ANATOMY OF EPHEMERALITY: REVISITING SUSTAINABILITY THROUGH MUTABLE FORMS/

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Abstract. Sustainability today represents more than a pressing requirement in architectural or design practices – over the course of the 21st century, it has evolved into an inherent attitude withing any creative or conceptual endeavour. From a niche concern associated with utopian-driven modernist experiments in the previous century, sustainability has become a pervasive paradigm that calls for holistic, rather than strictly causal, approaches – transcending the spatial and temporal boundaries of the designed object itself.

This study investigates the evolution of ephemeral architecture from the second half of the 20th century to the present day, focusing on the interplay between temporality, adaptability, and sustainability. Its central aim is to analyse how architectural objects initially conceived as temporary have been redefined over time – either by being stabilized into permanent functions or repurposed in ways which contradict their original intent.

The methodology is grounded in a comparative analysis of both historical and contemporary examples of modular, reusable, or relocatable architectural objects, and is articulated along three main directions: (1) the distortion of adaptability in objects originally designed as ephemeral – such as the emblematic case of the Nakagin Capsule Tower or experimental housing models of the 20th century and their respective utopian/futuristic views and approaches to housing (how they approached technology integration, local identity and, from a phenomenological point of view, the end-user's emotional response), (2) the inversion of the temporary–permanent relationship in recent projects, which increasingly extend beyond residential typologies due to shifting socio-economic variables, and (3) the retrospective reassessments of architectural solutions initially deemed sustainable, drawing on Tony Fry's concepts of "*defuturing*" and "*defamiliarizing the familiar*" as a theoretical frame for critique.

The utopian drive that once animated experimental architecture now calls for a renewed reading – one grounded in realistic, context-aware forms of sustainability. Rather than abandoned, these speculative frameworks can be reactivated as critical tools for questioning and reshaping present-day practices.

Preliminary findings reveal a disjunction between design intent and the socio-economic trajectories which shape the lifecycle of ephemeral architectural objects. Furthermore, they highlight how certain practices once validated as sustainable may become problematic over time, whether in terms of resource use, maintenance, social integration or emotional response.

The paper advances a critical reflection on the current limitations of sustainability discourse, particularly in how it is applied within complex systems that bind technology, architectural adaptability, and evolving societal needs. It argues for an expanded analytical framework capable of addressing design decisions in light of an inevitable and often overlooked ephemerality.

Introduction. Sustainability in the 20th Century. The first steps toward a new critical thinking vis-à-vis sustainability stemmed from early realisations of how finite and fragile Earth's resources are. During these formative years, human well-being to be conceptually bound to the broader metanarrative of planetary well-being.

Resources were depleting, pollution had become a grim reality, and overcrowding was rising - all while consumption and production accelerated at an alarming rate during the second half of the 20th century. Thus, a more holistic approach became necessary to grasp the magnitude of a much larger issue: the containment of the unsustainable.

This challenge could not be solved merely through new legislation or state-imposed regulations. Architects and designers emerged among the frontrunners in rethinking and mending the very system that had fueled hyper-consumption and hyper-production. Yet, sustainability - at least in its modern, applied sense - was still a new and evolving concept. Architecture and product design had often been sustainable only incidentally, as a byproduct of broader aesthetic, social, or economic ideas rather than from an explicit ecological intent.

We believe that the notion of the mutable form represents one of the earliest expressions of applied sustainable thinking, even though it often carried a seemingly contradictory attribute: ephemerality. These two qualities- mutability and ephemerality -might appear at odds within sustainable discourse. Yet their relationship is more nuanced than it first seems, especially in concrete applications such as the evolution of domestic space in the city, whose exploration accelerated through experimental searches for transient dwelling models beginning in the 1960s–1970s.

