*1970's photo of Las Fronteras social housing, Torrejón de Ardoz, Madrid. Source: Modulo Hele de Rafael Leoz.*

# AI-Driven generative prototyping for the reconstruction of Gaza

Graziella Bernardo [1,*], Luis Palmero [2]

[1] Department for Humanistic, Scientific and Social Innovation. University of Basilicata, Italy.
[2] Department of Building Construction. Universitat Politècnica de València, Spain.
*Email: *graziella.bernardo@unibas.it, lpalmero@csa.upv.es*

**Abstract:** Rafael Leoz (1921–1976), Spanish architect and theorist, made a pioneering yet underacknowledged contribution to modular and participatory architecture through his HELE module (*Habitación Expandible Lineal Evolutiva*), a combinatorial system based on polyhedral logic and open-ended design. Originally conceived as a response to post-war housing shortages in Spain, the HELE system promoted structural flexibility, user autonomy, and community participation. Despite receiving praise from figures like Le Corbusier and a nomination for the Nobel Peace Prize in 1968, Leoz's work remains marginal in architectural historiography. This article repositions his legacy within the framework of contemporary humanitarian and environmental challenges. Through critical study of technical and scientific literature and AI-driven design, we reinterpret the HELE module as a framework for ethical and context-sensitive architecture. The paper proposes a speculative reconstruction model for Gaza that integrates AI-driven parametric design, sustainable materials such as compressed earth blocks and recycled rubble, and participatory construction practices. The outcomes underscore the potential of systemic, modular design to support resilience, collective agency, and spatial justice in post-conflict territories. The study demonstrates how AI can function not as a substitute for human creativity but as an ally in realizing adaptive, inclusive, and materially grounded architectural futures, extending Leoz's vision into the 21st century.

**Keywords:** Rafael Leoz; HELE module; AI-driven design; modular systems; Compressed Earth Blocks (CEBs); Compressed Rubble Blocks (CRBs).

**Received:** 23/04/2025; **Accepted:** 08/05/2025; **Available online:** 09/05/2025; **Published:** 30/06/2025.

**Cite as:** Bernardo, G., Palmero, L. (2025). 'AI-Driven generative prototyping for the reconstruction of Gaza'. *VITRUVIO - International Journal of Architectural Technology and Sustainability*, *10*(1), e23801. https://doi.org/10.4995/vitruvio-ijats.2025.23801

# 1. Introduction

Contemporary architecture is increasingly confronted by intersecting global crises - climate change, armed conflicts, forced migration, and growing socio-economic inequalities - that expose the profound limitations of dominant architectural design paradigms. The accelerating climate emergency, marked by rising temperatures, extreme weather events, and resource scarcity, has heightened the vulnerability of both urban and rural communities worldwide (World Bank, 2021). Simultaneously, armed conflicts and humanitarian disasters have displaced over 100 million people globally, demanding urgent yet often inadequate responses from the architectural and urban planning sectors (UN-Habitat, 2020).

Despite the urgency of these challenges, mainstream architecture remains largely aligned with capital-intensive development models, privileging stage effects, profit, and elite interests over equity and social need. Instead of addressing the spatial and material realities of those most affected by displacement and precarity, much of contemporary architectural production serves affluent minorities, reinforcing spatial segregation and systemic exclusion (Sennett, 2018; Till, 2009). In this context, the ethical function of architecture - its potential to contribute to social justice, human dignity, and environmental resilience - is increasingly compromised.

Nonetheless, alternative design approaches can be adopted. Modular, adaptable, and participatory design systems offer powerful counter-narratives to dominant top-down models. Among the early and under-recognised contributors to this lineage is Spanish architect Rafael Leoz (1921–1976). In the late 1960s, Leoz proposed the HELE module (Habitación Expandible Lineal Evolutiva), a polyhedral, open-ended housing system based on mathematical harmony and social cooperation. His built prototype - the experimental housing Complex La Frontera in Torrejón de Ardoz (1973-1977) – anticipated contemporary debates around flexible housing, resilience, and co-design (Leoz, 1967; García-Huidobro et al., 2008)

Despite being praised by Le Corbusier and nominated for the Nobel Peace Prize in 1968, Leoz's systemic and ethical approach has been marginalised in architectural historiography (Ferrando, 2016; García-Germán, 2018). Considering current crises, however, his work warrants renewed attention as a generative and adaptable framework for contemporary design.

