Flexibility

Designing for Evolution: Transforming over time, function, and user experience

PARKASSOCIATI

Indice

01 Intro

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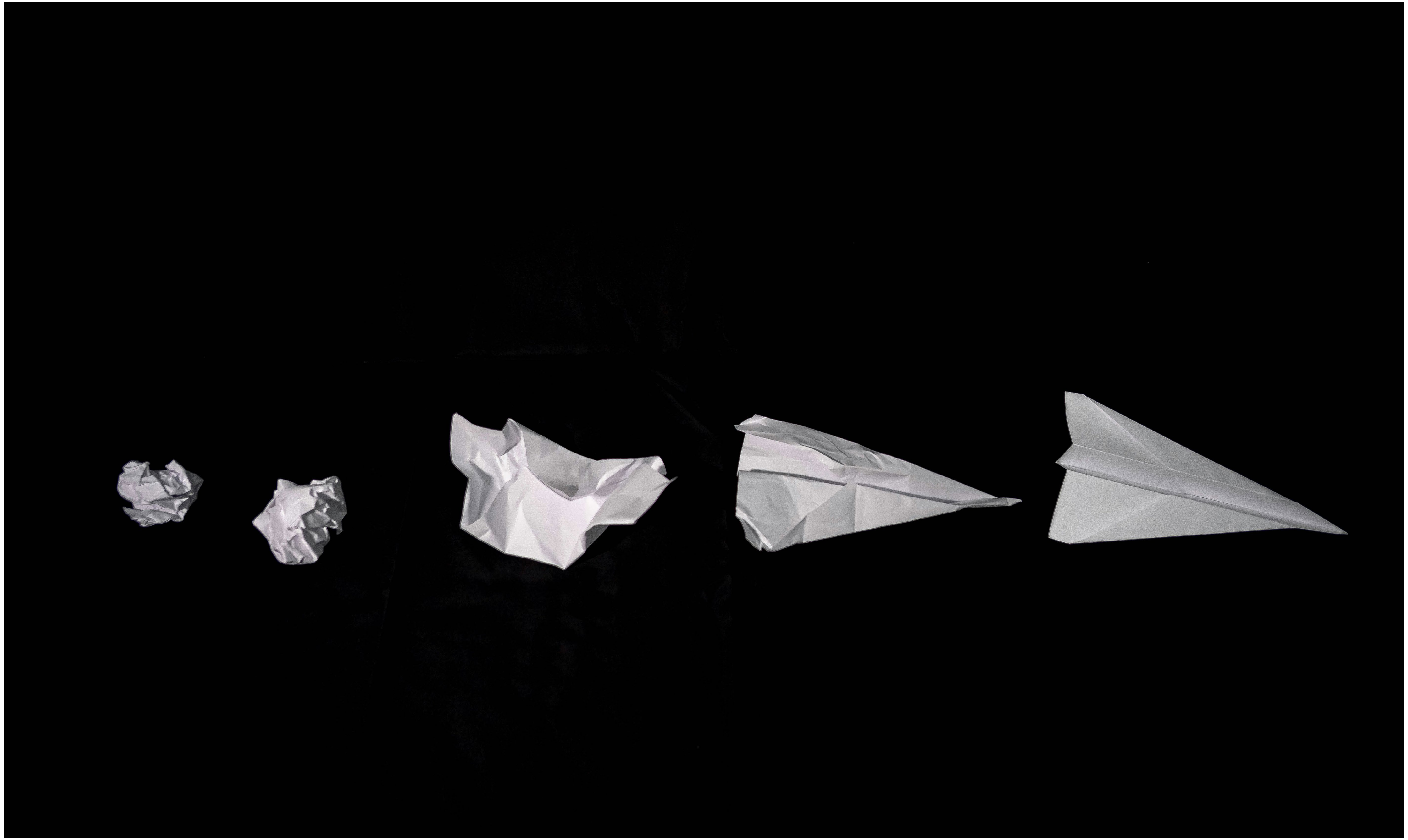
Dynamic And Transformable Architecture



Modern society is captivated by the latest technological advancements, often viewing them as indispensable tools that streamline daily tasks. This mindset extends into architecture, where design choices are meticulously analyzed for their efficiency in energy usage and conservation.

Yet, amidst this focus on functionality, there lies another aspect of architectural performance worth exploring transformation. Transformable architecture possesses the unique capability to alter its structure, space, and purpose through physical movement. In an era where technology sometimes isolates individuals from one another, it also has the potential to create architectural spaces that encourage active participation and interaction between users and their surroundings.

“Cities are part of the climate change problem, but they are also a key part of the solution.”
Kamal-Chaoui & Robert, 2009.

Climate Emergency And Architecture

2060

Around half of all new buildings are expected to be constructed

55%

Percent of the energy consumed in constructing a new building is attributed to material extraction and production

2050

Emissions from buildings are projected to doubled since 2017, primarily due to the increasing demand for new floor space.

Niall Patrick Walsh. "The Facts about Architecture and Climate Change" 18 Aug 2021. ArchDaily.

Why Architecture Should Transform?

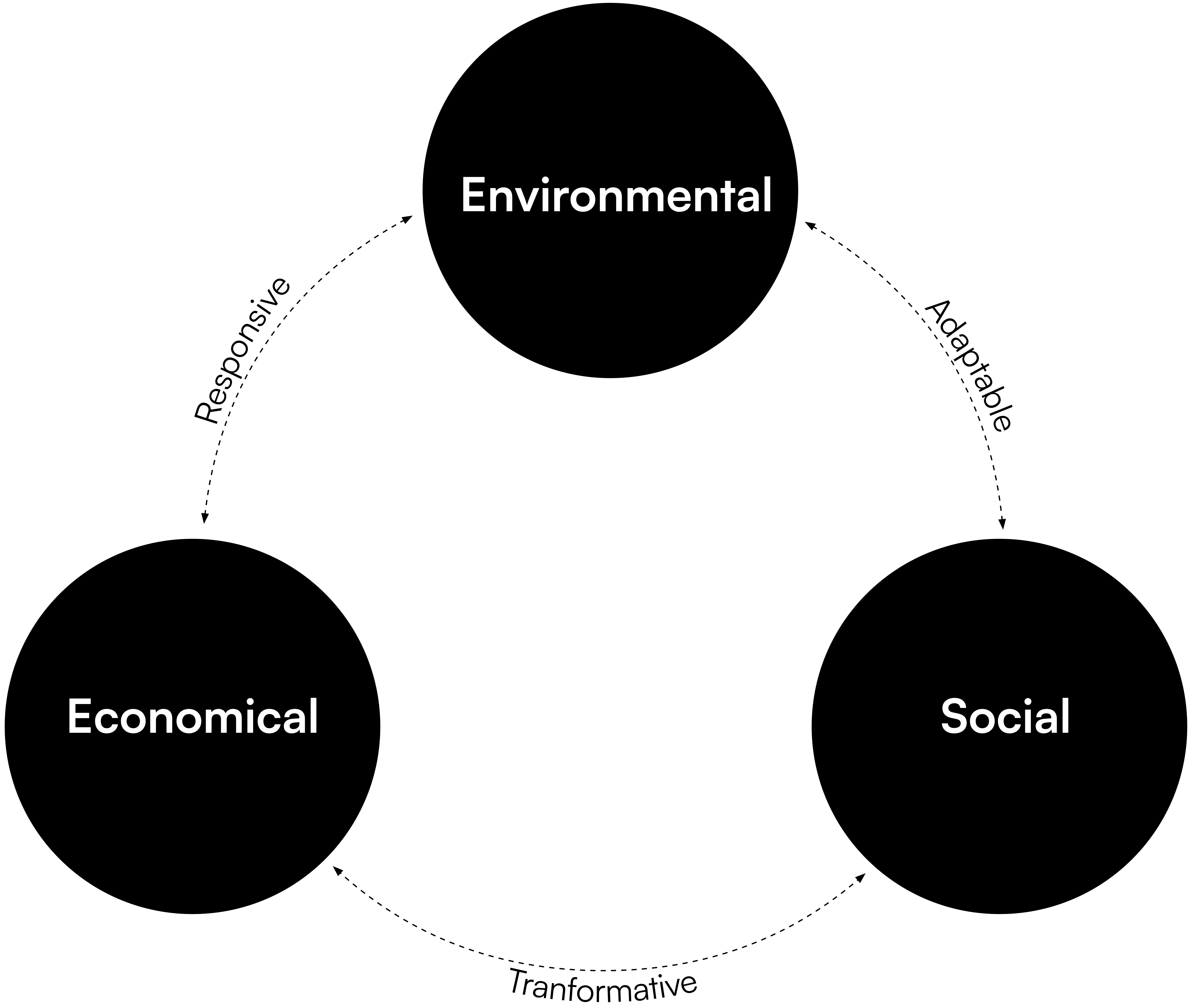
Transformable architecture offers a versatile approach for buildings and structures, catering to the need for adaptability. Whether it's streamlining for transportation or adjusting shape to meet evolving functional and aesthetic demands, this strategy addresses the fluidity required in modern architecture. In today's world, where users' needs constantly evolve, architecture must be responsive, allowing users to participate in shaping their built environment. Transformability empowers users to realize their architectural aspirations while offering an avenue for environmental integration, promoting energy efficiency and cost savings.

By fostering dynamic spaces that interact with their surroundings, transformable architecture not only maximizes user engagement but also paves the way for innovative solutions that address environmental concerns and foster unexpected possibilities.

“Charles Darwin has suggested that the problem of survival always depends upon the capability of an object to adapt in a changing environment. This theory holds true for architecture.”
Zuk and Clark, 1970.

Can buildings be designed to dynamically respond and adapt to both natural and human-made factors?

Responsive Architecture

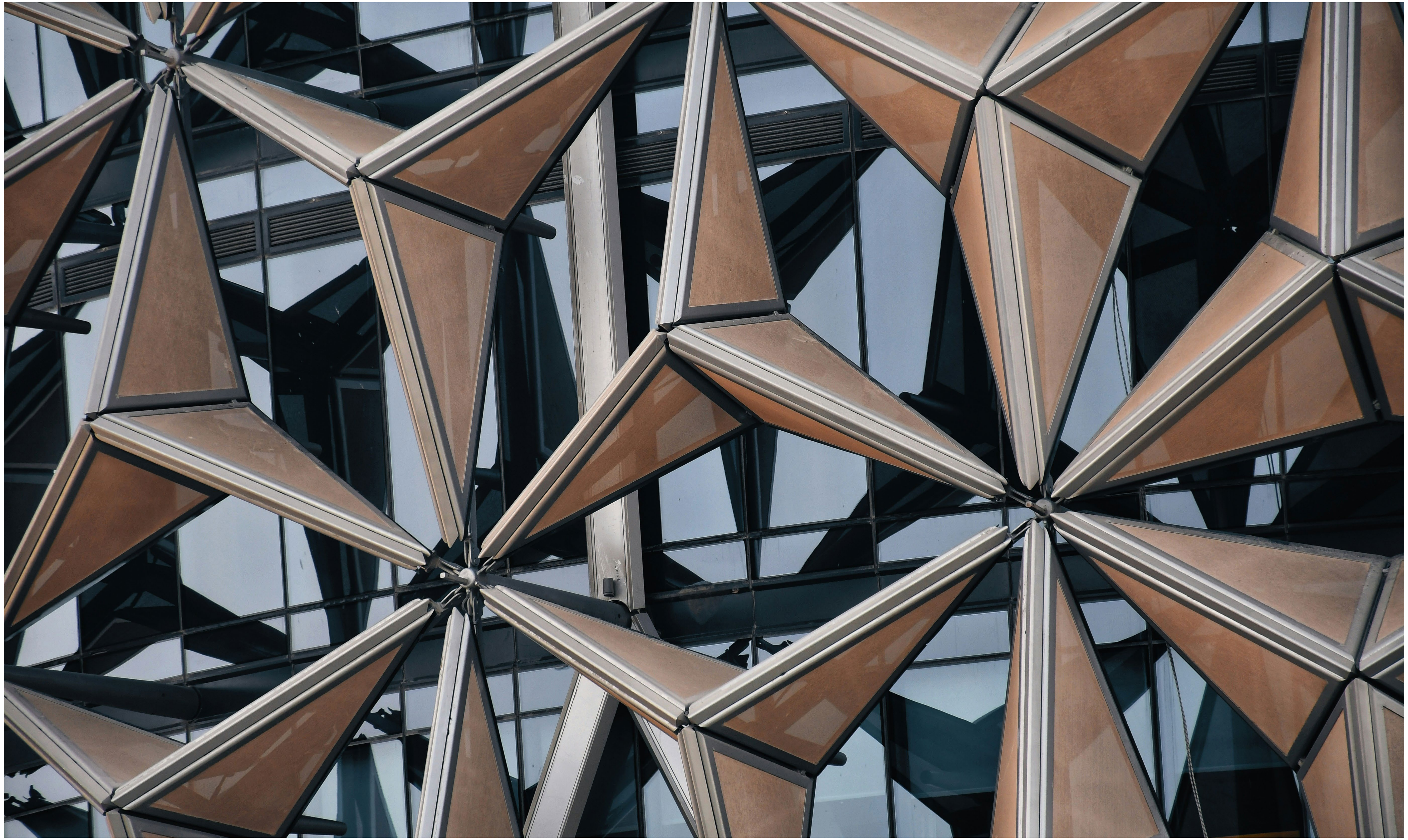


Environmental Responsive Architecture

Climate-responsive architecture incorporates climate data from a specific area to design efficient buildings that harmonize with the local climate. This approach considers various factors such as temperature, historical weather patterns, sun path, solar position, environmental conditions, seasonality, and topography. The design objective is to minimize excessive energy consumption, minimize environmental impact, and prioritize sustainability.

In response to the demand for intelligent, interactive, and adaptable architecture, kinetic architecture integrates moving components that operate independently while maintaining structural integrity. Kinetic buildings have the capability to synchronize with the natural rhythms, shifting direction and form as seasons transition from spring to summer and from sunrise to sunset. This adaptability allows structures to dynamically respond to weather conditions, imbuing them with a sense of vitality. Moreover, kinetic architecture empowers architects to incorporate realistic assessments of both human needs and environmental factors.

In adapting to change, the intelligent modulation of human activities and environmental conditions becomes essential. By extending architectural design to accommodate human capabilities and enhance everyday activities, kinetic architecture fosters an environment that seamlessly integrates with our needs.



Social Responsive Architecture

Social adaptability in architecture encompasses the ability of built environments to respond to the evolving needs and behaviors of individuals and communities within them. Beyond just physical functionality, socially adaptable architecture prioritizes the enhancement of human experience and interaction, fostering a sense of belonging, inclusivity, and well-being.

One aspect of social adaptability involves creating spaces that are flexible and multifunctional, capable of accommodating a variety of activities and gatherings. This flexibility allows spaces to be easily reconfigured or repurposed in response to changing community needs, events, or cultural practices. Additionally, it considers the promotion of social interaction and connectivity within architectural designs. This can be achieved through thoughtful layout planning that encourages chance encounters and informal gatherings.

