Generative Design for the Masses:

A Toolkit for Customized Housing

DLA Doctoral Dissertation Booklet

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Street view of the Bashayer El-Kheir housing project in Alexandria, Egypt, displaying the imposing scale of uniform high-rise residential towers (source: author)

1. Preface

This booklet presents a concise overview of research dedicated to enhancing **mass housing** through **generative design**, an approach that unites advanced computational methods with the architect's essential understanding of social and cultural aspects. Rapid population growth and urban expansion often result in large-scale, standardized developments that leave little room for occupant-specific adaptation. While they address urgent quantity requirements, such projects risk overlooking the personal and contextual elements that foster a sense of home and community. By proposing a structured generative design toolkit, this study explores how architects, planners, and stakeholders can simultaneously realize economies of scale and accommodate diverse user needs.

2. Abstract

The design of mass housing projects presents considerable obstacles in balancing the requirements of diverse residents with efficient and cost-effective frameworks. The emergence of generative design approaches presents a revolutionary chance to alter this industry. This study aims to overcome the constraints of standardized mass housing designs, which often lack personalization and negatively impact residents' quality of life.

This research utilizes a mixed-methods approach, which involves conducting literature reviews, case studies, and surveys of designers, developers, and residents. The objective is to assess the effectiveness of current generative design tools in the context of mass housing. The results lead to the creation of a toolkit that combines generative technologies with certain stages of the design process. This toolkit utilizes the most advantageous characteristics of novel generative design tools to optimize the process of customizing mass housing, guaranteeing both functionality and user-centered design. The primary objective of this research is to provide a meaningful contribution towards the development of housing solutions that are more sustainable, equitable, and tailored to individual needs.

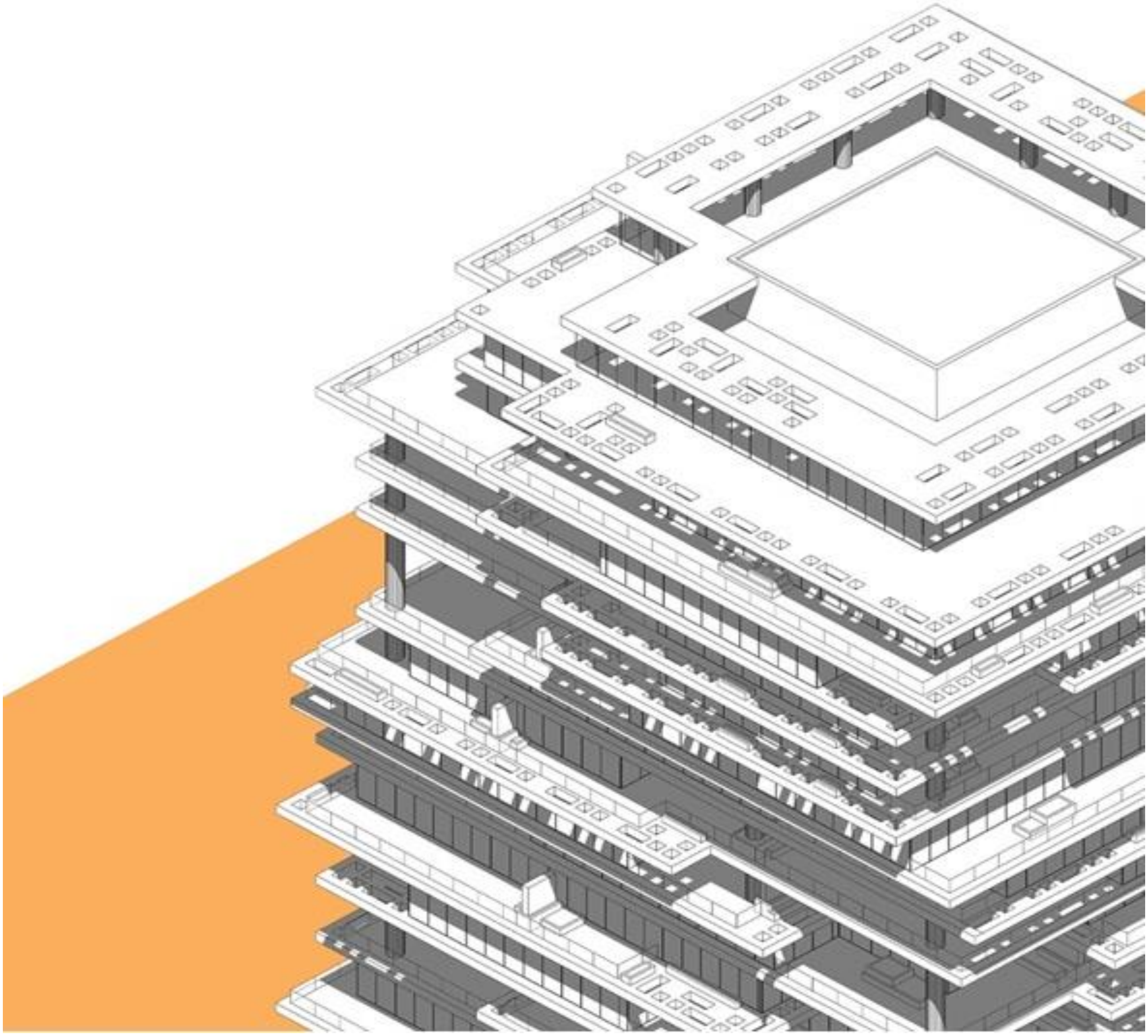
Keywords: Mass housing, Customization, Generative design, Design Toolkit, Architectural design process

