

Expanded Enclosure:
Utilizing Conditioned Micro-Climates and
Spaces to Develop Gradated Envelopes

by

Yasir Amr

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|Author's Declaration|

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by examiners. I understand that my thesis may be made electronically available to the public.

Thesis Author:

Yasir Amr

Waterloo ID: 20568678

B. Architecture + Thesis: Virginia Polytechnic Institute and State University, May 2014

M. Architecture + Thesis: University of Waterloo, December 2015

Committee Members:

Supervisor: Prof. Maya Przybylski

Member: Prof. John Straube

Member: Prof. Richard Andrighetti

External: Dieter Janssen - Architect and Director of DJA

|Abstract|

Architecture is more often than not in the habit of creating spaces separated by generally impermeable partitions that give occupants a high level of control - whether it is directed at achieving shelter, privacy, etc.... While this does address basic human needs, it tends to lead to structures with subdivided interiors. Such a system is useful in programs that call for a high degree of control with regards to privacy and climatic control, however in certain programs, this can result in a loss of cohesion in the design as well as a loss of connectivity between key elements and moments in the architecture.

Alternatively, some architects have explored the notion of an architecture that is laid out in an open gradated condition as opposed to being defined by strict barriers. Such a proposal opens up the possibility for a program that is transparent and free to fluctuate under certain conditions. Conversely, it loses the privacy and control provided by a typical partitioned and enclosed design.

This thesis proposes that architecture does not need to be solely laid out in either subdivided spaces or open gradated ones. Instead it puts forth the possibility that architecture can be enriched by making a careful amalgamation of both autonomous zones that develop key independent moments alongside fluid spaces that lend to the creation of continuous transitions and gradated program. Each system has its merits and disadvantages, and thus each can be carefully applied to programmatic elements that call for one over the other. This provides continual transitions and shifting programmatic potential, simultaneously transforming areas of high control from blocked off rooms to key architectural moments emphasized by a sudden degree of separation in an otherwise fluid system. To help 'dissolve the wall' in fluid spaces, the qualities normally hidden in wall space such as systems and insulation are translated into the habitable space by means of microclimatic augmentation.

These ideas are further explored vis-a-vis a design proposal of a hypothetical a library based in Amman, Jordan that encompasses both kinds of spaces. Modern library programs extend from traditional book storage to include public activity (such as art galleries and event spaces) as well as elements that require climatic control or privacy (such as rare book rooms and digital media centers). This makes it a suitable program for exploration of both kinds of spatial layouts, and the site's predictable geo-climatic qualities lend to a greater degree of experimentation in layouts and climatic enhancement of spaces.

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...I will not be attempting a third.

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-
- Yates, Amanda. Oceanic Spaces of Flow. In “Architecture in the Space of Flows”. ed. Andrew Ballantyne and Chris Smith, 75. Abingdon, Oxon: Routledge Publishing, 2012.
- Banham, Reyner. Environmental Management. In “The Architecture of the Well-tempered Environment”. ed. Reyner Banham, 18. Chicago, Illinois: University of Chicago, 1969.
- Müller, Stephen. ArchDaily. *Jacob and Wilhelm Grimm Center*. May 27, 2013. Accessed October 29, 2015. Available from <http://www.archdaily.com/376900/jacob-and-wilhelm-grimm-centre-max-dudler>.
- Ibid.
- Buffalo History Gazette. *Larkin Administration Building*. October 04, 2011. Accessed October 29, 2015. Available from <http://www.buffalohistorygazette.net/2011/10/larkin-administration-building-of.html>.
- Dezeen. *Lesser Known Brutalist Buildings*. September 14, 2014. Accessed October 29, 2015. Available from <http://www.dezeen.com/2014/09/14/fuckyeahbrutalism-top-11-brutalist-buildings/>.
- Rohspace. Dezeen. *Nameless Architecture adds Concrete Church to Korean Town*. March 09, 2014. Accessed October 29, 2015. Available from <http://www.dezeen.com/2014/03/09/rw-concrete-church-south-korea-nameless-architecture/>.
- Banham, Reyner. Environmental Management. In “The Architecture of the Well-tempered Environment”. ed. Reyner Banham, 20. Chicago, Illinois: University of Chicago, 1969
- Carruthers, Kenneth DB. “Architecture is Space; the Space-Positive Tradition.” *Journal of Architectural Education* 39, no. 3 (1986): 19.
- Ibid, 19.
- Ibid, 17.
- Ibid, 18.
- Ridgeway, Matthew. “Consideration of Four Thresholds”. B.Arch Independent Research, Virginia Polytechnic and State University, 2013. 1.
-
- Hensel, Michael. *Digital Materials*. Lecture, Material Seminar by ROM Gallery, Oslo, Norway, April 25, 2010. (Accessed September 13, 2015). Available from <https://vimeo.com/11615108>.

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source

Digital Photograph. Abiya Mashrabiya. *Mashrabiya, Fretwork, Jali, and Decorative Screens*. Accessed October 3, 2014.

Available from <http://www.abiya-mashrabiya.com/>.

Hensel, Michael and Defne Sunguroglu Hensel. "Extended Thresholds III: Auxiliary Architectures".

Architectural Design 80, no. 1 (2010): 78.

Ibid, 83.

Suzuki, Yukiharu and Associates. Trendir. *Barn Style Home Design*. June 22, 2010. Accessed October 30, 2015.

Available from <http://www.trendir.com/house-design/barn-style-home-design-by-japanese-architecture-firm.html>.

Guralnik, Margot. Remodelista. *An Architect's One-Room Family House*. June 09, 2014. Accessed October 30, 2015.

Available from <http://www remodelista.com/posts/architect-takaaki-kawabata-janson-goldstein-one-room-family-house-upstate-new-york>.

Arch Daily. *Chiarano Primary School by C+S Architects*. October 02, 2014. Accessed October 30, 2015.

Available from <http://www.archdaily.com/550344/chiarano-primary-school-c-s-architects>.

Diller, Scofidio and Renfro architects. DS+R. *Blur Building*. 2002. Accessed November 23, 2014.

Available from <http://www.dsrfny.com/>.

Ibid.

Ibid.

Ibid.

Kehagias, Nicholas. Nicholas Kehagias works. *Climatic Territories*. 2011. Accessed November 24, 2014.

Available from www.nicholaskehagias.com/datacenter/.

Ibid.

Ibid.

Lally, Sean. Weathers LLC. *Sirenuse*. 2011. Accessed December 08, 2014.

Available from <http://www.weathers.cc/Sirenuse>.

Lally, Sean. Weathers LLC. *EOS*. 2014. Accessed December 08, 2014.

Available from <http://www.weathers.cc/EOS>.

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**Unless otherwise stated, all unlisted diagrams are created by the author of this thesis.

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Ibid.

Rahm, Philippe. Philippe Rahm Projects. *Jade Eco Park*. 2013. Accessed December 14, 2014.

Available from <http://www.philipperahm.com/data/projects/taiwan/index.html>.

Ibid.

Lally, Sean. Weathers LLC. *EOS*. 2014. Accessed December 08, 2014.

Available from <http://www.weathers.cc/EOS>.

OMA Architects. OMA Projects. *Yokohama Master Plan*. 1992. Accessed May 23, 2015.

Available from <http://www.oma.eu/projects/1992/yokohama-masterplan/>.

Arch Daily. *Maison Simon / Mathieu Noël & Élodie Bonnefous architectes*. January 12, 2014. Accessed May 22, 2015.

Available from <http://www.archdaily.com/465664/maison-simon-mathieu-noel-and-elodie-bonnefous-architectes/>.

Brittain, James. KPMB Architecture. *Fort York Library*. 2014. Accessed February 17, 2015.

Available from <http://www.kpmb.com/index.asp?navid=30&fid1=91&fid2=124#desc>.

Arch Daily. *Andrée Chedid Media Library by D'HOUNDT+BAJART Architects and Associates*. September 29, 2014. Accessed February 17, 2015.

Available from <http://www.archdaily.com/550315/andree-chedid-media-library-d-houndt-bajart-architects-and-associates>.

Arch Daily. *Dalarna Media Library by Adept*. June 03, 2014. Accessed February 17, 2015.

Available from <http://www.archdaily.com/511535/dalarna-media-library-adept>.

Arch Daily. *Media Library and Cultural Centre / Barbotin + Gresham Architects*. October 13, 2011. Accessed February 17, 2015.

Available from <http://www.archdaily.com/112856/media-library-and-cultural-centre-barbotin-gresham-architects>.

Arch Daily. *Arthur Rimbaud Media Library and Cultural Centre by Dacbert Cochet Chapellier Architects*. March 04, 2011. Accessed February 17, 2015.

Available from <http://www.archdaily.com/116112/arthur-rimbaud-media-library-and-cultural-centre-dacbert-cochet-chapellier-architects>.

Dezeen. *Serpentine Gallery Pavilion by Sou Fujimoto*. June 04, 2013. Accessed March 23, 2015. Available from

<http://www.dezeen.com/2013/09/29/i-tried-to-create-something-between-architecture-and-nature-sou-fujimoto-on-serpentine-gallery-pavilion-2013/>.

Ibid.

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source

Dezeen. *LitraCon Light-Transmitting Concrete*. January 20, 2008. Accessed October 22, 2015.

Available from <http://www.dezeen.com/2008/01/20/litracon-light-transmitting-concrete/>.

LitraCon. *Products*. 2010. Accessed October 22, 2015.

Available from <http://www.litracon.hu/en/products/litracon-blokk>.

The Architects Newspaper. *Product > In The Mix*. July 20, 2011. Accessed October 22, 2015.

Available from <http://archpaper.com/news/articles.asp?id=5517#.VilzJisn076>.

Etherington, Rose. Dezeen. *Translucent Concrete by Andreas Bittis*. December 17, 2007. Accessed October 22, 2015.

Available from <http://www.dezeen.com/2007/12/17/translucentconcrete-by-andreas-bittis/>.

Brandt, Maxwell. Geography Lists. *Amman (Jordan)*. April 2010. Accessed November 15, 2014.

Available from http://www.geographylists.com/jordan_amman.html.

Abduljalil, Leen. Received by request via email. February 27, 2015.

Bonsor, Kevin. How Stuff Works - Home & Garden. *How Smart Windows Work*. Accessed August 14, 2015.

Available from <http://home.howstuffworks.com/home-improvement/construction/green/smart-window.html>.

Canadian Center for Architecture and Urban Studies. *Cedric Price: Fun Palace*. Accessed December 18, 2015.

Available from <http://www.cca.qc.ca/en/collection/283-cedric-price-fun-palace>.

01

[Opening]

|Introduction|

“That architecture has often traditionally been preoccupied with the ‘hard’ (structure, forces, geometries of form), letting the ‘soft’ (qualitative environments, mood, atmosphere) become secondary, or residual, is a fairly obvious fact. Looking back, we find endless variations on form defined through structure and envelopes, often ignoring what’s in between these fixed elements... This space, however, has always been imbued with endless qualities, behaviors, and effects...which are...distinctly material in nature”¹

-Sean Lally

Architects such as Philippe Rahm, Sean Lally, and Reyner Banham make a case that contemporary architecture concerned with efficiency and outward appearance often becomes internally subdivided into hard-divides of space and program that lead to a slotted and disrupted organization.² Programmatic and climatic control along with privacy are the key points within such designs, but at the cost of continuity and interconnectivity between spaces. The experience of occupants traversing through the architecture also maintains the chance of becoming too limited through excess striation of the space.

Such architects offer an alternative model to this, suggesting an architecture that acknowledges transitional space and experiential connectivity as its central focus. Space in this model is focused around nodes of activity or program that would ideally act as a membrane; one capable of fluctuating in response to the intensity of programmatic activities and climatic energies. This intensity is affected by the quality of the program and its response to other nodes or environmental conditions.³ Architects such as Lally who advocate this model suggest that energies can be used to create gradated conditions of space in lieu of thick walls, and that by expanding these walls into habitable membranes the architectural qualities of a space can be enhanced.

This thesis aims to show that architecture should reflect consideration of both forms of space, recognizing what each can bring to the design as specific spaces and as a whole. As such, while capable of following one model or the other, architecture can be composed of both forms of space. In turn, the architecture can be enriched by the amalgamation of spaces that take on these spatial approaches. This concept is explored in three main parts within this thesis.

The first of the three main chapters discusses *flow* within space. *Flow* in this sense is concerned with the movement of occupation and activity throughout a specific set of spaces. Out of this comes the suggestion of programs that have the capability of fluctuating in response to external conditions. This chapter also explores two spatial models that have become regularly cited in the works of other architects pursuing this subject: Rayner Banham’s *campfire* and *tent models*. These models are briefly evaluated against one another for the benefits and downsides of each. This exploration of the campfire model in particular expands into an investigation of *positive space continuity* and *threshold*.

The second portion of this thesis approaches methodology in creating open spatial configurations. It looks into the work of architects such as Michael Hensel and its understanding of physical components in mediation of dissolving spatial barriers. This brings about the question of the relation between materiality, space, environment, and user in the creation of selectively permeable physical qualities. Following this is a second more conceptual look at dissolving barriers that rejects the physical entirely. Here, this thesis emphasizes the notion of the sensorium, microclimates, and microclimatic case studies. This finalizes in the suggestion of a method of ‘expanding the wall’ where systems, insulation, etc... that would normally be tucked into the wall space are brought out into the habitable space through the augmentation of microclimates. The wall itself under this method may exist not as a container of energy and systems but as a tool in direction of *flow* and creation of permeable and expanded boundary conditions. Supplementary to this is a quick overview and understanding of the representation of microclimatic effects as dynamic forces in architectural drawings.

¹ Sean Lally. “Softspace: From a Representation of Form to a Simulation of Space”. ed. Sean Lally and Jessica Young. (Abingdon, Oxon: Routledge Publishing, 2007). Preface.

² Reyner Banham. Environmental Management. In “The Architecture of the Well-tempered Environment”. ed. Reyner Banham. (Chicago, Illinois: University of Chicago, 1969). 18.

³ Ibid, 20.

After an exploration of spatial and climatic qualities, the third chapter is a design proposal of a library that contains both tent and campfire-like spaces. The library is selected for its variety of programmatic elements with a wide range of spaces that require low level, mid level, and high levels of climatic and *flux* control. The selected site of Amman, Jordan compliments the experimental layout with ideal environmental conditions, such as favorable thermal conditions and predictable weather patterns. Before getting into the design itself the thesis in this section presents a catalogue of devices; passive and active, physical and dynamic; that lend to the creation and augmentation of the proposal. Microclimatic effects are naturally explored and represented here, however, it should be noted that the values represented in this thesis are non-numerical and do not represent empirical data.

The thesis concludes discussing the challenges faced in the exploration and proposal. After having analyzed the advantages and disadvantages of each system separately, it presents the positives and negatives of a system that is comprised of both campfire and tent models. Finally, the thesis explores additional possibilities in the speculative realm of the proposal and spatial concepts.

02

[Flow and Space]

|Flow and Flux|

When talking about the differences between an architecture of strict subdivisions and an architecture that relies on indistinguishable gradations in an open layout, one major consideration is the movement of occupants throughout the design. In the former, occupants are faced with layouts of paths consequential of the divisions in the design, with some spaces along the paths permeable only to a few. *Flow* in this scenario is a product of guided and mapped out conditions of access. In the latter spatial condition, however, movement is free to sprawl with ease of access in virtually all directions.

As such, the relationship between architecture and *flow* occurs when architecture concerns itself with how purposefully it can direct, permit, or pause the general occupant activity and experiential movement, or *flow*, within itself. The spatial qualities of the architecture are then determined by how *flow* is treated.

Herkleitos of Ephesus, a pre-Socratic Greek philosopher, is known for having stated that we can never step into the same river twice for the water within it is constantly changing.⁴ The names we give to rivers, then, are not actually for their waters but for their banks, that which contains and guides the flowing waters. In a similar manner, architecture is not the experience of *flow* itself but is that which contains and guides the *flow* of spaces and the experience that comes out of it.⁵

The term *flow* tends to evoke the notion of smooth, fluid movement. However, when concerned with spatial and architectural qualities, *flow* can be a component of movement in either *smooth space* or *striated space*,⁶ respectively representing open gradated layouts and subdivided structures. It is how *flow* is dealt with that determines spatial quality. *Flow* may be guided, paused, and released in a controlled manner or otherwise left to blur and diffuse about freely.

Gilles Deleuze and Felix Guattari coined these spatial terms in their book “A Thousand Plateaus” which provides a conceptual framework that has been translated into mannerisms of architecture. As is their style, they never directly define the terms, instead offering definition through examples, mundane and otherwise.

A noteworthy example in the chapter about smooth and striated space is the variation between fabric, which is considered *striated* due to its grid-like subdivision of elements, and felt, which instead is *smooth* due to the lack of subdivisions and a flowing non-modular mesh of various patterns.⁷ Thus, striated space may be considered homogeneous in its order and smooth space heterogeneous in its amalgamation of various forms.

Deleuze and Guattari emphasize that no one space is purely smooth or striated. The sea or the desert, according to the two philosophers, may be considered the archetype of both striated and smooth space, dependent on the scale at which the sea or desert space is examined.⁸ Grains and drops may act independently on a small scale, but merge on a larger scale to smooth space, only to be striated once more by the cutting and shaping effects of wind, man, animal, and nature. On a larger scale once more this resembles the quality of felt in the intermingling of various unique patterns lending to one larger smooth meta-space. What this means in architectural terms, as far as this thesis is concerned, is that any one design may be formed out of the interaction between both subdivided and gradated spaces as opposed to favoring one over the other.

4 Andrew Ballantyne and Chris L. Smith. Fluxions. In “Architecture in the Space of Flows”. ed. Andrew Ballantyne and Chris L. Smith. (Abingdon, Oxon: Routledge Publishing, 2012). 2.

5 Ibid, 3.

6 Gilles Deleuze and Felix Guattari. 1440: The Smooth and The Striated. In “A Thousand Plateaus: Capitalism and Schizophrenia”. (Minneapolis, University of Minnesota Press, 1987). 474-500.

7 Ibid. 475-476.

8 Ibid. 478-479.

Flux in mathematical terms of transport and movement is defined as the amount of *flow* occurring per unit of area.⁹ Translated to architectural terms, *flux* relates to the rate of connectivity and fluidity brought on by *flow* in architecture. In other words, *flux* in architecture is the change in which activity and programmatic occupancy occur.

Amanda Yates, a senior lecturer of AUT University concerned with *flow* between landscape and interior, says that “Architecture is always in a condition of *flow*, channeling people, rainwater, breezes, birdsong, energy, while architectural boundaries or material accumulate or abrade, swell or settle, transforming through time”.¹⁰ She says even the most static architecture fluctuates both physically (such as in the examples of heating, cooling, expanding, contrasting, eroding, and accruing) and experientially as outlined in this chapter. Yates goes so far as to state that *flow* in architecture becomes an event where space is constantly undergoing a state of *flux*.¹¹

In her works, both in practice and in theory, Yates examines the opportunities of interior and exterior exchanging and enhancing movement between one and the other. This is most effectively seen in ‘Tokatea House’ (figure 1.1) which she constructed in order to examine the state of *flux* between spaces. According to Yates, spatial experience is enhanced in the *flux* that occurs on both a spatial (physical layout and material interplay) and sensory (experiential and climatic) level. Moments of *flow* are emphasized by the contrast between spaces that allow it to proceed naturally and those that direct it elsewhere through a hard divide. The interaction of the occupants with these spatial conditions creates continual *flux*.¹²

What is to be understood here is that architecture should not reject *flow* between spaces, favoring subdivided spaces of autonomous qualities throughout the entire system, but neither should it let it *flow* out of control. Instead it should guide it and direct it, allowing for complete pauses or entire dispersals in carefully selected moments. It is up to the architect to determine when *flow* is constant, in a state of a *flux*, or at a continuous halt in order to understand and best be able to underscore architectural moments.

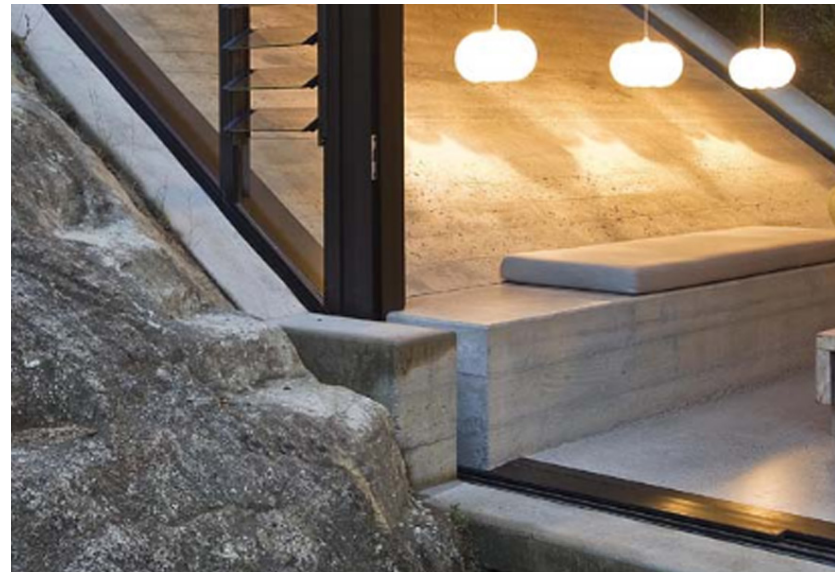


Figure 2.1 - “Tokatea”.
By Amanda Yates. 2005. Whitby, New Zealand.

9 Byron Bird. “Transport Phenomena.” New York: Wiley Publishing, 1960.

10 Amanda Yates. Oceanic Spaces of Flow. In “Architecture in the Space of Flows”. ed. Andrew Ballantyne and Chris L. Smith. (Abingdon, Oxon: Routledge Publishing, 2012). 63.

11 Ibid. 64.

12 Ibid. 65-66.

|The Tent and the Campfire|

A driving force behind early architecture was the need for shelter from natural elements in order to achieve suitable comfort and living conditions. The primitive hut, in conjunction with additional resources and aids, offered dryness in the rain, a solid barrier against the wind, heat in the winter, and shade in the summer.¹³ Shelter as a key component has not been forgotten in today's architecture, however, it is often translated to the construction of large, permanent and subdivided structures that can, in some cases, entirely reject the environment and context in which the architecture is placed.¹⁴ Furthermore, it is not just the interior-exterior relationship that is lost, but the subdivisions leave every space within those two realms acting independently of others.

There are of course advantages to this: privacy is ensured and there is a higher level of control of certain conditions from space to space. Ultimately though, the architecture is no longer a unified singularity with fluid transitions and experience through the site as a continuous whole may be lost. This notion resonates with Deleuze and Guattari's concept of smooth space.

This model follows Reyner Banham's notion of the 'tent' (figure 2.2) in his spatial explorations of a metaphorical comparison of 'tent' and 'campfire' spaces that directly relate to the spaces of *flow* explored earlier. Both models exist as forms of environmental aids, that is to say passive or active elements that augment the architecture to gain some degree of control over environmental forces. The tent aims to create high levels of privacy with a central focus on thermal and acoustic barriers. This ultimately leads to a greater degree of divided solitary zones, protecting and sheltering occupants by rejecting elements and creating a clear separation between one space and the next.¹⁵

This carries on into typical everyday models of architecture where spaces of all kinds, not just localized sites of interior-exterior interaction, are placed with thick dividing walls between them. Each space exists within itself without interaction with other spaces around it. Some of these spaces can be grand and well designed, but shaped only by its own sub-program and climate it remains static and without indication of connections to the design as a whole. In short, these spaces exist only within and of themselves. Figures 2.3 - 2.7 show some interiors and exteriors that possess thoughtful architecture but ultimately remain subdivided in the tent manner, either occurring between interiors or the design and its context.

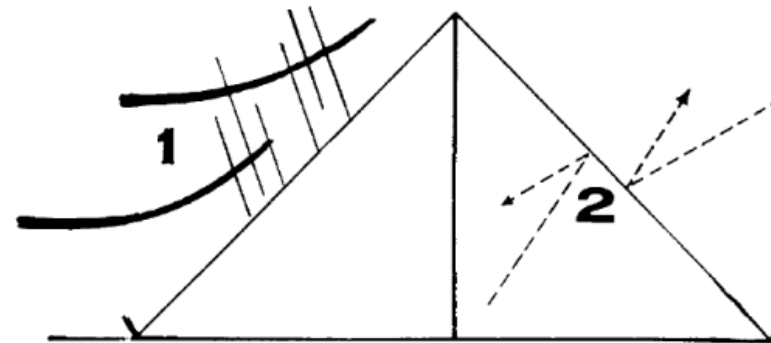


Figure 2.2 - "Environmental Behavior of a Tent".
Diagram by Banham. *Architecture of the well tempered environment*. 18.

1. Tent membrane deflects wind and excludes rain
2. Reflects most radiation retaining heat, excluding solar heat, maintaining privacy.

¹³ Marc-Antoine Laugier. *General Principles of Architecture*. In "An Essay on Architecture". (Los Angeles: Hennessey & Ingles Inc, 1977). 12-14.

¹⁴ Banham. *Environmental Management*. 18.

¹⁵ *Ibid*, 18-20.



Figure 2.3 - "Jacob and Wilhelm Grimm Center - Main Reading Room".
By Max Dudler. 2009. Berlin, Germany.

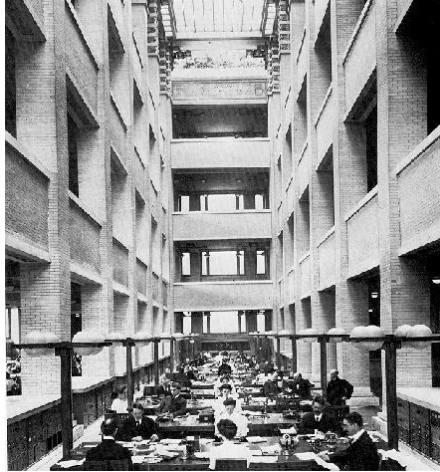


Figure 2.5 - "Larkin Administration Building - Atrium".
By Frank Lloyd Wright. 1906. Buffalo, New York, USA.



Figure 2.6 - "Shri Ram Center for Art and Culture".
By Shiv Nath Prasad. 1969. New Delhi, India.



Figure 2.4 - "Jacob and Wilhelm Grimm Center - Exterior".
By Max Dudler. 2009. Berlin, Germany.



Figure 2.7 - "RW Concrete Church".
By Nameless Architecture. 2013. Byeollae, Korea.

The ‘campfire’ (figure 2.8) instead acts and reacts to other spaces and the environment itself. While it offers little in passive protection or privacy of the tent’s kind, it acts as a central unit of energy offering light and heat around which activities, ceremonies, and program are capable of being situated amongst fluctuating zones of energy. The spaces it creates are without strictly defined borders, but rather exist along a gradated spectrum from its center and out into the environment. These spaces also shift in reaction to external stimuli, or ideally even in reaction to spaces of another ‘campfire’ node of energy. In fact, the campfire model suggests that all spaces, natural or built, external or internal, each act as a form of energy node (where the energies may incorporate occupation, climate, or use)¹⁶, placing all spaces on potentially equal footing (figure 2.9). Rather than unmoving and stoic, program and space built around one or more central nodes perform dynamically and fluctuate accordingly.

Banham goes on to say that in the past, the tent and the campfire were viewed by nomadic tribesmen as being of the same essential materials (wood, animal products, etc...) but were different in what they could offer in different climatic situations. Nomads would make decisions based on how effectively available materials could be utilized in response to their environment rather than repeatedly selecting a single method. In this light, Banham criticizes architects that favor the tent’s ideal of subdivision and non-interactive performance without considering if a campfire-like architecture could exist within the provided context first.¹⁷ Perhaps it is time for campfire-like designs to be explored further for their potential. Within this thesis, a notion of space that contains the flexibility of nomadic conceptions will be explored, supported by investigations of physical layouts and climatic augmentations that allow for experimentation with both campfire and tent systems in a single design.

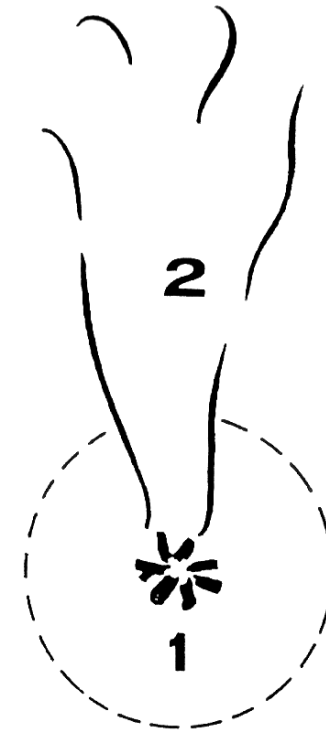


Figure 2.8 - “Environmental Conditions Around a Campfire”.
Diagram by Banham. *Architecture of the well tempered environment*. 20.

1. Zone of radiant heat and light
2. Downwind trail of warmed air and smoke.

¹⁶ Ibid, 20-22.

¹⁷ Ibid. 24.

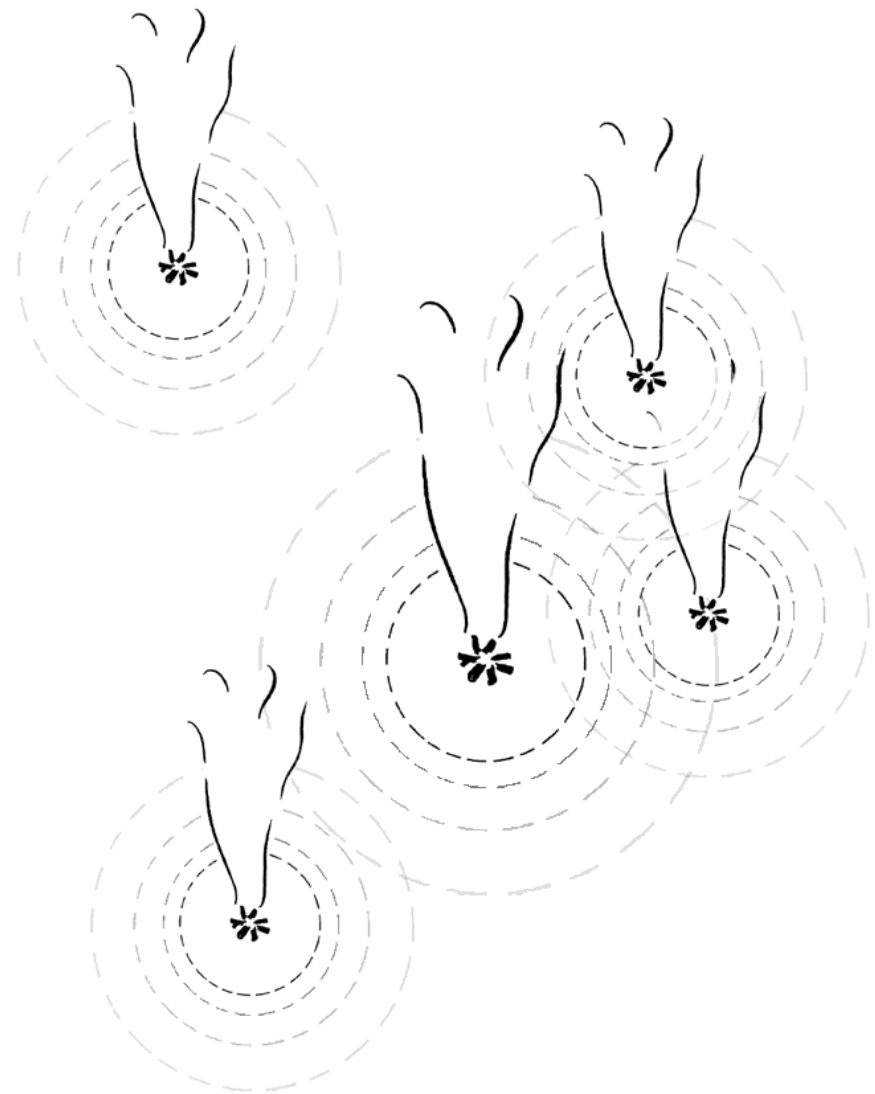
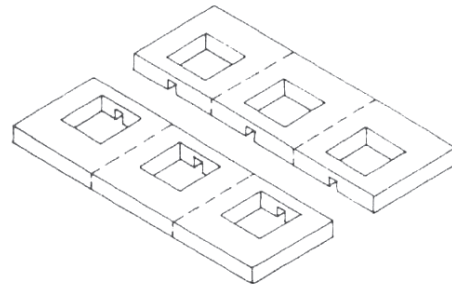


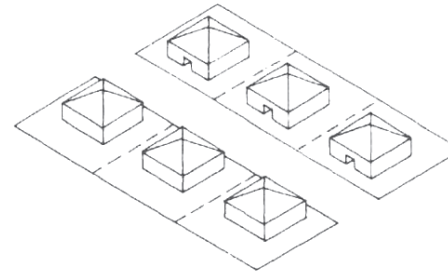
Figure 2.9 - "Campfire Multiplicity".
Diagram by author, expansion of original diagram by Banham (see left).

|Space Positive Continuity|



+space

The Eastern Courtyard House



+form

The Western Tract House

Certain cultures of the past and present including Greek, Roman, and Islamic have developed an architecture that more closely follows the ideals of the campfire model. Structures in these settings with an open layout in mind offer a continuity that allows for the architecture to extend into surroundings and be more involved in the environ-social context on both performative and spatial levels. Kenneth Carruthers, an architecture researcher and educator, explores this phenomenon in what he calls the 'space positive tradition', with particular focus upon traditional Islamic architecture.¹⁸

Carruthers first begins his exploration of simple home archetypes of the Middle East and the modern West, (figure 2.10) referring to them respectively as *architecture of space* and *architecture of form*, comparing how space is treated in each. Three central ideologies are identified in Carruthers' findings that are applicable to the design of *campfire-space* structures:

- 1- Form is monumental and introverted, space is non monumental and extroverted. (Figure 2.11)
- 2- Outside becomes inside. (Figure 2.12)

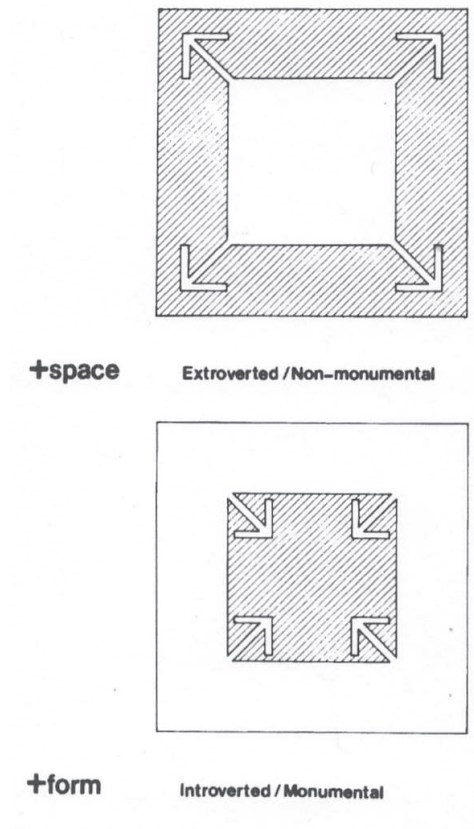
3- Space is not the leftovers on a Cartesian grid after form is made, but instead carefully planned from the start.

Architecture that concerns itself with subdivisions of non-interactive spaces becomes monumental. The design becomes a testament to the sum of interior spaces as opposed to the multiplicity of them working together. This leaves the design to stand out as a monolith within its environment, ignoring the surrounding context.

In designs with a focus on space continuity, however, much like traditional homes, mosques, and bazaars of the East, the 'outside' is welcomed into the 'inside' (figure 2.13). Plazas and courtyards act as threshold spaces between exterior and interior, between public and private, and between natural thermal conditioned and filtered ones (through the use of vegetation, water features, and material). The larger scale the architecture and the more feasible the program, the more likely there are sub-courtyards, or - from another point of view - more pockets of exterior space interjecting the interiors and ultimately blurring the divide.¹⁹

¹⁸ Kenneth DB Carruthers. "Architecture is Space; the Space-Positive Tradition." *Journal of Architectural Education* 39, no. 3 (1986):17.

¹⁹ *Ibid*, 18-20.

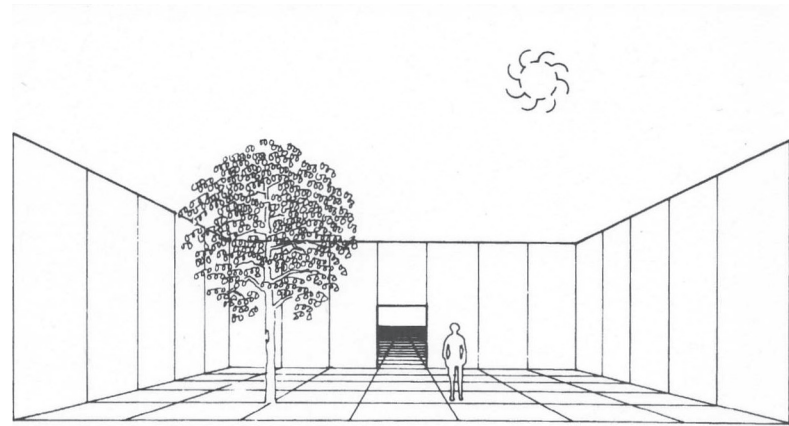


Furthermore, these spatial constructs are not formed from the negative after a plan of interior spaces has been made. They are central to program, function, and design. This contrasts to architecture of form where surrounding space is simply unused space. As such, positive space continuity is not just a continuity of transition but one of effective consumption where every bit of the context is incorporated into the design.

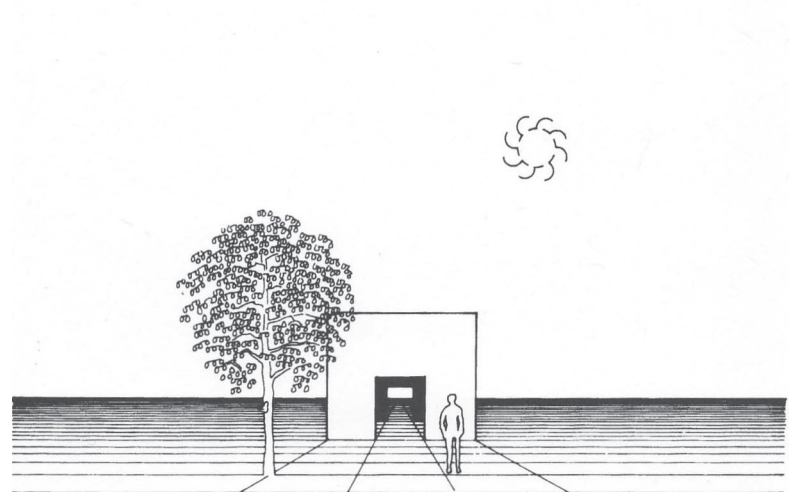
Again, architecture of space is simply an exploration into a physical and spatial layout of how to achieve effective campfire-like designs in the architecture, proving that functionality and planning are not sacrificed by ‘opening up’ the design more to the environment. What is important here is the recognition that the elements are not to be rejected from affecting the design and then synthetically fabricated through machines or other methods, but can instead be filtered to desirable comfort zones and living conditions.

Left: Figure 2.10 - “Space and Form Houses”.
Diagram by Carruthers. Architecture Is Space: The Space-Positive Tradition

Above: Figure 2.11 - “Space is Extroverted/Non-Monumental, Form is Introverted/Monumental”.
Diagram by Carruthers. Architecture Is Space: The Space-Positive Tradition.

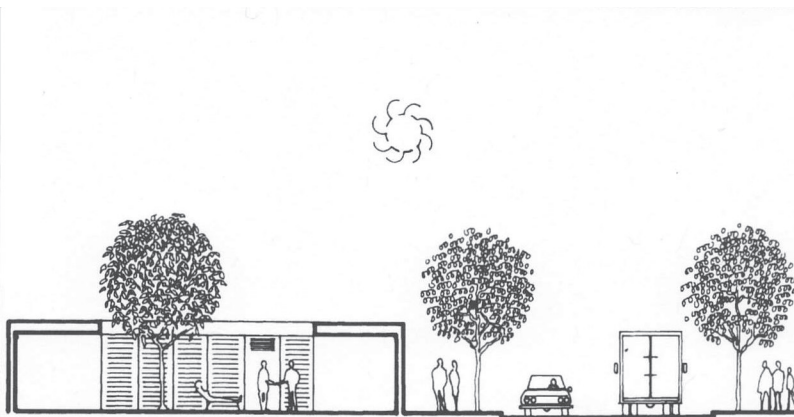


+space **Inside the Outside** Objective Space



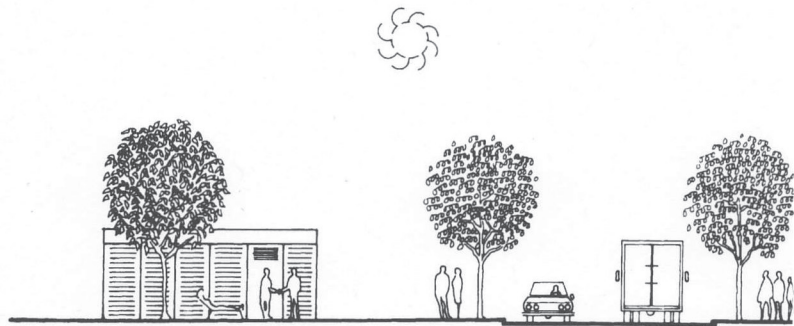
+form **Outside the Inside** Objective Space

Figure 2.12 - "Inside and Outside".
Diagram by Carruthers. Architecture Is Space: The Space-Positive Tradition.



+space

Separation / Contact



+form

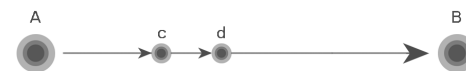
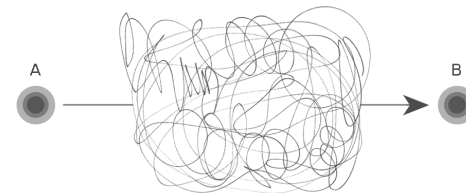
Loss of Privacy in the Public Domain

Figure 2.13 - "Privacy in Space and Form".
Diagram by Carruthers. Architecture Is Space: The Space-Positive Tradition.

[Threshold]

Based on the evidence so far, one may state that the general geographical and climatic conditions found in a suggested context are what drive the success of either *tent-form* or *campfire-space* constructs. While these factors do indeed layout preferable conditions, it is not the only consideration when it comes to deciding which relation works best in any given context. The type of *flow* and relation between spaces is potentially even more deciding than geo-climatic conditions.

There are a number of ways an occupant can be guided from point A to point B, and to go into them more thoroughly may be a thesis of its own. Transition between these points (be they spaces, nodes or moments) can exist as anything between straight forward, winding, requiring a moment of pause, allowing for deflection, forcing transition through other points, and so on (figure 2.14). This transition may be highly influenced by spatial layout, materiality, or energetic intervention of devices simulating an environment or condition. Regardless of how the *flow* is achieved, the moment in which two spaces interact and how they react are important, and it is here that the threshold gains importance.²⁰

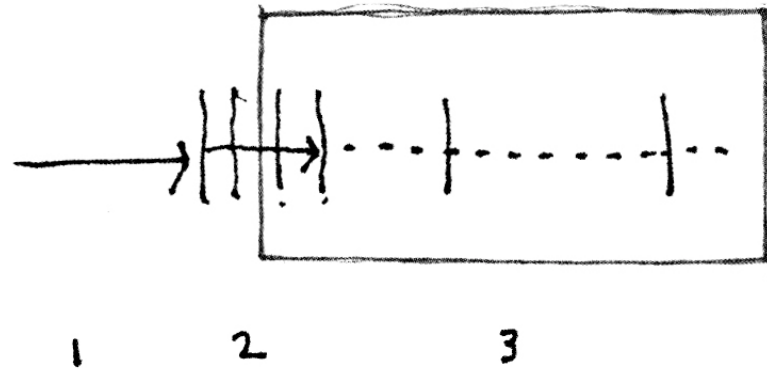


²⁰ Architecture Design Primer – Demystifying Architectural Design. *Threshold: Link and Separator*. January 8, 2013. Accessed July 29, 2015. Available from <https://architecturedesignprimer.wordpress.com/2013/01/08/threshold-link-and-separator/>.