This article reinterprets Leoz's HELE system through a critical and technological lens. By integrating Artificial Intelligence (AI)-driven design tools with principles of modularity and material circularity, we explore how Leoz's architectural grammar can inform socially and ecologically responsible reconstruction strategies. Gaza - a territory marked by chronic violence, material deprivation, and profound psychological rupture - serves as the experimental site for this exploration.

Our hypothesis is that architecture, when ethically framed and technologically expanded, can function as a platform for collective agency, dignity, and peacebuilding. Through a combination of theoretical research, computational design, and sustainable material strategies, this study positions architecture not merely as a technical discipline, but as an ethical and systemic practice for human development in the face of crisis.

# 2. Research methodology

This research adopts an interdisciplinary methodological framework, combining architectural historiography, theoretical analysis, and experimental digital design. The objective is to critically reinterpret Rafael Leoz's HELE module considering contemporary design challenges, through a process that integrates archival and historical-theoretical analysis with generative prototyping carried out by AI assisted visualization.

The first phase of the study consisted of a detailed examination of primary and secondary sources concerning Rafael Leoz's work. This included the analysis of his published writings, architectural diagrams, and documentation related to his works. These sources were studied in relation to broader architectural debates on modularity, systemic design, and user participation emerging in the 1960s and 1970s

The second phase involved mapping Leoz's ideas against current architectural and design theory. In particular, the study engages with contemporary discourses on adaptive architecture, ethical design practices, and participatory systems. Literature on spatial justice, resilience, and post-conflict reconstruction provided a theoretical grounding for recontextualising the HELE module in present-day crises (Till, 2009; Sennett, 2018; Picon, 2010).

The third phase explored the potential of AI-assisted design tools for the speculative reinterpretation of the HELE system. Visual prototypes were developed using prompts and structured workflows within this AI-based conversational interface (ChatGPT with image generation capability), focusing on modular configurations, material strategies, and contextual adaptation.

Throughout the process, the study maintained a critical stance toward the use of digital tools, treating AI not as an autonomous agent of form-making, but as a medium for expanding design inquiry in relation to ethical and systemic frameworks. The methodological process remained deliberately open-ended and speculative, in alignment with the flexible and participatory ethos embedded in Leoz's original vision.

## 3. Geometry for Humanity: Rafael Leoz and the Ethics of Modular Architecture

Rafael Leoz de la Fuente (1921–1976), an architect born in Pamplona and educated at the Escuela Técnica Superior de Arquitectura de Madrid, stands out as one of the most original and radical voices in post-war European architecture. His work brings together geometric precision, modular experimentation, and a deep ethical concern for social justice through the built environment. Leoz envisioned architecture not merely as the creation of forms, but as a dynamic system capable of responding to human needs through structured adaptability. His theoretical and built work sought to reimagine housing as a right, and the dwelling as a living organism—a concept he articulated through the HELE system (Habitación Expandible Lineal Evolutiva), a spatial unit shaped like an "L" and composed of four cubes (Figure 1). It was successfully presented at the 1961 São Paulo Biennial, and Leoz showcased it, along with the rest of his theoretical proposals—which were based on the industrialization of housing and promoted prefabricated and modular construction processes - at dozens of conferences around the world. However, despite the enthusiastic reception of these theories, particularly in Latin America and with the explicit support of Le Corbusier and Jean Prouvé, they were met with a more critical reception within Spanish architecture (Diaz, 2015).

