Neuro- Infotecture

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Syracuse Architecture

Neuro- Infotecture

Rethinking Architectural Design Methodology Influenced by Neuroscience

Topics

Thesis Statement

The project aims to develop a dialectical architectural design guide correlating users' specific neurological experiences with built environment conditions which is integrated with potential neuromorphic mechanisms to enhance architecture performance and user experience.

Project Narrative

The project aims to study the influences of neuroscience on architectural design methodology through constructed researches on neurological experience and neuromorphic architecture.
The study of neurological experience focuses on how the built environment influences human neurological responses with specific spatial conditions. While the study of neuromorphic architecture focuses on the perception- action mechanism which allows the built environment to generate specific actions or effects based on the corresponding perceptions from environment or users.
The information study assists the development of the neuromorphic mechanism by identifying the input, output and the logic of the perception- action cycle.
Based on the above study and researches, a new architectural design methodology is synthesized to integrate neuromorphic mechanism into the user- centric design philosophy to enhance architecture performance as well as optimize user experience.
The resulted architectural design methodology is implemented in a library design project which is expected to catalyze a dynamic human- information interactive relationship.

Thesis AG Connection

The thesis project is expected to contribute to the ***"Imaging Immersion / Immersion Imaging"*** thesis advisory group in the following aspects:

- The thesis project expands the research focuses from specific visual perceptions to all sensory perceptions in general as "Sensory Immersion" for the understanding of architectural experience.
- Instead of the subjective synthetic visual effects which many other projects in the AG are interested in, the thesis project focuses more on the objective causal relationship between perceptions and the resulting effects.

Background

Information

In light of the universal impact of the ongoing Information Revolution, the development of information technology and information study has generated immense potentials for the relationship between human and the built environment as well as architecture operating mechanisms.

General

In the general concept, information refers to any attribute inherent in and communicated by two or more entities that produce specific effects or responses.
The study of the processing of relative information such as perception, storage, retrieval may inspire the design of perception- action cycle that embed within responsive or interactive architecture operating mechanisms.

Special

Diagram 1

Diagram 2

In the special circumstances where information is specifically used for human communications, information can be encoded within various mediums in various forms (image, text, etc) and then stored, transmitted or perceived via typical interfaces.
Corresponding architectural typology keeps developing along with the development of information mediums and interfaces.
As the prerequisite of any information exchange activities, the built environment shares close relationship with the implementation of information medium and interfaces.

Neuroscience

Neuroscience is the scientific study of how the nervous system develops, its structure, and what it does.
Neuroscientists focus on the brain and its impact on behavior and cognitive functions, or how people think.

ANFA

Among the most known efforts for the study of such topics is ANFA, The Academy of Neuroscience for Architecture, which was founded by the San Diego Chapter of AIA. ANFA strives to foster collaboration among neuroscientists and architects to explore, through scientific methods, the range of human experiences with elements of architecture, and ANFA conferences, held biennially at Salk Institute, is one the major ways to disseminate the research findings to emerging professionals, and students.

Two Approaches

Based on the existing research on neuroscience and architecture, especially those from ANFA, two major approaches have been founded to address the topics: neurological experience and neuromorphic architecture which respectively represents human- centric and architecture- centric ideas.

- **Thesis Advisory Group**

  Imaging Immersion/ Immersion Imaging

- **Thesis Instructors**

  Professor. Amber Bartosh
  Professor. Mark Linder

1

ACADEMY OF NEUROSCIENCE FOR ARCHITECTURE
ANFA

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3

Neurological Experiences

Qualitative as well as quantitative relations between neural activities and typical characteristics of the built environment are able to be determined through researches with limited variables and assigned metrics, which becomes valuable instructive during architectural design with expected user- centric experiences.

Diagram 3

Neuromorphic Architecture

Brain functions as a highly parallel, responsive and adaptive system as neuron activities exchange information among sensory organs, brains and effectors.
The operating principles of human neuron system may inspire the development of neuromorphic architecture operating principles based on "Perception- Action and Cycle" that enhances performance, adaptability, flexibility and user experience.

Discipline Comparison

The interdisciplinary study of architectural design and neuroscience has demonstrated systematic similarities and contrasts.

Architecture

Architectural design is a multi-variant process bringing integrated ideas to solve design problems.

"whole-part-whole"

Science

Conduct experiment that is repeatable, has assigned metrics, which too many variables are problematic.
A series of smaller, subsidiary experiments add up to a larger whole:

"part+part+part= whole"

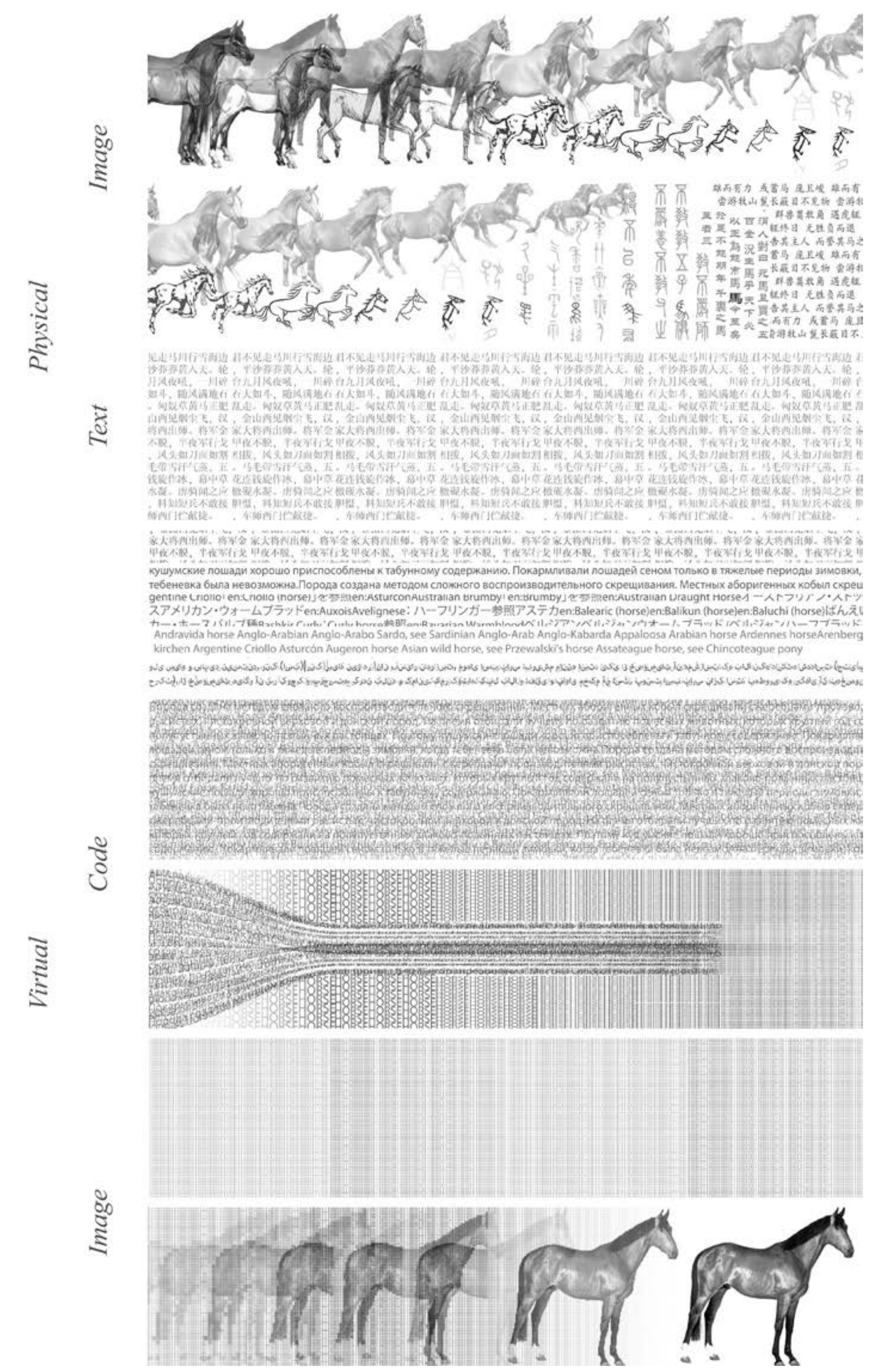

Diagram 1

Text is derived from image to explain and appropriate the world, after extracting and abstracting information from image, text is becoming more and more self- explanatory and becomes an isolated system. The further abstraction of information leads to the birth of codes which then are used to generate images again.

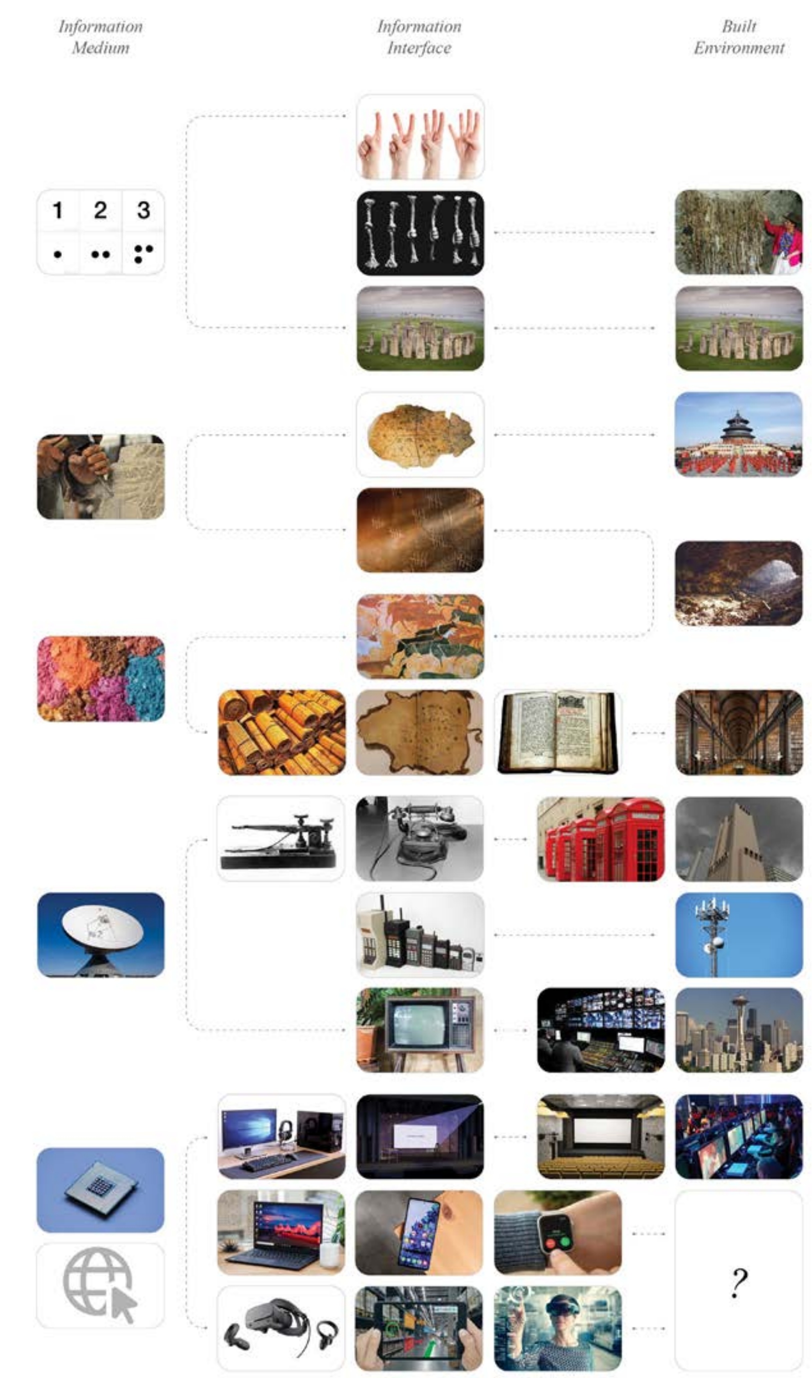

Diagram 2

The evolution of information medium and interface comes with the adaptations of built environment as the information processing (storage, transmission, retrieval) device.

Neurological Experience

(Human- Centric)

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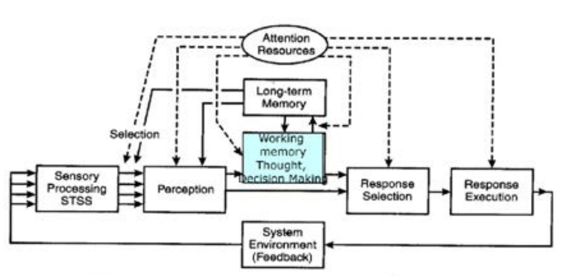

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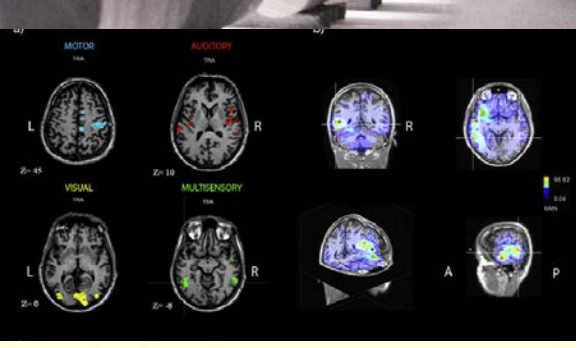
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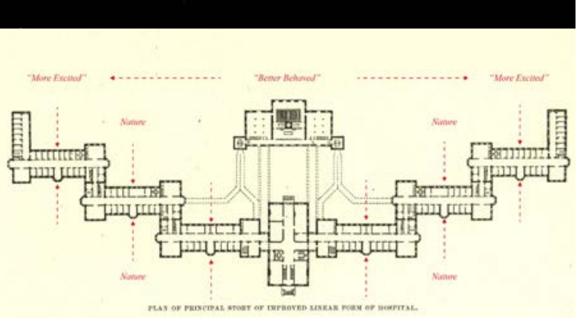
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What

Definition

The study of neurological experience focuses on how the built environment influences human psychological, physiological or cognitive responses through various human senses during various human activities.

Human Senses

Major: Visual / Eye Auditory / Ear Somatosensory / Hand (Skin)

Minor: Gustatory/ Tongue Olfactory / Nose

Neurological Response

Diagram 4

Psychological

Psychological responses within a given built environment refer to the change of mental or emotional state triggered by particular physical properties of the built environment.
Specific psychological responses may include stress, fatigue or anxiety reduction, emotional stimulation such as excitement, etc.

Physiological

Physiological responses within a given built environment refer to the autonomic or involuntary bodily changes triggered by particular environmental conditions.
The possible psychological responses may occur within human respiratory, aural, musculoskeletal, circadian systems and may impact the overall physical comfort.
Specific psychological responses may include changes in heart rate, respiration, perspiration, and certain hormone levels.

Cognitive

Cognitive responses within a given built environment refer to the performance of information processing during all manners of human activities.
Specific cognitive processes may include perception, memory, reasoning, judging and language.

Why

Neurological Fundamental

All subjective "experiences" find their roots at neurological fundamentals: the perceptions of the signals from the external environment via sensory organs lead to internal bio-chemical reactions, which will produce specific neurological signals that received by brains. The excitations or inhibitions of specific areas of the brain by such signals produce the "experience".

Sensory Immersion

Diagram 5

Phenomenology (Architectural)

Different from the precision, delicacy and schema from an architectural drawing, the quality of architectural-spatial experience is a simultaneous, synthetic, comprehensive and subjective combination of the overall sensory perceptions, emotions, phenomena, atmosphere or ambiance which many architects and theorists regards as "phenomenology".

Multi-sensory Integration (Neurological)

Multi-sensory integration, also known as multimodal integration, is the study of how information from the different sensory modalities (such as sight, sound, touch, smell, self-motion, and taste) may be integrated by the nervous system. A coherent representation of objects combining modalities enables animals to have meaningful perceptual experiences.

How

1

Precedents (Historical)

The "Kirkbride Plan", 19 C.

Based on the past experiences architects gradually started to try to use the built environment to strategically influence human neurological responses, and the "Kirkbride Plan" advocated by psychiatrist Thomas Kirkbride for mental hospitals in the 19th century was one of the first attempts, where natural light, air circulation and connection to nature become crucial components for the recovery of patients from mental illness. 2

3

The Kirkbride Plan tended to be flat and large institutional buildings, with the symbolic staggered narrow wings extending outward from the center. The flat building massing increases the contacting surface with nature and therefore enhances the access of natural 4
view, lighting and ventilation conditions. 5

Additionally, the more "excited" patients are placed on the lower floors, farthest from the central administrative structure, and the better-behaved, more rational patients are situated in the upper floors and closer to the administrative center for more comfortable and productive experiences.

Some mental hospitals that adopted the "Kirkbride Plan" include:

Trenton Psychiatric Hospital, Trenton, NJ, 1848

St. Elizabeths Hospital, Washington, DC, 1855

Evidence-based Design

Diagram 6

Evidence-based design (EBD) is the process of constructing a building or physical environment based on scientific research to achieve the best possible outcomes.
Evidence-based design is especially important in evidence-based medicine, where research has shown that environment design can affect patient outcomes.


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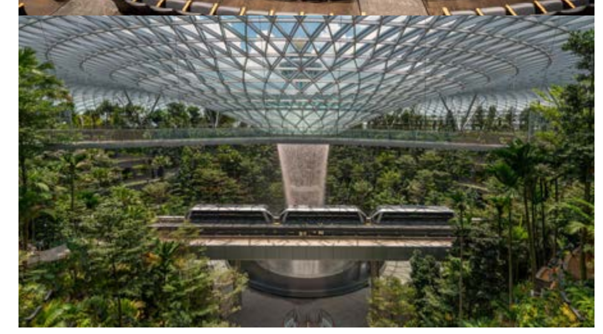
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Factors (Visual)

Evolutionary Psychology

The study of evolutionary psychology focuses on the typical spatial condition, as the products of natural selection 6 7
favored by our ancestors for survival and reproduction.

- *Prospect*
- *Refuge* 8
- *Mystery*
- *Hazard*

Proxemics

The study of Proxemics focuses on use of space and the effects that population density has on behavior, communication, and social interaction. 9

- *Physical Proximity*
- *Sociofugal/ Sociopedal Space*

Biophilic Impact

The study of biophilic impact focuses on how to use humans' inherent predisposition for natural and organic elements for the design purposes.

- *Connection with Nature*
- *Natural Light / Dynamic Light*
- *Natural Material*
- *Biomorphic Forms*

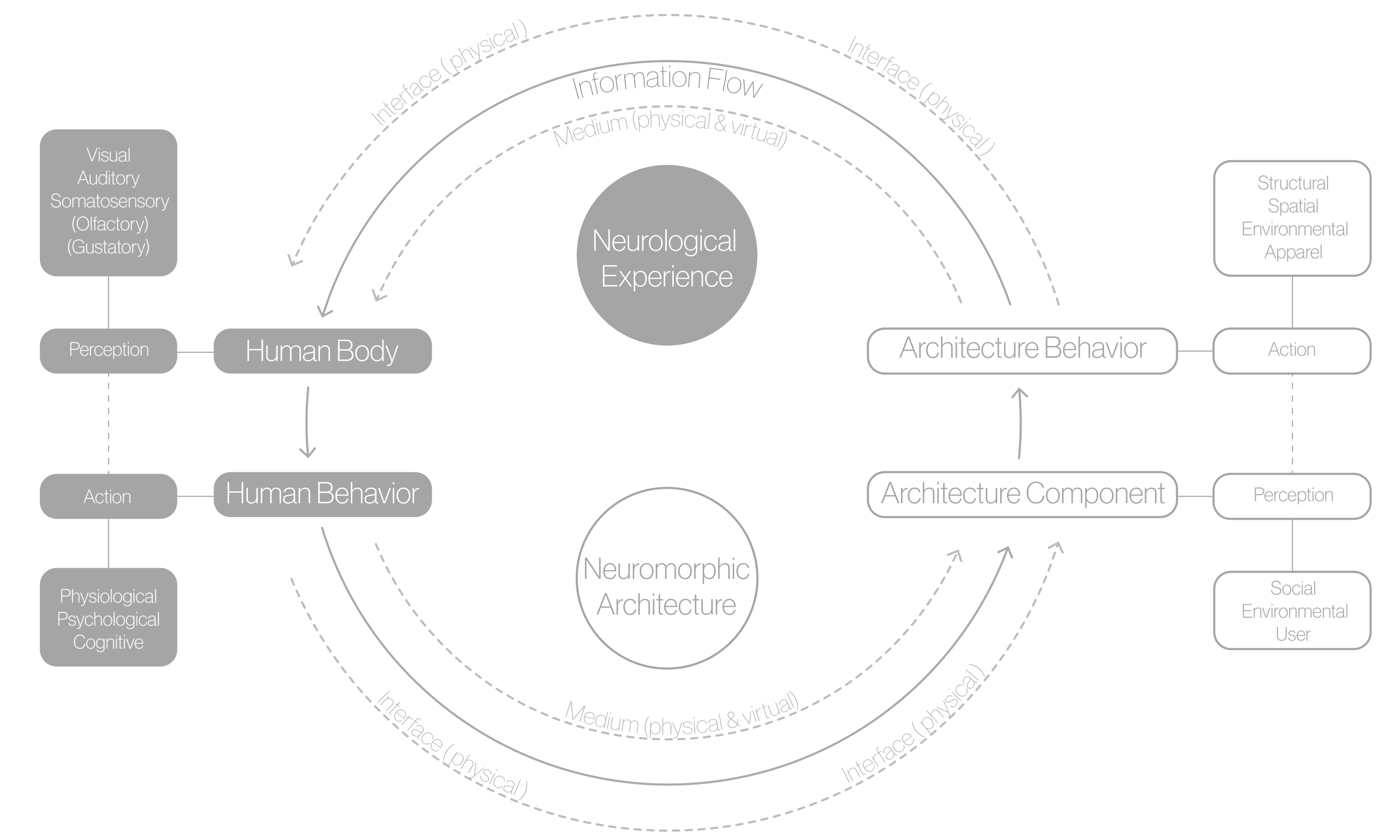

Diagram 3

The study of neurological experience and neuromorphic architecture demonstrates human- centric and architecture- centric design ideas. Both tracks of study share reciprocal relationships regarding information flows and "perception - action cycle"