One of the early pioneers of this approach was Kisho Kurokawa, a leading figure of Japanese Metabolism, a postwar architectural movement that sought to reconcile change, impermanence, and adaptability with the continuity of human and ecological systems in the realm of transient, ephemeral dwelling. Today, however, metabolic principles have expanded far beyond the early association between ephemerality and the organic growth of the city, addressing twenty-first-century challenges ranging from climate change and environmental hazards to rapid urban expansion. Beyond specific reusable solutions, ephemerality itself has become a conceptual framework even for permanent forms of habitation, shaping a broader philosophy of dwelling, society, and sustainability. In this sense, metabolic philosophy and its applications offer a dynamic understanding of the relationship between sustainability and ephemerality, expressed through three key lessons: (1) its original intentions; (2) the present state of its built outcomes and their influence on contemporary architectural thinking; and (3) the gap between theoretical expectations and the actual functioning of ephemerality and mutability.

The Mutable Form – Three Directions.

1. First Lesson – Of Past and Present of Metabolism and Its 'Organic' Capsule. Mutable forms in Metabolist architecture sit at the uneasy intersection of hope and anxiety, shaped as much by the Cold War's tension

as by technological ambition. The Metabolists imagined cities that could continually regenerate themselves, yet their visions weren't simply optimistic forecasts of a sleek techno-future. They emerged from a climate where "*dream world and catastrophe*" coexisted, which turned adaptability into both a survival mechanism and a utopian gesture. Critics like Tafuri and Dal Co later described Metabolism as an "*international concept of utopia*" (Tafuri, Dal Co, 1976, as cited in Cho, Shin, 2014), a label that captures the movement's global reach but also its fragile, almost performative idealism - architecture as a defense against uncertainty, expressing a world that might need to change overnight.

Architects of the 1960s often pictured future living spaces as tightly woven together with emerging technologies, treating the home less as a static shelter and more as a platform supported by automated systems. Peter Reyner Banham captured this shift with a provocative thought experiment: if the services that make living possible can operate independently of the building's physical envelope, does the traditional notion of "house" still hold any meaning? (Banham, 1965). Japanese Metabolists amplified this line of thinking, stretching the concept of technologically mediated habitation to its most radical conclusions.

Metabolism emerged from an effort to articulate a distinctly Japanese spatial identity, one that stood apart from other global architectural traditions. Instead of relying on the old metaphor of the city as a machine, the movement adopted the language of biological metabolism - imagining the urban environment as a living organism that grows, sheds layers, and pulses through cycles of renewal. This emphasis on vitality allowed the Metabolists to move beyond the rigid, mechanical vision of functionalist planning, while still channeling biological processes into the logic of their proposed megastructures.

At the core of Metabolist theory lies the idea that different components of a city age at different speeds. Some elements can be replaced or upgraded without dismantling the whole - much like cells within a living body. This principle is what gives the Nakagin Capsule Tower its conceptual meaning: the capsule operates as the architectural equivalent of a biological cell, a unit designed for renewal within a larger, continuous structure. The building becomes a material expression of the Metabolists' belief that urban form should evolve through selective transformation rather than total reconstruction.

Following Kurokawa's concept, the Tokyo tower was never meant to function as a conventional apartment block (Kurokawa, 1977). It was imagined as a hub of compact living units - single-room capsules that could serve business people, traveling professionals, or artists in need of temporary workspace. Each module left the factory fully outfitted, complete with appliances, finishes, and all the necessities for short-term habitation. The 144 capsules were bolted onto a concrete core with high-tension fasteners, installed at a pace of several units per day, allowing the entire structure to take shape within a month.

What made the system remarkable was its built-in replaceability. Each capsule was designed to last 25–35 years, yet it could be detached from the central spine without disturbing its neighbours, allowing new modules tailored to specific uses – sleeping quarters, bathrooms, kitchens, and so on – to be added. The tower functioned as a kind of architectural organism, capable of renewing its individual components while keeping the larger structure intact.