As this thesis aims to achieve a space of gradated conditions and layout, so too must we consider that the threshold can exist beyond a singular moment. Matthew Ridgeway in fact emphasizes that the threshold exists in three stages: the approach, the threshold's focal point, and the reverberation (figure 2.15). This indicates that the threshold is more than just about transitioning between spaces but is also about transitioning from a space into a liminal expanded zone into another space.²¹

The threshold, much like the types of transitions that were listed earlier, can exist in a number of forms too. It can be a singular moment with nothing more than a wall separating two systems, a secondary buffer space that exists as a median between these two spaces or, more ideally - in this study- a space existing as an expanded condition taking on qualities of two spaces (figures 2.16-2.18).

²¹ Matthew Ridgeway. "Consideration of Four Thresholds". B. Arch Independent Research, Virginia Polytechnic and State University, 2013. 1



Left: Figure 2.14 - "Flow Examples between point A and point B".

Above: Figure 2.15 - "Threshold Diagram".
Diagram by Ridgeway. Consideration of Four Thresholds.



Figure 2.16 - "Singular/Lack of Threshold".



Figure 2.17 - "Buffer Threshold".



Figure 2.18 - "Expanded Threshold".

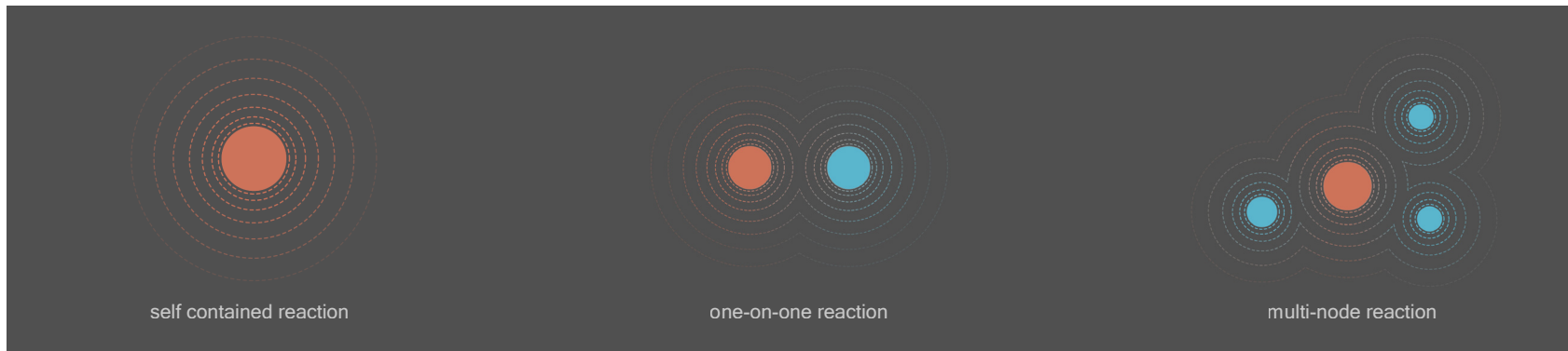


Figure 2.19 - “Spatial Energy Singularities and Multiplicities”.



Figure 2.20 - “Spatial Energy Flux Interactions”.

Traditionally doorways and entries into buildings are labeled as thresholds, however the term can be broadened to being the moment where any two spaces interact. Returning to the notion touched upon earlier of spaces acting as energetic nodes, Berrizbeitia and Pollack define threshold as a point in which “a stimulus is of sufficient intensity to begin to produce an effect” and “the edge between two ecosystems, the zone of highest exchange and diversity”.²² This definition appropriately ties in with the *campfire-space* view in which spaces are treated as centers of various energies.

The type of *flow* mentioned earlier can then be viewed from another perspective. We can consider how *flow* is directed between one space and another by looking at involved spaces as nodes of occupational and programmatic energy. The type

of *flow*, in this sense, can be understood by how two or more nodes partaking in the transition direct their energies around themselves and around one another (figures 2.19-2.20).

In essence, the moment of interaction between two spaces, be it rejection, singular *flow*, or equal *flux*, is a factor to be considered and emphasized when determining the best *campfire-space* or *tent-form* designs. Depending on the circumstances, achieving an entirely fluid transitional *campfire-space* design across an entire site may entail allowing the threshold to become large and encompassing enough that the membrane and threshold become interchangeable.

²² Berrizbeitia and Pollack, “Inside Outside”, 93.

03

[Methodology]

|Elements of Continuous Space|

The German architect Michael Hensel has written a number of notable works regarding connection and *flow* within spaces, often referencing Banham's work in his own. While his research and teachings often focus upon performance driven architecture, his work also calls for fluid space and continuous transitions. Hensel often ties the two together, using performance capabilities of modern architecture and technologies to merge membranes into an extended threshold while still maintaining the unique readings and experiences of each space.²³

Hensel, like Banham, criticizes modern architects who still choose to follow 'medieval corridor' planning that offers little interaction in exchange for static efficiency. He believes that they should move to a form that encourages greater connection and ultimately what is a single yet more heterogeneous layout.

In one of his writings, "*Space Reader: Heterogeneous Space in Architecture*", Hensel states that such a transitory heterogeneous design is one that should always be in a dynamic state of *flux*. He compares the elements of two spaces in *flux* to a chess game where the components are constantly moving back and forth across the board in reaction to one another.²⁴

Hensel developed his own model of the elements that he believed would comprise of an effective open layout model that references Banham's campfire (figure 3.1). These elements are the subject (the effects and affects of the occupant), the environment, the spatial organization, and finally, the material organization. The primary difference here, however, is that Hensel places emphasis on the availability of material components, whereas Banham's work would suggest very thin or non-existent membranes.

Within this model, the elements do not exist together in an effort to increase the productivity of the space or its efficiency. Instead, the relationships between these elements are meant to encourage interaction and develop a continuity that fluctuates in relation to the other elements within the system. By seeing every possible aspect as part of an interactive system, the architecture becomes more unified.

²³ Michael Hensel. *Towards an Inclusive Discourse on Heterogeneous Architecture*. In "Morpho-Ecologies". ed. Michael Hensel and Achim Menges. (London: AA Publications, 2007), 17.

²⁴ Michael Hensel. *En Route: Towards a Discourse on Heterogeneous Space beyond Modernist Space-Time and Post-Modernist Social Geography*. In "Space Reader: Heterogeneous Space in Architecture". (Chichester, U.K.: Wiley Publications, 2009), 21.

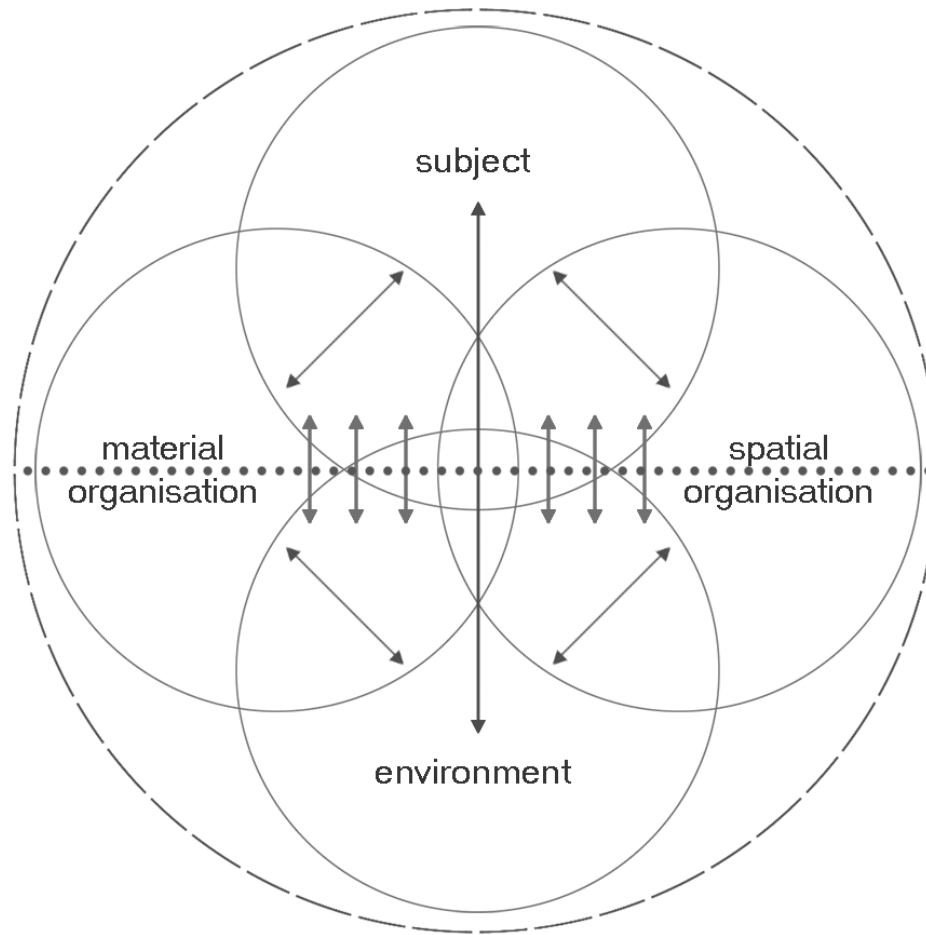


Figure 3.1 - "Performance Oriented Design Elements".
Diagram by Hensel. Digital Materials Lecture. 2010.

As he is concerned most with performance in architecture, Hensel focuses on the material organization aspect of his model. The mashrabiya (figure 3.2), another element of Islamic architecture, is often quoted in his performative material works as an effective component. Hensel illustrates its capabilities in highlighting the relationship between space, material, and environment.

The mashrabiya is an intricate piece of screen work traditionally carved from a single unit of wood. With little treatment applied to it, the screen lattice is free to react in similar aspects to wood found in nature: creaking and warping, expanding and contracting, in response to its environment. While acting in place of a barrier between one space and the next, it still allows for a visual and climatic conversation between the environment and spatial organization through the material as each mashrabiya reacts to the changes of heat and light.

From his studies of the mashrabiya, Hensel explores wood in different configurations and assemblies to create modern versions of the screen that display this environmental and spatial dialogue. In an experiment carried out at the Izmir University of Turkey, Hensel and his students designed a multitude of wooden screens whose forms change in relation to their desired context. This forms a working example of a campfire model's fluctuations in relation to its own environmental conditions.²⁵ Not only is this dialogue carried through each screen experiment, but the placement of the various affected pieces create a transition between exteriors, interiors, and the spaces between them. Ultimately, what Hensel is emphasizing through his extensive study of the mashrabiya is the capability of certain materials and systems to dissolve boundaries between spaces and still perform functionally without the need for a high degree of mechanics and climatic control.

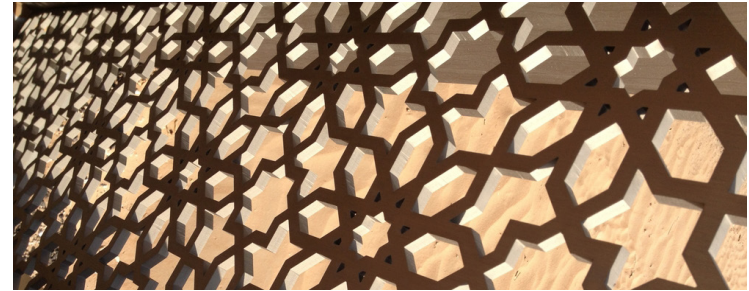
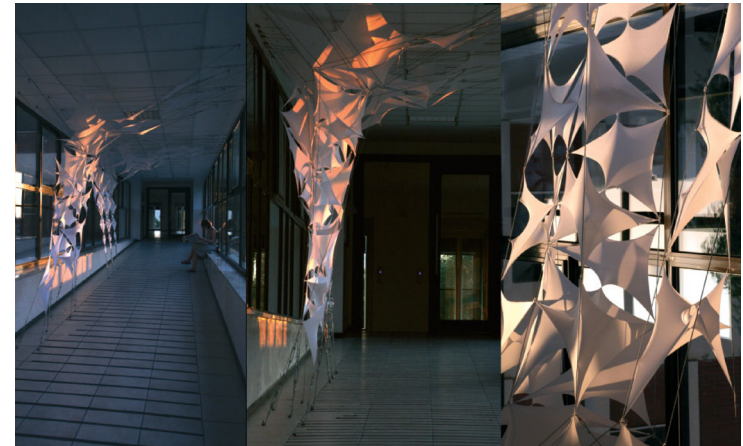
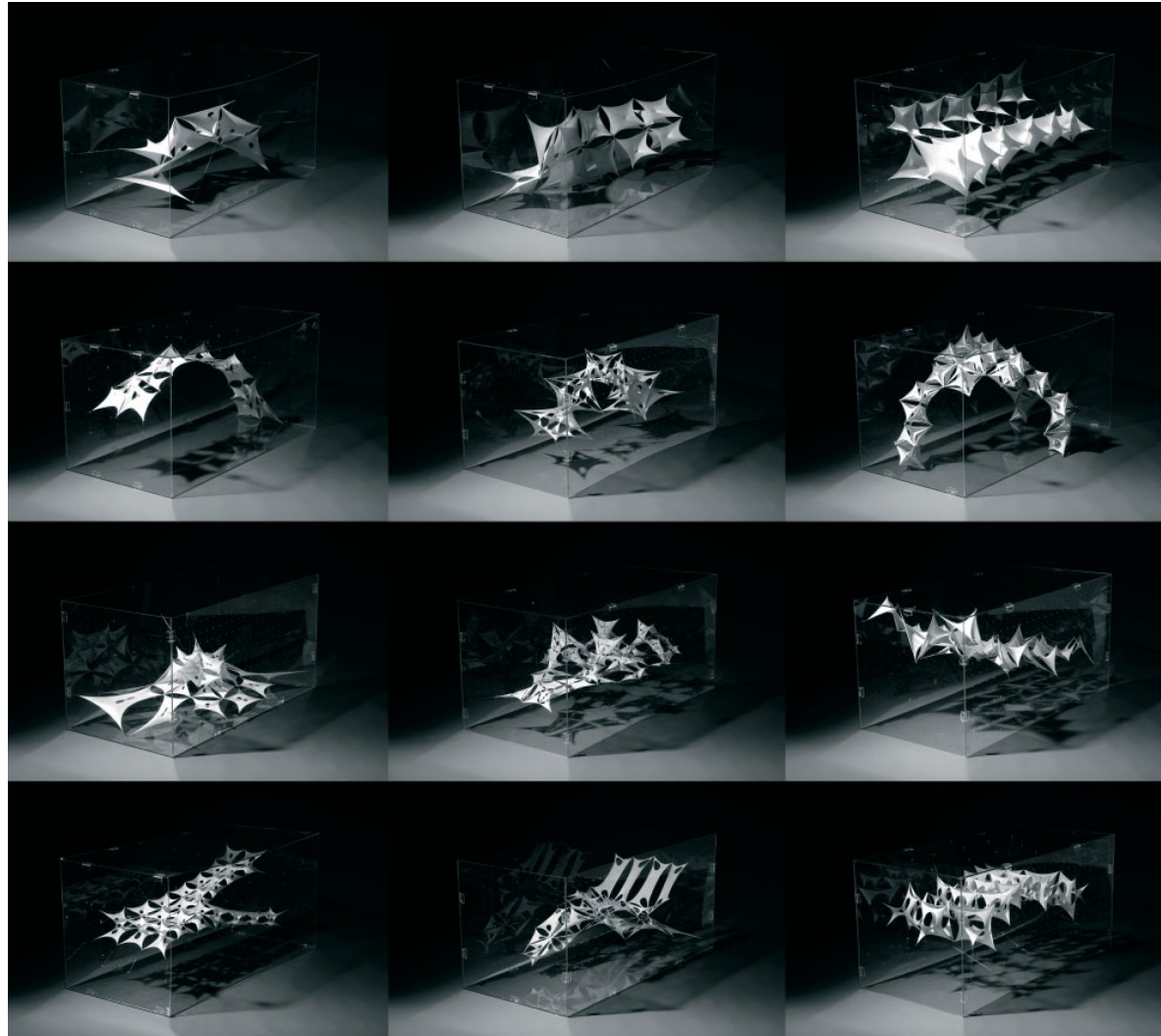


Figure 3.2 - "Mashrabiya Detail Pattern".
By Abiya Mashrabiya.



Figures 3.3 - "Membrane and Cable-Net Systems - in Site".
By Michael and Dephne Hensel. April 2009. Izmir, Turkey.

²⁵ Hensel and Hensel. "Extended Thresholds III: Auxiliary Architectures". 79-80.



Figures 3.4 - "Membrane and Cable-Net Systems - Iterations".
By Michael and Dephne Hensel. April 2009. Izmir, Turkey.

Naturally the mashrabiya does not serve as the sole example of material qualities lending to a dissolution of boundaries between spaces. There are a number of options at the architecture's disposal that lend to the creation of subtle changes in layout that can either produce more open space or otherwise mark a threshold between spaces without having to utilize physical divides. Some examples include the use of rice screen walls in East Asian cultures (which operate somewhat on the same level as a mashrabiya), glass walls, mechanical partitions and curtains, changes in floor and ceiling height, and so on (figures 3.5-3.7).



Figure 3.5 - "Hamamatsu House".
By Yukiharu Suzuki + Associates. 2007. Hamamatsu, Japan.



Figure 3.6 - "Metal Screen and String Screen".
By Takaaki Kawabata. 2014 (Remodel of 1960's cabin). Garrison, New York, USA.



Figure 3.7 - "Chiarano Primary School - Garden and Student Room".
By C+S Architects. 2014. Chiarano, Italy.

|The Sensorium|

While Hensel focuses on utilizing physical and material attributes of architectural elements to redefine spatial connections, other architects have considered utilizing and manipulating sensory components to achieve the same effect. This resonates with the relation between subject and environment in Hensel's model. Caroline Jones, an art theorist, historian and critic at MIT, states that this relation is born out of what she calls the '*sensorium*'.

Jones defines the sensorium as "*the resulting set of experiences...the subject's way of coordinating all the body's perceptual and proprioceptive signals as well as the changing sensory envelope of the self.*"²⁶

There is an incredible amount of stimuli being received, interpreted, and reacted to on a subconscious level between our personal senses and the environment we find ourselves in. If each of these sensory stimuli in our immediate vicinity were to be mapped out, the result would be our personal sensorial envelope. This provides a glimpse of the immediate sensorium acting as a transitional dynamic force between occupant and architecture. Figure 3.8 represents an arbitrary snapshot of a sensorium containing heat, light, humidity, and sound interacting with the human system.

For the most part, however, our senses are often overlooked when understanding of space. Consequently, spaces in architecture tend to reflect this lack of understanding sensory information and a standard model of 'tent'-like efficiency is followed.²⁷ This remains true in fields of design where the product of a designer's work is often suited to some sort of moment or physical attribute of the user. These are indeed important in shaping unique designs when properly addressed, but when the interaction of the user's sensorium is taken into account, the experience of using such design elements becomes more in tune to the user.²⁸

Jones firmly believes in taking one or more senses into account during the design process and encourages other designers, artists, and architects to consider the invisible realm of sensory forces acting around us. Andrew Payne, a senior lecturer of architecture, landscape, and design at the University of Toronto, believes that the enhancement of the sensorium should be a central consideration in architecture. He states that architects may learn more by analytically deconstructing spaces into a realm of senses and dynamic forces than by constructing them physically.²⁹ Payne goes on to state that the sensorium, when utilized properly, is capable of transforming architecture into an interactive field of engagement between the self and the environment.³⁰

The very notions of breaking down divides and fluctuations of program through engagement creates a sense of smoothed transitions and *flow*, tying back to the *campfire-space* model.

26 Caroline A Jones. *The Mediated Sensorium*. In "Sensorium: Embodied Experience, Technology, and Contemporary Art." ed. Caroline A Jones. (Cambridge, MA: MIT Press, 2006), 7.

27 Ibid. 5-26.

28 Ibid. 22.

29 Andrew Payne. "Surfacing the New Sensorium". *Praxis: Journal of Writing and Building*, vol. 9 (2007): 7.

30 Ibid 8.

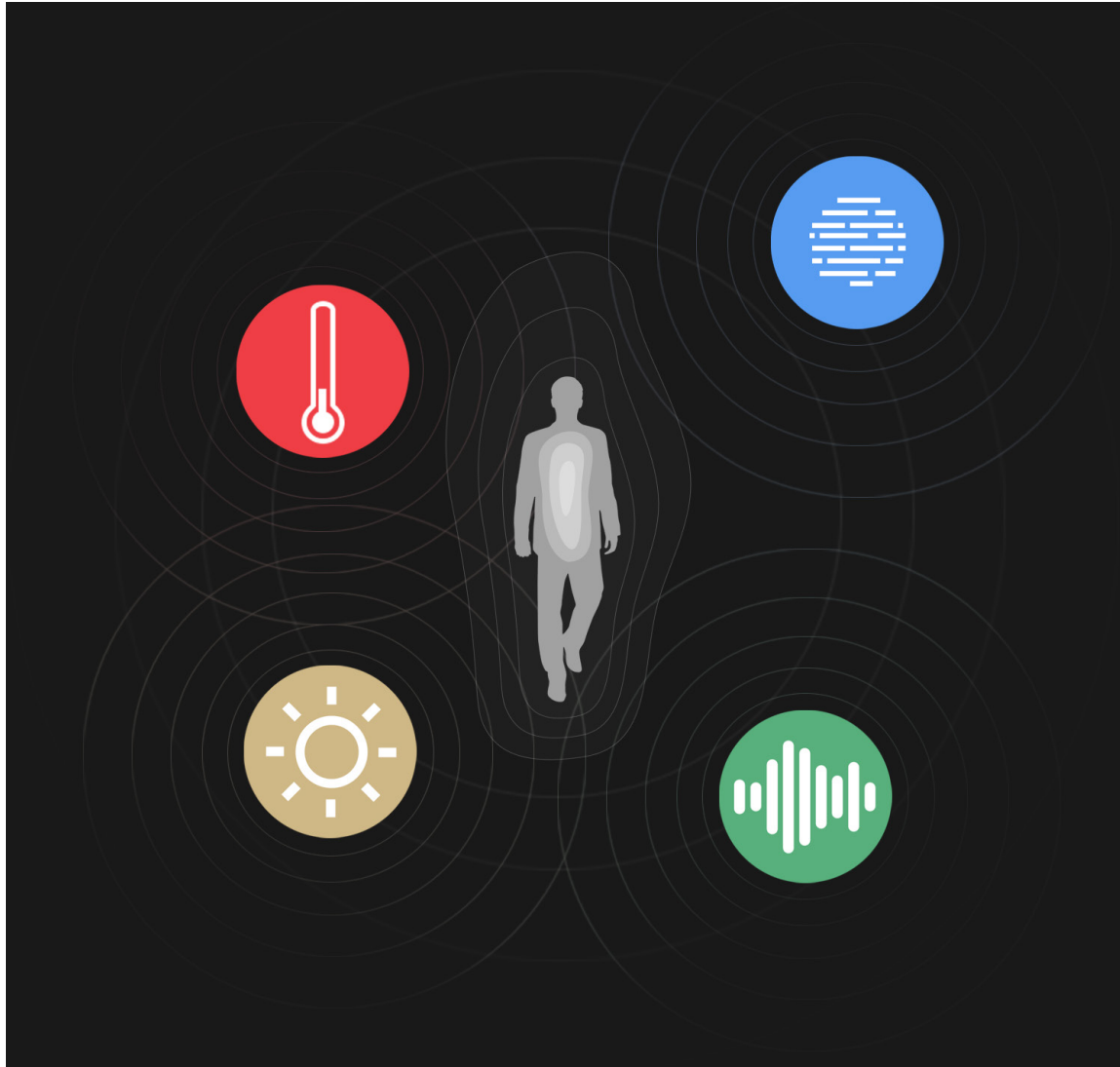


Figure 3.8 - "The Sensorium and the Sensorial Envelope".

|Microclimatic Case Studies|

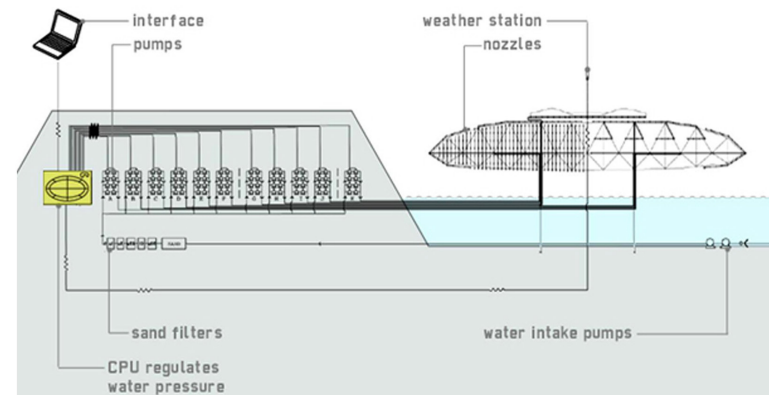
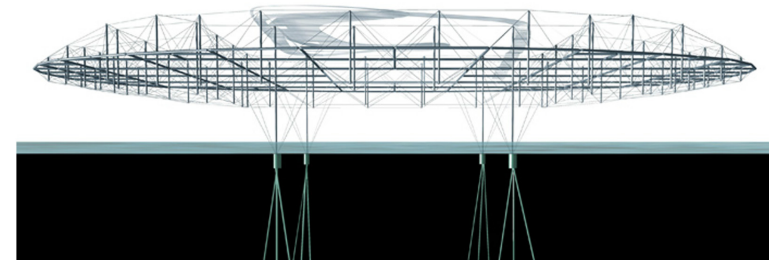
Case study: Blur Building by DS+R

Some have taken on the concept of the sensorium in their works to better understand the various effects that architecture has on the sensorial envelope and how it relates to spatial organization and the user.

One of the earlier examples is found amongst the works of Diller Scofidio + Renfro architects. Their *Blur Building* entered in the 2002 Swiss Expo utilizes mist as a threshold condition that stretches out from the building out to its surroundings, enforcing a new approach to sensing our surroundings and a method of extending space in a non-physical manner. Only structure for movement, support, and devices appear as actual physical components of the architecture but is in fact hidden by the iconic expansive field of mist.

The mist debilitates our primary sense of vision in an experiment of senses and communication. While people may walk in effectively blinded, the visitors are intended to wear a 'brain suit' that is programmed with inputs via individual surveys before entering.³¹ Depending on how compatible or not the wearer is in comparison to another user, the brain suit will send a multitude of messages through sensory methods including sound, pressure, and light that break away from our clear construct of regular vision as a primary understanding of environment.

Unfortunately, the suits remained conceptual. Regardless, this project emphasizes how our other senses can be used in understanding spaces, and effectively that space can exist more so out of a component of micro-climate, rather than of physical conditions.



31 Diller, Scofidio and Renfro architects. DS+R. *Blur Building*. 2002. Accessed November 23, 2014. Available from <http://www.dsrfny.com/>.

Top: Figure 3.9 - "Blur Building - Structure".
Mid: Figure 3.10 - "Blur Building - Jackets".
Bottom: Figure 3.11 - "Blur Building - Systems".
By DS+R Architects. 2002. Yverdon-les-bains, Switzerland



Figure 3.12 - "Blur Building - Entry".
By DS+R Architects. 2002. Yverdon-les-bains, Switzerland

Case study: Climatic Territories by Nicholas Kehagias

Climatic Territories was envisioned as a proposal for Facebook’s digital data centers in Prineville, Oregon. The proposal, rather than addressing specific components of a typical programmatic layout, investigates expanding enclosure and blurring the distinction between spaces. This is achieved via a micro-climate primarily composed of mist similar to the effect in the *Blur Building* which pushes the project into the sensorial realm more so than strict borders could.

The embodiment of this notion is found primarily in the exterior landscape element *‘mist park’*.³² Recycling water and air from the filtering systems of the data centers, the park produces a large amount of mist as its name suggests in two methods: one focused to a specific point in and around the park and the other spread out further along the periphery of the site.

Consequently, two forms of threshold are created that can fluctuate due to the conditions of the site’s program use and external climatic levels. This creates an architecture that is not mediated by the typical expectations of an enclosure such as ceiling or walls. Instead *Climatic Territories* marks its enclosure by the processes of water’s cooling and condensing to form a thick experiential and diffused border.

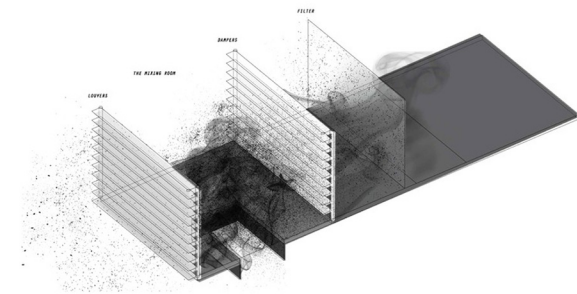


Figure 3.13 - “Filtering”.
Diagram by Kehagias. *Climatic Territories* - NK Works.

32 Nicholas, Kehagias. Nicholas Kehagias works. *Climatic Territories*. 2011. Accessed November 24, 2014. Available from www.nicholaskehagias.com/datacenter/.

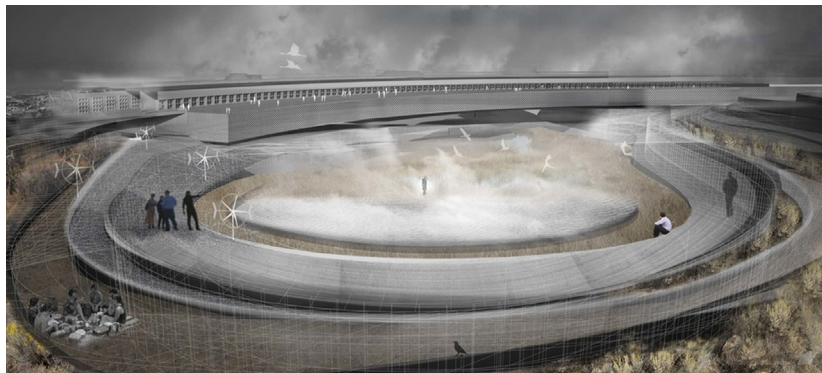
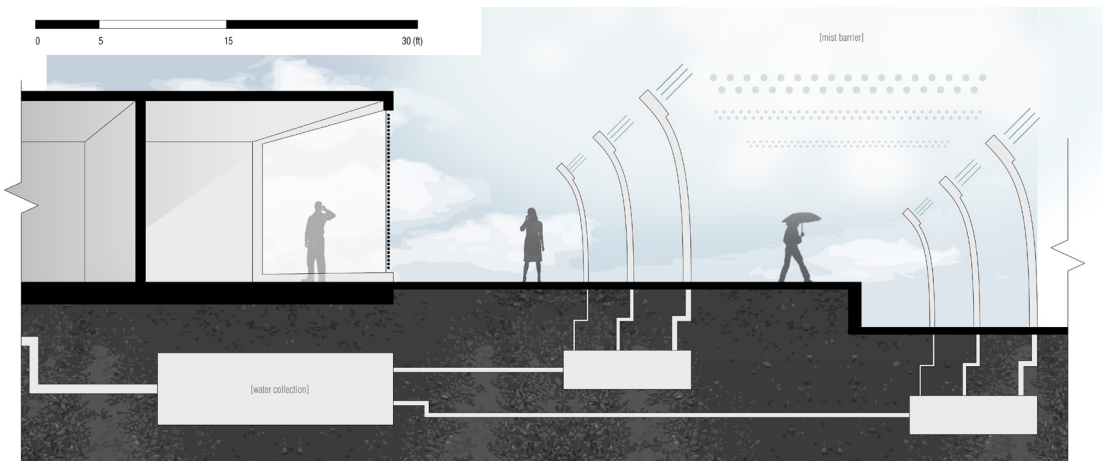
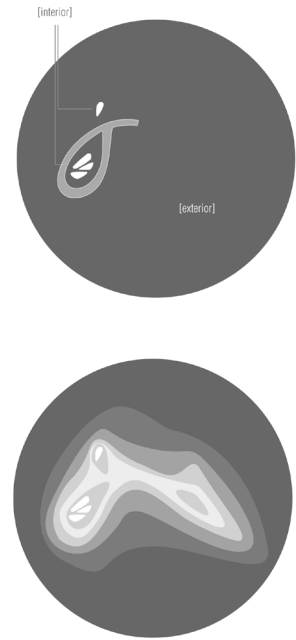
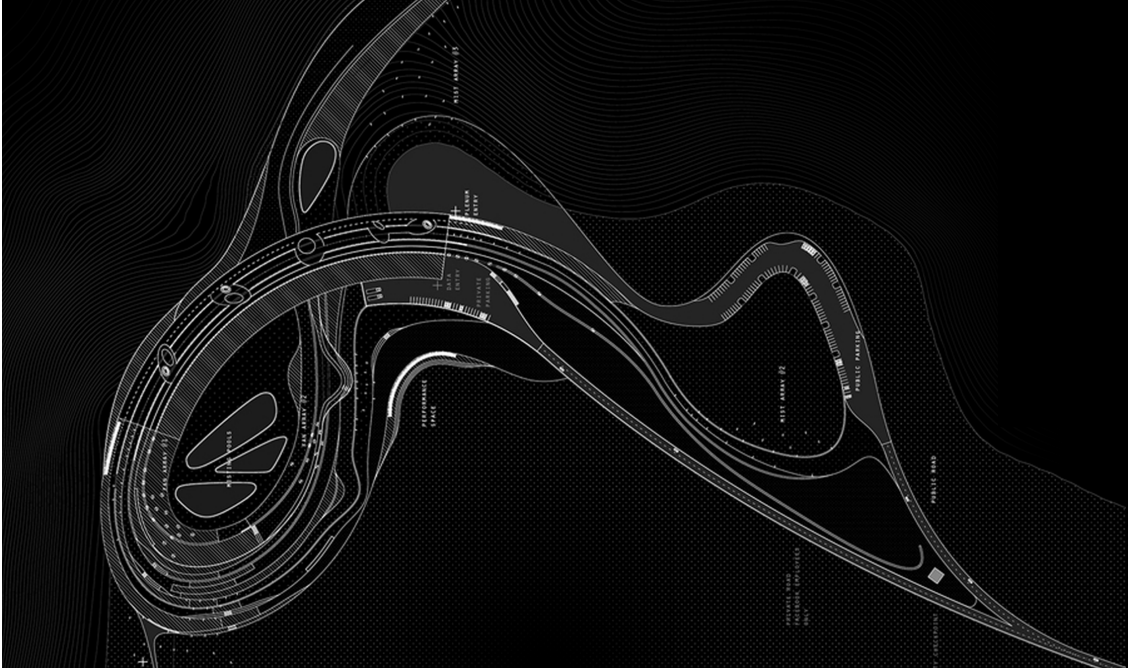


Figure 3.14 - “Climatic Territories - Mist Park”.
By Nicholas Kehagias (Conceptual). 2011. Prineville, Oregon, USA.



Above left: Figure 3.15 - "Climatic Territories - Plan".
Diagram by Nicholas Kehagias. Climatic Territories - NK Works.

Above right: Figure 3.16 - "Climatic Territories On/Off Conditions".
Diagram by author, based on work by Kehagias.

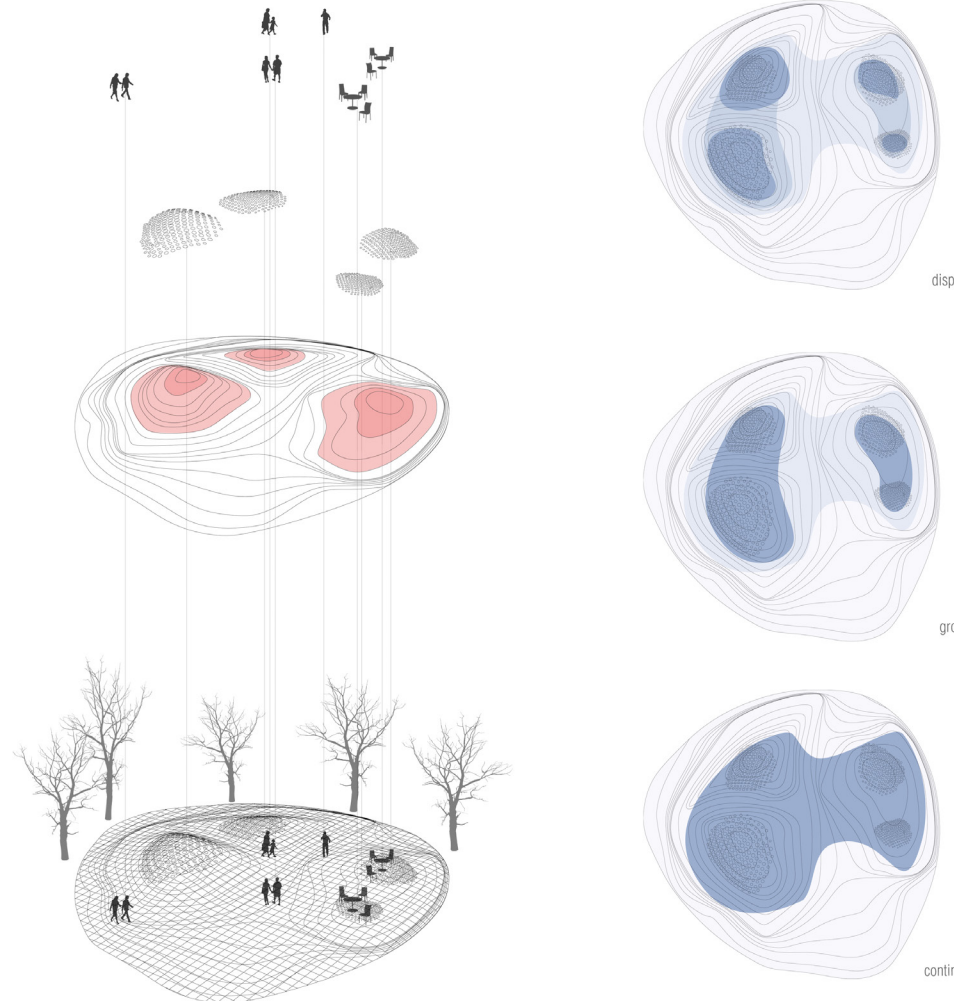
Left: Figure 3.17 - "Climatic Territories Section".
Diagram by author, based on work by Kehagias.

Case study: Sirenuse by Sean Lally

Sean Lally, an architect who continuously advocates the use of energy in shaping architecture, extensively explores various ways to use microclimatic effects in architecture. These projects contain a number of hypothetical atmospheres and sites (often as public spaces of both interior and exterior settings) that address climate as a tool and not something merely an architect should try to protect space and occupants from. His model rendering and representation of dynamic forces pushes his work beyond theory and begins to take a more practical form. In fact some of his work has begun to be produced, while most still remain impressive detailed concepts.

One particular conceptual work of interest is Lally's *Sirenuse* set in Chicago 2011. *Sirenuse* was envisioned as a large public space that uses elements of heat, light, texture, contours, and even furniture to encourage subdivisions of the public space into micro-spaces of their own, effectively becoming a sort of liminal enclosure in itself that exists on the boundaries of the exterior it resides in (figure 3.18-3.20).³³

Within *Sirenuse*, sensorial envelopes are developed within which man and his immediate space are challenged and molded into sensory rather than physical parameters that make the space. Through variant uses of these parameters and the inclusion of furniture in an outdoor space, certain points within the plaza invite levels of activity more so than others. This space becomes highly pertinent during the colder fall and winter seasons of Chicago, where such spaces often go unused. However it is not quite as effective in warmer conditions, with this being the project's one flaw; existing primarily during one setting.



Left: Figure 3.18 - "Layers of Sirenuse".
Above: Figure 3.19 - "Activity Centers + Flow Plans"
Diagrams by author, based on work by Lally.

³³ Sean Lally, Weathers LLC. *Sirenuse*. 2011. Accessed December 08, 2014. Available from <http://www.weathers.cc/Sirenuse>.

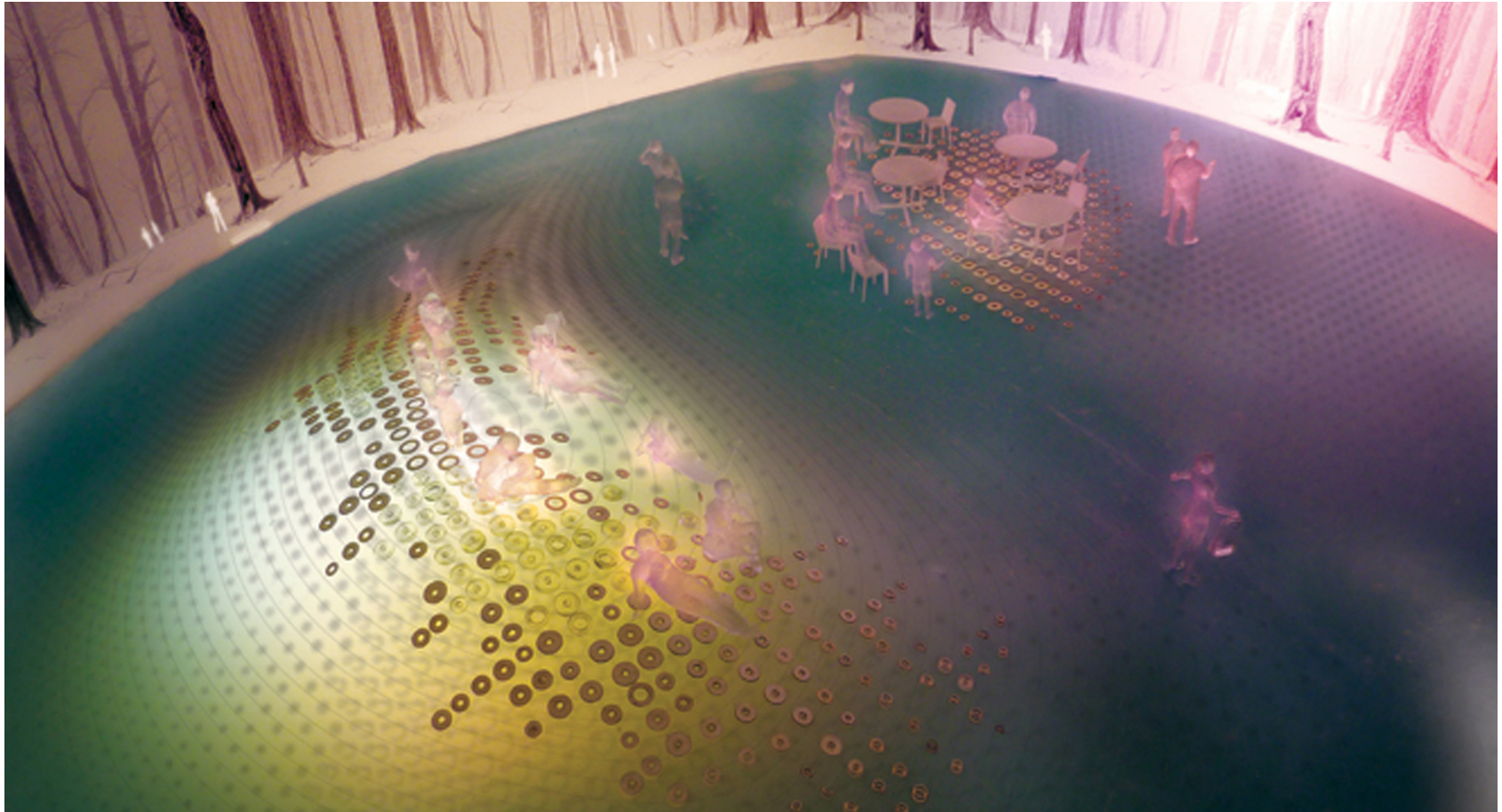


Figure 3.20 - "Sirenuse - Model".
By Sean Lally (Conceptual). 2011. Chicago, Illinois, USA.

Case study: EOS by Sean Lally

EOS by Lally is a simpler concept that defines temporary space through the use of drone-driven climate producers. It deals with an individual's immediate sensory envelope and the reaction between two or more of these envelopes with one another.

People can signal a drone to them that provides gradated spaces of light and heat that can then be adjusted to personal needs and desires.³⁴ This is more interesting when people get into groups where each of the devices attempts to create an environment suitable for the group its assigned to as a whole, creating mobile temporary microclimates that are in continuous *flux*. The interaction is not just between the drones and the ground but also the degree of occupational *flux* that moves in and out of it. Lally's representation displays the changes and effects of the drones and people as energy sources and space shapers.