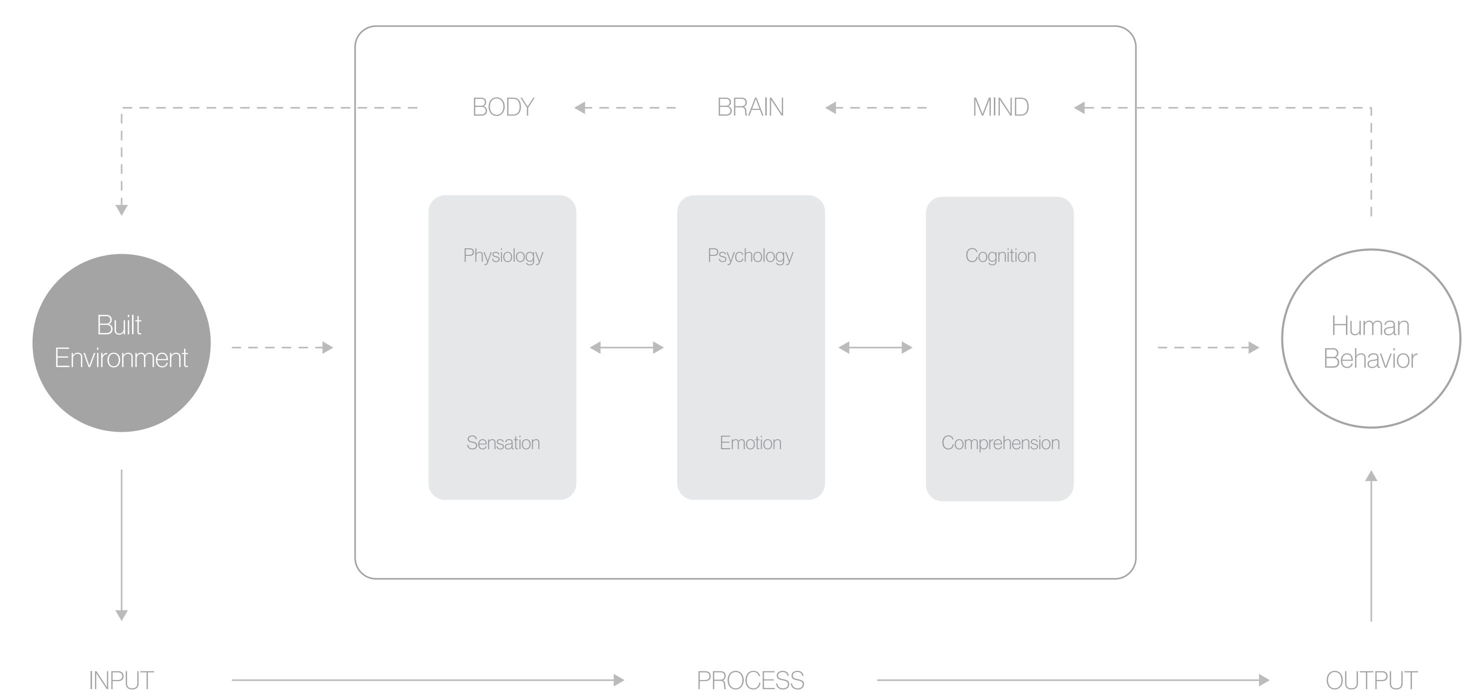

Diagram 4

All three types of neurological responses (psychological, physiological and cognitive) construct the bridge between the build environment and human behaviors.

Neuromorphic Architecture

(Architecture- Centric)

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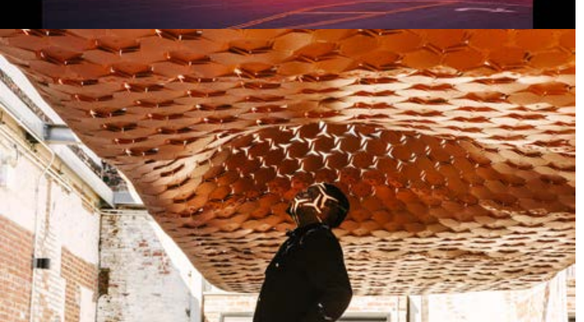

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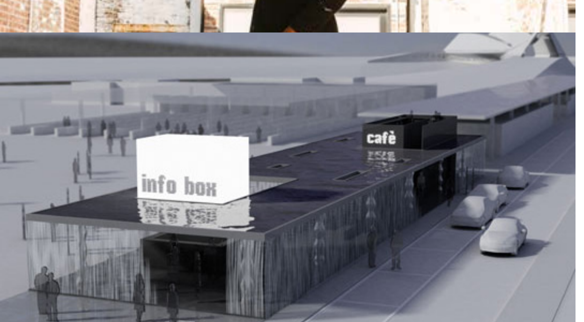

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What

Definition — The study of neuromorphic architecture focuses on mechanism which allows the built environment to transform and respond to changing natural situations, social situations or user demands.

Nervous System

Micro- scale — Each neuron receives input signals and transmits output signals from other neurons through neuron fibers (dendrites and axons). One neuron connects to adjacent neurons or effector cells by synapse, the gap where the signals are transmitted.

Macro- scale — Human nervous system allows the input signals from sensory organs or human brains to transmit to and excite the effector cells that generates specific actions and responses.

Perception Action Cycle — The analogy between neuron and architecture lies in the Action- Perception Cycle which occurs between the organism and environment during the course of a sensory-guided sequence of behavior towards a goal.
The Perception-Action cycle is composed of continuous flow of information and action between the brain and the world around it in a repeatable manner: sense, predict, act, (adjust).

Possible Perceptions — Natural Environmental Condition; Number of Participants; Privacy/ Publicity; Entertainment/ Productivity

Possible Actions — Spatial Component; Environmental Device; Structural Component

Why

Performance (Architecture) — The neuromorphic mechanism enhances architecture performance and minimizes energy consumption by adjusting supplies catering to specific necessities

Aesthetics (Architecture) — The neuromorphic mechanism allows architecture to generate variable sensory stimulations for aesthetics.

Flexibility (User) — Compared to the more traditional static human-architecture relationship, the neuromorphic architecture generates more programmatic flexibilities which maximizes the spatial usability.

Engagement (User) — The neuromorphic mechanism provides users the possibility to customize the built environment according to personal psychological, physiological or cognitive necessities.

How

The prescribed — The model of the prescribed mechanism works like a film. It is a particular kind of preconceived story, performance, or program unfolding over time.

Precedents

Facade — *Bund Finance Center, Heatherwick Studio / Foster & Partners, Shanghai, China* 1

Lighting — *Barnards Farm Sitooterie, Heatherwick Studio, Brentwood, UK* 2

Lighting — *Beijing National Aquatics Center, PTW Architects, Beijing, China* 3

The responsive — Responsive mechanism means that the architecture responds to its environment by perceiving information from its general environment and responds to it without people's active participation. This passive response allows for no direct interactivity or intelligence input.

Precedents

Environmental — *Media-ICT, Cloud 9, Barcelona, Spain* 4

Blur Building, Diller & Scofidio, Lake Neuchâte, Switzerland 5

Spatial — *The Shed, Diller & Scofidio, NYC, NY* 6

The interactive — Interactivity refers to the mechanism that people are able to input information to certain architectural components that accordingly produce expected/ unexpected output architectural behavior.

Precedents

Enteractive, Electroland, LA, CA 7

Urban Imprint, Studio INI, Installation 8

Digital Water Pavilion, MIT Senseable City Lab, Zaragoza World Expo, Spain 9

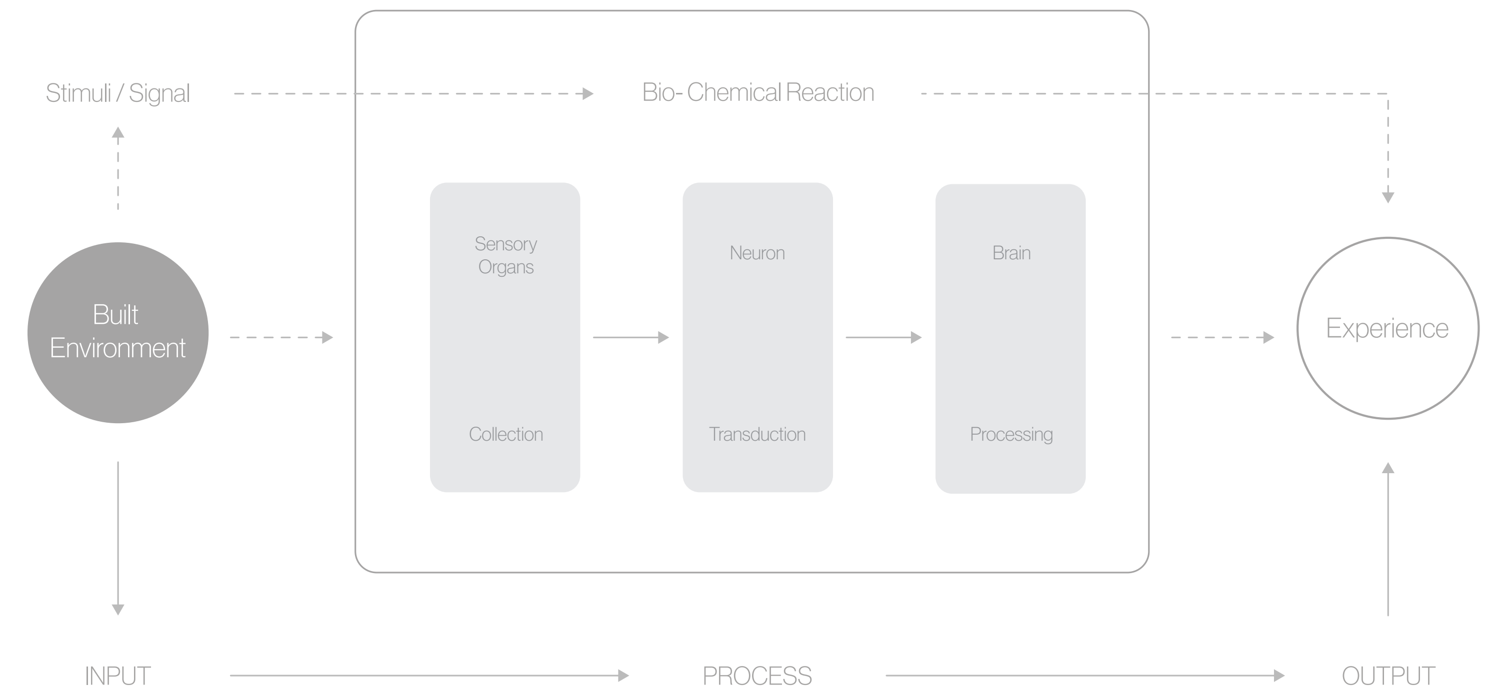


Diagram 5

The "experience" is formed by the perceived information from the built via sensory organs which is then integrated with existing knowledge in the brain.

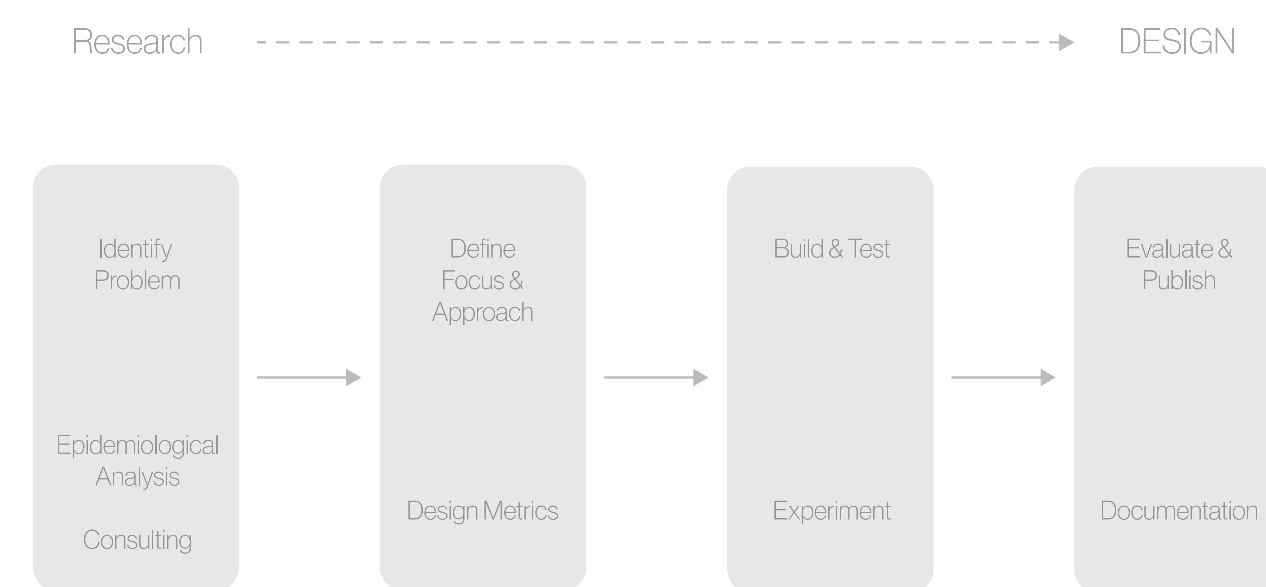


Diagram 6

The rise of interdisciplinary research- design methodologies such as Evidence Based Design has provided architects with systematic approaches to use built environment to influence human neurological experiences.

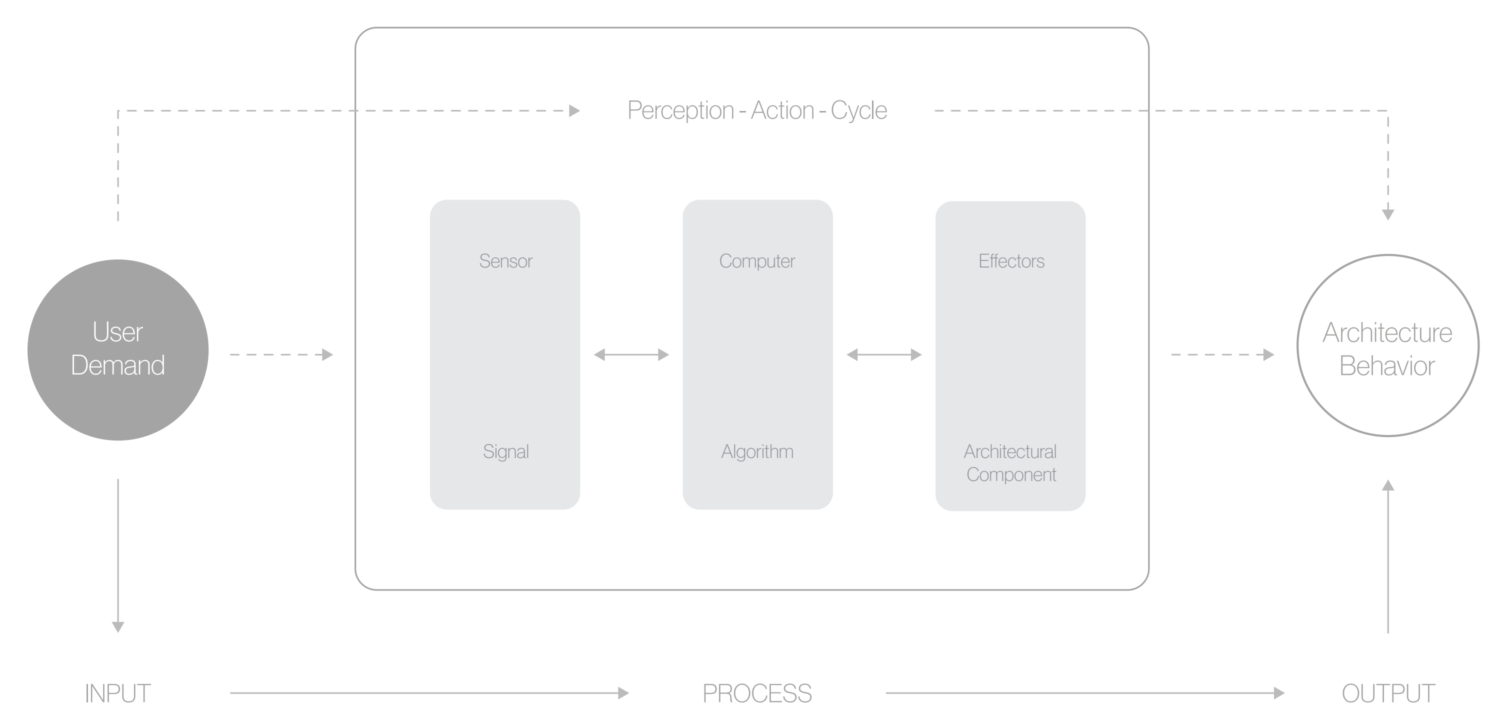


Diagram 7

The Perception-Action cycle construct an opposite flow of information between humans and architecture: user demand as the input information for expected or unexpected architectural behavior.

Research References/ Annotated Bibliography

		FACTOR	PHYSIOLOGICAL	COGNITIVE	PSYCHOLOGICAL
Visual	Evolutionary Psychology	*Prospect*	**Reduced stress** (Grahn & Stigsdotter, 2010)	**Reduced boredom, irritation, fatigue** (Clearwater & Coss, 1991)	**Isovist analysis captures properties of space relevant for locomotion and experience** (Jan M Wiener, Gerald Franz, Nicole Rossmanith, Andreas Reichelt, Hanspeter A Mallot, Heinrich H Bulthoff, 2007)
Visual	Evolutionary Psychology	*Refuge*		**Improved concentration, attention and perception of safety** (Grahn & Stigsdotter, 2010; Wang & Taylor, 2006; Wang & Taylor, 2006; Petherick, 2000; Ulrich et al., 1993)	
Visual	Evolutionary Psychology	*Mystery*			**Induced strong pleasure response** (Biederman, 2011; Salimpoor, Benovoy, Larcher et al., 2011; Ikemi, 2005; Blood & Zatorre, 2001)
Visual	Evolutionary Psychology	*Hazard*			**Resulted in strong dopamine or pleasure responses** (Kohno et al., 2013; Wang & Tsien, 2011; Zald et al., 2008)
Visual	Biophilic Impact	*Nature Connection*	**Lowered blood pressure and heart rate** (Brown, Barton & Gladwell, 2013; van den Berg, Hartig, & Staats, 2007; Tsunetsugu & Miyazaki, 2005)	**Improved mental engagement/ attentiveness** (Brown, Barton & Gladwell, 2013; van den Berg, Hartig, & Staats, 2007; Tsunetsugu & Miyazaki, 2005)	**Positively impacted attitude and overall happiness** (Barton & Pretty, 2010)
Visual	Biophilic Impact	*Peripheral Stimulation*	**Positively impacted on heart rate, systolic blood pressure and sympathetic nervous system activity** (Li, 2009; Park et al, 2008; Kahn et al., 2008; Beauchamp, et al., 2003; Ulrich et al., 1991)	**Observed and quantified behavioral measures of attention and exploration** (Windhager et al., 2011)	
Visual	Biophilic Impact	*Natural Light / Dynamic Light*	**Positively impacted circadian system functioning** (Figueiro, Brons, Plitnick et al., 2011; Beckett & Roden, 2009) **Increased visual comfort** (Elyezadi, 2012; Kim & Kim, 2007)	**Positive influence on intellectual performance** (Santiago Porras Álvarez, 2020)	
Visual	Biophilic Impact	*Natural Material*		**Decreased diastolic blood pressure** (Tsunetsugu, Miyazaki & Sato, 2007) **Improved creative performance** (Lichtenfeld et al., 2012)	**Improved comfort** (Tsunetsugu, Miyazaki & Sato 2007)
Visual	Biophilic Impact	*Biomorphic Forms*			**Observed view preference** (Vessel, 2012; Joye, 2007) **Observed view preference** Salingaros, 2012; Hägerhäll, Laike, Taylor et al., 2008; Hägerhäll, Purcella, & Taylor, 2004; Taylor, 2006)
Visual	Spatial Proximity	*Physical Proximity*		**Improved creative performance** (Kyungjoon Lee, John S. Brownstein, Richard G. Mills, Isaac S. Kohane)	**Personal space; the behavioral basis of design.** (Englewood Cliffs, N.J., Prentice-Hall 1969)
Visual	Spatial Proximity	*Sociofugal/ Sociopedal Space*		**Critical impact on various personalities** (Sommer, Robert 1967)	
Somatosensory		*Thermal Comfort & Ventilation*	**Positively impacted comfort, well-being and productivity** (Heerwagen, 2006; Tham & Willem, 2005; Wigö, 2005)	**Positively impacted concentration** (Hartig et al., 2003; Hartig et al., 1991; R. Kaplan & Kaplan, 1989)	**Improved perception of temporal and spatial pleasure (alliesthesia)** (Parkinson, de Dear & Candido, 2012; Zhang, Arens, Huizenga & Han, 2010; Arens, Zhang & Huizenga, 2006; Zhang, 2003; de Dear & Brager, 2002; Heschong, 1979)
Auditory		*Sound*	**Positively impacted comfort, well-being and productivity** (Heerwagen, 2006; Tham & Willem, 2005; Wigö, 2005)		

Prospect (a)

Evolutionary Psychology

Definition

Oxford Noun.
- The possibility or likelihood of some future event occurring.
- A mental picture of a future or anticipated event.
- An extensive view of landscape.