The idea of mutability becomes especially vivid in projects that were never meant to outlast their own flexibility. The Nakagin Capsule Tower is the clearest case: a building conceived as ephemeral and replaceable, a living organism in architectural form, yet paradoxically frozen by technical, economic, and cultural constraints. Experimental housing models of the twentieth century attempted similar gestures of impermanence, weaving technology, local identity, and futuristic aesthetics into structures that promised emotional freedom for the inhabitant (much like experimental futuristic plastic houses, such as House of the Future, by architects Alison and Peter Smithson, or Monsanto's version, simply titled House of the Future). Their adaptability was meant to give end-users a sense of agency and connection – housing as a responsive partner rather than a static shell. In practice, these mutable forms reveal both the allure and the fragility of designing for a future that refuses to stand still.

The reach of Metabolist philosophy stretched beyond the unique culture and case of post-war of Japan and into Europe as well. A striking example is found in the work of architect Claude Prouvé, particularly the 1970s "SIRH experimental building", an eight-storey structure planned as a series of individually manufactured modules, very much in the spirit of Kurokawa's tower. Prouvé's involvement with what later came to be known as SIRH began in 1965, when he selected as his thesis topic "étude théorique pour le développement d'un habitat industrialisé évolutif" – a theoretical study on creating a scalable, industrialized form of housing. In 1969, the Société Industrielle de Recherche et de Réalisation de l'Habitat (SIRH) was founded by Claude Prouvé, engineer Georges Quentin, and the well-known Jean Prouvé, with the purpose of advancing the research initiated in Claude's thesis.

As with Kurokawa's tower, the SIRH building was conceived as a cluster of modular capsules that could be configured individually in response to local or zonal requirements. The project was highly innovative, but despite nearing completion, construction came to a halt in 1974 due to financial constraints rather than conceptual or technical shortcomings.

2. Metabolism's Evolving Lessons in the 21st Century: From Mutability to Emerging Types. If the Cold War dualism was, according to some, the catalyst for Metabolism, today other factors drive this phenomenon – climate change, widespread pessimism, and the rise of hyper-consumerism. The twenty-first century faces its own crises.

One of these stems from the intrinsic dilemma surrounding the fate of Nagakin Tower, dismantled in 2022, which paradoxically crystallized aspects of permanence – both in the way it was continuously inhabited and in the fact that some of the 23 remaining capsules were recirculated or even musefied, thus ironically becoming a historical record of a sustainable philosophy of ephemerality. This is exemplified by Evangelos Kotsioris's initiative and Kurokawa's office restoring a capsule at MoMA exactly as it was originally furnished in the 1970s.

However, traces of Metabolist philosophy persist in various forms, the most evident strand being ephemeral domesticity. It is not unexpected that, considering Metabolism emerged in post-disaster Japan, the conceptual legacy continues to manifest in contexts defined by crisis and instability. Contemporary disaster-relief housing and emergency shelters frequently adopt typological strategies based on modular components, such as shipping containers. Although conceived as temporary, in countries like Japan – regularly exposed to large-scale natural hazards, these units often remain inhabited for several years.

A relevant example is Shigeru Ban's proposal for container-based temporary housing, developed in response to an earthquake that left 3,800 of the community's 4,500 homes partially or entirely destroyed. Organized as two- to three-storey aggregates, the units were conceived with the intention of being redeployed in future disaster scenarios, rather than serving as permanent dwellings. Given Japan's maritime transport–driven economy, the shipping container – a globally circulating and inherently reusable object—paradoxically becomes anchored to a temporary domestic function. Paradoxically, and perhaps in tension with contemporary sustainability discourse, this phenomenon has, over the past decade, become increasingly apparent in permanent housing far removed from hazardous contexts, emerging across diverse continents and social strata – from high-standard collective dwellings to individual residences.

In this sense of hazard, ephemeral domesticity becomes a prolific branch of the continuity of metabolic philosophy, even in projects that take a different approach to materials – more organic – such as Home for All in Rikuzentakata (2012, Toyo Ito, Sou Fujimoto, Akihisa Hirata). Reinterpreting partially the structural typology of Metabolism, it proposes rather a return to materials like wood and a detachment from the futuristic ideal in favour of interiors that instead evoke the vernacular. Not being a dwelling in itself, but a function complementary to the temporary housing of an affected community – a gathering space without bedrooms—the use of wood, evoking an improvised fort, reinforces ephemerality in context.

Nevertheless, the lessons of Metabolism are interpreted differently in the field of strategies for urban housing, particularly under the vision of architects such as Sou Fujimoto, for whom the various socio-economic variables and crises of the 21st century require similar models based on connectivity:

> "*I see the forest as a model for architecture and society. It shows us how distinct identities can thrive in diversity while still being connected – and how harmony between humans and nature can be rediscovered.*" (Fujimoto, 2025, Wallpaper)

The lessons of Metabolism, however, extend well beyond the issue of ephemeral domesticity in the 21st century. They reach into the field of permanent collective housing, where methods originally associated with temporary or emergency structures are sometimes reinterpreted depending on scale, site, and social conditions. In this sense, solutions range from dwellings composed of lightweight, potentially ephemeral structural systems – such as the Tokyo Apartment (2010, Sou Fujimoto), conceived as a response to the spatial constraints of central Tokyo – to socio-economically opposite cases, such as the Follies in Montpellier, a permanent residential complex nonetheless structured according to analogous compositional principles.

If we were to place Home for All alongside the Tokyo Apartment, a striking contrast emerges in their respective approaches to materiality: typological, replicable light-frame structures are employed for permanent housing, whereas emergency architecture relies on materials such as timber without claiming permanence. Meanwhile, the Folies reinterpret the bourgeois dwelling within a multi-unit building, translating a culturally loaded typology into a contemporary collective form.

Even so, these divergent approaches continue to generate hybrid solutions reconciling the two directions. A case in point is Malka Studio's project in Montpellier (2023, unbuilt) – a vertical village rising from a 19th-century building and constructed from recycled materials, whose ephemerality derives from its adaptable logic. This structural openness becomes relevant even in proposals paradoxically associated with luxury housing, which actually stems from an unpretentious, humble logic evoking organicity, as the architect described:

> "*not a real estate project, but a mobile, living, organic structure combining architecture and urban planning, community life and culture open to all... built on a flexible, extensible framework supporting an organic process of growth, allowing the Follies' morphology to transform as new occupants and modules arrive and depart.*" (Studio Malka, 2023)

Familiar structural logic was tested in experimental projects continuing earlier philosophies, like Domino 21 in Madrid (2004, ETSAM, derived from Corbusier Domino), but here mutability relies on consumption and expansion of individual footprint within a permanent dwelling scenario.

3. Theoretical Framework: "Defuturing". Retrospective reassessments of architectural solutions initially celebrated as sustainable have revealed the complexities and contradictions inherent in these designs. Drawing on Tony Fry's concepts of "defuturing" and "defamiliarizing the familiar," such critiques highlight how projects once framed as progressive or ecologically responsible may, in practice, contribute to the erosion of social, cultural, or environmental continuity - in short, they are, as of nowadays, unsustainable. What was once perceived as an innovative or adaptive approach to housing or urbanism may, upon closer scrutiny, demonstrate unforeseen forms of obsolescence or dependency on systems that limit true sustainability. Fry's framework encourages architects and scholars to question the assumptions embedded in both material and conceptual dimensions of design, recognizing that sustainability is not a static achievement but a continuously negotiated, context-dependent process.

When applied to Metabolist projects such as the Nakagin Capsule Tower or Claude Prouvé's SIRH building, Fry's concepts illuminate the tension between visionary adaptability and practical limitations. These modular

systems were designed to accommodate change, update components, and integrate technological advancements, yet economic constraints, technological dependency, and shifting social needs often hindered their long-term viability. The "defamiliarization" of traditional housing - living units as detachable, replaceable capsules - reveals both the radical ambition and the inherent vulnerabilities of these designs. At the same time, "defuturing" becomes evident in the way these utopian models – though conceived as forward-looking – sometimes fail to anticipate the social and environmental trajectories that ultimately shape urban life. This oversight also influences the typological frameworks through which new forms of sustainable architectural thinking are developed. By critically reassessing such experiments, contemporary architects can draw lessons about flexibility, holism, and technological integration while remaining attentive to the risks of projecting idealized futures without fully accounting for material, social, and ecological realities.