Ultimately, social adaptability in architecture serves to create environments that not only meet the functional needs of users but also support their social, cultural, and emotional well-being. By fostering dynamic, inclusive, and responsive spaces, socially adaptable architecture contributes to the creation of thriving and resilient communities.

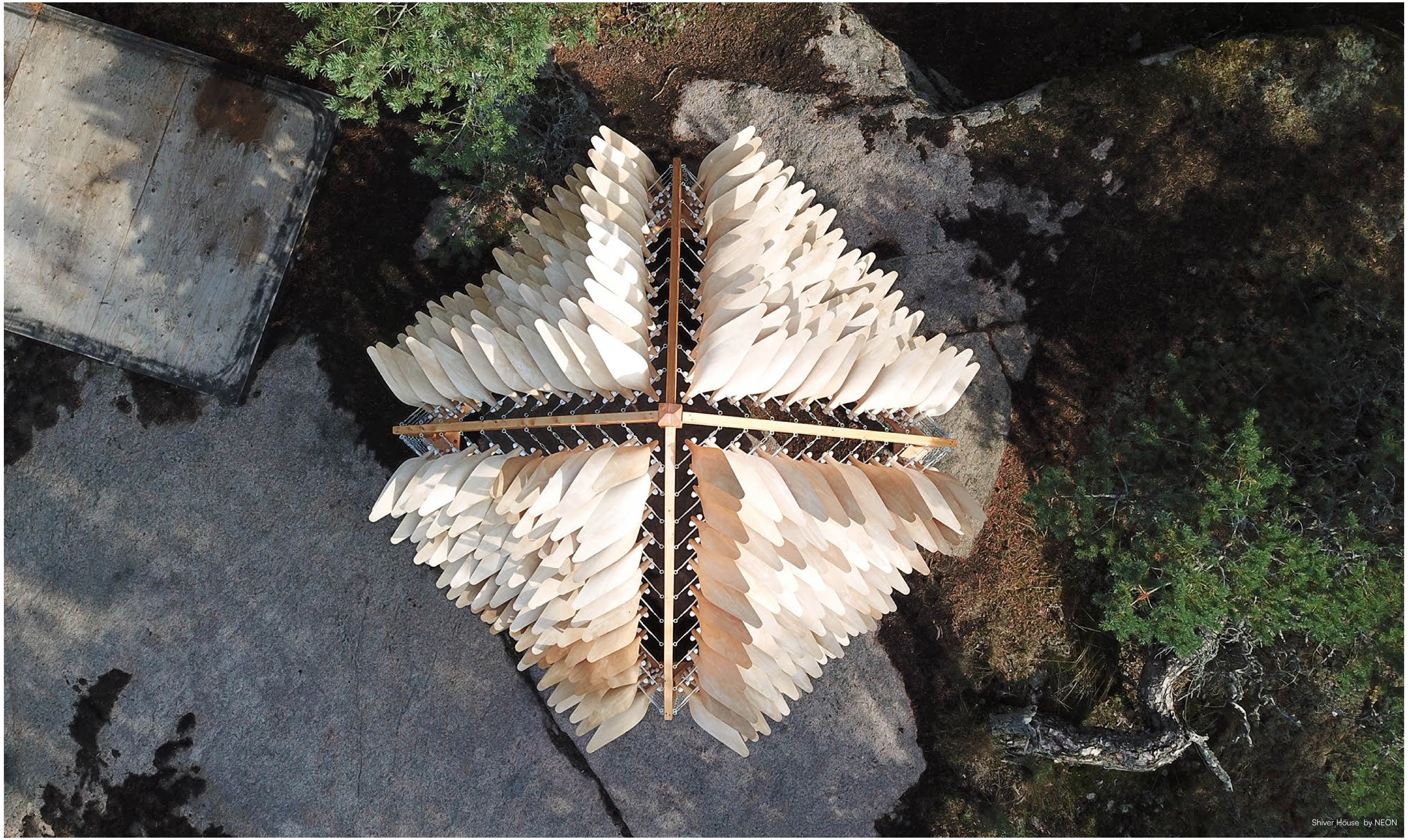
Propuestas para una plaza, Fritz Haeg & Nils Norman

Economical Responsive Architecture

Economical adaptability in architecture encompasses the capacity of buildings to optimize their function, lifespan, and resource utilization over time, while also capitalizing on technological advancements. This adaptability enhances efficiency, sustainability, and economic viability, ensuring that buildings remain relevant and cost-effective throughout their service life.

One key aspect of economical adaptability is the efficient utilization of resources. Buildings designed with adaptability in mind can minimize material consumption and waste generation by incorporating modular construction techniques, reusable components, and sustainable materials. By reducing the environmental footprint associated with construction and maintenance, these buildings contribute to long-term cost savings and environmental sustainability.

Another benefit of economical adaptability is the ability to respond to changing market demands and user needs quickly and cost-effectively. Flexible building designs allow for easy reconfiguration or expansion, enabling spaces to evolve over time to accommodate new uses or tenants without the need for costly renovations or redevelopment. By reducing lifecycle costs, maximizing resource efficiency, and embracing innovation, economically adaptable buildings offer long-term benefits for both owners and occupants while promoting sustainability and resilience in the built environment.



Shiver House by NEON

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02

Dynamic Architectural Solutions

Concept Of Adaptability

The concept of adaptability is rooted in an organism's or system's ability to respond to fluctuations in natural conditions. This study explores how living organisms capture, convert, store, and utilize energy, water, and daylight, investigating nature's methods of cooling, heating, shading, and light control. While buildings are traditionally perceived as static and inert entities, their surrounding environment and internal conditions are dynamic. Therefore, there is potential to draw inspiration and insights from nature to enhance the adaptability of building façades, leading to improved building performance.

Incorporating adaptability into architectural design requires a deep understanding of change dynamics and the intelligent response that architecture should exhibit. This process entails recognizing the need for buildings to evolve and adapt in harmony with their surroundings, embracing principles derived from nature to inform innovative solutions for architectural design.

But how do we make our building adaptive, responsive, flexible or even transformable?

Adaptability

Transformability

Convertibility

Kinetic architecture

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Adaptability

Adaptability in architecture refers to the ability of a structure to respond effectively to changing needs, conditions, and environments over time.

Transformability

Convertibility

Kinetic architecture

Adaptability

Adaptability, within the realm of architecture, refers to the inherent capability of a building to accommodate a diverse range of functions and activities without necessitating substantial alterations to its core architectural structure. This quality is crucial in sustainable architecture, as it enables buildings to meet the evolving needs of occupants while minimizing environmental impact. Socially, adaptability fosters safe and effective communication within spaces, promoting a sense of comfort, environmental quality, health, and safety for building users. Economically, adaptable buildings are more resource-efficient and have the potential for longer life cycles.

Environmentally, adaptability reduces energy consumption and mitigates the effects of extreme climatic conditions (Nakib, 2010). Nature serves as a model for how architecture can be responsive and adaptable, fostering new relationships between people, spaces, and climate. By observing the interaction and modification of living organisms with their environment, architects can learn to bridge the gap between organic and inorganic design principles. Just as nature adapts to its surroundings, architecture can be designed to respond and adapt to changing conditions.

To create adaptive, responsive, and flexible buildings, we must consider how to leverage insights from nature to inform their designs. This entails addressing questions such as how to integrate bio-inspired principles into architectural practice and how to utilize nature's strategies for the benefit of building occupants and the environment. These considerations are essential for to seek to develop bio-inspired architecture that is both innovative and sustainable.

Adaptability

Transformability

Transformable architecture involves designing buildings and spaces that can physically change their form, layout, or configuration to adapt to varying needs and conditions. These structures typically incorporate movable or reconfigurable elements such as walls, floors, or ceilings,

Convertibility

Kinetic architecture

Transformability

Transformability encompasses the dynamic capability of both interior and exterior spaces to undergo substantial modifications or alterations without necessitating new construction. It is a concept deeply rooted in adaptability, where spaces can readily evolve to meet changing needs, preferences, or circumstances. This fluidity not only pertains to the spatial layout and configuration but also extends to the functional aspects and aesthetic characteristics of the space.

One key aspect of transformability is its emphasis on mobility and responsiveness. Spaces designed with transformability in mind are often equipped with movable or modular elements that can be repositioned, reconfigured, or even entirely removed to accommodate different activities, events, or user requirements. This flexibility enables spaces to transition seamlessly between various functions or purposes, maximizing their utility and versatility.

Examples of transformable spaces abound in both architectural and design realms. Fabricated structures, such as modular housing units or prefabricated buildings, exemplify the concept by offering the flexibility to assemble, disassemble, or reconfigure components according to changing needs or site conditions. Temporary accommodations, such as pop-up shops or event venues, demonstrate transformability by providing adaptable spaces that can be quickly assembled and dismantled as required.
In addition to physical adaptability, transformability also encompasses innovative design solutions that leverage advanced technologies or creative engineering techniques to enable dynamic spatial transformations. For instance, floating buildings equipped with retractable roofs or movable façade panels exemplify the integration of transformative features into architectural structures, enabling them to adapt to varying environmental conditions or user preferences.

Ukrainian-Danish Youth House / prototype

Adaptability

Transformability

Convertibility

Convertibility in architecture refers to the ability of a building to undergo changes in its functions or uses through a process that involves some level of construction or permanent alteratio.

Kinetic architecture

Convertibility

Convertibility in architecture refers to the ability of a building to undergo changes in its functions or uses through a process that involves some level of construction or permanent alteration. Unlike flexibility, which focuses on accommodating multiple functions without altering the architecture itself, convertibility entails making deliberate modifications to the building's structure or layout to support new functions or activities.

In the practice of architecture, the concept of convertibility underscores the importance of anticipating future needs and designing buildings that can adapt to changing requirements over time. This involves thorough planning during the initial stages of design, where feasibility studies, research, and long-term projections are conducted to identify potential future uses and incorporate them into the design.

Once the objectives of convertibility are established, the design team can develop plans that balance flexibility with practical considerations such as budget constraints and sustainability goals. By integrating adaptable features and modular components into the design, architects can create buildings that are capable of accommodating a wide range of functions and activities without the need for extensive renovations or reconstruction.

However, the challenge of convertibility often arises during the design-construction process, particularly in fast-track projects where construction may begin before the entire design has been finalized. In such cases, providing flexibility in the early stages of design can help accommodate future changes and modifications more easily.

Quinta Monroy / ELEMENTAL

Adaptability

Transformability

Convertibility

Kinetic Architecture

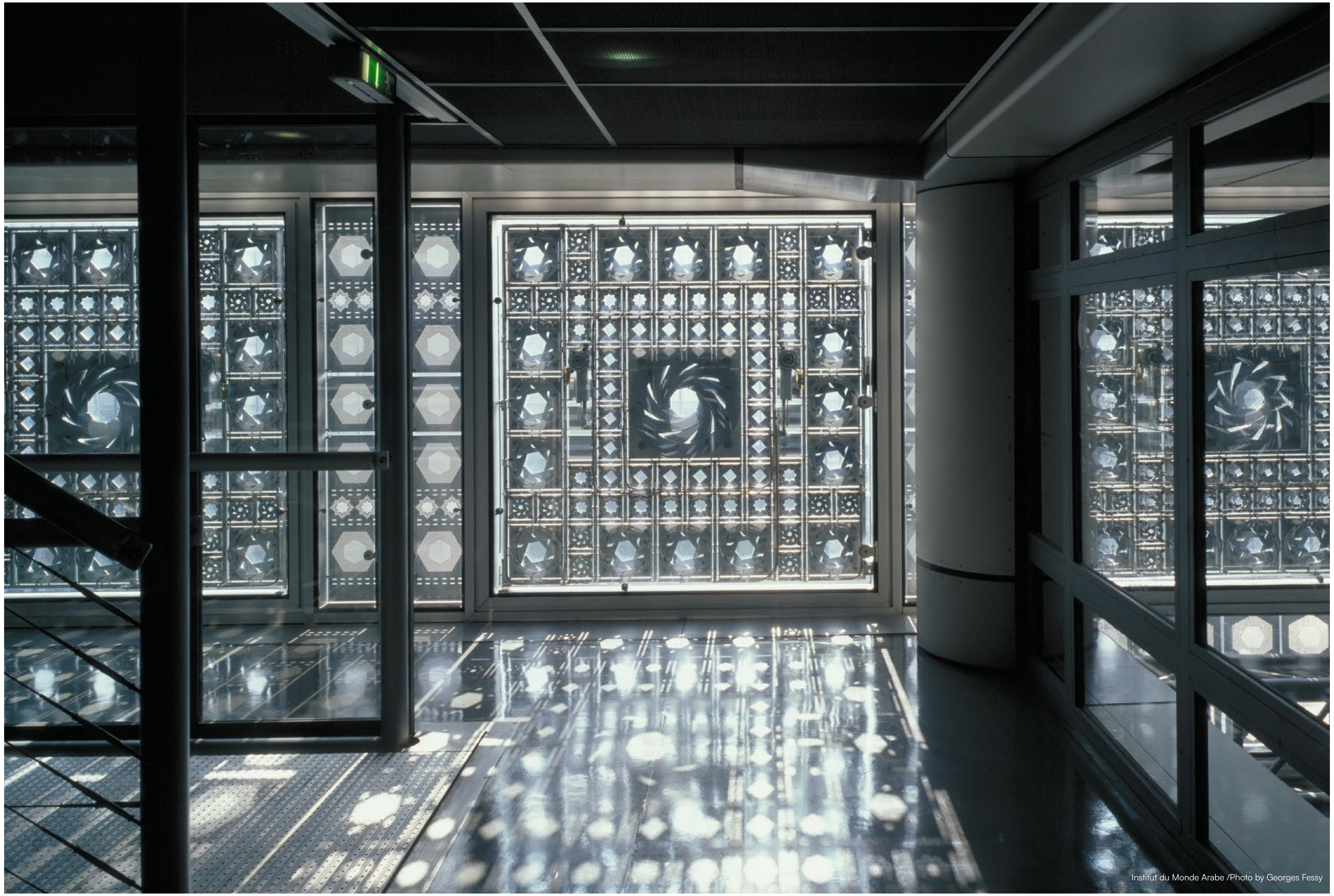
Kinetic Architecture is a design concept that integrates moving parts or mechanisms into buildings and structures, enabling them to physically transform, reconfigure, or adapt to changing conditions.

Kinetic Architecture

Kinetic architecture is the innovative practice of integrating moving elements into building design. These dynamic structures feature components that can operate independently without compromising the building's stability or safety. Kinetic architecture techniques serve various purposes, from practical functionality to artistic expression, and even environmental adaptation.

One of the key aspects of kinetic architecture is its ability to respond to changing environmental conditions or external threats. For example, buildings in earthquake-prone areas may incorporate seismic isolation systems that allow certain parts of the structure to move independently, reducing the risk of damage during seismic events. Similarly, structures in hurricane-prone regions might feature kinetic façade systems that can be closed to protect against high winds or opened to maximize natural ventilation during calm weather.