The HELE module was conceived as a generative tool for creating adaptive, scalable and participatory housing systems based on mathematical principles, including the Fibonacci sequence, topological geometry, and the golden ratio (Leoz, 1960; Leoz, 1969). For Leoz, geometry was not abstraction but a universal grammar of order and equity: "Beauty is born of comprehensible order; architecture must be nourished by mathematics in order to serve humanity" (Leoz, 1967, p. 22). The HELE module was not only a compositional mechanism, enabling residents to progressively expand their homes, respond to changing family needs, and even participate in the construction process. Leoz argued that user freedom must operate within a harmonious framework: "It is not enough to grant freedom to the user; we must offer them a harmonic system within which they can recognise themselves" (Leoz, 1973, p. 19).

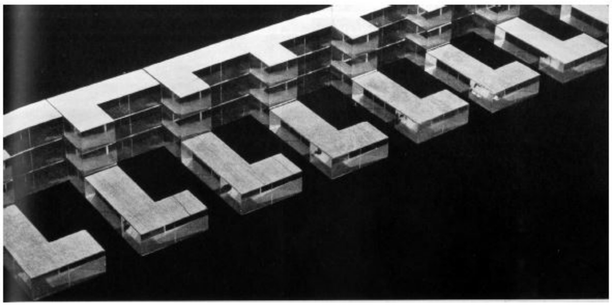

**Figure 1** | HELE module and its axonometric variations. Source: Leoz, 1967.

The HELE module was a social structure conceived with an approach that combined human-scale flexibility with systemic control (Ferrando, 2016). It allowed for the customization of domestic space and encouraged the progressive self-completion of housing, especially by lower-income families. In this way, Leoz anticipated ideas that would be further developed by Yona Friedman, who promoted open-ended mobile architecture (Friedman, 1970) and John Habraken, whose "supports theory" similarly separated permanent structures from adaptable infill (Habraken 1972).

Leoz himself wrote: "The home must not be conceived as a closed form, but as a system capable of evolving with life itself" (Leoz, 1967, p. 14). This statement encapsulates his belief in architecture as an ethical system, one that must accompany the social and temporal transformations of its users.

His nomination for the Nobel Peace Prize in 1968, though largely forgotten, reveals the international resonance of his ethical and social architectural vision—a vision grounded in the right to inhabit and transform space with dignity (García-Germán, 2018).

The only practical application of the HELE module in social housing was the experimental project of the Las Fronteras social housing, initiated in Torrejón de Ardoz (Madrid). The project was issued in 1973, although work did not begin until 1975 and was completed in 1977. Rafael Leoz passed away during this period, so he was only able to witness the early stages of what was intended as the first experimental social housing project based on his theoretical principles (Figures 2-4).

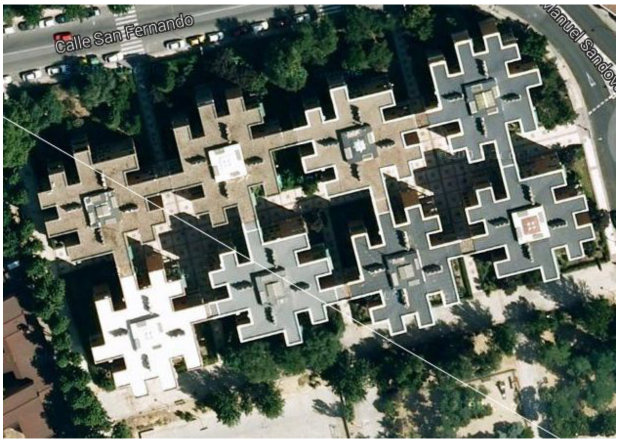


**Figure 2 |** Aerial view of the experimental social housing Las Fronteras, Torrejón de Ardoz, Madrid. Source: Fundación Rafael Leoz.