In other words, designing sustainably requires confronting the realities of the defutured: innovations that once addressed contemporary needs now stand as relics of avant-garde thinking, promising in their time yet unable to anticipate the shifts in industrial and social priorities that followed. Both Kurokawa's and Prouvé's buildings have ultimately been abandoned and slated for demolition rather than repurposed according to their original logic of change and adaptability through mutable forms. This kind of immediate, causal response – discarding what no longer fits instead of transforming it – reveals how limited and restrictive our broader approach to sustainability can be. Fry points out that addressing issues such as automotive pollution should not rely solely on producing new, even electric, vehicles, but on looking past the immediate problem toward more fundamental, systemic solutions. Mutable forms, with their inherent capacity for transformation, offer a framework that can be developed into genuinely sustainable approaches rather than temporary or surface-level fixes.

Contemporary (Sustainable) Integration of Past Methods. Reviving Metabolist ideals in their original form would have little relevance in today's world, because the social, environmental, and technological conditions that shaped those visions have changed radically. What proves valuable instead is a critical re-engagement with their legacy - selectively reinterpreting their ideas in light of current and anticipated challenges. This approach treats the Metabolists not as creators of ready-made solutions, but as catalysts whose work can inform more grounded and responsive visions of tomorrow's cities. Through this lens, their ideology becomes a resource for contemporary thinking rather than a blueprint to be reproduced. As one author notes:

> "*To resuscitate their* [*Metabolist architects*] *ideals as they were in today's society would be meaningless. The process of critical appropriation and selective revision of the past, on the other hand, can help us elaborate well-informed visions of the future in the light of our current and forecasted challenges*" (de Oliveira, 2011, p.81).

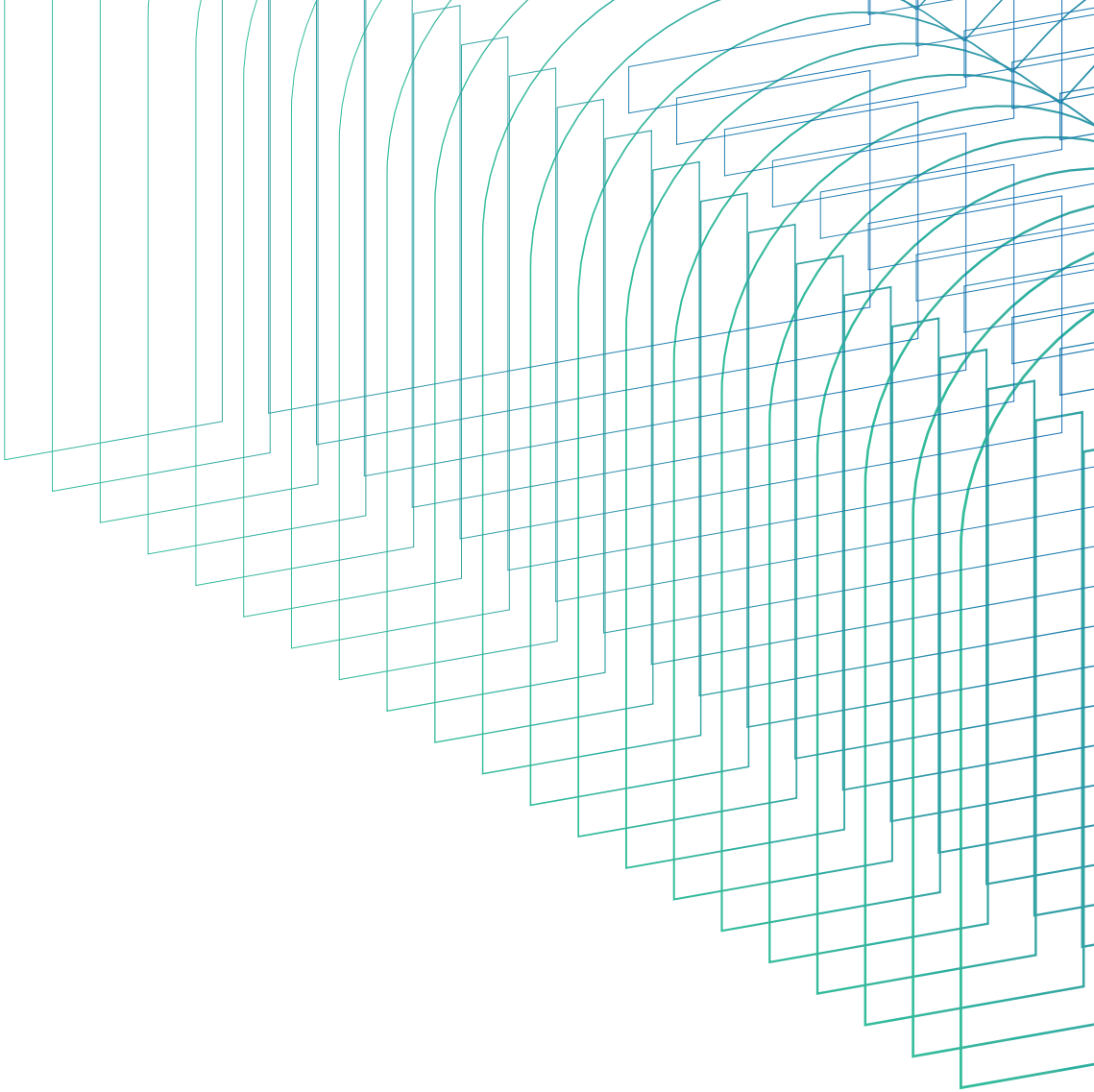
He continues by stating that "we can borrow from the Metabolists not only their acceptance of change, adaptation and uncertainty, but also of the holistic and of the role of technology in the construction of cities" (de Oliveira, 2011, p.81).