In summary, kinetic architecture represents a dynamic fusion of form and function, where innovative design techniques are employed to create buildings that not only adapt to their surroundings but also inspire awe and wonder through their movement and transformation. Whether driven by practical necessity or artistic vision, kinetic architecture pushes the boundaries of traditional building design, offering a glimpse into the future of sustainable, adaptable, and experiential architecture.



Institut du Monde Arabe /Photo by Georges Fessy

03

Transformable Structures

Dynamic architecture serves as a responsive interface that seamlessly connects spaces, activities, and communities.

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Kinetic Architecture

William Zuk and Roger Clark

"Architectural forms that are inherently displaceable, deformable, expandable, or capable of kinetic movement." They elucidated the implications of kinetic architecture by describing design as a "continuous process" that persists beyond the completion of the building.

(Zuk and Clark, 1970).

Robert Kronenberg

Kinetic architecture as "buildings or building components with variable mobility, location, and/or geometry"

(Kronenberg, Lim, and Chii, 2003).

Michael Fox

"Either transformable objects that dynamically occupy predefined physical space or moving physical objects that can share a common physical space to create adaptable spatial configurations"

(Fox and Kemp, "Interactive Architecture," 2009).

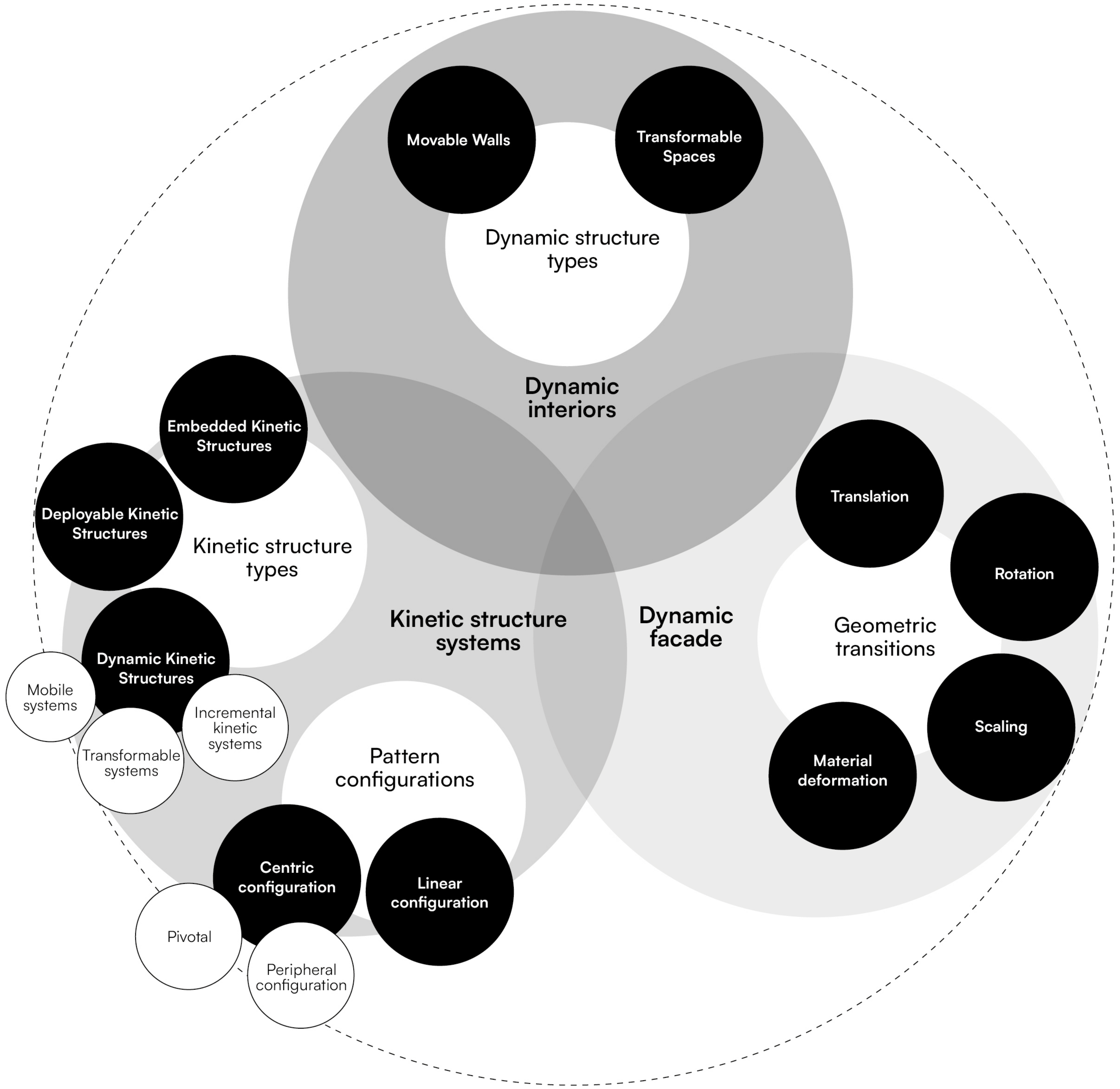
Timeline Of Dynamic Structure

- **1934** — Pier Nervi, Revolving home
- **1964** — Ron Herron, Walking cities
- **1969** — Andrew Rabeneck, Adaptive architecture by using cybernetic technologies
- **1970** — Zuk and Clack: Kinetic Architecture
- **1972** — Charles Eastman: Adaptive-conditional architecture
- **1987** — Jean Nouvel, Institut du Monde Arabe
- **1991** — Chuck Hoberman, Expandable Geodesic dome

Timeline Of Dynamic Structure

1995	John Frazer, An Evolutionary architecture
2001	Santiago Calatrava, Milwaukee Art Museum
2002	Robert Kronenberg, transportable environments
2003	Studio Gang Architects, Starlight theatre
2009	David Fisher, Dubai dynamic Towers
2010	Michael Fox, Interactive Architecture
2010	Michael Schumacher, Mover: architecture in Motion: Dynamic components and elements.

Dynamic Architecture Applications



Dynamic Facade

Towards design for Environmental Performance

A dynamic facade refers to an architectural element or system that is capable of movement and transformation. Unlike traditional static facades, which remain fixed in form, kinetic facades can dynamically adjust their appearance, position, or properties in response to changing conditions such as weather, sunlight, or user interaction.

As technology continues to advance and architectural facades evolve, the role of environmental considerations remains paramount, if not heightened. Innovative technological advancements now afford designers the opportunity to create architecture that responds to environmental cues in increasingly intriguing ways. This often materializes through dynamic facades architectural exteriors that dynamically adapt, transitioning buildings from static structures into dynamic, ever-changing surfaces. Dynamic facades have taken on a plethora of forms over time, acting as a nexus between aesthetics and functionality, blending captivating visual elements with environmental responsiveness.

At times, these designs prioritize aesthetics over regulating factors such as light, temperature, or precipitation. While dynamic facades represent a relatively recent phenomenon, their manifestations already demonstrate significant diversity, ranging from modular configurations to expansive sun-shades, aluminum cladding, or even integrated digital projections. Each design serves a unique purpose, reflecting distinct objectives and priorities. Architects increasingly recognize the potential of dynamic facades as a powerful tool to address enduring architectural challenges beauty, sustainability, and occupant comfort in bold, innovative, and technologically-driven ways. This underscores the importance of further research and development in harnessing the full potential of dynamic facades to redefine the future of architecture.

The Shed, a Center for the Arts / Diller Scofidio + Renfro

Typologies Of Movement

Swivel

The movement of an object around a fixed point, typically in a circular or rotational motion.

Rotate

Similar to swiveling but often implies a broader range of motion around an axis.

Flap

A movement characterized by a swinging or pivoting motion, often resembling the action of a door or flap opening and closing.

Slide

The linear movement of an object along a surface, typically in a horizontal or vertical direction.

Fold

The action of bending or creasing a material along a line to create a compact or layered form.

Expand

The opposite of folding, involving the stretching or unfolding of a material to increase its size or volume.

Gather and roll up

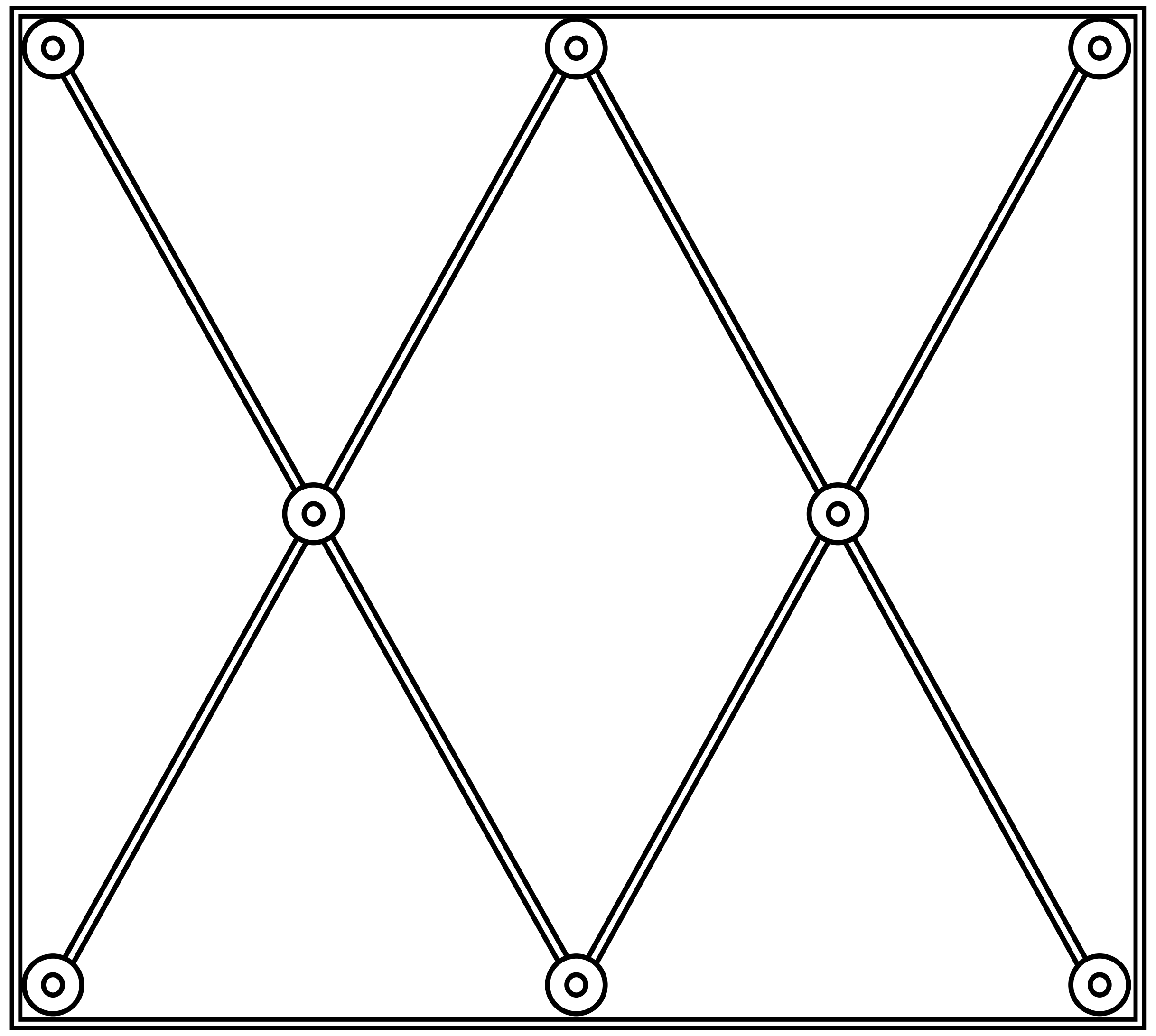
The process of collecting or bringing together loose or spread-out elements into a compact or bundled form, often followed by rolling or winding.

Pneumatic

Movement facilitated by the use of compressed air or gas, often utilized in systems such as air-powered actuators or pneumatic cylinders to achieve motion.

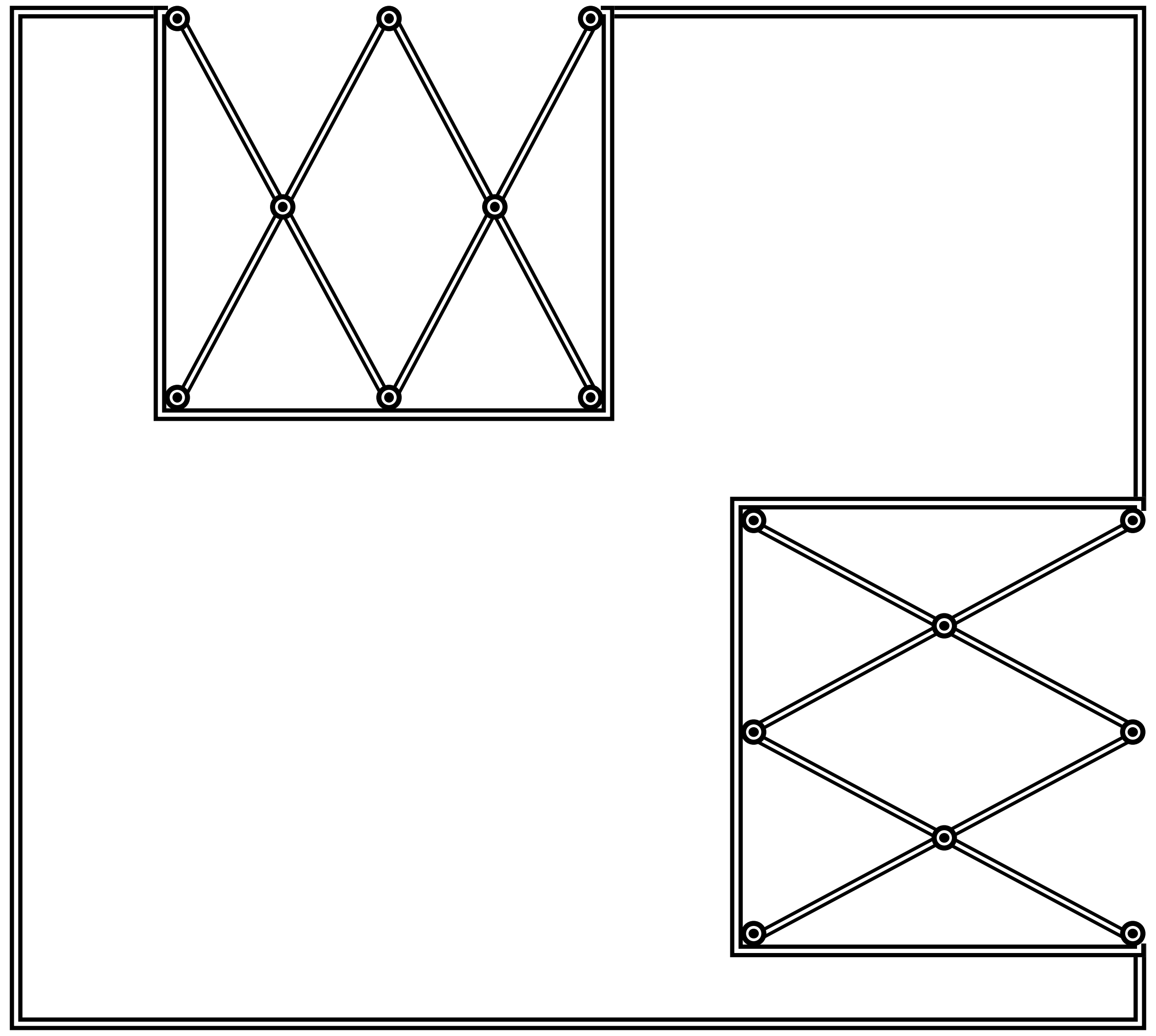
Typologies of structure in the context of dynamic Structures, refers to categorizing different types of architectural and engineering systems based on their kinetic capabilities.

