

# TRANSFORMATION OF EDGE IN ARCHITECTURE: INTEGRATION OF ADAPTIVE KINETICS AND SCREEN IN NATURE

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## **Keywords:**

Adaptive Edge, Kinetic Architecture, Screen, Built Environment, Interior vs. Exterior.

## **Abstract:**

This thesis synthesizes an individual knowledge acquired through the last four years within the Architecture program by developing a proposal and application of architectural edge to sequential spaces within a specific environment. A design that would adapt to the surrounding environmental factors to optimize on the sources of ventilation, optimal views, and light. A series of layered tone and line drawings were used to develop a series of edge conditions developing into physical models of transformative edges.

To start, general research on Architects who specialize in Kinetics and Screens such as Olson Kundig and Scarpa to distinguish certain typologies and Architectural applications. Case Studies will investigate the variety of material and scale applications. Sketches of effects and movement are preformed to analyze the transformation of space and relationship between interior to exterior space based on the position of kinetic edge.

As a result, edge will evolve into a series of spaces that incorporate developed edge conditions into a site, in conclusion to analyze the way in which edge effects the feeling and quality of space within the environment.

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## 1. INTRODUCTION

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### 1.1 The Epitome of Architecture: Environment

The basis of Architecture derives from the most pure and natural forms that are inherently provided by the world that graciously provides and surrounds it. Architecture and structures take a subordinate position in the overall context of nature. The relationship between Architecture and the environment is a continuously connected web of giving and taking. Jim Olson, a practicing Architect who using landscape to its fullest potential, states “I see our environment as continuous and connected; everything affects everything else. Architecture should fit into its context in a way that makes a better whole. Climate, Culture, landscape or cityscape, architecture, interiors, art...they are all one integrated environment.”<sup>1</sup> This core idea of an interrelationship between Architecture and Nature encourages the inhabitable space to turn our attention away from the interior to experience the world around us. Architectural Edge, individually defined as the spatial boarder between the interior and exterior of a space, directly integrates the built environments to the nature that it surrounds. In turn the edge becomes the embodiment of focusing and sharpening our senses to understand itself within a context.

Characteristics of building’s edge and envelope are relevant to architectures ability to perform harmonically through meeting the demands

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<sup>1</sup> Olson, Jim. *Jim Olson. Art in Architecture*. Edited by Matt Anderson. Bellingham, WA: Whatcom Museum, 2013. Page 13.

of the client and the site while also actively responding to the evolving climate conditions.<sup>2</sup> The introduction of kinetics to the building edge offers a desired and innovative way for the building to adapt. The theoretical goal of this adaptation is to procreate a blurred edge between the physical separation of interior to exterior spaces. As the architect firm, Olson and Kundig, states “Dissolving the boundaries between enclosure and landscape, to bring in as much of the surrounding beauty as possible and to make interior space “explode out of the box” into the larger context.”<sup>3</sup> This effect not only enhances the integrity of the structure but the experience of the occupant through the encouragement of human interaction with specific edges.

Kinetic architecture, having the characteristic of physical motion, is the most obvious way to integrate context into the interior of space; the subtle idea that stationary edges such as screens could also thrive in motion based on the way the edge evolves due to its interaction with light, climate, and occupation. Tom Kundig states, “...the architectural experience calls for the senses of balance, movement, orientation, continuity, time, self, and existence.”<sup>4</sup> Architecture should optimize on the above characteristics in various scales overall framing the landscape, to create an experience of

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<sup>2</sup> Goldberger, Paul, and Oscar Riera Ojeda. *Olson Sundberg Kundig Allen: Connecting Architecture Art Craft in Twelve Residential Projects*. New York: Monacelli Press, 2001. Page 6.

<sup>3</sup> Goldberger, Paul, and Oscar Riera Ojeda. *Olson Sundberg Kundig Allen: Connecting Architecture Art Craft in Twelve Residential Projects*. New York: Monacelli Press, 2001. Page 7.

<sup>4</sup> Kundig, Tom. *Tom Kundig: Houses 2*. New York: Princeton Architectural Press, 2012. Page 9.

place while creating a sense of continuity through beauty and simplicity inside of the architecture.