3. Dissertation theses

Thesis 1

Generative design methodologies can enhance the efficiency and creativity of the mass housing design process compared to conventional design methods.

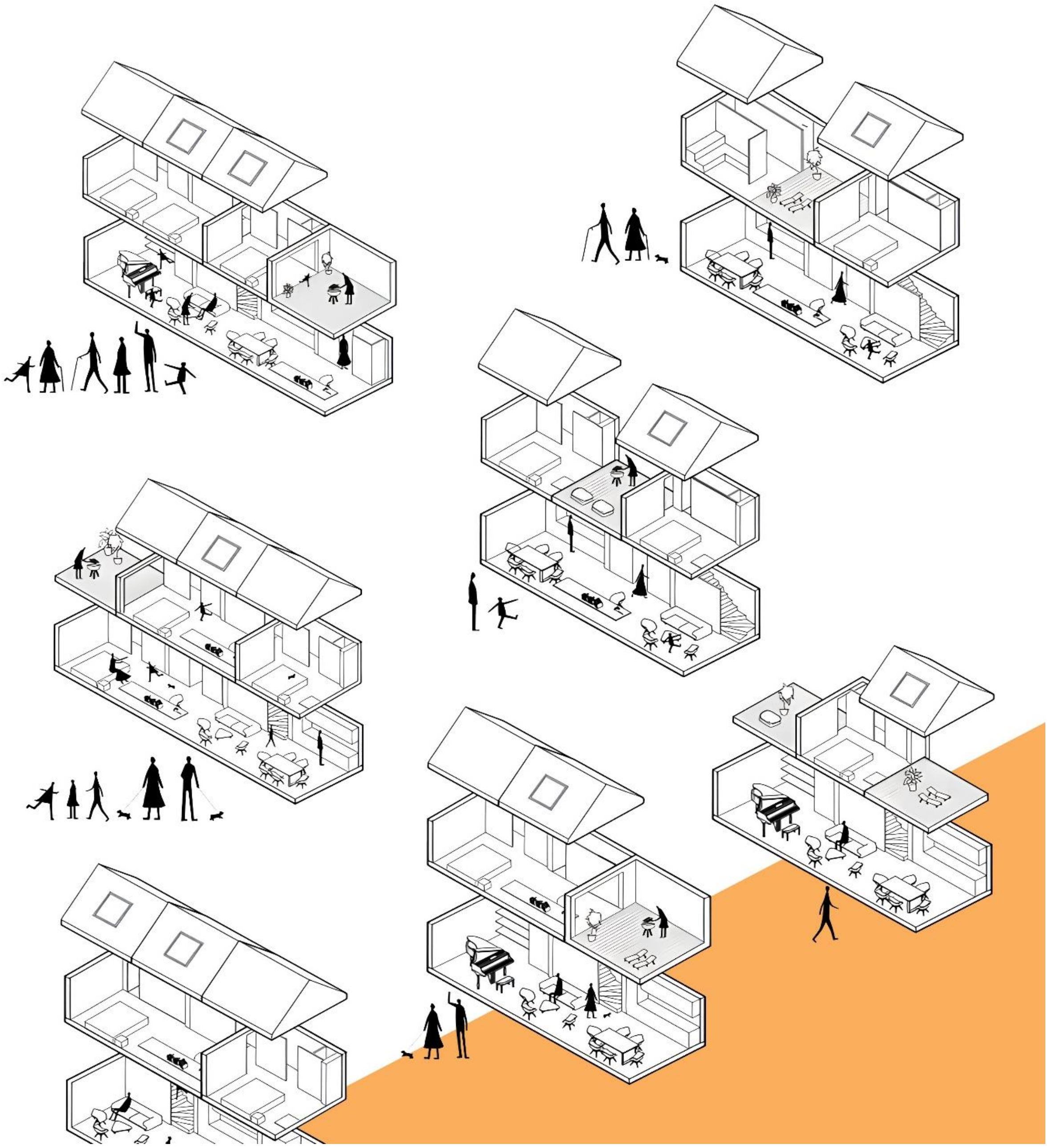
The hypothesis is supported by the findings obtained from the case study and the survey administered to housing experts. Generative design tools have shown a notable decrease in the time needed for the initial design stages, allowing for quick prototyping and iteration. Moreover, these technologies helped the process of creative exploration by creating a diverse array of design alternatives, thereby amplifying creativity.



Thesis 2

A tailored generative design toolkit can effectively bridge the gap between individual housing customization and the economies of scale associated with mass housing production.