Typologies Of Structure



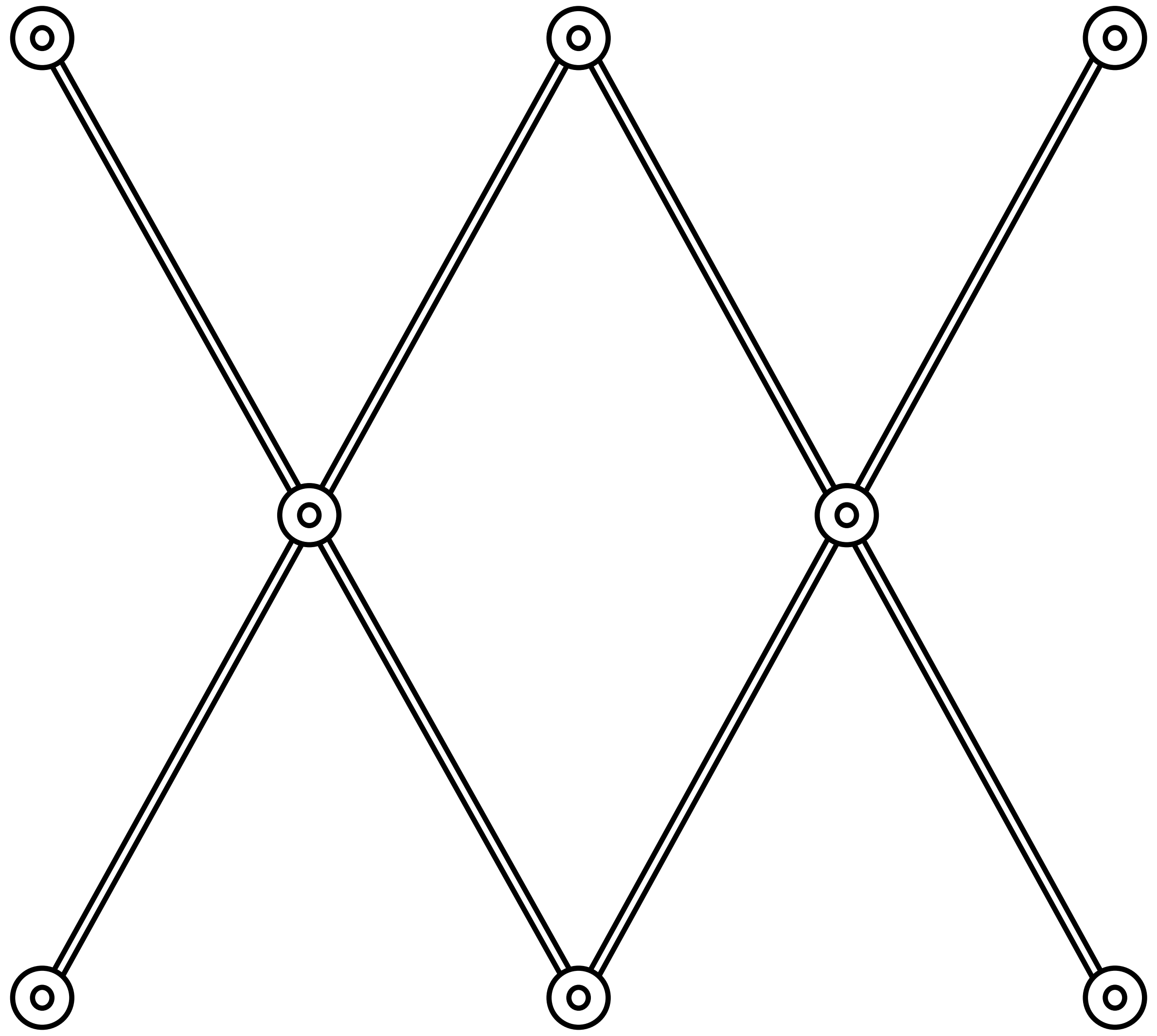
Embedded kinetic structures

Systems that are integrated within a larger architectural entity in a fixed position. These structures primarily function to regulate the overall architectural system in response to various factors, particularly environmental changes like seismic activity and wind conditions. Embedded kinetic structures represent the most advanced category of kinetic architecture and are typically accompanied by computational control.



Deployable Kinetic Structures

Typically situated in temporary locations and easily transportable. These systems are characterized by their capacity to be assembled and disassembled in reverse, providing mobility rather than motion within a fixed framework. They are commonly utilized in exhibit design, pavilion construction, and stage design, where the need for rapid assembly and disassembly is paramount. Unlike embedded kinetic structures, deployable kinetic structures are seldom paired with computational control.



Dynamic Kinetic Structures

Are integral components within a larger architectural context but operate independently in terms of control. These dynamic systems encompass a wide range of elements, from small architectural features to larger ones such as doors, windows, movable partitions, furniture, and ceilings. Given their independent functionality, it is common to find dynamic kinetic systems coexisting within buildings equipped with embedded kinetic systems. Can be categorized as follows: mobile systems, transformable systems and incremental kinetic systems.

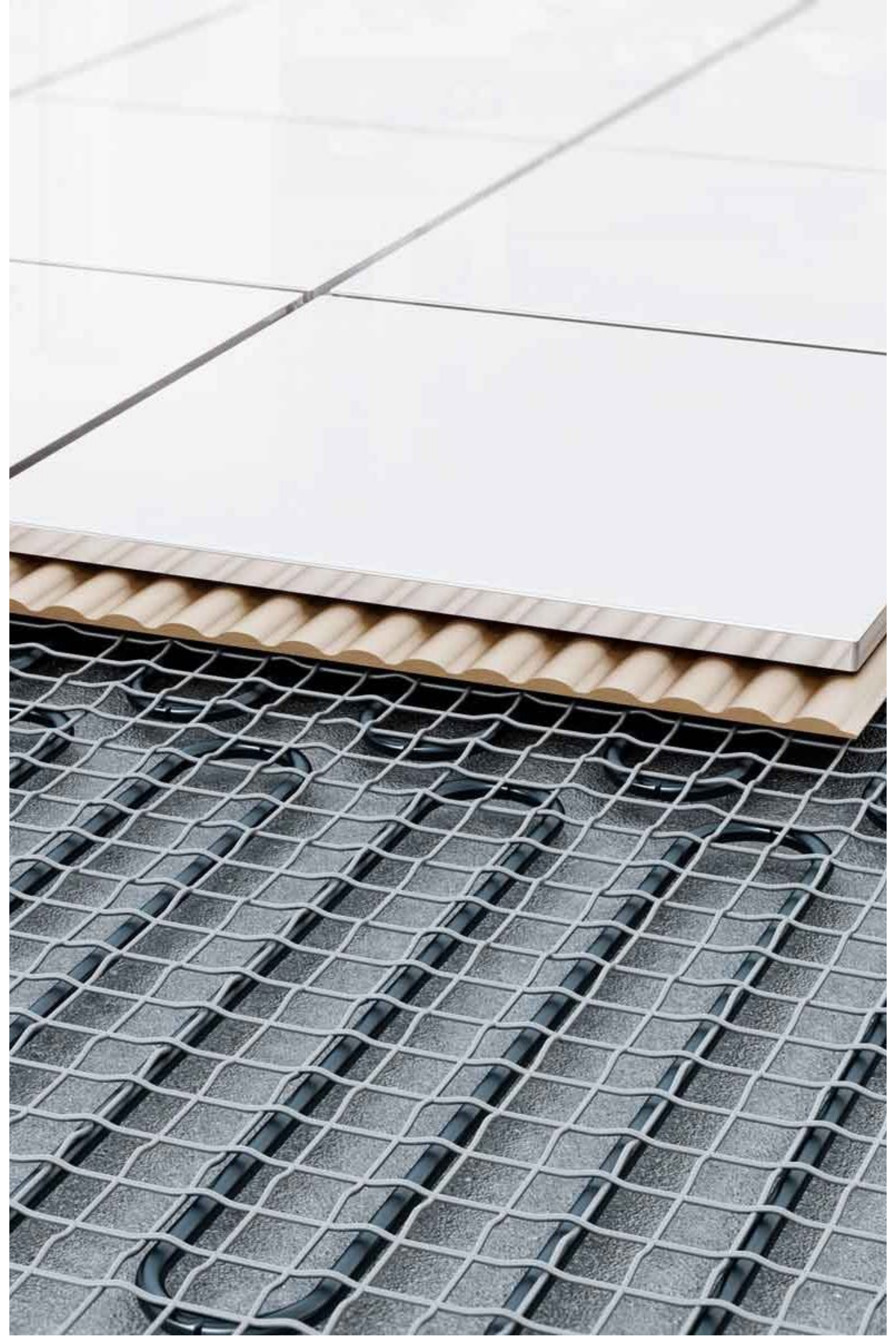
Active Materials

Active materials in transformative architecture refer to materials that can adapt, change, or respond to various stimuli such as temperature, humidity, light, or mechanical stress. These materials are often integrated into building designs to enable dynamic transformations in response to external conditions or user requirements. In transformative architecture, these active materials are employed to create structures that are flexible, responsive, and capable of adjusting their properties or configurations to optimize performance, energy efficiency, and user comfort. They enable buildings to adapt to changing environmental conditions, improve sustainability, and enhance the overall user experience.

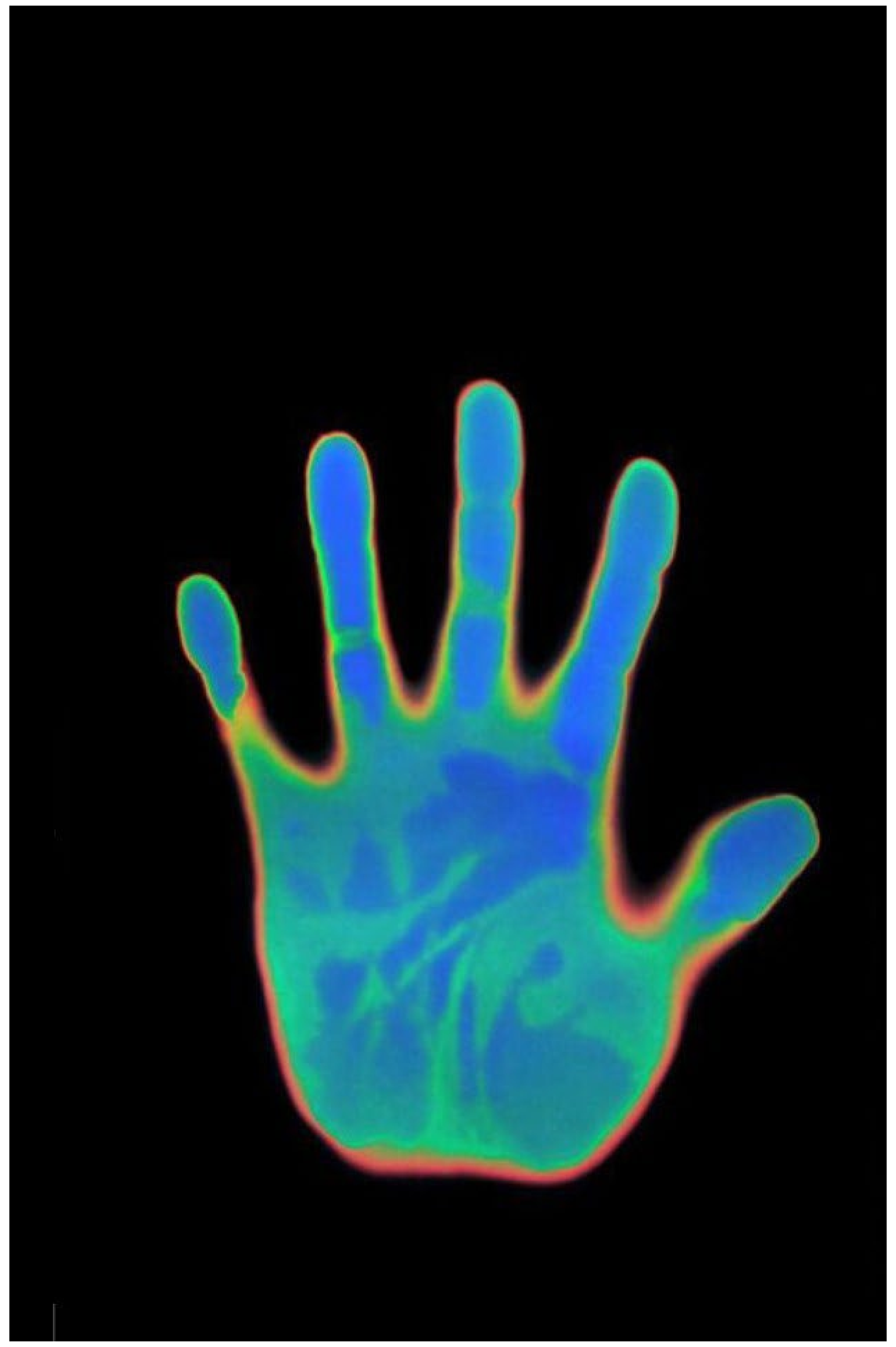
Active Materials

Shape Memory Alloys (SMAs): These materials have the ability to return to a predetermined shape when heated or subjected to a specific stimulus. They are used in architectural applications such as kinetic façade systems that can open and close to regulate daylight or ventilation.

Electrochromic Glass: This type of glass can change its tint or transparency in response to an electric voltage. It is often used in smart windows to control the amount of light and heat entering a building, thus reducing the need for artificial lighting and cooling.



Piezoelectric Materials: These materials generate an electric charge in response to mechanical stress or pressure. They are utilized in flooring systems that harvest energy from footsteps to power lighting or other building systems.