The study does provide an interesting and simple overlay with physical conditions and structures on the site. However, the major issue faced here is that Lally only directly deals with heat and light and treats them almost as a single condition (albeit they are often occurring hand in hand). This is opposed to the notion that there are multiple dynamic forces that could be acting in the micro-centers (for example, it offers little acoustically). Arguably, this is a portable reactive version of Banham's campfire.

Viewing his representation, he does, however, examine the situational readings of the temporary envelopes he creates and how they respond to the inclusion of occupants or users, tying into Hensel's diagram suggesting connections between material, space, subject, and environment.

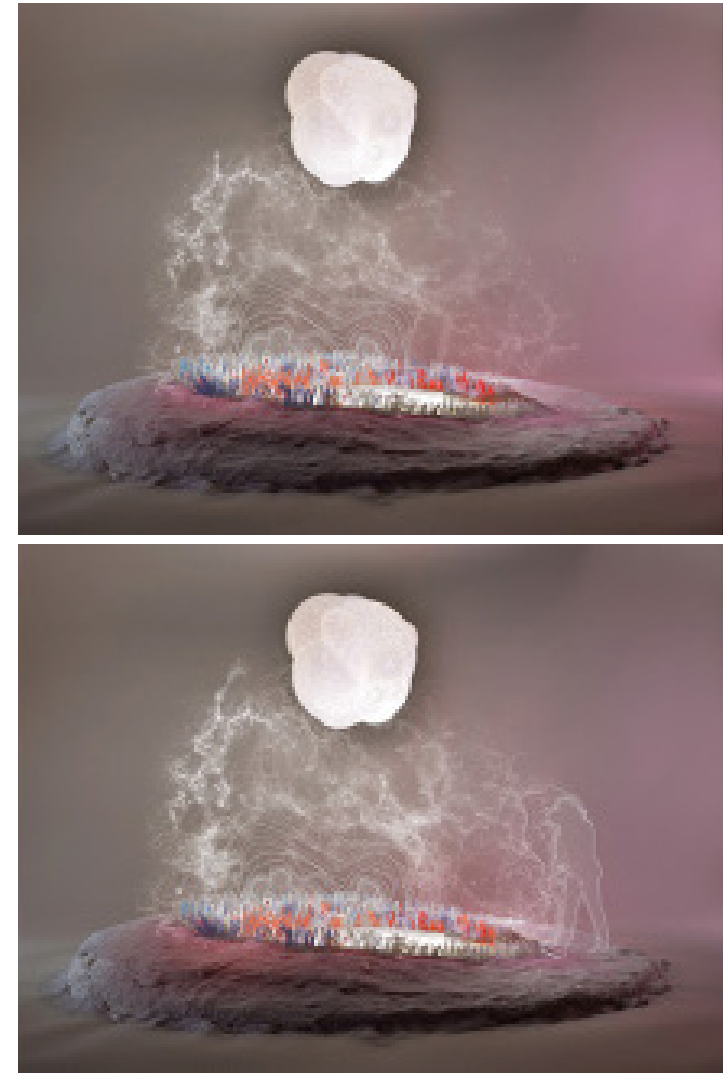


Figure 3.21 - "EOS - People Energies 1".
By Sean Lally (Conceptual). 2014. Unspecified Location.

³⁴ Sean Lally. Weathers LLC. EOS. 2014. Accessed December 08, 2014. Available from <http://www.weathers.cc/EOS>.



Top: Figure 3.22 - "EOS - People Energies 2".
Bottom: Figure 3.23 - "EOS - People Energies 3".
By Sean Lally (Conceptual). 2014. Unspecified Location.

Case study: Taichung “Jade Eco” Park by Philippe Rahm

Philippe Rahm is another architect concerned with translating architecture from the physical into the meteorological and sustainable. His project *Taichung Park* (AKA *Jade Eco Park*) is to be constructed sometime 2015/2016. The design is based on climatic variations mapped by computational fluid dynamics simulation.³⁵ What this means is that some areas of the park are naturally warmer, more humid and more polluted while some of them are naturally colder, dryer, and cleaner. Suggested situational points within the park need not be classified purely into one of these two conditions of course, but can exist in any sort of combination along a scale of each factor. These microclimates are augmented in order to increase the preexisting local climates of spaces for creating more comfort, or even discomfort to guide people along specific routes and spaces.

Each map (figure 3.25) in Rahm’s representations specifically corresponds to a particular atmospheric parameter and its variation of intensity throughout the park. The first one corresponds to variations in the heat on the site, the second one describes the variations in humidity in the air and the third one the intensity of the atmospheric pollution.

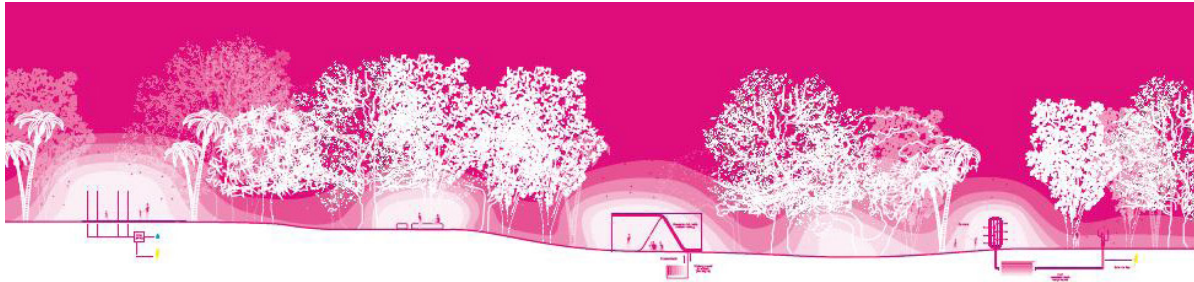
35 Philippe Rahm. Philippe Rahm Projects. *Jade Eco Park*. 2013. Accessed December 14, 2014. Available from <http://www.philipperahm.com/data/projects/taiwan/index.html>.

Each map shows how the intensity or strength of the respective atmospheric parameter is modulated through the park. The resultant park is composed as a diversity of microclimates and a multitude of different sensual experiences.

To materialize these climatic maps, a catalogue of climatic devices (natural and artificial) was invented. They reinforce areas that are already more comfortable by lowering, reducing, inverting, and diminishing the heat, humidity and pollution. These devices exist as both passive and active components depending on the needed climatic condition and the degree of the desired condition. They are further classified into three categories:

- 1) Cooling devices
- 2) Drying/dehumidifying devices,
- 3) De-polluting/cleansing devices.





Left: Figure 3.24 - "Taichung Park - Energies".
By Philippe Rahm. In Construction. Taichung, Taiwan.

Above and right: Figure 3.25 - "Taichung Park - Climate Maps".
By Philippe Rahm. In Construction. Taichung, Taiwan.

|Expanding the Wall|

So far there has been an exploration of two major components in the pursuit of creating expanded liminal or transitional space and gradated points of activity and program that blur into one another. First, was the recognition of relationships that occur between primary components of physical layouts, these being between user, material, space, and environment as defined by Hensel. As stated, the focus of application of these points was found in choices of physical materiality and making choices of physical qualities when it comes to space within its environment. Alongside this, a major mentality here emphasized by Kenneth Carruthers was that space should be part of the program and not leftover on site, where activity is allowed to fluctuate in and out of it with more freedom.

The second major point was the utilization of microclimates which entirely dissolved the wall, making use of energies found within the level of interaction between user and the environment, i.e. the sensorium as defined by Jones. Spaces were dictated not by physical boundaries but as centers of activity with associated climates to those activities suited to particular layouts. The product was often viewed amongst the explored case studies as a living portrayal of Banham's campfire model where spaces blurred into the surrounding context or other nodes of climatic energies, at the cost of privacy and shelter.

For the purposes of this thesis, an approach that combines the capabilities of the physical and climatic approaches will be explored. The idea behind this is approach is 'expanding the wall' (figure 3.26). Walls are more often than not standing barriers between spaces that become sub-dividers because of a lack of permeability due to thickness, often warranted to the need of tucking away mechanisms, insulation, dampening, and the sort.

For the components of the wall that are primarily functional, there exists the potential to reconfigure them into a form of microclimate utilizing specialized devices and layouts. This instrumentalization of architectural elements allows for a loosely defined space of some kind. For example, acoustic dampening in walls can be replaced by a series of noise cancellation devices that create a 'wall' of acoustic control capable of being traversed and one that remains visually permeable.

This stream of thought can be further applied to other conditions, such as thermal and humidity control that wall insulation offers, perforated and set apart shading screens or devices for light control, and so forth. This method is possible because of space traditionally left over in a site being utilized to allow for expansion. Furthermore this opens up an opportunity for the 'space between spaces' to become capable of occupancy, traversable, and integrated into the gradated condition of the potential spaces it intertwines with.

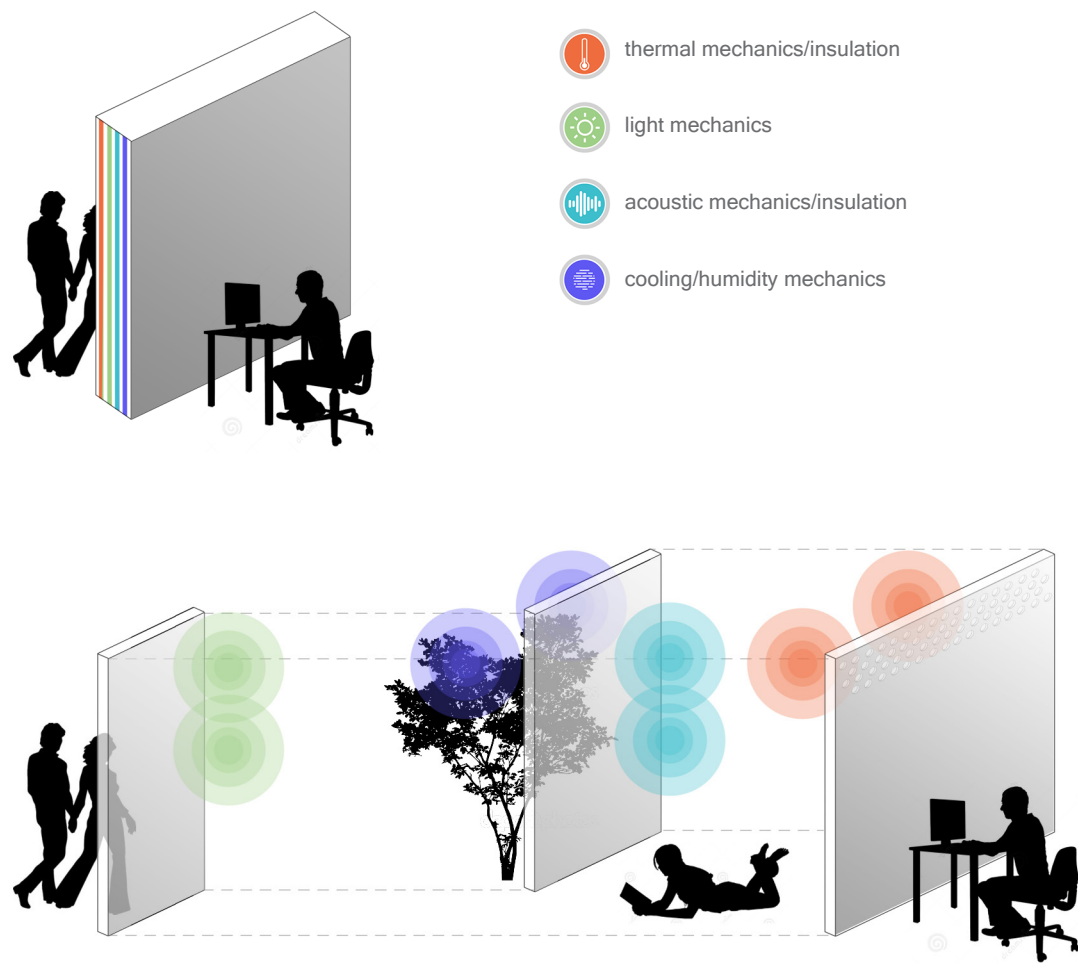


Figure 3.26 - "Expanding the Wall".

|Dynamic Representation|

Before venturing into the design, it is pertinent to explore the capabilities and understanding of representational methods of unseen dynamic forces. Naturally in architecture diagrammatic portrayal of every aspect of space has to be presented. However with the complexity of dynamic forces, how this is to be done and has been a matter of discussion amongst architects.

Since the sensorium is the combined effect of sensorial multiplicities acting at once, to us as humans - who rely heavily on visual responses - the sensorium goes by mostly undetected. Some modern art exhibitions or experimental public labs may offer a way of translating a sense into some form of visual aspect as seen in Jones' "*The Mediated Sensorium*". Arguably though, translating sensory conditions into visual responses causes a loss in understanding the condition's full potential.

However, if the sensorium is to be part of the architecture, it needs to be represented in a manner much like any other architectural element. Based on literary and experimental works of other architects, it is impossible to identify a single common method. Architects are still experimenting with various techniques of representation in both the general setting of design and the novel field of sensorium. More often than not, a system is developed for at least one sensory condition that takes primary organization within the design, however, most cases do not take into account the various conditions acting upon a space at once.

Phil Ayres, assistant professor of architecture at the Royal Academy of Fine Arts in Copenhagen, investigates the relation between representation and that which is being represented in architecture. Ayres highlights that this relationship occurs on three levels, all of which are related between subject and its timeline.

Firstly, the architect must consider the subject itself.³⁶ As a designer, a decision must be made as to what is primarily being represented. Secondly, there is a duration in which the representation can actively represent the subject.³⁷ It is this key moment or moments that should be represented rather than an entire continuous set of snaps in time which would be less effective in representing crucial occurrences of sensorial conditions and changes.

Finally, in order to find these moments the architect must be aware of how both the representational methods and the space change over time.³⁸ This means that at any key particular moment the architect may or may not find advantage in using the same representation method or physical space for representation.

Brady Peters, an architect who specializes in digital design and fabrication as well as acoustics, confirms these notions in his exploration of representation of acoustics in sound. Sound has always been a prominent component in architecture. However its representation has remained largely scientific rather than architectural. Peters, similar to Ayres, states that sound much like other dynamic forces occurs spatially AND temporally; thus needs to be represented in both spatial and temporal manners.³⁹

36 Phil Ayres. *Reconsidering Relations*. In "Persistent Modeling: Extending the Role of Architectural Representation". ed. Phil Ayres. (Abingdon, Oxon: Routledge Publishing, 2012). 3.

37 Ibid. 4.

38 Ibid. 5.

39 Brady Peters. *Design issues of time-based phenomena and the notion of a persistent model: a parametric exploration of acoustic performance*. In "Persistent Modeling: Extending the Role of Architectural Representation". ed. Phil Ayres. (Abingdon, Oxon: Routledge Publishing, 2012). 82-84.

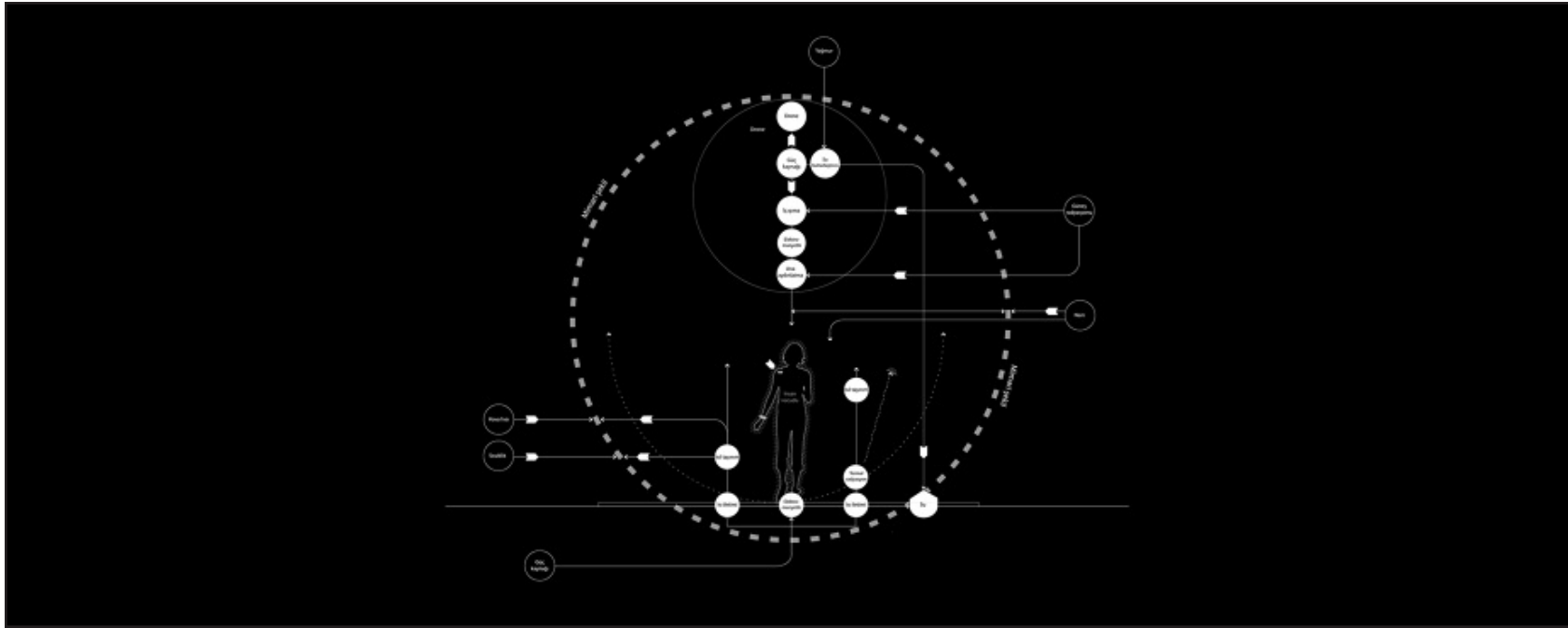


Figure 3.27 - "EOS - Energy Diagram".
Diagram by Lally, EOS - Weathers Studio, 2011.

Michelle Addington, an architect and engineer of the Yale Climate and Energy Control group, has also dealt with the notion of sensorial and climatic conditions and the representation of these conditions. She states that tools and knowledge for developing representation of dynamic forces begin with the architects approach to the sensorium in its building context.⁴⁰ Addington suggests that representation must match the energy that is being represented. For example, is the energy itself something occurring on a macro- or mesa-scale as sound does, or more like conduction transfer on a micro- or nano-scale? The representation must reflect this scale.

Furthermore, the architect must consider the difference between threshold and boundary. In her definition the boundary is "an active region of negotiation rather than a transitional space".⁴¹ This is comparative to the point in which an energetic or programmatic difference occurs. The threshold on the other hand, creates a boundary between energies rather than a transition, short or otherwise. Also how the energies are induced affect how we perceive them on a human scale, and thus, should be represented with a level of variation between conditions.⁴² In other words, Addington heavily stresses that energies are acting in different manners, different scales, and within different perceptions. Consequently, the representation, though it may be similar, must be capable of differentiating amongst the various conditions in the same manner.

40 Michelle Addington. *The Phenomena of the Non-Visual*. In "Softspace: From a Representation of Form to a Simulation of Space". ed. Sean Lally and Jessica Young. (Abingdon, Oxon: Routledge Publishing, 2007). 39.

41 Ibid. 41

42 Ibid. 45

Rahm and Lally displayed methods of bringing the sensorium into a comprehensible view in their architectural drawings and renderings. However, their diagrams are usually limited to the notion of energies acting independently of one another, unless closely related like heat and light in Lally's work. In order to design a *campfire-space* based construct, sensory representation of a sensory multiplicity is needed to better understand the effects across different times and places within the context.

While not a project surrounding the use of sensorial conditions or thresholds, OMA's noteworthy program/occupation diagram of the Yokohama master plan provides insight into multiple-factor dynamic representation (figure 3.28). This diagram is a two part piece. The first part displays the relative occupancy use over time for each program, with each graphic displayed in the same graph but standing independently of one another. In the second, the same graphics are given a gravity of sorts, so that visually these readings fall and slide into one another creating a base line occupancy over time for the entire project.⁴³

Translating this diagram into a workable representative method for this thesis, energies can be mapped out against spatial points across sections and plans, as opposed to occupation over time. This can also exist in two cooperative parts, where each energy condition is read separately and then contributing to the whole.

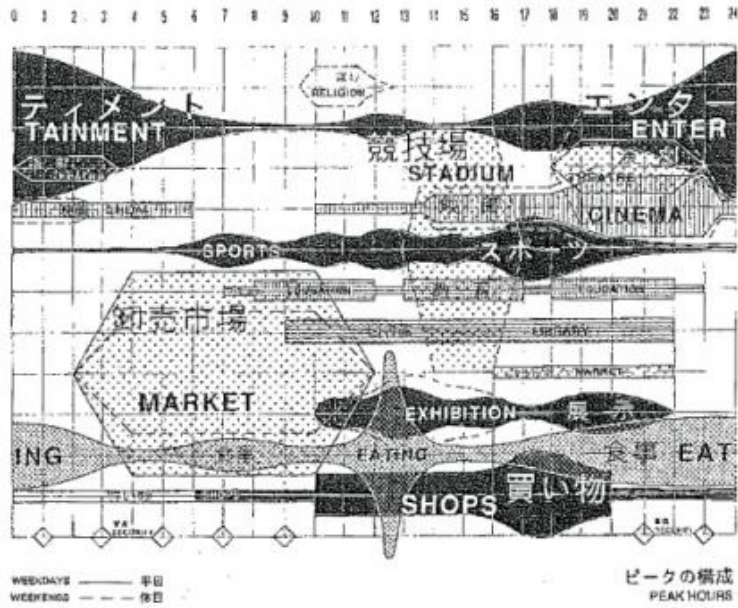
Over the next few pages is a preliminary attempt at understanding this strategy in mapping energies across space. These are examined through a number of architectural works and an early personal iteration of a designed structure pertaining to this thesis.

In each, all energies across a space at any moment are displayed as a single variable rather than broken down to better understand not only the structure of this representation, but also how the thresholds act differently in an energetic sense in relation to their physical structures. As this is general display, the first diagram typology where energies are displayed separately is deemed to not be pertinent here.

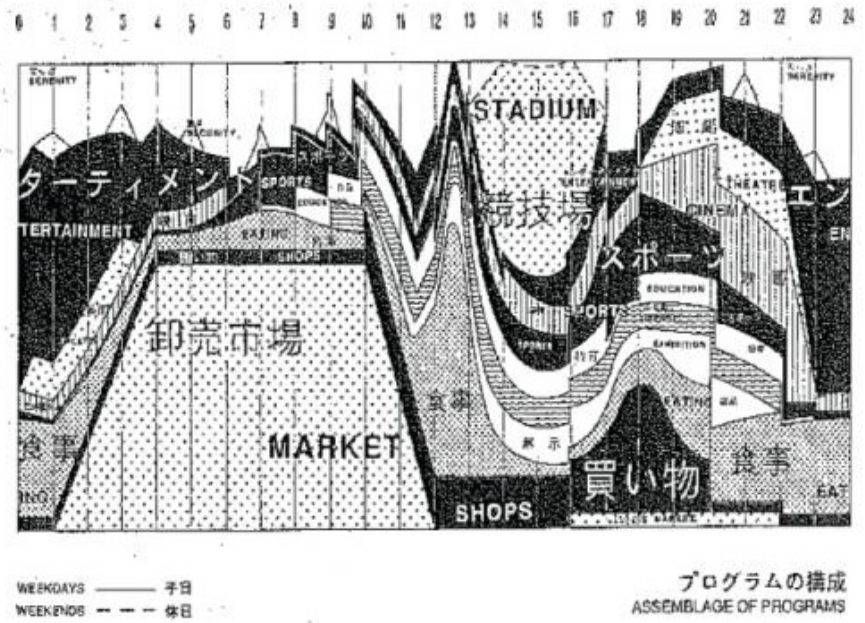
Through evaluating these literary, precedent, and graphic studies, it is revealed that there is no single method of representation, but rather the representation of this work is best described when acting as multiple diagrams working together to create a whole. As such, diagrams representing physical space ought to work in unison with diagrams utilizing more abstract graphics of climate and sensory conditions.

Of these diagrams, there should be those that reveal how the systems and conditions are induced, how the conditions act across the space separately and as a single climatic component, and how the energy changes in accordance with time and/or changes in external or programmatic elements. These diagrams will act singularly as snap shots but add to one another to reveal a clearer understanding of energy, space, and time across the design.

⁴³ OMA Architects. OMA Projects. *Yokohama Master Plan*. 1992. Accessed May 23, 2015. Available from <http://www.oma.eu/projects/1992/yokohama-masterplan/>.

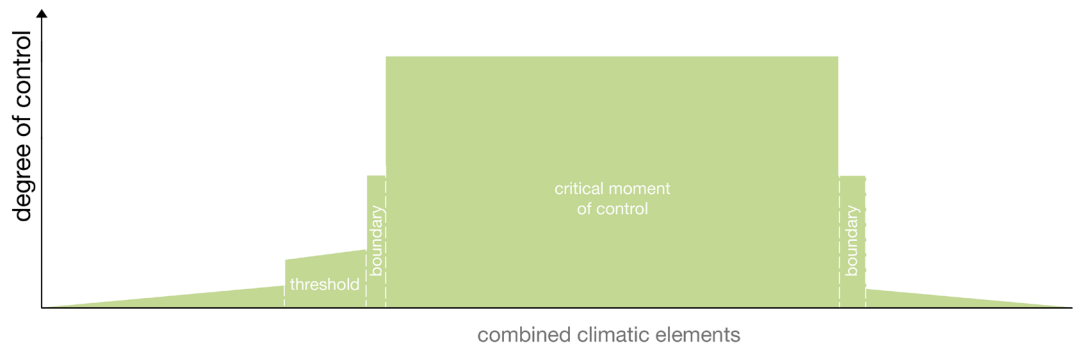
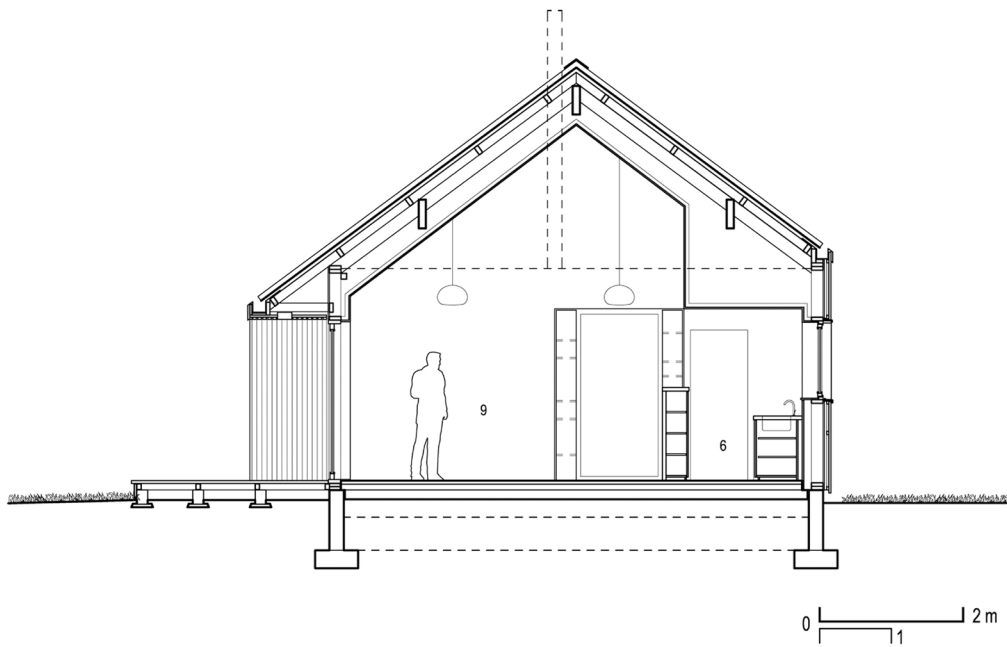


Peak Hours



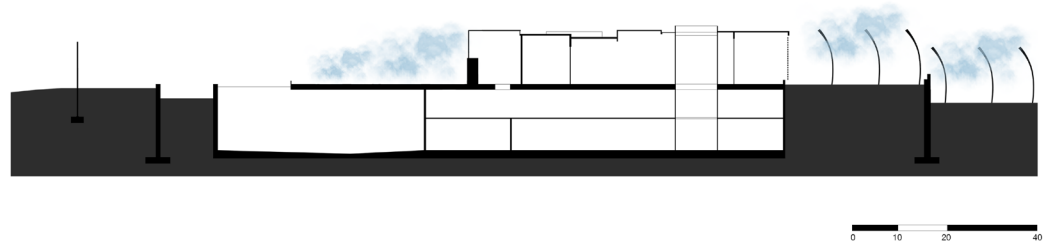
Program

Figure 3.28 - "Yokohama Master Plan Diagram".
Diagram by OMA, Yokohama - OMA Projects.



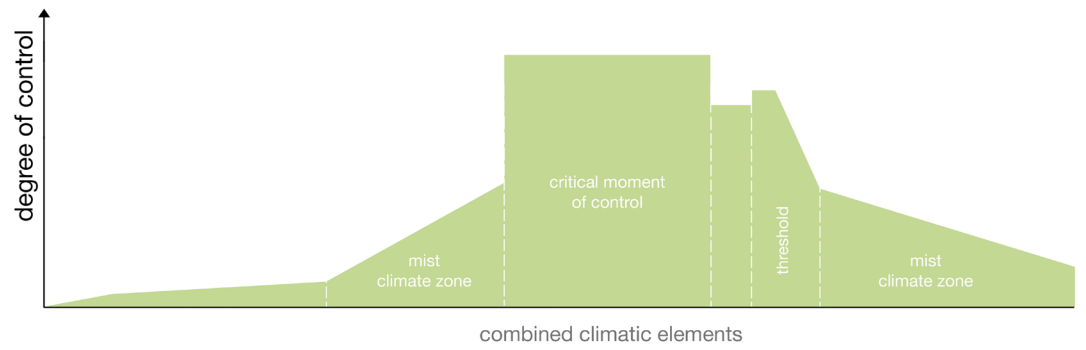
Top: Figure 3.29 - "Maison Simon - Section".
Diagram by Noel + Bonnefous. Maison Simon - Arch Daily.

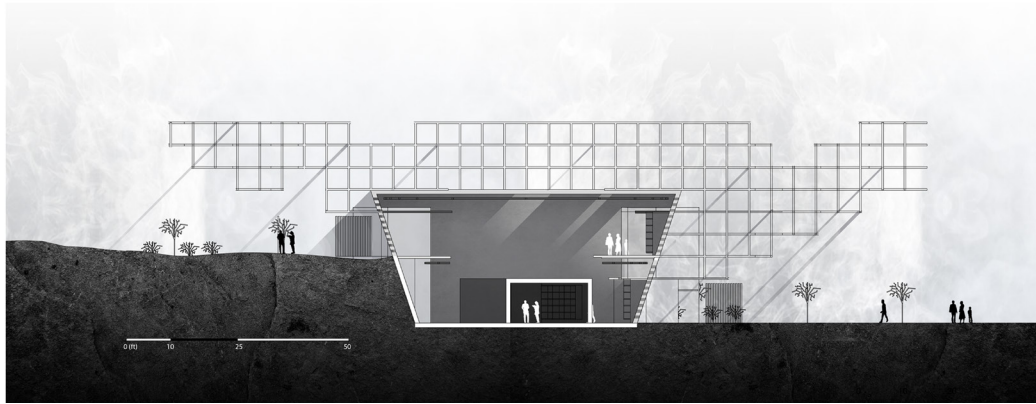
Bottom: Figure 3.30 - "Archetypal House Energy Section".



Top: Figure 3.31 - "Climatic Territories Section".
 Diagram by author, based on work by Kehagias.

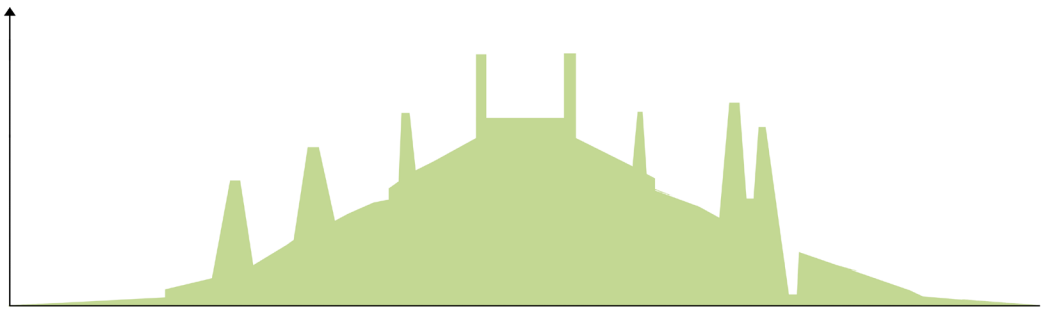
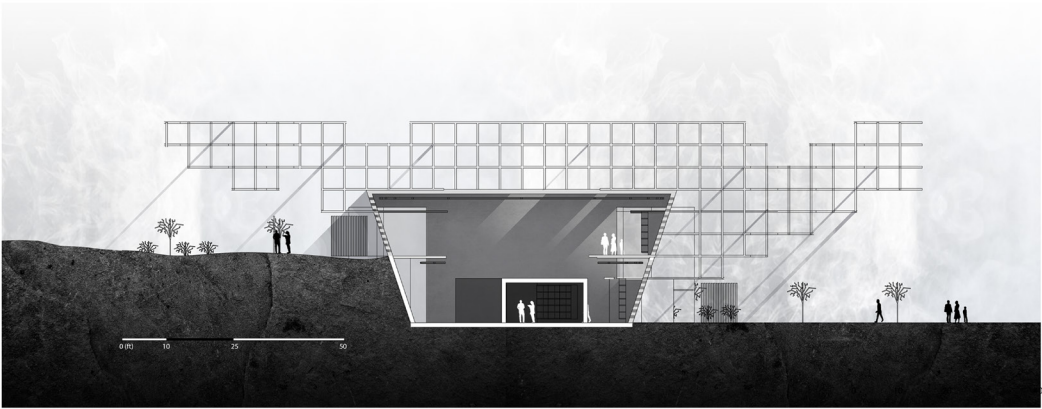
Bottom: Figure 3.32 - "Climatic Territories Energy Section".





Top and top right: Figure 3.33 - "Section of Early Iteration".

Bottom: Figure 3.34 - "Smooth Library Energy Section"



Bottom: Figure 3.35 - "Haptic Library Energy Section"

04

[Design Proposal]

|Program and Zones|

The selected program in which to present the benefits and experimentation of both tent and campfire spaces in a single design is a library. Already libraries depend on the need for microclimates within rooms that necessitate controlled light and humidity conditions for preservation of books, particularly when it comes to rare collections. Many of the spaces within libraries that are most occupied by users also require a microclimate of some form involving other sensory elements. For example, reading spaces require a microclimate of low-level noise and adjustable lighting for reading and work. As a public structure the library also offers a variation in program in which to experiment from typical book storage and services to event spaces.

A number of libraries with mix-use programs were briefly explored to gain insights into the type of spaces that could be used. Figures 4.1 through 4.5 display some of the libraries that were selected. In addition to previously mentioned reading and work spaces, event spaces, and rare book collections, modern libraries often involve programs that include workshops, private and public meeting rooms, gallery spaces, and lecture or performance halls. Furthermore, new age libraries often reflect in their design an acknowledgment of the transfer from printed media to digital. While libraries still devote the majority of their space to book stacks, digital centers of various types for research or education purposes often become a fundamental component of the program.

In the following pages, the selected program of the library design is presented in two primary forms. First, is about purely understanding the spaces in a programmatic sense, which helps to categorize the entire design into three major centers: a library center, a social center, and a cultural center (Figure 4.6). Private spaces were later placed in centers that suited their program and climate - office spaces were set in the cultural center for a climate that required low noise, workable lighting, and thermal and humidity levels set to human comforts as opposed to books, and meeting spaces were set alongside workshops for similarity in program and climatic needs.

The second diagram illustrates each of these spaces in terms of their climatic needs and the degree of privacy needed in order to understand how the spaces operate and are set relative to one another (figure 4.7). These values were based in understanding how the spaces operated and set relative to one another. These values do not represent any empirical measurements of these spaces.



Figure 4.1 - "Fort York Library".
By KPMB. 2014. Toronto, Ontario, Canada.



Figure 4.2 - "Andrée Chérid Media Library".
By D'HOUNDT+BAJART Architects & Associates. 2013. Tourcoing, France.



Figure 4.3 - "Dalarna Media Library".
By ADEPT. 2014. Falun, Sweden.



Figure 4.4 - "Media Library + Cultural Center".
By Barbotin + Gresham Architects. 2010. Lisses, France.



Figure 4.5 - "Arthur Rimbaud Media Library + Cultural Center".
By Dacbert Cochet Chapellier Architects. 2010. Antony, France.

Figure 4.6 - "Library Program Spaces".

After a brief investigation of a number of libraries, the diagram portrays selected programmatic spaces to be executed within the design proposal. Spaces are understood in terms of private, public, and plaza spaces, but more importantly as programmatic centers of library, social, and cultural programs.

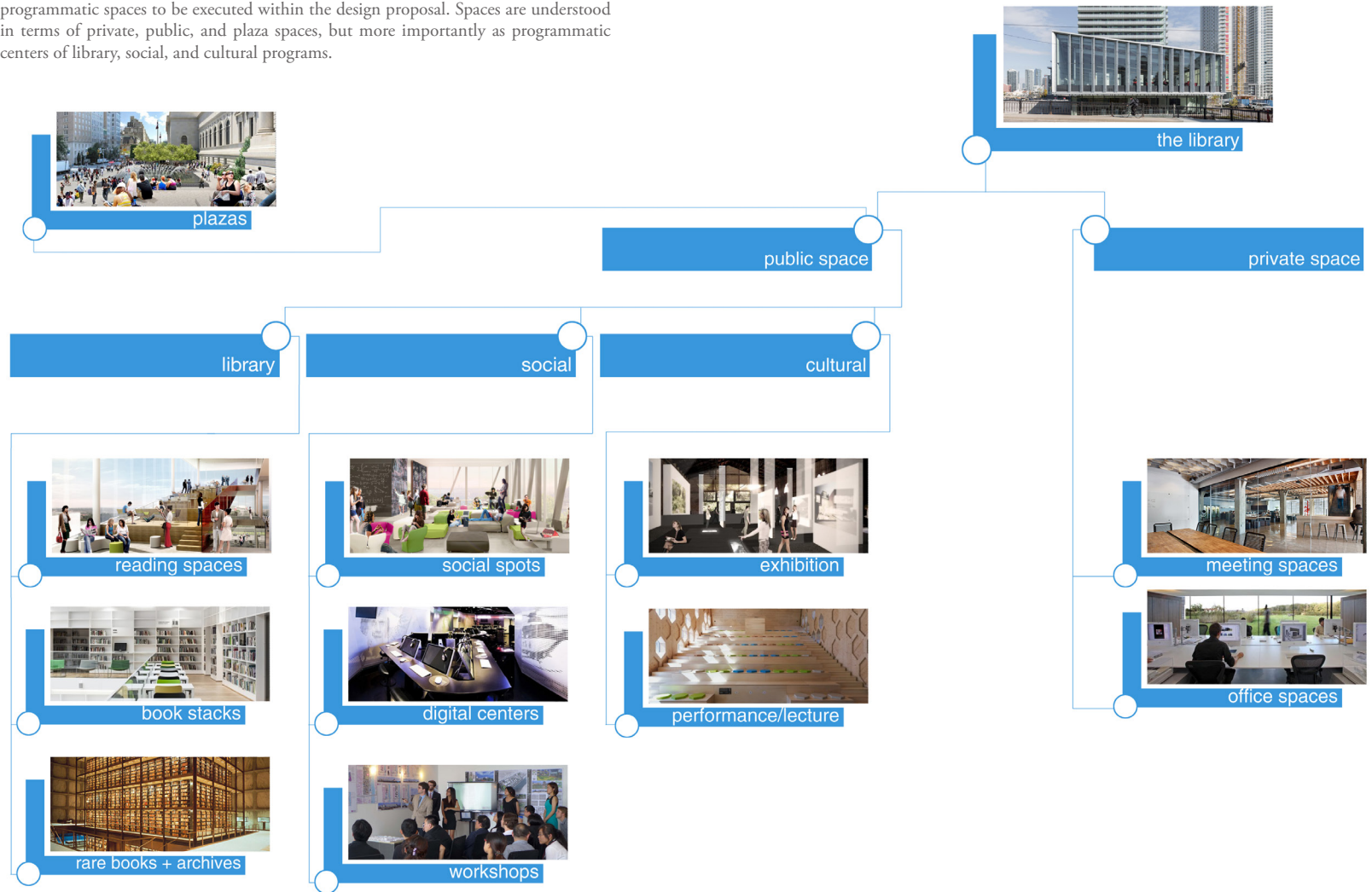
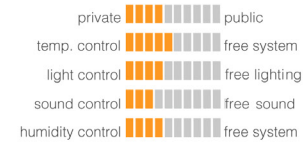
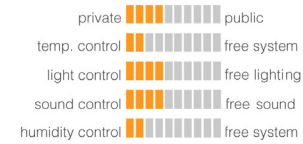
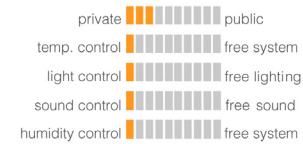
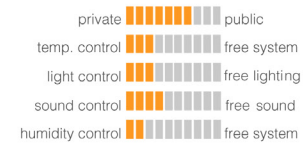
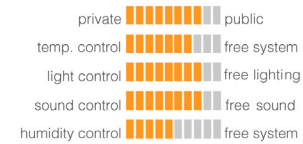
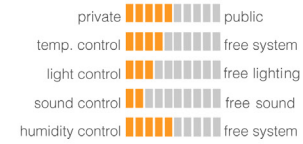
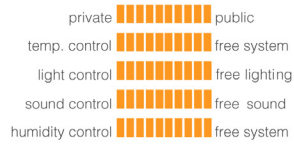
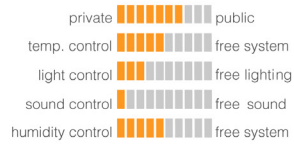
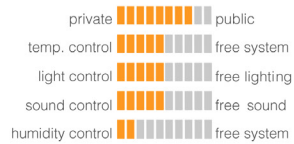
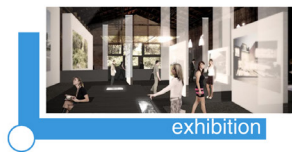
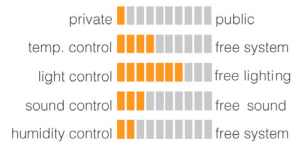
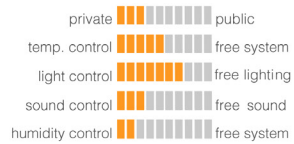


Figure 4.7 - "Comparison of Climates in Library Spaces". Each of the proposed spaces is analyzed in terms of major climatic and private control components. This offers insight into the ranges of climates and the potential opportunities to share energies in a spatial layout.



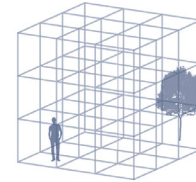
A third diagram is represented here that is the product of both program and climate. The diagram is initially similar to the programmatic one, layering each space into the social, cultural, and library centers. The spaces are then laid out across a spectrum of their degree of control. Those with a higher degree of control are set further down the graph while those that do not need highly specific conditions (relatively speaking) are set further up.

This leads to the creation of four major *zones* that exist across the site with varying levels of control and *flow* permeability. These are labeled, in ascending order of control, the open, frame, porous, and solid zones. Alternatively these can be respectively referred to as the zones of no intervention, low control, mid control, and high control.

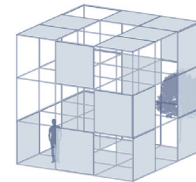
The primary concept of the zones is that as an occupant moves from a space of low control to one of high control, the architecture reflects an increasing degree of appearing more solid, controlled and confined. In other words, the occupant moves through *campfire-space* to *tent-form* layouts. In conjunction with this, a gradual change occurs in the intensity of climate alongside a shift in material choices to dissolve the strict divide between interiors and exteriors.



open
frame



frame
porous



porous
solid

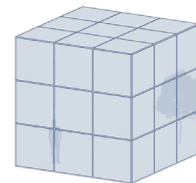
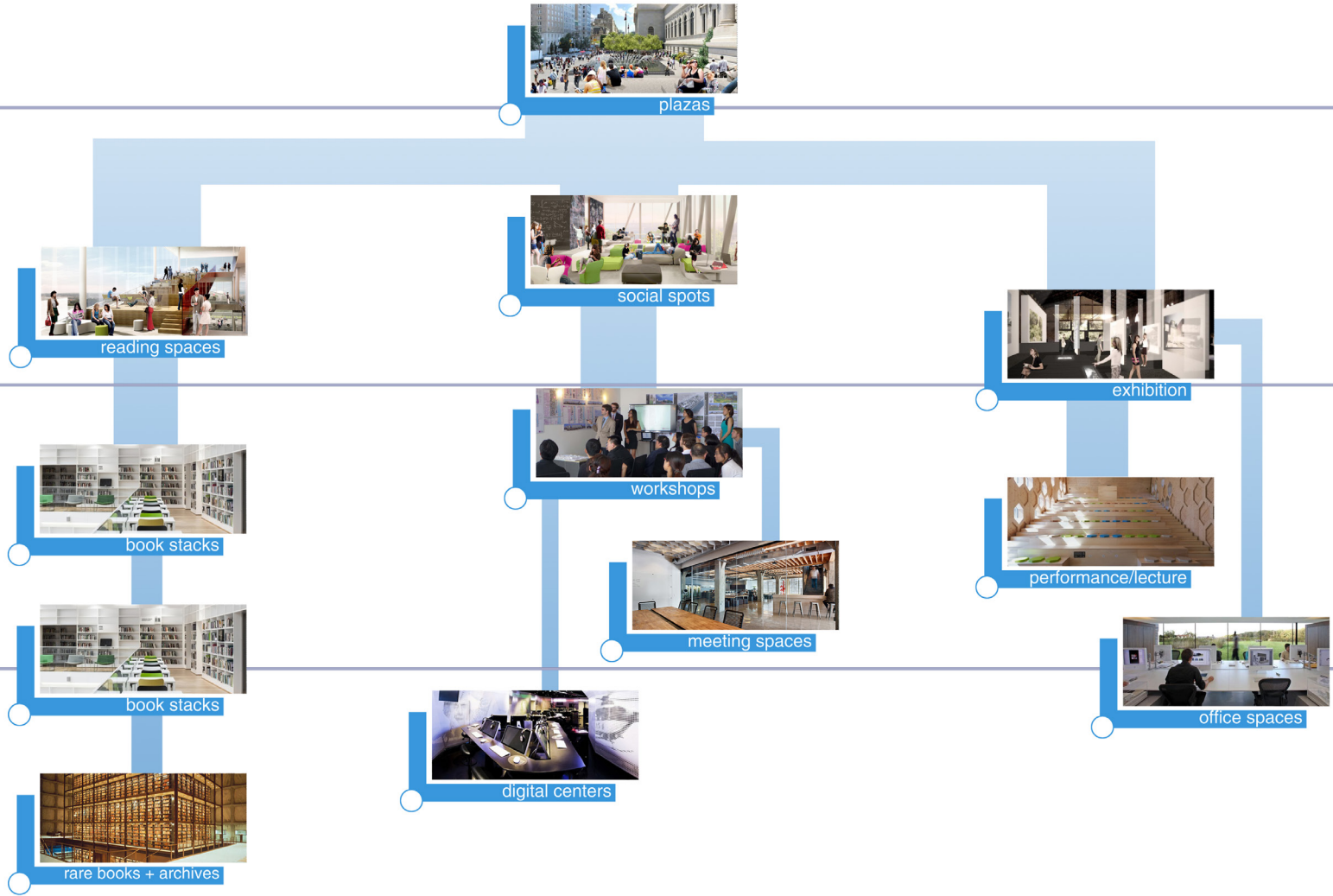


Figure 4.8 - "Degree of Control and Library Zones".

A hybrid of the previous two diagrams allows for relative control and initial spatial layout to be observed. Spaces are laid out with an understanding of both programmatic connections and climate control. This aids in defining zones of varying degrees of control: open/no intervention, frame/low control, porous/mid control, and solid/high control.



|Catalogue of Devices|

With the scope of the project there are numerous passive and active devices that play a role in both physical and microclimatic augmentation of space in order to manage *flow*. These devices also stretch across the frame, porous, and solid zones, and may slightly alter in effect, design, or layout depending on their location. This section lists and categorizes the various devices and the effects they would contribute to the microclimates as well as which ones are best suited to specific programmatic elements.

It is important to keep in mind that these devices have not been tested empirically in a real site or contained environment. As such, the effects and qualities that they portray in later representations are speculative and conceptual. Furthermore, the full mechanical workings of the systems displayed in the catalogue may not be entirely portrayed in the representations either, as spatial and programmatic layout take precedence in the represented conceptual design. However, the general speculative effects of microclimate are portrayed.

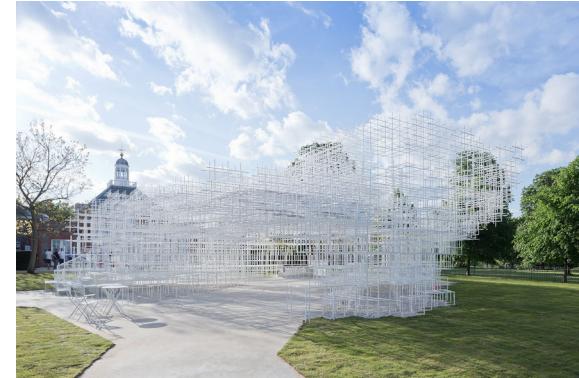
The catalogue defines the devices into three major categories: the lattice, the infill materials, and the climatic augmenters.

The Lattice

The lattice forms the physical backbone of the library. The basic concept is inspired by the work of Japanese architect Sou Fujimoto who employs light frame modular approaches in his designs. Of particular consideration is his Serpentine Gallery Pavilion in London (figures 4.9-11).

The lattice extends in x, y, and z axes across the entire site in three major groupings. Each major programmatic portion (library, cultural, and social centers) acts as a central node from which the lattice grows out of. This creates an interesting moment of overlap and density at the space where two portions of the lattice meet (seen later in figure 4.14).

Such a system works on multiple levels. It offers a form of regularity across the site that may at first seem striated to give order in planning. However, on a site scale it is a smoothed flowing space in its thematic repetition. Additionally, it offers structure to the building components. Finally, it also acts as a conduit to house the other devices across the entire site.



Figures 4.9-11 - "Serpentine Pavilion".
By Sou Fujimoto. 2013. London, England.

As the lattice is comprised of numerous modular units, various sizes were considered. The primary module option was for a regular cube of 10 feet in each axis. This size is able to accommodate the average human in height, as well as allow for some *flow* and potential objects to occupy. In of itself, such dimensions could comprise of a small room.

From here, the development of secondary modules followed the removal or addition of lattice elements that could theoretically make other modular spaces with differences in size occurring in multiples of five feet. Figure 4.12 represents five, ten, fifteen and twenty foot cubic modules.

The larger the module the more suited it is to event space, mass interaction, and a flexibility in potential program. Consequently, as seen most clearly in plan views of the entire site, larger modules were found more towards the periphery of the site and surrounding plaza-like spaces, while smaller modules became more frequent as their layout got closer to the porous and solid zones. The porous and solid zones, in fact, are made up entirely of regular grid-like ten foot cube modules with infill.

The five foot modules are a special case, occurring instead where the offset fringes of a lattice intersected with another. Again, this is more clearly seen in plan views, and explored in figure 4.14.

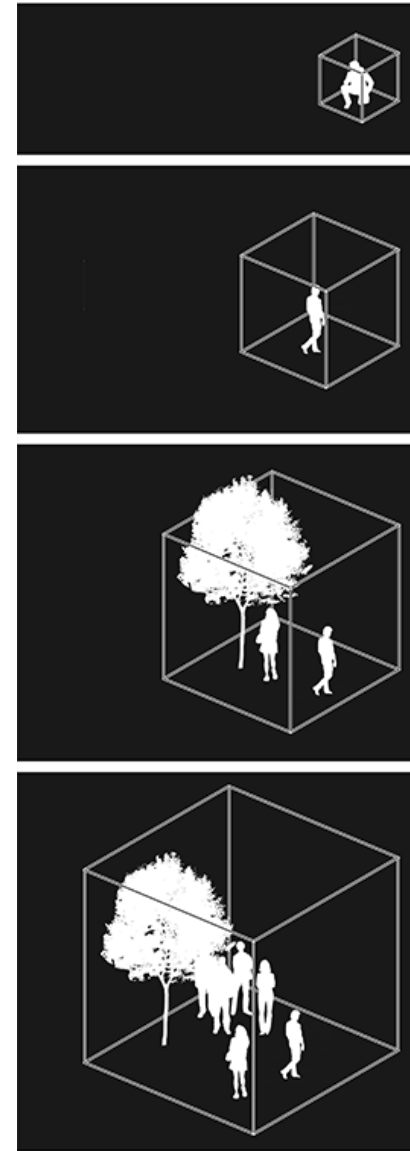


Figure 4.12 - "Lattice Module Tests". The lattice is formed out of regular modules of cubic spaces (a product of the interaction of the x,y,z axes). A number of dimensions are tested to find an appropriate 'main' spatial form to base the lattice upon.

Similar to the study of size was a study of the density of a regular twenty foot cubic zone. The density in this sense differed based on the size and consequently number of modules used within any selected three-dimensional space (figure 4.13).

Overall, this test displayed similar results to understanding sizes. Space with a high density was optimal for creating free-to-fluctuate climatic zones that were not tied to certain degrees by specific programs. Mid-density spaces were ideal for general transport and low level occupancy, while low density level areas were suited best for gathering or public event spaces.

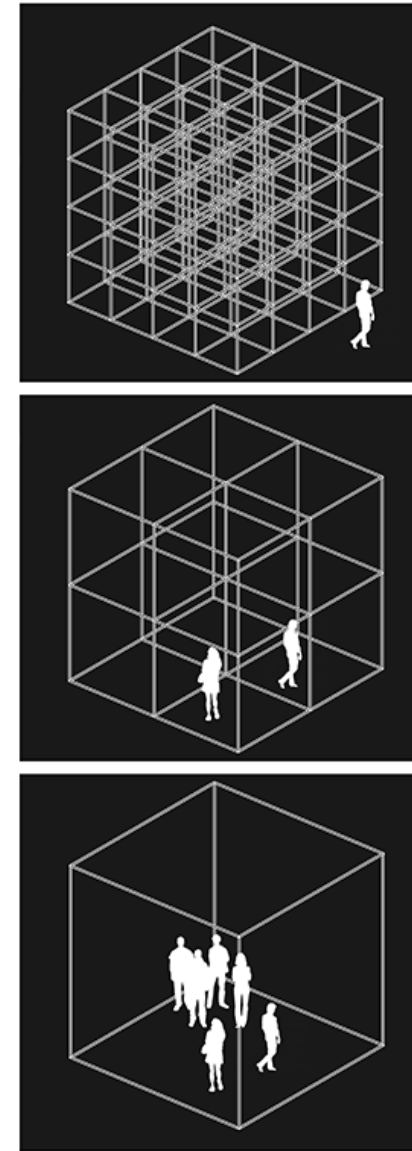


Figure 4.13 - "Lattice Density Tests".

The modular cubic dimensions are also tested in multiplicities to form a space of a desired size with a change in density. Similar to the different arrangements a modular unit can provide as a singular space, the change in densities offer a multitude of scales of interactions and events.

Figure 4.14 illustrates the main formation operations involved in shaping the lattice. Firstly is the offset, which occurs with consideration of the main solid space component of that programmatic center as the focal point of the lattice (for example, the rare books room in the library center).

The offsets follow the base module of ten feet in difference from the central solid zone. The degree to which the space is offset relates directly to how strongly climatic control is needed for that particular zone, which was determined by the previous diagram figure 4.8 displaying the level of control desired for each programmatic space. Infill material can then be placed strategically to mark the blur between respective zones.

The second part of this figure shows how the five foot cubic modules are created by a simple overlap of the offset fringes in each center. These centers, being more 'solid' within the framework, guide occupant *flow* and create spaces of 'climatic follies' where climatic augmenters do not need to be set to any specific condition.

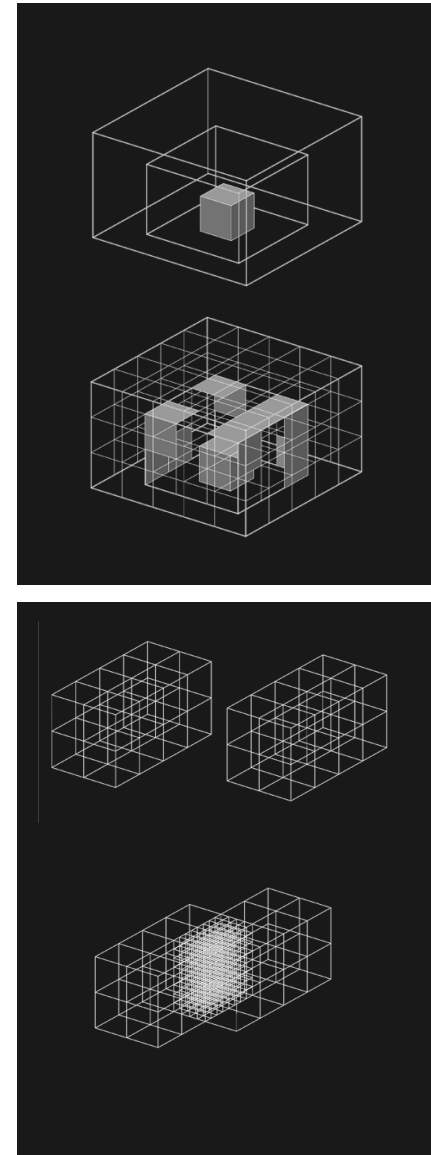


Figure 4.14 - "Lattice Intersection and Offsets".

Two primary operations exist in the lattice's spatial approach:

- 1) The lattice grid is offset from solid space 'focal points' of the programmatic centers. The degree of the offset is determined by the degree of control needed from these focal points.
- 2) At the fringes of the offsets the lattice components are intended to overlap. The focal points are offset from each other so that the overlap creates spaces of higher density.

As the user moves through the various zones, the lattice experiences slight changes to reflect this difference independent of the level of climatic control or of material choices with regards to the infill. Figure 4.15 displays these changes occurring in a smaller setting, moving from frame to porous and finally to solid zones.

Primarily for the lattice itself, more regular base modules of space are selected to opt for a layout with less sprawl and more guiding of *flow*. The quantity and type of infill material also increases and changes respectively to reflect areas of higher control.

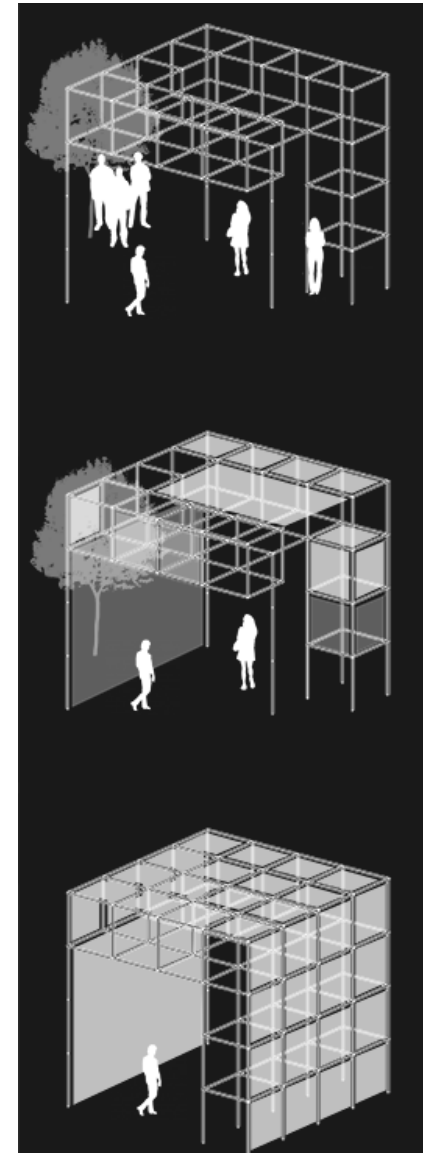
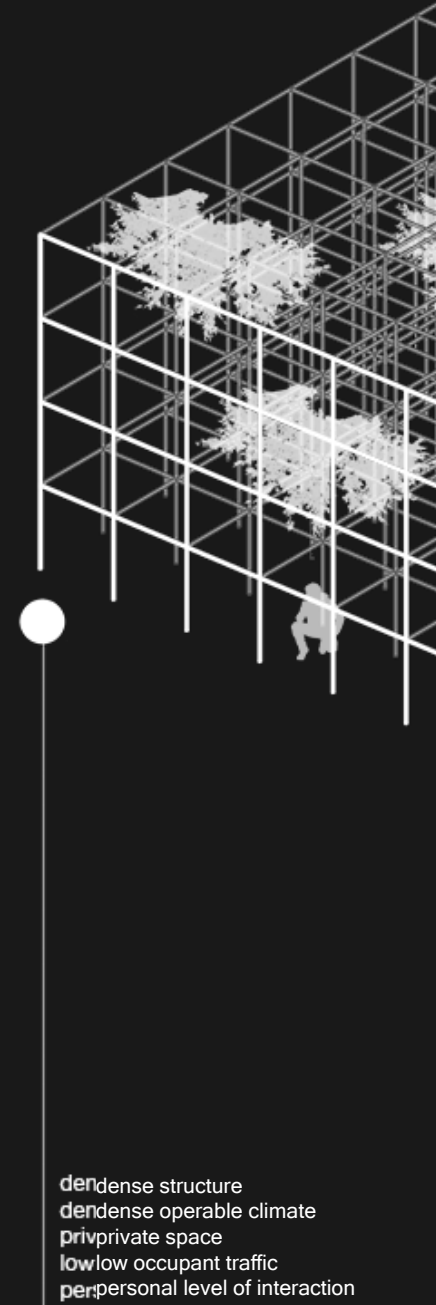


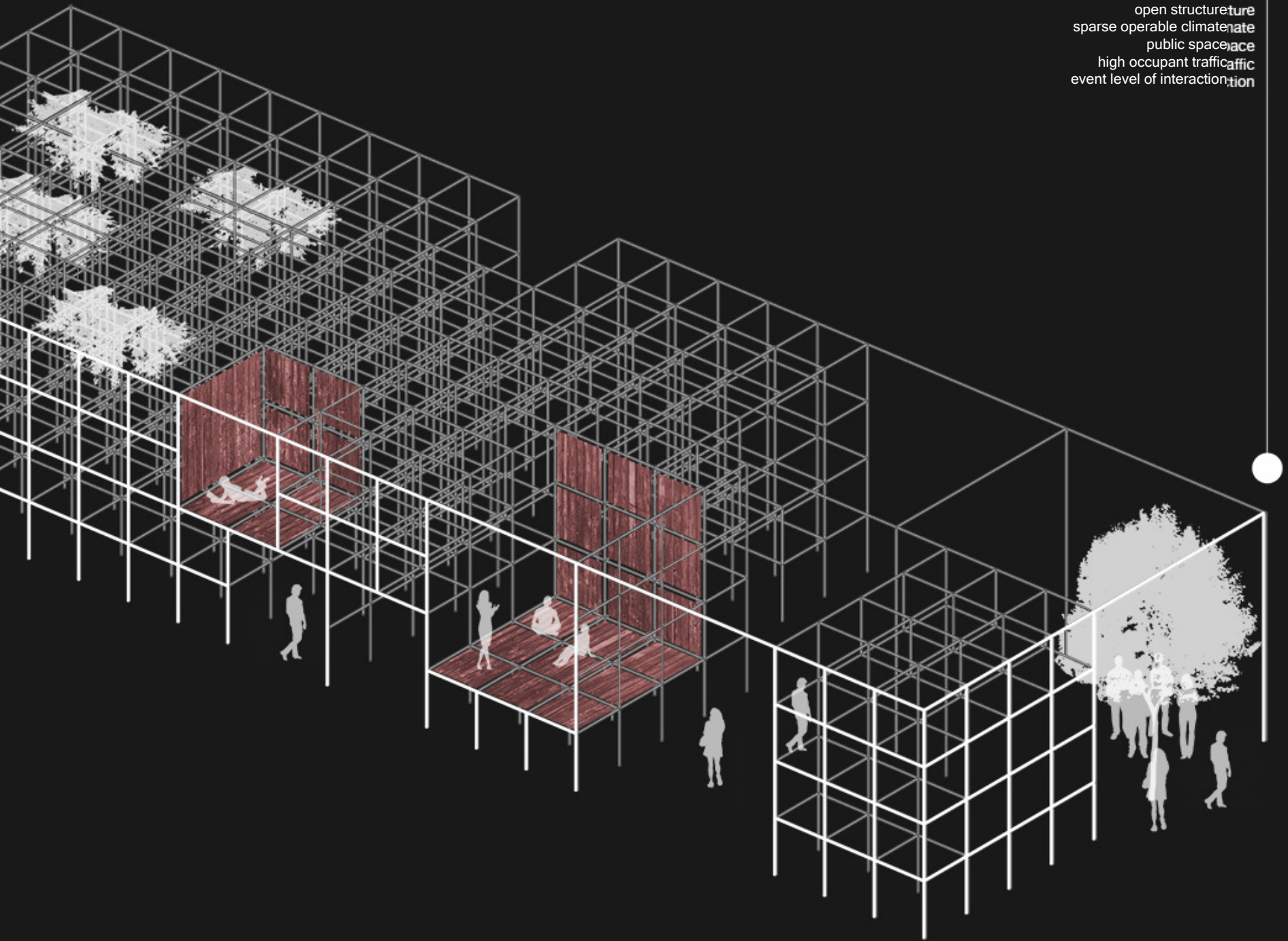
Figure 4.15 - "Lattice Changes across Zones".

Across the indistinct zones of the design, the lattice experiences changes in its performance and appearance. Primarily it reflects the increasing degree of control with an increasing degree of solidness through choices of infill material, as well as organization of climatic devices.

Figure 4.16 - "Fluctuating Lattice".
This diagram portrays the previously mentioned changes across zones occurring across a hypothetical space separate from the design proposal. Here, the main components of the lattice are combined into a layout involving larger event and public spaces, more intimate porous areas, and 'climatic folly' zones. Not portrayed here (but explored later) are high control solid zones.



open structure
sparse operable climate
public space
high occupant traffic
event level of interaction



Infill Material

As the occupant moves from an area of lower control to one of higher control, the architecture should reflect this. With the notion of ‘expanding the wall’ in mind, the various infill materials (named as they fit into the typical ten foot by ten foot grid of the lattice) display varying degrees of ‘being a wall’.

Glass may appear in zones of higher control too. In these zones they exist as LCD privacy glass which goes from transparent to opaque as desired when a small current runs through the glass. This is explored further in the analysis and design of high control solid spaces.

Figure 4.17 portrays the changes of these infill materials as occupants are guided from open space through the zones until reaching the highest control spaces. These go from being unfilled grid portions in low control zones to vegetation, glass, screen work, and concrete walls of various translucencies and opacities in more controlled zones.

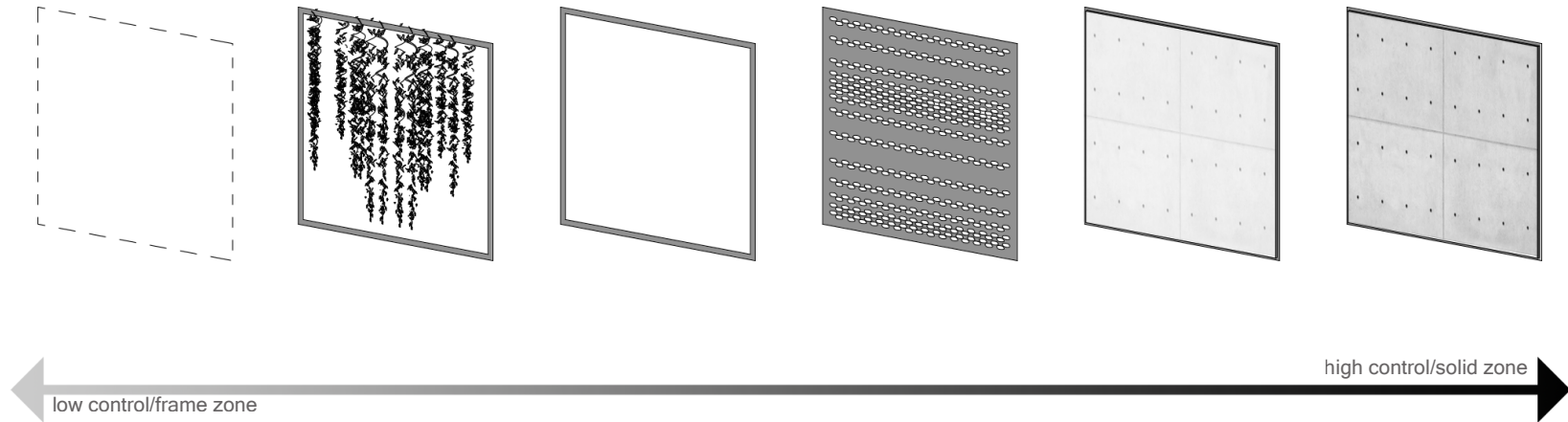


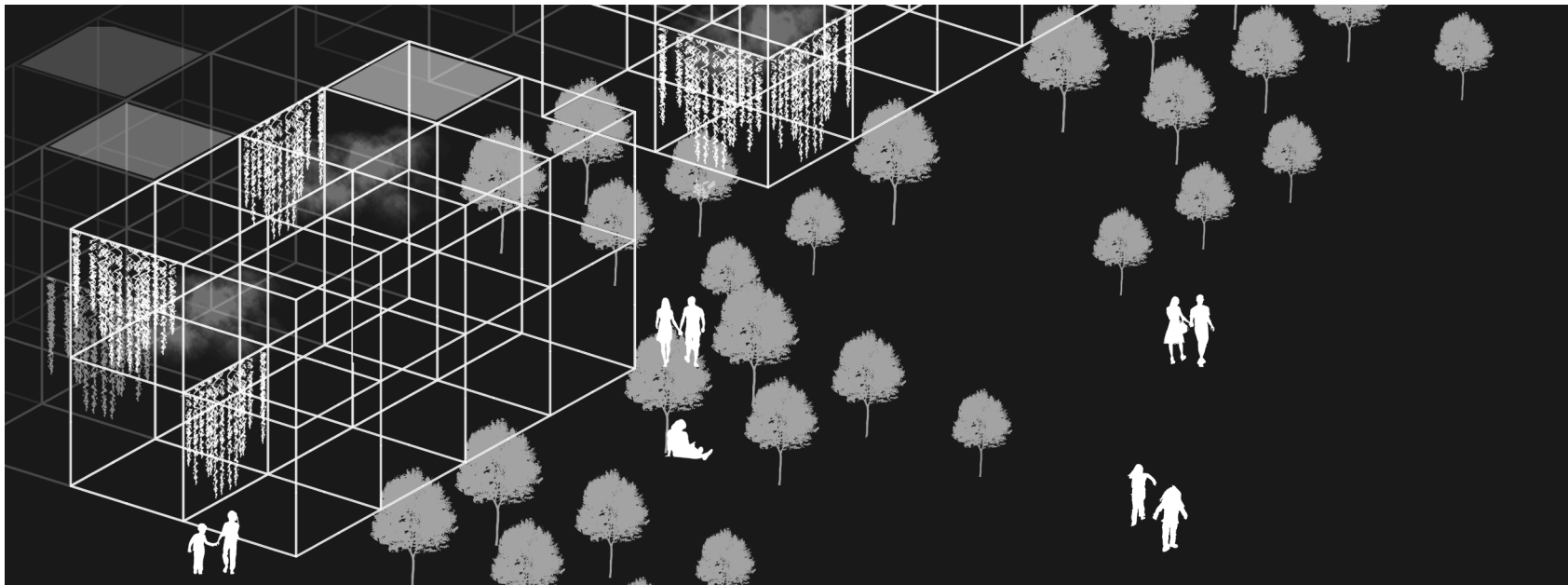
Figure 4.17 - “Infill Materials”.
Infill materials are the primary method of ‘solidifying’ the architecture around spaces of increasing degree of control. Named as such due to fitting into the square spaces of the lattice, they vary from completely permeable to completely impermeable. The types and relative quantities selected reflect the zone in which they are located.

The vegetation exists as both trees and hanging vines that can be fitted into any height of the lattice. They are not only the first formation of a 'wall' but they are also the reflection of the surrounding nature in the lattice space. Furthermore, the trees exist in the same modular system of the lattice in more open spaces where the lattice elements do not extend, acting as a mediation between landscape and framework (Figure 4.18).

The vegetation is mostly found where mist machines would be, in order to receive water and take advantage of these systems, in addition to utilizing their natural exchange with the surrounding air to spread the climatic effect of the mist. They do not stand within portions of the porous zones and the entirety of the solid zones.

Figure 4.18 - "Vegetation in the Design".

Vegetation acts as primary infill, connecting the landscape to the beginnings of the lattice, as well as providing shade and a degree of moisture control.



Inspired by Hensel’s studies of the mashrabiya and its arabesque ties to the local community of Amman (the selected site), screens were employed in the design of the library. While they serve their usual purpose of providing shade and privacy through the filtration of light, they also act as a level of building membrane. Rather than open space being suddenly met by solid thick walls that subdivide the spaces, screens provide a sort of ‘next stage’ formation of walls after vegetation with a thin lightweight perforated material.

As with traditional mashrabiya, various patterns can be considered and implemented. Primarily, the uniform material is subdivided by geometric means so as to place an array of perforations (figure 4.19). Perforations are then either increased or decreased in size, with smaller perforations set between child and adult eye levels to shield occupants from sunlight and offer low level privacy. Larger perforations are found above and below the eye level zone for ventilation and ambiance lighting (figure 4.20). This shape will be the primary form of screens and will be used in representations and renders of the design. However, other shapes can be used depending on the specific needs of spaces, allowing for the use of larger or smaller perforations, adding a whimsical and playful element to the design that is still responsive in nature to specific environmental needs of said spaces (figures 4.21 + 4.22).

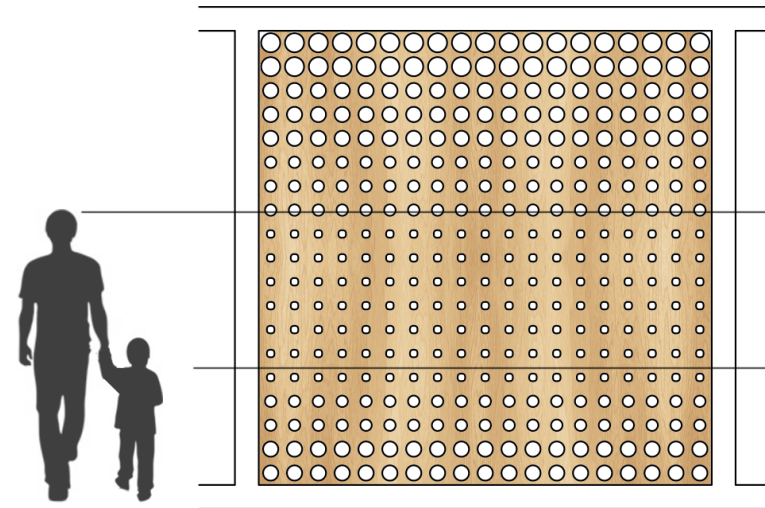
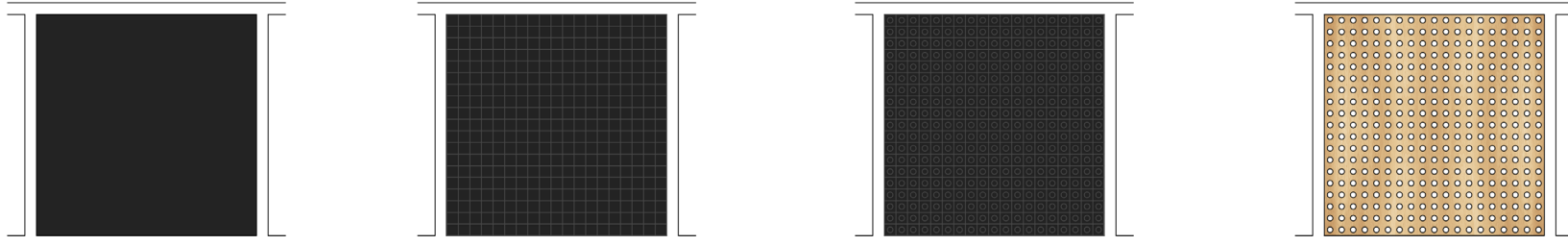


Figure 4.20 - “Main Screen Type”.
The primary alterations in the perforations are changes in size to ensure higher privacy and less light occurring at eye level, with larger perforations found at the top and bottom for ventilation and light.

Figure 4.19 - “Basic Screen Formation”.

The basic design of the screen work follows a very basic grid like formation with perforations placed in the regular form. From here alterations can be made as desired.



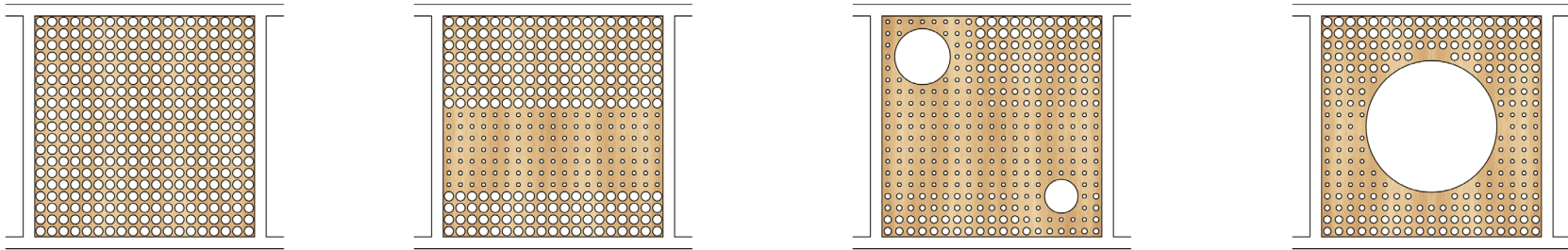


Figure 4.21 - "Alternative Screen Types".

Size changes do not have to occur uniformly across the screen pattern. Irregular changes can be implemented for unique patterns or in response to specific environmental conditions or climatic needs.

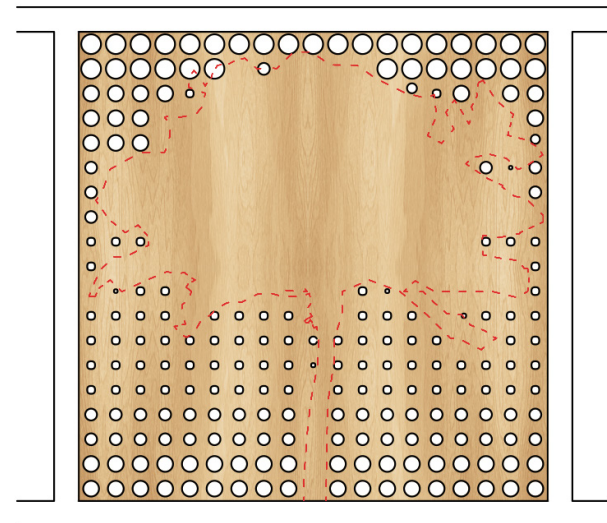
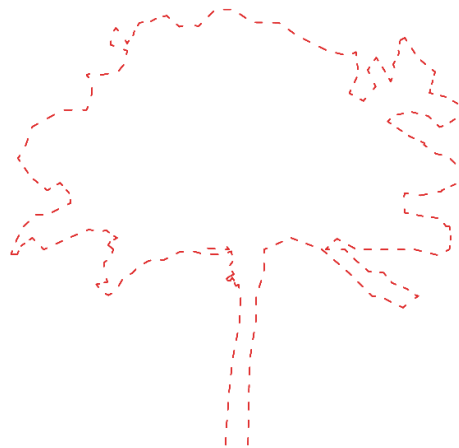


Figure 4.22 - "Shape Pattern Screen Type".

Pattern can also be edited by complete removal of perforations to make representations of patterns or objects. This provides a more playful component rather than performative.

Following the screens when approaching higher control elements of the program are walls that take on more solid forms. This creates a variation of concrete walls that range from translucent to completely solid.

Translucent walls are made with a typical concrete mixture that adds fiber optics to its aggregate mix. Figures 4.23-4.26 illustrate already existing versions of these walls.

The fiber optics allow for refraction of light through the wall, reducing its visual solidness, while continuing to exhibit the strength of concrete mix. Much like how the screens exhibit a range of openness and control, the percentage of fiber optics in the aggregate mix can be increased or decreased to obtain desired amounts of translucency or opaqueness (figures 4.27-4.28).

The thickest most solid walls are of course formed of regular concrete mix without fiber optics in the aggregate. These walls have insulative material and any concentrated mechanical systems hidden in them as a typical wall would to ensure areas of high control in climate, privacy, and *flow*.



Figure 4.23 “Cella Septichora Visitor Centre”.
By Litracon. 2004. Szent István tér, Hungary.



Figure 4.24 “LitraCon Wall”.
By LitraCon. 2005. Unspecified Location.



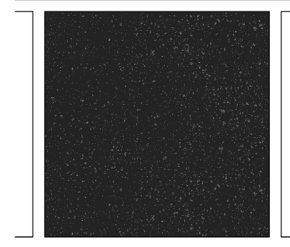
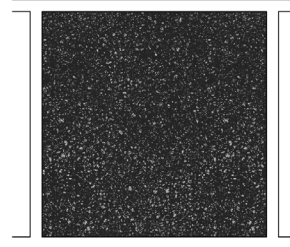
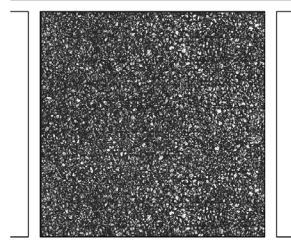
Figure 4.25 “Translucent Concrete Wall”.
By Andreas Bittis. 2007. Unspecified Location.



Figure 4.26 “Luccotherm Facade”.
By Luccon. 2009. Unspecified Location.

Figure 4.27 - “Degrees of Translucency”.

Despite being on the end of the spectrum of infill materials, concrete walls have their own degrees of permeability, dependant on the amount of fiber optic aggregate in the mix.



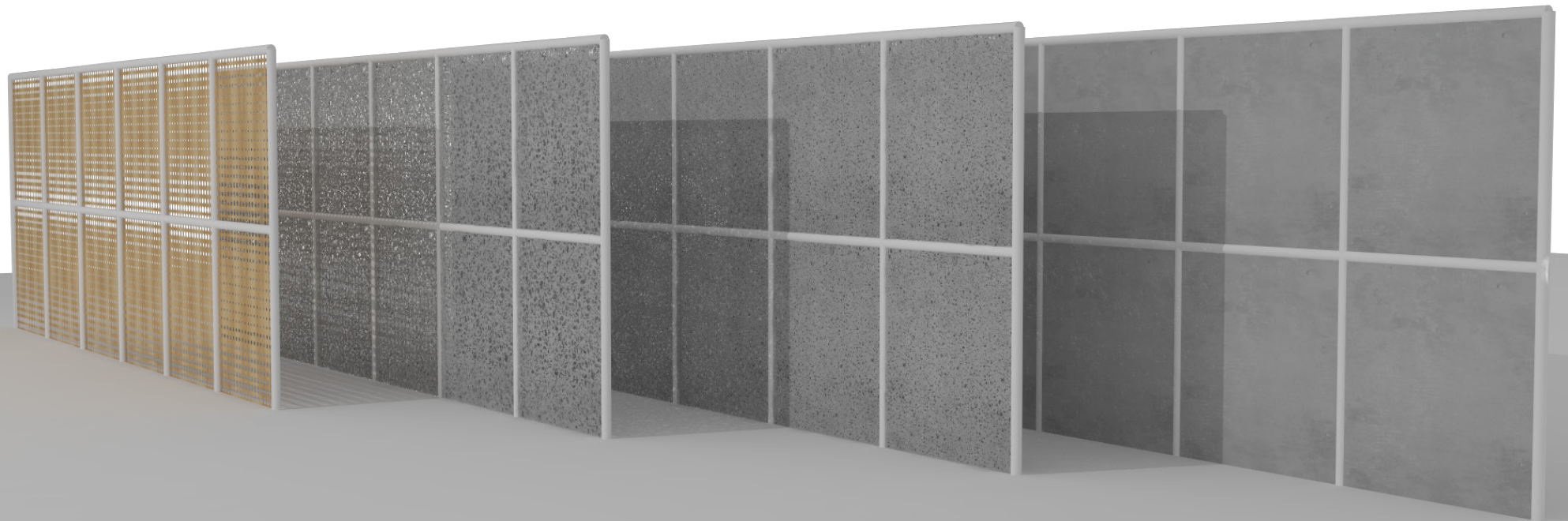


Figure 4.28 - "Translucent Wall and Screen Comparisons".
The rendering displays the changes of translucency across the concrete walls in comparison to a typical screen arrangement.

Microclimatic Augmenters

Unlike the infill material that attunes to a more solid architecture as it hones in on centers of higher climatic control, microclimatic augmenters alter across zones in the quality of their organization, and how they are suited to specific programmatic needs. Figure 4.29 shows a solid space with organized focused climatic nodes and a frame or open space with scattered varied climatic nodes.

For example, a meeting space in the microclimatic library design requires climatic augmenters attuned more specifically to creating a microclimate of low noise from outside sources. However, the digital center and rare books room have greater need for specific thermal and humidity levels for their operation and storage. These spaces also allow users of the spaces to more actively control the intensity of the devices. Alternatively, the ‘climatic follies’ found in the frame zone require little organization or control of the climatic intensities. Instead, as seen in some cases explored within this catalogue, spaces that do not require a high climatic control but still contain microclimatic augmenters may vary in the intensity of their output based on the run off material of spaces requiring strict climatic levels.

As far as this thesis is concerned, climate does not simply refer to weather elements, but extends to any form of energy which can contribute to a change in space. In this sense, there are a great many number of sensory elements that can contribute to the microclimate of a space, however, for the purposes of this thesis, the scope is limited to four main conditions that offer numerous climatic combinations as explored earlier in programmatic needs. These climatic conditions are: mist (or humidity), heat, light, and sound. The devices releasing these climates as outputs are represented in figure 4.30 as singular nodes occurring at the intersection of two lattice axes, however, conceptually they may also occur as linear mechanics across the axial space between two intersections.

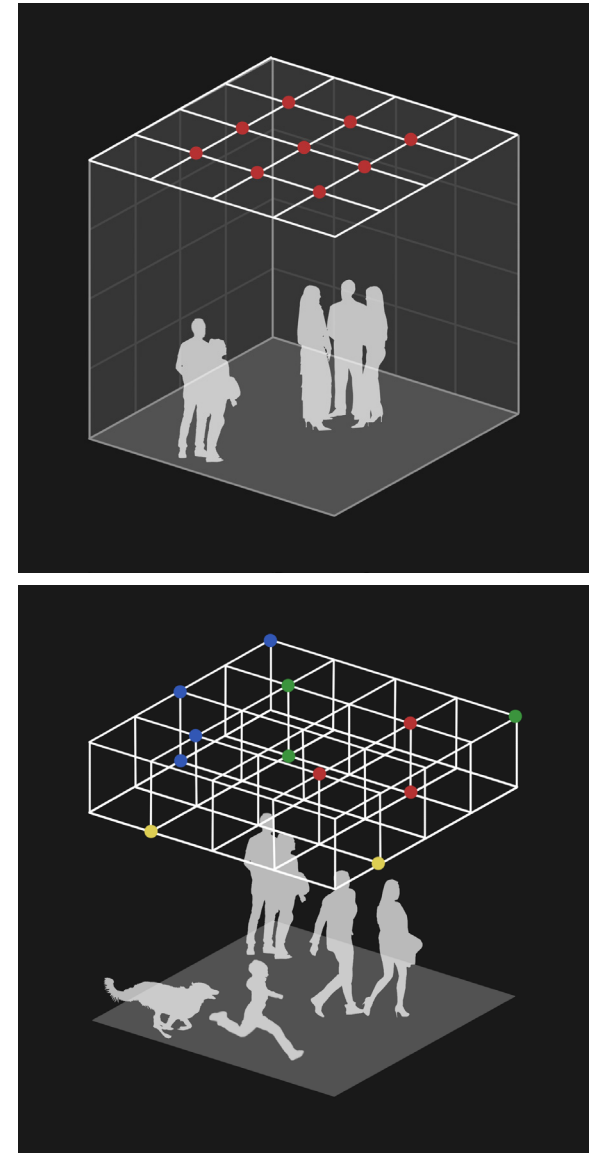


Figure 4.29 - “Augmenters across Zones”.

Microclimate devices across different zones vary primarily in their organization and climatic focus. The upper half displays a space with greater focus and intensity of a single microclimate, while the lower half is a freer zone that contains multiple climates with little organization.

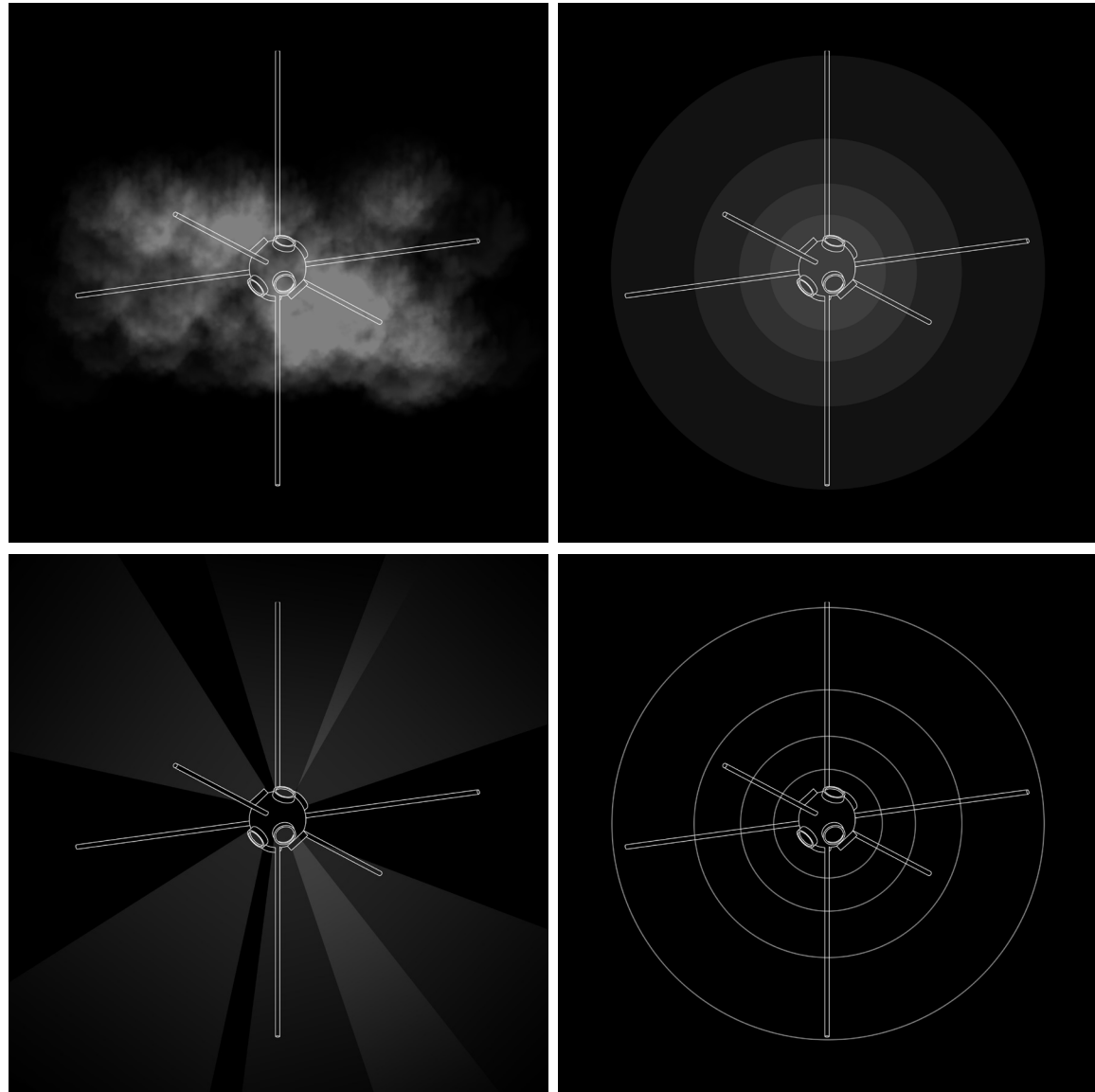


Figure 4.30 - "Climatic Singular Nodes".
There are multiple sensorial qualities that can be utilized in the creation of microclimatic spaces. To avoid clutter of too many variables, four main elements were selected: mist/humidity, heat, light, and sound. The devices exist primarily as nodular mechanisms at the intersection of the lattice axes.

The mist machines work in a similar manner demonstrated in the explored study of Climatic Territories by Nicholas Kehagias. Considering a number of solid spaces in the design require a separate coolant system, it would be a simple matter of recycling the filtered water and air from the systems to be used as mist in the rest of the project. Gray water and collected rain water in the system can also be filtered and utilized in this manner (figure 4.31).

The mist creates areas of increased humidity and adds a fluctuating visual component of the design that is reflective of the usage of the solid devices (figure 4.32). Furthermore, this provides a system for watering the native vegetation found on the site, which, by their nature, do not require much hydration. However, because of the size of the site and spread of devices, additional water may need to be brought in from an external source.

In terms of locating mist machines within the zones of the design, they would be located most frequently in the open-space and frame zones as the output is more difficult to control.

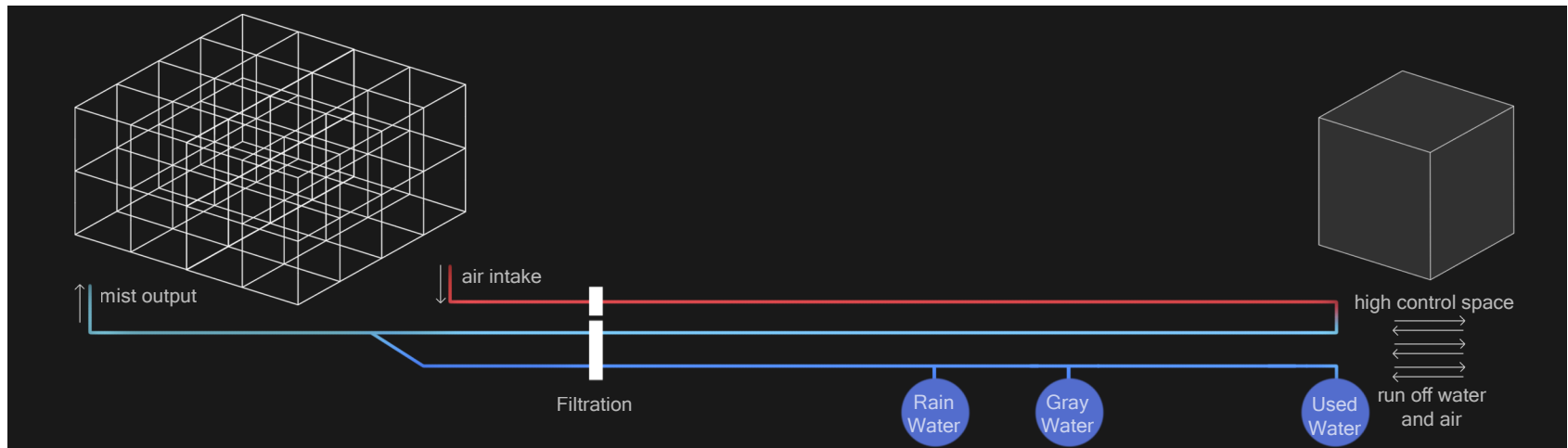


Figure 4.31 - "Mist Mechanics".

The hard details of the system mechanics are not explored as their effect is more important to the thesis than the system itself. However the mist machines are speculated to be supplied via filtered rain water, gray water, and coolant run off from higher control spaces in the design.

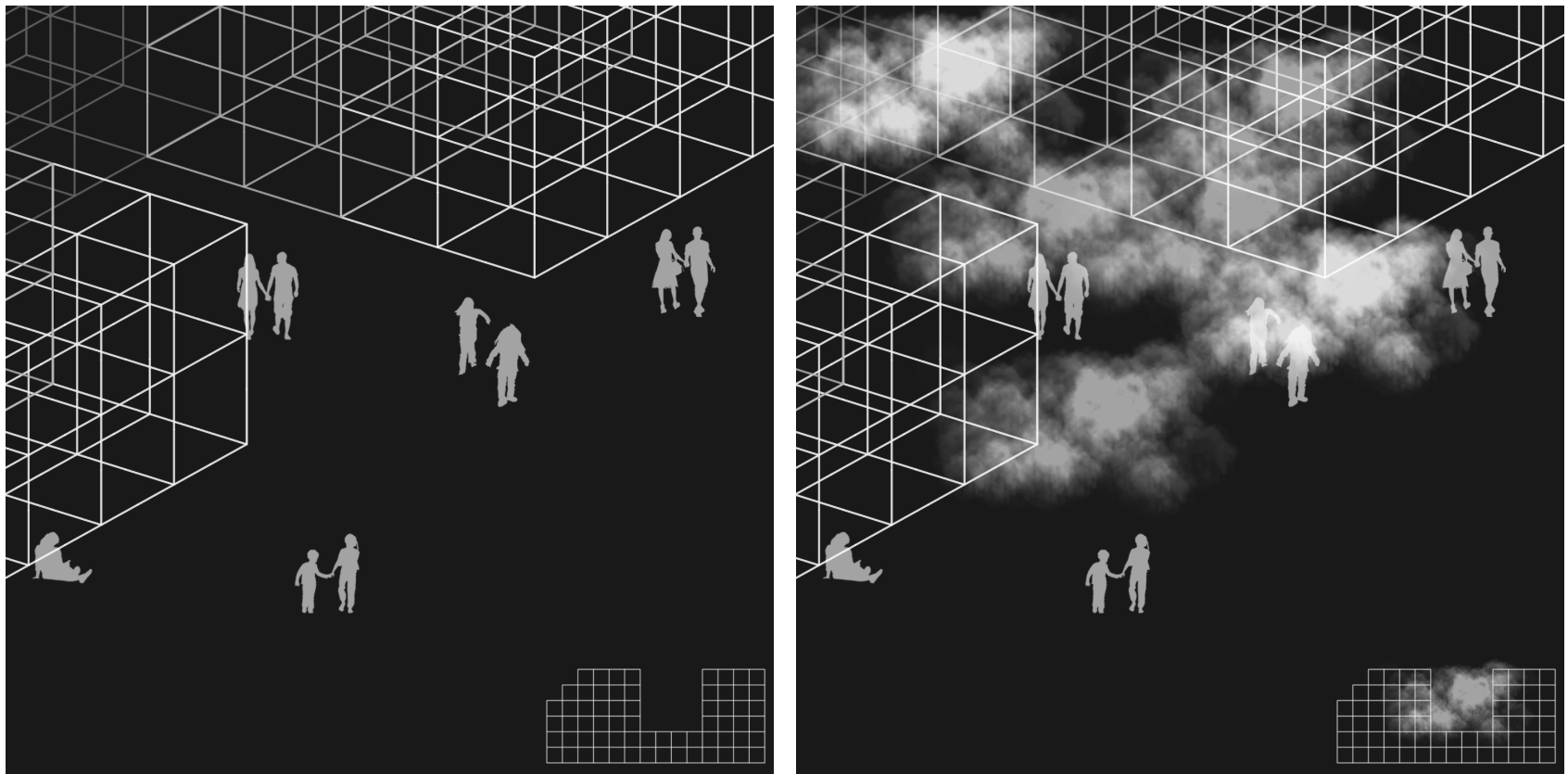


Figure 4.32 - "Mist - On and Off Conditions".

Mist operates as a form of permeable amorphous barrier brought on by climatic changes to humidity. The devices are spaced to provide moisture to vegetation as well as create temporary but traversable spatial constructs. It is an active component that fluctuates in intensity in relation to the availability of usable water.

Mist machines work to create an active fluctuating element that is born out of the creation of a microclimate. Heat works in a similar manner here. As part of the ‘expanding the wall’ method, thermal radiator devices take the place of both active thermal heaters and insulation that would normally be hidden in the wall’s structure. Heat pumps or HVAC units in solid and frame zones would be incorporated into the upper layer of the structures where they can be hidden from the areas of occupancy behind building and infill material. In open space or frame zones, these parts of the system would most likely be placed in the ground. The pipes that are part of the lattice act as both intake and output for these devices, being able to recycle the heat (figure 4.33).

In frame and solid zones the thermal radiators would act mainly as a typical heat system installed in constructed spaces to ensure comfort for occupation. In open and frame zones, however, the thermal radiators may act in response to changes in the environmental temperature, creating pockets of cool space in the heat of the day or summer, or creating heated areas in the cool of night or winter (figure 4.34). This creates sub-pockets of fluctuating social programs within the site.

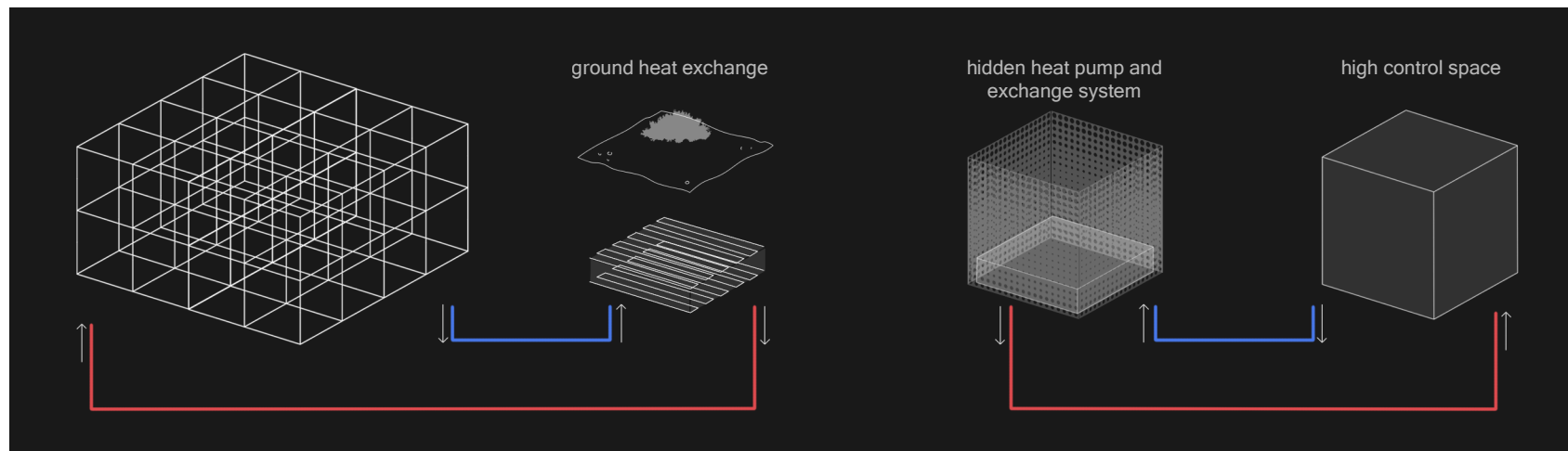


Figure 4.33 - “Heat Mechanics”. The lattice ‘pipes’ would act as both air intake and outtake to allow for heat exchange. In more open zones this can occur in connection with subterranean heat exchange system, while in more solid zones, HVAC heat exchange systems can be used concealed behind screens above the program spaces.

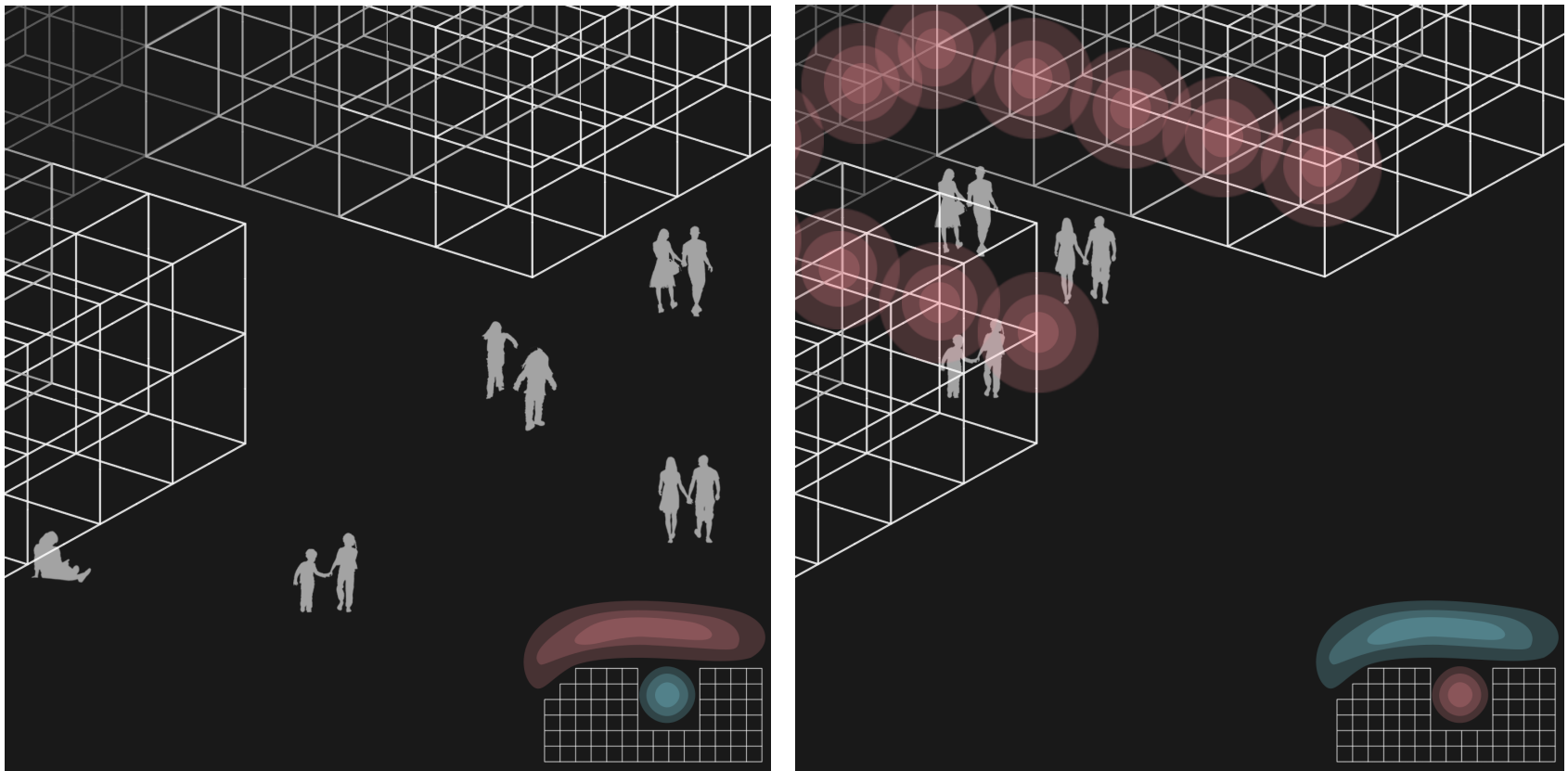


Figure 4.34 - "Heat - On and Off Conditions".
Heat operates through making spaces more welcoming and desirable within human comfort ranges, within larger contexts that may be colder. In conditions where the context is already at an optimum level the heat devices may be turned off, but create contrast in colder conditions when turn on.

Light is also a similar functional component of basic building operations, but can have quite an effect on marking space through light. In darker spaces or at night, the organization of light emitting devices can demark spaces that can be as concentrated or dispersed as desired by the design (figure 4.35). Similar to the pockets of thermal activity brought on by the thermal radiating devices, light emitting devices can fluctuate in response to programmatic desires of users (for example, setting spaces in the gallery), or to environmental conditions (creating pockets of activity and program in dark spaces or places that would otherwise be unusable in the frame and open zones at night).

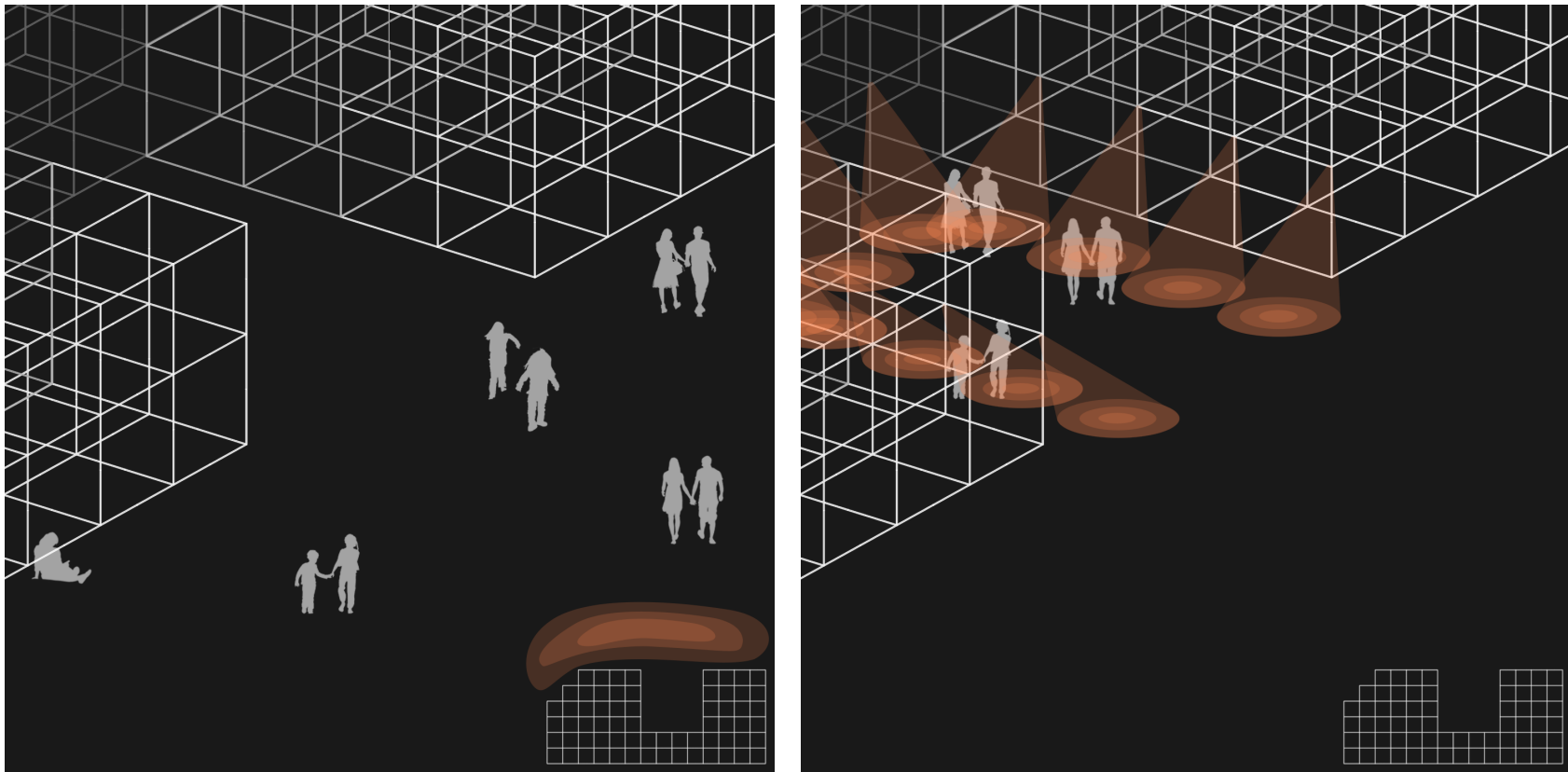


Figure 4.35 - "Light - On and Off Conditions".
Light devices operate similar to heat in that they create a climate that contrasts the context it is in. In darker conditions this creates well lit pockets and stimulate programmatic use of that area.

Unlike the other three major climatic elements, the devices working to modify sound based microclimates act primarily as filters rather than active producers. In essence, these sound devices work along the lines of basic noise cancellation technology. Ambient sound is recorded and played back through the device. The sound waves played back are set to a slight delay so that the amplitudes of source and output waves overlap and negate (figure 4.36).

The advantage of this is to create acoustic separation in areas as controlling as solid zones, and pockets of open space that gain an invisible barrier of privacy through non-physical ‘walls’ of sound cancellation (figure 4.37).

Sound cancellation devices are mostly centered in the immediate space, much like the light emitting devices yet unlike the thermal and mist devices that need secondary system placed components out of view.

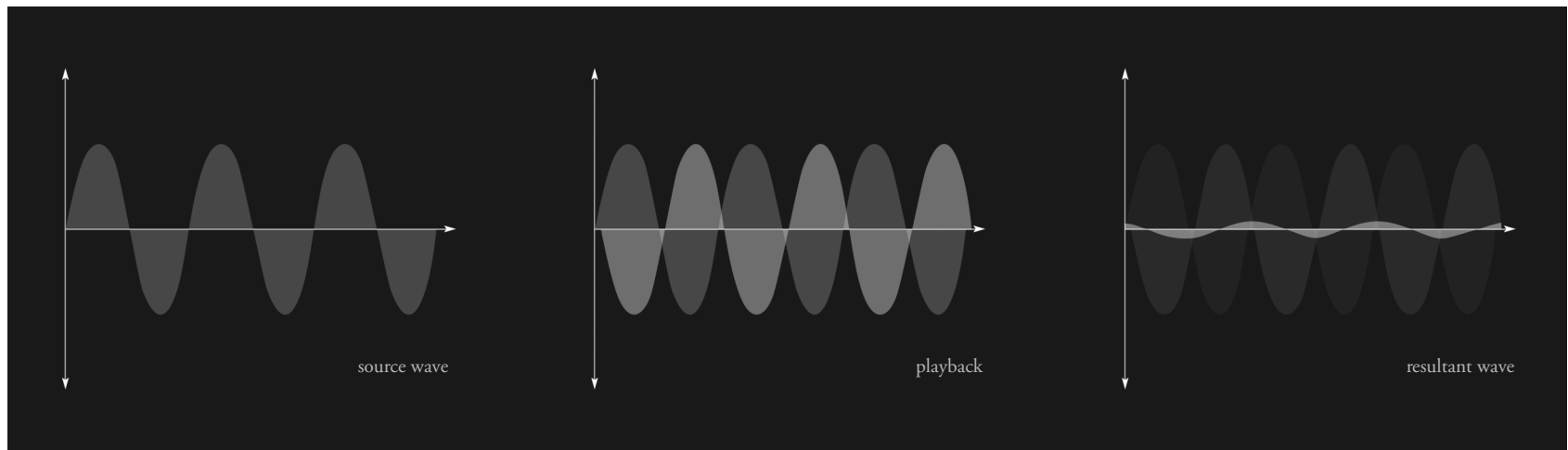


Figure 4.36 - “Sound Mechanics”.

The diagram is a simple representation of basic sound cancellation technology to be implemented in acoustic microclimates of the proposal. Source sound is received by the device and played back with the proper amplitude and shift in frequency for an overlay of sound, resulting in negation of acoustic activity.

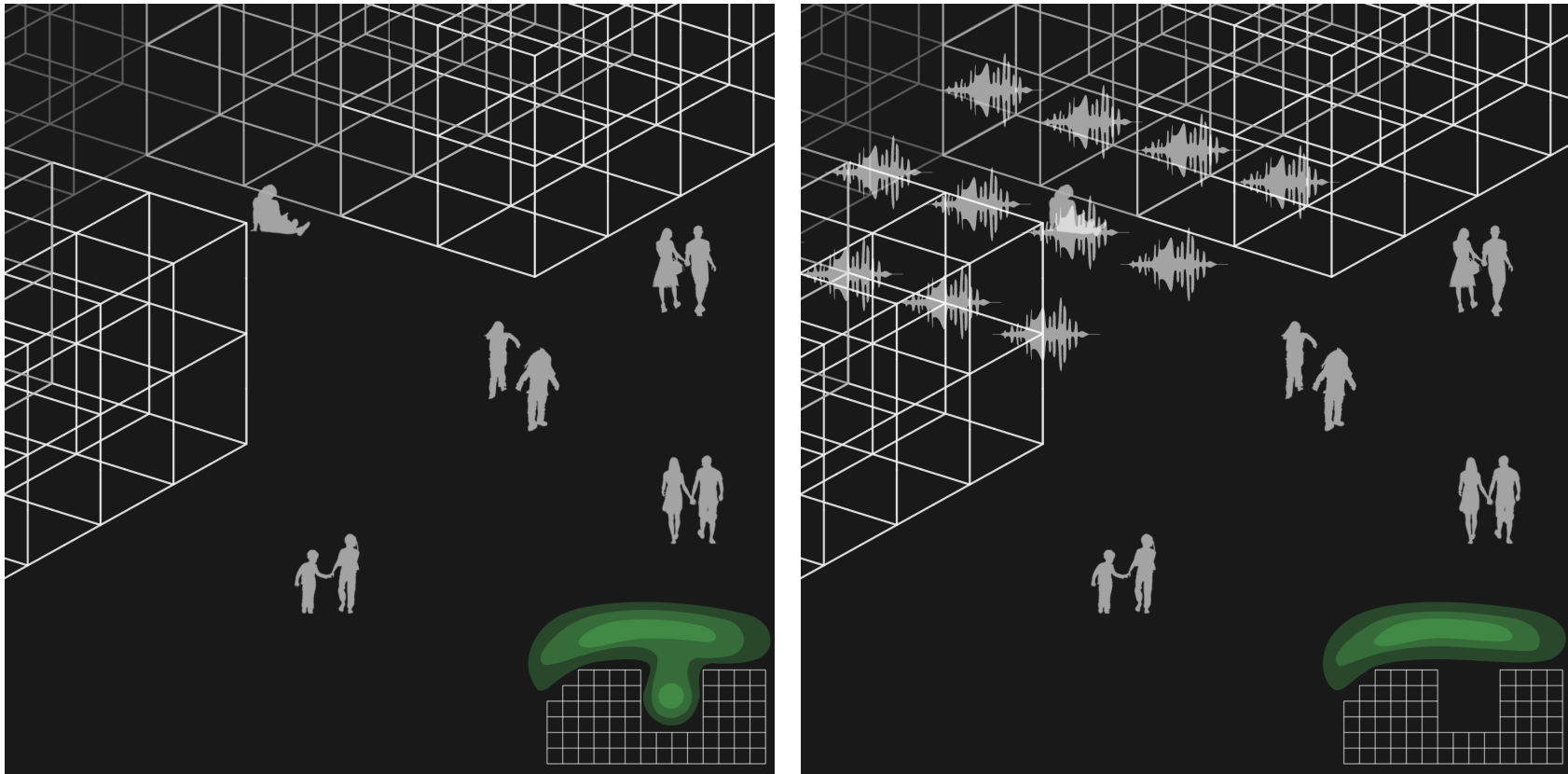


Figure 4.37 - "Sound - On and Off Conditions".
Sound cancellation devices offer pockets of space for more privatized activity by canceling surrounding noise and providing acoustic internalization of a zone. This however does not affect other climatic effects or block off the site and architecture through strict divides.

|Site and Conditions|

The city of Amman, Jordan (figure 4.38) was selected as the context for the design proposal. Since the proposed library contains open layouts, expanding program, and microclimatic experimentation, an ideal context would have a climate of its own that is steady and within more favorable ranges. Amman also provides an Arabesque social context which the library can further reflect with the involvement of mashrabiya-like screens in the design. However, it should be stated that the design is in no way an attempt to solve a specific community or global issue that affects Amman, and that the choice in site context is purely for the reasons listed.

On average, the city enjoys warm to hot weather year round with little rain or unexpected turns. The record low and record high temperatures were -10°C in January and 45°C in August, with the average temperature year round laying in the lower twenties. Furthermore, sunlight is experienced almost consistently for approximately 310 days of the year and only 51 days of rainfall.⁴⁴ Wind was not a major issue either, with West-bound winds being the greatest within a range of 8-12km per hour (4.5-6.5 knots), which is no more than a light to gentle breeze on the Beaufort Wind Scale.⁴⁵ Being a desert climate the thermal fluctuations between night and day encourage continuous programmatic fluctuation. Figures 4.39.

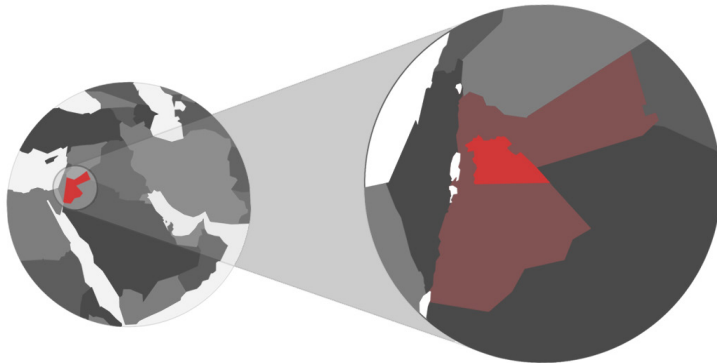


Figure 4.38 - "Jordan and the Amman Region".

⁴⁴ ClimaTemps. *Amman Climate and Temperatures*. 2013. Accessed October 31, 2014. Available from <http://www.amman.climateemps.com/>

⁴⁵ Ibid.

⁴⁶ SPC. *Beaufort Wind Scale*. Accessed October 31 2014. Available from <http://spc.noaa.gov/>

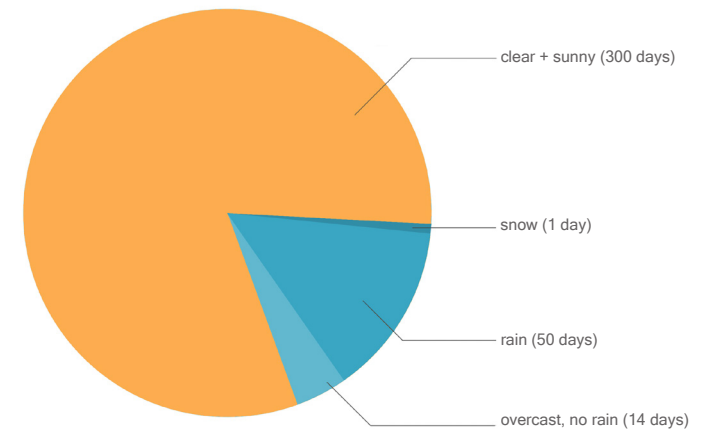


Figure 4.39 "Forecast Breakdown in Amman". Generally the site provides predictable and favorable environmental conditions in which to experiment with microclimatic effects.

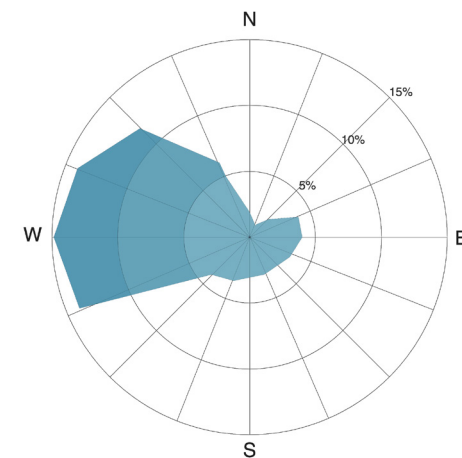


Figure 4.40 - "Amman Wind Rose". The site's wind conditions are also favorable, offering westward winds that do not exceed breezes on average according to the Beaufort wind scale.

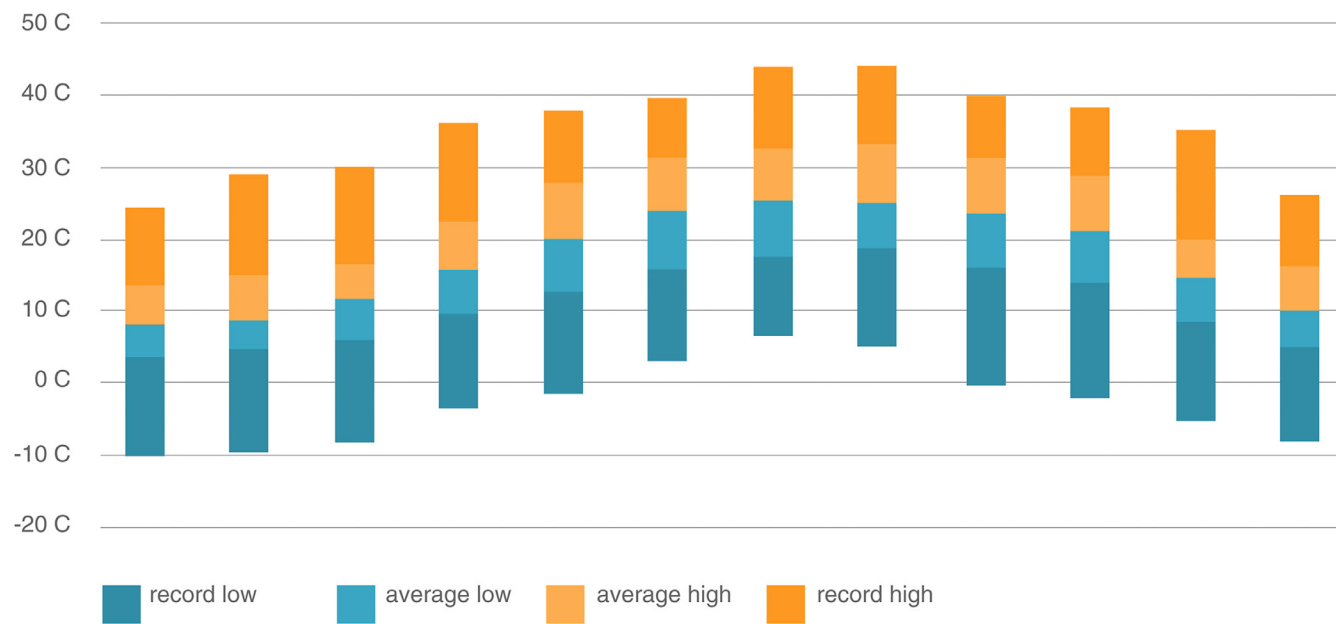
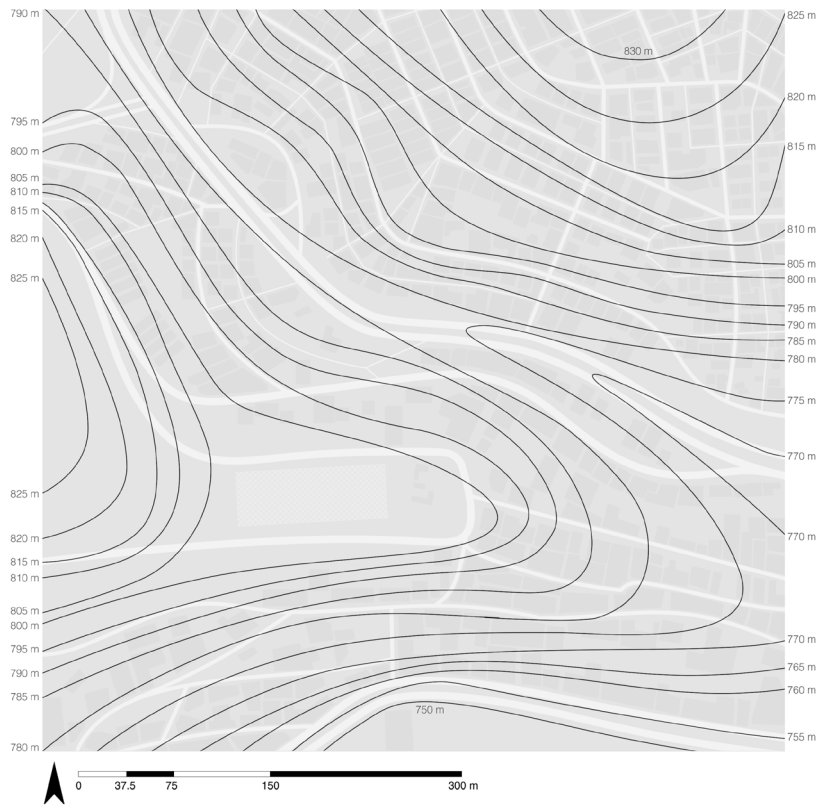
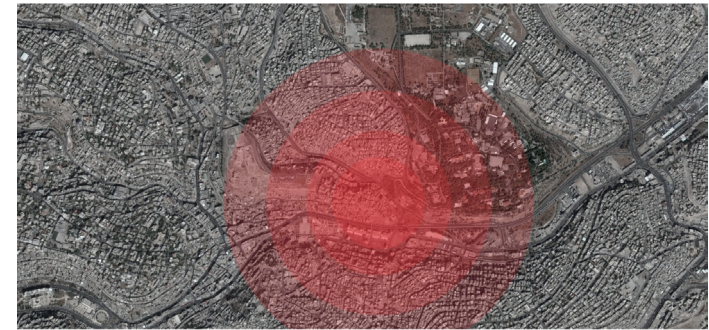


Figure 4.41 - "Amman Temperature Ranges".
 Amman's temperature ranges from below freezing to warm, however the average rates follow predictable and favorable patterns, as with the wind and forecast.

The specific site lies within Amman's downtown district (figures 4.42-4.43). Here, history and modern life meet. This is an area with a high density of apartments that scale up the valley-like contours of the city and a large hustle and bustle of old and new market zones alike.⁴⁷ Most notably there are some ruins from the era in which the Roman Empire had stretched through the Middle East. The most famous of these are the Roman Amphitheater and the ruins of the temple of Heracles.



⁴⁷ Google Maps Data. *Amman Jordan*. 2014. Accessed October 31, 2014.



City 1:3000 scale



Neighborhood 1:900 scale



Plot 1:300 scale

Figures 4.42 (left) and 4.43 (above) - "Selected Site". The downtown area of Amman is a hilly and densely populated area but provides a location of cultural significance with connective roots to the city's context.

The latter of these two actually occurs only a few feet away from the selected site, which also overlooks the lowest point of the valley, which more or less divides the downtown area's commercial zones from the residential zones. This makes it an ideal location for a public-oriented program, acting as a central crossroads for merchants, locals, and tourists alike. Some green space also exists in this area, allowing nature to potentially extend into the selected site and eventually the design itself, as this thesis hopes to achieve through extended threshold (figure 4.44).

The major constraints found in this site are the shape left behind from the contours. Older streets were laid out in correspondence with the contours, further narrowing the site down and forcing a general rectilinear site. These roads, coupled with the lack of solid public transportation in Amman, have also been known to cause some confusion in urban circulation. The site resides amidst this mesh network of roads and contours.

Despite this, the available site does leave behind enough space for a decent sized structure to be built upon it, albeit one that is oriented in a particular direction. The higher elevation overlooking the downtown area as well as its proximity to a famous local site also provides the site and the suggested design with some “geographic advertising” to make up for the narrow access and physical constraints. Furthermore, while public transit may be difficult, pedestrian paths cut through the valley at points of convenience, allowing for pedestrian *flow* for locals, tourists, and shop keeps.

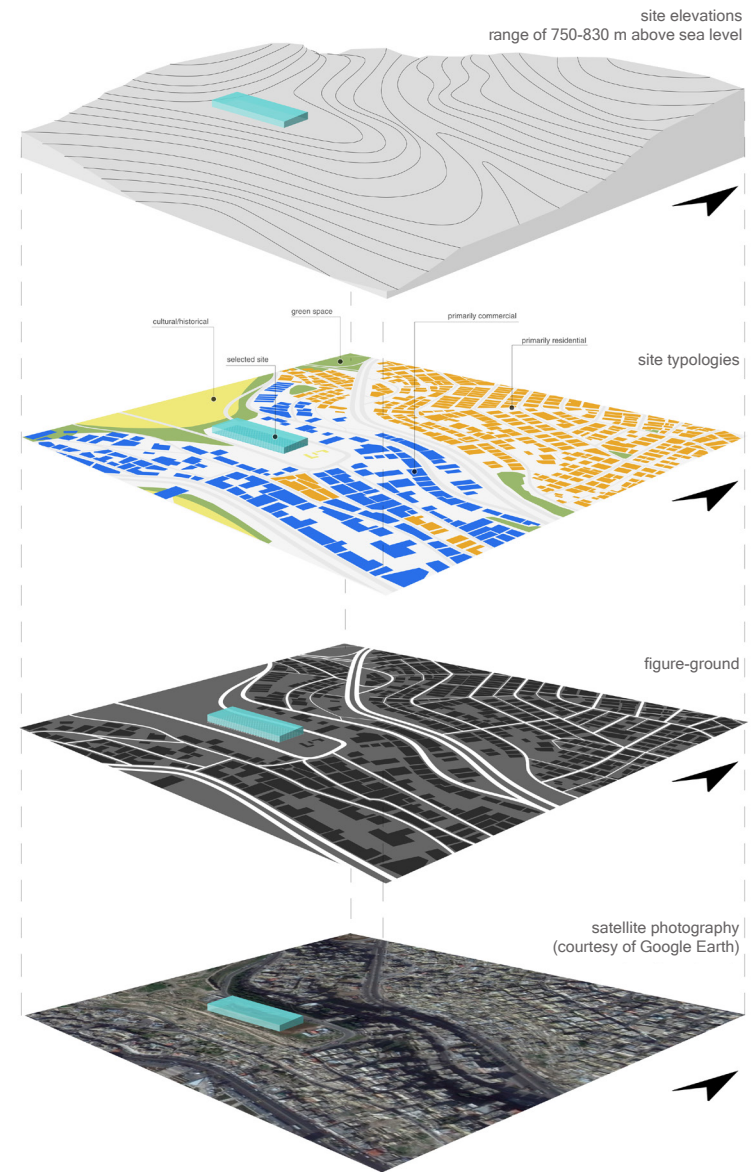


Figure 4.44 - “Site Analysis Maps”.

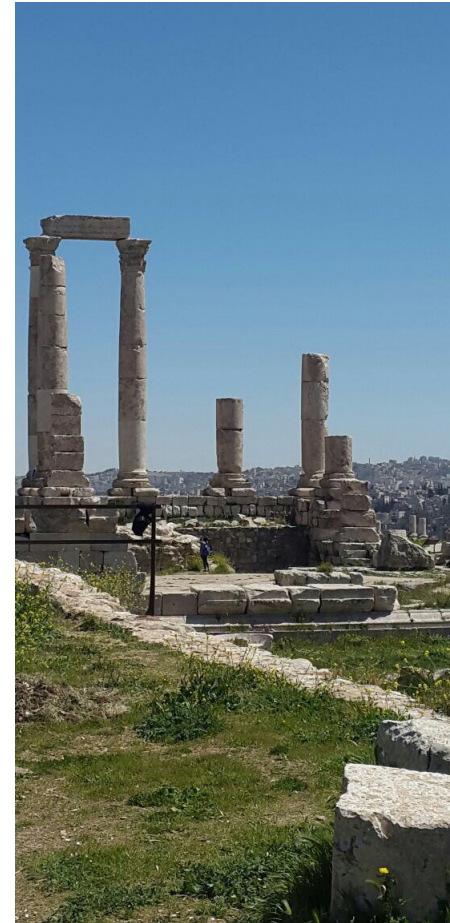
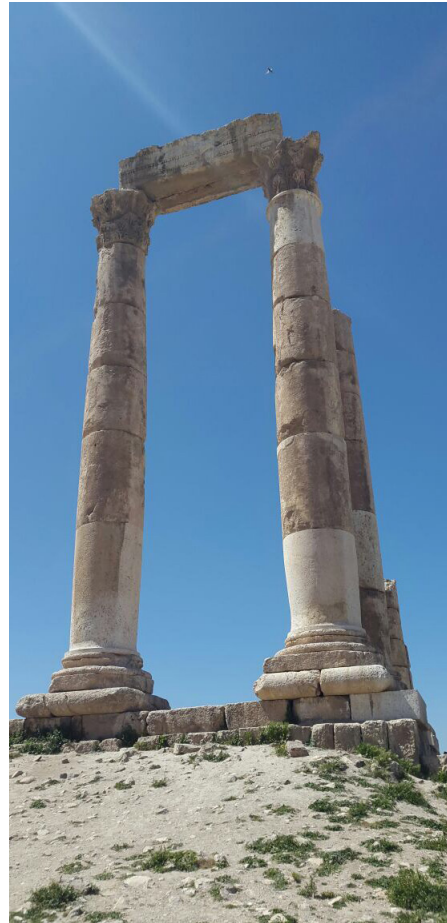
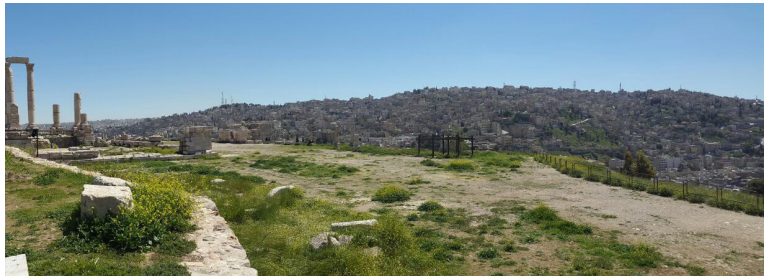
The diagram explores the various layers in the immediate vicinity of the site in downtown Amman. The map portrays general figure-ground, typology, and contour information and relations.

Downtown Amman



Figures 4.45 - 4.48 - "Downtown Amman"
Photographs by Maxwell, Geography Lists - Amman Jordan.

The Site



Figures 4.49 - 4.53 - "Amman Citadel and Site"
Unknown. 160-170 AD. Amman, Jordan.

|The Microclimatic Library|

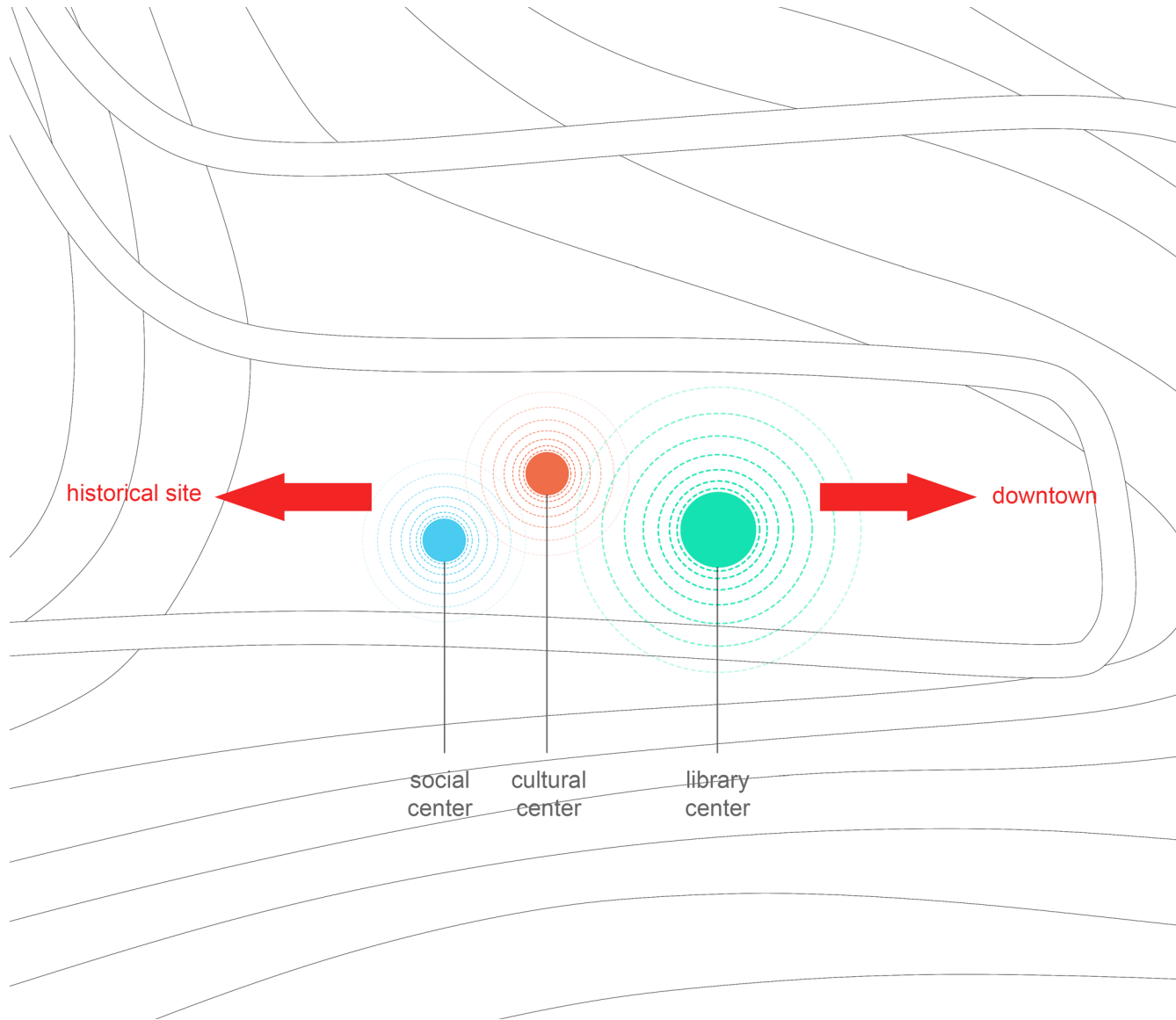
Having reviewed strategies, program, devices, and site, the following pages go through the final spatial considerations and various representations of the actual design proposal. This section begins with a general positioning of the three main social, cultural, and library centers of the design, followed by conditions occurring in climatic zones that take advantage of elements explored in the devices catalogue. With an understanding of the spaces, a distribution of program and primary elements comes next portrayed across the physical space. The subsequent drawings consist of section and plans that reveal physical layouts, degrees of control, and the microclimatic spread within each. The section is concluded with renderings of the spaces.

It should be noted again that the values represented are not empirical, merely conceptual. Furthermore, only one major winding section was chosen so as to represent the notion of a single fluid movement from one of the site to the other as opposed to the traditional selection of multiple section cuts through the site. This section extends in multiple directions making it highly descriptive of the design. Finally, the microclimatic sections and plans are color coded according to what is assumed to be the most dominant climatic effect in a specified zone, and not indicative of one single microclimatic element acting individually.

Figure 4.54 - "General Site Layout".

The diagram shows the layout of the three main programmatic centers. The social center is laid out closest to the historical site of the ruins to attract potential tourists and visitors. The cultural center mediates between the social and library centers.

Formation in Site

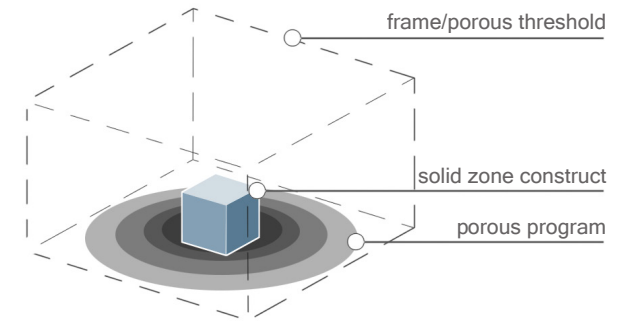


Programmatic Fluctuation

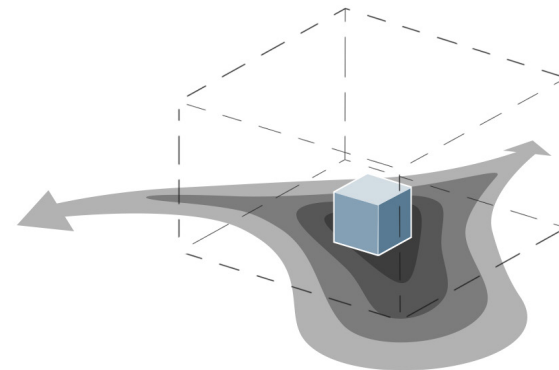
As previously stated, the lattice is the main structural component of the design that also acts as the device conduit. The lattice across the zones was briefly touched upon earlier but specific conditions that act in combination of listed devices are explored here. These conditions involve the main differences of functionality and design between the open, frame, and porous zones and the solid zone.

Generally speaking, the open, frame, and porous zones have no strict subdivision between them, and are instead a further development of the zone that preceded them. The differences occur when climatic control is adjusted or the control of *flow* through the space is handled with a greater degree of 'solid' materials. However, these changes do not occur suddenly except in the case where the porous and solid zones meet. Otherwise, the zones blur into one another, adding or subtracting elements at their shared thresholds.

The open zone remains largely untouched by the design. The frame zone is the start of the lattice in creating a spatial organization as well as low intensity climatic elements that may be more spaced out than organized for particular functions. The porous zone acts primarily as the field in which 'porous program spaces' can provide a buffer between areas of high control and low control. It is also within the porous zone that program is able to fluctuate more freely under specific circumstances (figure 4.55). Examples of such programs that may experience such fluctuations are represented in figures 4.56-4.59. This is similar to Banham's analogy of the campfire reacting to environmental conditions.



porous program under restricted conditions



porous program under unrestricted conditions

Figure 4.55 - "Porous/Frame Zone Fluctuation". Depending on the conditions, program within the porous zone can be allowed to expand or contract between frame and porous zones. Solid zones however remain static in comparison.

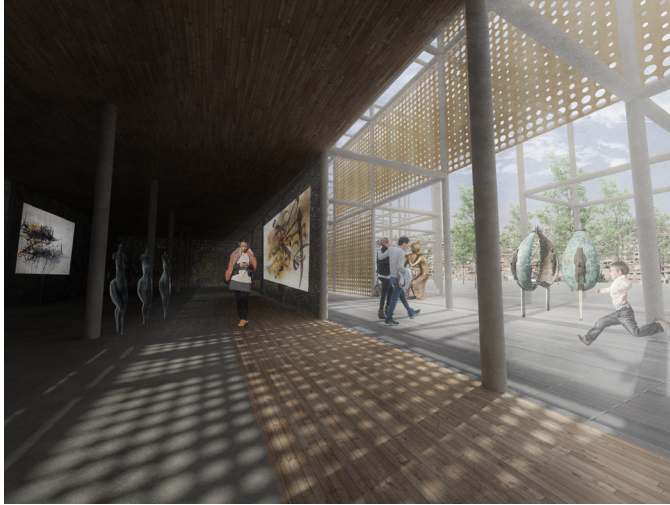


Figure 4.56 - "Gallery Fluctuation - Summer Condition".

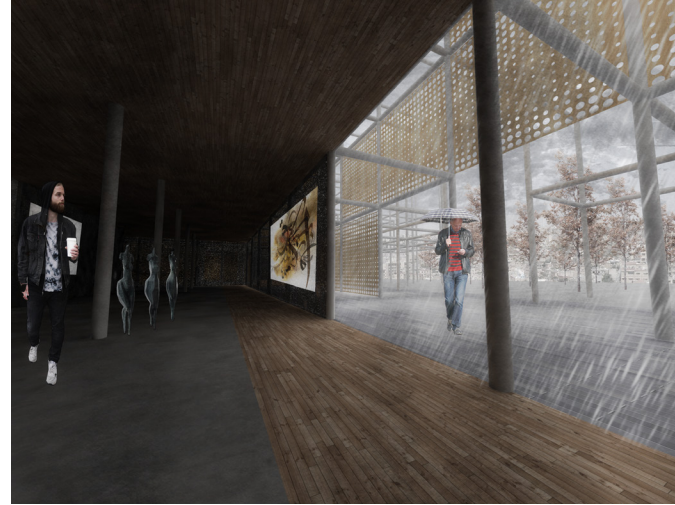


Figure 4.57 - "Gallery Fluctuation - Winter Condition".

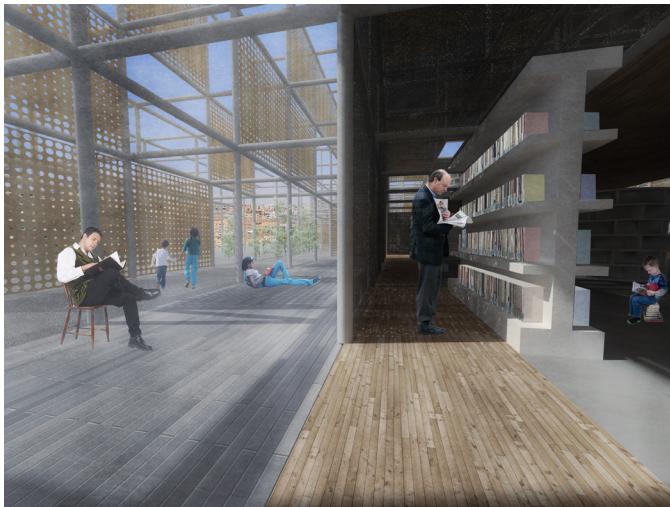


Figure 4.58 - "Library Fluctuation - Summer Condition".

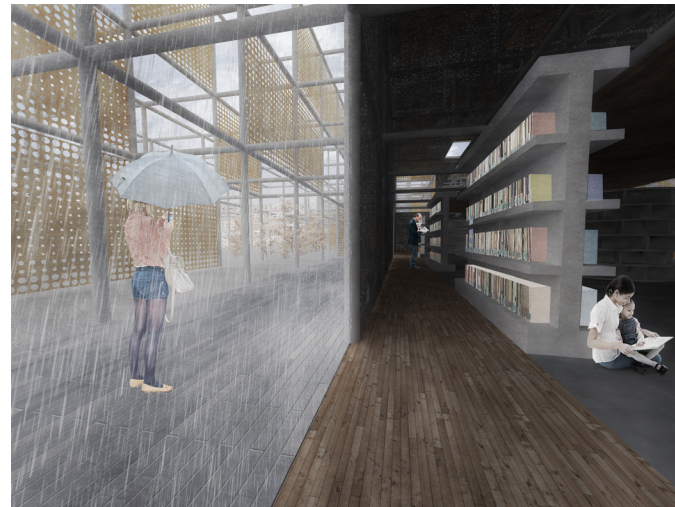


Figure 4.59 - "Library Fluctuation - Winter Condition".

Certain library spaces and the gallery are examples of program capable of expanding under certain situations. Reading spaces and art pieces that require less moderation of climatic control can fluctuate into the frame zone with favorable climatic conditions.

High Control: Solid Pods

Areas of highest control need to be entirely self internalized, following the principles of Banham’s tent model. As such, the solid zones were designed as pod spaces. These pods, in design, resonate with the materials and qualities of elements found in other zones, but with a higher degree of impermeability. For example, the solid zone pods each have a metal layering with perforations similar in pattern to the wooden screens in the lattice but with smaller openings and a material that appears more solid and static. Figures 4.60 and 4.61 show a basic example of a solid pod and the types of pod spaces respectively.

The pods are also designed to be capable of sliding into the lattice in raised situations (figure 4.62). Primarily this lifts the pods into their own structural support separate from the raised walkways used by occupants. It also allows for the pod to physically ‘separate’ itself from the design in a visual sense while still being tied back in organization and material choices. The solid pods placed on a ground level are also lifted slightly by an individual micro-lattice of sorts placed beneath the pod to allow for the same slight separation (figure 4.63).

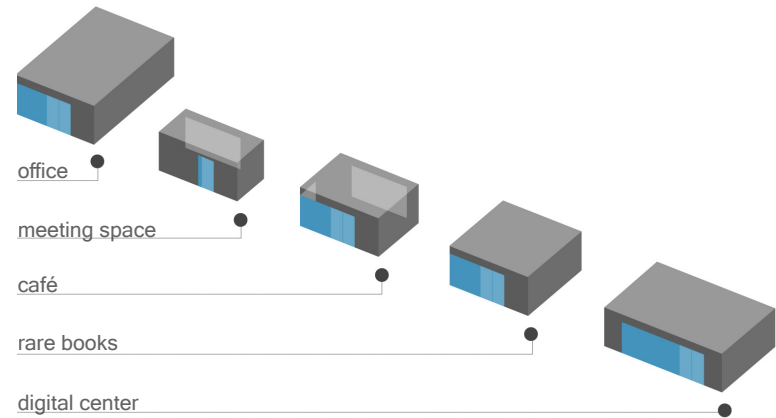


Figure 4.61 - “Pod Programs and Exposure”. There are five main forms of solid spaces developed into pods. Meeting spaces and workshops were considered interchangeable. Certain pods could be more ‘public’ despite needing more control, and is reflected in the exposure through glass.

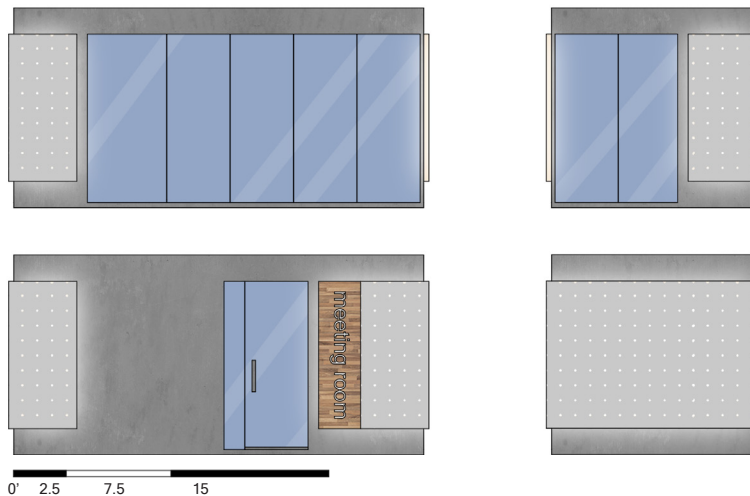


Figure 4.60 - “Pod Example - Meeting Room”. A simple look at the elevations of a solid pod portraying material and layout. The pods are also built around the ten foot modular unit of the lattice.

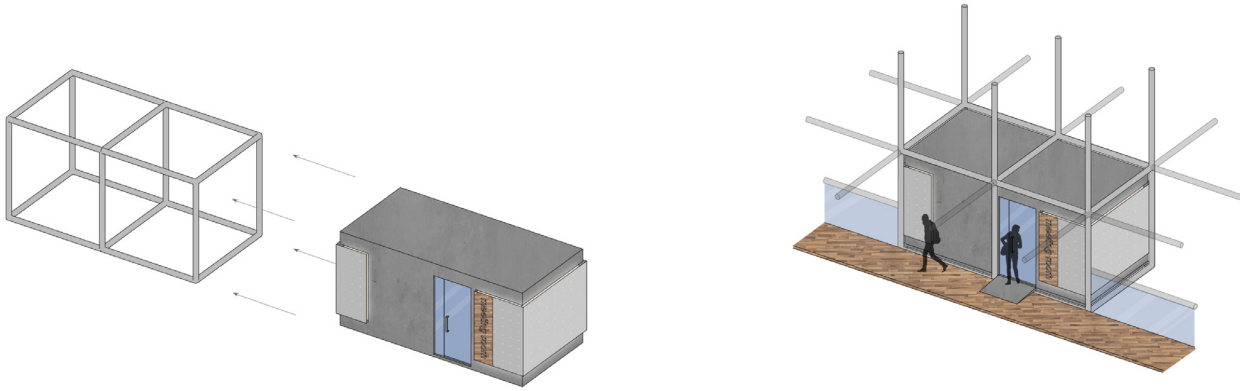


Figure 4.62 - "Pods in the Lattice".
 The pods are designed to be inserted into the lattice structure for support and for a degree of separation from the horizontal circulation and flow of occupants.



Figure 4.63 - "Pods on the Ground".
 Unlike pods lifted into the lattice space, pods on the ground level do not need the added structure. However an individual 'micro lattice' is place beneath the pods for enhanced separation.

Even with areas of high control and desires for the pods to appear more impermeable than other spaces, glass is utilized in the pod facades. This is done because some of the solid spaces are still more public in program (such as the cafe space and digital center) which could be reflected in the more open design. Secondly, spaces like the meeting rooms may utilize the glass to show if the space is occupied or not to avoid interruptions.

The challenge was being able to provide controllable openings. The solution exists in the use of electrochromic glass. This glass is capable of appearing translucent as typical glass in a regular condition but opaque when a current safely runs through it.⁴⁸ The basic workings of the electrochromic layer rely on the use of a liquid crystal display that reacts to a current by orienting the crystal in a manner that is impermeable to light (figure 4.64).⁴⁹ This system allows for a sort of 'digital curtain' that indicates occupant usage in spaces of fluctuating privacy (figure 4.65), or otherwise filters out light in spaces such as the rare books room. Figures 4.66-69 portray the affect of this glass on the solid pods in spaces across the design.

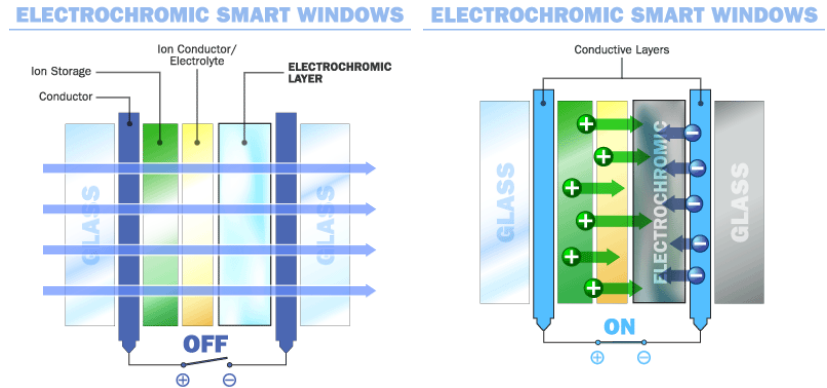


Figure 4.64 - "Electrochromic Smart Windows".
Diagram by Bonsor. How Smart Windows Work - How Stuff Works.

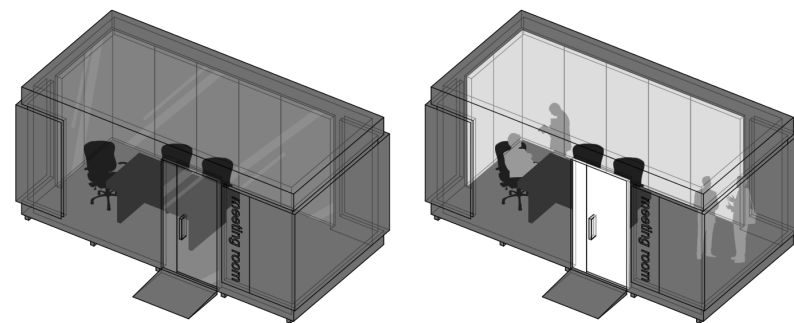


Figure 4.65 - "Meeting Room: Unoccupied and Occupied".
Electrochromic glass allows for switching between translucent and opaque conditions. In spaces with fluctuating occupancy, this feature can indicate when a space is available or not. In a sense, the solidness of the pod is also in fluctuation with the program and activity.

⁴⁸ Wissen Way. *Switchable Glass which changes from Clear to Opaque - Smart Glass*. April 19, 2015. Accessed August 14, 2015. Available from <http://www.wissenway.in/2015/04/switchable-glass-which-changes-from.html>.

⁴⁹ Kevin Bonsor. How Stuff Works - Home & Garden. *How Smart Windows Work*. Accessed August 14, 2015. Available from <http://home.howstuffworks.com/home-improvement/construction/green/smart-window.html>.



Figure 4.66 - "Library Pod Glass - Off Condition".



Figure 4.67 - "Library Pod Glass - On Condition".

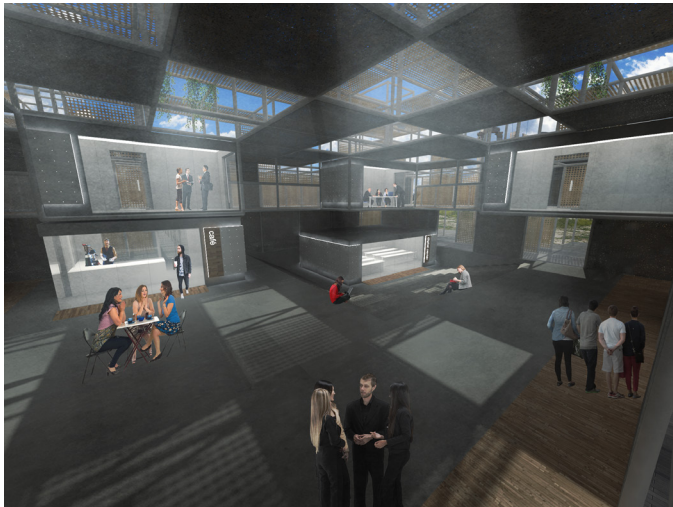


Figure 4.68 - "Social Pods Glass - Off Condition".

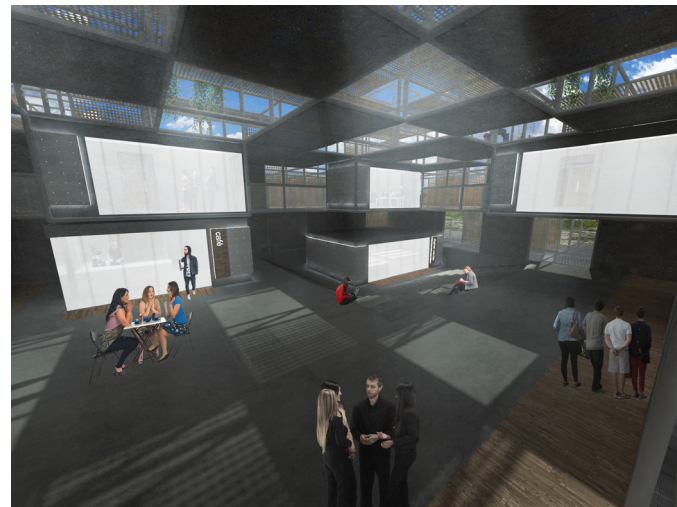
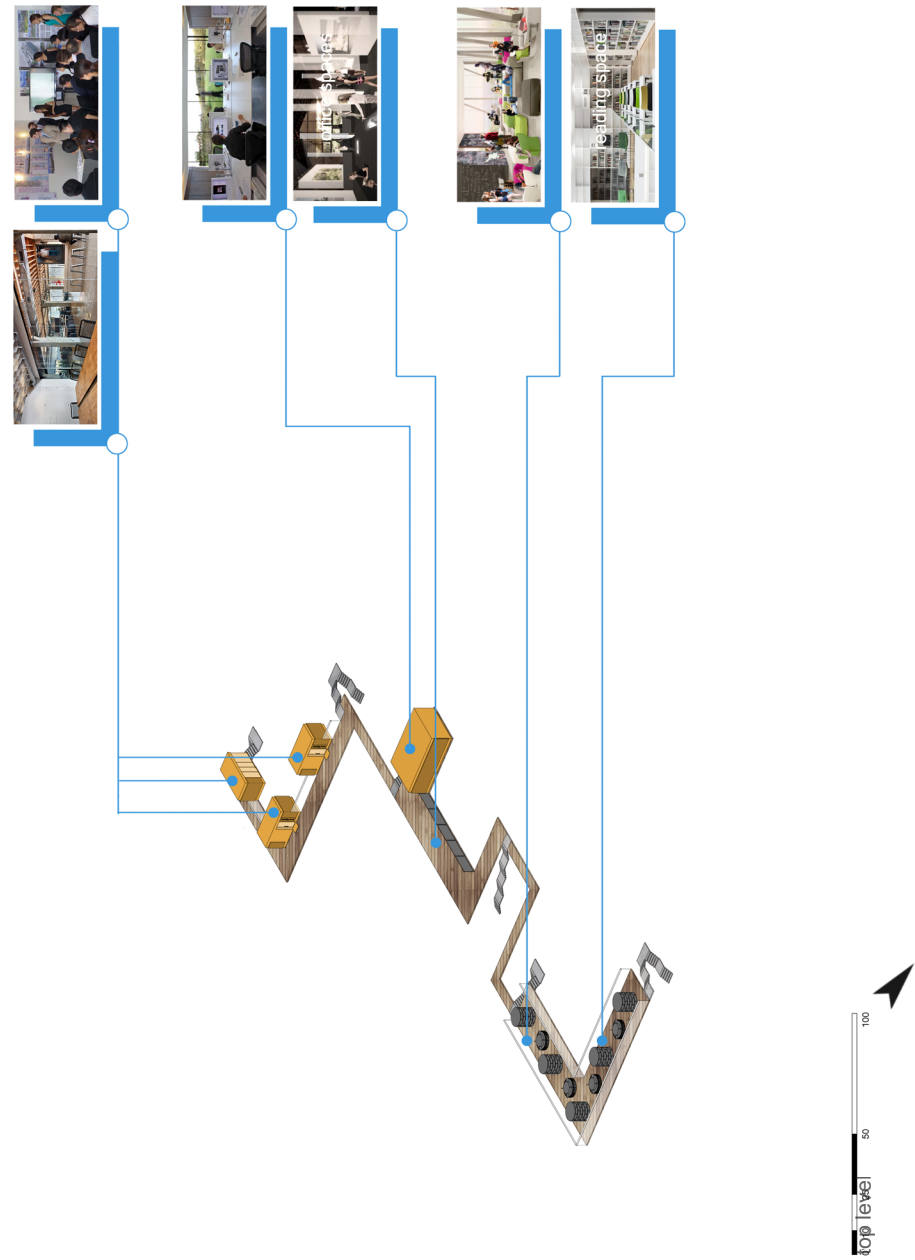


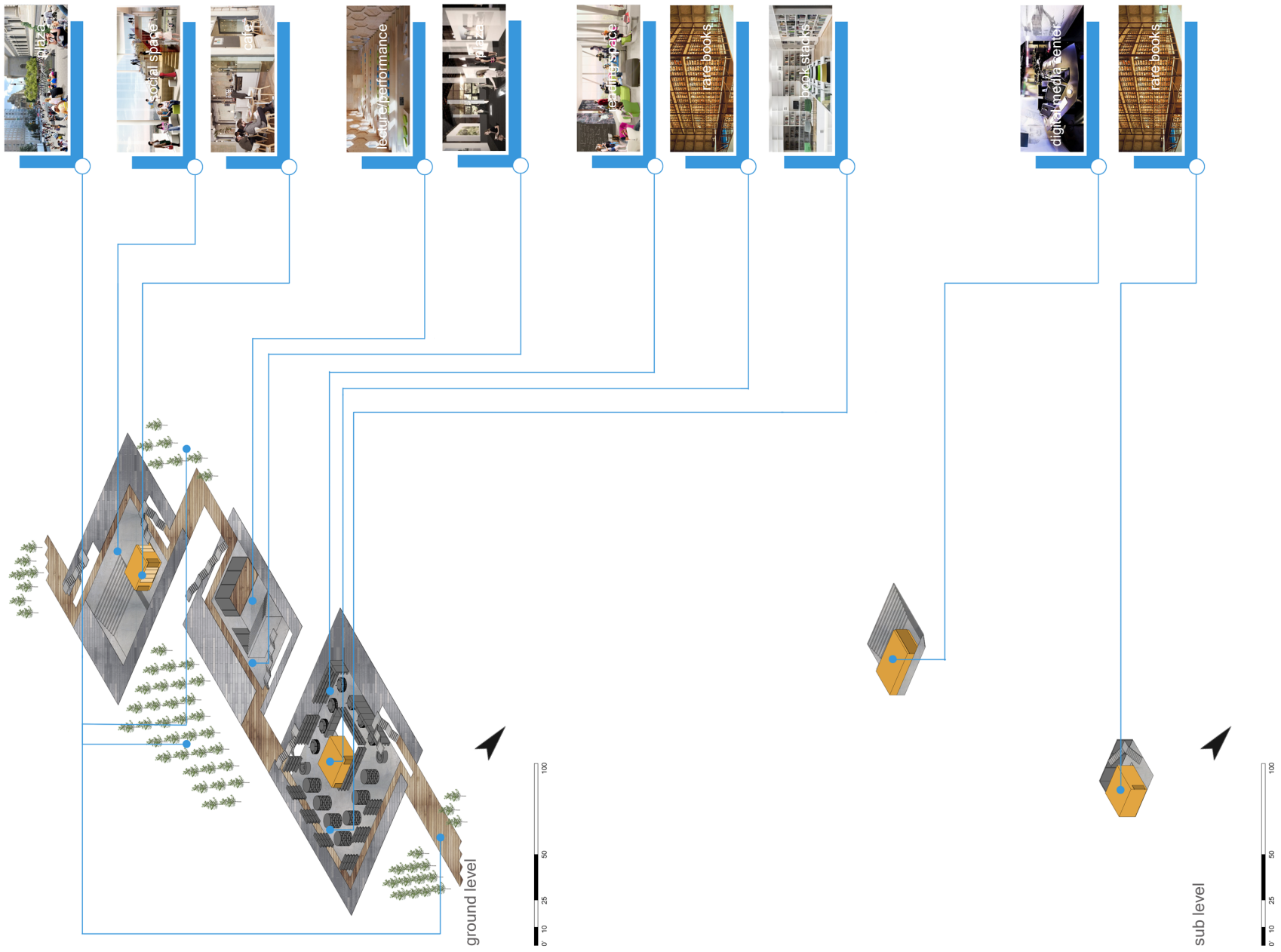
Figure 4.69 - "Social Pods Glass - On Condition".

These renderings show comparisons of the electrochromic glass in use across solid pods. Certain spaces like the rare book room and the cafe may have them in a continuous state of opacity or translucency respectively due to privacy control. Meeting rooms fluctuate in privacy and the glass may be used depending on occupancy.

Program

Figure 4.70 - "Program Layout Axonometric".
This diagram portrays the final layout of the various spaces as programmatic elements across the three main floors of the site.

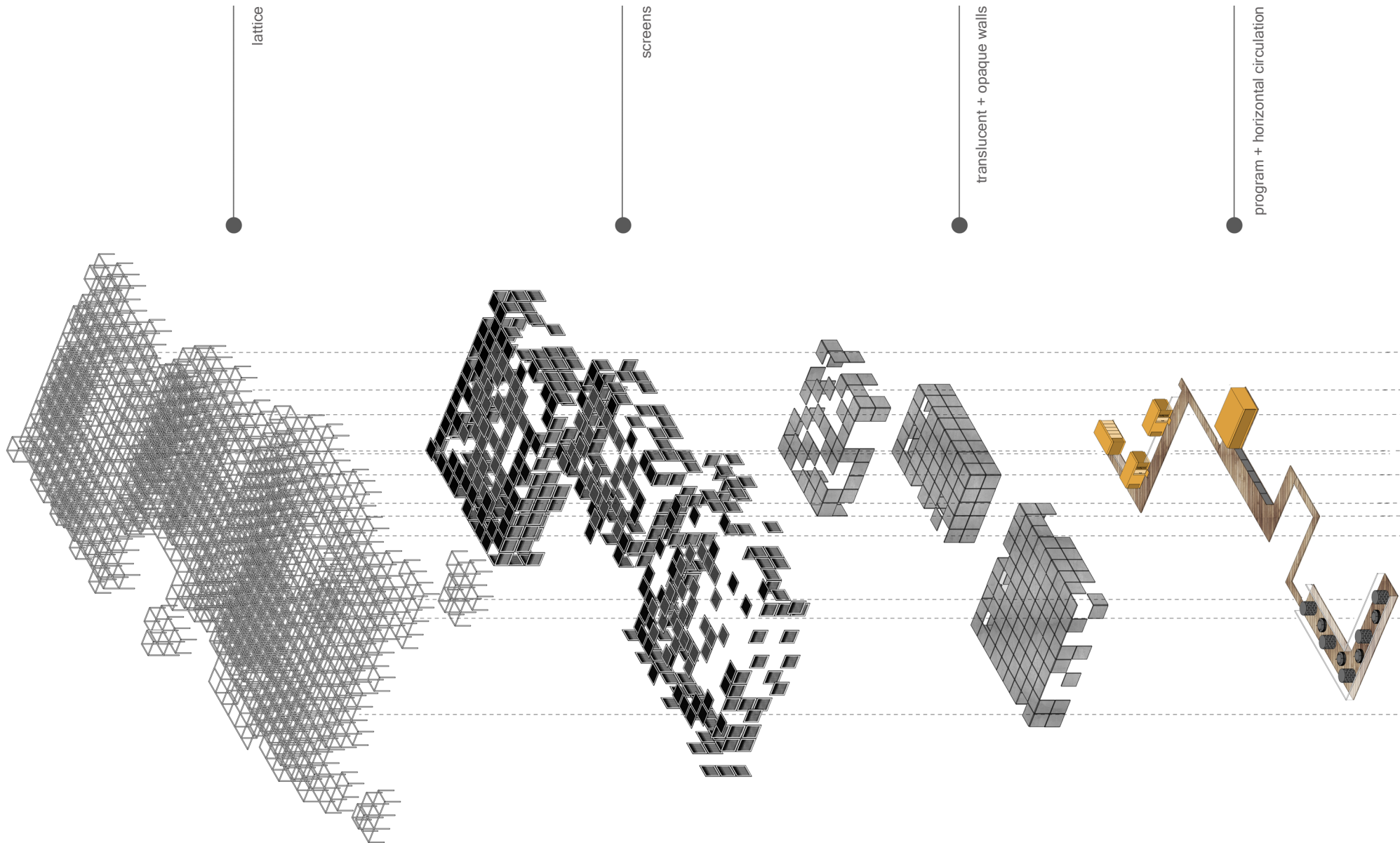




Main Components

Figure 4.71 - "Components Axonometric".

This diagram portrays the design as a layering of the spatial components across the site.



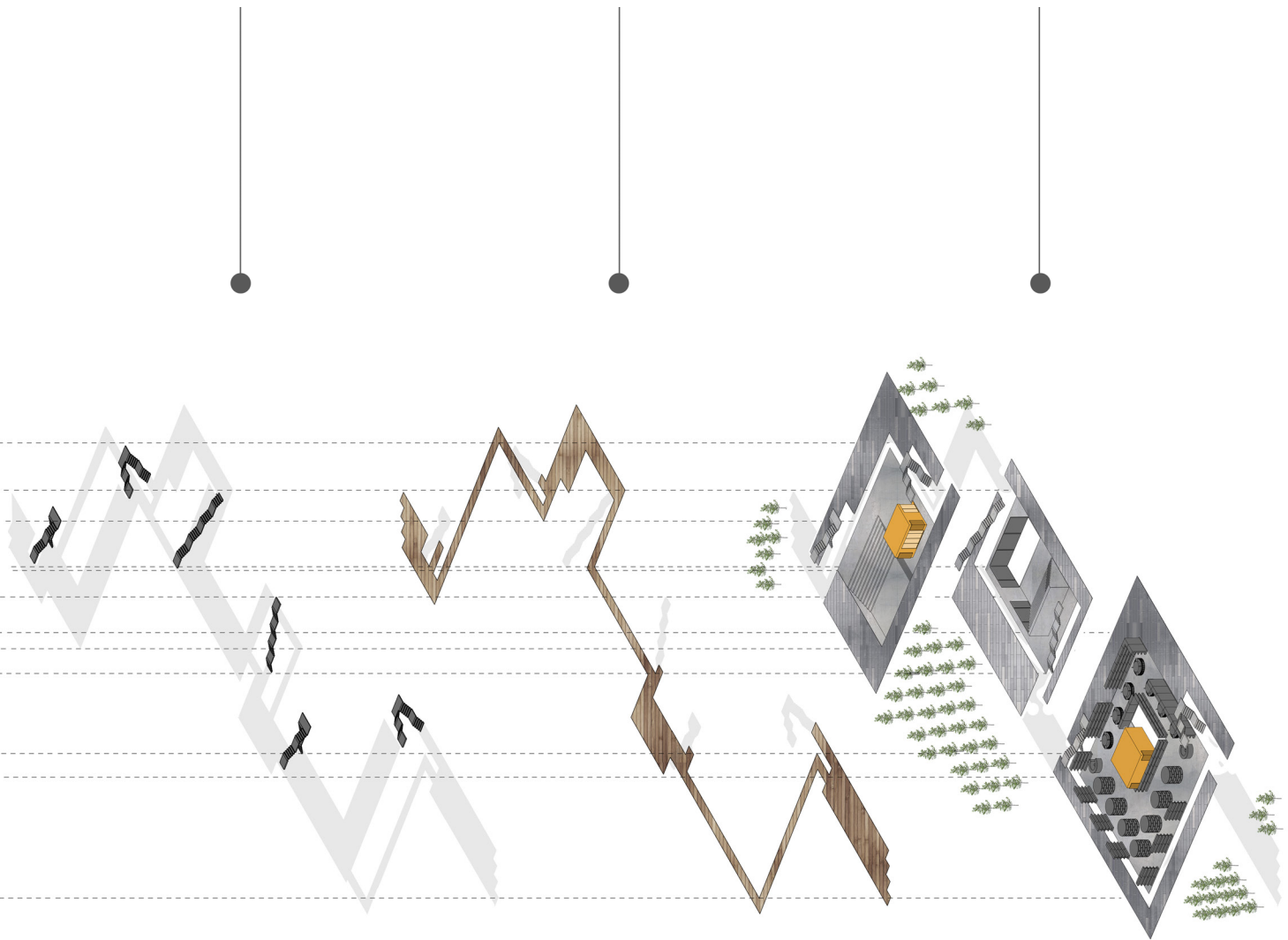


Figure 4.72 - "Section and Site Plan".
Traditionally multiple sections with singular directions in each are used in architectural representation. As this thesis aims to create a sense of continuity throughout the site, there is one primary section that serpentine throughout the design. A larger more detailed view is found in figure 4.61.