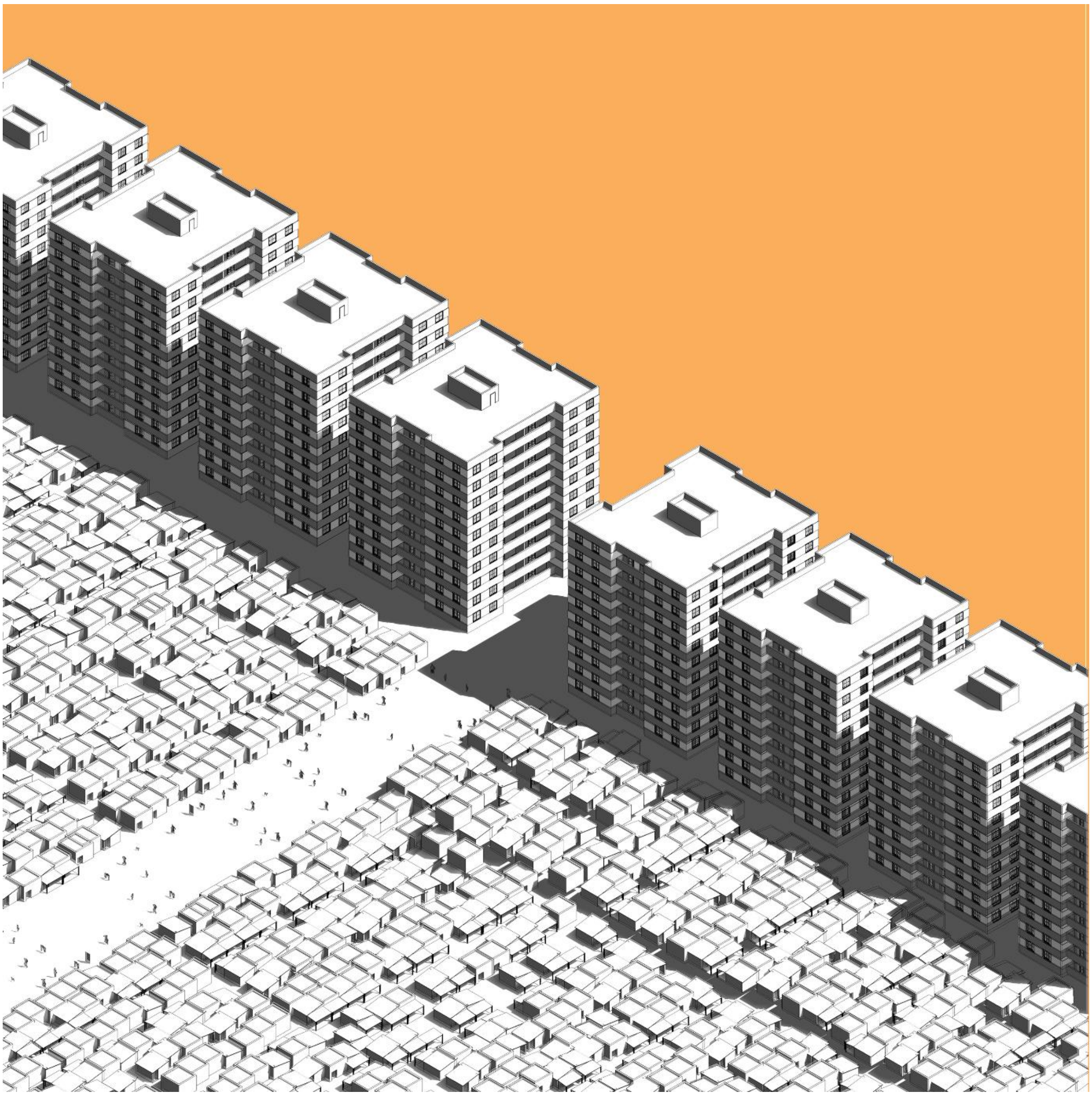
The case study demonstrated how the utilization of generative design tools allowed for extensive customization without sacrificing the benefits of mass production. An important discovery was made regarding the capacity to rapidly modify designs according to personal tastes while yet maintaining scalability. This evidence confirms the idea that generative design tools have the ability to integrate personalized customization with the efficient manufacturing of large-scale housing, thereby removing a significant obstacle in the scope of mass housing.



Thesis 3

The integration of generative design in mass housing projects leads to improved sustainability and adaptability of housing solutions.

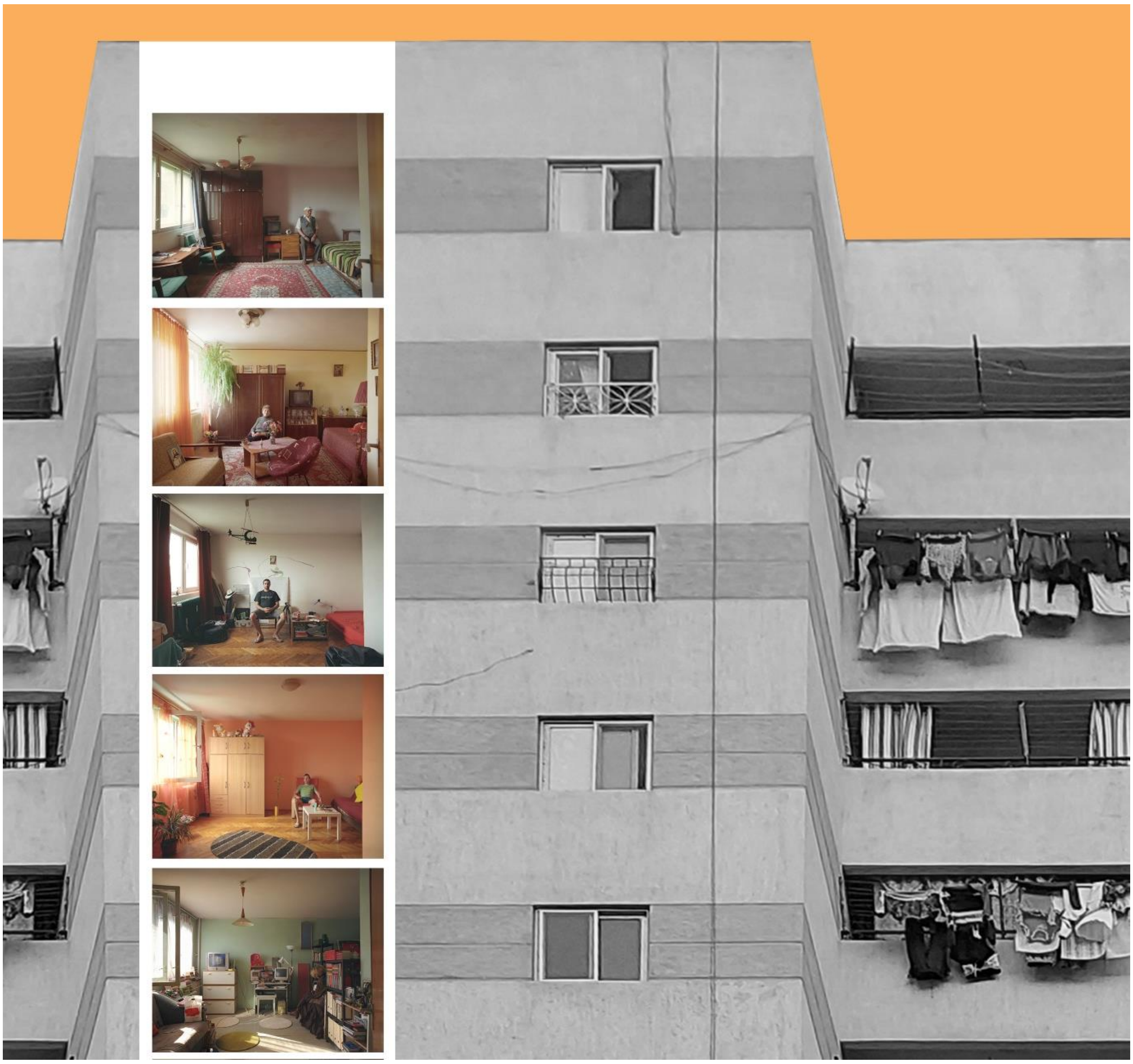
The sustainability study phase revealed that generative design tools such as Finch and Autodesk Forma have the capability to enhance designs for environmental performance by integrating sustainable materials and energy-efficient layouts. The comparative results from the case study demonstrated that projects utilizing these tools will attain better sustainability metrics in comparison to conventional methods. This result corroborates the premise that generative design improves the sustainability and adaptability of mass housing options.



Thesis 4

User participation in the generative design process increases satisfaction with and acceptance of mass housing projects.