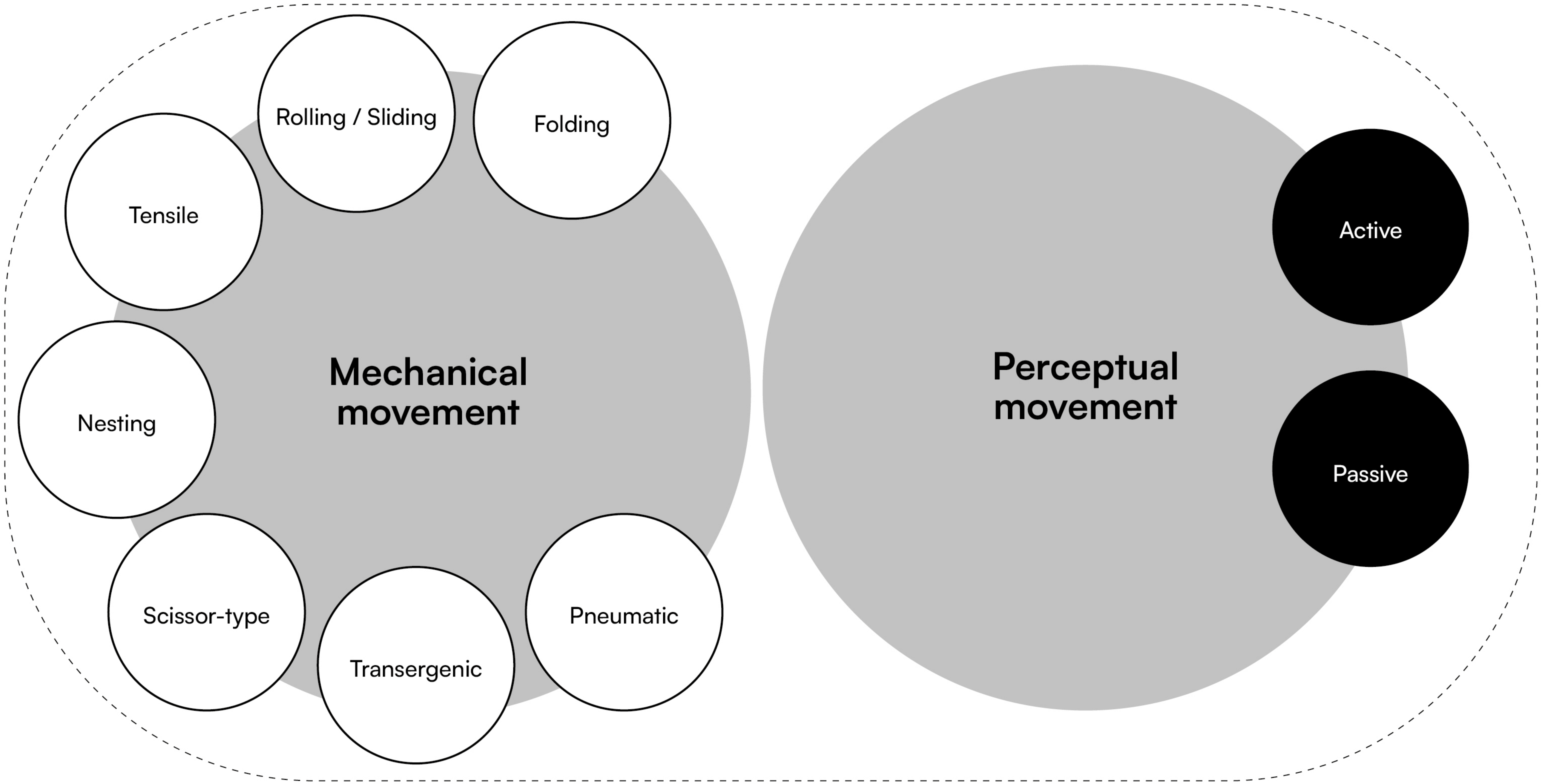


Thermochromic Paints or Coatings: These coatings change color or opacity in response to temperature variations, helping to regulate interior temperature and reduce energy consumption. They can be applied to building surfaces or roofing materials to reflect sunlight during hot weather and absorb heat during colder conditions.

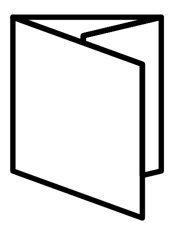
Biological Materials: Some architectural projects incorporate living organisms or biological processes to create dynamic and responsive structures.

Two fundamental categories of dynamic design movement are recognized: mechanical models and perceptual ones. Mechanical movement models are subdivided into seven distinct categories. Conversely, perceptual movement is classified into two categories.

Categories Of Dynamic Design Movement

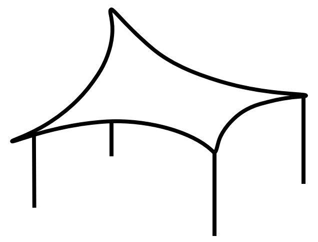


Mechanical Movement



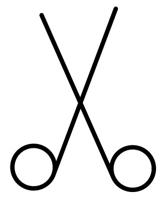
The folding principle

The folding principle stands out as the most accessible method for implementation, hence its widespread adoption. There exists a multitude of ways to reconfigure interior or exterior spaces through the utilization of folding surfaces, linear components, or flexible materials. Designs incorporating folding elements are often viewed as economical solutions, primarily due to the simplicity of their execution - employing linear and radial movement of the folding components - which minimizes the need for intricate parts and simplifies maintenance.



The tensile principle

Involves the utilization of a fabric or mesh surface capable of folding and unfolding. Throughout history, this technique has been widely employed due to its ability to facilitate dramatic transformations with relative ease. Tents and similar tensile structures, utilized for creating cover, partitions, or spatial elements, offer extensive coverage thanks to the lightweight nature of their expanded surface and the relatively light supporting framework. While suitable for large-scale applications, it’s important to note that the resulting space may not offer complete closure or security.



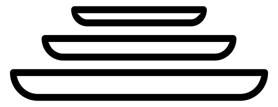
The scissor-type principle

Entails the utilization of folded reciprocal frames. This method involves an intricate folding action of linear elements that can produce surprisingly expansive spaces governed by complex geometric relationships. Notably, Chuck Hoberman is a prominent figure in this field, continually innovating and refining designs both on a macro-scale (in architecture) and a micro-scale (in toys).

Mechanical Movement

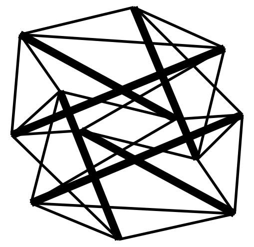
The rolling/sliding principle

Relies on assemblies with low friction, with the wheel being the most elementary example. This principle involves linear or radial movement achieved through the rolling or sliding of components along non-abrasive surfaces, such as Teflon. In architecture, it finds extensive use in retractable roofs for stadiums, but its applicability extends to any scenario where a volume of space or a surface needs to slide to achieve a desired effect. Sliding actions can be either predetermined or free, particularly for spatial elements. Its economic viability stems from its simplicity, especially effective when transformations occur between predetermined points.



The nesting principle

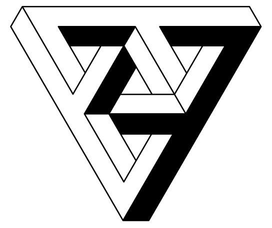
Commonly observed in product design, optimizes transportation, storage, and use by allowing objects to stack efficiently. Architecturally, it offers the advantage of space economy, organizing spatial elements based on their temporal use—varying spatial configurations for sleeping, eating, working, and more. Allan Wexler stands as a prominent figure in this field, blending art and architecture through various built paradigms.



The transergetic principle

Embodies a sophisticated structural system inspired by biomimetic and biomechanical systems, which distribute forces through a network of elastic and rigid elements, managing compression and tension separately. Tensegrity, pioneered by Kenneth Snelson, exemplifies this principle, serving as a prominent technique for creating multi-morphing dynamic structures. Notably, Frei Otto explored this principle, drawing from nature to develop Movable Guyed Masts. Presently, the HybGrid prototype by Jordi Truco and Sylvia Felipe represents a captivating application of this concept, showcasing its potential for significant alterations in spatial form within freeform buildings.

Perceptual Movement



Active principle

Revolves around orchestrating illusions either ambient or intense within an existing space to distort how people perceive it. By employing audio-visual compositions, a wide spectrum of transformations, ranging from subtle to profound, becomes possible, potentially leading to a complete alteration of the spatial experience. This principle capitalizes on the established methods through which human eyes interpret visual stimuli and the brain processes spatial images. It involves creating an additional “media layer” over specific spatial elements that the design aims to emphasize, rather than relegating them to the background of human perception. Support for its applications comes from an array of sensors that relay data to a central processing unit stationed within the intervention area. Depending on the design objectives, the unit selects themes deemed most effective for the given situation.

The passive principle

Involves the straightforward integration of intelligent phase and energy-altering materials into a space, allowing observers to witness changes resulting from the programmed responses of these materials to particular conditions. Unlike the active principle, this approach does not facilitate the design of specific events but rather establishes a general responsive setup wherein users can perceive otherwise imperceptible phenomena, such as temperature or pressure indicators. Such materials are capable of visualizing a broad spectrum of time-related changes associated with various energy fluctuations, including electromagnetic occurrences. They convey these changes not only through alterations in color but also through illumination or physical movement.

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04

Morphing Spaces

Metamorphosis

Metamorphosis, a common occurrence in the biological world, particularly among insects, involves changes in physical conditions, habitats, or behavior. In architecture, metamorphosis refers to how buildings can act as catalysts for space, as demonstrated by Santiago Calatrava's exhibition “The Metamorphosis of Space”, where he highlights how new iconic structures influence the evolution and alteration of surrounding spaces.

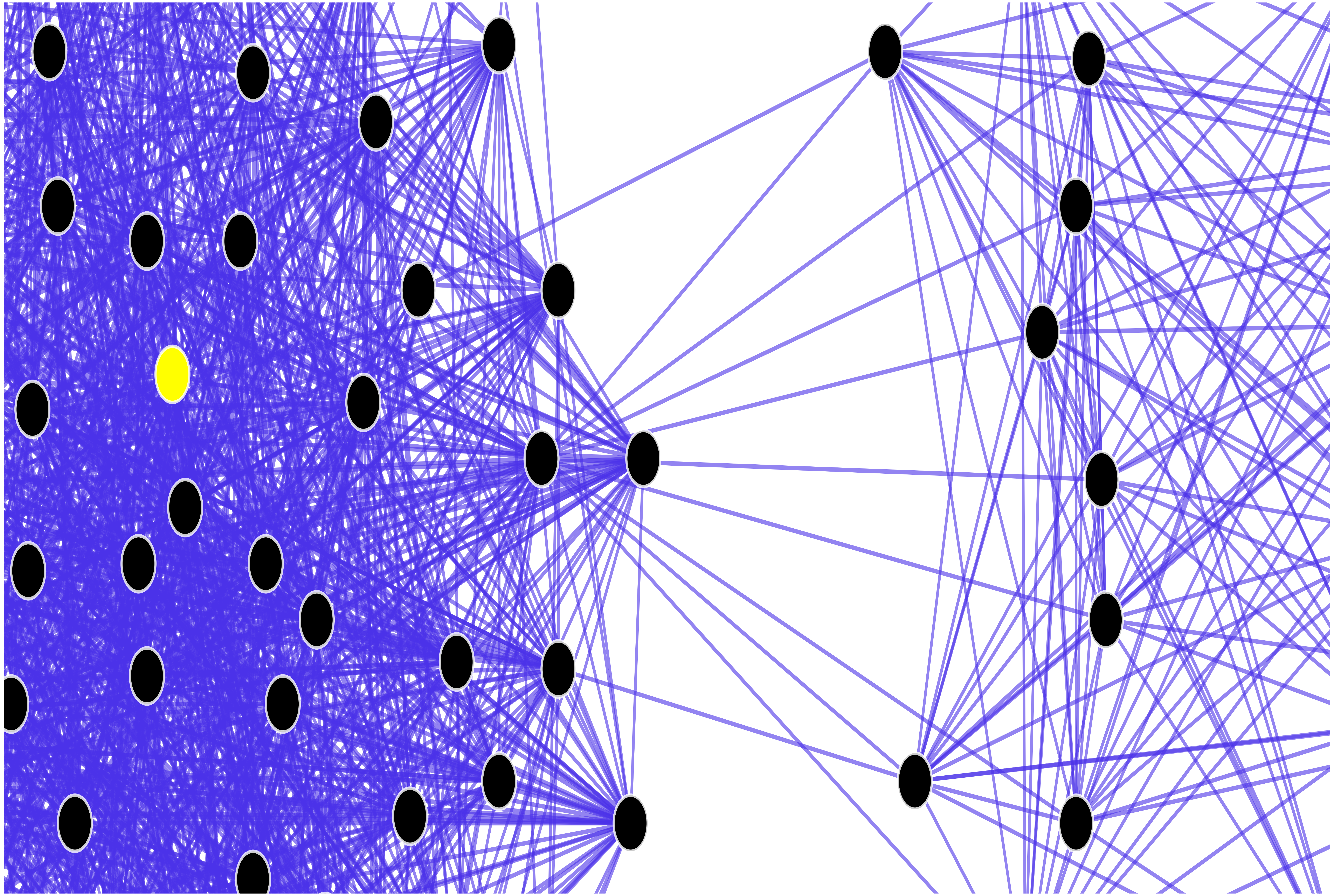
Another aspect of metamorphosis in architecture involves the timely response of materials, made possible by technological advancements. For example, advancements allow for the adjustment of window glazing opacity based on sunlight through chemical reactions between liquids and gases. Responsive facade skins can also adapt to their thermal environment. These transformations are reversible and can be automated or manually controlled.

However, Space Metamorphosis, characterized by its ability to adapt to different users, functions, and time, remains relatively unexplored in architecture. We believe that developing the concept of Space Metamorphosis has the potential to address issues related to urban sprawl and resource overuse while creating attractive environments for work and living. To comprehend how space metamorphosis can be achieved, it is crucial to analyze the relationship between space and time. While space is perceived as three-dimensional, time is experienced as intervals related to the passage of hours, days, and weeks. Theorist Paul Virilio coined the term “time-space compression” to describe this relationship, which he considers a fundamental aspect of contemporary life.

Functionalism

Functionalism in architecture underscores the significance of designing a building to serve its intended purpose efficiently. A versatile space, by definition, implies adaptability to multiple functions. Consequently, designing flexible space entails meeting diverse requirements dictated by its intended uses. For instance, a gallery's lighting needs differ from those of a movie theater, just as the flooring in a gymnasium contrasts with that of a typical classroom. Merely having an open-plan layout isn't adequate for flexibility; it's essential but insufficient. Spatial flexibility hinges on a space's functional performance, implying that the ability to accommodate various purposes effectively is paramount.