Building Edge appears in various forms and typologies throughout the history of Architecture; Architects such as Tom Kundig, Jim Olson, Carlo Scarpa and Shigeru Ban approach the core idea of edge in a multitude of perspectives. These architects activate the edge through operable and stationary assemblies, what these architects have in common is their ability to redefine and challenge the fundamentally accepted theories of traditional architecture.

## **1.2 Precedent Research**

In beginning the investigation of architecture through the detail of edge, precedent that held influence on the shape of this thesis was the ideas of Tom Kundig, Jim Olson, Carlo Scarpa and Shigeru Ban. The continuous relevance of edge and the definition of edge within the environment through their projects sets a substantial foundation.

Tom Kundig, an owner and design principal of an Architecture firm in Seattle, Washington has received some of the world's highest design recognitions for his work with rugged material, exposed structural systems, and mechanical devices. His use of "Gizmos" or mechanical devices are what receives high recognition, understanding how static elements become kinetic through dynamic movement with the direct participation of the occupant, as seen in Figure 1.1. The main question remaining to be

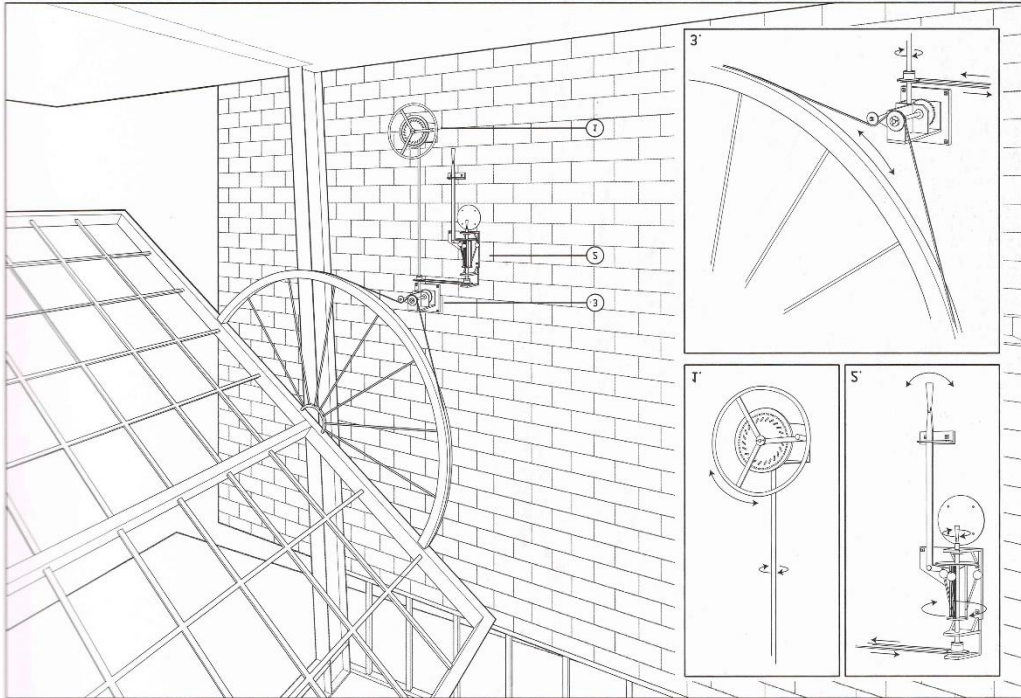


Figure 1.1 – Tom Kundig’s “Gizmo” at Chicken Point Cabin in Idaho  
<https://n7470126.wordpress.com/2011/03/20/part-a-archetype-tom-kundig-chicken-point-cabin/>

investigated of how to open architecture to the influence of the larger landscape. His typology appears alive and breaths with its surroundings; As Kundig says, ““Mechanical details add something of the romantic air of railways, steam engines, farm machinery, and steel lift bridges. The gadgets also introduce an element of humor; architecture is not dead serious, after all.”<sup>5</sup>

Jim Olson works alongside Kundig in the architecture firm Olson Kundig in Seattle, Washington, he is best known for his design of houses that contain ambitious art collections. