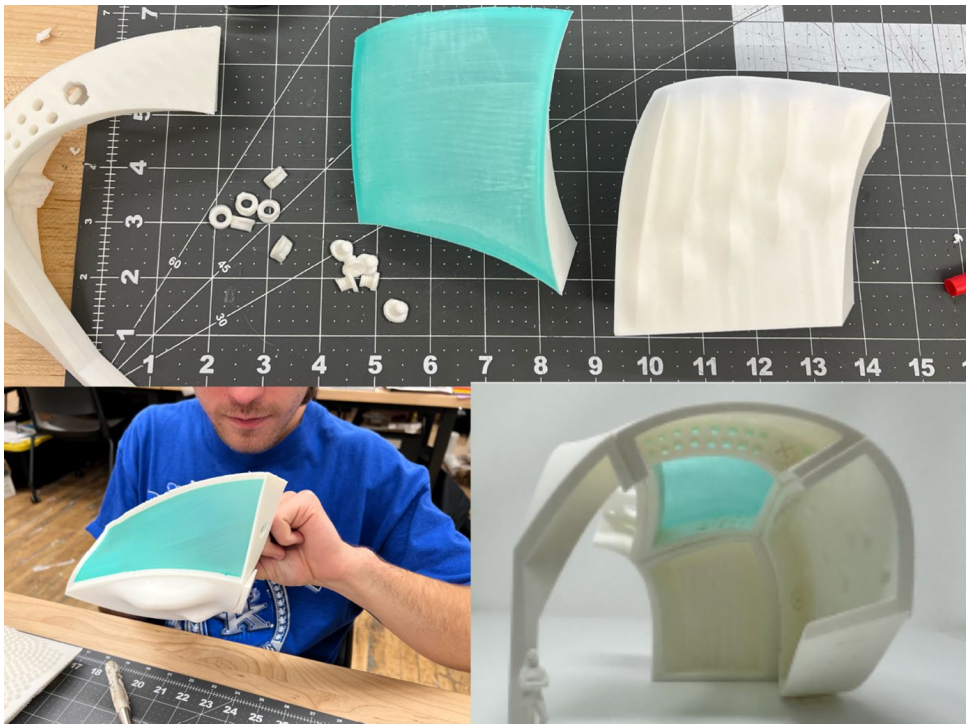

Figure 5. Exploratory Procedures: Prototyping Assemblies

In turn, these sketch overlays were digitally translated using Fusion 360's Geometric Pattern Tool to subtract excess material from panel frame membranes and ribs. The software's workflows for mechanical joint creation facilitated the integration of hybrid rivet-screw connections for joining panel-frames together serially to form larger extents of Spatial Spanning Structures. In this pursuit, the Bambu Lab X1C 3D Printer enabled the prototyping process of panel-frame modules, which were printed individually and connected using 3D-printed rivet-screw components. The 3d printer's affordances include multi-material prints for simulating integrated architectural assemblies that combine glazing systems framed by spatial-structural elements, as well as dissolvable supports - allowing students to fabricate intricate overhangs and internal structures with greater ease, reducing

the time and labor typically required to remove breakaway supports. Unlike breakaway supports, which demand manual removal and risk surface damage, dissolvable supports enable the realization of complex geometries with less effort, allowing for faster iteration to maintain cognitive flow throughout the prototyping process.

Autodesk Fusion 360 workflows were introduced through demonstrations, tutorials, and workshops, supplemented by iterative 3D-printed prototypes during the first part of the semester. Initially, these workflows were directly integrated with small-scale proxy projects, allowing students to apply newly acquired skills at a controlled, manageable pace. This served two purposes: first, to help students overcome the challenges of learning Fusion 360, and second, to mediate the learning curve without overwhelming students with the complexity of the full design prompt.

During the first half of the semester, Initial proxy projects were introduced at a manageable scale, representing spatial spanning structures measuring 50 x 50 feet with a height of 25 feet. These early schemes did not yet address the complex demands of the final project, which required a substantial scale shift to 900 x 900 feet wide and 200 feet tall, with full programmatic integrations for automobile, railway, and flight travel modalities. Furthermore, the Initial proxy project served pedagogically as the primary instructional instrument of the project, while the final project served as the assessment instrument from which students' retention of course concepts focusing on spatial-structural integration through Exploratory Procedures was evaluated. Exploratory Procedures learned during the first half of the semester were then repeated by students independently in teams of two, at the larger scale, with the instructor's role shifting from technical tutor to design mentor—guiding students through final design development to encourage students' independent application of foundational course concepts.

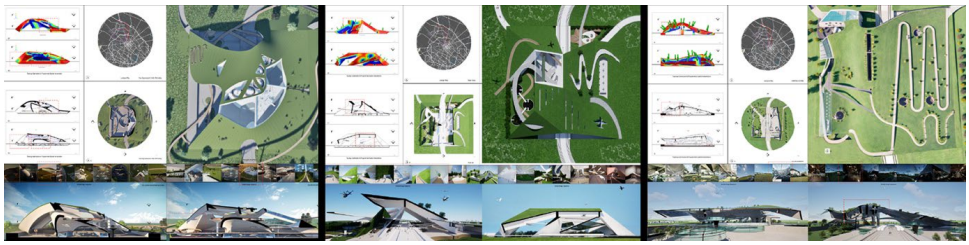

Figure 6. Example Range of Final Project Presentation Boards

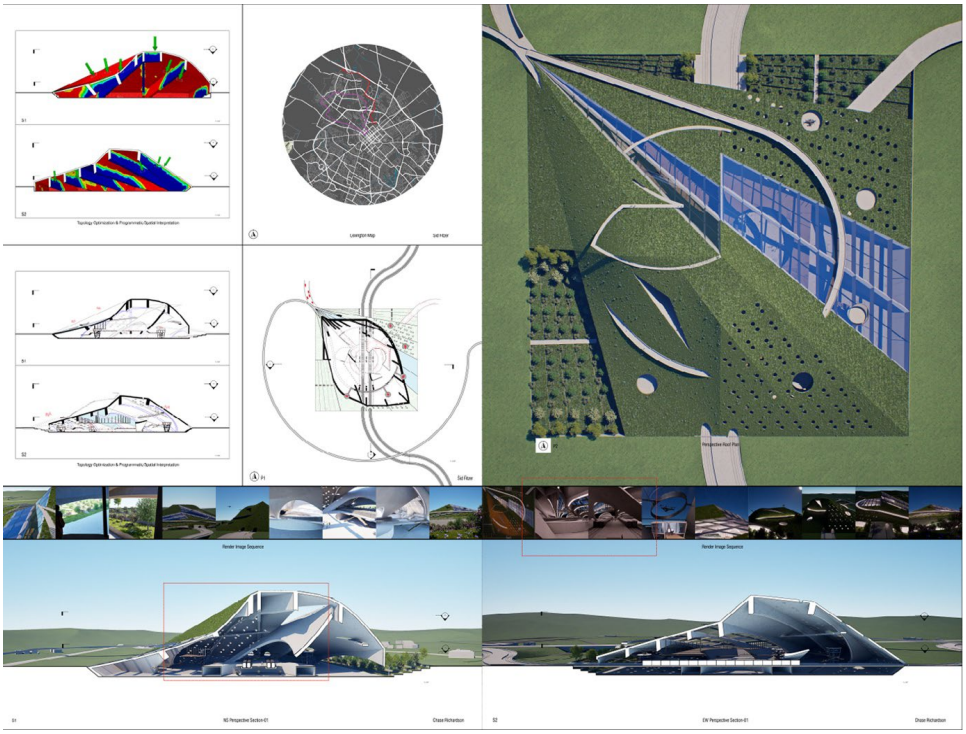

Figure 7. Example Final Project Presentation Board

As the project was scaled up, students revisited the landscape on a bike field trip to deepen their personal embodied insights; in turn, Exploratory Procedures were reiterated with a focus on creating apertures through the larger Spanning Spatial Structure toward the completion of holistic final architectural schemes with full spatial-structural-programmatic integrations for hike and bike paths, vertical take-off and landing aircraft, and daylighting corresponding to conditioning the transport station below.

CASE STUDY QAULITATIVE EVALUATION

Through qualitative analysis of student outcomes, several key insights emerge. During the proxy project phase, a pivotal realization occurred when T-spline and topology optimization-derived schemes were physically enacted by assembling 3D-printed panel-frame components. The instructor observed students' deep tactile engagement as they connected panel-frames with 3D-printed mechanical fasteners and tested them in various lighting conditions. In consultations, students noted that assembling prototypes helped them better understand structural dynamics they had previously observed in Fusion 360's topology optimization color-coded graphic outputs indicating structural stiffness zones. Transitioning to mechanically connected 3D-printed components revealed both challenges and opportunities. Engaging with prototypes made students newly aware of difficulties, such as the inaccessibility of mechanical fasteners in geometrically complex "pinched" conditions and testing proxy-project prototypes under varied lighting conditions led to new realizations about spatial atmospherics and potential user experience.

Figure 8. Prototype: Multi-Material Panel-Frames Assembled with Mechanical Connectors

The development of students' increasing ability to anticipate topology optimization results before running simulation workflows in Fusion 360 was particularly notable. Through iterative, recursive digital-physical processes, they improved their ability to foresee material removal patterns, allowing for more precise adjustments to geometric variables in T-spline-derived Spatial Spanning Structures. This predictive skill, shaped by both physical prototype and digital analytic engagement, enabled them to make more informed strategic design choices before computation confirmed their hypotheses.

While students engaged physically with their prototypes, they reassessed prior digital decisions, realizing that materials are active agents shaping design strategies. Students integrated structural efficiency with spatial aesthetics, recognizing how subtracting material could potentially enhance porosity for daylighting, ventilation, and circulation—further linking design formation with structural performance.

Throughout the proxy-project phase, students developed their topology optimization/prototyping Exploratory Procedures and successfully applied them in their final projects. Particularly notable were student teams' development of integrated spatial-programmatic-structural 'episodes,' where hike and bike pathways were threaded through topology optimization-derived apertures in panel-frame structural ribs and membranes. The range of variations across projects demonstrated students' retention of integrated design-structural concepts as well as their ability to apply them with personalized ingenuity, leveraging their embodied insights and perceptions.

Throughout the semester, material iteration emerged as a generative force rather than a validation tool. Students developed an embodied understanding of structural logic, recognizing design and engineering as inextricable systems acting as co-creators of both spatial and structural expression.

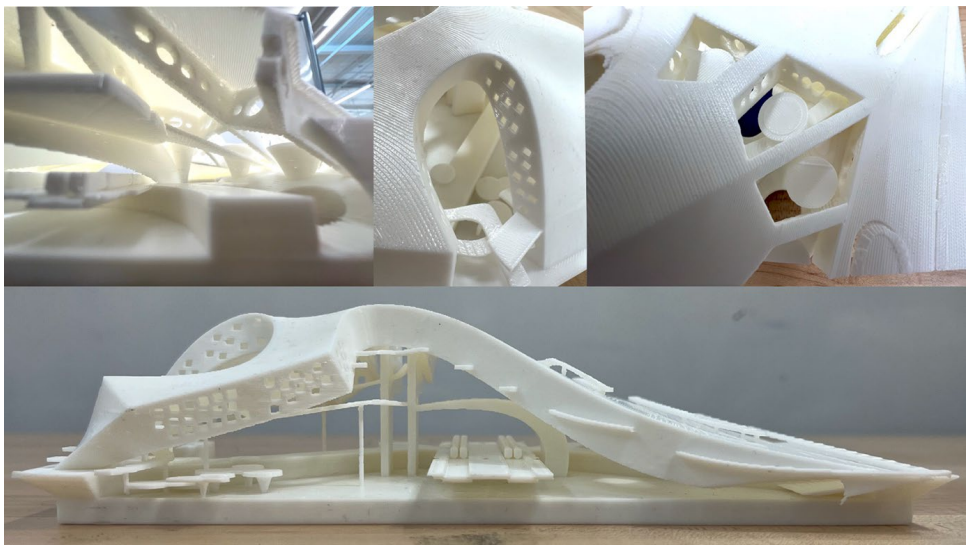

Figure 9. Topology Optimization Translation to Spatial-Programmatic-Structural 'Episodes,'

FUTURE QUANTITATIVE ANALYSIS OF STUDENT OUTCOMES

Building upon the qualitative analysis, a key focus of the next iteration of this pedagogic model will focus on students' ability to predict topology optimization outcomes before running simulations.[15] To assess their initial understanding, students will complete a pre-test, where they will be given a variety of instructor-defined cross-sectional geometries and loading conditions and asked to sketch expected material removal patterns based on intuition and prior knowledge. Students will then receive formal training in topology optimization and T-spline modeling, learning how structural forces influence material distribution and how computational tools predict efficient load paths.[16] They will apply this knowledge in an iterative design process, refining their predictions by comparing Fusion 360 simulations with physical 3D-printed prototypes, followed by a post-test to measure the development and retention of their skills.

To improve the accuracy of physical models, the instructor and a collaborating structural engineer will establish techniques for calibrating material properties so that 3D-printed prototypes closely approximate real-world materials to mimic the weight and stiffness of concrete, steel, and carbon fiber reinforced panel-frames. Real-world loading conditions will be simulated using scaled weights, allowing students to haptically engage with the ways in which their prototypes respond to applied forces. This inclusion of physical model testing will enhance students' developing intuition of load-bearing behavior and structural mechanics by comparing real-world loading results with computational predictions.

A key enhancement in this iteration will be the quantitative daylighting analysis of topology-optimized spatial porosity.[17] To assess the impact of topology optimization-derived material reduction on daylighting performance, students will compare lux levels of physical prototypes under simulated daylighting conditions with immersive digital simulations. They will analyze how structural porosity influences light distribution, shadow casting, and spatial perception, integrating this feedback into their design refinements.

Students will engage in structured feedback loops throughout the course, incorporating insights from prototype testing, instructor critiques, and collaboration with a structural engineer. The engineer will supplement the course by providing evaluations of structural feasibility, helping students identify design weaknesses and optimization opportunities, and working with the primary instructor to validate the structural principles embedded in the studio process. To measure how effectively their skills develop relative to ongoing feedback, students' revisions will be benchmarked and charted with ongoing quantified assessments throughout the process. Students' skill development with regard to assembling and testing prototypes will be progressively measured for fabrication time, mechanical fastening fidelity, and structural performance, offering insights into the development of their applicable spatial and material knowledge. Considering the rigor and complexity of this proposed revised pedagogy, instruction would be distributed over the duration of two semesters to provide for a more manageable learning experience

CONCLUSION

By structuring design learning as a sequence of exploratory procedures, this research contributes to architectural pedagogy by positioning materials, tools, and digital workflows as active cognitive mediators.[18] While previous studies such as González and Doris Zahner have applied embodied learning in architectural education,[19] and Pelman and Zoran have explored materials as learning agents,[20] this study extends these discussions by demonstrating how materials, spatial interaction, and computational analysis function as a composite learning matrix that enhances students' spatial-structural reasoning. In particular, this research builds upon Karana et al.'s Material-Driven Design

framework by situating material affordances within an iterative digital-physical feedback loop that merges topology optimization, physical prototyping, and real-time structural validation.[21]

Furthermore, this study expands Kolarevic's work on action-based design cognition[22] by demonstrating how structural simulation and prototyping can be integrated into an iterative, enactive pedagogical cycle. This study refines design/build methodologies like those examined by Kieran and Timberlake[23] by embedding computational structural feedback into hands-on prototyping, ensuring that students learn to integrate structural analysis and material behavior directly into their design thinking.

This study's contribution is situated in the reframing of traditional studio pedagogy, where design ideation and structural analysis are integrated rather than supplemental aspects of architectural curricula. Through this Embodied Cognition Theory, Material-Driven Design-informed learning model, developing not only technical proficiency but also an integrated understanding of spatial, structural, and programmatic relationships.

Beyond the classroom, the pedagogical shifts proposed in this study have significant implications for professional practice.[24] By dissolving the early cognitive divide between design and engineering, this study posits future architects as active agents in structural decision-making, reducing reliance on post-facto engineering remediation. In doing so, it seeks to cultivate a generation of architects who engage structure not as an afterthought but as an intrinsic part of design reasoning, strengthening architectural agency through the integrated development of spatial, structural, and material thinking in practice.

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OBJECTIFYING THE CACHE: ON FORGETTING AND SPATIALIZING MEMORY

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INTRODUCTION

It is human nature to collect objects from our lives. Objects hold layers of individual and collective meaning, of emotional, cultural and even monetary value. Though many objects are not kept for their performance value they are instead kept as a representation of an experience, or part of our identity through physical presence. They become the souvenirs of our lives, witnessing our memories. It's almost as if we let go of the object, then we will also be letting go of the memory, as such, we catalog our objects, place them in storage, and keep them protected, even if they never surface again to see the light of day.

Overtime, memories are known to become distorted. The details get blurry, and even the time of occurrence can be difficult to place in our minds. Keeping objects to document our lives can help us to recall these experiences. However, an object out of context is like having a memory but not knowing who it belongs to. While in our everyday lives, the objects of our spaces witness our existence, when placed in storage, they are without their spatial context, which like our memories, the objects themselves also become blurry.

Perhaps it is less about the physical characteristics of the objects, and more about the memories that they evoke, through their representation of our lived experiences. Yet, if this is their critical purpose, then perhaps we must find a way to also remember the spatialized context of these physical keepsakes. While it might be unrealistic to preserve every space, and keepsake that has meaning to us to preserve memory, we can capture spatial context, and catalog objects through readily accessible digital methods.

Remembering is critical to identity formation, where many of our memories related to identity, are connected to the domestic interior. Layering this with the prevalence of human migration, it becomes possible that memories of past homes might be forgotten. As the time from an episodic memory increase, our ability to see the memory with clarity, decreases at an accelerated pace.[1] Even when physical reminders exist that might prompt a memory of a previous home, of memory, the movement when our homes are no longer our own, becomes the moment where we begin to forget. As our relocation patterns change, and occur with more frequency, it becomes increasingly likely that we may not be able to return to the interiors that are most significant to our identity. So, if we can't revisit, do we need to consider new methods of remembering?

Context

As a personal point of context, memory has become critical in my own life, through culture and identity that is held within objects. During a recent trip to Santiago, Chile, I visited the Museum of Memory, where immediately upon entry, patrons are confronted with the overwhelming presence of the faces on the wall of the disappeared. The museum centers on the events leading up to, during, and after, the 1973 Coup d'etat in Chile, where the Allende government was overthrown by the Pinochet dictatorship. The museum is of personal significance, as my family escaped Chile after the 1973 Coup. Each face on the wall of the disappeared represents not only a person who was taken, but the memories that were taken with them. In the case of my family, they survived the coup, with their memories, but had to leave their belongings behind when they fled to Canada. With objects of personal significance, my family arrived in a new country with only their own lived experiences as a means to preserve their home, and memories. However, as they've passed on, with few artefacts that remain from their lives, few of their memories preserve.

The act of forgetting is an evolutionary system, or more directly a system of survival. Our brains hold on to episodic memories, and retain, and recall what is useful in present circumstances, and let go of, or forget, what no longer serves us.[2] However, when we are forced to let go of our objects, or leave our homes beyond our own consent, forgetting is no longer an evolutionary system that serves us. Additionally, as in the work of Martin Heidegger, it is a human condition to strive for "nearness" to our things,[3] and it is through this nearness, beyond simple geographic proximity, that we can assert our identity within our domestic interiors.

It is the objects that help us to situate our bodies in context and relate to architecture. Archaeologies try to understand people and behaviors of the past through discovery of artefacts that were housed within the built environment. While a singular object may prompt thoughts of utility and value, objects on their own need context to interpret. Context of owner, use, place, and value. Context can be created, learned, or can be authentically formed over time and could be the relationship between a singular object and other objects, as in the perception of a collection, promoting us to reflect on the intention or shared values of a collection, and the significance of each individual object within that collection. In the case of Archeologists, while earlier conclusions established that hunter-gatherer cultures tended to rely less on the objects, and their mobile architecture as a means to reflect identity and memory, more recent research has uncovered that studies of hunter-gatherers did not overly focus on dwellings, as geographies changed frequently, however, upon close inspection, artefacts, or objects, of domestic interiors, even of those who lived nomadic lifestyles, were critical to society and cultural practices, and identity.[4]

Dependencies

For people, objects always exist in relational context, as in the role to individual identity, comfort, security, but also are always situated within a place, either an originating place, or present place. Through their study of modern dwellings, and relationships between people and things, Csikszentmihalyi and Rochberg-Halton assert that "Objects, then, serve to express dynamic processes within people, among people, and between people and the total environment.[5]"

Domestic geographies and thing theory

Interestingly, human memories often involve familiar things, or events, but additionally, memories are geographically situated. Human memories are formed and need to be situated in a particular geography.[6] In this case, the situating of objects within an interior, is common, in particular in relation to the human body. Through cataloging objects, as a collection of things within our domestic spaces, we are boldly stating that these things, are important to us, and to the future. The distinction between

"detached observation and representation" and "involvement and care" extends to the difference between objects and things.[7]

While it is human nature to collect things, culturally, some collect more than others. For example, the US has the most storage space per capita than any other country in the world.[8] An obsession with things, perhaps, but also an attempt to hang on to memory, or to utilize the role of objects as a tool of memory recall. Within North America, things are often stored in a garage, basement, or storage unit rental, but when they are stored, they are taken out of the context of the interiors in which they were cherished, and revert to the role of simple artefacts, or objects. As Heidegger states, objects become things, when we care for them, when they hold a place in our memories, but this only occurs when they can be situated in a place or geography associated with the memories.

Making space for testimony

In Maya Zack's 2009 "Living Room,[9]" an interior space was recreated from holocaust survivors, through testimony from lived experiences, and presented as large-scale digital prints that surrounded the wall surfaces of the gallery space. For many that were forced to flee their homes, they were never able to return, or if they did, their homes did not exist as they had remembered them. Maya Zack-reconstructed realities from borrowed memories. Although not identical to the original domestic interiors, Zack was able to resituate memories within a physical replication of interior space.

This work relies on the memory of an individual, but we can't always trust our own memories.

Human memories blur over time, are heavily biased[10], and unreliable to create a replica identical to the original.

Consumerist obsessions and wasteful objects

Reflecting on the state of the world in the present, there exist many new and ongoing circumstances that cause our memories to be at risk, both in our minds, through the objects that we keep, and the interiors that situate them. In this case, there are some big questions to begin asking. Through capitalist consumption, and subsequent throwing away of things, more objects are involved in our lives, and more are disposed of, without holding significant memory or meaning. The waste itself is a problem, in climate crisis, and impact of landfill on habitats, and indigenous lands. Additionally, as we've become globally connected through technology, our habits, ways of the everyday, and the places that we occupy, are changing. Within North America, we've seen the abandonment, or re-programming of the shopping mall, with online shopping, prevalent, this abandonment is becoming common place, the place where we once would go to make memories in space, in the 80s and 90s, to purchase objects that would contribute to memories, are fading away. While as a society we are making more things to be disposed, at the same time we are also throwing away the spaces, interiors, in favor of what is new, and are then left to rely heavily on the memories that are held in our minds. Could a more careful attention to capturing and cataloging memories in the present, the objects, and interiors that are important to us, help to combat some of these concerns of wastefulness, and disposability of objects? And what is at risk, if we lose either, or both the objects, and spaces of our memories?

Catalogues of memory and time

We define eras of time by our connection to objects and spaces, as well as the materials and methods used to make these objects,[11] and by extension, it is not a reach to assert that objects, spaces, bodies, and time cannot exist authentically without contextual reference.

Catalogues are a curated collection of things, often including significant details, and the act itself of cataloguing, acknowledges significance of each item that is collected, as well as the moment in time.

Worn embrace[12] is a catalog that I developed based on a collection of found domestic object that were left on the curb, by their former owners, with intention to be transported to landfill. Through the active collection of objects, in a way, I became both an auto-ethnographer, and rescuer of still usable things. Once collected, I imagined how, and by whom the objects were used, and then carefully documented their form, dimensions, materials, fabrication methods, such that they could be remade in the future.

One of the found objects, a stool, as illustrated in Figure 1, was disposed of in my neighborhood. After collecting, pattern methods from fashion design were used to capture the details of a 3D object.[13] While this study proved to be useful in rescuing things that were destined for landfill, the catalog in this case is a prediction that there might also be future value, in understanding the things that were once important, and subsequently thrown away within my neighborhood, and are now perhaps more of a collective memory, situating it in the geographical context of my community, versus an interior space, or the landfill in which they were destined for. In this case, I could only guess where these objects lived, and who engaged with them through analog methods of documentation, and without knowing the originating interior space for context.

Figure 1. Found Objects Catalogue

Case study 158 cm

158 cm was a project where I began to consider a challenge within the present circumstances. In this case, the increase in forced migration due to war, climate change, human rights, or other issues of economic impact. Through learning about my family's relocation experience, I understood that they were limited to bring only a single suitcase when they fled Chile for Canada. 158 is the perimeter dimension of the suitcase. I wondered about all the objects that were left behind, and the choices that my family, and others, had to make when they fled. The closest experience I had, was once going over an escape plan should our home catch on fire, and include which things would be bring with us, if we only had time to grab what we could carry in our arms.

158, was a study examining significance of objects, and how many, and which types of personal objects could in fact fit within a 158 cm suitcase, should someone have time to consider what would be critical to preserve. The outcome of this, revealed, that often there wasn't enough space to carry everything of significance, the ability to return was significant to understand, to understand destination, and what memories are lost without context of past interior.

Childhood rooms

I have many boxes in my basement, with personal belongings, some from my childhood, as my parents downsize to an apartment and didn't have space for my objects. I've moved these things with me, from home to home, country to country, but they rarely make it out of the storage, and the box itself is rarely opened. Often, I don't think of the things inside, when I'm able to recall specific memories of my childhood, where these objects lived in my bedroom, my most personal space.

My childhood bedroom no longer remains accessible to me, and even if I could revisit it, I imagine that it would not align with my memory, but the place is significant, in connecting the objects to my memories. I wondered how my own memories would be different, if I had a photograph of my childhood bedroom, as none exist. So, I decided to start scanning my own domestic interior spaces, such that I could revisit this moment from the present, when I arrive in a moment of the future.

Using *Light Detecting and Ranging* (LiDAR) scanning software, interior spaces can be scanned to capture the context of memory, the context of our objects that hold witness to our lives.

An extension of this study, I began to scan two bedrooms monthly, to track significant objects within them, how they move, what gets removed and what gets added over time. While the intention is to preserve an accurate depiction of things and the interiors where they belong, the impact of this available contextual memory in the future is unknown in the present. Eventually this catalogue will involve analysis of objects, those that are added, lost, removed, and perhaps even those that are placed in storage years from now. Using a simple smartphone app, through LiDAR and Photogrammetry, one can scan dimension, texture, and form of objects and their interior contexts, as demonstrated in Figure 2. I hope to understand the memories that the objects kept in storage bring, and the added value of subsequently being able to revisit the interior virtually as a memory later.

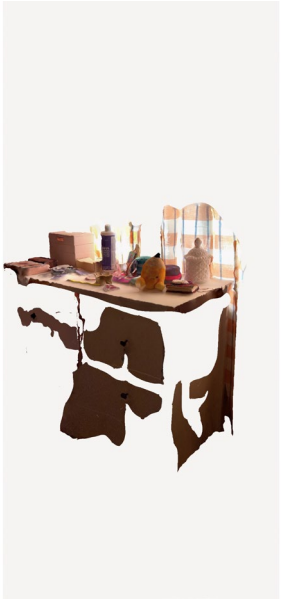

Figure 2. Room scanning in progress.

Unveiling

Not all memories need the distance of time to be able to remember. Unveiling was a project of scanning my existing living space, and then revisiting the space, using virtual and augmented reality, only moments after the initial space was digitally catalogued. Through this method, any interior, and the objects within them, can become memory, shortly after their capture, but only exist as memory, if

the viewer experienced this recreated digital reality, in authentic physical form. Whereas someone unfamiliar with the interior, and the objects within, could experience the space, as it would be their first interaction with the digital representation of the space, and the objects, it would instead be a first impression, and not hold presence of memory.

Figure 3 Unveiling and revisiting interiors out of context

CONCLUSION

A proposal

Remembering that the relationship between objects and things is a difference of care and that memories are geographically situated, and people relate to their own identities and memories through their most significant things, we can imagine a need for a new form of memory preservation. As an act of care, for our future selves, our future memories, I have become a cataloguer, one that documents the present, with care to preserve what might be significant for the future. While many of these studies stem from a personal desire to preserve memories, and objects in their context, to leave fewer gaps as my mind blurs what was reality, there is opportunity to extend this methodology to others who are at risk of loss of domestic spaces, and their things. For example, for those that are at risk of forced migration, or climate disaster, emergency preparedness now must involve cataloging existing objects and interior spaces, to prevent cultural erasure, assist with preserving memory, and resettlement, and for future generations to understand how we lived.

Emergency preparedness is something many become familiar with in grade school, perhaps even practiced different versions depending on geography. Some may practice tornado drills in school or a fire escape plan with your family at home. For those that live in geographies prone to hurricanes, emergency preparedness might include boarding up windows with plywood when a storm is imminent, or perhaps the preparation of an emergency kit should the heat, or power go out. In any case, there exists unpredictability in the permanence of domestic dwellings, and the things that we keep within them. As illustrated in Figure 4, cataloging of domestic interiors and our most important things, can become part of a practice of emergency preparedness, a sort of insurance policy of cultural identity, and comfort through memory.

Figure 4. Emergency Preparedness – Scanning rooms and objects

While the long-term impact of cataloging our domestic interiors and things within them cannot be known, what is certain is that there is a need to document, as domestic interiors, and our subsequent memories are increasingly at risk. Could there be other implications of an intentional practice of cataloging the everyday spaces that we occupy? If we were required to catalogue all our objects, would we buy less? Or would we hold on to more of our stuff? Could we recreate familiarity through the making of a digital twin, experiencing an interior again that once brought us comfort in the past? Through a digital cache could we easily share the memories and experiences in our minds, when the physical objects and interiors are no longer available? Would we need less storage space for our things, if we could capture them, our interiors, our objects, and most personal memories within the seemingly infinite space of the digital cache?

NOTES

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[10] Simon Nørby. 'Why Forget?'
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[12] Worn Embrace was a creative autoethnographic study completed in 2021, of found objects in Cleveland Heights, Ohio, USA.
[13] This was completed prior to the availability of readily accessible 3D capture smartphone applications

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REASSESSING FORM AND CONTENT IN HOUSING DESIGN IN THE HYPER COMPUTATIONAL AGE

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INTRODUCTION

This paper focuses on the question of form and content in housing design. Following are the questions that this paper works through, albeit briefly: (1) What is form and content, with respect to two broad models of philosophy? (2) How have architects understood the idea of form and content with respect to housing design so far? (3) What is the reassessment of form and content in housing design? (4) Why reassess form and content in housing design in the age of hypercomputation? (5) How does this reassessment help the pedagogy of housing design?

FORM AND CONTENT: TWO BROAD MODELS OF PHILOSOPHY

The idea of form and content can be understood in two opposite ways, depending on the school of philosophy or ontology that you work with. In most monist traditions, form is always considered as existentially poor. What matters is the content or the source from which forms are produced. In this school of thought, the content could be either matter, ground, elements, or being in general.[1] In the terms of contemporary philosopher Graham Harman, these philosophical schools *undermine* forms.[2] In the other school of thought, content is generally considered subordinate to form. One could say that content is undermined here, however, it will soon be conveyed that, this is not the case.[3] At any rate, this school of philosophy holds that forms are the very stuff of reality. Aristotle's big contribution to philosophy is rearticulating the idea of form and matter.[4] For Aristotle form is another term for substance. However, for Aristotle, matter is not some raw or fundamental matter from which reality is built upwards. Instead, matter is mainly seen as part or those forms that are part of a whole or a substance. In that sense, any form can become matter for another form. As Aristotle writes: "For the matter is a part, since it is this that is present within the thing and comes to be something."[5] Something similar is found in Husserl's idea of parts, where he argues that a part is something that is *distinguished in* an object: "We interpret the word 'part' in the widest sense: we may call anything a 'part' that can be distinguished 'in' an object," [6] Similarly, Husserl's idea of whole or a form is that of a foundation that covers the entirety of its contents or parts: "By a Whole we understand a range of contents which are all covered by a single foundation without the help of further contents."[7] In more recent history, Marshall McLuhan has also offered a similar definition of *content*, especially with respect to media theory. McLuhan also holds that content is not some raw data or unformulated matter, but it is always articulated, which is nonetheless a part of some *medium*. "the "content" of any medium is always another medium."[8] One of the philosophers from our time who has addressed and

contributed to this idea of form and content is Graham Harman, who tells us that there is a rather strange and loose relation between form and its contents. While it may take more space to illustrate this point, for the purposes of this essay what we can keep in mind is that in a certain sense, objects both have do not have their contents. In other words, objects are both beyond their contents but also need them for their existence: "objects both have and do not have these qualities."[9] This idea of form and content, as developed by Graham Harman, is tested further in this presentation especially by posing it alongside some of the important architectural theories, especially concerned with housing and housing design.

FORM AND CONTENT IN HOUSING DESIGN

Here too, the two broad schools of philosophy have had great impact on architectural thinking. We can broadly classify them into questions of either free plan or free form (theorizing a loose relation between form and its content), or that of entangled plan or form (theorizing a tight relation between form and content, and sometimes even prioritizing content over form).These two philosophical positions are best reflected in the theories of Corbusier on one side, with his idea of free plan, and Patric Geddes on the other side, with his idea of seeing the house within the larger environmental and ecological setting. If Corbusier advocated free plan, then, by analogy it can be said that Geddes was an advocate of the entangled plan. Perhaps it is best exemplified by these two drawings by the respective authors. Let me quickly take you through some of the ideas which argue on the side of form in architecture, to begin with, followed by a set of propositions in favor of content.

Corbusier at the beginning of 20th century demonstrated that modern domestic architecture can be a fairly free object, which can enable free configuration of space.[10] Rossi in the middle of the 20th century demonstrated that this degree of freedom is perhaps more evident in the historical urban artifacts, which have sustained over long centuries, and have shaped the city around them.[11] These two ideas have found resonance in the 21st century in an interesting manner. On the one hand offices like Atelier Kempe Thill have proposed that contemporary urban housing should be seen by and large as a structure and infill approach to allow a greater degree of freedom to the inhabitants to build their house within a house.[12] Like a multistoried *maison-domino*. On the other hand, architects like Lacaton and Vassal, and many other architects concerned with retrofitting and repurposing buildings, have explored the capacity of modernist buildings to be retrofitted and expanded to improve the lives of the inhabitants.[13] In all these ideas, it can be noticed that while the architectural object is central, all of them celebrate a degree of freedom or loose relation that form has with its contents.

As mentioned earlier, in the lineage of monism form is typically undermined in favor of an all-encompassing reality where everything is interconnected or emerges from. One of the prominent voices that championed this way of thinking with respect to cities and housing is Patric Geddes.[14] This is clearly seen in the influence on the thinking of Team-X, especially in the Doorn Manifesto drafted by Alisson and Peter Smithson, where they modify Geddes' valley section to suit their contemporary realities.[15] This should help in clarifying that how in this lineage of thinking, the object of housing design is undermined in favor of the larger context that it is part of. Even if their own works were extremely formal in exploration, their theoretical standpoint does underplay the aspect of form.[16]

REASSESSMENT OF FORM AND CONTENT IN HOUSING DESIGN

If in the 20th century and even in our own times, these two ways of considering form and content have undermined each other, we need to think of ways in which we can consider the autonomy of the architectural objects, while also reconciling the importance of contents. As discussed in the first section of the presentation, Graham Harman argues that ontologically speaking, objects both have and

do not have their qualities. However, one of the other arguments that he builds is that objects and contents always come in a pair, and never in isolation. In that sense, there can be no objects without content and no content without objects. As Rossi had put it, type is deeper than its appearance and material. In that sense, we need to extend Harman's idea of form and content fully, to arrive at the following possible theoretical proposition: architectural object (or in this case the object of housing design) is neither just contentless-form, nor is it absolutely dependent on raw content, but it is precisely somewhere between form and content, occupying a middle level of reality—nonetheless acting as a foundation for its contents.

Reassessing form and content in housing design in the age of hypercomputation

We haven't yet answered, why do we need to reassess form and content in housing design? Besides the reasons to develop theoretical propositions about the architectural object, there are also practical reasons to do so. Firstly, I think the question of housing is not considered in a nuanced manner. This has not given us good methodological tools for housing design. We are currently stuck with too much sociology or too little sociology with respect to housing. Secondly, the rise of AI technology also in a way tends to present an all-encompassing urgency that architects and housing designers need to address, and perhaps we can consider other factors that influence housing demand and hence housing design as well.

Since AI related technology has been available for mass use amongst designers and architects, it has received this kind of popular questions, which is either too enthusiastic or too nightmarish.[17] In either case AI appears like the end game, or the only game in the town. It is also seen as this all-encompassing reality, and as perhaps the only reality that we need to be concerned with now. However, we will soon see that it is not the case. As mentioned earlier, the ontological dichotomy of form and content is evident at the very heart of the computational tools being developed for housing design now. On the one hand, there is still the question of novel tectonics, with a tint of participatory and gamification approach, as exemplified by ZH Code and team.[18] On the other hand there are also AI tools like Finch 3d, which, along with new modeling possibilities, also offer quicker ways to manage space distribution and repurposing of existing buildings.[19] However, these aspects are not necessarily as new as they seem. Since at least 2015 companies like WeWorks have been using Machine Learning tools to better manage their coworking spaces.[20] Which also goes on to perhaps prove an even older prediction or proposition made by Renier de Graaf and AMO in 2010, where they predicted that perhaps technology in architecture will help us manage existing buildings and urban fabrics more than only helping architects in developing novel tectonics.[21] In any case, AI and related new technologies will also stop appearing all encompassing, or even pressing matters for architects, if we also consider the aspects of global digital divide.[22]

Let us now understand how the housing crisis is reported in India, and what the actual numbers tell us. The 2012 Housing Census Report[23] qualifies the housing shortage in the following manner:

Households living in non-serviceable katcha	0.99
Households living in obsolescent houses	2.27
Households living in congested houses requiring new houses	14.99
Households in homeless condition	0.53
Total	**18.78**

Table 01. Source: Report of The Technical Group on Urban Housing Shortage (TG-12)

One of the things that is evident here is that most of the housing shortage is from congested households who may need new houses. In the last part of the essay, I demonstrate how this situation can be addressed through strategies of incrementality, even in the case of more formal projects. However, since the reporting of this crisis is presented in absolute terms, the only two ways in which the state and the market is responding is either in terms of building new mass housing stock or, that of improve conditions of slums. While these are important measures, what these two approaches do not consider is the broad range of programs and types of housing that are getting produced in response to the urbanization processes and the rental housing demand that come with it, especially in smaller cities in India. Let us now understand how urbanization is changing in India, with respect to small and medium cities, or meso-cities, and what impact it has on housing. Meso-cities[24] in India have been undergoing slow but interesting urban transformations, and by diverse programs. For example, as destinations of coaching classes for competitive exams, for new FinTech related companies, sometimes large I.T. corporations, as attractive destinations for aging and retired population; or as favored locations for new universities, for start-up incubations hubs, for new manufacturing industries, for tourism and culture, among other things. All these catalysts have been encouraging a wide range of housing programs and typologies to emerge. Despite such diverse and nuanced ways in which housing is being produced across the meso-cities in India, the only ways in which housing design is seen is in these two manners: of slum improvement and rapid and scaled up construction of mass housing, across the country. While these urbanization processes do not have the velocities of bigger cities, but they are nonetheless symptomatic of the changing urbanization scenario in India.[25]

FORM AND DESIGN IN THE PEDAGOGY OF HOUSING DESIGN

This brings us to the last question of the presentation: How does this reassessment of form and content help in the pedagogy of housing design? As pointed in the previous section, there is a methodological crisis in housing design, primarily due to how housing is conceptualized: housing design is currently stuck with either too much sociology or too little sociology. In that sense, first and foremost, by rearticulating architecture of housing or housing design as something that lies between form and content, helps in distinguishing two broad kinds of housing projects and two broad sets of methods (which are well established):

1. *Projects that are independent of their specific contents*: for example, when you do not know whom, you are designing for, how it will be built, how much money it would cost, etc.
2. *Projects that are extremely dependent on, or entangled with, specific contents*: for example, when we deal with known user groups, specific budget constraints, construction type, etc.

This distinction helps in choosing and deploying relevant methods to approach these respective project types. Allow me to quickly demonstrate these two approaches with help of the two studios that I conducted in the last two semesters at CEPT University:

Free Form / Free Content: Adaptable Housing Design[26]

This project looks at housing for the Olympics, in the city of Ahmedabad in India. Ahmedabad is developing new projects to bid for the 2036 Olympics. In this design Navya James mobilizes the idea of adaptable floor plan and façade such that the project can be developed for housing the athletes during the Olympics and for affordable housing and / or free market real estate after the Olympics. Navya also considers such projects as opportunities to develop more mixed use and mixed program developments with amenities and facilities, that can eventually also benefit the neighborhood communities as well. This project is a clear case that explores the potential of free form and free content in housing design. The challenges here entail how to design the structure, circulation, and services that allow for easier modification, than a conventional housing project.

Figure 1. Housing for Olympics as More Housing for the City, Credits: Navya James, CEPT University

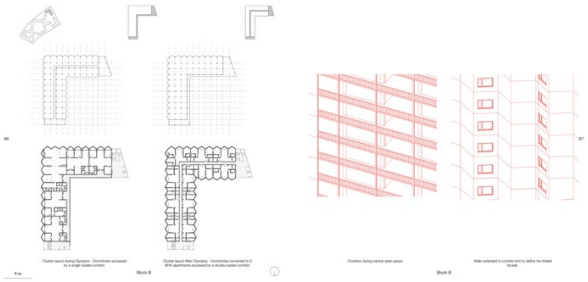

Figure 2. Housing for Olympics as More Housing for the City, Credits: Navya James, CEPT University

Entangled Content and Form: Slum Redevelopment[27]

Let us now see a project that works from the side of content and arrives at a form. Manasvi Vadodaria looks at the case of slum redevelopment in Ahmedabad. However, since the project would entail rehousing the slum dwellers, it was important for Manasvi to study the practices of living, ways of utilizing space inside and outside the houses, challenges of slum redevelopments, and so on to arrive at certain design decisions. She noticed that people roughly use 15-30 percent of the space outside their house for their daily chores or some economic activity. This informed Manasvi's design decision to provide that additional space to every unit in her proposal as well.