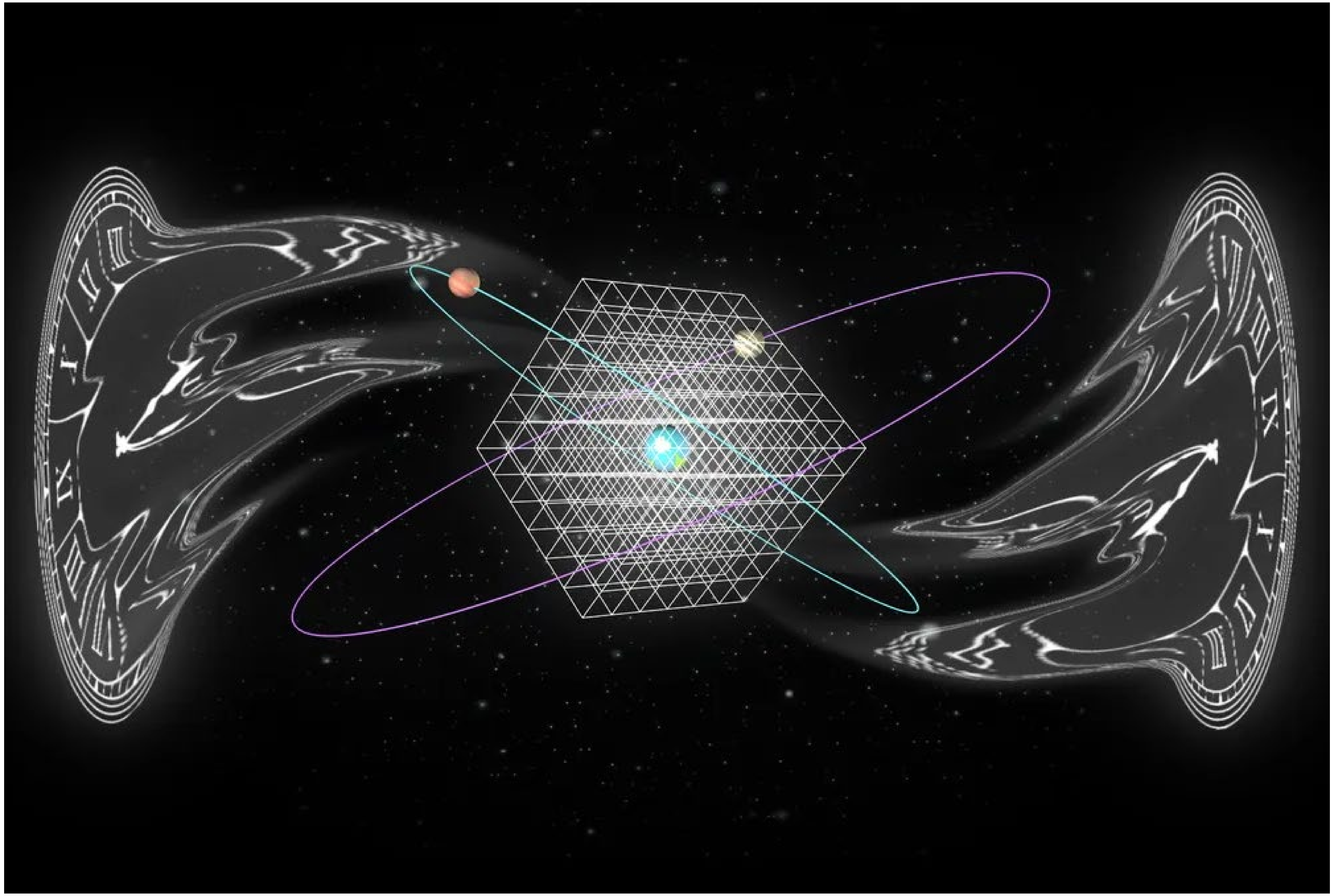
However, a paradox arises. The concept of flexibility often encounters conflicting viewpoints on a space's functions: proponents of Functionalism, advocating for tailored design, and detractors, challenging such rigid adherence to function. This tension between control and freedom complicates the realization of truly flexible spaces, rendering it challenging, if not unattainable. Achieving flexibility doesn't solely rely on the design of a space; it also involves implementing building systems that complement it.



Space And Time

Insights from physics and the organizational principles of the universe were considered to inform the development of space transformation concepts. For instance, Le Corbusier expressed a keen interest in mathematical laws, likening mathematical knowledge to “flashes of fundamental truth” and comparing mathematics to a realm holding the key to great systems. Physicists are regarded as profound thinkers, and their theories are a source of inspiration for exploring the applicability of their understanding of Time and Space in architecture.

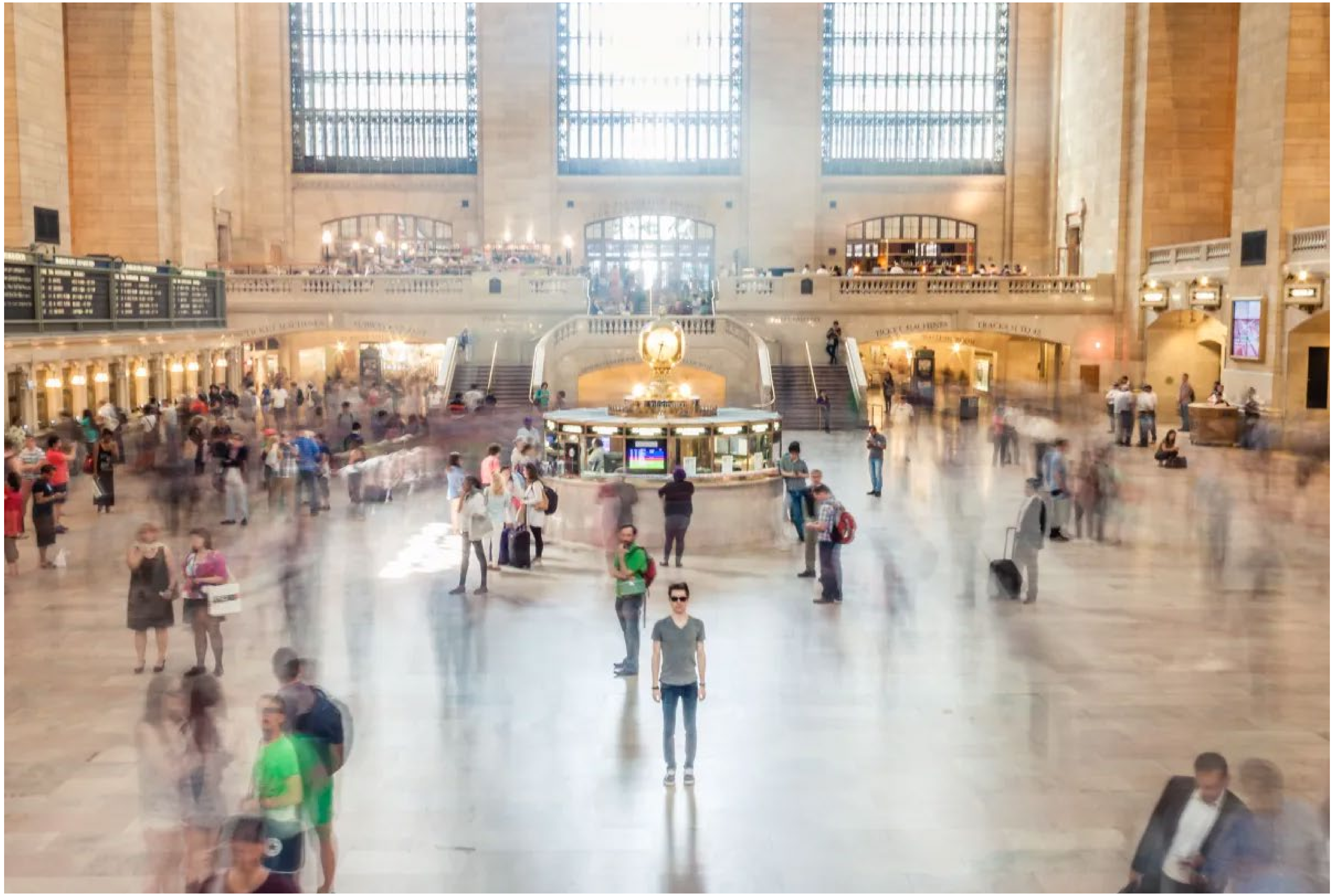
Throughout the nineteenth century, notable physicists explored the intricate connections between Space and Time. Einstein, in particular, consolidated previous research and proposed that Space and Time are interdependent. In 1908, Hermann Minkowski furthered this notion by suggesting that Space and Time could be viewed as components of a single four-dimensional spacetime fabric. He famously stated, “Henceforth space by itself, and time by itself, are doomed to fade away into mere shadows, and only a kind of union of the two will preserve an independent reality.” These discoveries significantly impacted the scientific community, providing explanations and simplifications for various theories. The close relationship between Space and Time in astrophysics and mathematics provides a foundation for considering both parameters holistically in architecture.



Space And Time In Architecture

In architecture, the concept of "time" often refers to history, the past, present, or future. Architecture is often regarded as a time-based art because it evolves with our perception and experience of space. Phrases like "architecture of now" evoke images of how a place looks and functions currently compared to how it appeared two decades ago.Time can be understood as intervals or durations, encompassing hours, days, weeks, months, or seasons. However, each interval is perceived differently. This variability introduces the notion of elasticity. To illustrate, consider the scenario where individuals typically leave their homes in the morning and return in the evening. Despite their dynamic lives, they perceive their home as static, frozen in time during their absence. It's as though the house ceases to exist the moment they leave, akin to the concept of time dilation introduced by Albert Einstein. According to relativity theory, time dilates, or slows down, in a moving reference frame, revolutionizing our understanding of time as an interval dependent on reference points.

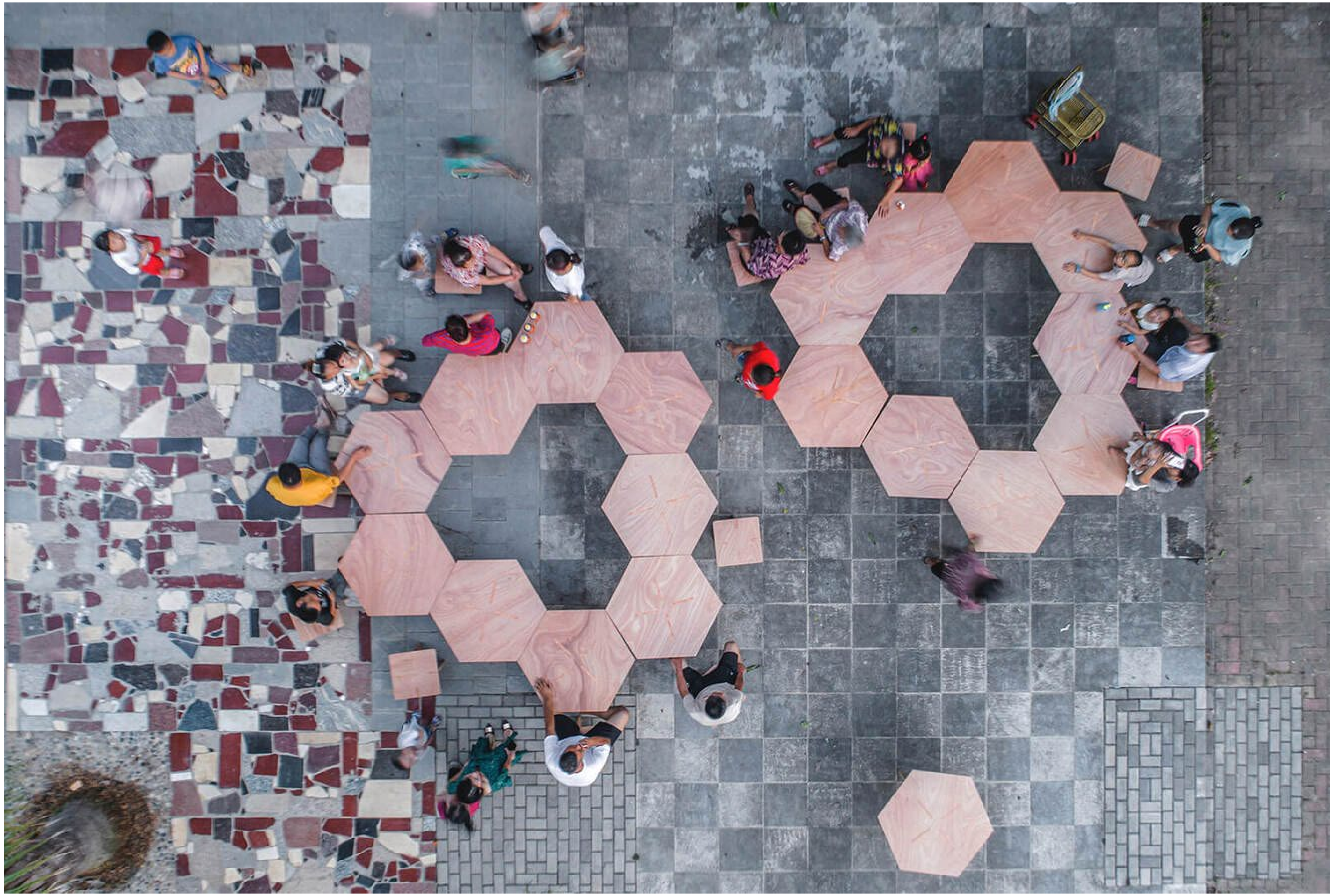
Relating this understanding of time to the concept of Space Metamorphosis, the mechanism can be described as stretching virtually imperceptible time lapses experienced by users to accommodate additional uses. This dynamic manipulation of time imbues space with a responsive character, aligning it more closely with natural processes. The invention of trains, cars, planes, telegraphs, telephones, and the internet has fundamentally altered our perception of the relationship between Time and Space. Similarly, advancements in the building industry, such as parametric design and 3D printing, accelerate the construction process. According to Virilio, we are now entering a realm of "speed-space," characterized by electronic transmission and high-tech machinery. These shifts in perception directly impact our lifestyles and adaptability to living and working spaces, offering opportunities to explore user flexibility characteristics.



Flexibility Of The User

The era of globalization and “speed space” reshapes our perception of place and our attachment to it, prompting an examination of users’ flexibility and its direct correlation to the Space Metamorphosis concept. Richard Sennet notes the increasing number of people feeling inclined to adopt a nomadic lifestyle, with little recollection of their living arrangements a decade ago. This flexibility imbues a sense of freedom, allowing individuals to easily relocate and find new homes. The traditional notion of attachment to living or working spaces diminishes as people embrace the unknown, finding inspiration and satisfaction in novelty, breaking away from routine.

Despite these global shifts and increased flexibility, the “My house is my castle” philosophy persists, extending beyond living spaces to encompass possessions like cars and belongings. Many prefer ownership of fewer items over sharing, raising questions and concerns about mixing functions, especially in sacred spaces like housing. The well-being of individuals is closely tied to their living environment, with many unwilling to compromise their strong attachment to their homes, even for potential benefits.
Sennett’s notion of “mutual accommodation through dissociation” is scrutinized, highlighting the peace of mutual indifference as inadequate. Cooperation among users, driven by shared interests and a desire for diverse experiences, is crucial. Sennett’s assertion that the end of citizenship practices would signify a loss of understanding divergent interests underscores the importance of maintaining curiosity about others. Trust and tolerance are essential for implementing the concept successfully. The concept seeks to strike a balance between mutual indifference and curiosity about others, examining relationships between public and private spaces, ownership versus rental arrangements, and fostering flexibility.
As people increasingly prioritize experiences over possessions, providing adaptable spaces becomes increasingly relevant.