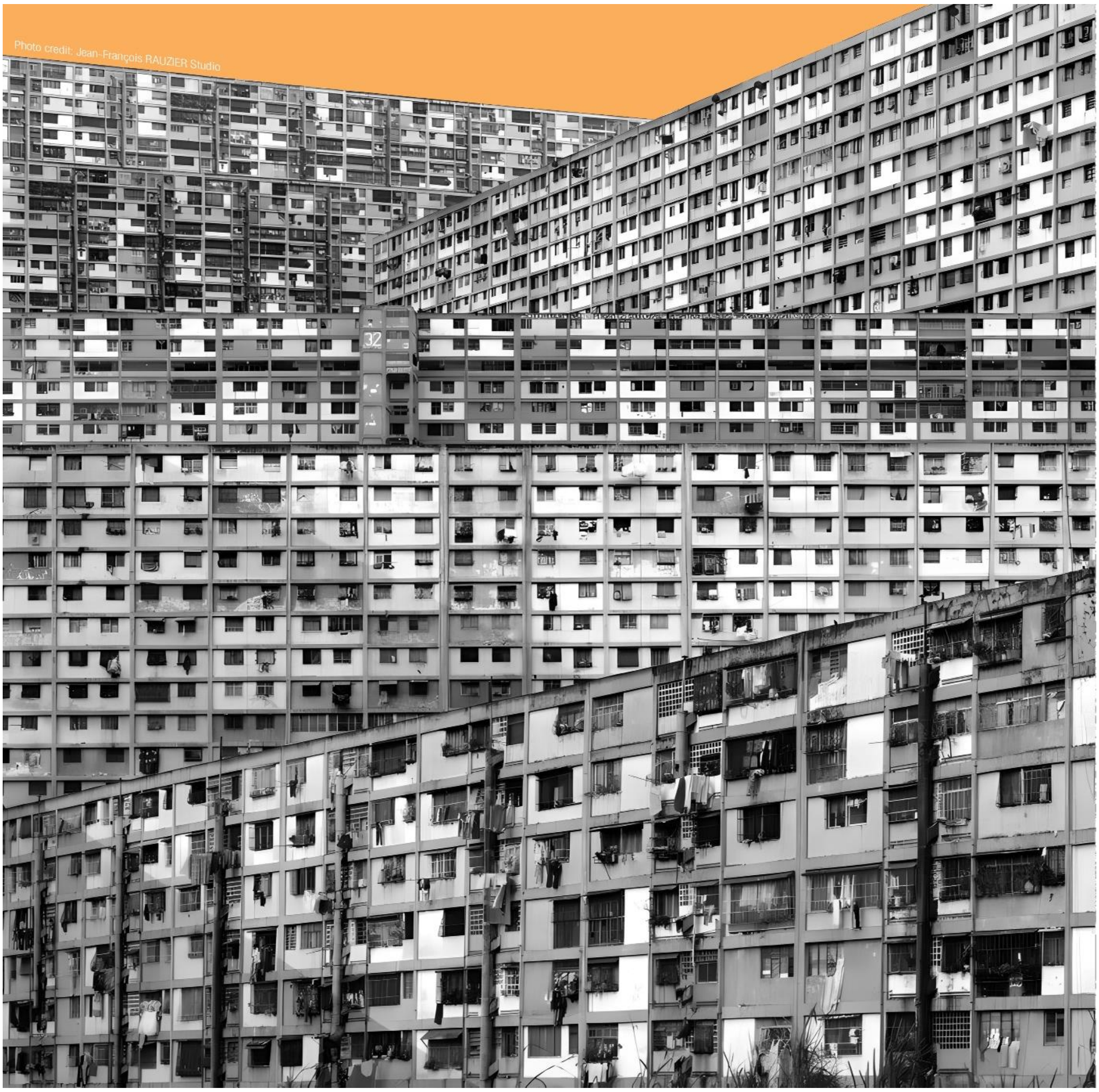
Utilizing Natural Language Processing (NLP) chatbots for collecting detailed resident preferences and subsequently incorporating this data into the design process resulted in increased satisfaction ratings among participants. The survey revealed that user interaction in the design process was vital for acceptability, as 75% of respondents emphasized the significance of community amenities that were directly influenced by their opinion. This finding provides evidence that the use of generative design techniques to encourage user participation leads to higher levels of happiness and acceptability in housing projects.



Thesis 5

Identifiable barriers to the widespread adoption of generative design in mass housing can be mitigated through strategic toolkit development and stakeholder engagement, facilitating broader implementation.

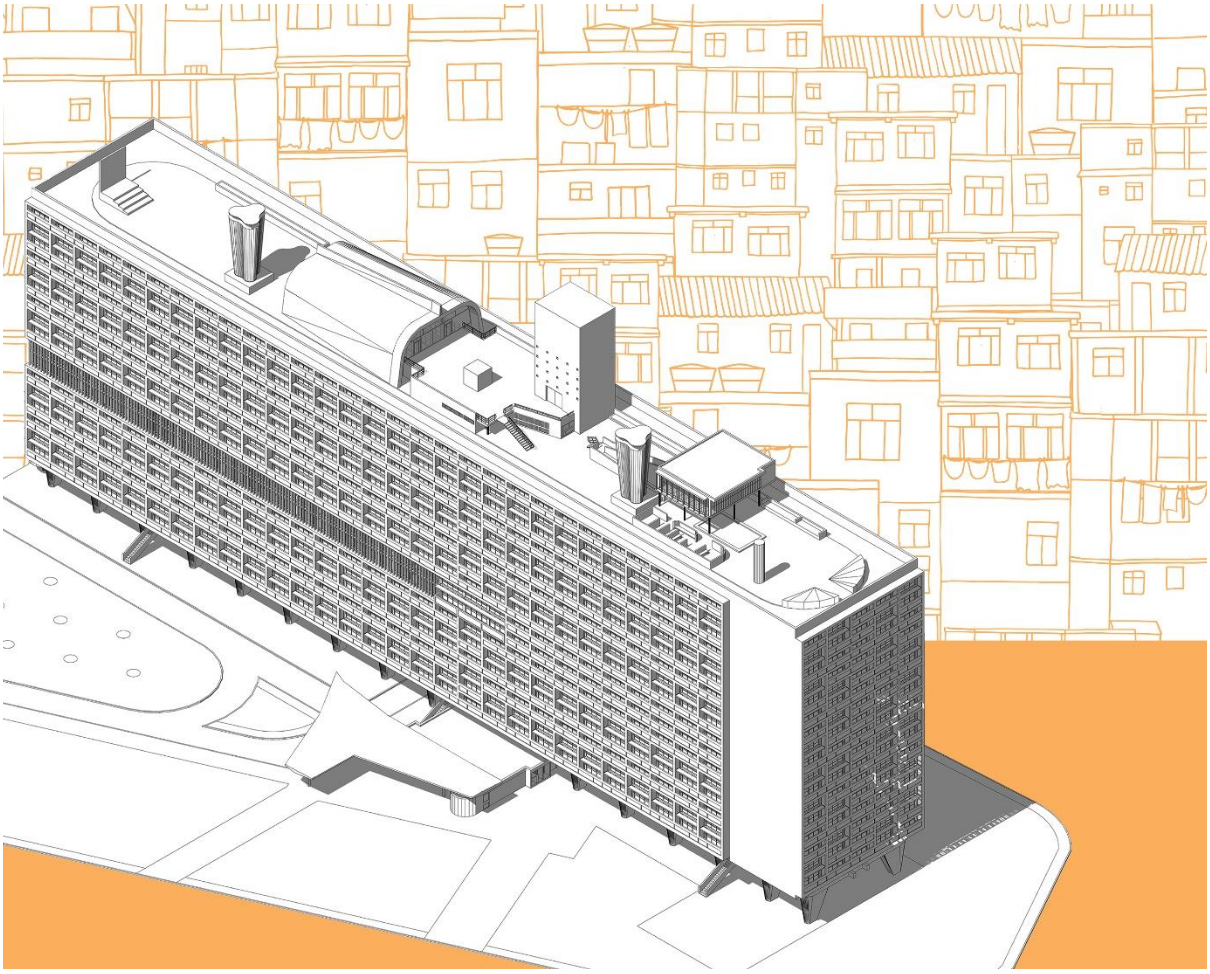
The study identified various obstacles, including technological complexity, need for training, and integration with current operations. Nevertheless, the case study showed that the obstacles could be overcome by implementing focused onboarding programs for the tools, user-friendly interfaces, and smooth integration with existing systems, all of which were facilitated by iterative development and feedback loops. This finding provides evidence that the strategic development and active involvement of stakeholders can help reduce obstacles to adoption.