Architecture
- An unobstructed view over the physical environment for certain distance.
- Relatively large isovist from certain view points within physical environment.

Neurological Experience

Description

The spatial experience with favorable "Prospect" property generates feelings of openness, freedom, safety and control, especially for participant within unfamiliar environments.

Literature

The "Prospect" factor incorporates research from various fields such as evolutionary psychology, environmental psychology and spatial ecology.

The expected cognition and health benefits by the "prospect" factor include reductions in stress, fatigue and boredom and enhancements of feeling of safety, cognitive performance and visual comfort.

The propose of the theory of "prospect and refuge" explains why certain environments conditions are preferable by humans, which meets the basic human psychological needs of secure[1].
Visual preferences, including aesthetic preferences, may also find their roots in evolutionary psychology. The presence of water or plant may indicate the availability of resources in the given habitat [2].
A similar environmental psychology theory, Savanna Hypothesis, argues that humans prefer habitats that are similar to the primitive conditions such as African savannas. Both predators and preys in the savanna, for example, prefer to stay on trees or high lands, which provides them with the ability to monitor the surroundings for potential danger or food sources. Such condition is also expected to be genetically predisposed by humans where large isovist areas generates sense of control over the surrounding environment[3].

Design Methodology

Abstract

The general objective during the design process is to provide participants with visual anticipations for potential opportunity and hazard within physical environment.

The most common method of achieving prospect is to provide an elevated viewing position which is suitable for all design conditions. Other design methods may include the creating isovist area across multiple spaces, especially when clear distinctions are presented. (Hildebrand, 1991).

Execution

1. Provide single isovist with focal lengths of ≥20 feet, preferably 100 feet [4].
2. Remove opaque visual partitions or limit the heights below average human eye height according to different conditions (standing/ sitting).
3. Use transparent or translucent material for visual partitions.
4. Strategically arrange circulation space (corridor, doors, stairs) to form visual connections between interior and exterior space and among various related programs.
5. Form critical relationship between "prospect" and "refuge".
6. Created elevated platforms within height ceiling interior spaces or exterior spaces.

Neuromorphic Design Speculation

Specific neuromorphic interactive networks can be formed between user activity requirements and height of visual partitions, transparency of the material of partitions, floor height and ceiling height of determined space to enhance the prospect property of the pace.

Reference

1. Appleton, Jay. The Experience of Landscape. Chichester: John Wiley and Sons, 1996.

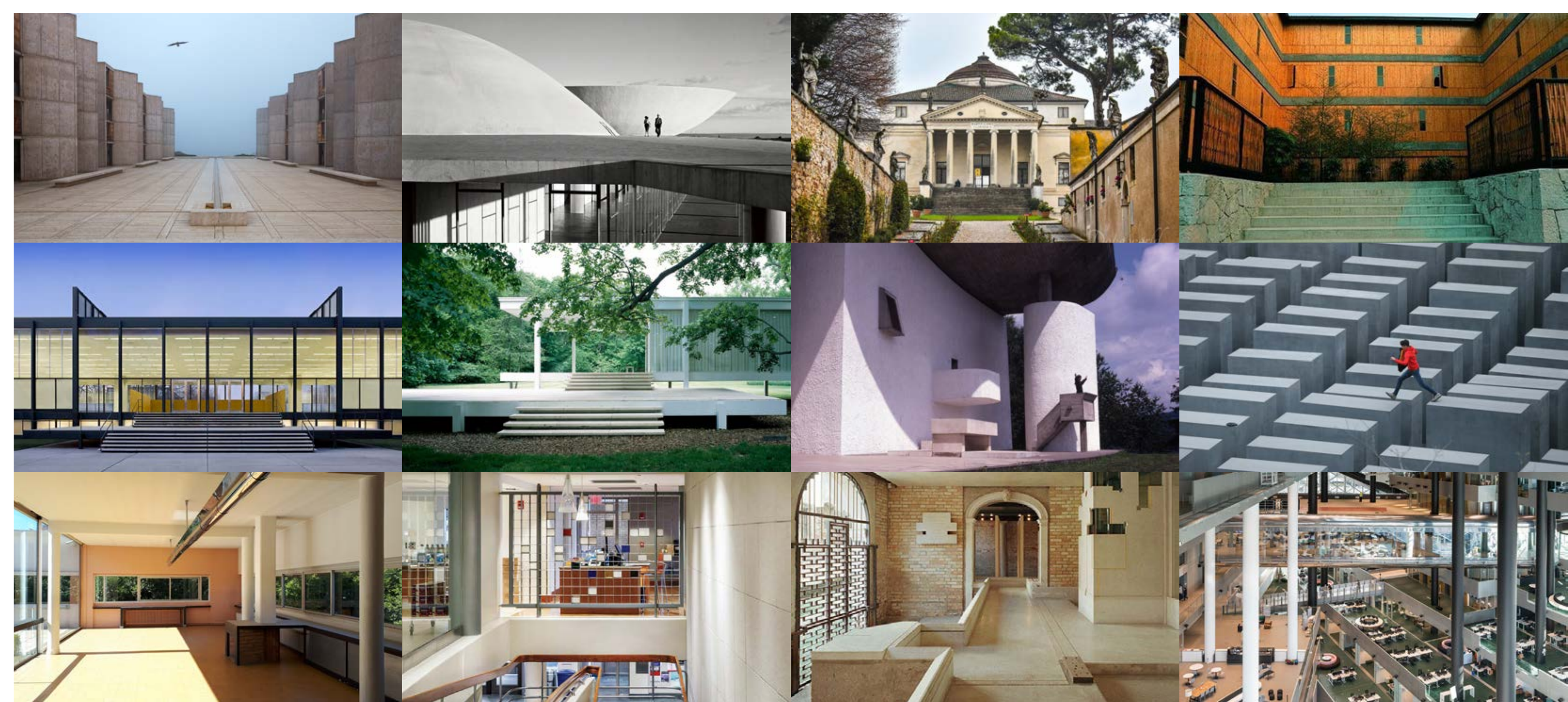
2, Mithen, Steven. "The Adapted Mind: Evolutionary Psychology and the Generation of Culture. Jerome H. Barkow , Leda Cosmides , John Tooby." Journal of Anthropological Research 53, no. 1 (1997): 100–102. https://doi.org/10.1086/jar.53.1.3631124.

3. Kellert, Stephen R., Edward O. Wilson, and G. H. Orians. "Humans, Habitats, and Aesthetics." Essay. In The Biophilia Hypothesis. Washington, D.C.: Island Press, 1993.

4. Herzog, Thomas R., and Anna G. Bryce. "Mystery and Preference in Within-Forest Settings." Environment and Behavior 39, no.

1	2	3	4
5	6	7	8
9	10	11	12

1. Salk Institute, Louis Kahn
2. Brasilia Government Complex, Lúcio Costa & Oscar Niemeyer
3. Villa Rotonda, Andrea Palladio
4. China Academy of Art, Wang Shu
5. Crown Hall, Mies van der Rhoe
6. Farnsworth House, Mies van der Rhoe
7. Ronchamp Chapel, Le Corbusier
8. Holocaust Memorial, Peter Eisenman
9. Villa Savoye, Le Corbusier
10. Harkness Commons, Harvard University, Walter Gropius
11. Querini Stampalia Palace, Carlo Scarpa
12. Axel Springer Campus, OMA



Refuge (b)

Evolutionary Psychology

Definition

Oxford Noun.
- Something providing shelter.
- An institution providing safe accommodations for women who have suffered violence from a spouse or partner.

Architecture
- Visual or physical withdrawal from dominant environmental condition by the implementations of spatial partitions.

Neurological Experience

Description

The spatial experience with favorable "Refuge" property yields feelings of safety, protection, relaxation, separation and detachment from the mainstream activity.

Neurological Explanation

The "Refuge" factor incorporates research from various fields such as evolutionary psychology, environmental psychology and its relationship with "Prospect" factors.

Refuge factor serves an important role in stress and fatigue reduction, cognition and concentration enhancement and emotional protection.

Within a primitive habitat, the factor of prospect and refuge usually come in pairs for the survival of both preys and predators when the potential to explore (prospect) and the ability to hide (refuge) can be provided simultaneously[1]. The benefits of refuge can be explained both physiologically and psychologically. The trees in the savanna not only provides animals with thermal/ lighting comfort but also provides them with ability to hide from predators or preys[2].
During the condition where both prospect and refuge are present, the overall neurological response to the latter will be enhanced[3].
The effect of refuge factor does not solely rely on the size of the refuge area but rather the immersiveness of the refuge area[4]. For instance, to achieve the best restorative impact of the city parks, the strategic placement of the plants next to open space matters more than the pure size or the quantity of the parks[5,6].

Reference

1, 6. Appleton, Jay. The Experience of Landscape. Chichester: John Wiley and Sons, 1996.

2. Kellert, Stephen R., Edward O. Wilson, and G. H. Orians. "Humans, Habitats, and Aesthetics." Essay. In The Biophilia Hypothesis. Washington, D.C.: Island Press, 1993.

3. Grahn, Patrik, and Ulrika K. Stigsdotter. "The Relation between Perceived Sensory Dimensions of Urban Green Space and Stress Restoration." Landscape and Urban Planning 94, no. 3-4 (2010): 264–75. https://doi.org/10.1016/j.landurbplan.2009.10.012.

4. Nordh, H., T. Hartig, C.M. Hagerhall, and G. Fry. "Components of Small Urban Parks That Predict the Possibility for Restoration." Urban Forestry & Urban Greening 8, no. 4 (2009): 225–35. https://doi.org/10.1016/j.ufug.2009.06.003.

5. Ruddell, Edward J., and William E. Hammitt. "Prospect Refuge Theory: A Psychological Orientation for Edge Effect in Recreation Environments." Journal of Leisure Research 19, no. 4 (1987): 249–60. https://doi.org/10.1080/00222216.1987.11969696..

Design Methodology

Abstract

The objectives of the Refuge factor can be analyzed in two scales. From a larger, environmental scale, the refuge factor requires protective space that is both easily accessible and spatially separated from the dominant environment. From the personal scale, however, refuge factor requires physical protections of the visual blind area for human body, that is, usually one's back, side and overhead.

Execution

1. Use suspended horizontal partitions such as drop ceilings to constrain ceiling height.
2. Create indentations or sunken floors from the major floor level.
3. Use mezzanine within high ceiling interior space or exterior space to divide space.
4. Arrange subsidiary small scale side spaces such as "alcoves" along the dominant space or circulation.
5. Adopt different and usually less intrusive and less obvious lighting condition in the refuge areas.
6. Create visual partitions within the rather larger and open space.

Neuromorphic Design Speculation

Specific neuromorphic interactive networks can be formed between user activity requirements and height of visual partitions, transparency of the material of partitions, floor height and ceiling height of determined space to enhance the refuge property of the pace.

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5	6	7	8
9	10	11	12

1. Bologna Street Side Loggia
2. Interactive Bus Stop in Sweden, Rombout Frieling Lab
3. Telephone Booth in U.K.
4. Homeless in NYC
5. Newhouse I (entrance), I.M. Pei
6. Substitute Bench Area at a Soccer Stadium
7. Central Pavilion, Carlo Scarpa
8. Holocaust Memorial, Peter Eisenman
9. Miller House, Eero Sarrinen
10. Fashion Show Stage and Audience
11. Amsterdam Orphanage, Aldo van Eyck
12. Syracuse University Bird Library Study Pods

Mystery (c)

Evolutionary Psychology

Definition

Oxford Noun.
- Something that is difficult or impossible to understand or explain.
- The condition or quality of being secret, strange, or difficult to explain.

Architecture
- Use ambiguous or partially obscured visual elements, abstract symbols or sounds to provoke the desire of exploration or imagination of the environment.

Neurological Experience

Description

The spatial experience with favorable "Mystery" condition produces feelings of enticement, invitation, excitement, uncertainty and sometimes also feelings of rejection and danger, which encourage further investigation of the environment of the participants.

Neurological Explanation

People usually have two basic needs for newly perceived environments: to understand and to explore[1]. And such psychological needs usually involve a series of transitions of personal status[2].

The sense of mystery is generated during the process of exploration and from the contrast of the result of exploration and the anticipation beforehand. The neurological responses benefited from the sense of mystery include improved preference of the space and enhancement of pleasure.

The engender of sense of mystery usually comes with the change of depth of visual field which allows for visitors' imagination; therefore, a medium to large depth of field is more preferable compared to a small one[3]. Furthermore, the strategic obstruction or reveal of certain element along the depth of visual field may also trigger people's curiosity and desire to explore[4].

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Design Methodology

Abstract

Design methods to generate Mystery involves two major aspects: motion and static. The first category of design methods requires either a specific spatial sequence with explicit or implicit visual cues at transitions or a non- hierarchical space that intend to puzzle the participants. This type of design methods aims to invite participants to physically explore the built environment with or without specific goals. The other design type of design methods use single, static visual elements such as abstract graphics, dazzling forms and religion- related symbols to trigger participants imaginations.

Execution

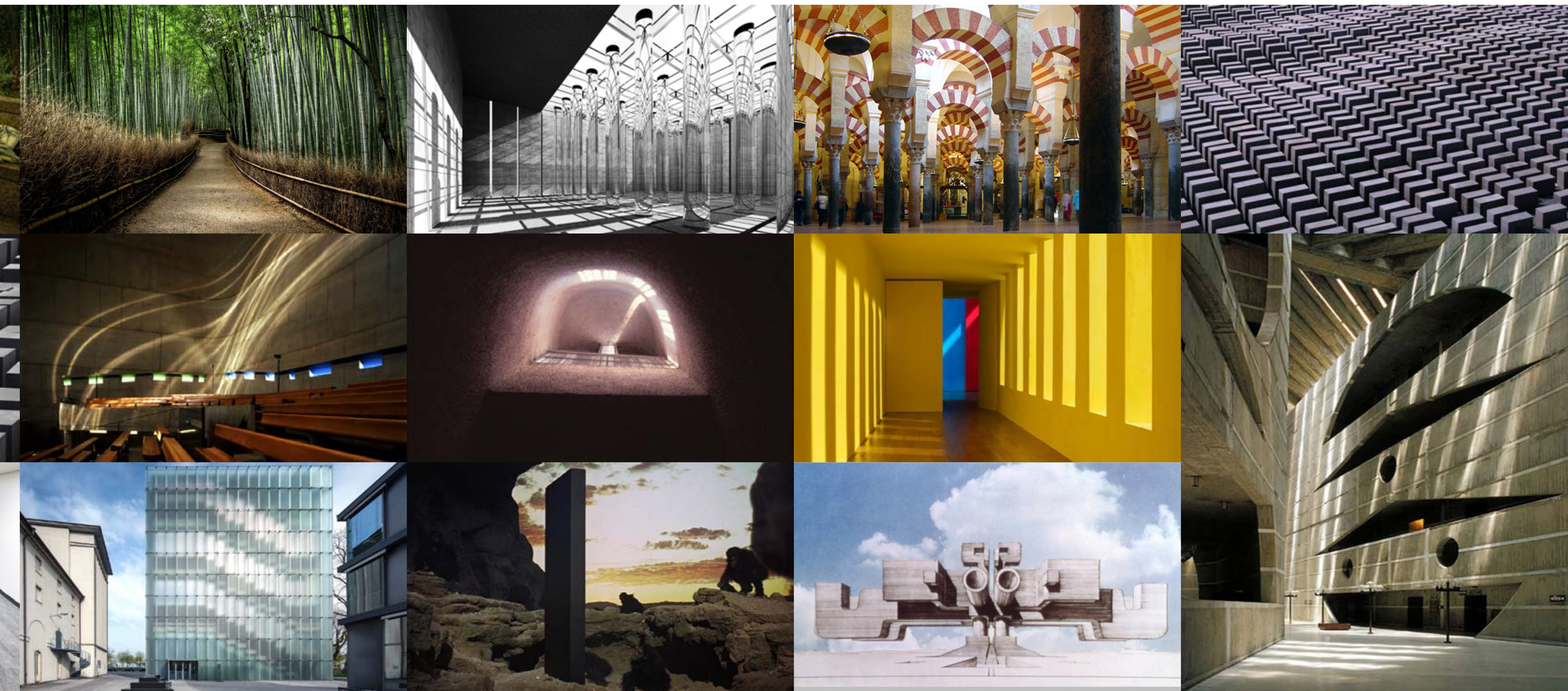
1. Adopt curves instead of edges to invite people for further exploration of the space.
2. Strategically arrange the visual cues for various spaces to draw participants to follow the specific circulation.
3. Alter lightings & shadows to shorten visual depth within a space.
4. Use repetitive elements as peripheral objects to obscure major circulation.
5. Use repetitive elements to confuse participants' orientation.
6. Implement reflective material to generate reflections within the environment.
7. Cultural or religious symbols are able to foster sense of mystery.
8. Simple and abstract forms usually trigger participants imaginations and interests.
9. Use sound to draw attentions and interests from participants.

Neuromorphic Design Speculation

Specific neuromorphic interactive networks can be formed between participants and visual expressions of architectural elements such as facade to trigger engagements and explorations.

1	2	3	4
5	6	7	8
9	10	11	

1. Bamboo Forest
2. Danteum (render), Giuseppe Terragni
3. Cathedral of Córdoba, Juan De Ochoa
4. Holocaust Memorial, Peter Eisenman
5. Ronchamp Chapel, Le Corbusier
6. Ronchamp Chapel, Le Corbusier
7. Casa Gilardi, Luis Barragan
8. National Assembly of Bangladesh, Louis Kahn
9. Kunsthaus Bregenz, Peter Zumthor
10. Black Monolith, 2001 Space Odyssey (movie)
11. Urban Communication-Interchange, Hans Hollein



Hazard (d)

Evolutionary Psychology

Definition

Oxford Noun.
- A potential source of danger.
- Chance; probability.

Verb.
- Put (something) at risk of being lost.

Architecture
- Visually perceived safety threat with physical properly-protected structure.

Neurological Experience

Description The spatial experience with favorable "Hazard" property produces feelings of danger, excitement, curiosity and surprise.

Neurological Explanation The factor of hazard is usually triggered by the environmental condition that poses visually perceived danger but with reliable safety control [1].

The hazard condition during architectural experience may trigger physiological responses such as the secretion of dopamine and adrenaline, which will catalyze the feeling of pleasure and excitement.

However, the hazard condition should be controllable and provides visitors the opportunity to retrieve from such condition during measurable period of experience. The long exposure to hazard condition may lead to dopamine overproduction which may then cause competitive, aggressive behavior and having poor impulse control[2].

Reference

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Design Methodology

Abstract The objectives of the Hazard factor are subjected to various degrees. From a more serious degree, the objective may involve creating tendencies of falling from high levels, being hit by seemingly unstable structure from above. From a more trivial degree, the hazard factor may aim at creating conditions for the participants to get wet or dirty. The general methods usually involves visual illusion, or strategically design of visual angles or materials.

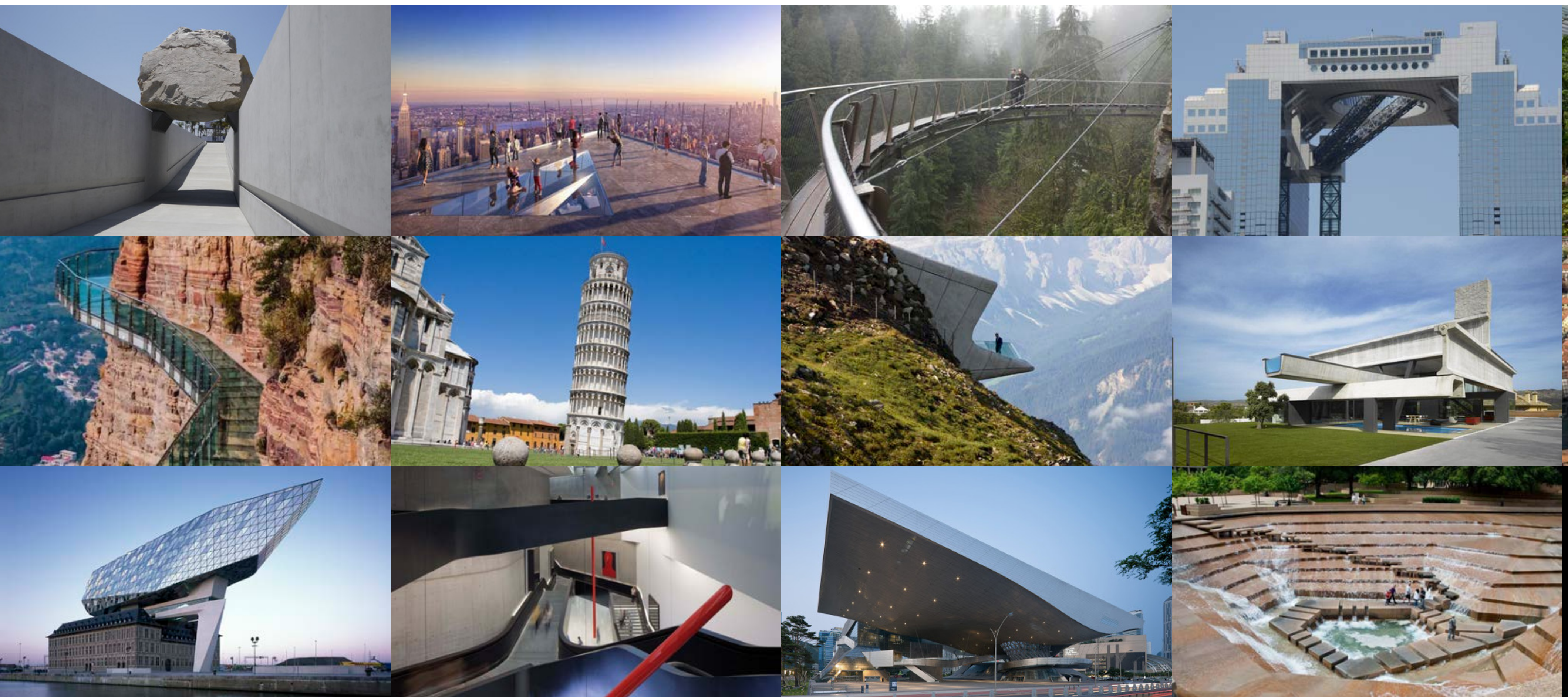
Execution
1. Transparent material for floors, railings or peripheral partitions at high level spaces are common methods to produce hazard conditions.
2. The use of cantilever or suspension structure will also generate hazard conditions.
3. Create sky- walks or corridors across an open space.
4. Vertically combine space to form single high ceiling space.
5. Strategically hide structure that support visually imposing elements.
6. Create accidental or non- rhythmical movement of certain elements that may physically interact with participants.
7. Adopt visually anti- gravity architectural forms or structures such as inclined columns or floors.