Singular Section

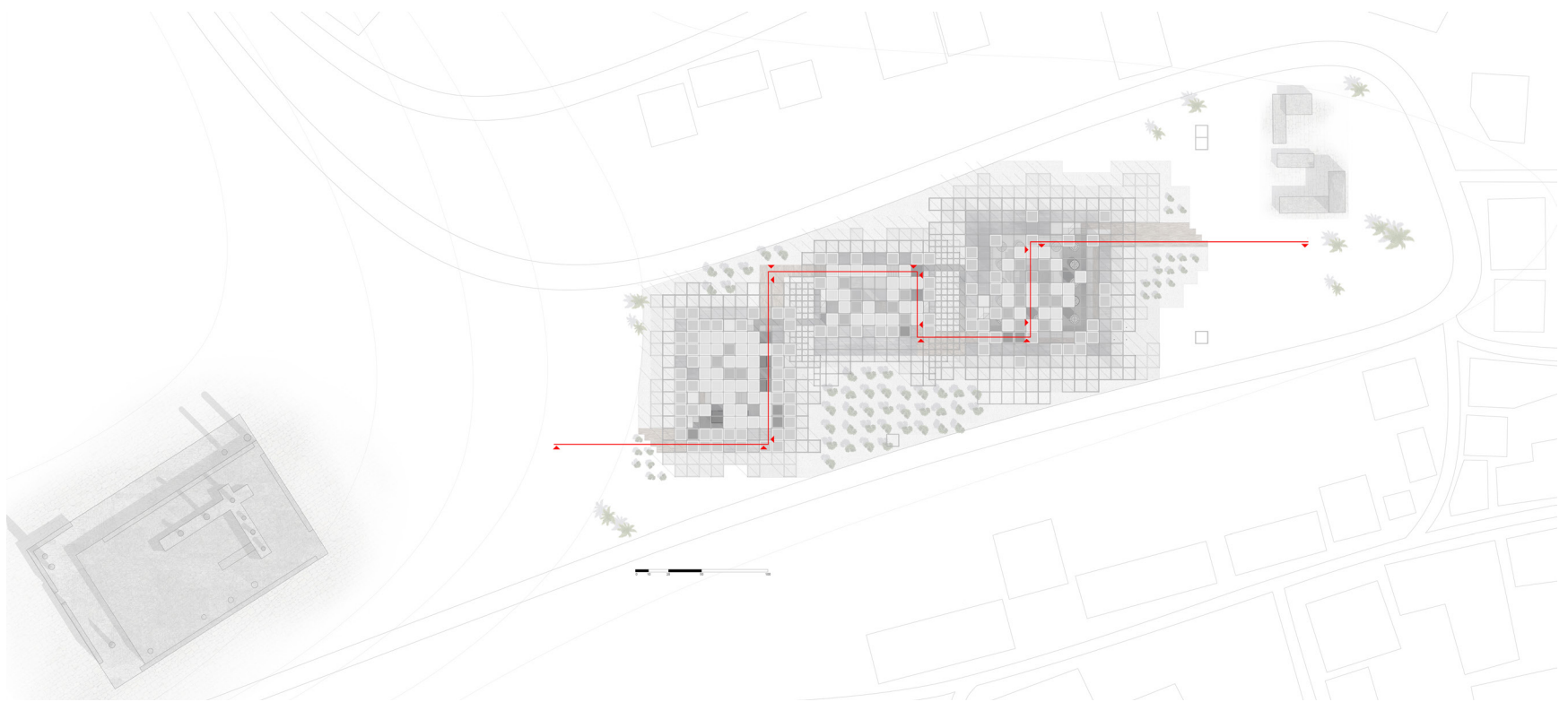






Figure 4.73 - "Section Energy Flux".
The diagrams explored in the end of the methodology chapter are implemented here. Utilizing the design's section, the main climatic elements (heat, light, humidity, and light) are explored across the space at four different key moments.

-  thermal node/microclimatic effect
-  light node/microclimatic effect
-  humidity/mist node/microclimatic effect
-  sound node/microclimatic effect

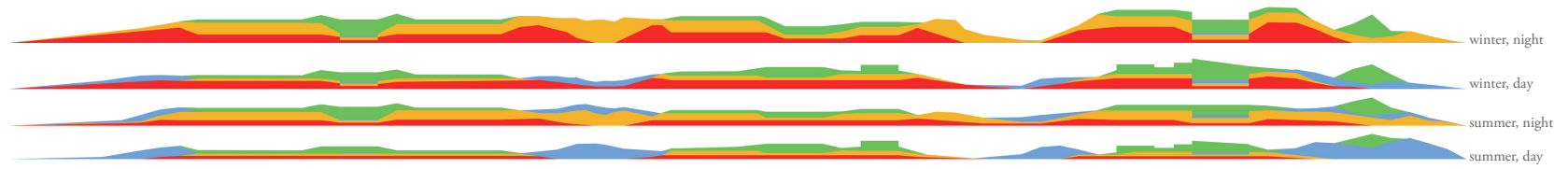
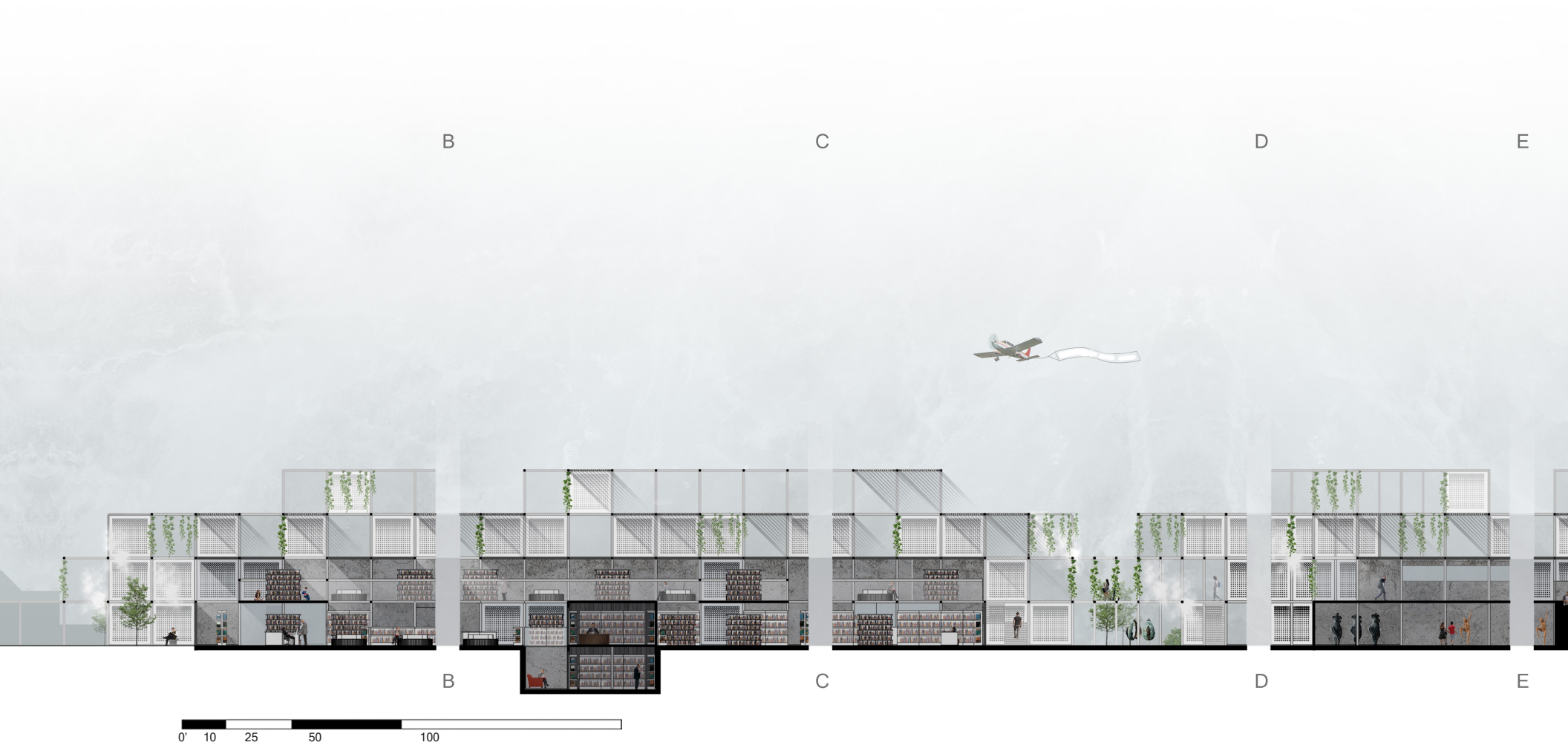


Figure 4.74 - "Physical Section - Enlarged".
Within this enhanced version of the section it is clear to see areas of program interacting with the infill devices throughout the lattice. The section also portrays the design merging into the site within the frame and porous zones, while the solid zones are heavier in contrast.



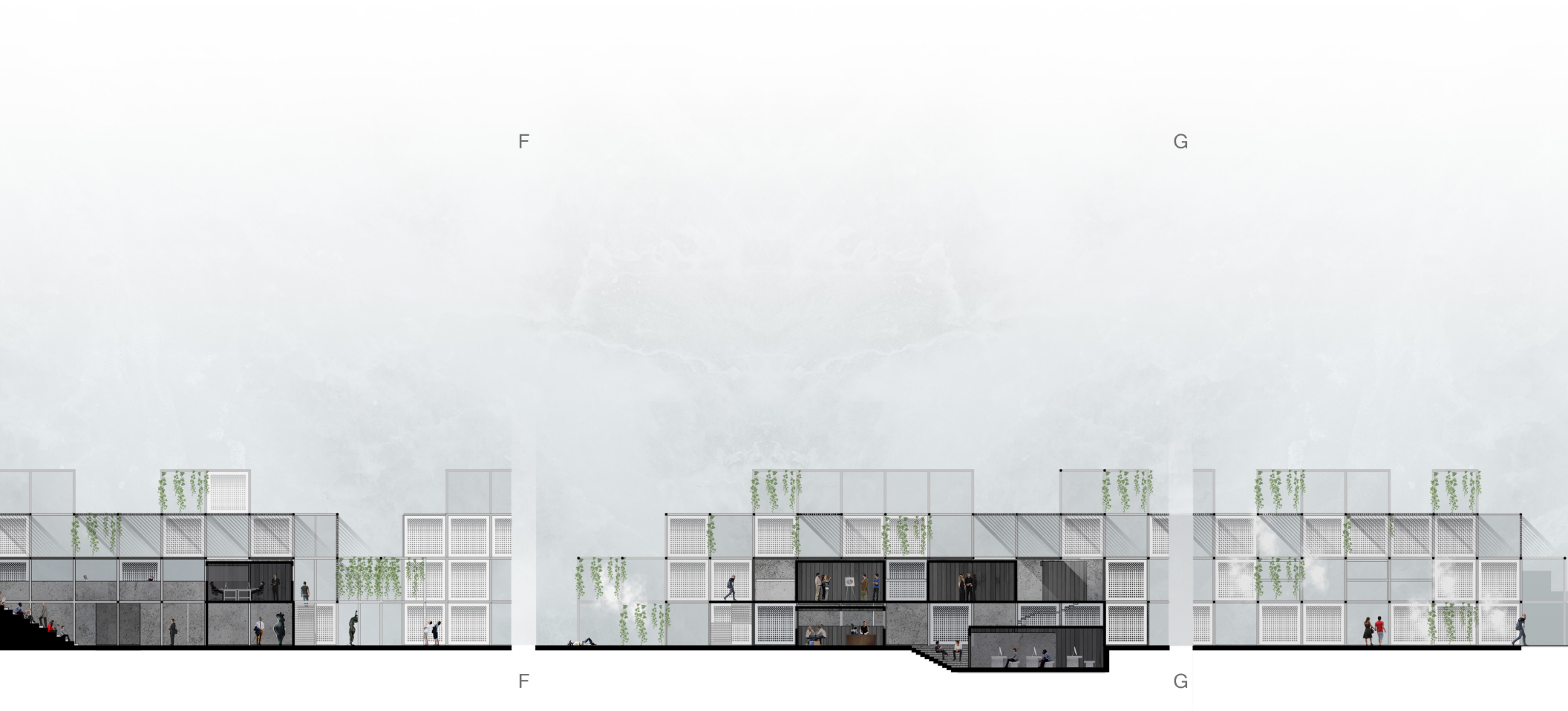
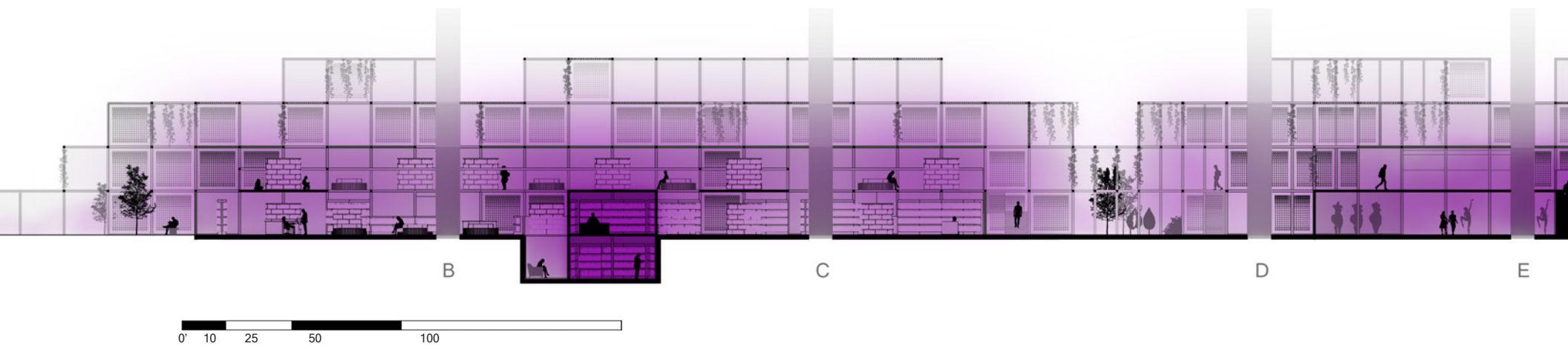


Figure 4.75 - "Control Section - Enlarged".

This diagram is an alternate version of the main section. The primary information here is the amount of control that occurs throughout the design. The level of control is more concentrated and solidary within the solid zone space, and disperses throughout the other zones, dissolving into open space.



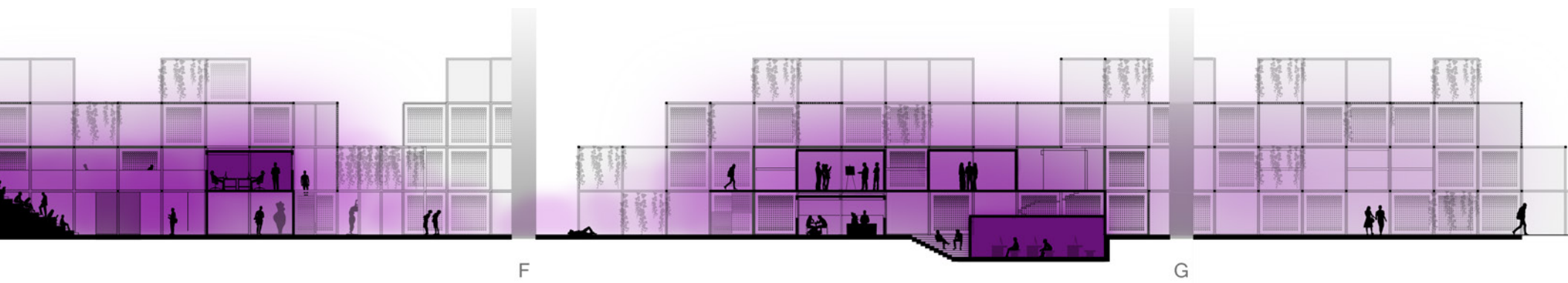




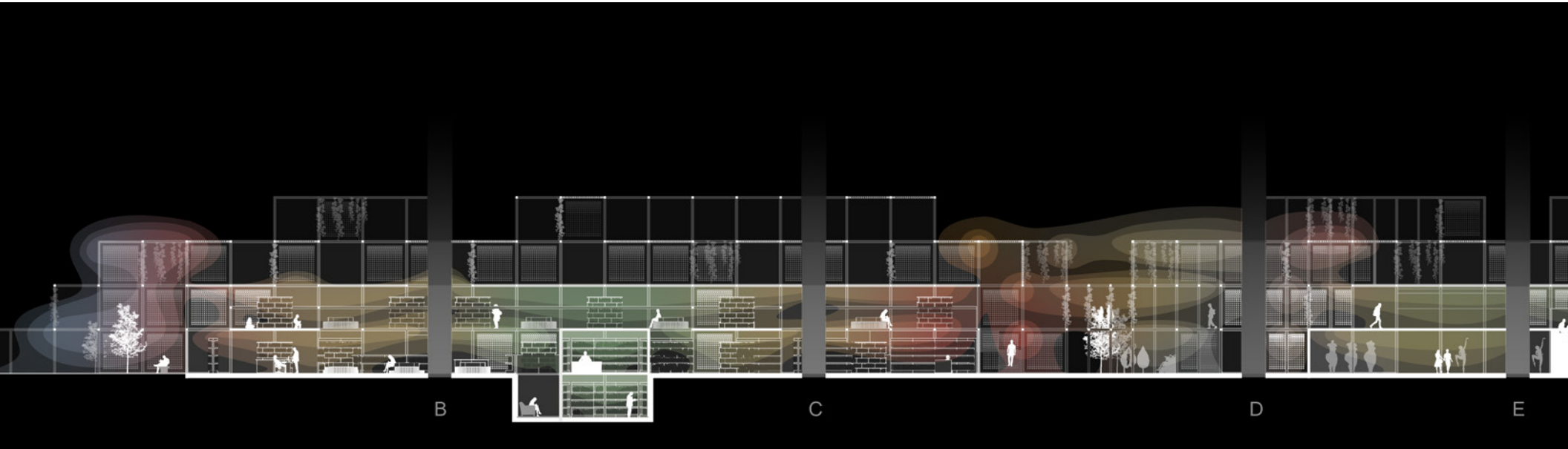
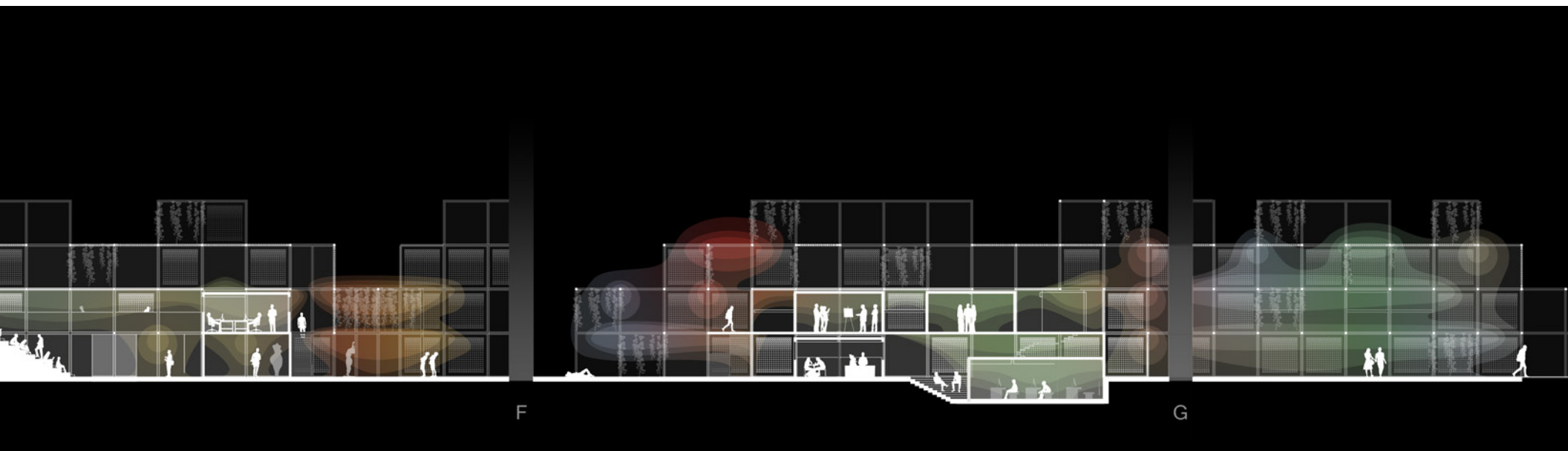


Figure 4.76 - "Microclimatic Section - Enlarged".
Rather than intensity of control, the type of climatic energy control is displayed here. To avoid clutter it is the primary climatic element displayed in each portion. The energy layouts are generalized.

-  thermal node/microclimatic effect
-  light node/microclimatic effect
-  humidity/mist node/microclimatic effect
-  sound node/microclimatic effect





Floor Plan: Sub Level

The following pages depict plans of the sub, ground, and upper layer of the design proposal. Just as with the section diagrams, each floor is represented across three diagrams: a plan depicting a general physical layout, one depicting intensity of control, and one depicting climatic effects.

Figure 4.77 - "Sub Level: Physical Plan".

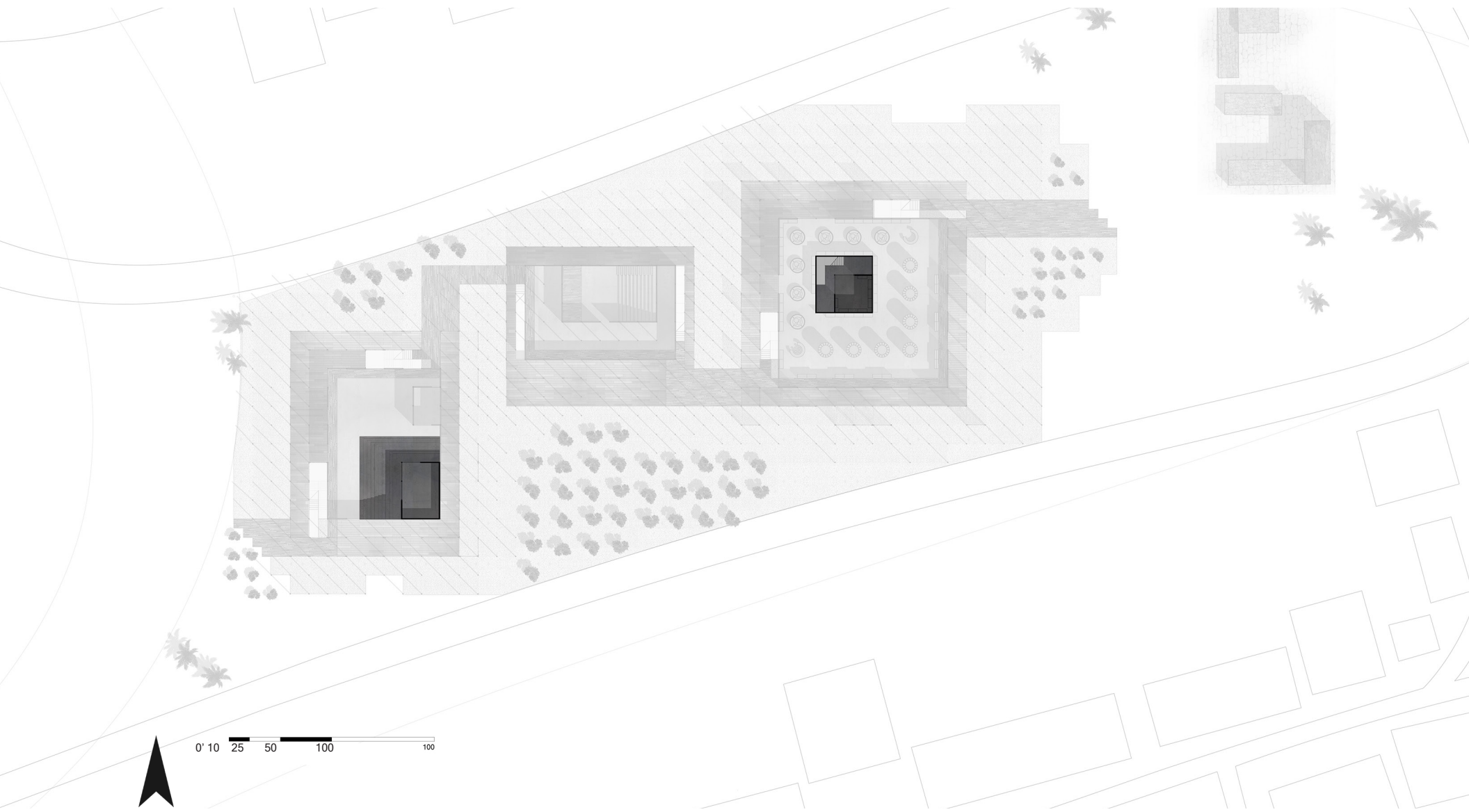


Figure 4.78 - "Sub Level: Control Plan".

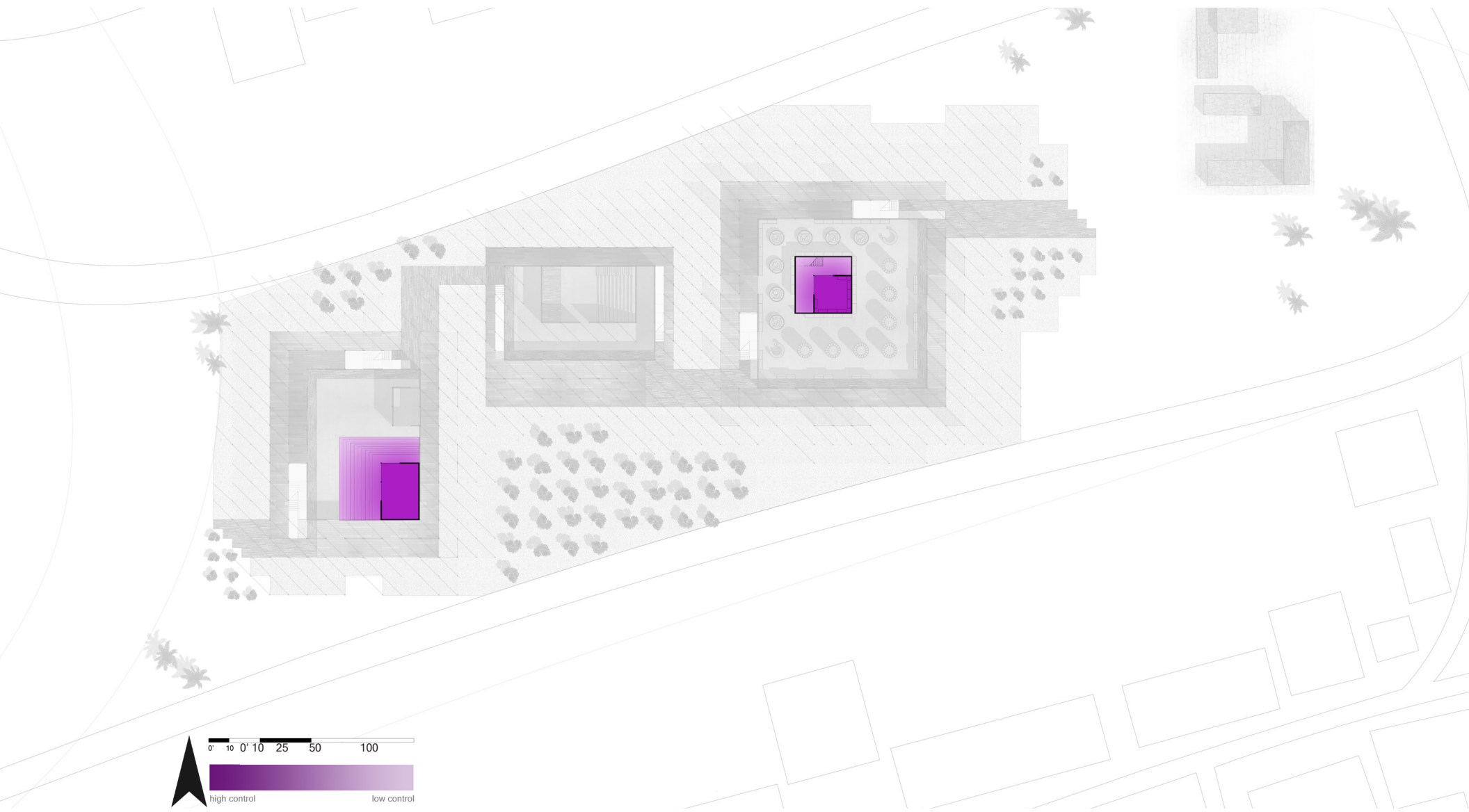
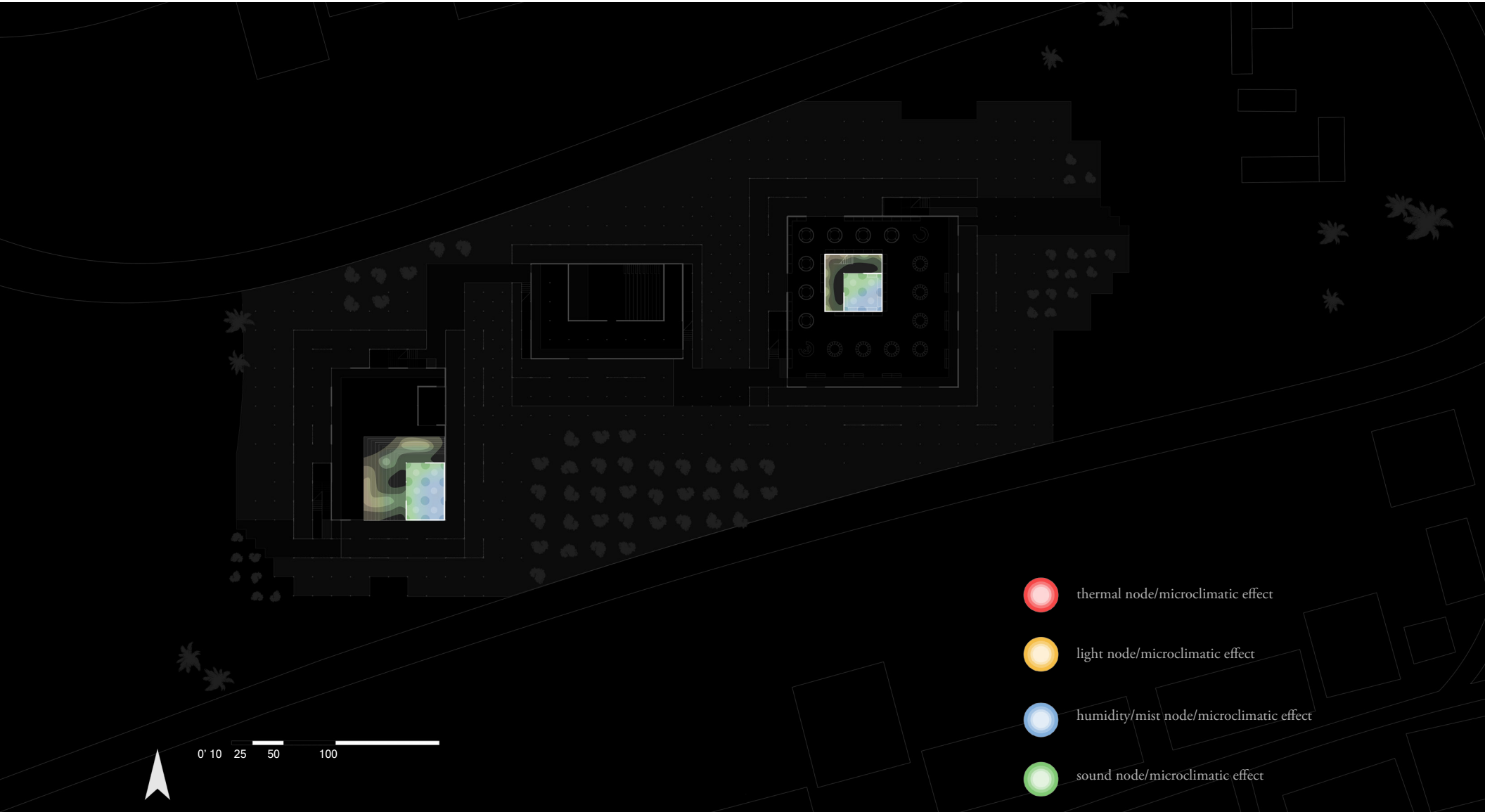


Figure 4.79 - "Sub Level: Microclimatic Plan".



Floor Plan: Ground Level

Figure 4.80 - "Ground Level: Physical Plan".

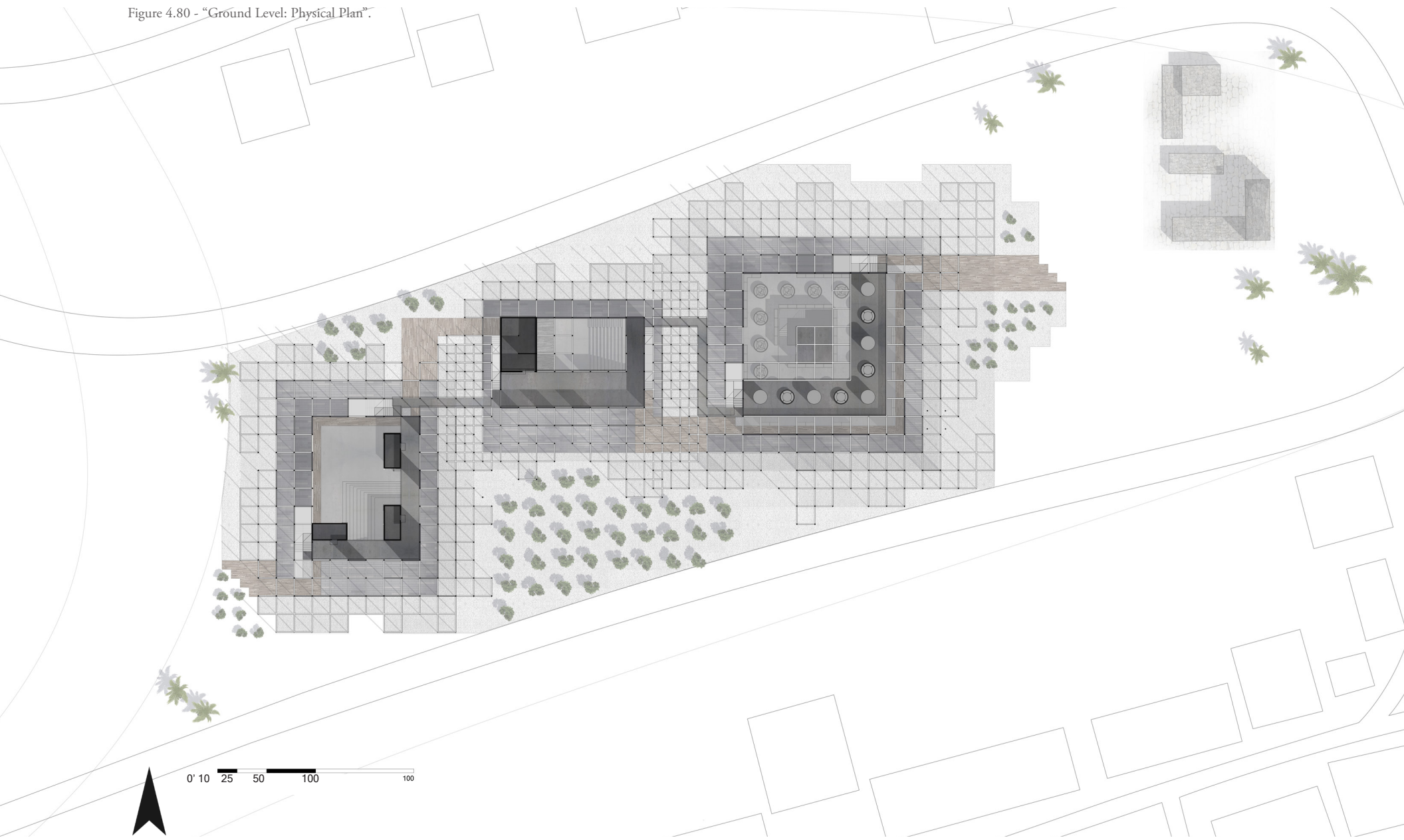


Figure 4.81 - "Ground Level: Control Plan".

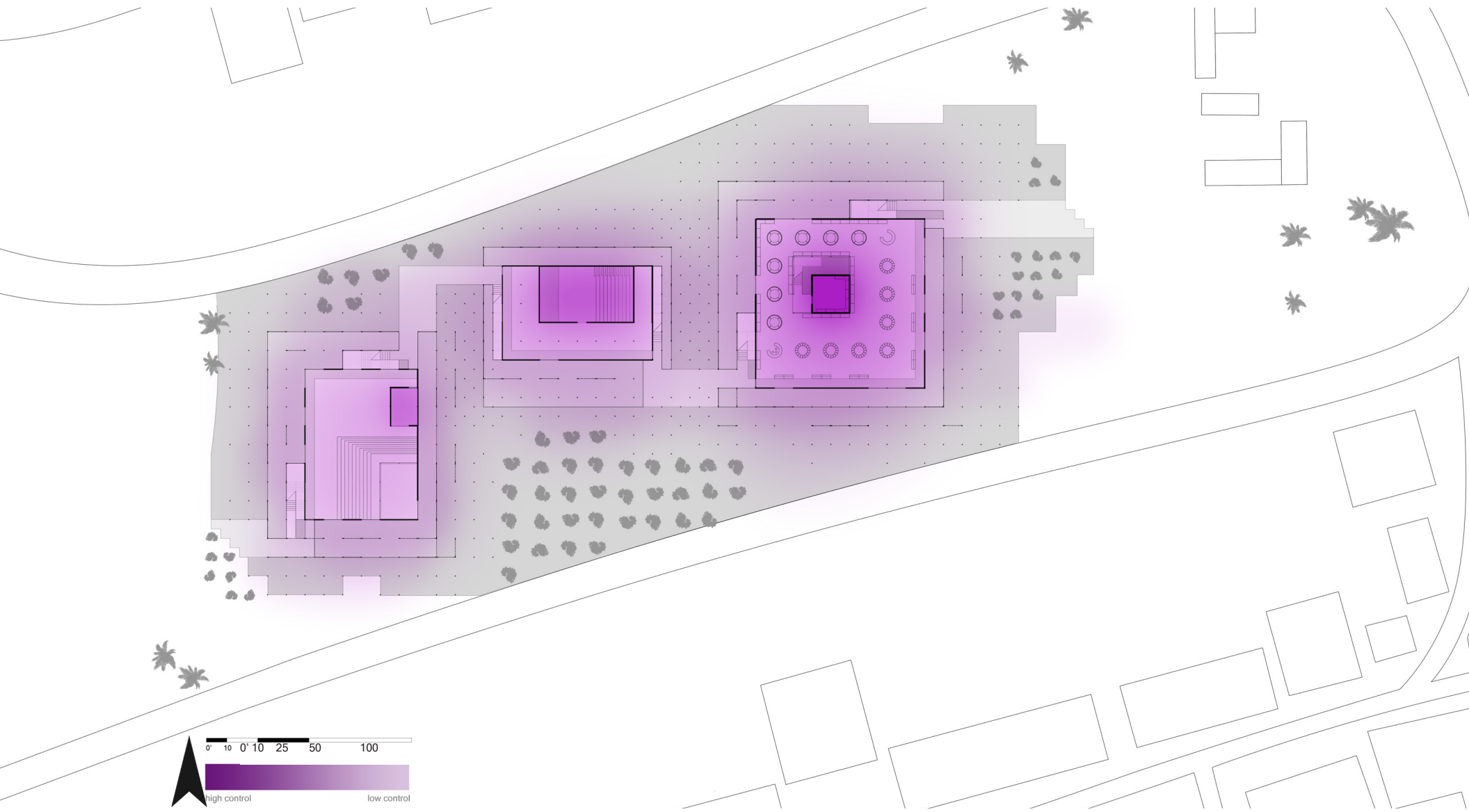
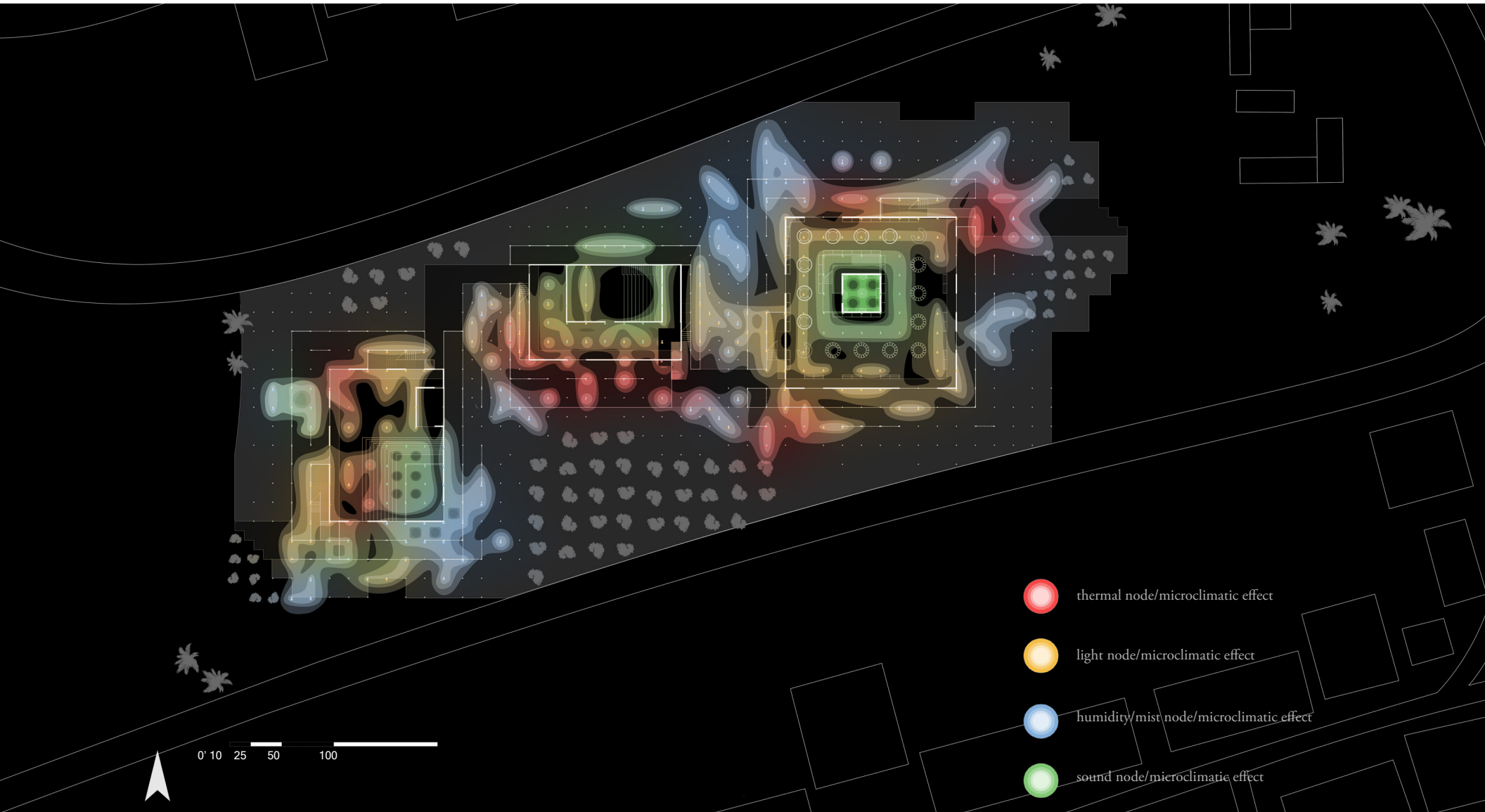


Figure 4.82 - "Ground Level: Microclimatic Plan".