Figure 3. Analysis of slum settlement in Ahmedabad. Credits: Manasvi Vadodaria

Figure 4. Translating the analysis into design decisions. Credits: Manasvi Vadodaria, CEPT University

Entangling Form and Content: Conservation Approach Modernist Housing[28]

Another studio which explores this idea from a different perspective is Conservation Approach to Moder Historic Housing, conducted together with Sonal Mithal Modi. This studio is heavier on the content side is to make a case for conserving modernist housing stock in Indian cities. There has been a steady and growing interest in conserving modernist architecture in India, and it comes with its own challenges as well. However, conservation of modernist housing projects has not yet received the recognition and traction that is typically enjoyed by some of the iconic projects from both early and late 20th century master architects. The focus of our studio was to look at the state provided housing that was built between the 1960s and 1990s and to make a case for a conservation of active modernist housing projects. One of the projects we found was an experimental housing project in the city of Surat, in Gujarat, which had a street in the sky configuration, built roughly during the 1970s or 80s by the state, and it was difficult to identify the architects who worked on the project. Unfortunately, this was demolished recently.[29] In any case, students identified various causes and types of disrepairs in these modernist housing projects. Here the approach was to train students in the technicalities of retrofitting and repairing of Reinforced Cement Concrete buildings, and the challenges that come with working with sites that are active, state provided and inhabited by low-income communities. One of such challenges was to also think about changing demands, aspirations, and how to accommodate these challenges in the conservation strategies.

Figure 5. Chosen sites and strategies applied. Credits: Students from the studio, CEPT University

These three examples should help in clarifying the relevance of the discussion on form and content in housing design, without retorting to older forms of *formalism*. Here I follow Graham Harman's clue that formalism, which is ultimately a discussion on form and content, should be redefined to makes space for hybrid entities, which in terms of housing design would mean including context and events, and yet acknowledging the finitude of the hybrid objects.[30]

NOTES

[1] Julian Marias, *History of Philosophy* (Courier Corporation, 2012), 19-25.
[2] Graham Harman, "Ch. 3: On the Undermining of Objects: Grant, Bruno, and Radical Philosophy," in *The Speculative Turn: Continental Materialism and Realism*, ed. Levi R. Bryant, Nick Srnicek, and Graham Harman (re.press, 2011), 21–40.
[3] This school of thought perhaps begins with Socrates but only gains a full-bodied ontology in the hands of Aristotle. See Julian Marias, *History of Philosophy* (Courier Corporation, 2012).
[4] Julian Marias, *History of Philosophy* (Courier Corporation, 2012), 59-85.
[5] Aristotle, *Metaphysics*, trans. C.D.C Reeve (Hackett Publishing, 2016), 114.
[6] Edmund Husserl, *Logical Investigations Volume 2*, ed. Dermot Moran, trans. J. N. Findlay, 1st edition (London ; New York: Routledge, 2001), 5.
[7] Husserl, *Logical Investigations*, 34.
[8] Marshall McLuhan, *Understanding Media: The Extensions of Man*, First MIT Press edition, 1994 (Cambridge, Mass: MIT Press, 1994)., 8.
[9] Graham Harman, *The Quadruple Object* (Zero Books, 2011), 141 (One can also include in this list such philosophers as Bruno Latour, Manuel De Landa, Leibniz, among many others who have some or many intersections with the lineage of Aristotelian thought and metaphysics.)
[10] Le Corbusier, *Toward an Architecture*, ed. Jean-Louis Cohen, trans. John Goodman, 1 edition (Los Angeles, Calif: Getty Research Institute, 2007).
[11] Aldo Rossi, *The Architecture of the City* (MIT Press, 1984).
[12] Atelier Kempe Thill, "Specific Neutrality: A Manifesto for New Collective Housing," *A+t*, 2002, 4–13.
[13] Massimo Faiferri, *Re-Invent: Reuse and Transformation in Lacaton & Vassal's Architecture* (LISt Lab, 2018).
[14] Jaqueline Tyrwhitt, ed., *Patrick Geddes in India* (LIFE SPAN PUBLISHERS & DISTRIBUTORS, 2021).
[15] Dirk van den Heuvel and Max Risselada, eds., *Team 10: In Search of a Utopia of the Present 1953-1981* (Rotterdam: nai010 publishers, 2006).
[16] Distinction and primacy of either form or content, is not just limited to housing design or questions of cities, it is also very much present in the discourse on the architectural object generally as well. For example, consider Kersten Geers' book *Without Content* (2021) prioritizes the question of form and its autonomy, and Rem Koolhaas and OMA's book *Content* (2003) prioritizes the world as a content over form in itself. Architectural object is either considered free of content or extremely entangled with worldly contents.
[17] Oliver Wainwright, "'It's Already Way beyond What Humans Can Do': Will AI Wipe out Architects?," *The Guardian*, August 7, 2023, sec. Art and design, https://www.theguardian.com/artanddesign/2023/aug/07/ai-architects-revolutionising-corbusier-architecture.
[18] *CAADRIA 2020_Keynote Shajay Bhooshan*, 2020, https://www.youtube.com/watch?v=ohonvowWa2E.
[19] *Finch*, 2023, https://www.youtube.com/watch?v=cHLk1TxKcL0.
[20] Nicole Phelan, "Designing Offices with Machine Learning," November 9, 2016, https://www.wework.com/ideas/research-insights/designing-with-machine-learning.
[21] Reinier de Graaf, ed., "Roadmap 2050: A Practical Guide to a Prosperous, Low-Carbon Europe" (OMA, 2010), https://www.oma.com/publications/roadmap-2050-a-practical-guide-to-a-prosperous-low-carbon-europe.
[22] "Widening Digital Gap between Developed, Developing States Threatening to Exclude World's Poorest from Next Industrial Revolution, Speakers Tell Second Committee | Meetings Coverage and Press Releases," October 6, 2023, https://press.un.org/en/2023/gaef3587.doc.htm.
[23] Amitabh Kundu, "Report of the Technical Group on Urban Housing Shortage (TG-12)" (Ministry Of Housing And Urban Poverty Alleviation National Buildings Organisation, 2012), http://nbo.nic.in/pdf/urban-housing-shortage.pdf.
[24] Meso cities refers to scales of cities that fall between megacities and small cities, a term that I have used to discuss the urbanization of small and mid-size cities in India. Also see, Eric Denis and Marie-Hélène Zérah, eds., *Subaltern Urbanisation in India: An Introduction to the Dynamics of Ordinary Towns*, 1st ed. 2017 edition (New York, NY: Springer, India, Private Ltd, 2017).
[25] Nidhi Adlakha, "Rise of the Non-Metros," *The Hindu*, September 21, 2018, sec. Real Estate, https://www.thehindu.com/real-estate/realty-market-in-indias-non-metros/article25005642.ece.
[26] "Housing For Olympics As More Housing For The City | CEPT - Portfolio," accessed February 19, 2025, https://portfolio.cept.ac.in/2024/M/fa/form-of-housing-content-of-life-and-landscape-of-policy-hd4005-monsoon-2024/housing-for-olympics-as-more-housing-for-the-city-monsoon-2024-phd23455.

[27] "Strategies For In Situ Slum Redevelopment Khodiyarnagar | CEPT - Portfolio," accessed February 19, 2025, https://portfolio.cept.ac.in/2024/M/fa/form-of-housing-content-of-life-and-landscape-of-policy-hd4005-monsoon-2024/strategies-for-in-situ-slum-redevelopment-khodiyarnagar-monsoon-2024-phd24476.
[28] "PG MCR Studio 2 | Retroactive Housing | CEPT - Portfolio," accessed February 19, 2025, https://portfolio.cept.ac.in/2024/M/fa/retroactive-housing-cr4005-spring-2024. This studio was conducted together with Dr. Sonal Mithal Modi. Student's works can be seen on the following link.
[29] "Man Darwaja Tenements to Be Razed," *The Times of India*, October 29, 2024, https://timesofindia.indiatimes.com/city/surat/surats-man-darwaja-tenements-set-for-demolition-as-redevelopment-efforts-move-forward/articleshow/114742508.cms.
[30] Graham Harman, *Art and Objects* (Wiley, 2019), 32-47.

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SUPERBLOCKS IN ABU DHABI: IMPROVING NEIGHBORHOOD LEVEL, WALKABILITY, AND GREEN SPACE ACCESS

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INTRODUCTION

Neighborhood accessibility is a key part of what makes cities livable. It affects how people interact with their surroundings and how easily they can meet daily needs. When essential services like schools, shops, clinics, and parks are within walking distance, everyday life is more convenient and inclusive, especially for people who don't own cars. Accessible neighborhoods also encourage walking and outdoor activity, helping to build stronger community ties and a greater sense of belonging. These environments often become more vibrant and human-centered, supporting healthier lifestyles and reducing dependence on cars. With fewer vehicles on the road, there's less congestion and pollution, contributing to a cleaner, more sustainable urban environment.

Abu Dhabi, the capital of the United Arab Emirates, has seen dramatic changes over the last century. In the 1950s, it was a small town with only around 4,000 residents. Today, the city has grown to over 1.5 million people.[1] The discovery of oil in the 20th century sparked this transformation, bringing new wealth and development opportunities.[2] With this growth came a new car-focused vision for the city. Abu Dhabi was designed with large superblocks that prioritize vehicle access. While these made it easier to drive, they also created barriers for people who walk, making the city less friendly for pedestrians.

The main question of this paper is: Can the automobile-centric superblocks of Abu Dhabi be adapted to be more human-centric? the paper explores how these areas might become more walkable and socially engaging by improving pedestrian access, adding more green space, and rethinking how streets and public areas are laid out, especially in the context of the region's hot climate. The methodology used includes GIS mapping to understand the current urban layout, along with on-site observations and interviews with residents. Together, these methods provide a detailed look at what works, what doesn't, and how minor urban design interventions can turn Abu Dhabi's superblocks into more livable and walkable places. This paper contributes to studies on Gulf urbanism by offering strategies for converting car-oriented blocks typical of the region into pedestrian-friendly, human-centered environments, promoting a shift towards more sustainable and socially vibrant urban landscapes.

LITERATURE REVIEW

Gulf Urbanism

In the Gulf, urbanization was driven historically by reliance on the hydrocarbon sector, resulting in rapid, large-scale urban development. The Gulf Cooperation Council (GCC) countries, Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the UAE, have an urbanization level of about 85%, among the highest globally. This growth poses challenges as cities balance development and environmental concerns. Influenced by oil and gas industries, Gulf cities developed car-oriented, energy-intensive, and sprawling urban forms.[3] Elsheshtawy describes the shift from traditional souqs and compact neighborhoods to car-centric metropolises prioritizing aesthetics over community needs.[4] He critiques the top-down planning that overlooks pedestrian access, cultural heritage, and social spaces, advocating for a blend of traditional and modern urbanism. Building on this, Alawadi, Abdelghani, and Daghash highlight the gap between sustainability plans and their execution, noting persistent car dependency and lack of climate-responsive, pedestrian-friendly design.[5] They call for actionable strategies like shaded walkways, green corridors, and compact forms to create inclusive and sustainable Gulf cities.

The Potential of the 'Superblock' in Urban Design

The superblock idea has its origins in the planning of the city of Barcelona. The Superblocks that were developed in the city aimed to reduce traffic problems, encourage walking, and improve the overall quality of life by breaking up large city blocks into smaller, more pedestrian-accessible blocks. This idea came in the 1920s, based on modernist urban planning theories that aimed to use the city best for mobility and socializing purposes.[6] As shown in Figure 1, a superblock is essentially a larger neighborhood block, significantly exceeding the standard size of a typical neighborhood block.

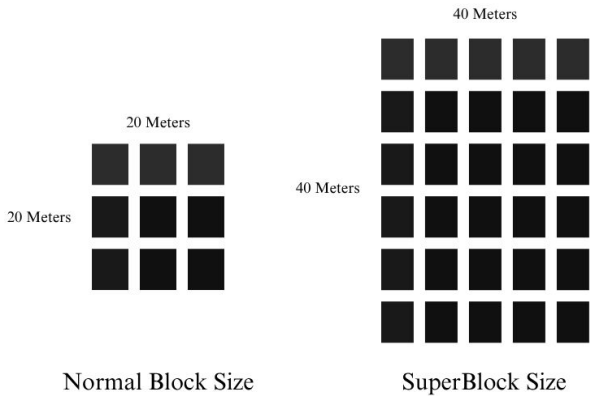

Figure 1. The difference between a normal block size and a superblock.

The superblock is a plan that combines several smaller city blocks into one large block, surrounded by streets for cars, but the inside is for pedestrian paths, parks, etc. This includes creating lively neighborhoods with noise and air pollution reduction, increasing walkability, and having green spaces for social interaction.[7] The superblock designs in the case of Barcelona, delivered significant enhancements in public health, environmental quality, and social cohesion after their implementation.[8] Now, other cities worldwide, such as Seoul and New York, are trying out different versions of the superblock model because they, too, have realized that they have problems of traffic congestion, environmental degradation, and decreasing public health.[9]

Key Features of Superblock Urban Design

The superblock theory is that in the inner portions, pedestrians own, and cars do not. Inside the superblocks, the streets are more comfortable for the residents by reducing their use of automobiles. Moreover, open spaces for open markets, public meetings, and recreational areas are become available.[10] This kind of layout also supports more active forms of transportation like walking and cycling and, therefore, a healthier urban environment.

Many superblocks also integrate green infrastructure, such as parks, community gardens, and water management systems, to make them more environmentally friendly. For example, in Barcelona, which has used the superblock model much more extensively, these blocks decrease traffic noise and accidents, help minimize urban heat islands and increase air quality due to the lack of vehicles.[11]

Superblocks in the GCC

Superblocks are widely used in the master planning of GCC cities, particularly in Abu Dhabi, due to rapid urbanization and large-scale developments.[12] Based on modernist planning principles, they enhance land-use efficiency, car access, and infrastructure deployment. Superblocks support high economic and population density and multifunctional land use, but they also raise concerns about walkability and connectivity. Their scale can limit pedestrian access and social interaction between blocks.[13] Additionally, their self-contained nature may weaken neighborhood social ties. Despite these challenges, superblocks remain central to urban planning in Abu Dhabi and the GCC, with ongoing efforts to improve connectivity and quality of life.[14]

ZOOMING IN: ABU DHABI AND ITS SUPERBLOCKS

Abu Dhabi, the capital of the UAE, is a rapidly evolving city known for strategic urban planning and sustainability. With modern architecture, cultural landmarks, and expanding infrastructure, it supports national development goals. The Abu Dhabi 2030 Urban Structure Framework Plan guides future growth, aiming to balance economic expansion, cultural preservation, and environmental sustainability, envisioning a globally competitive city with connected centers, walkable neighborhoods, and green spaces that enhance quality of life.

Figure 2. Abu Dhabi 2030 Urban Structure Framework Plan. Source: Department of Municipal Affairs and Transport, 2017

Abu Dhabi's rapid urbanization, fueled by economic growth and large developments, has produced a car-centric city of wide roads, high-rises, and sprawling neighborhoods.[15] Despite modern infrastructure, green space access is limited, especially in dense or low-income areas where parks are often isolated or require private transport. The arid climate and fragmented layout, with gated communities and physically separated neighborhoods, worsen the issue.[16] As a result, pedestrians, especially children, the elderly, and low-income workers struggle to reach safe recreational areas,[17] while poor pedestrian infrastructure and long distances reduce connectivity and social interaction.

Accessibility Analysis

A comprehensive analysis using Geographic Information Systems (GIS) assessed walkability and access to key components, parks, mosques, retail malls, schools, hospitals, and parking within Abu Dhabi's superblocks. The study used two buffer zones: 400 meters (4-minute walk) and 800 meters (8- minute walk), offering a clear view of how easily residents can reach essential amenities on foot.

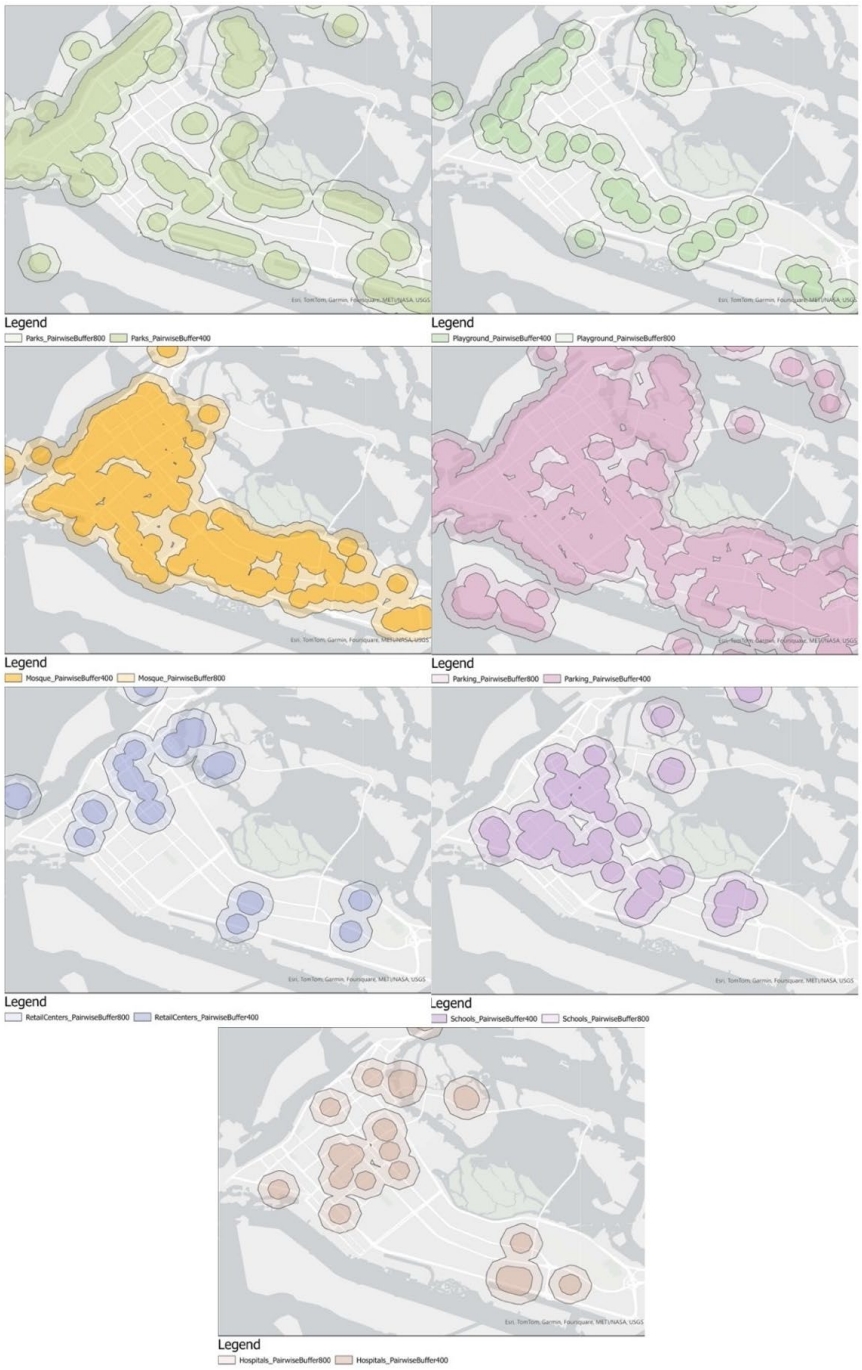

Figure 3. Superblocks Accessibility Analysis

As shown in Figure 3, the map illustrates 400-meter and 800-meter buffer zones around key amenities, parks, playgrounds, mosques, parking areas, retail spaces, schools, and hospitals within Abu Dhabi's superblocks to analyze their accessibility and visualize the spatial extent of each amenity's influence within the city's urban fabric.

The analysis revealed a significant shortfall in access to essential facilities within many Abu Dhabi superblocks. Despite modern planning, several areas lack parks, mosques, retail malls, schools, hospitals, and parking within reasonable walking distances, highlighting urban planning gaps that affect walkability and residents' quality of life. Addressing this requires strategic improvements to urban design and infrastructure.

Overall Superblock Ranking, case study analysis

Following the analysis of Abu Dhabi's neighborhoods, the study assessed superblocks based on accessibility to amenities, parks, playgrounds, mosques, parking, retail malls, schools, and hospitals, using a scoring system: 1 point if within 400 meters (4-minute walk), 2 points if within 800 meters (8-minute walk), and zero if farther. Each block could score up to 14 points (99.9%). The results showed most superblocks scored between 66.6% and 44.4%, indicating moderate accessibility but highlighting a planning gap.