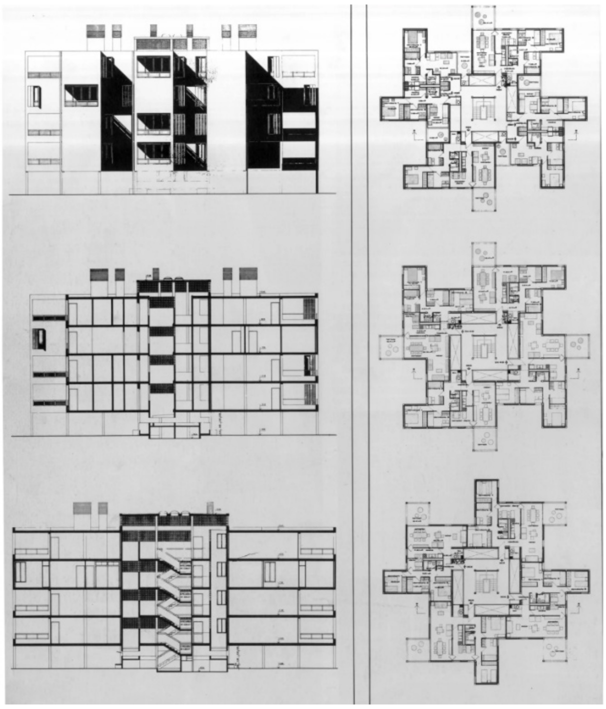

**Figure 3 |** Elevations and plans of Las Fronteras social housing, Torrejón de Ardoz, Madrid. Source: Modulo Hele de Rafael Leoz.

Today, as housing crises, climate adaptation, and participatory planning gain renewed urgency, the thought of Rafael Leoz remains not only relevant but prescient. His vision—modular, ethical, evolutionary—invites us to rethink architecture not as the production of objects, but as a system of relationships: geometric, human, and temporal.

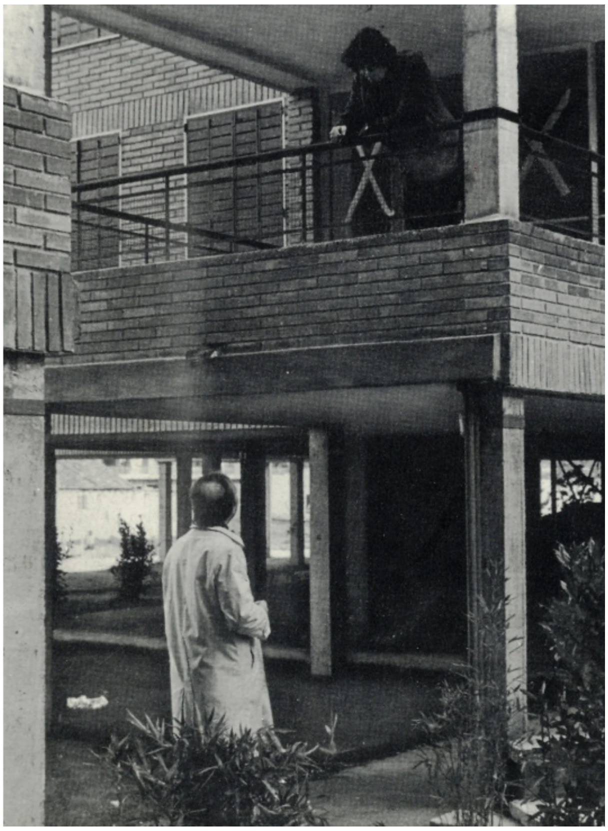

**Figure 4 |** 1970's photo of Las Fronteras social housing, Torrejón de Ardoz, Madrid. Source: Modulo Hele de Rafael Leoz.

The main goal of the project was to conduct a comprehensive experiment encompassing construction methods, economic factors, and the sociological and psychological aspects of individuals, families, and communities. The design aimed to test the behaviour of a community large enough to yield meaningful results while remaining small enough to preserve human connections. It was conceived as a laboratory for the application of Leoz's ideas on "evolutive" spatial systems—a term he borrowed from biological thought to emphasize the capacity of housing to grow and adapt over time (Leoz, 1967). The project employed the HELE module, capable of infinite combinations, extensions, and aggregations according to the evolving needs of its inhabitants. The Las Fronteras building complex project stands as a rare example of a fully modular, flexible, and participatory housing prototype in post-war Spain.