Floor Plan: Top Level

Figure 4.83 - "Top Level: Physical Plan".

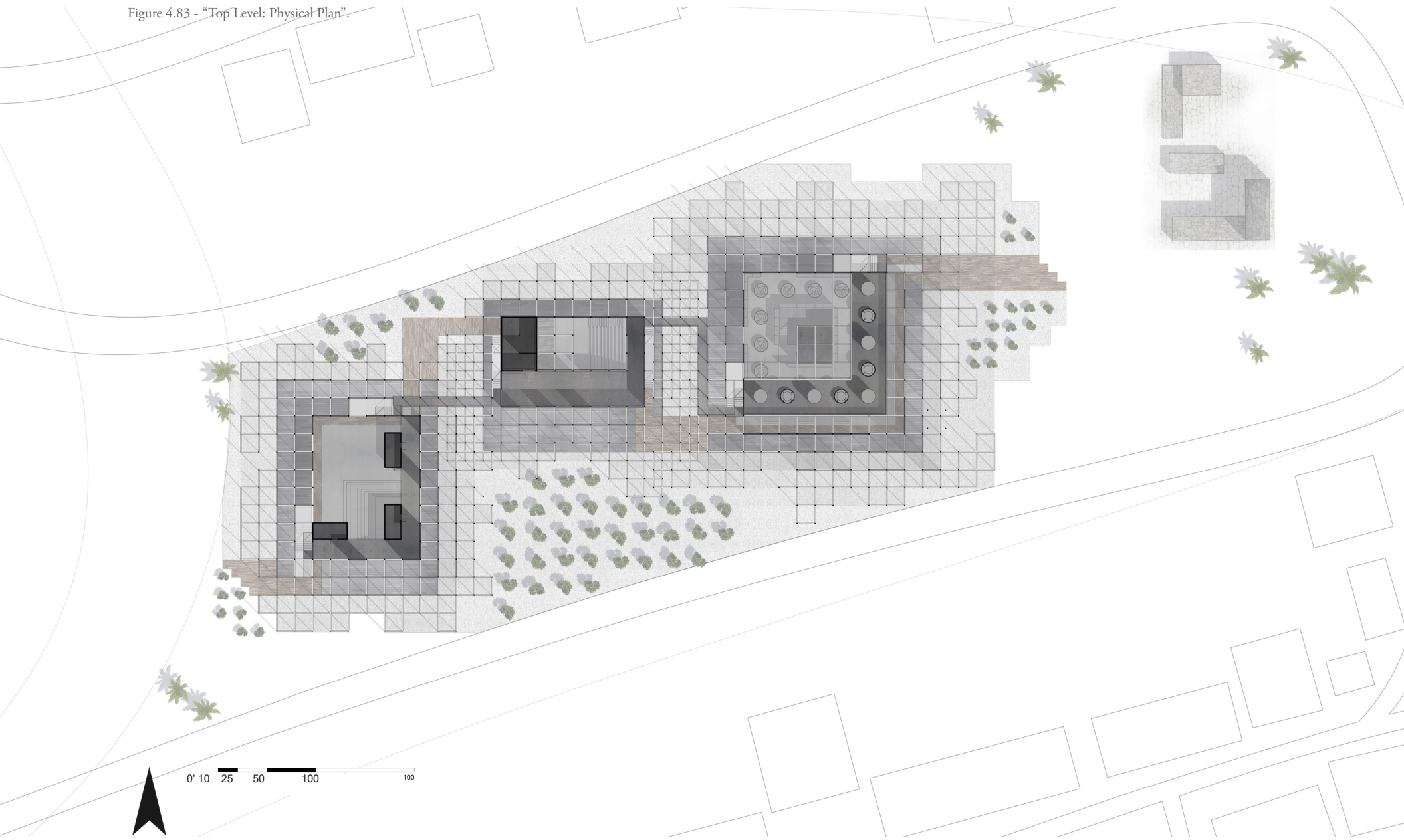


Figure 4.84 - "Top Level: Control Plan".

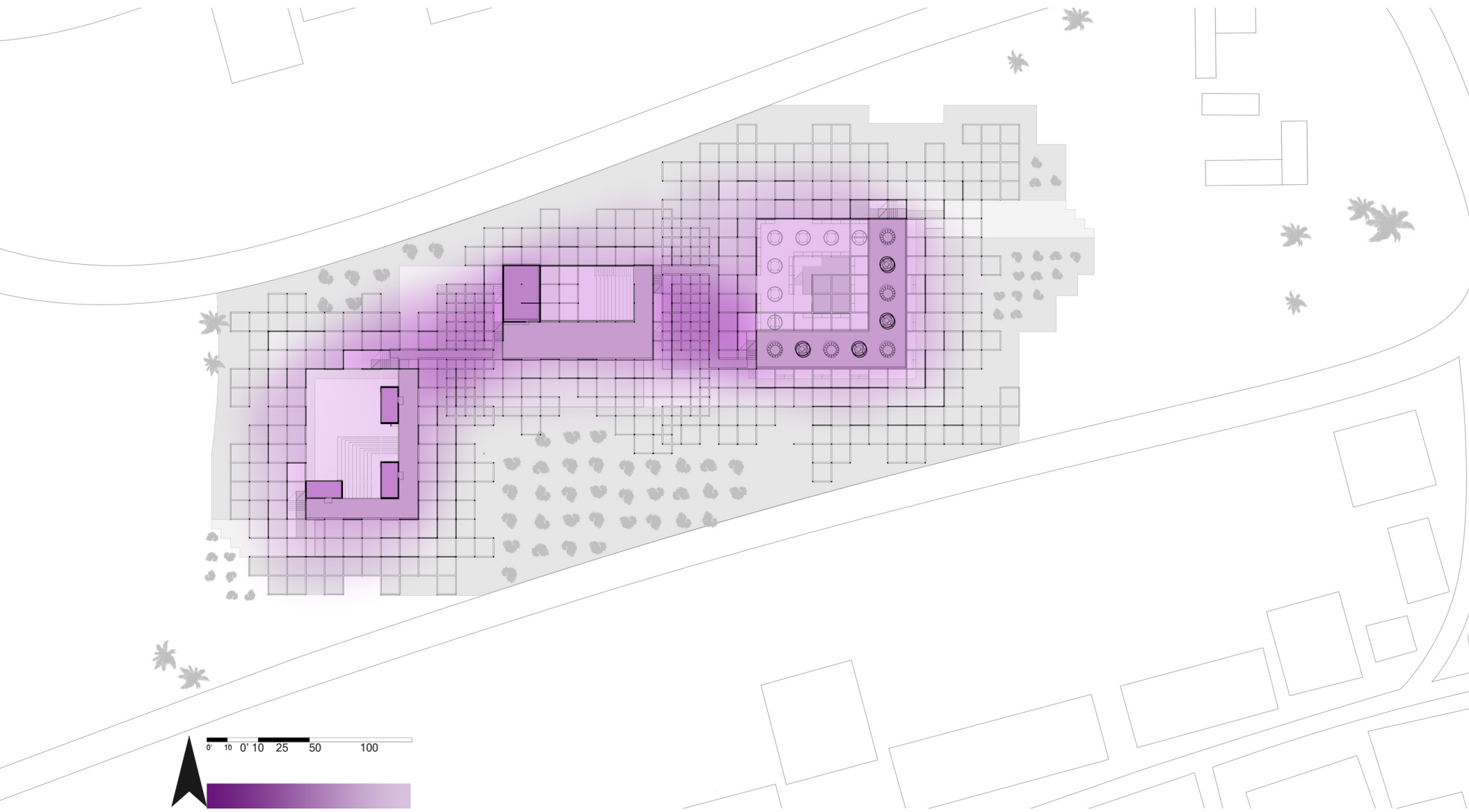
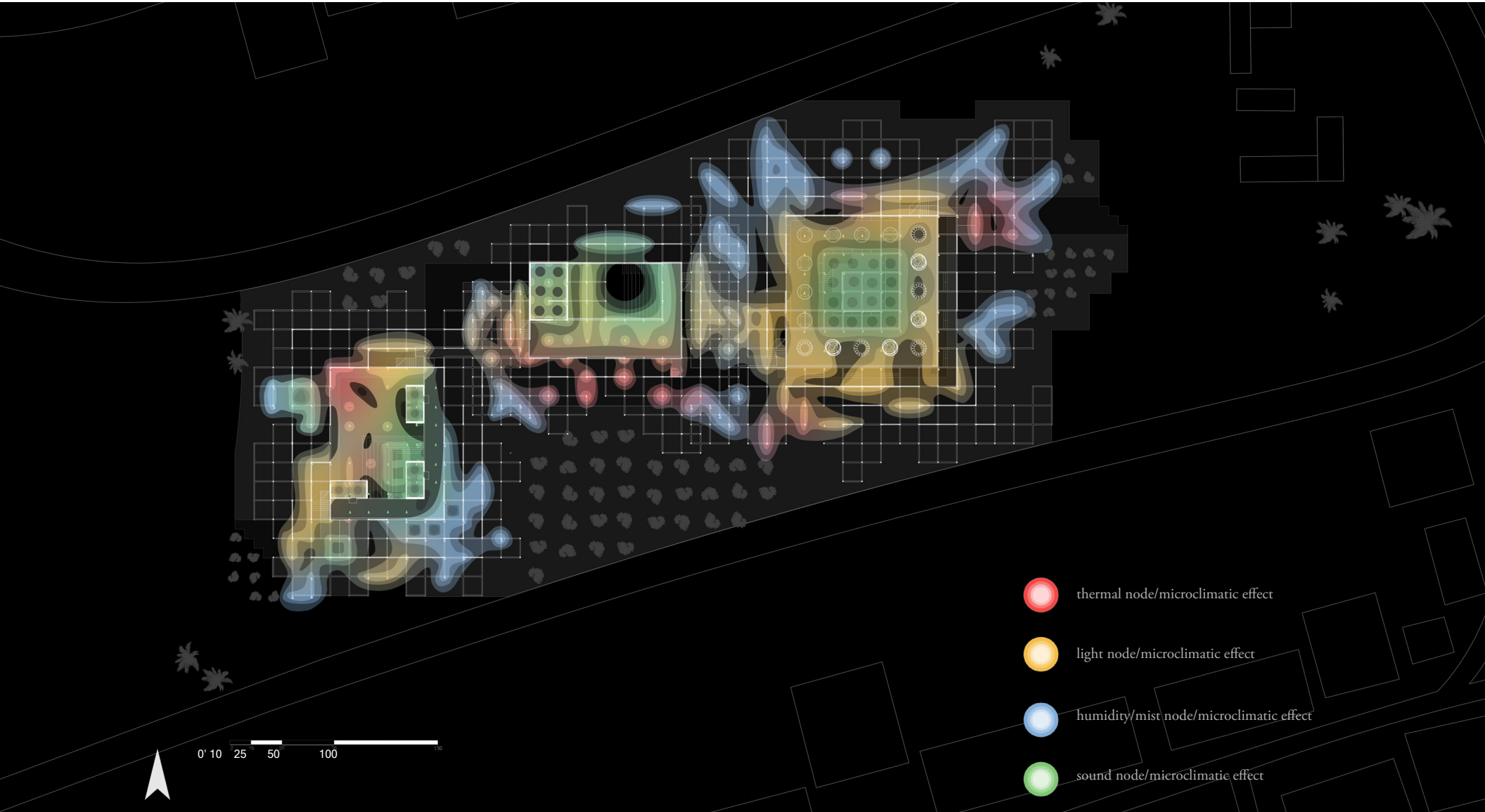


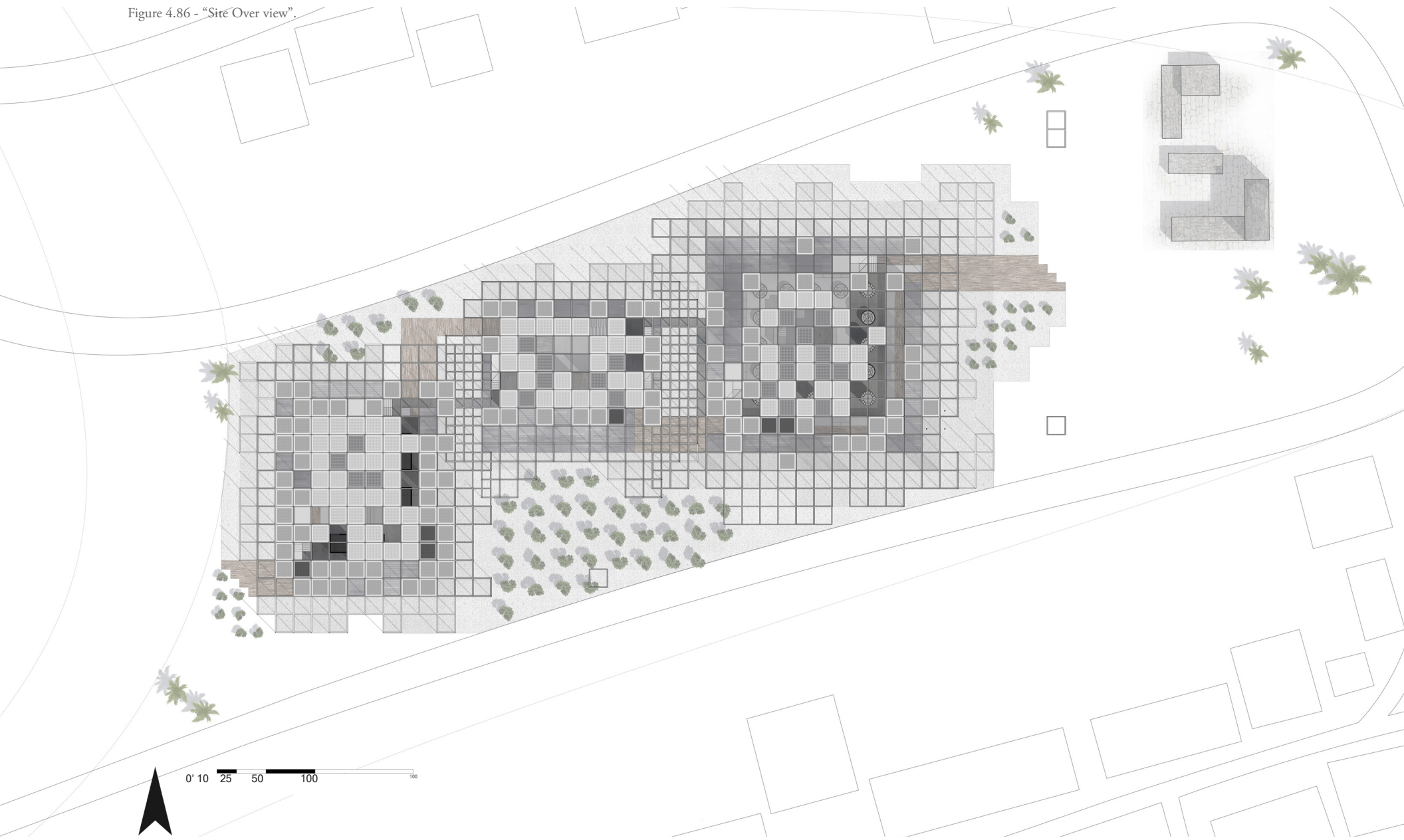
Figure 4.85 - "Top Level: Microclimatic Plan".



Site Plan

The site plan is similar to the other plans but has little information to give in terms of control intensity and climatic elements. Instead, the site plan provides a look into the dispersal of screens in the horizontal plane. The screens are more focused in areas where climatic control (particularly of light) is needed. For example, they are more densely grouped over library spaces but less so over social spaces.

Figure 4.86 - "Site Over view".



Elevations

Like the site plan, elevations reveal more in their physical rather than dynamic conditions. Primarily represented here is the scattering of screens, vegetation, and a loose understanding of the city's context in relation to the design itself.

Figure 4.87 - "East Elevation".



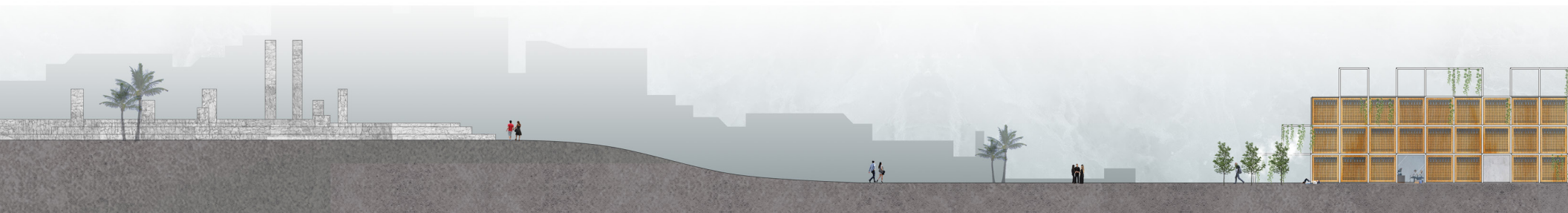
Figure 4.88 - "West Elevation".



Figure 4.89 - "North Elevation".



Figure 4.90 - "South Elevation".



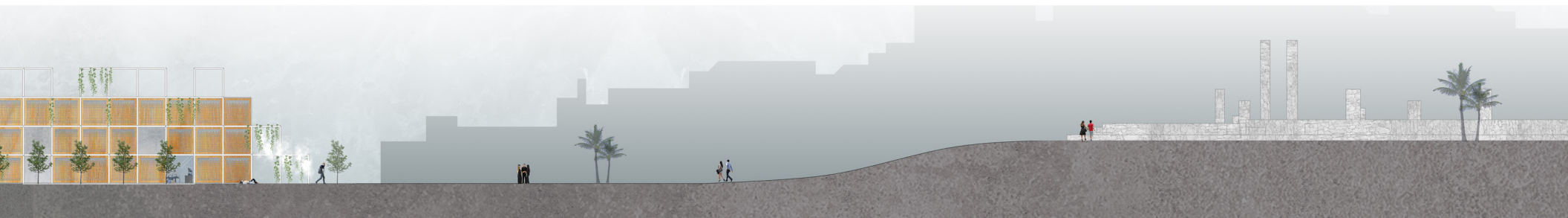




Figure 4.91 - "The Library Past the Ruins".

Here the library is situated within the context of downtown Amman in a more visual representation. In the rendering the design becomes more dense and solid toward its cores. This form resonates with the nearby ruins that are more solid in areas and skeletons of their past selves in others.



Figure 4.92 - "Entering".
As visitors enter the threshold of the site between ruins and library, material and spatial organization become more evident and the microclimatic effects begin to come into play.



Figure 4.93 - "Lower Gallery".

As part of the porous zone the gallery space exemplifies a spatial layout that shows components of both frame and solid zones. In the lower area the space is more solid with a majority cover of translucent concrete walls and few openings. This combined with a slightly more organized layout of climatic devices makes it ideal for more sensitive art materials such as paintings.



Figure 4.94 - "Upper Gallery".

As part of the porous zone the gallery space exemplifies a spatial layout that shows components of both frame and solid zones. In the raised area there is a greater number of openings to allow light in and set the city as a backdrop. The interplay of the different kinds of spaces within a porous zone space show the fluidity the architecture is capable of achieving.

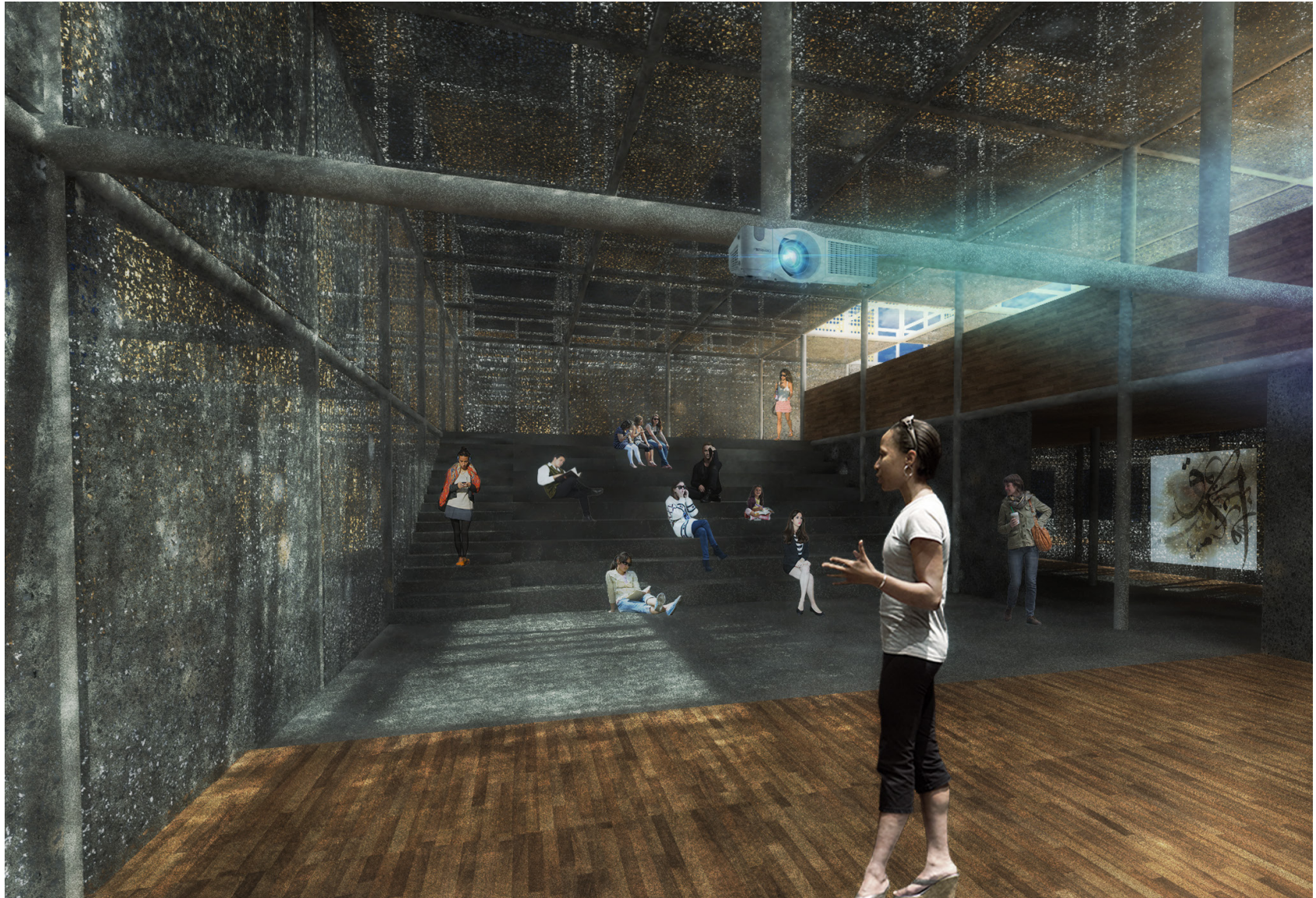


Figure 4.95 - "Performance Hall".

The lecture and performance hall acts as a 'buffer' space within the porous zone and offers a mediative transition between a more open upper gallery and a more solid controlled lower gallery. Barriers between these spaces are much more climatic in the intensity of light and sound control as opposed to strict physical separations.

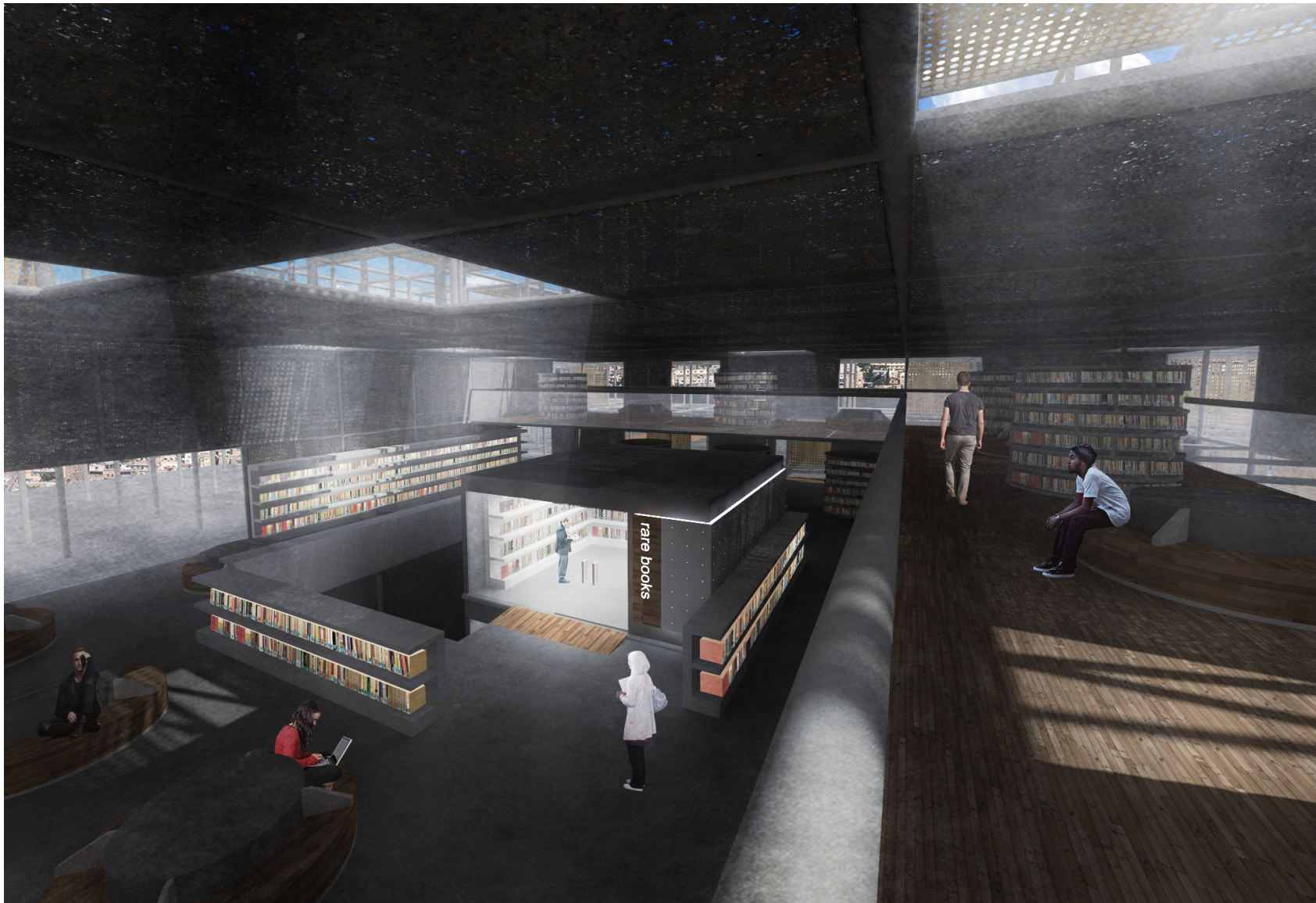


Figure 4.96 - "Library Center".

The library center displays a spatial layout that is more open in transition between zones. Impermeable boundaries are minimal allowing free flow throughout the space until occupants come across the solid pods of the rare book rooms. The book stacks near it act as a form of 'fortification' and mediation before arriving at the pod space, similar to infill material that is unique to this area.

05

[Closing]

|Conclusion|

This thesis analyzes spaces by looking to them as centers of energy, privacy, and climatic conditions, and through these factors, offers a means to understanding where these spaces lie within this tent-campfire spectrum. This proved to be a complex undertaking. Typically, the 'true-and-tried' method is to design spaces that are subdivided into a logical organization that offer efficiency, privacy and shelter. However, what is lost is the experience through the design as a whole and connections between spaces both interior and exterior.

This thesis does not denounce this system but instead offers a look into alternative approaches in spatial layout. Initially, what is explored is Banham's notion of the campfire and tent models, respectively one that is open and gradated and the other introverted and divided. Other architects have used Banham's work on the subject matter to explore spatial constructions in order to obtain more free-flowing program and open structures.

This has led to a methodology comprising of both physical material calculations, as well as tapping into the sensorial envelope as an architectural element. The former explores ways of guiding and dispersing occupational activity or *flow* throughout the space. The latter, a somewhat complex and still fresh subject in the field, involves defining spaces with less strict boundaries, ones that are set forth by climatic conditions rather than physical ones. Programmatic elements that share similar energy readings can thus break down their physical barriers in this manner to share microclimatic qualities.

The design proposal put forth explores how these spaces can be combined in the creation of a single program; in this case a mixed use public library. Within the library, spaces of both tent-and-campfire-like qualities are acknowledged. That is to say, certain spaces are recognized for their qualities or needs to be designed in one method or the other. The result is a system of both smooth and striated spaces that combine together to create a varied but heterogeneous *flow* throughout the site. Furthermore, most of the programmatic elements within this design fluctuate in response to natural environmental conditions, giving further but hidden dynamic value to the operation of the design. Additionally, the combination of the various spaces aids in transforming spaces of high control that would otherwise be pushed aside out of public view into key architectural moments due to the contrast to the open *flow* of the program.

Naturally, there were some issues brought to the surface. Primarily, one major consideration of the success of such a system is the environmental context. The site in this thesis is one that provides ideal conditions for such a system to be tried and tested. However, across the world there are of course locations of less than favorable conditions with higher unpredictability in climate that will cause the architecture to shift to one form over the other, particularly the use of sheltering subdivisions over gradated openness. A second potential roadblock is the dimensions of the site, as with any architectural project, but more so here as a system that entirely or partially follows the campfire model will undoubtedly physically expand into its surroundings.

The approach of the lattice in the design proposal, however, proves to be versatile. A number of configurations were easily explored due to the organized layout. In practice, the lattice can take on a number of shapes, orientations, and scales. Thus, this system can be applied to a number of programs and projects in which any form of tent or campfire spaces can be set and altered as desired.

More abstractly speaking, the thesis provides considerations to be applied to architecture in other conditions and climates. Primarily, this exists in understanding program spaces as centers with energy that can either be shared or highly internalized and controlled. Alternative layouts can be produced with a potentially greater level of efficiency by grouping programmatic spaces that can, in a sense, 'share' these energies. Moreover, spaces of high control do not need to be placed out of sight and out of reach of everyday occupant flow and usage. Instead, by forming moments of high contrast in fluid contexts, they can still be displayed within an open layout but become highlighted integral moments of the program. Finally, the thesis also shines a light on deliberations of tying the architecture into its surrounding context, as opposed to simply existing as internalized and monumentalized form. The key method explored here is the integration of elements of the design and the existing site into one another, creating an extended and transitional notion of threshold.

An unexplored area of the project that could be part of future speculation is the social impact of the architecture. The thesis itself was mainly concerned with the utilization of microclimatic and spatial qualities in manipulation of space and flow, and the selected program of a library reflected microclimatic and spatial needs. However, as a public program, there still remains unexplored potential in the social realm. The regular lattice and choice of infill and devices in the design proposal in its final form is reminiscent of the architect Cedric Price's unbuilt *Fun Palace* (figure 5.1). The project was conceived as a form of urban intervention that allowed for occupants to have a say and impact on the layout and form. This offered a mode of continuous and dynamic change to the structure's layout and potential program. In areas under looser control within this thesis' design proposal (where suggested fluctuations of program is listed to occur), there also exists the potential for such social interaction to occur between occupant and architecture. This not only adds a dynamic element outside of microclimate and layout that effects flow, but allows the membrane to expand and contract in a manner reflective of social engagement.

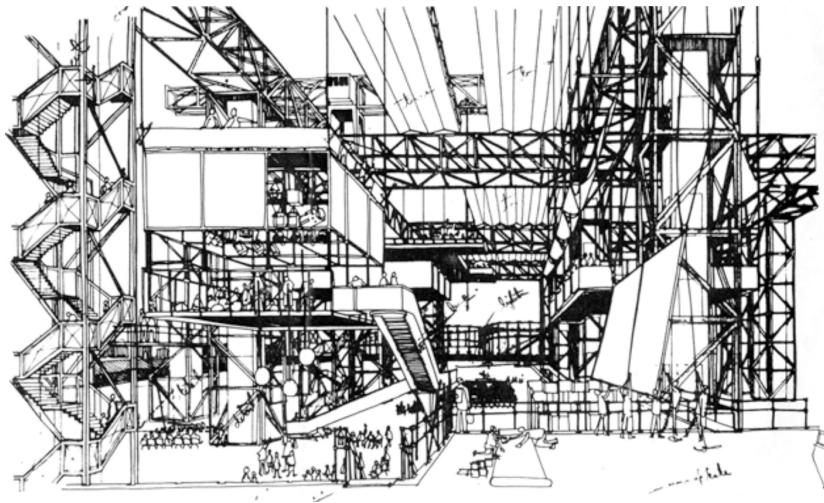


Figure 5.1 - "Fun Palace - Section".
By Cedric Price (Conceptual). 1964. London, England.

Further developments on the thesis would ideally also explore such microclimatic conditions with greater discretion and more exact results. Such an endeavor would include creating a small number of controlled spaces to be tested that examine physical dissolution of barriers through the use of climatic devices. This would involve explorations of climatic components acting solely and in conjunction with other elements. Not only will this be used to test numerical values but also provides insight to how a test group would react to such intervention and, subsequently, how the program and *flow* would be able to fluctuate to set parameters.

One final unanswered afterthought, more of a practicality, is the potential change in the cost of a project that would follow an expanding system of open and closed layouts. The issue here presents itself in the acknowledgment of the lattice's consequent need for extra support and structure as a result of spatial expansion. Ideally, the manufacture, assembly, and inclusion of active and passive devices could also be investigated more closely in further speculations within test studies (such as those suggested for empirical data of microclimatic devices).

So in conclusion, while there still remains factors to explore and consider, when it comes to understanding architecture and flow, architects may have to consider the two key spatial models of subdivided tent form and open campfire space. With each system comes its own set of benefits and drawbacks. Since programs often vary in the type of spaces this thesis proposes that one single system may not always be the answer to the design as a whole. The architecture itself may become more enhanced and diversified and yet retain a unified heterogeneous spatial quality by utilizing this method.

|Bibliography|

Addington, Michelle. *The Phenomena of the Non-Visual*. In "Softspace: From a Representation of Form to a Simulation of Space". ed. Sean Lally and Jessica Young, 38-51. Abingdon, Oxon: Routledge Publishing, 2007.

Arch Daily. *Andrée Chedid Media Library by D'HOUNDT+BAJART Architects and Associates*. September 29, 2014. Accessed February 17, 2015. Available from <http://www.archdaily.com/550315/andree-chedid-media-library-d-houndt-bajart-architects-and-associates>.

Arch Daily. *Dalarna Media Library by Adept*. June 03, 2014. Accessed February 17, 2015. Available from <http://www.archdaily.com/511535/dalarna-media-library-adept>.

Arch Daily. *Media Library and Cultural Centre / Barbotin + Gresham Architects*. October 13, 2011. Accessed February 17, 2015. Available from <http://www.archdaily.com/112856/media-library-and-cultural-centre-barbotin-gresham-architects>.

Arch Daily. *Arthur Rimbaud Media Library and Cultural Centre by Dacbert Cochet Chapellier Architects*. March 04, 2011. Accessed February 17, 2015. Available from <http://www.archdaily.com/116112/arthur-rimbaud-media-library-and-cultural-centre-dacbert-cochet-chapellier-architects>.

Architecture Design Primer – Demystifying Architectural Design. *Threshold: Link and Separator*. January 8, 2013. Accessed July 29, 2015. Available from <https://architecturedesignprimer.wordpress.com/2013/01/08/threshold-link-and-separator/>.

Ayres, Phil. *Reconsidering Relations*. In "Persistent Modelling: Extending the Role of Architectural Representation". ed. Phil Ayres, 1-10. Abingdon, Oxon: Routledge Publishing, 2012.

Bachelard, Gaston. "The Poetics of Space". Vol. 330. Beacon Press, 1994.

Ballantyne, Andrew and Chris L. Smith. *Fluxions*. In "Architecture in the Space of Flows". ed. Andrew Ballantyne and Chris L. Smith. Abingdon, 1-40. Abingdon, Oxon: Routledge Publishing, 2012.

Banham, Reyner. *Environmental Management*. In "The Architecture of the Well-tempered Environment". ed. Reyner Banham, 18-28. Chicago, Illinois: University of Chicago, 1969.

Berrizbeitia, Anita and Linda Pollack, "Inside Outside: between architecture and landscape". Gloucester, MA: Rockport Publishers, 1999.

Bird, Byron. "Transport Phenomena." New York: Wiley Publishing, 1960.

Bonsor, Kevin. How Stuff Works - Home & Garden. *How Smart Windows Work*. Accessed August 14, 2015. Available from <http://home.howstuffworks.com/home-improvement/construction/green/smart-window.html>.

Carruthers, Kenneth DB. "Architecture is Space; the Space-Positive Tradition." *Journal of Architectural Education* 39, no. 3 (1986): 17-23.

Clement, Gilles and Philippe Rahm. *Form and Function Follow Climate*. In "Environ(ne)ment – Approaches for Tomorrow". 152-159. Milan: Skira Publishing, 2007.

ClimaTemps. *Amman Climate and Temperatures*. 2013. Accessed October 31, 2014. Available from <http://www.amman.climatemps.com/>.

Deleuze, Gilles and Felix Guattari. *1440: The Smooth and The Striated*. In "A Thousand Plateaus: Capitalism and Schizophrenia". 474-500. Minneapolis, University of Minnesota Press, 1987.

Department of Statistics - Jordan. *Estimated Population Demographics*. 2014. Accessed October 31, 2014. Available from <http://web.dos.gov.jo/sectors/social/demographic-statistics/?lang=en>.

Dezeen. *Serpentine Gallery Pavilion by Sou Fujimoto*. June 04, 2013. Accessed March 23, 2015. Available from <http://www.dezeen.com/2013/09/29/i-tried-to-create-something-between-architecture-and-nature-sou-fujimoto-on-serpentine-gallery-pavilion-2013/>.

Diller, Scofidio and Renfro architects. DS+R. *Blur Building*. 2002. Accessed November 23, 2014. Available from <http://www.dsny.com/>.

Giedion, Sigfried. *The Third Space Conception*. In "Architecture and the phenomena of transition: the three space conceptions in architecture". ed. Gideon Sigfried. 266-300. Cambridge, MA: Harvard University Press, 1971.

Hensel, Michael. *Digital Materials*. Lecture, Material Seminar by ROM Gallery, Oslo, Norway, April 25, 2010. (Accessed September 13, 2015). Available from <https://vimeo.com/11615108>.

Hensel, Michael. *En Route: Towards a Discourse on Heterogeneous Space beyond Modernist Space-Time and Post-Modernist Social Geography*. In "Space Reader: Heterogeneous Space in Architecture". 9-35. Chichester, U.K.: Wiley Publications, 2009.

Hensel, Michael. *Material Capacity and Auxiliary Architecture*. Lecture, Silver Lecture Series by University of Applied Arts, Vienna, Austria, September 5, 2013. (Accessed September 13, 2015). Available from <https://www.youtube.com/watch?v=g9G2WEcFKRE>.

Hensel, Michael. *Performance Oriented Design from a material perspective: domains of agency and the spatial material organization complex*. In "Performatism: Form and Performance in Digital Architecture". Ed. Yasha J Grobman and Eran Neuman, 43-49. . London: Routledge Publishing, 2011.

Hensel, Michael. *Towards an Inclusive Discourse on Heterogeneous Architecture*. In "Morpho-Ecologies". ed. Michael Hensel and Achim Menges, 16-60. London: AA Publications, 2007.

Hensel, Michael and Defne Sunguroglu Hensel. "Extended Thresholds III: Auxiliary Architectures". *Architectural Design* 80, no. 1 (2010): 77-83.

Jones, Caroline A. *The Mediated Sensorium*. In "Sensorium: Embodied Experience, Technology, and Contemporary Art." ed. Caroline A Jones, 5-49. Cambridge, MA: MIT Press, 2006.

Kehagias, Nicholas. Nicholas Kehagias works. *Climatic Territories*. 2011. Accessed November 24, 2014. Available from www.nicholaskehagias.com/datacenter/.

KPMB Architecture. *Fort York Library*. 2014. Accessed February 17, 2015. Available from <http://www.kpmb.com/index.asp?navid=30&fid1=91&fid2=124#desc>.

Lally, Sean. "Softspace: From a Representation of Form to a Simulation of Space". ed. Sean Lally and Jessica Young, preface. Abingdon, Oxon: Routledge Publishing, 2007.

Lally, Sean. Weathers LLC. *EOS*. 2014. Accessed December 08, 2014. Available from <http://www.weathers.cc/EOS>.

Lally, Sean. Weathers LLC. *Sirenuse*. 2014. Accessed December 08, 2011. Available from <http://www.weathers.cc/Sirenuse>.

Laugier, Marc-Antoine. *General Principles of Architecture*. In "An Essay on Architecture". Los Angeles: Hennessey & Ingles Inc, 1977.

Leatherbarrow, David. "The Roots of Architectural Invention: Site, Enclosure, Materials". Cambridge: Cambridge University Press, 1993.

Loo, Stephen. *The (Not So) Smooth Flow Between Architecture and Life*. In "Architecture in the Space of Flows". ed. Andrew Ballantyne and Chris L. Smith. Abingdon, 199-214. Abingdon, Oxon: Routledge Publishing, 2012.

OMA Architects. OMA Projects. *Yokohama Master Plan*. 1992. Accessed May 23, 2015. Available from <http://www.oma.eu/projects/1992/yokohama-masterplan/>.

Payne, Andrew. "Surfacing the New Sensorium". *Praxis: Journal of Writing and Building*, vol. 9 (2007): 5-13.

Peters, Brady. *Design issues of time-based phenomena and the notion of a persistent model: a parametric exploration of acoustic performance*. In "Persistent Modelling: Extending the Role of Architectural Representation". ed. Phil Ayres, 81-90. Abingdon, Oxon: Routledge Publishing, 2012.

Rahm, Philippe. Philippe Rahm Projects. *Jade Eco Park*. 2013. Accessed December 14, 2014. Available from <http://www.philipperahm.com/data/projects/taiwan/index.html>.

Ridgeway, Matthew. "Consideration of Four Thresholds". B.Arch Independent Research, Virginia Polytechnic and State University, 2013.

Schwartzman, Madeline. "See Yourself Sensing: Redefining Human perception." London: Black dog publishing, 2011.

Sedlock, Julia. MAS CONTEXT RSS. *Challenging the Physical and Disciplinary Boundaries*. 2013. Accessed September 25, 2014. Available from <http://www.mascontext.com/issues/17-boundary-spring-13/challenging-the-physical-and-disciplinary-boundaries/>.

SPC. *Beaufort Wind Scale*. Accessed October 31, 2014. Available from <http://spc.noaa.gov/>.

Tucker, Lisa M. "Transitional Spaces: Blurring the Line Between Interior and Exterior." *Enquiry: A Journal for Architectural Research* 9, no. 1 (2012): 15-23.

Winton, Alexa G. *Inhabited Space: Critical Theories and Domestic Interior*. In "The handbook of interior architecture and design". ed. Graeme Brooker and Lois Wenthal, 40-49. London: Bloomsbury Academic, 2013.

Wissen Way. *Switchable Glass which changes from Clear to Opaque - Smart Glass*. April 19, 2015. Accessed August 14, 2015. Available from <http://www.wissenway.in/2015/04/switchable-glass-which-changes-from.html>.

Yates, Amanda. *Oceanic Spaces of Flow*. In "Architecture in the Space of Flows". ed. Andrew Ballantyne and Chris L. Smith. 63-79. Abingdon, Oxon: Routledge Publishing, 2012.