A renewed interest in Metabolism also highlights the movement's commitment to wholeness - a holistic understanding of the city as an interconnected, evolving system. From this standpoint, their openness to change, adaptation, and uncertainty retains significant relevance. The Metabolists saw technology not as a superficial layer but as an active ingredient in shaping urban life, a tool for integrating social, ecological, and structural needs. Borrowing these principles today means embracing cities as dynamic environments, where technological innovation and systemic thinking work together to support resilient and coherent urban futures.

Conclusion. The legacy of Metabolism demonstrates that the vectors of mutability are themselves in perpetual transformation, transcending their former status as fixed conditions or purely technical achievements. In dwelling projects, the sustainable dimension lies in the continuously evolving negotiation between material realities, social change, and various environmental or urban conditions that often intersect. While many twentieth-century experiments—such as the Nakagin Capsule Tower or the SIRH project—failed to achieve their intended adaptability, they revealed the profound potential of mutability, modularity, and systemic thinking. Contemporary reinterpretations show that the value of Metabolism lies not in replicating its forms, but in critically re-engaging its principles: accepting uncertainty, designing for change, and understanding the city as an interconnected organism. Some of the resulting projects, although realized as permanent structures, inherit aspects of the sustainable thinking originally proposed by Metabolism. By learning from both the ambitions and shortcomings of past visions, ephemeral models and mutability serve as key principles to navigate a fast-changing world and counter processes of defuturing. Thus, the past century provides lessons as a catalyst for future sustainable thinking.

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THE INNER LIFE OF NATURE-ADAPTED BUILDINGS: INTEGRATING FORM AND FUNCTION THROUGH STRATEGIC DESIGN/

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Abstract. Living organisms have evolved complex strategies to adapt and thrive in their environments, constantly balancing form and function to ensure survival, resilience, and efficiency. This evolutionary model offers a profound lesson for architecture, highlighting the potential of strategic design to create buildings and spaces that are not only functional but also regenerative, responsive, and comfortable for their inhabitants. This paper explores how architecture can draw inspiration from the adaptability and functionality of living organisms to integrate nature's principles into the built environment, with a particular focus on the processes of regenerative, bioclimatic, and biophilic design.