## 4. Reinterpreting the HELE Module through AI-Driven Design

Rafael Leoz's HELE module, originally developed as a grammar of spatial expansion and participatory adaptability, offers fertile ground for reinterpretation considering contemporary computational design tools. In particular, the integration of Artificial Intelligence (AI) into architectural workflows allows for a renewed exploration of systemic design - enabling architects to test multiple configurations, respond to complex environmental parameters, and simulate user-centred growth strategies in real time (Gero, 2020; Oxman, 2010).

In this study, AI was not employed for optimisation or standardised automation, but rather as a generative companion in the speculative reactivation of Leoz's modular logic. The use of prompt-based text-to-image AI systems within this platform facilitated the creation of architectural visualisations grounded in historical principles, while responding to site-specific and contemporary constraints. Prompts referenced modular geometries, participatory systems, and climatic adaptation, enabling the simulation of HELE-inspired configurations within highly constrained urban or post-conflict contexts.

This approach aligns with an emerging discourse that considers AI not as a substitute for design intelligence, but as a tool for amplifying human creativity and ethical intent in architecture. Scholars such as Picon (2010), Carpo (2017), and Gramazio & Kohler (2014) have emphasized that the true value of AI lies not in automating architectural labour, but in enabling richer feedback loops, design multiplicity, and adaptive systems thinking.

At the same time, this study integrates principles of circular design and material ecology, in resonance with current models of the circular economy in the built environment (EMF, 2019; Stahel, 2016). Moving beyond Leoz's prefabricated industrial logic, the reinterpretation explores how local and recycled materials—including compressed earth blocks (CEBs), rubble aggregates, lime-based plasters, and bio-based elements such as bamboo or palm wood—can be incorporated into modular strategies. This reflects a shift from linear extraction and consumption models toward resource loops, decarbonisation, and regenerative material cycles in architecture (Charnock, 2020; Pomponi & Moncaster, 2017).

Such an approach foregrounds a new ethic of material responsibility, in which architecture must respond not only to social and spatial dynamics, but also to the environmental metabolism of construction processes. The HELE module, reinterpreted through this lens, becomes a platform for contextual adaptation, combining modular flexibility with ecological intelligence.

This systemic reinterpretation also acknowledges contemporary frameworks such as Design for Disassembly, cradle-to-cradle design, and open building principles, which advocate for long-term adaptability, reuse, and user agency (Durmisevic, 2006; Gorgolewski, 2008). These models resonate with Leoz's original vision of housing as an open process—one that is incomplete by design and constantly reshaped by life itself.

In this sense, the use of AI-supported design is not an end, but a methodological bridge between past and present: it enables the architectural imagination to project historical ethics into future-oriented systems, aligning Leoz's modular vision with contemporary demands for sustainability, inclusion, and resilience.

### 4.1. Generative prototypes for the Reconstruction of Gaza

Gaza represents one of the most critical spatial emergencies of the contemporary world. Repeated cycles of conflict have led to widespread destruction of the built environment, displacement of populations, and the erosion of everyday life. Beyond the immediate humanitarian needs, the reconstruction of Gaza demands an architectural response capable of restoring dignity, memory, and spatial justice—not merely infrastructure.

Drawing on the modular spatial philosophy of Rafael Leoz—who envisioned architecture as a sculptural and organic process of urban growth (Leoz, 1969)—this project embraces modularity not as repetition but as variation, adaptability, and open-endedness. The core of the proposal is an L-shaped housing module inspired by Leoz's cellular system, adapted to the specific spatial, social, and climatic needs of Gaza. This modularity allows for expansion, aggregation, and the creation of interconnected semi-public courtyards, facilitating both privacy and communal life. The architectural composition, as seen in the conceptual design board and aerial views we developed (see Figures 5-6), is neither monumental nor monumentalizing—it is intentionally low-rise, rhythmically varied in height, and deeply embedded in the landscape, recalling the sculptural logic of settlements shaped over time rather than imposed at once.