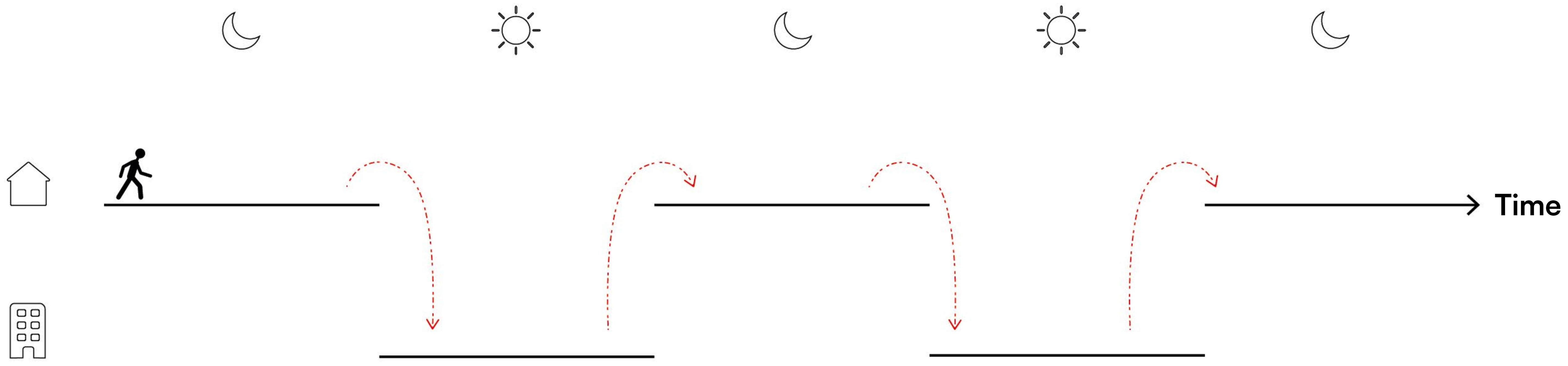


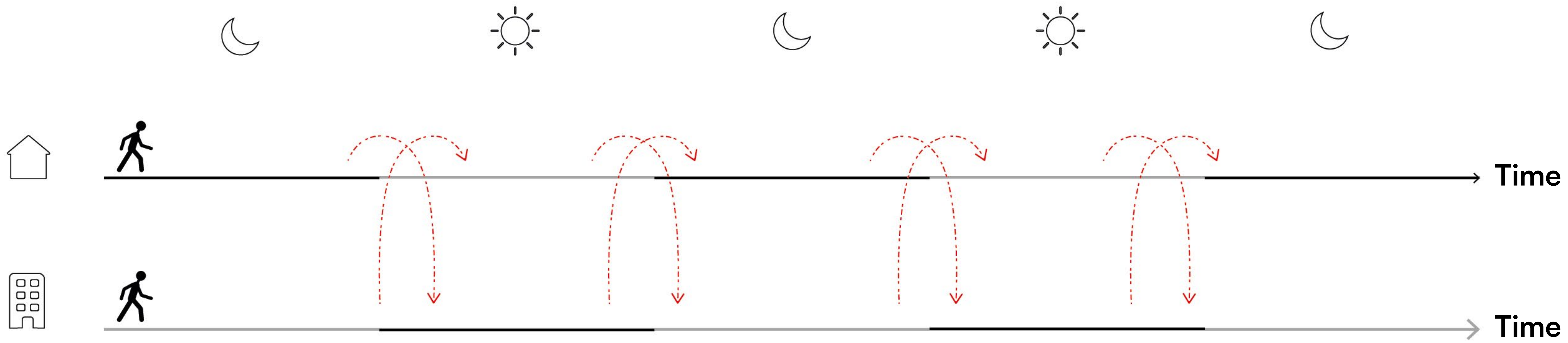
Time Elasticity

Theoretical analysis of Space and Time, along with considerations of user flexibility and the sense of place, has led to the formulation of an initial definition of Space Metamorphosis. This concept involves a cycle of spatial transformations driven by changing functions over specific time intervals, influenced by factors such as time, location, inhabitants, and resources. It impacts three primary scales: EXTERIOR/public, INTERMEDIA/E/common, and INTERIOR/private.

Exploring Time reveals a fascinating phenomenon: time elasticity, offering opportunities to explore the dual identity of space. Emphasizing users' perceptions underscores the importance of designing places with distinct identities, expressed through structure. Prioritizing both individual well-being and community comfort fosters cooperation and balance between public and private realms. People, their daily routines, relationships, and commitment to sustainable living facilitate Space Metamorphosis.

Time encompasses various intervals and durations, perceived uniquely. The concept of elasticity comes into play here. Consider a typical day: individuals leave and return home, perceiving the house as static despite their dynamic lives. This aligns with the scientific concept of time dilation, where time stretches relative to a moving reference frame, as proposed by Albert Einstein. Space Metamorphosis elongates virtually imperceptible time intervals to introduce additional functionalities, granting space dynamic characteristics.





Enhancing Public Space Through Kinetic Architecture

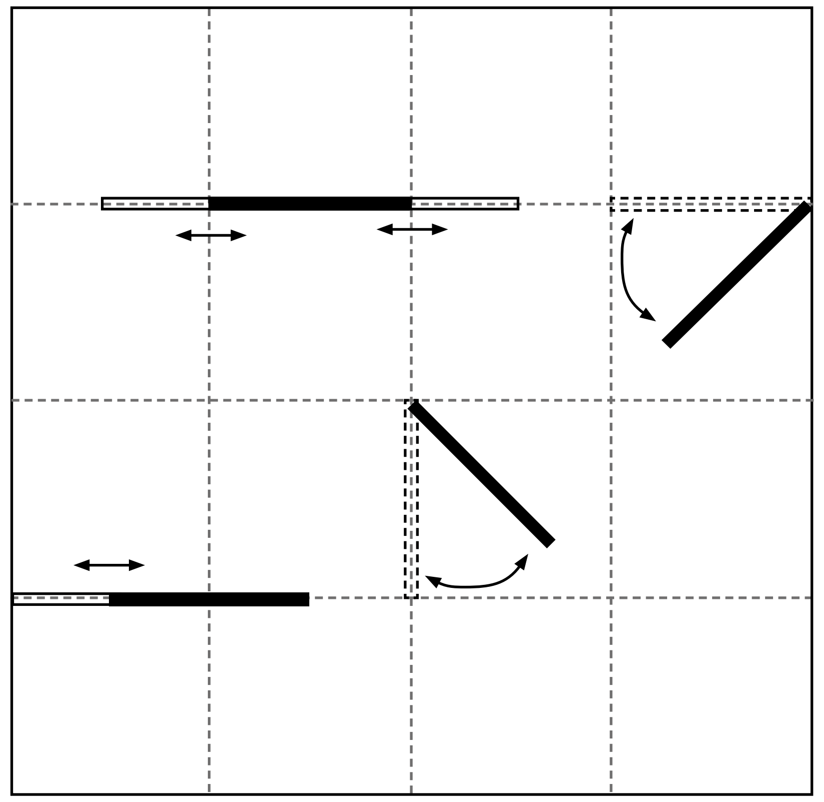
In public spaces, kinetic architecture functions as a responsive interface, seamlessly connecting various activities, spaces, and communities. Through innovative design strategies, public spaces can incorporate a range of dynamic elements such as retractable canopies, movable seating arrangements, and adjustable ramps. These features imbue shared spaces with versatility, accommodating diverse functions and activities while promoting accessibility and inclusivity.

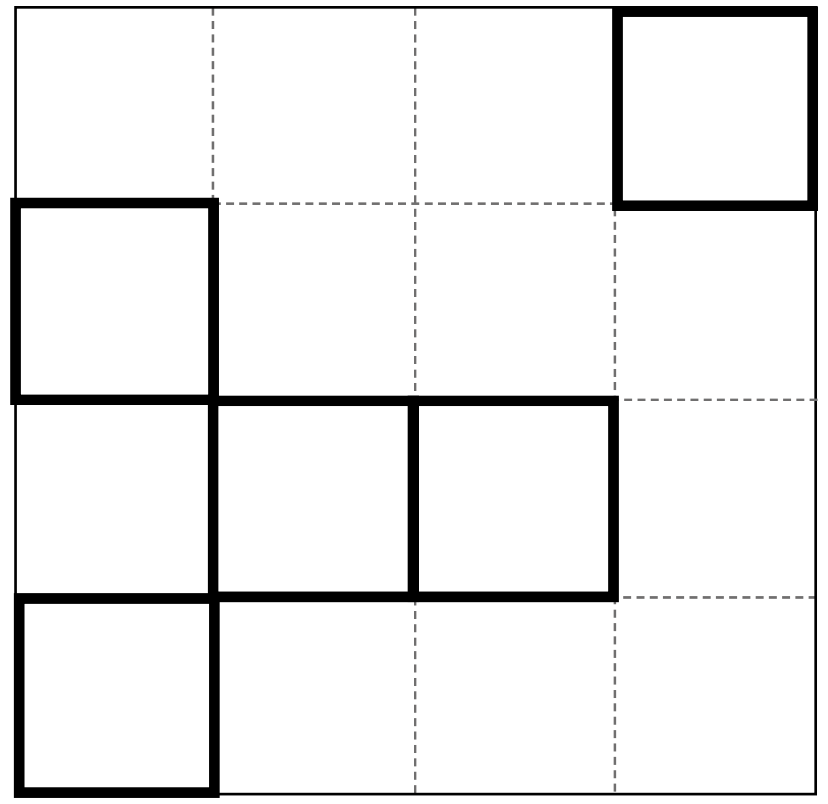
Beyond enhancing functionality, kinetic structures foster a sense of empowerment and ownership among users. By enabling individuals to interact with and influence their environment, these structures grant agency over experiences within shared spaces. Adaptable spaces communicate to users that their needs and desires play a crucial role in shaping urban communities, empowering them to actively participate in and contribute to these spaces.

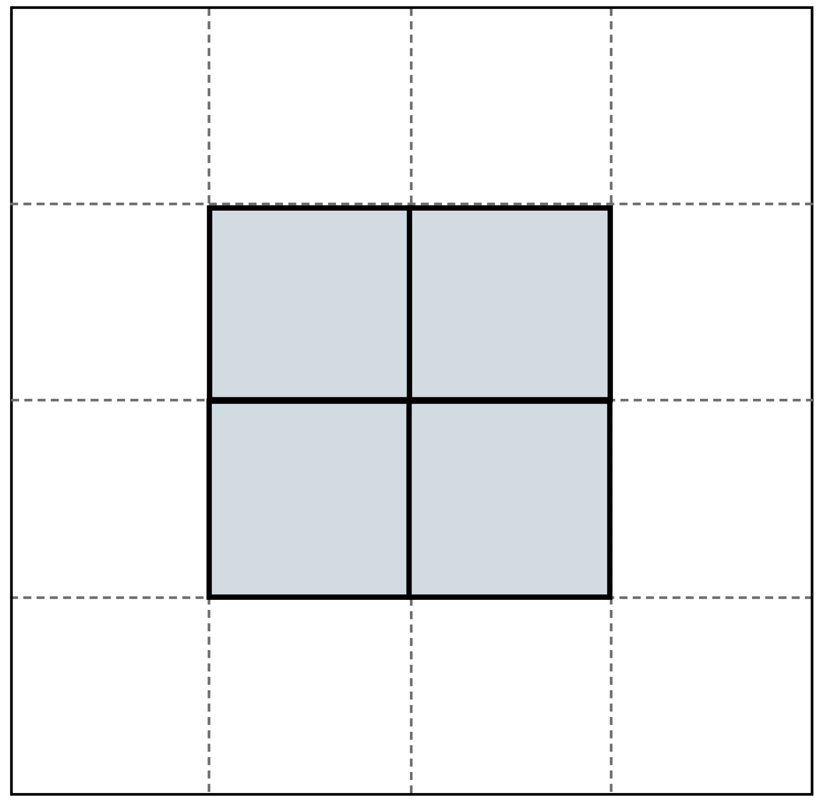
Successful integration of responsive elements necessitates ongoing dialogue with communities to ensure that their needs and preferences are considered. Early incorporation of universal design principles is essential to create truly inclusive spaces. Public spaces serve as vital hubs for social interaction, recreation, and cultural activities, making the impact of kinetic spatial configurations profound. Through the incorporation of adaptable features and thoughtful design principles, kinetic structures play a pivotal role in fostering a more inclusive and equitable society.

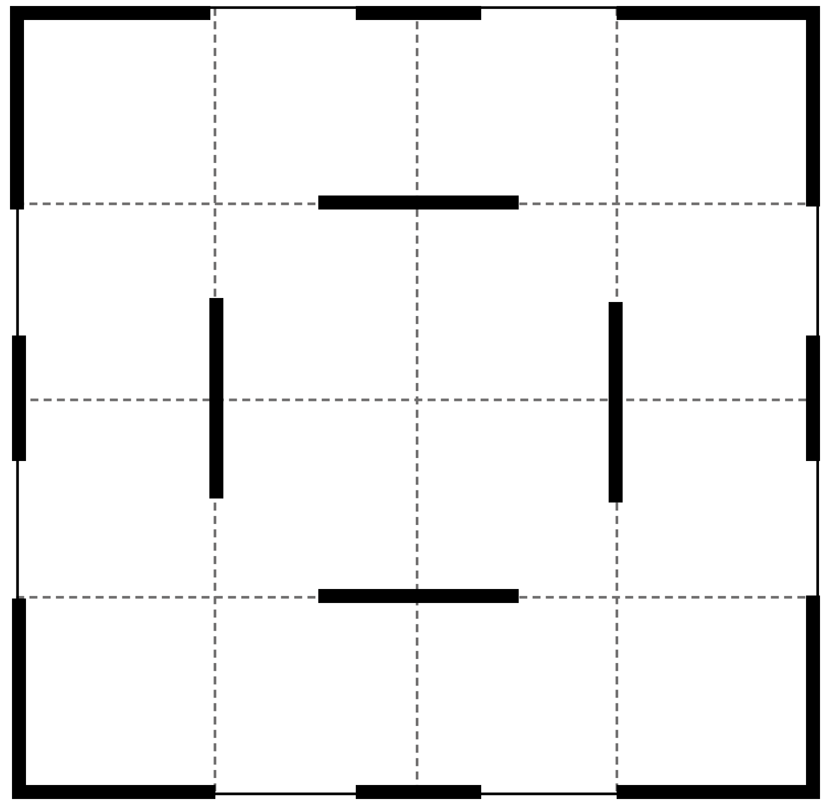
Patch-City Pavilion / ROOI Design and Research. Image © SFAP

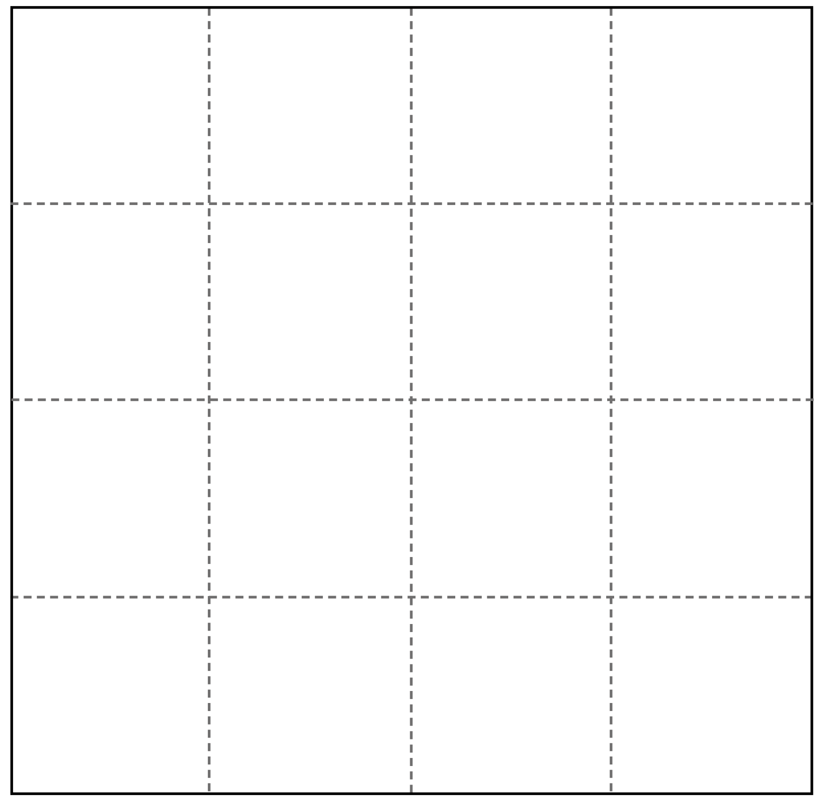
Methods Of Achieving Spatial Flexibiliy











Operational Elements

- The most straightforward approach to spatial flexibility.
- Achieved through operational elements, including doors, sliding or movable partitions, and mobile platforms.
- Flexibility as envisioned and integrated into the design.