Strategic design in architecture is the deliberate synthesis of form, function, and context, guided by a comprehensive understanding of natural systems and processes. By studying how organisms seamlessly integrate energy flows, resource management, and environmental responsiveness into their structures, architects can adopt a holistic approach that prioritizes human health, comfort, and well-being.

The integration of these principles - regenerative, bioclimatic, and biophilic - into a coherent strategic design framework offers architects and planners a powerful toolkit for shaping the future of the built environment. Nature-adapted buildings, conceived through this lens, not only respond to environmental challenges but also cultivate spaces where people can thrive. The synthesis of form and function through strategic design thus emerges as a pathway to healthier, more comfortable, and more meaningful buildings and urban areas.

This paper argues that architecture must embrace a dynamic, nature-based design philosophy to respond effectively to the challenges of contemporary living, from climate change to urban densification. By learning from nature's adaptability and resilience, strategic design can transform buildings into living systems that interact symbiotically with their surroundings, contributing positively to both the human experience and the broader ecological context. In this way, architecture becomes a medium for reimagining our relationship with the natural world, fostering a built environment that supports life in all its complexity.

Introduction. Architectural spatial organisms are fundamental components of everyday life, shaping the behaviours, habits, and sensorial impressions of those who inhabit and experience them. The adage "form follows function", famously articulated by Louis Sullivan, has laid a foundational understanding in modern design philosophy, emphasizing the necessity for architectural forms to reflect their intended functions. Pais advocates for a modern reassessment of this maxim, emphasizing that emerging architectural movements contest and broaden this principle by incorporating ecological and social factors into design methodologies (Pais, 2024). However, contemporary architectural paradigms have considerably evolved, revealing a more dynamic interplay among form, function, and the contexts of use. Over time, contemporary conceptions of architectural space have acquired new meanings, diversifying both the ways of thinking about design and the modes of intervention available to architects. The structural rigidity traditionally associated with buildings has become more fluid, the organization of functions has grown more dynamic, and construction methods and building product technologies have diversified. Collectively, these transformations have unveiled new opportunities for architectural practice, more congruent with contemporary developmental conditions and the developing paradigms through which space is conceptualised and created.

The necessity to reconfigure architectural methods in response to urgent climatic issues demands a synthesis of ecological awareness, human welfare, and regenerative principles. Placing the paper at this juncture creates a framework in which a nature-based perspective functions not just as a metaphor but also as a practical basis for building practice. This methodology is essential for transcending conventional sustainability towards authentically regenerative architecture solutions that promote resilient habitats and improve human quality of life.

The "inner life of buildings", based on natural solutions, as a key theme of this research, must be seen as a passage from metaphorical interpretations to tangible architectural principles, fostering practices that exemplify resilience and inclusivity. The systematic review made by Houlden et al. (2018) illustrates the advantageous effects of urban greenspace on mental health, highlighting the importance of incorporating natural aspects into urban environments. This research feeds design frameworks that prioritise the psychological well-being of occupants and underscores the importance for architects to address human emotional responses in conjunction with utilitarian considerations. Therefore, such themes as bioclimatic and biophilic design are intended to strategically support the decisions made throughout the design process. The "inner life" can therefore be understood as the set of flows, feedback loops, and adaptive responses that link climate, envelope, occupants, and ecology.

Languages of form and function within nature-adapted buildings. In contemporary architectural discourse, the integration of form and function in nature-adapted buildings is increasingly recognised as essential for attaining sustainability and resilience. This integration is based on an expanding corpus of research about biomimicry, biophilic design, climatic adaptability, and regenerative architectural approach, which jointly reconceptualises the building as a dynamic, learning entity situated inside its ecological environment.

Nature-Inspired Design Approaches. Biomimicry has become a significant method for harmonising architectural design and functionality with ecological principles. It entails the methodical examination and interpretation of natural processes, structures, and systems into design principles for the constructed environment. Elsamadisy et al.