The architectural strategy builds upon the vernacular construction knowledge of the region, where walls are often built using hand-formed limestone or concrete blocks, with flat roofs or shallow vaults that respond to Gaza's dry climate (Sayigh, 1999; Salem, 2021). These traditional methods reflect an ecological intelligence developed over centuries: thick walls moderate interior temperatures, deep-set openings control sunlight, and inward-oriented layouts provide protection from wind and visual intrusion. The project updates these principles using Compressed Earth Blocks (CEBs)—an evolution of adobe that merges tradition with modernity. CEBs are made by compressing local soil, sand, clay,

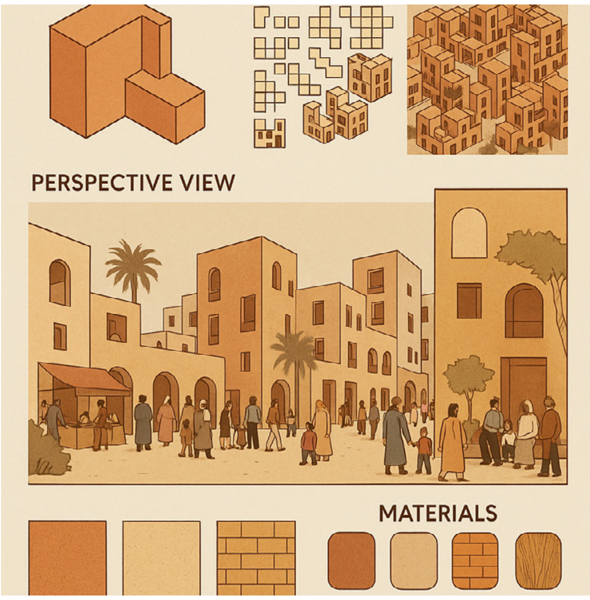


Figure 5 | Conceptual Design Board for the reconstruction of Gaza, showing modular L-shaped units inspired by Rafael Leoz, integrated with local material systems and symbolic urban forms.

Figure 6 | Aerial Urban View of a proposed neighbourhood in Gaza showing the aggregation of modular housing units with varied heights, communal courtyards, and pedestrian-friendly networks.

and a stabilizing agent such as lime or cement (5–10%) into modular bricks using manual or mechanical presses (Houben & Guillaud, 1994; Craterre, 2006). The result is a low-energy, breathable, and structurally resilient material that can be produced on-site using locally available labour and knowledge.

Beyond earth, the proposal embraces a circular approach to materials by integrating the rubble of war-damaged buildings. Concrete debris, stone fragments, broken tiles, and other demolition materials are repurposed in two main ways: first, as aggregates for new low-carbon concrete or CEB mixes; second, as architectural fragments reassembled into boundary walls, pavements, and memory surfaces. This method redefines waste as a resource and transforms ruins into the foundation of renewal, aligning with post-disaster design strategies advocated by UN-Habitat (2020). The use of recycled debris not only supports sustainability but also embeds material memory into the built fabric, where every reconstructed wall carries traces of what was lost, making rebuilding an act of both practical necessity and symbolic continuity. The composition reflects the principles of open, sculptural, and incremental urbanism. The material palette is completed with natural lime plaster—a breathable, antibacterial and climate-regulating finish; recycled wood and palm timber for shading, door frames, and pergolas; burnished earth finishes such as tadelakt for waterproofing and sensory tactility; and local woven textiles and natural fiber canopies for shading and enclosure. These elements are carefully selected not only for their low environmental impact but also for their cultural resonance and embodied beauty. The visual compositions that emerge in our design renderings (Figure 7) showcase a modular urban form punctuated by shared courtyards, shaded paths, and planted voids that act as pockets of public life, inviting encounter and coexistence. Figure 8 depicts a close-up view of a typical modular housing unit within the proposed Gaza neighbourhood, focusing on the tactile and material expression of the architecture. The walls are composed of compressed earth blocks (CEBs), with a visible granular texture resulting from the integration of fine sand, clay, and lime. In several areas, the reddish-brown tone of the earth is interrupted by light-colored inclusions—fragments of crushed concrete and stone salvaged from war debris, testifying to the circular reconstruction process. The façade is coated in places with natural lime plaster, its matte surface catching the sun with a gentle glow. Shading elements made from reclaimed palm wood project rhythmically over doorways and windows, while woven reed mats and local textiles offer soft screens and coverings. In the background, small plants grow between porous paving stones made of mixed rubble aggregate, reinforcing the bond between ecology and memory. Central to this vision is the idea that urban reconstruction must serve as an infrastructure for peace—a spatial framework that enables diverse communities to live together in dignity. In our renderings, people of different ethnic and cultural backgrounds are shown cohabiting, interacting in shared spaces, and reclaiming public life in the aftermath of conflict.