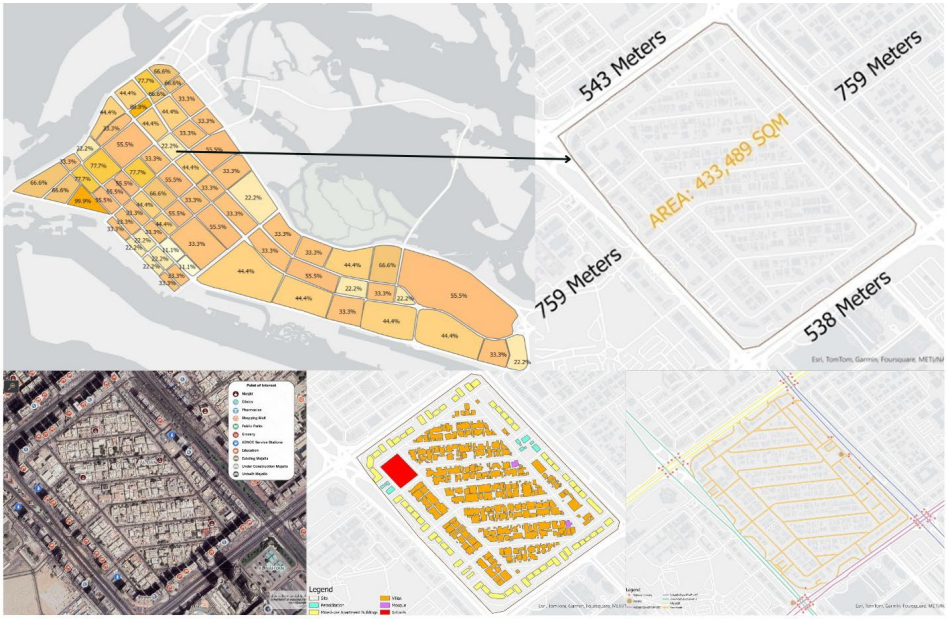

Figure 4. Overall Ranking of Blocks, Site Selection and Analysis

Al Danah neighborhood was selected for further study due to its low score of 22.2%, reflecting poor access to green areas and essential services. Developed early in Abu Dhabi's expansion, Al Danah features a mix of low- to mid-rise buildings, with villas in the center and mixed-use apartments along the edges. A GIS land-use map revealed a distribution of schools, mosques, clinics, and retail amenities, yet also underscored limited access to green spaces and walkability. The transportation network (Figure 4) shows a grid of main and minor roads prioritizing cars, with limited sidewalks and no cycling lanes, emphasizing the car-centric planning that hinders pedestrian mobility. Addressing these issues requires integrating walkable and bike-friendly infrastructure to improve connectivity and create a more sustainable, inclusive urban environment.

Shortest Path Analysis

To gain a deeper understanding of these deficiencies, a shortest path analysis was done using GIS tools. This analysis examined the actual distances from the neighborhood to the nearest amenities, providing precise data on accessibility. By mapping these distances, the study was able to highlight the extent of inaccessibility for key facilities, offering critical insights into how the neighborhood's layout and connectivity could be improved to promote walkability and enhance the quality of life for its residents.

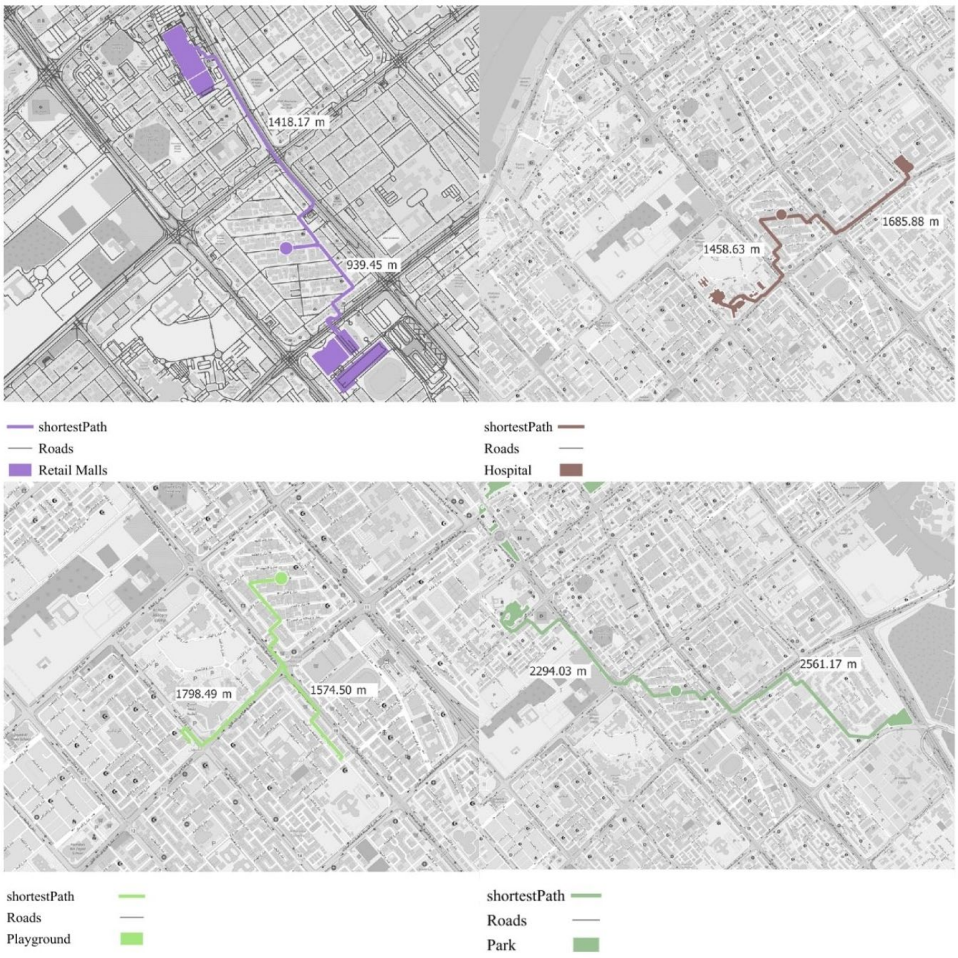

Figure 5. Shortest Path Analysis.

Figure 5 shows key amenities are beyond typical walking distances, posing accessibility challenges. The nearest parks are 2,294.03 meters (26 minutes) and 2,561.17 meters (30 minutes) away, while playgrounds are 1,574.50 meters (20 minutes) and 1,798.49 meters (23 minutes) away. Hospitals are 1,458.63 meters (16 minutes) and 1,685.88 meters (20 minutes) away. Retail malls are closer at 939.45 meters (12 minutes) and 1,418.17 meters (21 minutes) but still highlight the need for better urban planning.

Site Observations

One key objective of the site visit was to observe the pathways residents use to access nearby amenities and assess their condition. I focused on whether the sidewalks are sufficient, safe, and pedestrian- friendly by walking the routes myself to experience what residents face daily, noting obstacles, sidewalk quality, shading, and overall comfort.

Shortest Path Site Observations: Hospitals

Figure 6 highlights key locations where images were taken, offering spatial context to neighborhood observations. At Point A, the sidewalk ends at a parking garage entrance, posing safety risks for cyclists.

Point B reveals a narrow sidewalk in a villa district, limiting pedestrian movement. Point C shows no dedicated cycling or scooter lanes, forcing users onto the road with vehicles. At Point D, pedestrians walk on the street, indicating issues with sidewalk condition, accessibility, or design.

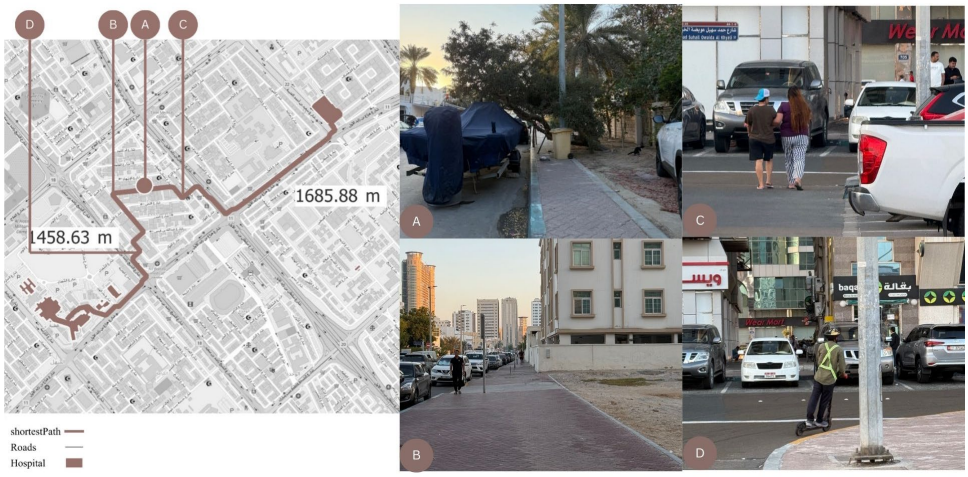

Figure 6. Shortest Path Observations to Hospitals

Shortest Path Site Observations: Playgrounds

Figure 7 highlights observations along the shortest path to the playground. At Point A, sidewalks are notably narrow, reflecting a recurring neighborhood issue. Residents on scooters share roads with cars, raising safety concerns. At Point C, sidewalks remain narrow, with parked cars overlapping them, further limiting pedestrian access.

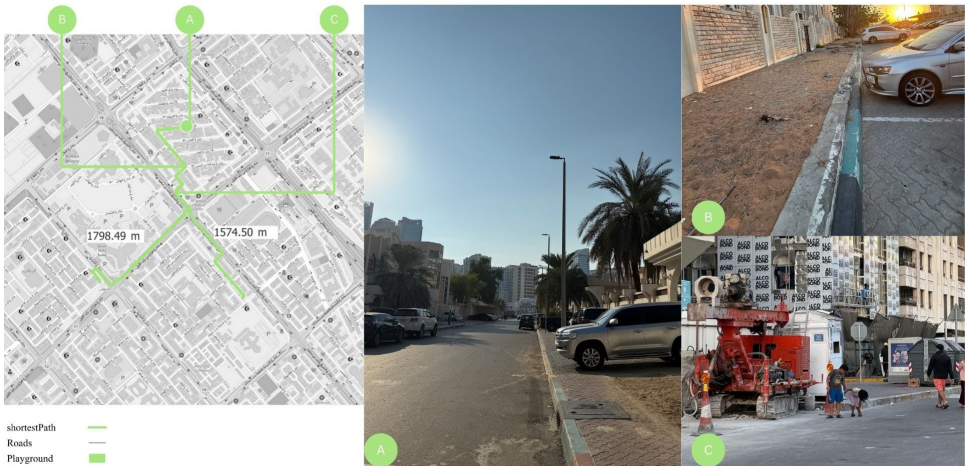

Figure 7. Shortest Path Observations to Playgrounds

Shortest Path Observations: Parks

Figure 8 shows the shortest path to the parks, highlighting issues affecting pedestrian movement. At Point A, a trash bin blocks most of the sidewalk, limiting access. At Point B, residents use the sidewalk as seating, reducing walkable space. At Point C, more people are seated, causing congestion and making pedestrian navigation difficult.