Modular System

- Achieved through the interchangeability of units
- Realized through the designer's intentions and modifications by users
- Can accommodate expansions or modifications

Arrangement of Spaces

- Achieved via zoning, condensing functional systems while allowing users freedom in the remaining space.
- Optimizes organization for circulation and interaction while accommodating diverse activities.
- Integrates multipurpose areas or flexible zones for easy reconfiguration.

Personal/ Public Adaptation

- Public adaptation in urban contexts focuses on spatial properties like size, lighting, and material due to its sensitivity, while personal adaptation has a higher tolerance.
- Flexibility achieved through users' adaptation to given conditions.

Erasing Programs

- Achieved through non-hierarchical spaces where no obvious hierarchy exists between rooms.
- Plans are nearly reduced to geometric patterns to accommodate various use scenarios.

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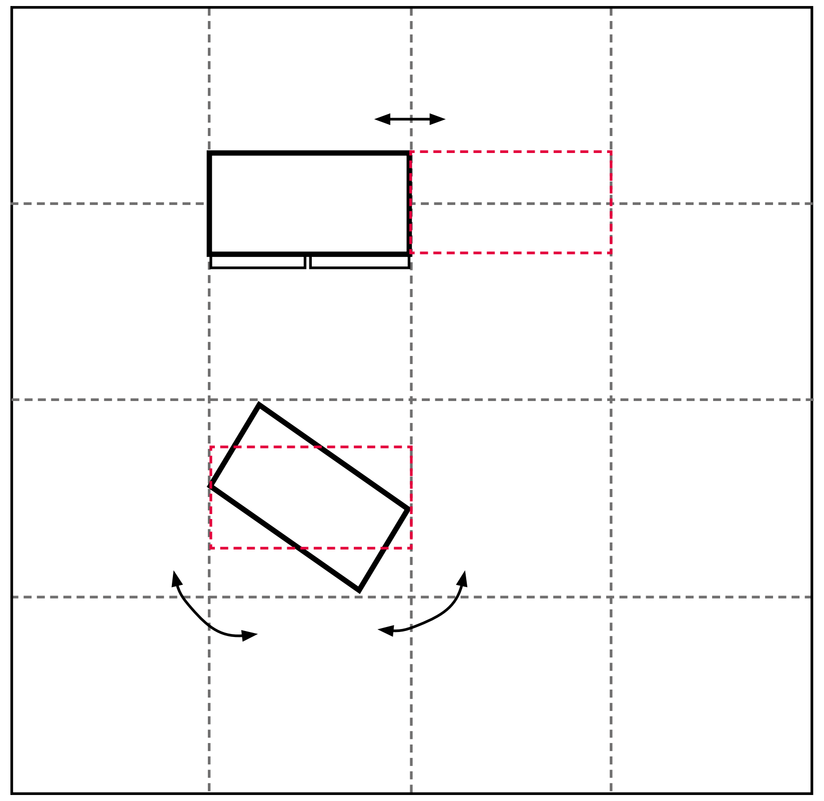

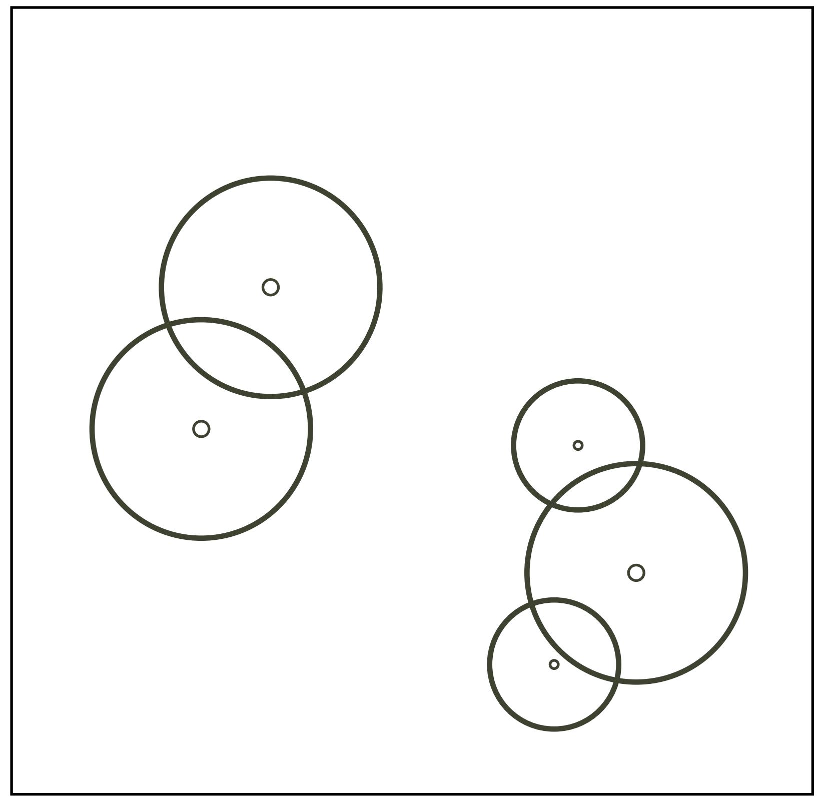

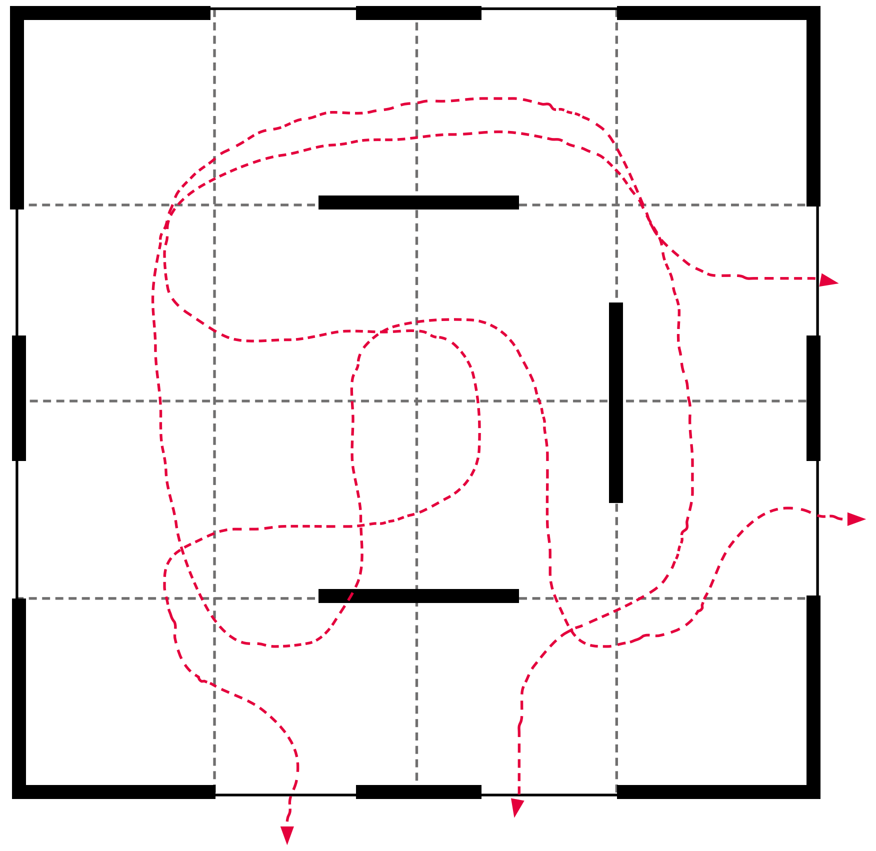

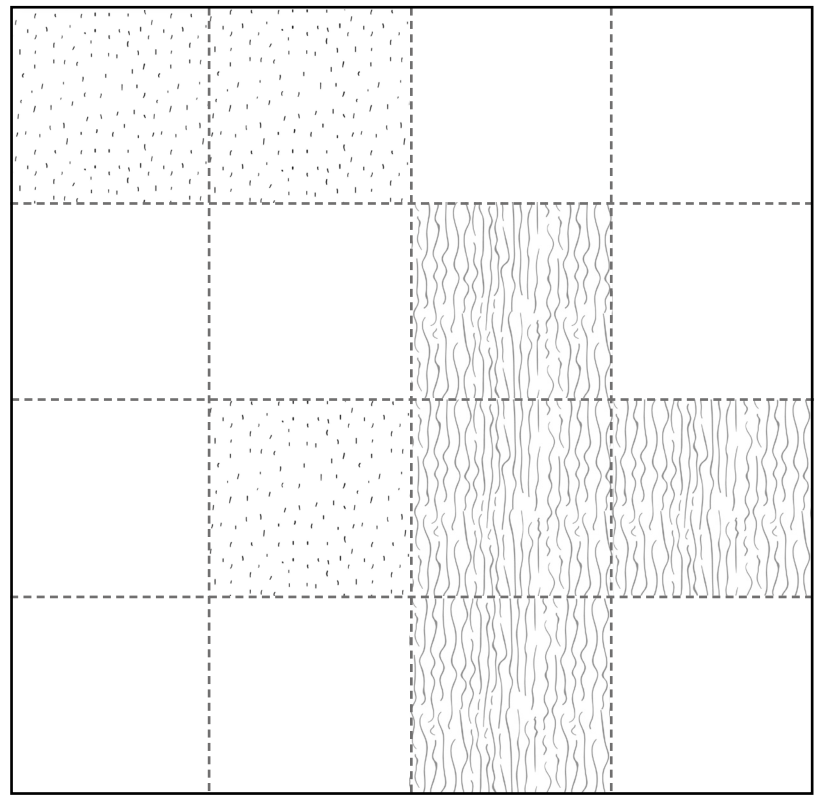

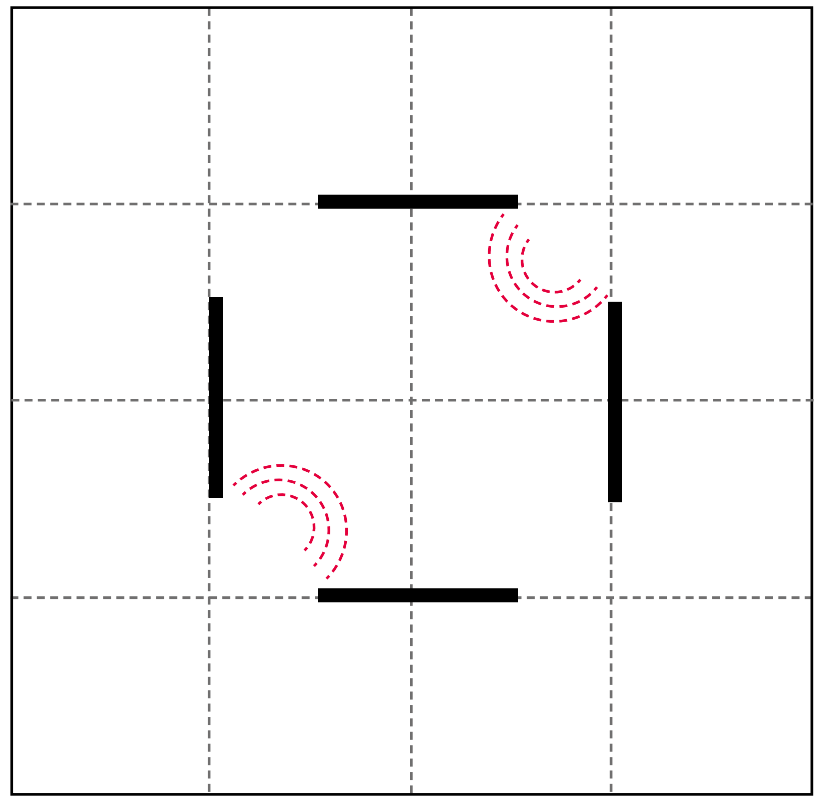

Multi-Functional Furniture and Fixtures

- Selecting furniture and fixtures with adjustable features, convertible designs, or built-in storage solutions to maximize space utilization.
- Integrating multi-functional elements such as fold-down beds, flip-up seating, and collapsible workstations to optimize room flexibility and functionality.

Outdoor Spaces

- Introducing gardens, rooftop terraces, or outdoor seating areas as extensions, providing access to nature and experience environments.
- Incorporating flexible outdoor event spaces or exercise areas that can accommodate wellness programs, group activities, yoga, exercises.

Flexible Circulation Patterns

- Incorporating wide corridors, clear sightlines, and intuitive wayfinding signage to promote efficient flow and adaptability to changing traffic patterns.
- Designing central hubs or flexible nodes within layouts that can serve as gathering spaces, collaboration zones, or alternative circulation routes as needed.

Spatial Modularity

- Designing modular building components, such as pre-fabricated wall panels, ceiling systems, and floor finishes, to facilitate rapid construction, renovation, or expansion.

Use of Technology

- Integrating flexible technology solutions, such as wireless connectivity, mobile workstations, to support seamless communication.

Futher Reading:

- Sensponding architecture: Towards a holistic approach to transformable design
- Transforming Architecture: Engaging the Built Environment
- Flexible: Architecture that Respond to Change
- Space metamorphosis
- Kinetic Architecture: Design for Active Envelopes

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