Figure 7 | Perspective view of a central square within the modular neighbourhood, equipped with shared public infrastructure and informal gathering spaces. People of diverse ethnic backgrounds are shown engaging peacefully, emphasizing architecture as a framework for coexistence.

This architecture is not monumental, but monumental in meaning; it is not decorative, but deeply expressive of care, patience, and hope. In this way, the project demonstrates how a materially grounded, ecologically conscious, and socially responsive architecture can support not just physical reconstruction, but the possibility of peace.

## 5. Conclusions

This study has sought to critically reinterpret the theoretical and design legacy of Rafael Leoz in the context of contemporary global emergencies, proposing a synthesis between the ethical, modular principles of the HELE system and the generative potential of artificial intelligence. The result is a systemic, participatory, and adaptive architectural model capable of addressing complex scenarios such as post-conflict reconstruction.

The design experimentation in the context of the Gaza Strip has highlighted the relevance of the HELE module as a tool for equitable, incremental, and culturally rooted reconstruction. Within this framework, the integration of material circularity strategies has played a pivotal role: the use of Compressed Rubble Blocks (CRBs)—manufactured from salvaged debris of war-damaged buildings—emerges as both a technically effective and symbolically powerful solution. The reuse of rubble not only reduces the environmental impact of the building process but also preserves a material and memorial continuity with what was lost, transforming reconstruction into an act of historical resilience and collective healing.

Artificial intelligence, in this context, has functioned not as a generator of form alone, but as an amplifier of design potential, enabling the simulation of flexible urban configurations responsive to climate, terrain, and evolving community needs. This approach reinforces the centrality of the human dimension in architectural design, reaffirming the importance of a non-deterministic, open-ended, and co-evolutionary built environment.

Figure 8 | Material Atmosphere and Texture Study . Close-up rendering of façades and materials, showing compressed earth blocks (CEBs), rubble-based components, lime plaster finishes, and palm wood shading systems. The image illustrates the tactile quality and ecological intelligence of the material strategy.

In a world increasingly shaped by climate crises, housing inequality, and conflict, architecture is called upon to reassert its social and environmental responsibility. Leoz, through his ethically grounded geometric language, offers a generative platform still relevant to these urgent challenges. The convergence of his vision with contemporary technologies reveals that architecture can transcend object-making and become an infrastructure of hope, capable of sustaining social cohesion, collective memory, and human dignity.

Ultimately, the architectural legacy of Rafael Leoz - amplified by the generative capabilities of artificial intelligence and sustained by low-impact construction practices such as CEBs and CRBs - demonstrates that architecture can and must move beyond mere shelter: it can become an active agent of social transformation, a catalyst for coexistence, and a concrete act of peace.

## Acknowledgments

The authors would like to thank Tachi Leoz for generously sharing information and visual materials. The authors also extend their gratitude to all those who contribute to the website Modulo HELE de Rafael Leoz https://modulohele.com/, which continues to preserve the memory and ideas of Rafael Leoz regarding an ethical approach to architectural design.

## References

Carpo, M. (2017). *The Second Digital Turn: Design Beyond Intelligence*. MIT Press. https://doi.org/10.7551/mitpress/9976.001.0001

Charnock, R. (2020). 'The Material Turn in Architecture: Rethinking Waste, Resource and Matter', *Architectural Design, 90*(4), 44–51. https://doi.org/10.1002/ad.2567

Craterre. (2006). *Building with Earth: Design and Technology of a Sustainable Architecture*. Birkhäuser.