Neuromorphic Design Speculation

Specific neuromorphic interactive networks can be formed between participants and visual expressions of architectural elements such as floors and ceiling to generates hazard conditions to trigger curiosity or generate pleasure for the participants.

1	2	3	4
5	6	7	8
9	10	11	12

1. Levitated Mass, Michael Heizer
2. Hudson Yards' Observation Deck, KPF
3. Capilano Suspension Bridge
4. Umeda Sky Building, Hiroshi Hara
5. Glass Cliff Walkway in China
6. Tower of Pisa, Bonanno Pisano
7. Messner Mountain Museum Corones, Zaha Hadid Architects
8. Casa Hemeroscopium, Ensamble Studio
9. Antwerp Port House, Zaha Hadid Architects
10. Maxxi Museum, Zaha Hadid Architects
11. Busan Cinema Center, Coop Himmelb(l)au
12. Fort Worth Water Gardens, Philip Johnson



Nature Connection (e)

Biophilic Impact

Definition

Architecture
- Connection with Nature refers to the spatial condition with various possible perceptions of nature. Possible perceptions of nature usually include visual, auditory, somatosensory and olfactory perceptions.

Neurological Experience

Description The availability of connection with nature through any perceptions during architectural experience blurs the boundary between artificial and natural environment and in general provides users with balanced, relaxing and restorative experiences.
The experience can be singular- sensory based or multi- sensory integrated. The visual connection with nature is the most dominant condition where perceptions of any natural elements such as plants, water and animals (non- captured and non- threatening) are able to produce biophilic impacts. Non- visual connections with nature may include auditory perceptions such as sound of winds through leaves and sound of birds, somatosensory perceptions such as touch of natural material and feel of breeze and olfactory perceptions such as smell of grass and flowers.

Neurological Explanation

Visual — Visual connection with nature is able to positive affect people's neurological experiences in reduced stress, enhanced cognition and accelerated recovery rate through lowering blood pressure, lowering heart rate, reducing fatigue and reducing negative emotions such as anger and sorrow. The neurological benefits will be positively affected by the increase of the level of f biodiversity rather than area of natural space[1].
Research shows that visual connection with nature stimulates larger parts of the visual cortex, which triggers more pleasure receptors in the brain, resulting in prolonged interest and faster stress recover[2].

Auditory — Compared to urban or office sound, nature sounds is proved to accelerate physiological and psychological restoration[3] and reduce cognitive fatigue and helps motivation[4].

Somato-sensory — Close interactions with nature such as gardening and horticulture activities are proved to be able to reduce self-reported fatigue among adults[5], and reduce perception of pain among seniors with arthritis. Feeling or touching of natural element such as leaves or trunks has shown to reduce anxiety through a change in cerebral blood flow rates[6].

Olfactory — Smell is able to trigger powerful memories through olfactory system. The use of scent of plant oils have proved to be effective for mental therapy. Research has shown that olfactory perception of herbs and phytoncides (essential oils from trees) have a positive effect on the healing process and human immune function[7].

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Design Methodology

The objective of connection with nature factor is to provide strategic and sufficient exposures to natural environment/ element within the given built environment. The ambient and immersive perceptions via multiple senses are more preferable than single perception.

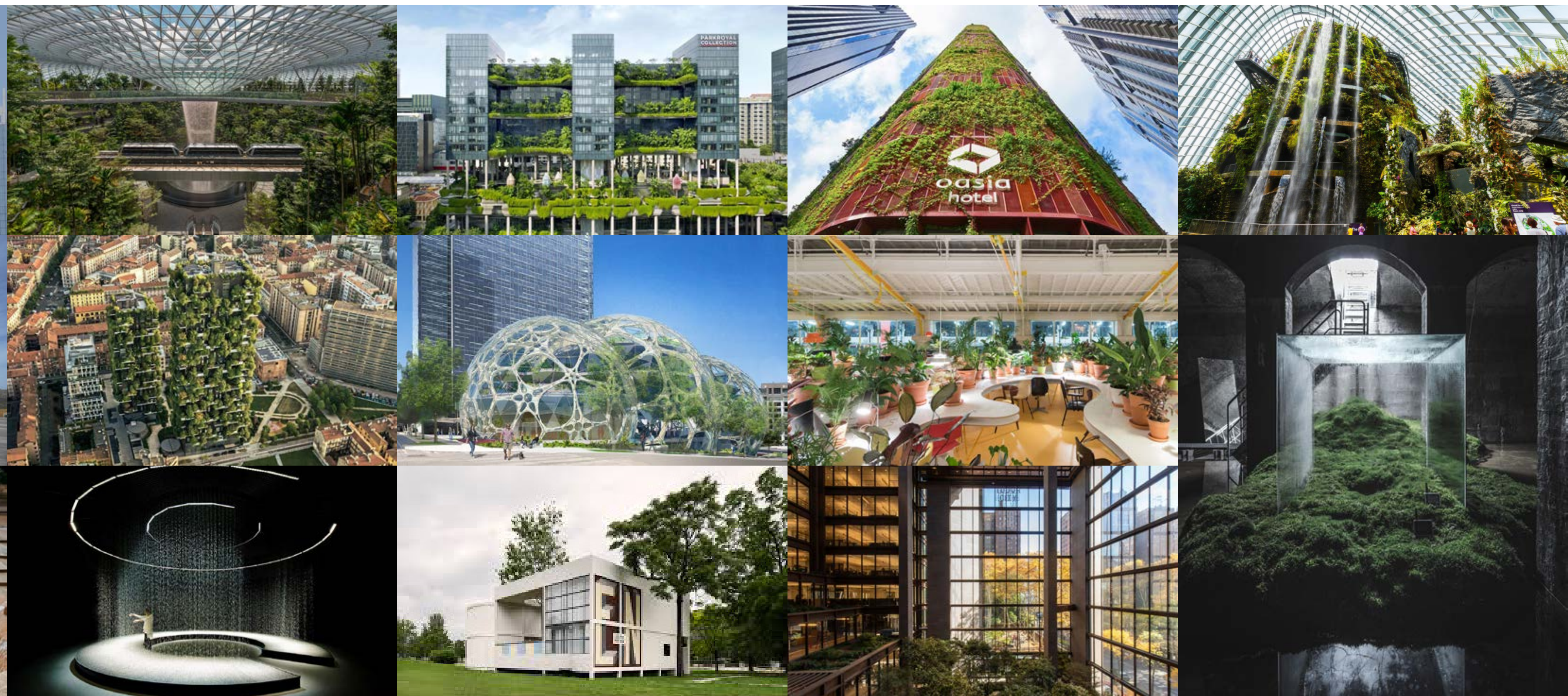
Execution
1. Introduce natural environmental system such as plant and water system in different scales into the built environment.
2. Provide easy accessibility to the natural environment from major programs.
3. Use transparent spatial partitions to make visual connections with nature.

Neuromorphic Design Speculation

Operable and transparent partitions could be useful in connecting the built environment and natural environment.

1	2	3	4
5	6	7	8
9	10	11	

1. Singapore Jewel Changi Airport, Safdie Architects
2. PARKROYAL on Pickering, WOHA
3. Oasia Hotel Singapore, WOHA
4. Cloud Forest , Wilkinson Eyre Architects
5. Vertical Forest, Stefano Boeri Architetti
6. Amazon Spheres, NBBJ
7. Second Home, SelgasCano
8. The Water, Hiroshi Sambuichi's
9. Light in Water, DGT Architects
10. Pavilon de l'Esprit Nouveau, Le Corbusier
11. Ford Foundation Center for Social Justice, Gensler



Peripheral Stimulation (f)

Biophilic Impact

Reference

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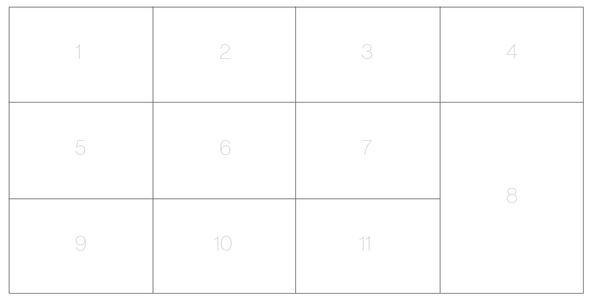


1. Barbouni (beach restaurant), K-Studio
2. Brisbane Domestic Terminal Carpark, UAP Workshop
3. Randall Museum, Charles Sowers Studios
4. Japanese Wind Chimes
5. Water installation, MadMatter Studio
6. Louvre, Abu Dhabi, Jean Nouvel
7. MIT Chapel, Eero Saarinen
8. Carpenter Center, Le Corbusier
9. Ronchamp Chapel, Le Corbusier
10. Val d'Orcia, Luciano Giubbilei
11. OLED Turbine, Avoid Obvious Architect

Definition

Architecture

- Peripheral stimulation refers to the implicit input of information through various sensory perceptions.

Neurological Experience

Description

Peripheral stimulation works as a intentional but swift "distraction" for users to produce the feeling of refreshing, relaxing and energizing.

Neurological Explanation

Peripheral stimulation has its most significant impacts on visual perceptions, while it also affects audio or olfactory perceptions to various extents.
Primary physiological benefits of peripheral stimulation include positively impacts on heart rate, eye accommodation, systolic blood pressure and sympathetic nervous system activity and its cognitive benefits include behavioral measures of attention and exploration.
The peripheral visual perception, outside the direct focus of the eye, is argued to be a visual illusion. Although neurological research suggests that peripheral vision, compared to visual perception from the central visual field can be less detailed and accurate, the resulting visual information may not be clearly distinguished between the two within visual cortex[1].
The major perception of peripherally presented stimuli is tested to have positive impact on individuals to divert attentional resources that result in anxiety[2].
Also as an important supplement of the indication and the reference of self-movement, peripheral visual perception helps users to enhance sense of positioning within a built environment[3].
Researches have shown that temporary exposure to unexpected and unobtrusive auditory and olfactory also have positive impact on human physiological response such as relieve anxiety and fatigue[4].
Within a working environment particularly, long time stationary visual focus on a digital screen for over 20 minutes may cause fatigue in eye muscle. The peripheral visual stimulation may help shift the focus briefly to surroundings allowing for short physical or mental break[5].
According to scientific studies of brain visual processing mechanism, human brain processes visual perceptions of living and non- living elements in different sections of the brain, where unpredictability of the movement of the subject serves a crucial criterion for distinguishing the two categories[6].

Design Methodology

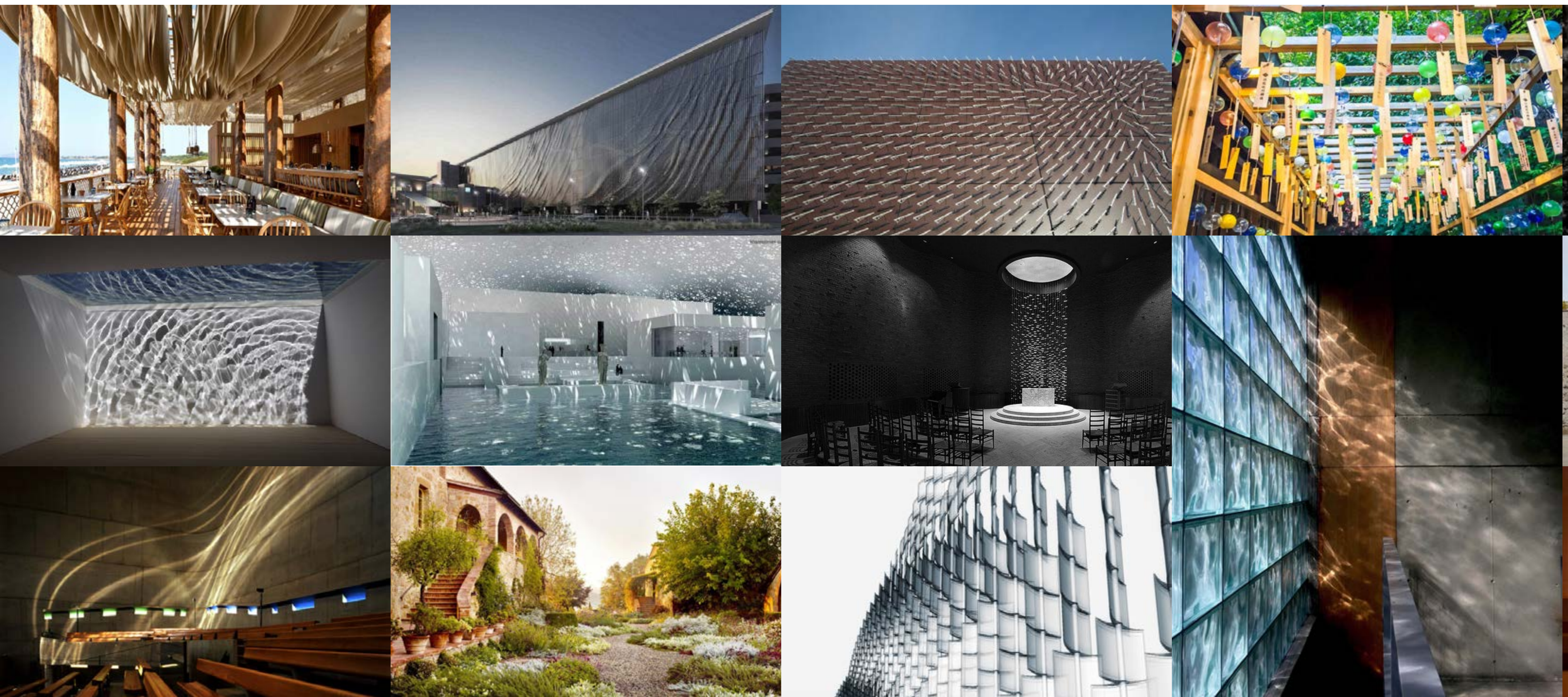
The objective of creating peripheral stimulation is to provide non-rhythmic and unobtrusive perceptual stimulation, and allow users to briefly take a break away from the current focus, which helps lower stress and fatigue level.
Source of such stimulations can be largely derived from natural elements such as breeze, sunlight, cloud (visual), birds chirping, sound of water (auditory) and scents from plant (olfactory).

Execution

1. Introduce natural environmental system as attractions of animals such as birds, butterflies and bees.
2. Take advantages of the non- rhythmic kinetics such as breeze and sunlight from natural system as direct source of peripheral perceptual stimulation or as the input of a neuromorphic mechanism.
3. Key qualities of randomness and unpredictability of peripheral stimulation could also be artificially generated by algorithm- based program for visual, auditory or olfactory information.

Neuromorphic Design Speculation

Neuromorphic mechanism could be implemented at various levels: on the prescribed level, algorithm based programs could be used on kinetics of lighting, facade or audios; on a responsive level, responsive mechanism could be built between natural elements (breeze, light, etc) and architectural components (facade, glazing, etc)



Natural Material (g)

Biophilic Impact

Reference

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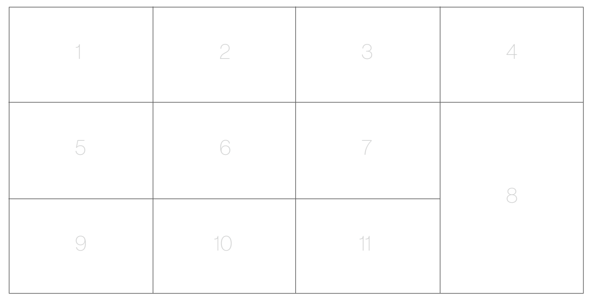


1. Bruder Klaus Field Chapel, Peter Zumthor
2. Saint Benedict Chapel, Peter Zumthor
3. Vipuri library, Alvar Aalto
4. Viipuri library, Alvar Aalto
5. 1413 House, Harquitectes,
6. SanBaoPeng Art Museum, DL Atelier
7. Vedana Restaurant, VTN Architects
8. Tverrfjellhytta, Snøhetta
9. Le Cabanon, Le Corbusier
10. Yusuhara Wooden Bridge Museum, Kengo Kuma
11. Daiwa Ubiquitous Research Building, Kengo Kuma

Definition

Architecture

- Natural material in architectural design refers to the indigenous materials that are sufficiently attainable from natural environment and require minimal processing for architectural design.
- Common natural material for architectural design include adobe, wood, bamboo, rammed earth, masonry, etc.

Neurological Experience

Description

Incorporation of natural material in architectural design may stimulate feelings of warmth, relaxation or concentration.

Neurological Explanation

Scientific studies show that positive physiological, psychological and cognitive measures are related to particular variables/ properties of natural material.

As one of the most easily accessible natural material, wood bears enormous potentials on human neurological benefits. Due to its hypoallergenic properties and reduced level of formaldehyde and other volatile substances, wood serves a crucial role in indoor air quality improvement[1].
Furthermore, during a study targeted at students, as a sign of parasympathetic nervous system activation, the relative rise of heart rate variability within wood- dominated classroom compared to a non-wood incorporated classroom has shown that wood material may help reduce human stress level[2].
During another study of involuntary physiological responses to objects in wood and non-wood offices, researchers found out that in the wood office environment, participants' skin conductance level and measurable divergent stress level are all shown to be lower than those within non- wood environment[3].
In a more quantitative- oriented research, researchers measured participants heart rate and blood pressure in rooms with respectively 45% and 90% wood coverage. The result showed that both measurements are lower in the larger wood- coverage environment[4].
Last but not least, the use of wood material is also proved to be associated with lower absenteeism, higher levels of concentration, and improved productivity according to a report for forest & wood products in Australia[5].

Design Methodology

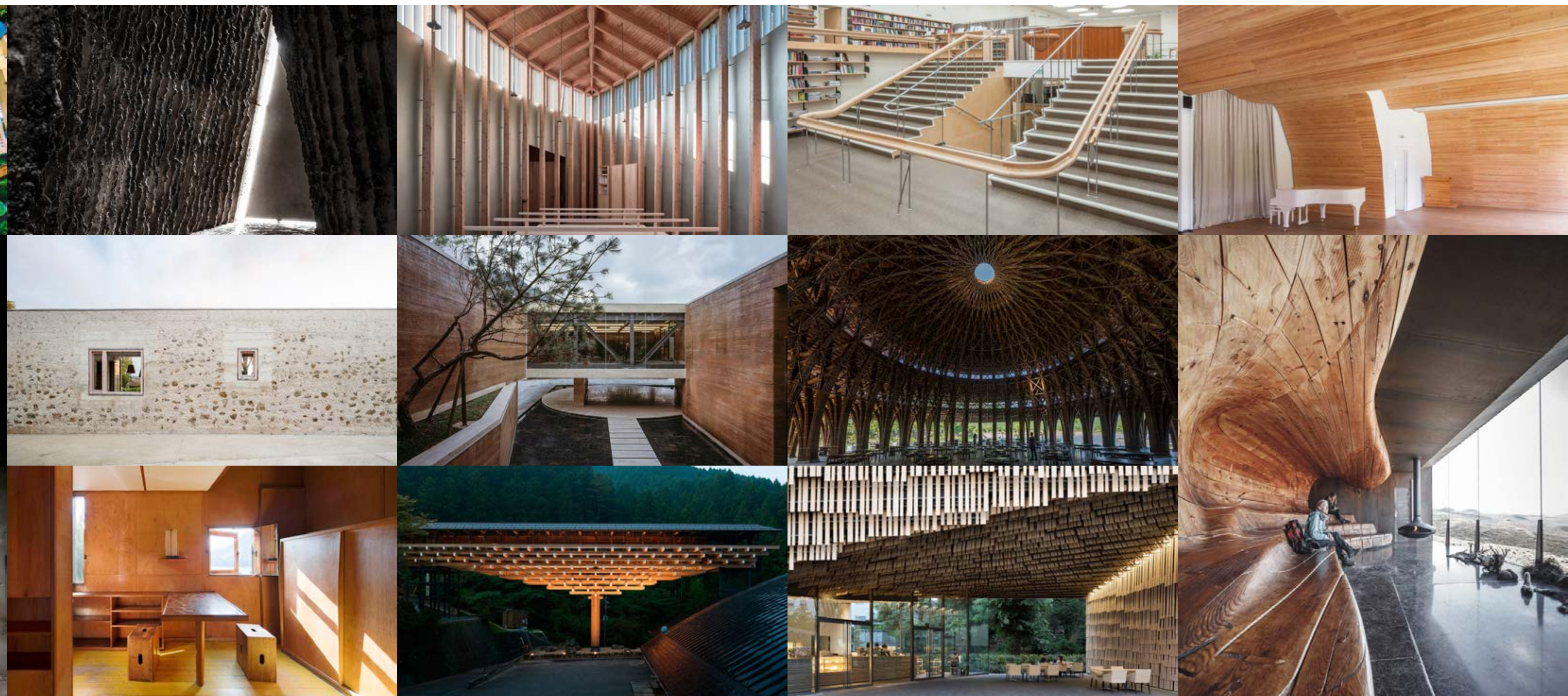
The objective of using natural material is to fully utilize properties (texture, color, scent, etc) of natural material to achieve expected neurological outcomes.