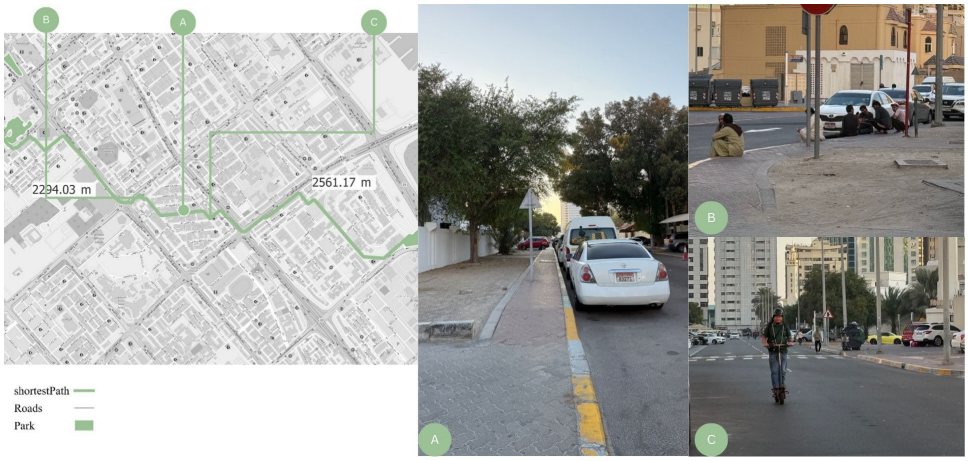

Figure 8. Shortest Path Observations to Parks

Shortest Path Observations: Shopping malls

Figure 9 shows the shortest path to nearby shopping malls, highlighting several obstacles. At Point A, a tree provides shade, but a parked car blocks part of the sidewalk. At Point B, sand surfaces make walking uncomfortable. At Point C, a tree and trash can fully obstruct the path, forcing detours. At Point D, people standing and sitting along the edges hinder pedestrian movement.

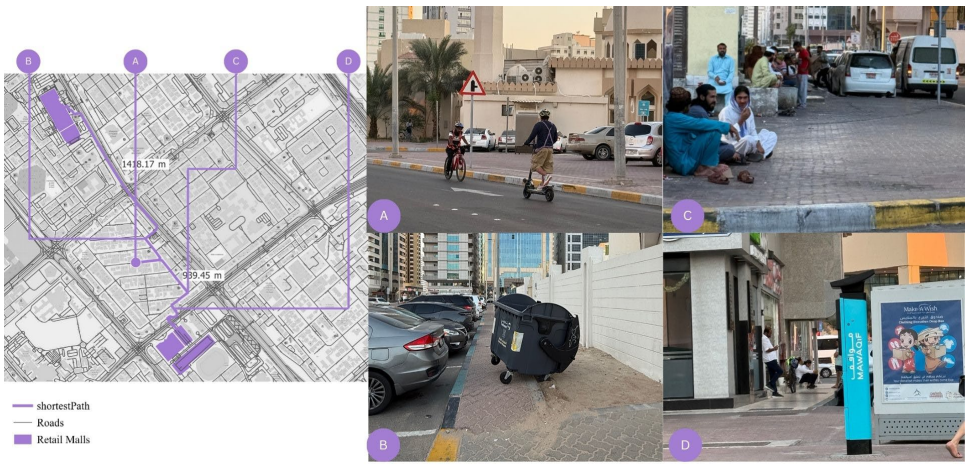

Figure 9. Shortest Path Observations to Nearby Malls

Interviews with residents

To gather insights efficiently, convenience sampling a non-probability method based on participants' availability and willingness was used, enabling quick data collection despite limited generalizability[18]. Twenty interviews with residents and people present in the area explored daily experiences, focusing on transportation habits, communal space access, and the overall environment. Participants shared challenges, unmet needs, and suggestions for improvement, offering valuable insights to guide solutions that enhance neighborhood life (Figure 10).

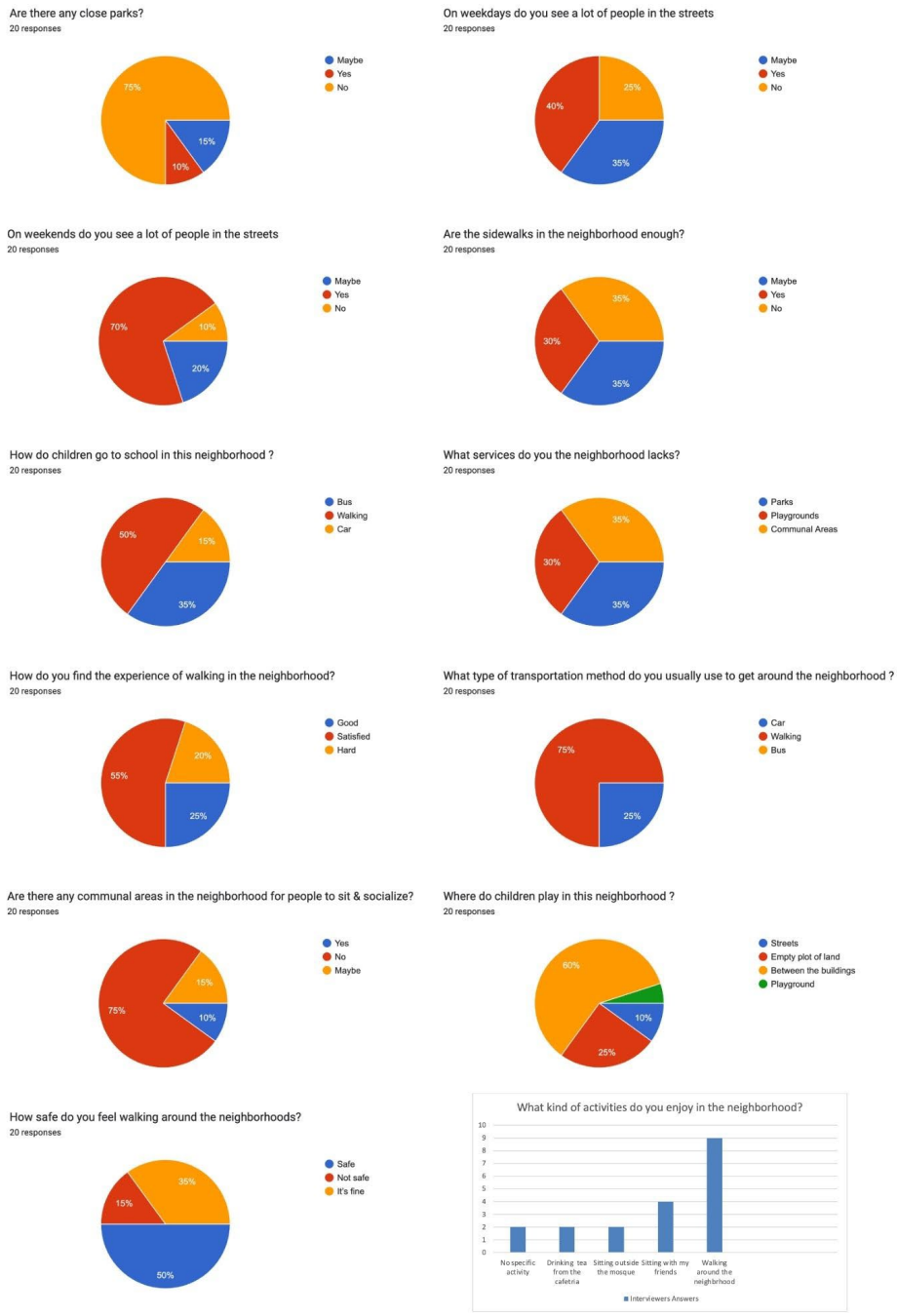

Figure 10. Interview Questions and Responses

When asked about park availability, 75% of residents said "no," 15% "maybe," and only 10% "yes," revealing a clear lack of nearby green spaces. Street life was seen as moderate on weekdays by 40%, but 70% noted active weekends, showing stronger community interaction during off-work hours. Only 30% found sidewalks sufficient, while 35% found them lacking and 35% were unsure. Despite infrastructure issues, 50% of children walk to a nearby school, while 35% use buses and 15% cars. Key neighborhood needs included parks and communal areas (35% each) and playgrounds (30%). Walkability was rated satisfactory by 55%, acceptable by 25%, and difficult by 20%, though 75% walk regularly, emphasizing the need for pedestrian infrastructure. Communal areas were lacking for 75%, with children often playing between buildings (60%), in empty lots (25%), or on streets (10%). For safety, 50% felt safe walking, 35% saw room for improvement, and 10% felt unsafe. Favorite

spots included mosques, cafeterias, supermarkets, and sitting with friends, while walking was the most enjoyed activity (9 respondents), followed by socializing (4), tea or mosque visits (2 each), and two had no preferred activity. These insights stress the need for improved walkability, shaded paths, and community-oriented design.

CONCLUSION

This research set out to address a pressing urban design challenge: how can Abu Dhabi's automobile-dominated superblocks be reimagined to support walkability, social interaction, and equitable access to green and communal spaces? By employing a multi-method methodology, integrating GIS-based spatial analysis, field observations, and community interviews, this study offers clear, evidence-backed answers to that question.

The selected case study of the Al Danah neighborhood revealed that, despite its central location, it suffers from significant deficits in pedestrian infrastructure, green space accessibility, and inclusive public realms. GIS mapping highlighted long walking distances to essential amenities such as parks, hospitals, and playgrounds, often exceeding 20 minutes, while field observations exposed physical barriers such as obstructed sidewalks, narrow paths, and unsafe road crossings. These infrastructural shortcomings were echoed in the voices of residents, 75% of whom reported a lack of accessible parks and communal areas, with children frequently seen playing in unsafe, improvised spaces like streets and empty plots.

Crucially, this research demonstrated that the lived experiences of residents often separate from the ideals of modern urban master planning. Interviews and behavioral observations underscored how residents adapt creatively to inadequate conditions, using shaded building edges for walking, sitting on podiums for socializing, and turning mosque exteriors into communal gathering areas. These behaviors reveal a demand for more inclusive and climate-responsive urban spaces.

By aligning spatial data with human-centered insights, this study makes a compelling case for the transformation of superblocks into walkable, equitable environments. Design interventions, such as shaded pedestrian corridors, distributed pocket parks, protected cycling lanes, and community-focused open spaces, must be prioritized to humanize Abu Dhabi's urban fabric. Moreover, the success of such interventions depends not only on spatial logic but on deep engagement with the needs and behaviors of local communities. Ultimately, this research contributes to the discourse on Gulf urbanism by offering a replicable framework for retrofitting car-centric urban environments into more livable, sustainable, and human-centered neighborhoods. The findings provide a strategic foundation for policymakers, urban designers, and planners aiming to reconcile modern infrastructure with the everyday needs of diverse urban populations, not just in Abu Dhabi but across the similarly structured GCC region and beyond.

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