Diaz, J. L. (2015). El módulo hele de Rafael Leoz. Una historia de contradicciones: del éxito internacional a la difícil relación con la arquitectura española, *Ra Revista de Arquitectura, 14*, pp. 37-50. https://doi.org/10.15581/014.14.1916

Durmisevic, E. (2006). *Transformable Building Structures: Design for Disassembly as a Way to Introduce Sustainable Engineering to Building Design & Construction*. Technische Universiteit Delft.

EMF (Ellen MacArthur Foundation). (2019). *Completing the Picture: How the Circular Economy Tackles Climate Change*. Available at: https://ellenmacarthurfoundation.org (Accessed: 10 April 2025).

Ferrando, J. (2016). *Flexible: Arquitectura que se adapta a los cambios*. Tenov, Barcelona.

Friedman, Y. (1970). *L'Architecture mobile*. Éditions de l'Équerre, Paris.

Fundación Rafael Leoz. (n.d.). *Archivo y proyectos*. Available at: https://fundacionrafaelleoz.org/ (Accessed: 12 April 2025).

García-Germán, J. (2018). *Thermodynamic Environments*. ACTAR Publishers.

García-Huidobro, F., Torres Torriti, D., Tugas, N. (2008) *El tiempo Construye Time Builds. El Proyecto Experimental de Vivienda (PREVI) de Lima: génesis y desenlace. The Experimental Housing Project (PREVI), Lima: genesis and outcome*. Editorial Gustavo Gili, SL, Barcelona.

Gero, J.S. (2020). 'Artificial Intelligence in Architecture: Generative Design Systems', *Computer-Aided Design, 128*, 102897.

Gorgolewski, M. (2008). 'Design for Disassembly in the Built Environment: A Guide to Closed-Loop Design and Building', *Building Research & Information, 36*(6), 518–519.

Gramazio, F., Kohler, M. (2014). *The Robotic Touch: How Robots Change Architecture*. Park Books.

Habraken, N.J. (1972). *Supports: An Alternative to Mass Housing*. Architectural Press, London.

Houben, H., Guillaud, H. (1994). *Earth Construction: A Comprehensive Guide*. Intermediate Technology Publications.

Leoz, R. (1960.) *Orden y Forma en Arquitectura*. Fundación Rafael Leoz.

Leoz, R. (1967). *Módulo HELE: Habitación Expandible Lineal Evolutiva*. Fundación Rafael Leoz.

Leoz, R. (1969). *Arquitectura y Geometría*. Fundación Rafael Leoz.

Leoz, R. (1973). *Construcción y Sociedad*. Fundación Rafael Leoz.

Modulo HELE de Rafael Leoz https://modulohele.com/ (accessed 13 february 2025)

Oxman, R. (2010). 'Theory and Design in the First Digital Age', *Design Studies, 27*(3), 229–265. https://doi.org/10.1016/j.destud.2005.11.002

Picon, A. (2010). *Digital Culture in Architecture: An Introduction for the Design Professions*. Birkhäuser.

Pomponi, F., Moncaster, A. (2017). 'Circular Economy for the Built Environment: A Research Framework', *Journal of Cleaner Production, 143*, 710–718. https://doi.org/10.1016/j.jclepro.2016.12.055

Salem, A. (2021). 'Gaza's Vernacular Architecture and Climate Resilience', *Palestinian Architecture Journal, 9*(2), 45–60.

Sayigh, H.M.A. (1999). *Sustainable Building in Hot Climates: Traditional Architecture of the Middle East*. Cambridge University Press.

Sennett, R. (2018). *Building and Dwelling: Ethics for the City*. Farrar, Straus and Giroux, New York.

Stahel, W.R. (2016). 'The Circular Economy', *Nature, 531*(7595), 435–438. https://doi.org/10.1038/531435a

Till, J. (2009). *Architecture Depends*. MIT Press.

UN-Habitat. (2020). *Rebuilding for Resilience: Post-Conflict Recovery Planning*. United Nations Human Settlements Programme.

World Bank. (2021). *Climate Change Overview*. Available at: https://www.worldbank.org/en/topic/climatechange/overview (Accessed: 8 April 2025)