Thesis 6

Generative design can streamline certain tasks in mass housing customization, yet it relies on human expertise to ensure broader social, cultural, and environmental factors are properly addressed.

Although AI-driven workflows accelerate repetitive or data-intensive design stages, a methodical approach to mass housing also depends on occupant well-being, cultural identity, and community aspirations; factors that automated systems cannot capture without informed human guidance. Generative tools work best when architects, planners, and residents provide context-specific input and oversight, adapting algorithms to local regulations, cultural norms, and sustainability targets. True long-term viability and community resilience in mass housing require more than efficiency alone; human expertise is vital for integrating social equity, environmental awareness, and economic feasibility into coherent design strategies.



4. Dissertation Summary

Mass housing developments are typically driven by pressing needs for affordable, rapidly constructed units, yet often fail to accommodate the varied preferences of diverse occupant groups. Generative design offers a computational approach to streamline repetitive tasks, enable rapid iteration, and incorporate evolving user feedback. This thesis explores how architects and planners can harness these automated processes without losing sight of contextual and cultural considerations.

A comprehensive **mixed-methods** methodology shaped the core of the research. First, qualitative interviews with industry experts and government officials highlighted the practical challenges of integrating user input into large-scale developments, particularly under strict budget and site constraints. Next, a quantitative survey collected feedback from over fifty professionals across multiple continents, revealing that technical complexity, training requirements, and workflow integration pose significant barriers to adopting generative tools. These insights informed the design of a **generative toolkit**, evaluating software based on functionality, usability, flexibility, integration, and scalability.

The **case study** focused on Alexandria, Egypt, where government-led housing initiatives exhibit uniform vertical blocks on the periphery of vibrant, historic neighborhoods. By contrasting a conventional BIM-based process with generative approaches, the study shows marked efficiency gains—often cutting "time on task" in half—and allowing architects to better accommodate resident preferences gleaned from surveys and chatbot interactions. While many technical and policy barriers remain, the core finding is that generative processes can align occupant needs with the economics of mass production. Architects, however, must guide these algorithms to ensure building codes, environmental standards, and social context are respected.

Ultimately, the research concludes that **mass housing** can be made more adaptable and human-centered by merging systematic, computational workflows with informed professional oversight. Such an approach does not discount the importance of standardization for cost or regulatory compliance but suggests a new paradigm: "mass customization," in which each unit retains enough flexibility to reflect the identity and aspirations of its residents.

5. “Our take on Africa” Exhibition

A synopsis of this research was showcased in an exhibition titled *Mass Housing Customization: Egypt’s Challenge*, presented in parallel with the Venice Architecture Biennale. Organized under the broader vision of the Department of Explorative Architecture, the display used a series of illustrated panels to narrate the historical, social, and technical dimensions of large-scale housing. The panels contrasted successful and failed housing projects worldwide, introduced the local Egyptian context—particularly the Bashayer El-Kheir developments—and delved into the generative design strategies discussed throughout this work.

The study conveyed how rapid iteration and generative design tools could address deeper cultural and community needs, not merely feasibility or cost efficiency. The exhibition thus complemented the thesis by reinforcing that generative design solutions are most effective when paired with robust community engagement and commitment to context-driven creativity.

Scan the QR code to listen to a podcast about the dissertation

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