Execution

1. Accentuate on the use of natural material rather than synthetic material when one is replaceable by the other.
2. Use organic natural materials such as wood or bamboo at particular user- interactive surfaces such as floor, railing, desk surface, etc.
3. Adopt natural color scheme as such green, wooden or earthy color.
4. Texture or grain of natural material is encouraged to be preserved during the processing of the material.
5. Scent of typical natural material can be strategically used to enhance neurological experience.
6. Adopt natural material- based structural system.

Neuromorphic Design Speculation

To be proposed.



Biomorphic Form (h)

Biophilic Impact

Reference

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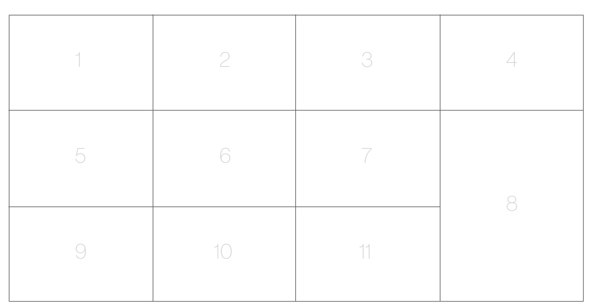

1. Sagrada Familia, Antoni Gaudi
2. Casa Batlló, Antoni Gaudi
3. Casa Milà, Antoni Gaudi
4. TWA Flight Center, Eero Saarinen
5. Orquideorama Botanic Garden, Plan B Architects + JPRCR Architects
6. Milwaukee Art Museum, Santiago Calatrava
7. Spanish Pavilion at Shangai 2010, EMBT
8. Hôtel Tassel, Victor Horta
9. Aqua Tower, Gang Studio
10. Grin Grin Park, Toyo Ito
11. Allianz Arena, Herzog & de Meuron

Definition- "Biomorph(ism)"

Oxford Noun.
- A decorative form or object based on or resembling a living organism.
- A graphical representation of an organism generated on a computer, used to model evolution.

Architecture
- "Designs that imitate natural or biological forms and shapes and patterns and textures that connect human beings to nature" [1].
- Also refers to as "Bio-organic architecture" during the Art Nouveau movement.

Neurological Experience

Description

Space with biomorphic forms may help with users' attention restoration, place identity and stress reduction.

Neurological Explanation

Scientists of evolutionary psychology have concluded that humans have inherent predisposition towards natural forms which is tested to stimulate positive emotional responses[2].

A stimulus-organism-response (S-O-R) framework[3] based research on servicesapes has shown that biomorphic forms are able to enhance place identity and increase users' space preference[4]. The adoption of biomorphic forms such as fractal forms helps restore users' attentions within servicesapes by enhancing users' visual processing fluency[5].

According to the research on environmental psychology, place identity can be defined as the emotional attachment between an individual and the built environment; and processes of personal temporality, self-coherence, correspondence, reflection and agency all contribute to the perception, memory and reasoning about a place[6]. The use of biomorphic forms, with its congruency of the system, is accordingly tested to able to visually enhance such cognitive responses between individuals and the built environment[7].

The study of evolutionary psychology has shown that the preference to specific place derives from the instinctive response by an individuals regarding their future behavioral intentions. And humans' inherent predisposition towards biomorphic forms is proved to result in cognitive engagement of exploring typical places and therefore leads to positive approach behavior[8].

Design Methodology

The objective of using biomorphic forms is to emulate or to reference natural forms or systems to achieve visually stimulated preferences.

Execution

1. Use fractal forms: the forms or patterns that repeat themselves at different scales.
2. Substitute right angles at corners with curvilinear turns.
3. Adopt curvilinear forms that imitate natural elements such as waves and shells.
4. Use biomorphic forms in structural design to achieve best structural efficiency.
5. Use biomorphic forms in the design of furnitures, railings, facade or wall decorations.

Neuromorphic Design Speculation

To be proposed.

Sociofugal & Sociopetal Space (i)

Proxemics

Reference

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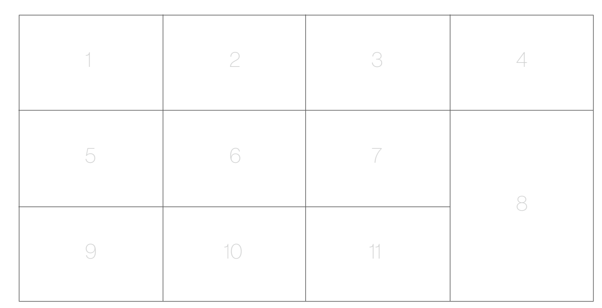


1. Unkonwn furniture design
2. Milder Office, Steven Holl Architects
3. Ichiran Ramen interior
4. Public stairway, Edge Design Institute
5. Bench Deisgn, Alleswirdgut Architektur
6. Camp Nou, soccer fans
7. CITY THREAD, Sports
8. Canadian Mental Health Association, Kiyoshi Izumi
9. Unknown atrium space
10. Miller House, Eero Sarrinen
11. Pioneer Courthouse Square, Herzog & de Meuron

Definition

Proxemics
- Proxemics is the study of human use of space and the effects that population density has on behaviour, communication, and social interaction.

Sociofugal Space
- The space that is designed to minimize contact among people.

Sociopetal Space
- The space that is designed to encourage interactions among people.

Neurological Experience

Description

Sociofugal space yields feelings of isolation, indifference or concentration. Sociopetal Space yields feelings of engagement, attraction and decentralization.

Neurological Explanation

The concepts of both "sociofugal and sociopetal" spaces were first carried out in 1960s by psychiatrists to describe the design of hospital interior space for intentional gathering or disperse of patients [1]. And the subsequent studies of how objects within particular paces were able to affect interactions between people were conducted by English psychiatrist Humphry Osmond as an important contribution to the development of the field of proxemics [2].

Sociofugal space deters interactions between people by implementing visual/ physical barriers. In the urban scale, such barrier may refer to infrastructure, traffics, vegetations that block citizens' access to services, goods or people [3]. In the more intimate personal scale, such barrier may refer to furnitures, vegetations or any opaque visual partitions that interferes interactions between people.

On the opposite side, sociopetal space invites people for interaction and socialization. In the intimate personal scale, sociopetal space provides participants with easy accessibility to any information for communication such as visual connection, audio transaction and any external information interface such as digital screens. In the urban scale, safety needs, sense of belonging, self-esteem and proper aesthetics all contribute to successful sociopetal spaces [4].

Design Methodology

The objective of creating sociofugal or sociopetal spaces is to enhance or obstruction physical accessibility or information exchange between people.

Execution

Sociofugal

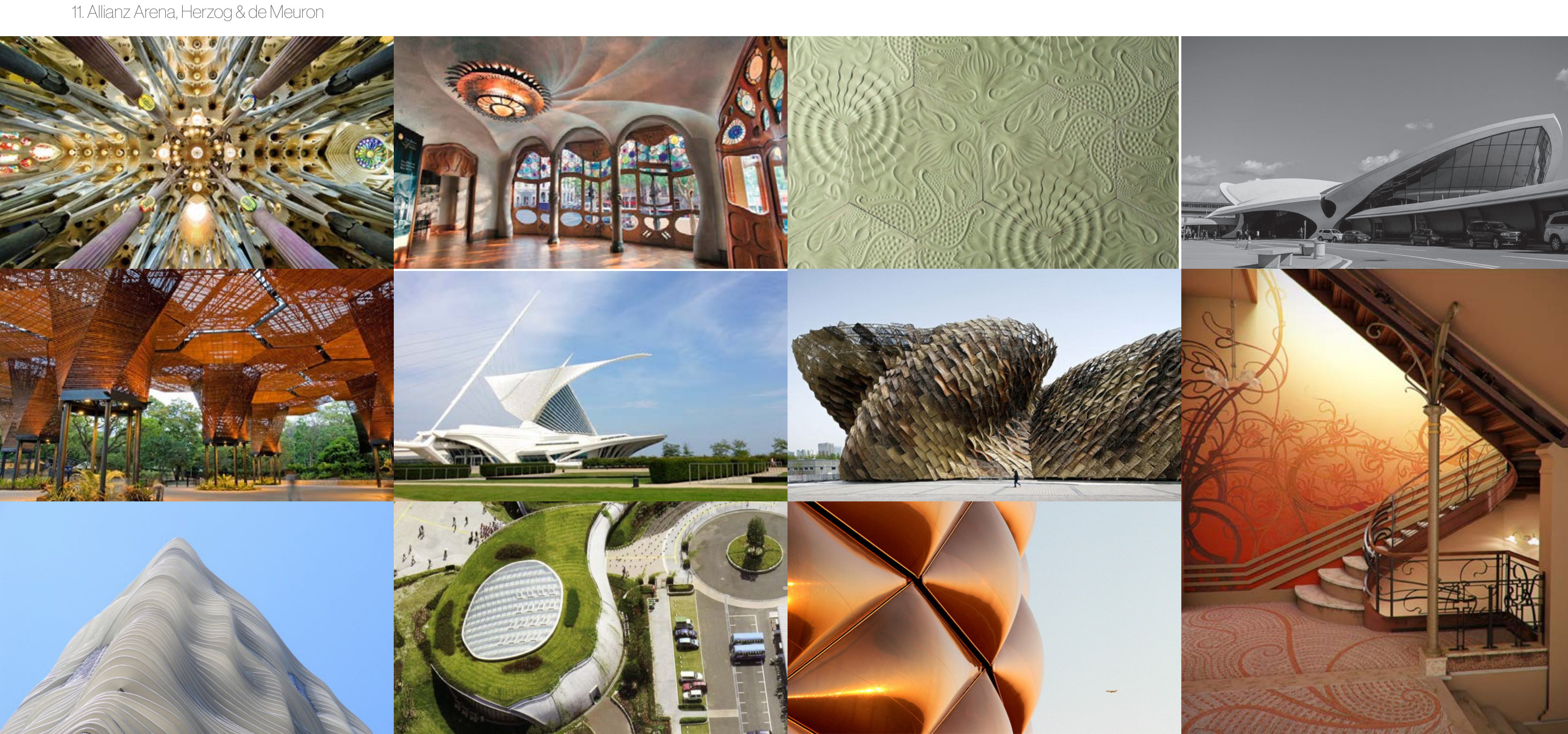
1. Use opaque or translucent visual partitions between individual occupied spaces.
2. Deviate furniture facing direction from one another in non-partition circumstances.
3. Create "refuge" spaces along primary or dominant public spaces or circulations.
4. Break up single open space with furniture or vegetations.

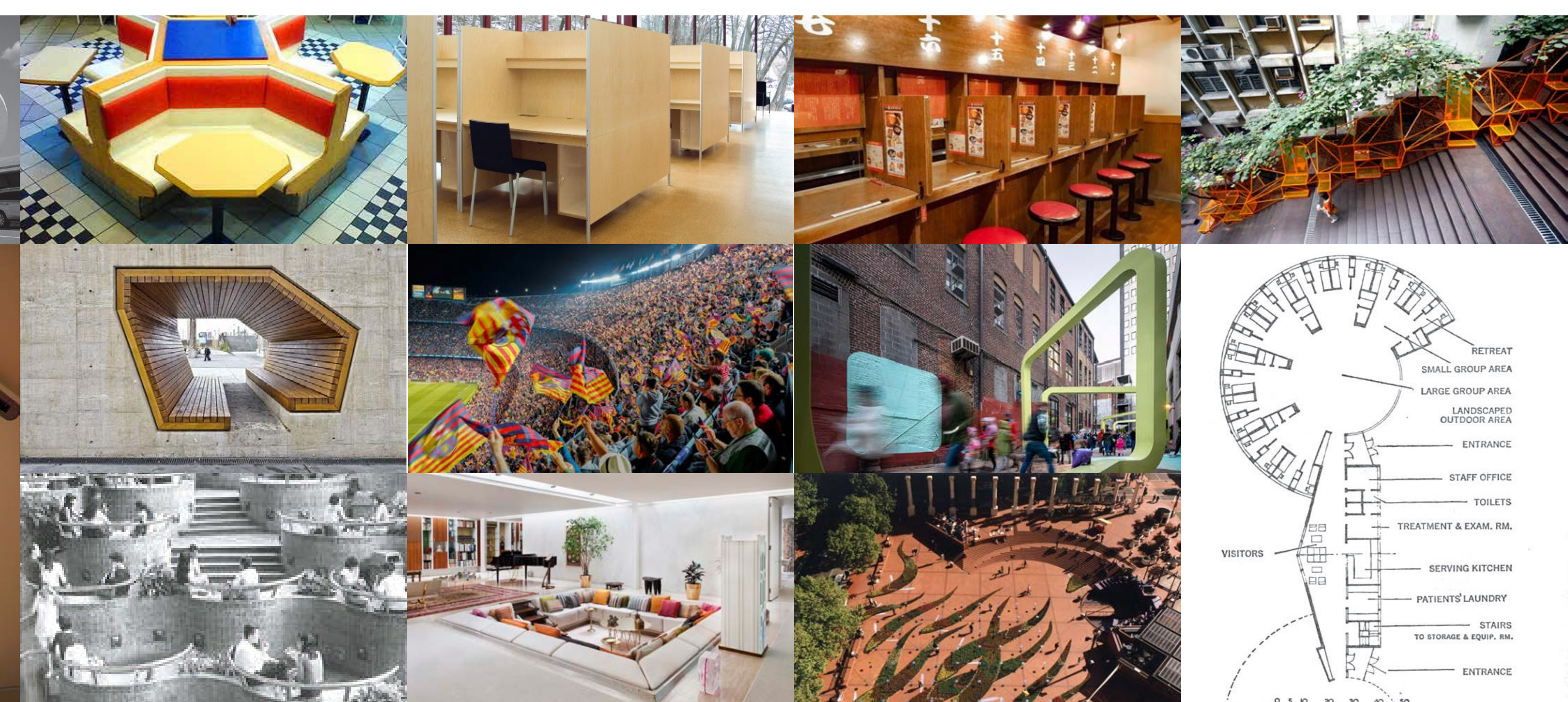
Sociopetal

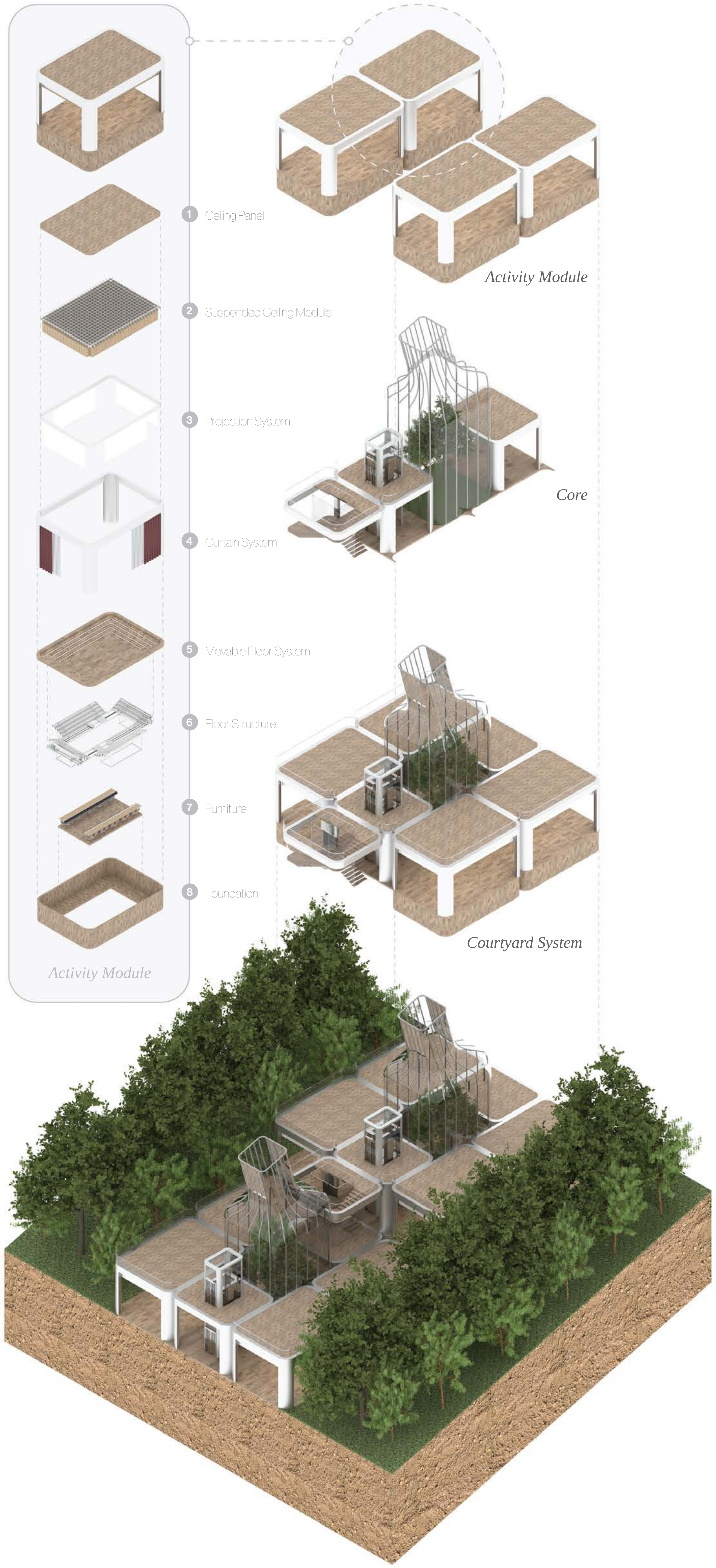
1. Remove visual partitions or use transparent visual partitions between individual occupied spaces.
2. Orient furniture facing one another.
3. Implement information interfaces that are mutually accessible between people.
4. Create sunken floors or amphitheaters in any forms to encourage interactions.

Neuromorphic Design Speculation

Kinetic or adaptive visual partitions, floors and furnitures can be implemented for the transformation between sociofugal and sociopetal spaces.







The Hut

Overview

Neurological Experience

a. Prospect

1 Provide single isovist with focal lengths of ≥20 feet, preferably 100 feet.

2 Remove opaque visual partitions or limit the heights below average human eye height according to different conditions (standing/ sitting).

3 Use transparent or translucent material for visual partitions.

4 Strategically arrange circulation space (corridor, doors, stairs) to form visual connections between interior and exterior space and among various related programs.

5 Form critical relationship between "prospect" and "refuge".

6 Created elevated platforms within high ceiling interior spaces or exterior spaces.

b. Refuge

1 Use suspended horizontal partitions such as drop ceilings to constrain ceiling height.

2 Create indentations or sunken floors from the major floor level.

3 Use mezzanine within high ceiling interior space or exterior space to divide space.

4 Arrange subsidiary small scale side spaces such as "alcoves" along the dominant space or circulation.

5 Adopt different and usually less intrusive and less obvious lighting condition in the refuge areas.

6 Create visual partitions within the rather larger and open space.

c. Mystery

1 Adopt curves instead of edges to invite people for the exploration of the space.

3 Alter lightings & shadows to shorten visual depth within a space.

5 Use repetitive elements to confuse participants' orientation.

9 Use sound to draw attentions and interests from participants.

d. Hazard

1 Transparent material for floors, railings or peripheral partitions at high level spaces are common methods to produce hazard conditions.

e. Nature Connection

1 Introduce natural environmental system such as plant and water system in different scales into the built environment.

2 Provide easy accessibility to the natural environment from major programs.

3 Use transparent spatial partitions to make visual connections with nature.

f. Peripheral Stimulation

1 Introduce natural environmental system as attractions of animals such as birds, butterflies and bees.

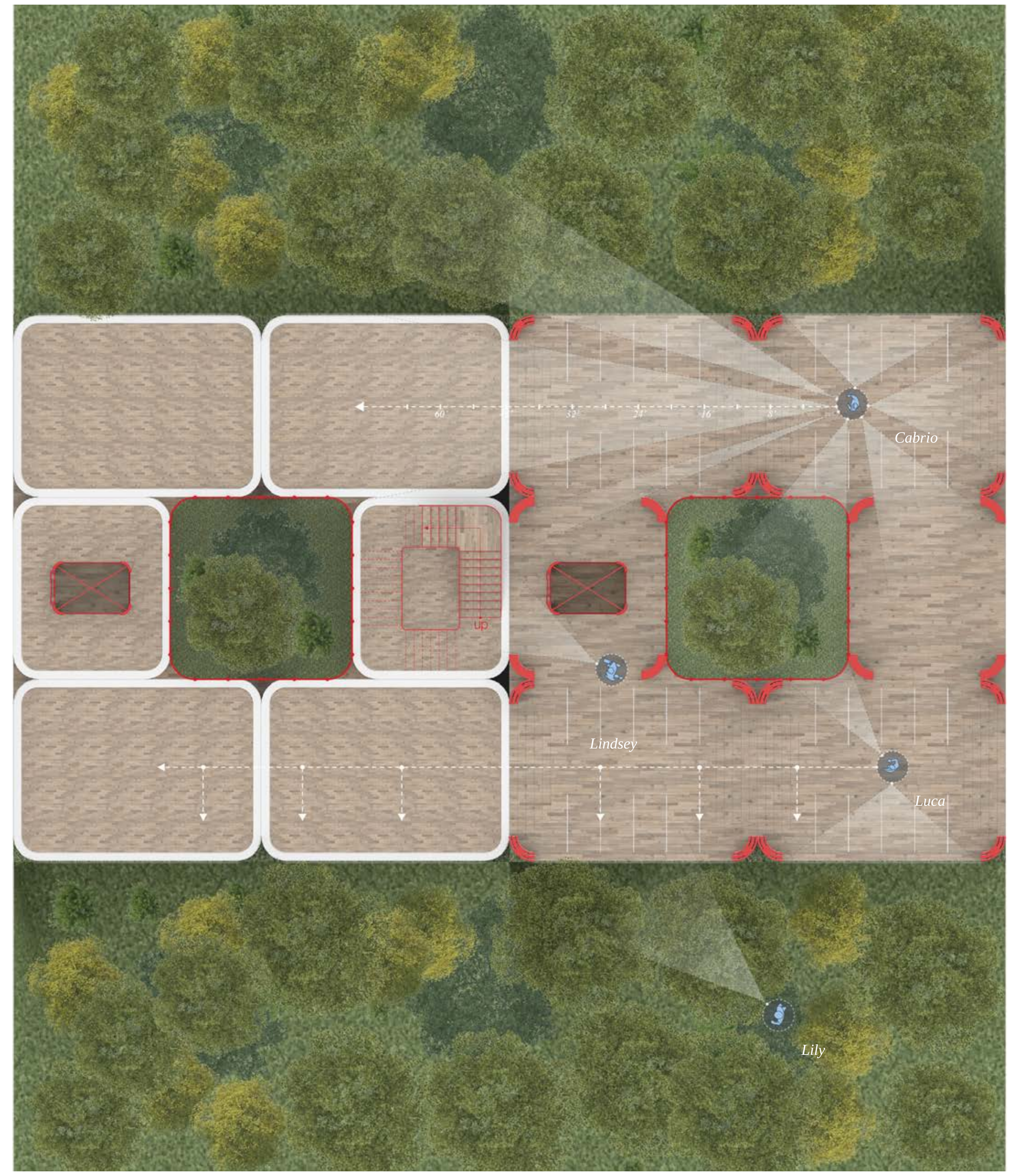
g. Natural Material

1 Accentuate on the use of natural material rather than synthetic material when one is replaceable by the other.

2 Use organic natural materials such as wood or bamboo at particular user- interactive surfaces such as floor, railing, desk surface, etc.

The Hut

Overview



4 Texture or grain of natural material is encouraged to be preserved during the processing of the material.

h. Biomorphic Form

2 Substitute right angles at corners with curvilinear turns

i. Sociofugal Space

1 Use opaque or translucent visual partitions between individual occupied spaces. (Ceiling system)

2 Deviate furniture facing direction from one another in non-partition circumstances.(Furniture system)

3 Create "refuge" spaces along primary or dominant public spaces or circulations.

i'. Sociopetal Space

1 Remove visual partitions or use transparent visual partitions between individual occupied spaces.

2 Orient furniture facing one another. (Furniture system)

3 Implement information interfaces that are mutually accessible between people.

4 Create sunken floors or amphitheaters in any forms to encourage interactions.

a.1 a.2 a.5 b.1 b.3 c.1 e. g.

Cabrio

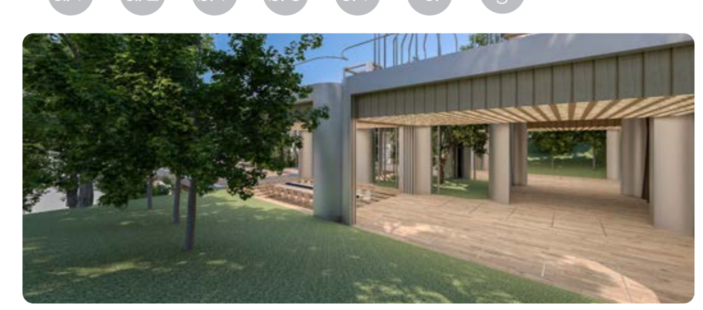
The removal of any opaque or static visual partitions provides single isovist (visual field) with long focal lengths at any point throughout the space.

a.2 a.3 b.1 b.2 b.3 c.1 e. g.

Luca

Natural systems are provided at flanking areas as well as internal courtyards for biophilic impacts.

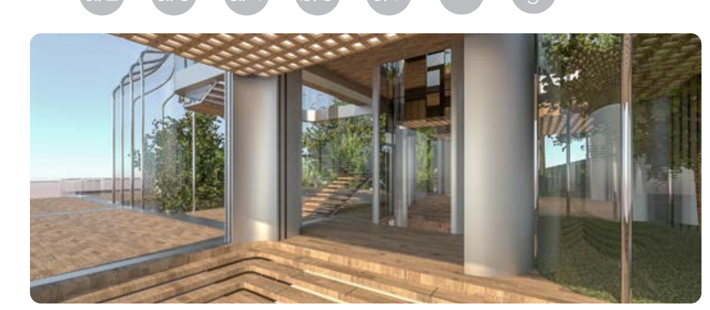
a.1 a.2 b.1 b.3 c.1 e. g.



Lily

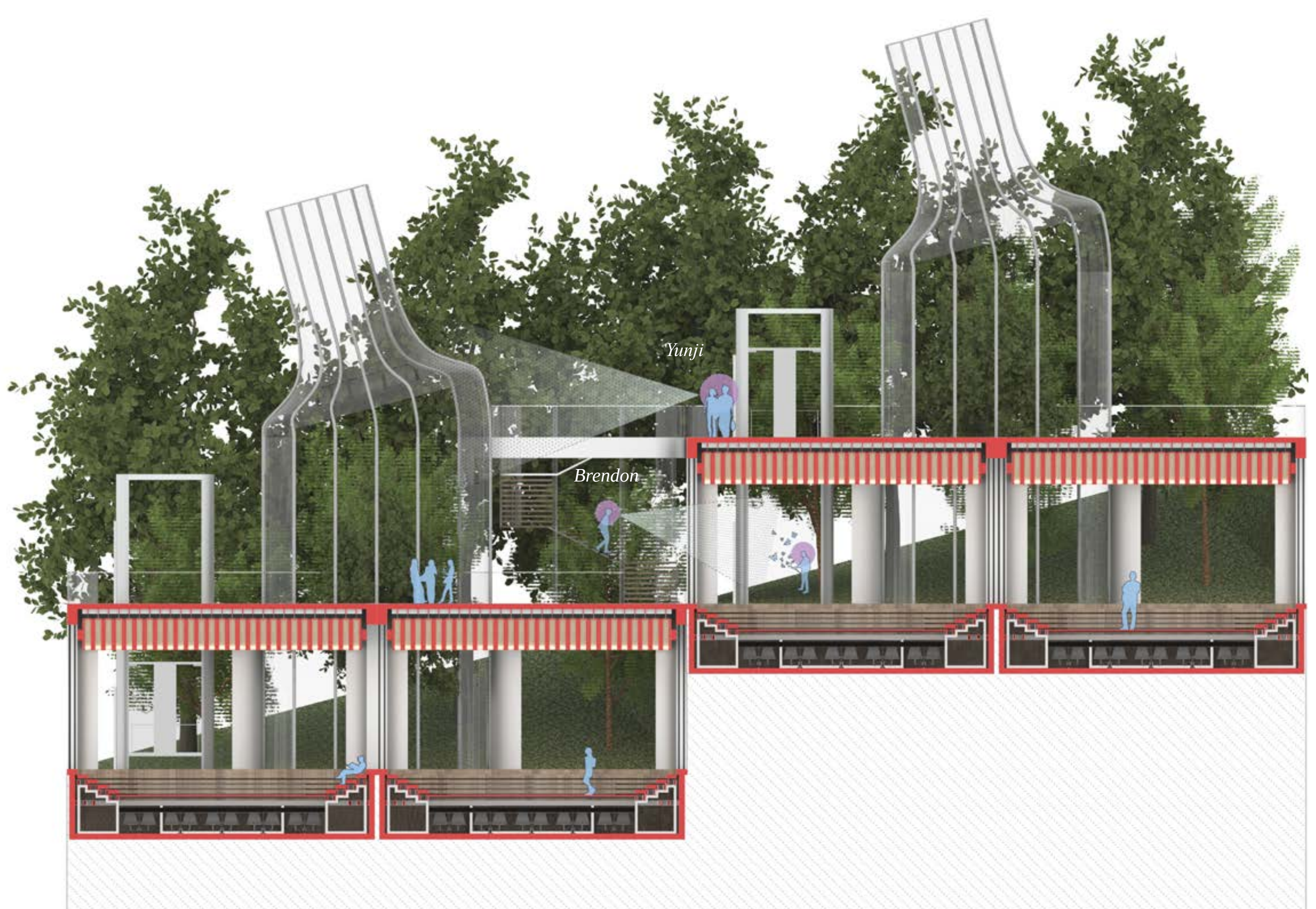
Along the dominant space or circulation, natural system works as "alcoves" for refuge space where people may retreat from the public.

a.2 a.3 a.4 b.3 c.1 e. g.



Lindsey

Circulation space are arranged to form visual connections between interior and exterior space and among various related programs.

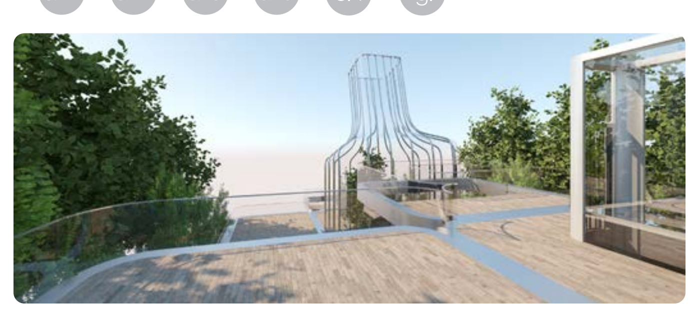


a.1 a.2 a.5 b.1 b.3 c.1 e. g.

Brendon

Circulation space adopts transparent visual partition to form visual connections between interior and exterior space.

a.1 a.2 a.3 a.6 e.1 g.

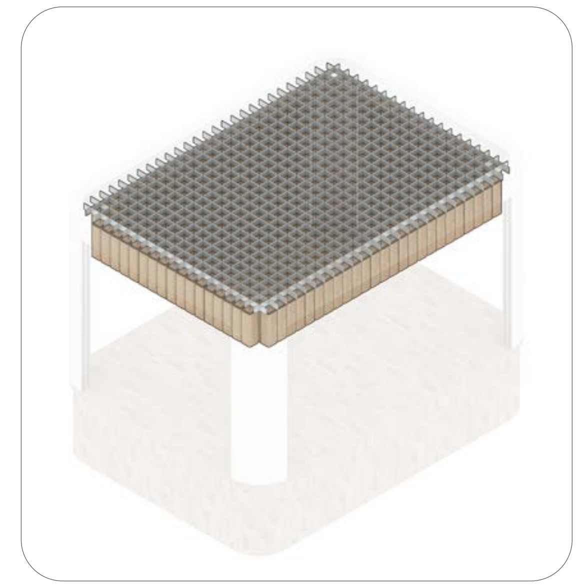


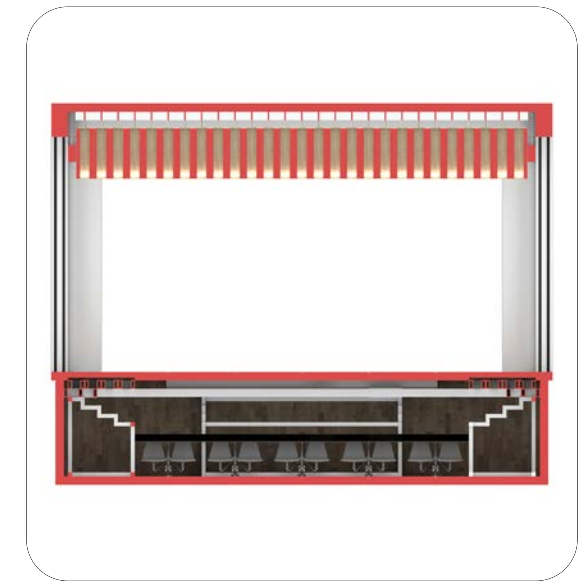
Yunji

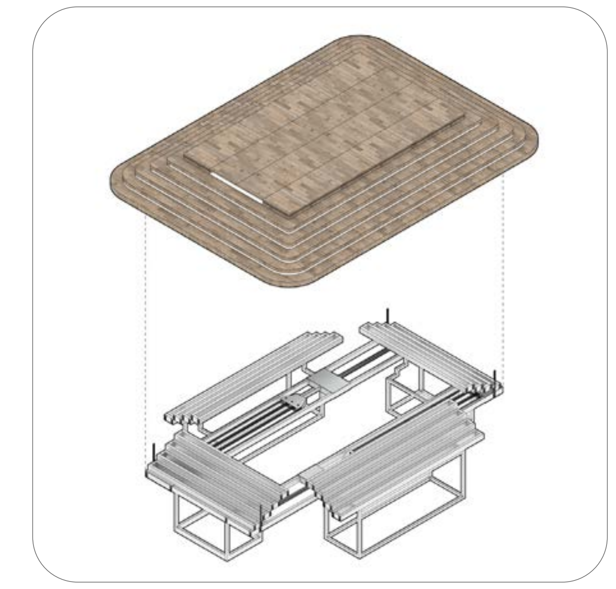
The critical prospect and refuge relationship is formed by the terrace view deck, flanking natural systems and hut modules.

Ceiling System

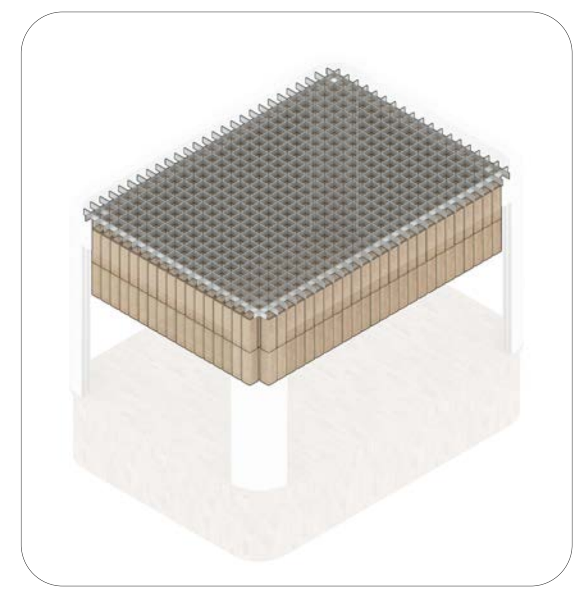
Floor System

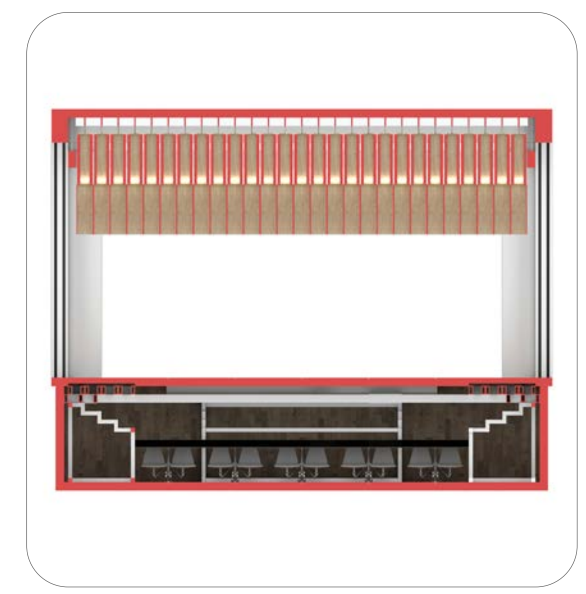


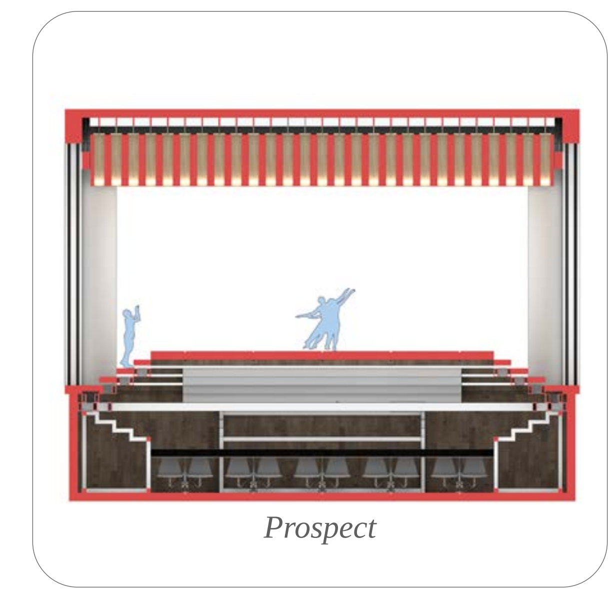


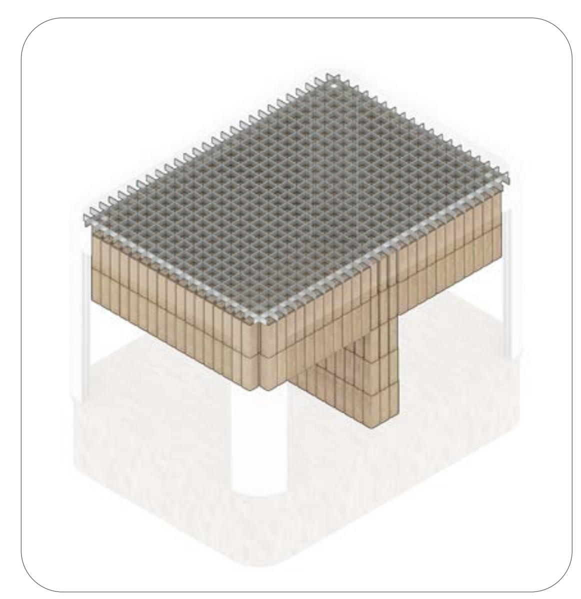


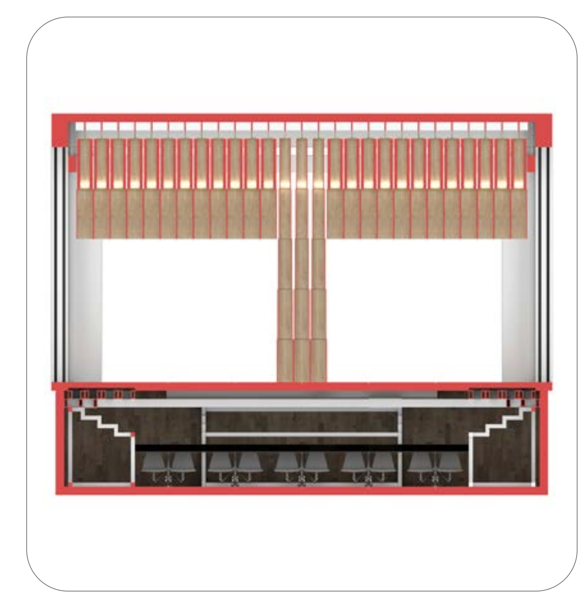
The Prescribed

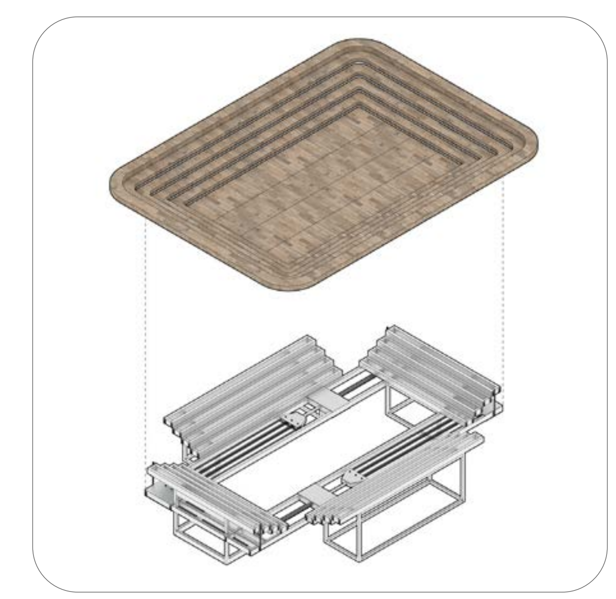




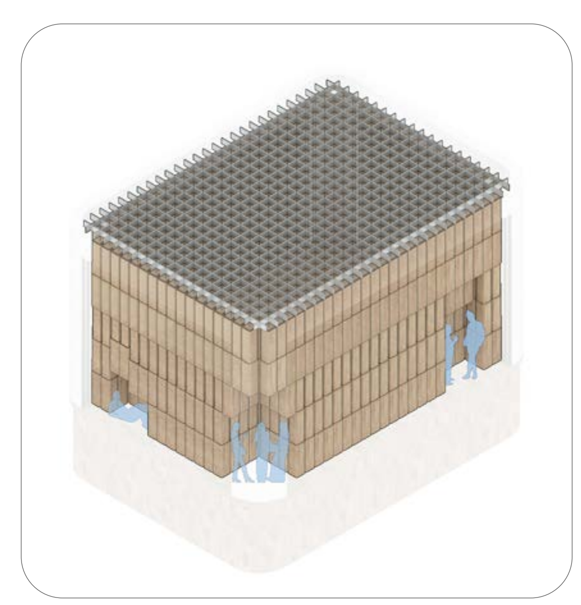


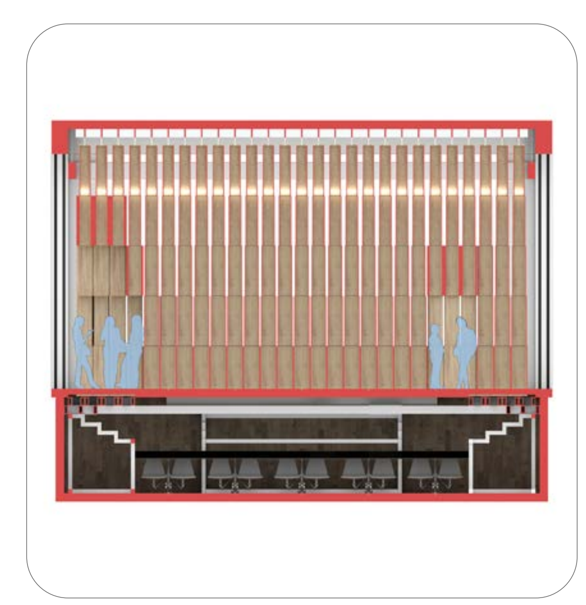


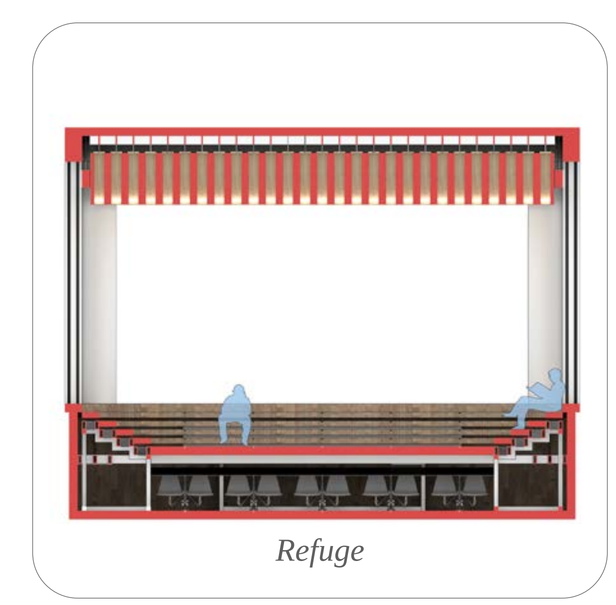




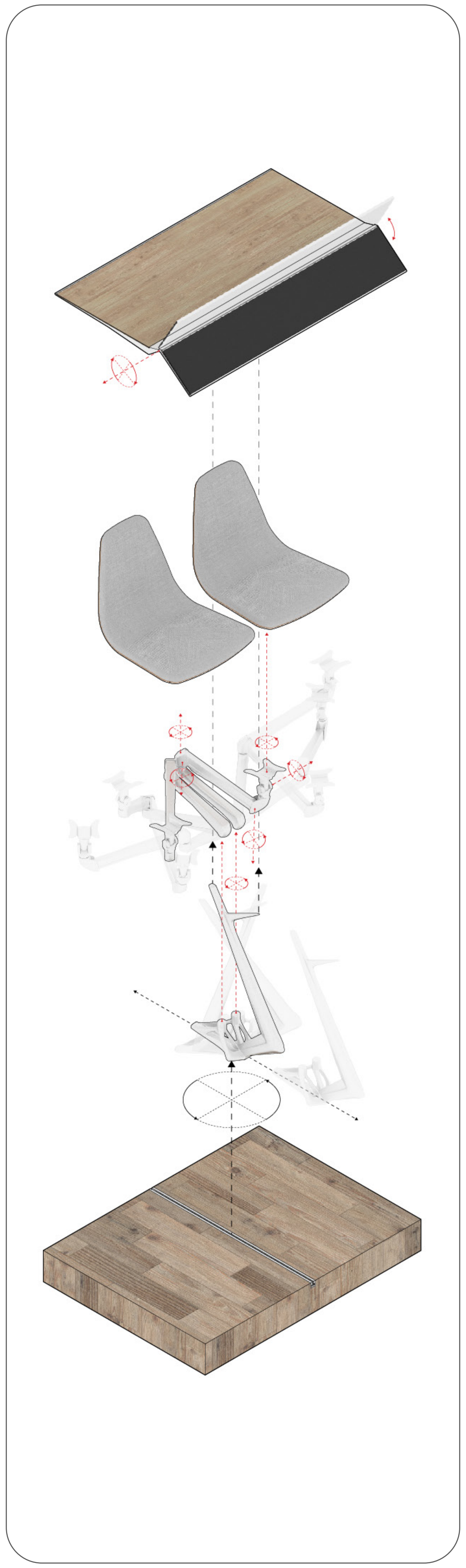
The Interactive

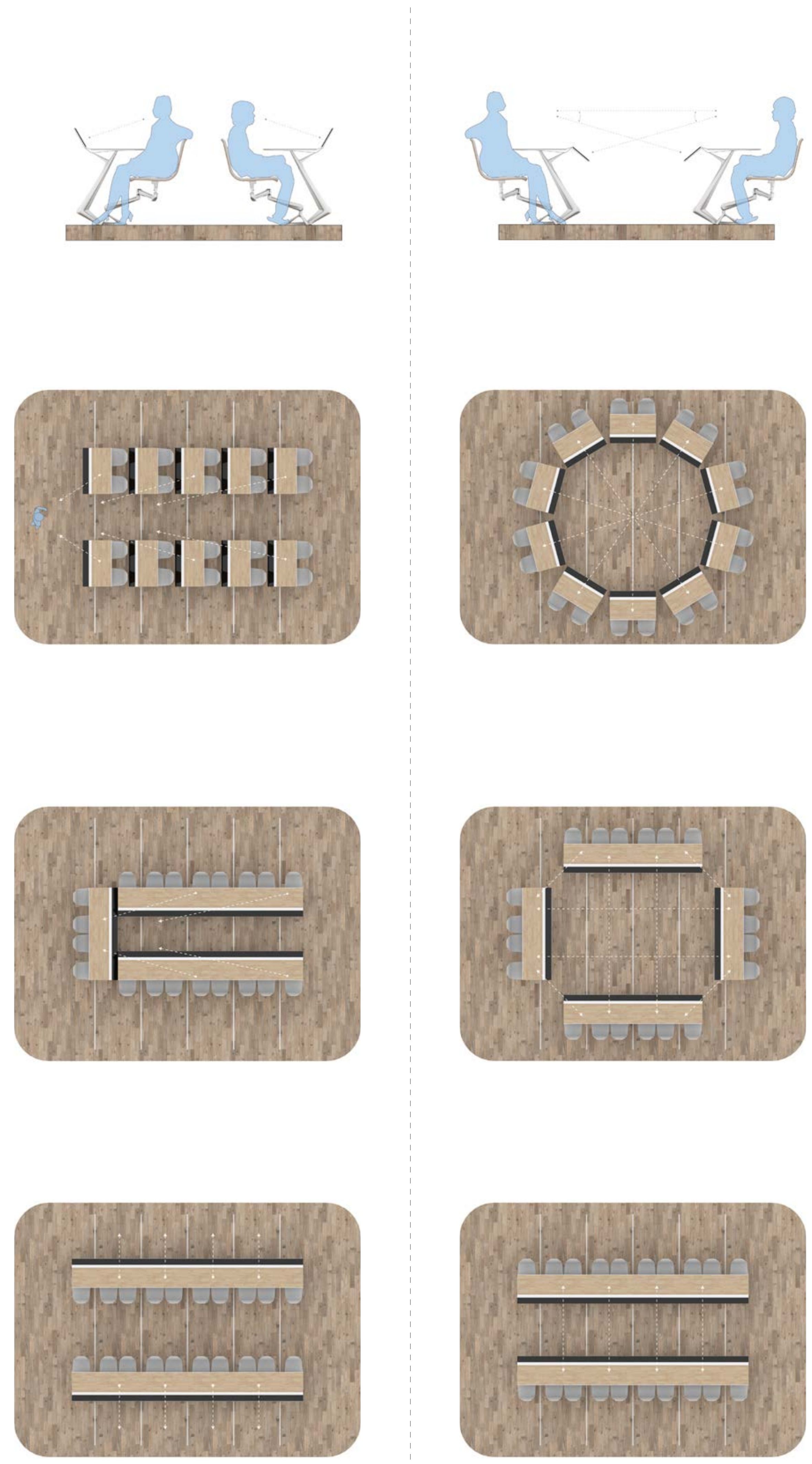






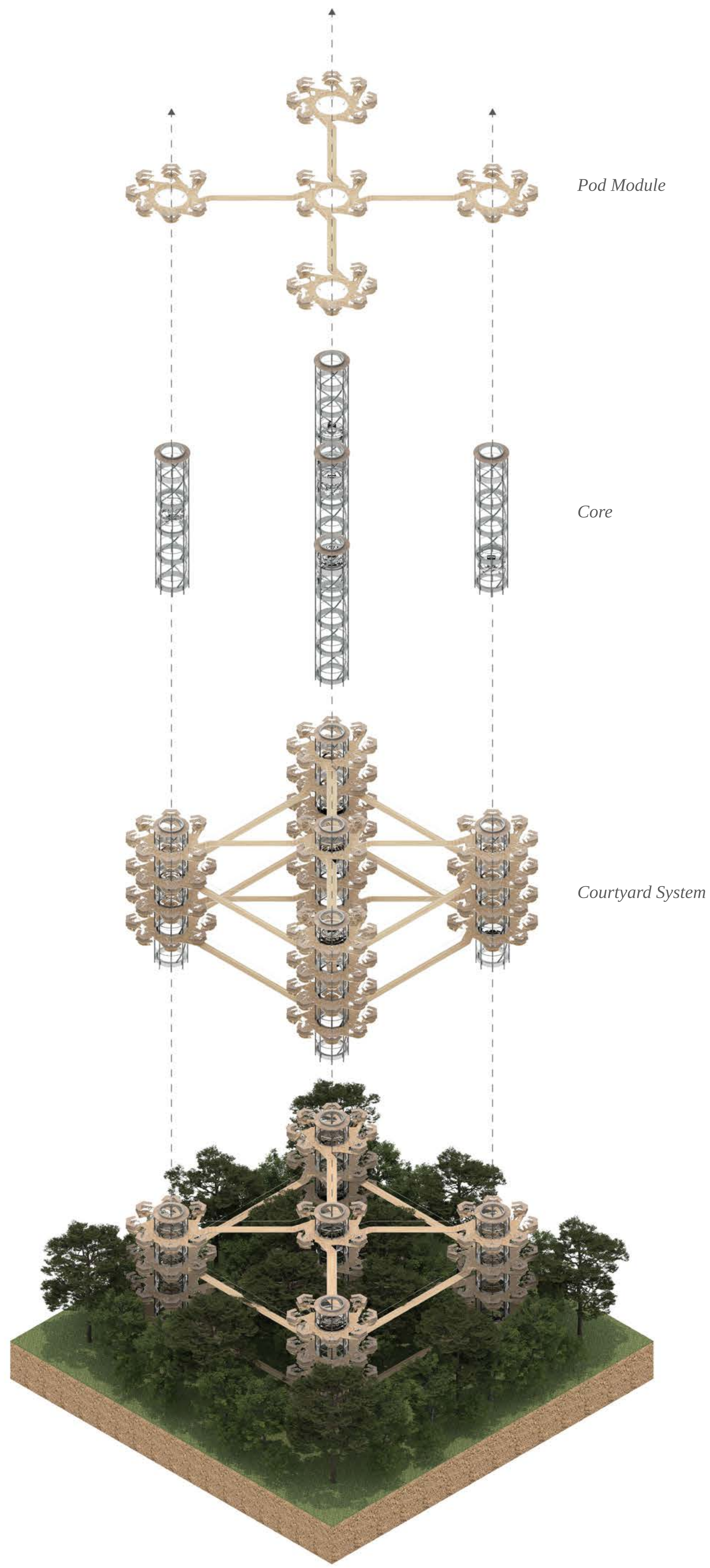
Furniture System





The Pod

Overview



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g. Natural Material

1 Accentuate on the use of natural material rather than synthetic material when one is replaceable by the other.

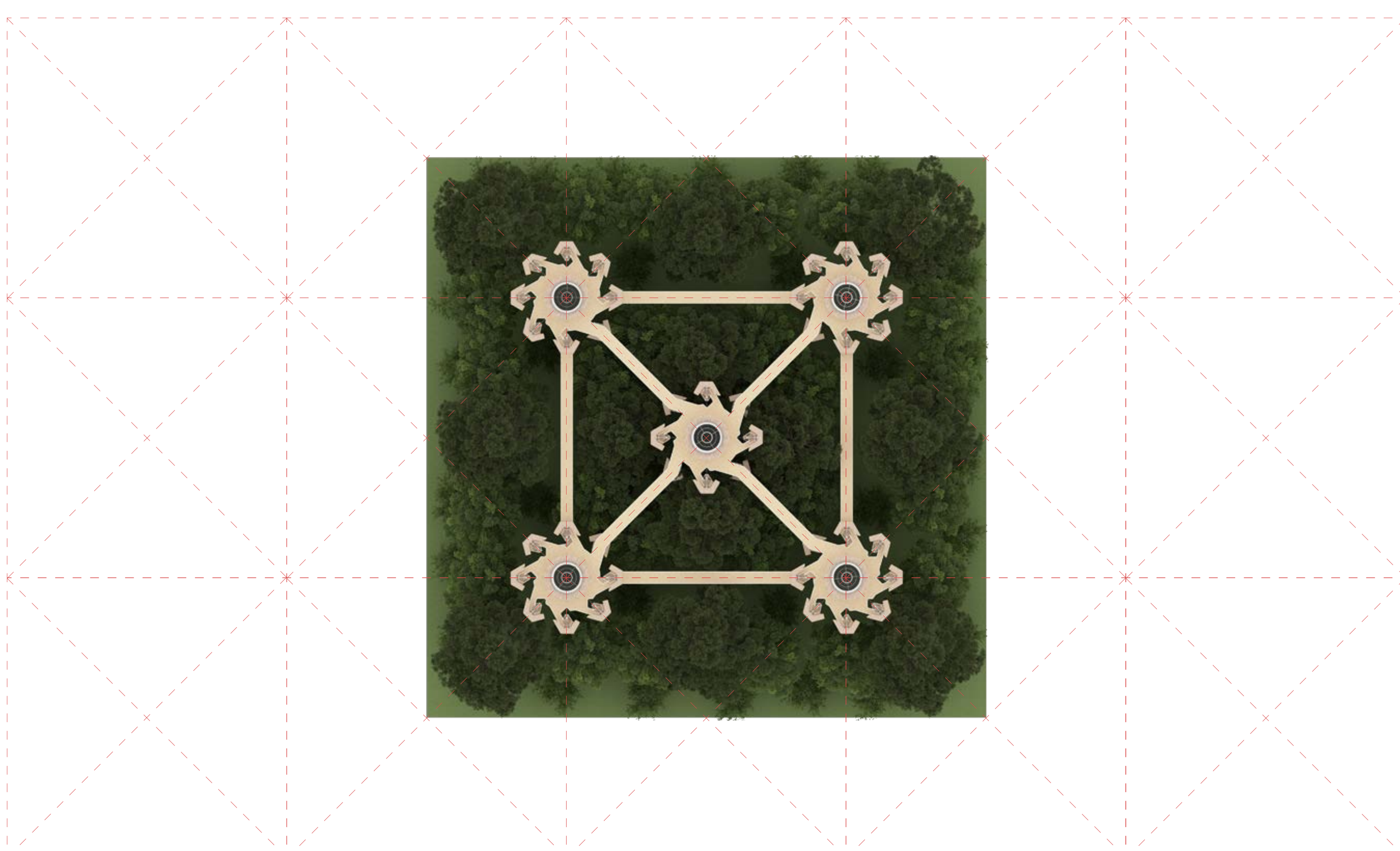
2 Use organic natural materials such as wood or bamboo at particular user- interactive surfaces such as floor, railing, desk surface, etc.

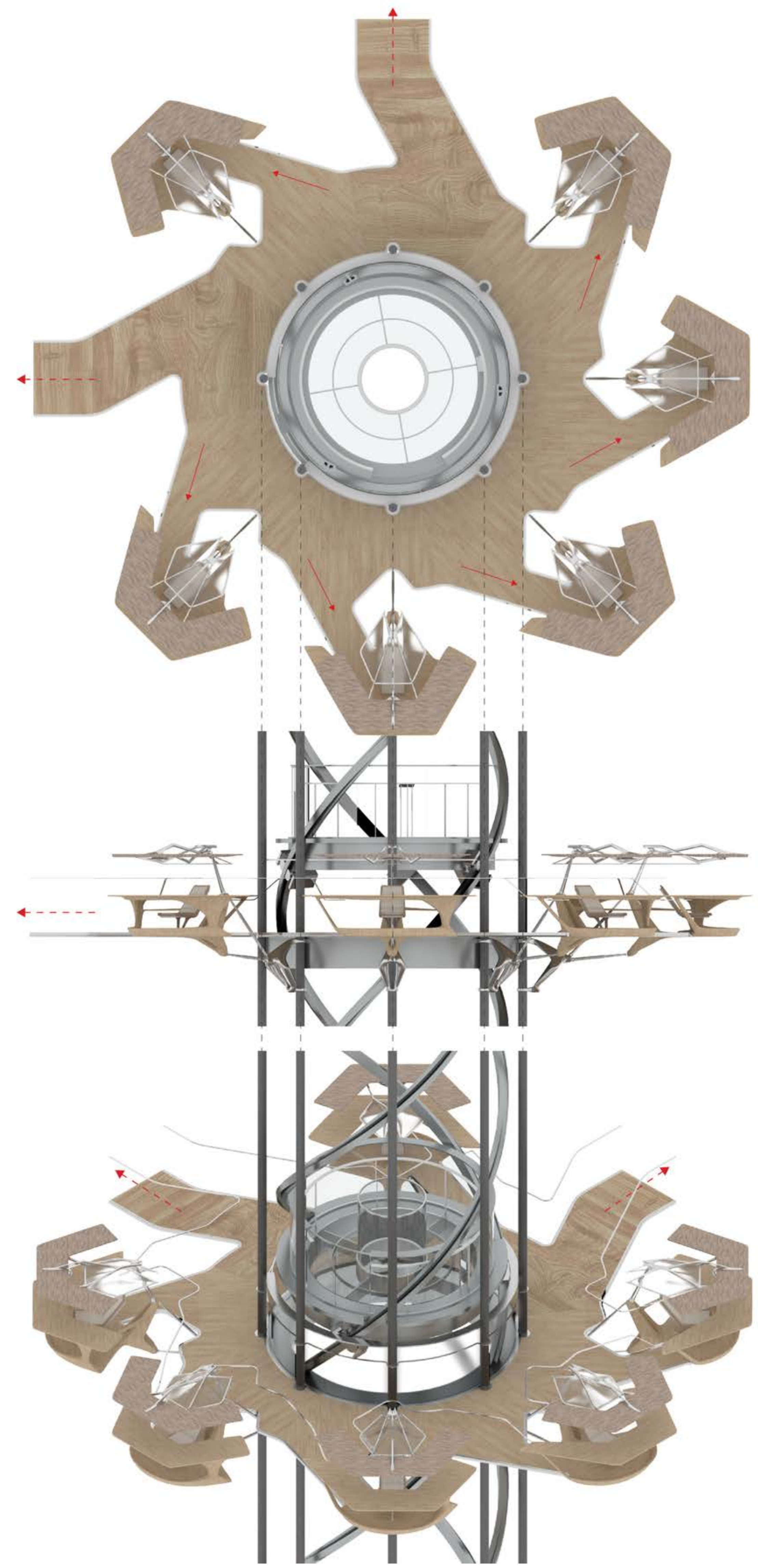
h. Biomorphic Form

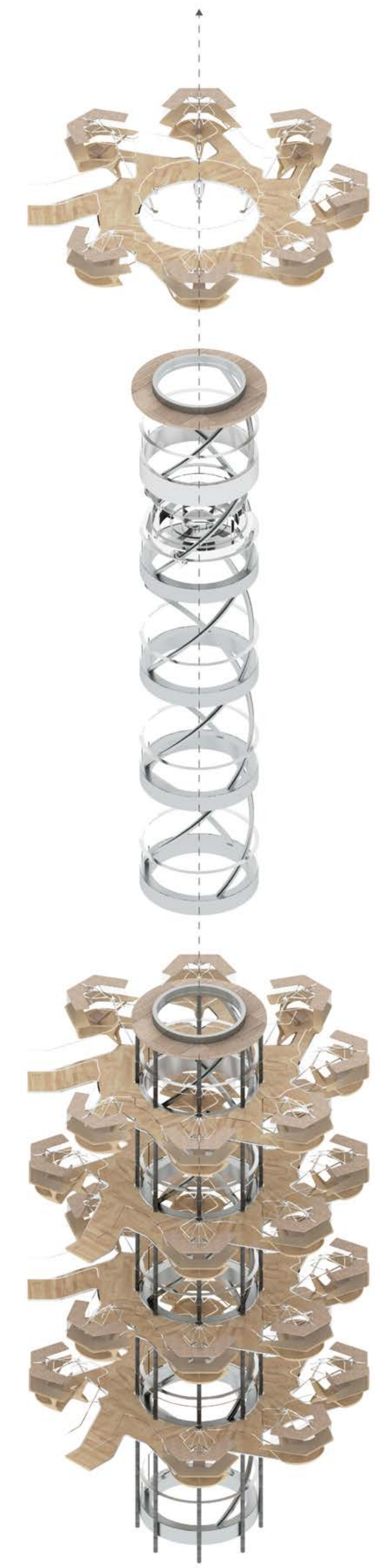
1 Use fractal forms: the forms or patterns that repeat themselves at different scales.

Fractal Plan

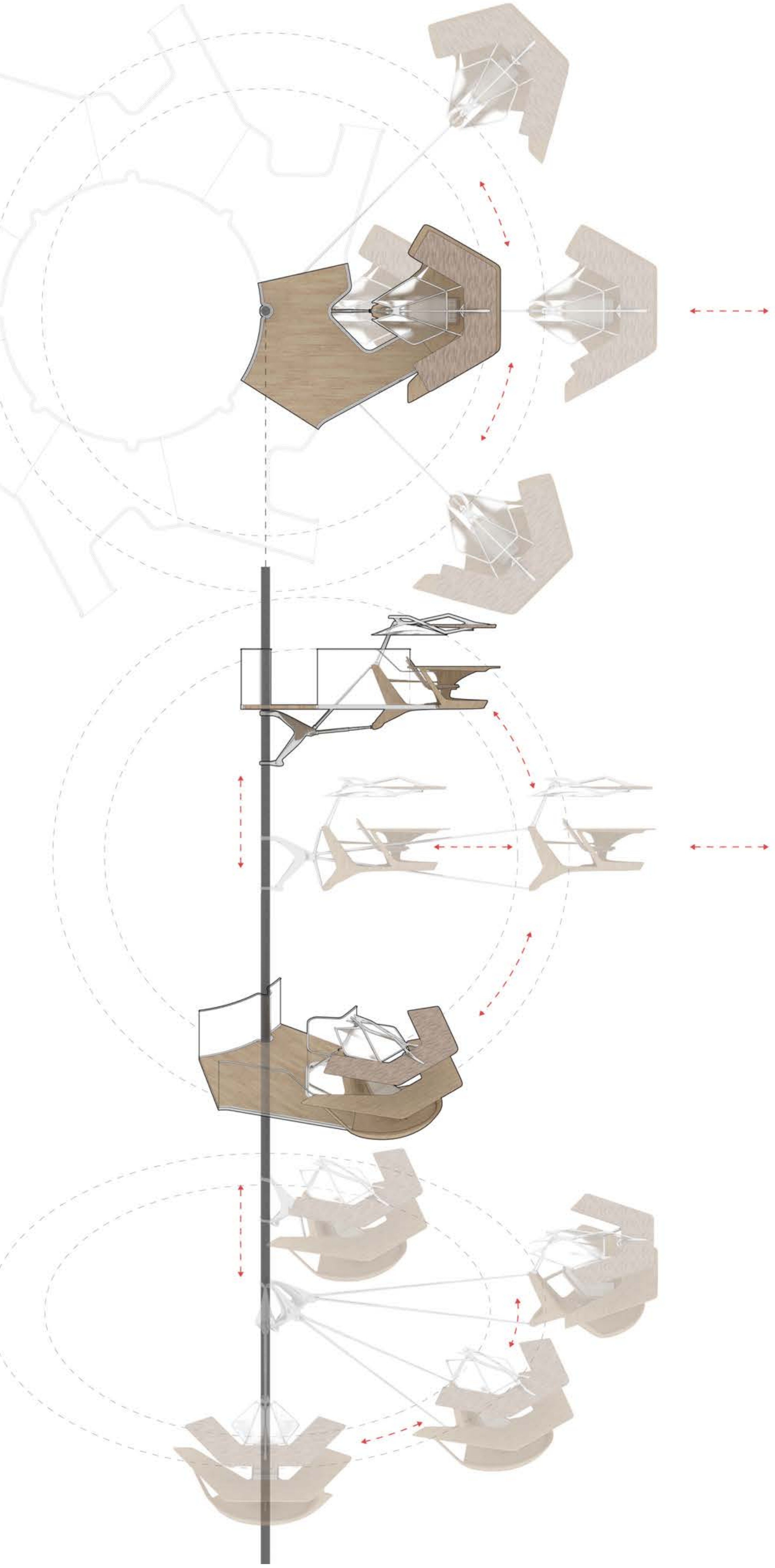
The Plan adopts a fractal square system for expansion, connectivity, enhancement of place identity and users' attention restoration.



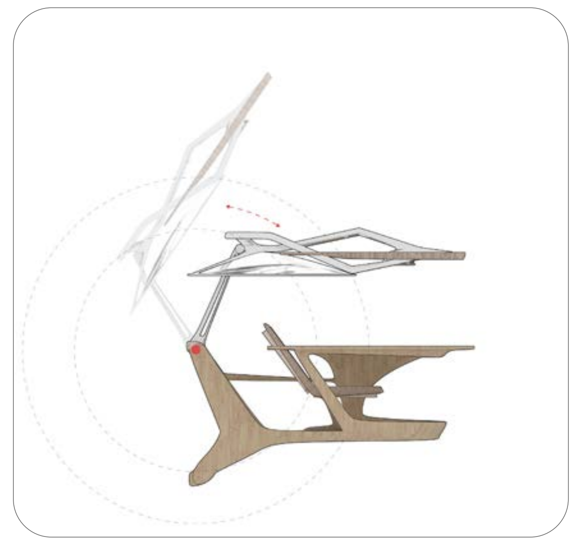


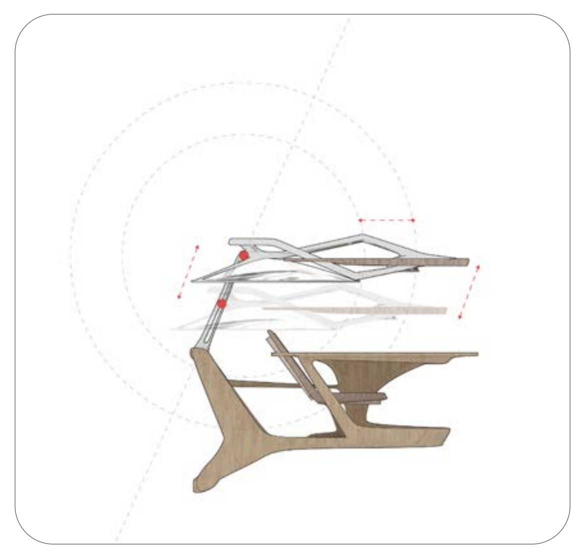


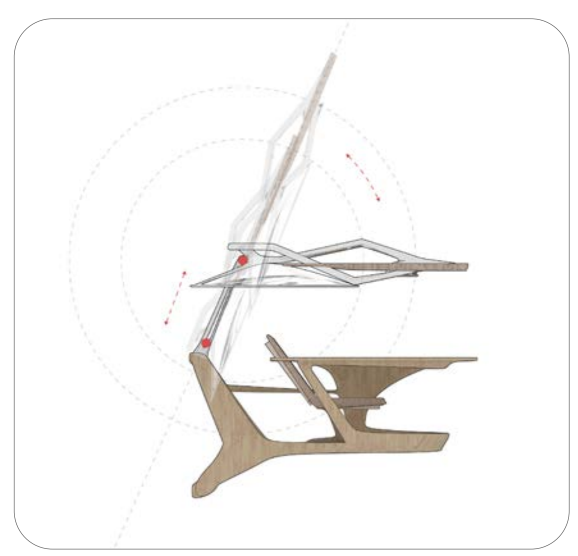
Pod Module

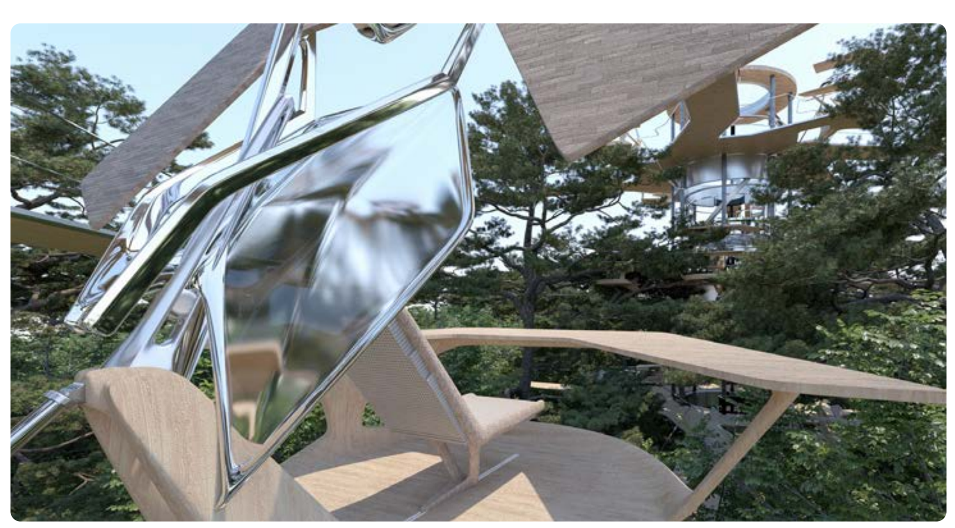


Neuromorphic Mechanism



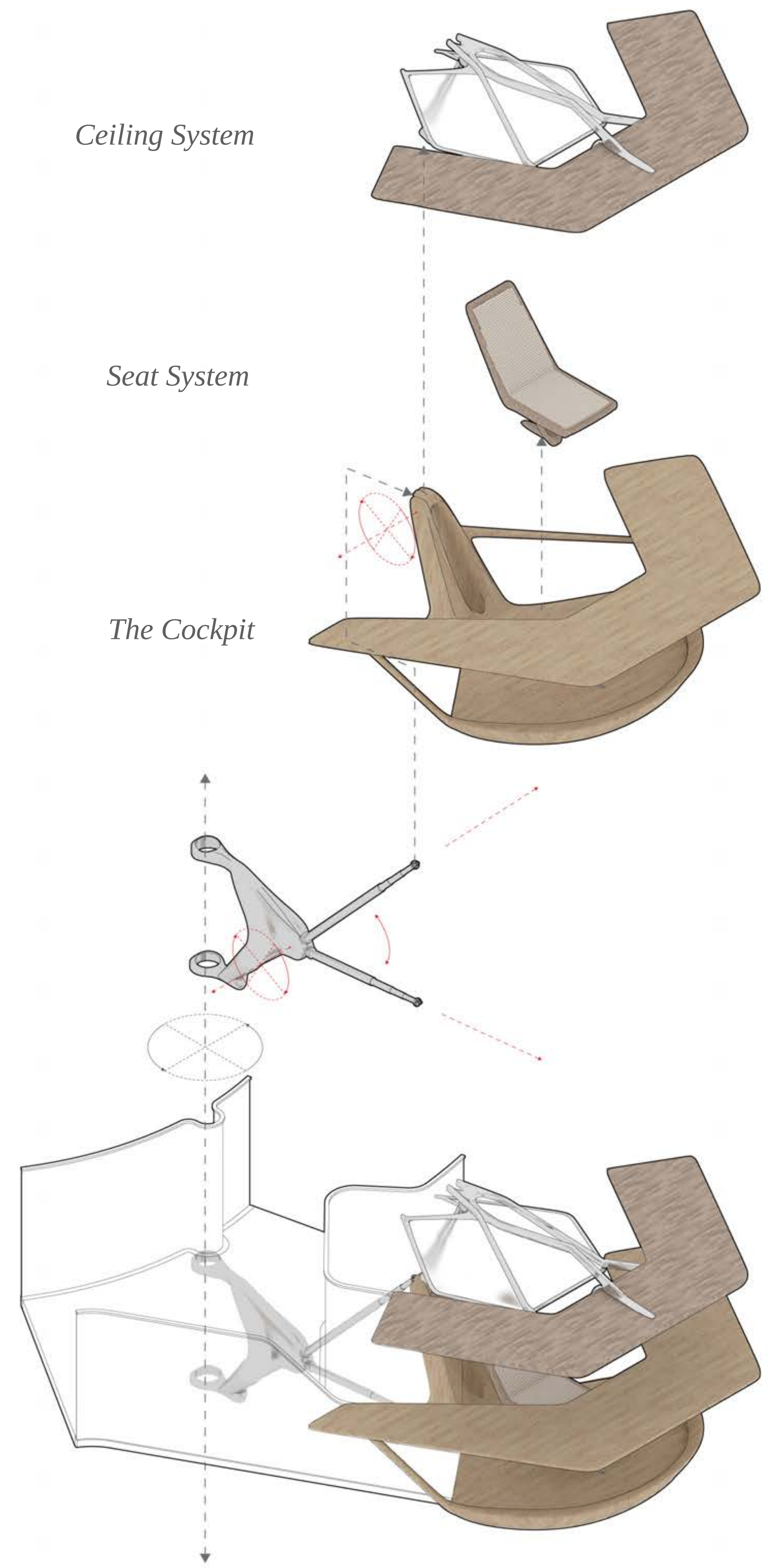


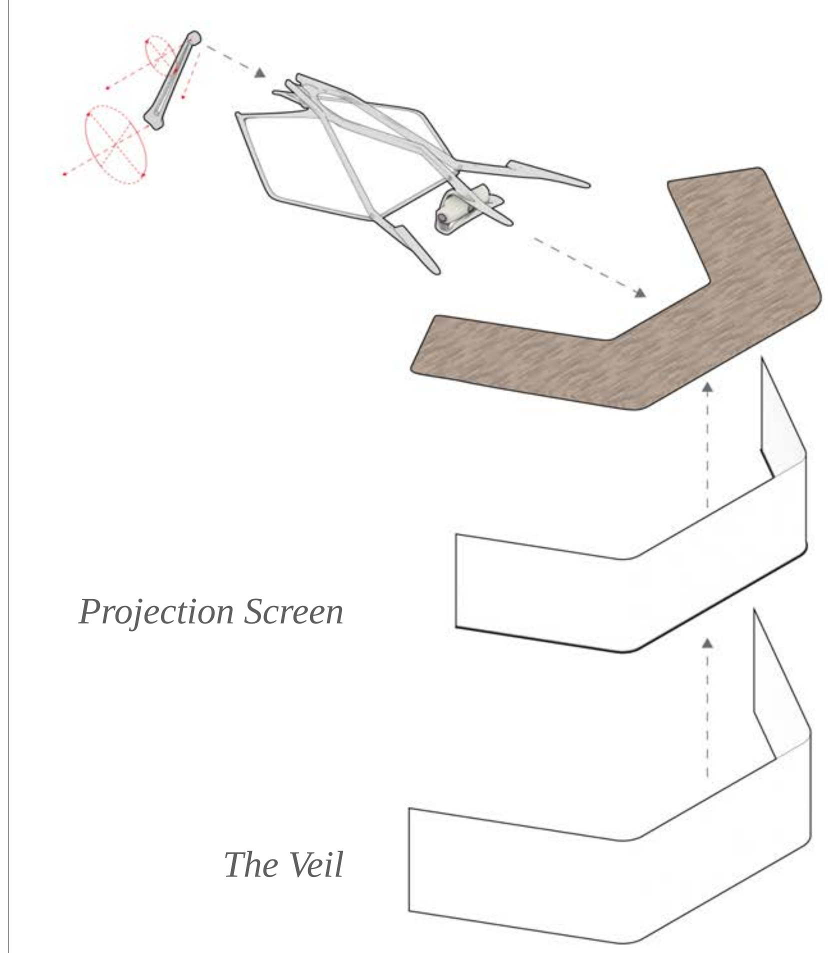




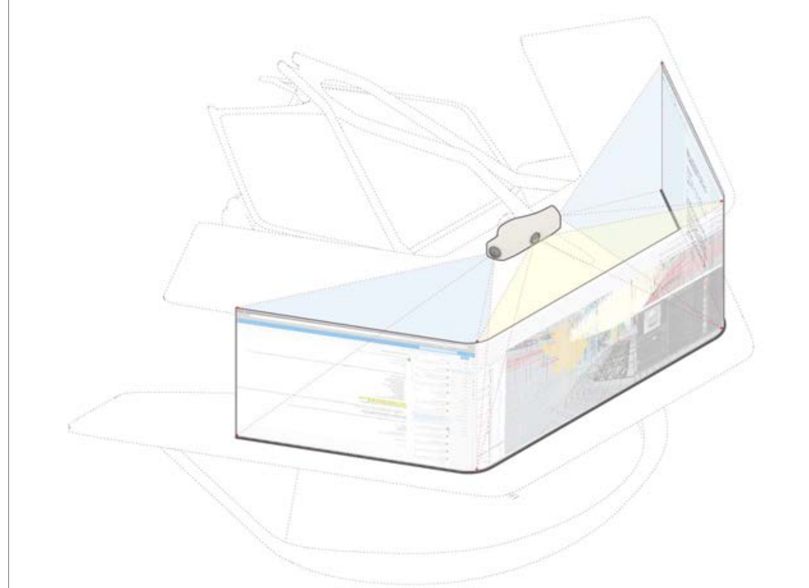
Each pod module consists of a clipping system, cockpit, seat and ceiling system which are dynamically connected to provide maximum adaptability for neuromorphic transformation.

Pod Composition

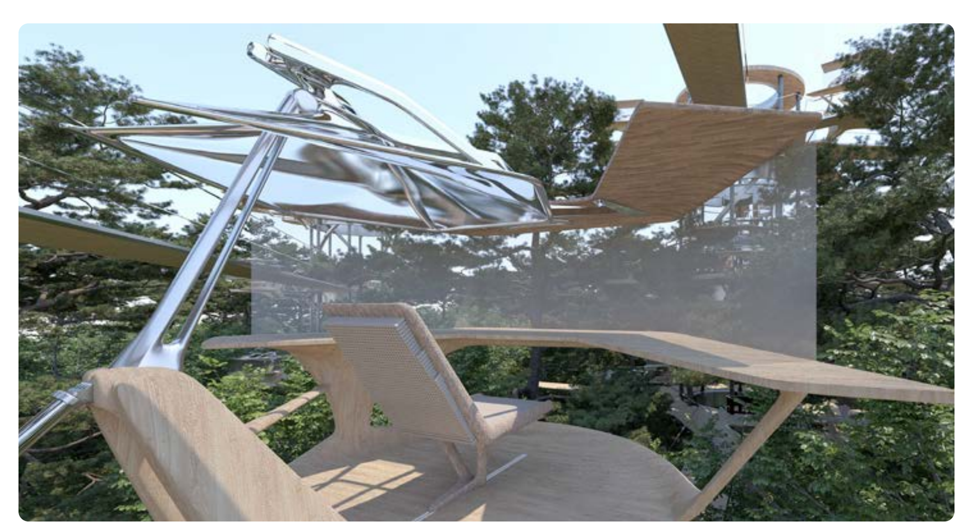




Ceiling System

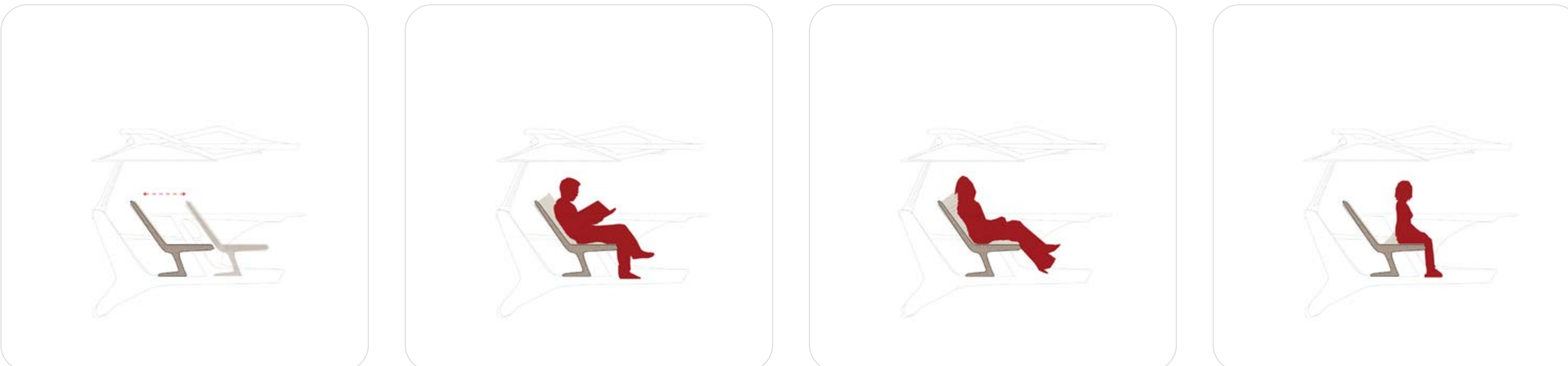


Information Interface



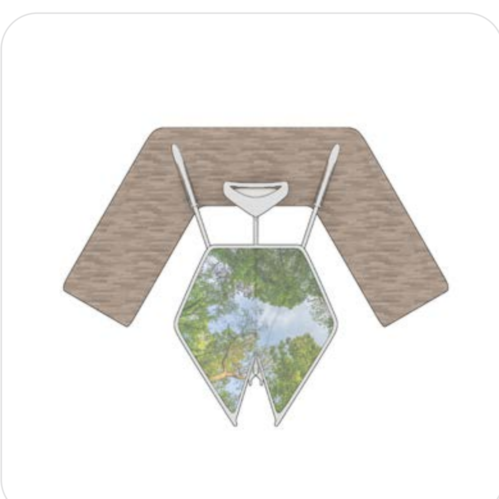
Seating System

The fabric covered pin system with human body sensors within the seat system is able to provide users with the optimal ergonomic sitting experiences.



Peripheral Stimulation System

The cap serves important roles for spatial restriction, peripheral stimulation and also artificial lighting. The bottom surface of the cap works as a digital screen where animations of various environments could be used as peripheral stimulation for users to reduce anxiety and fatigue or enhance cognition.



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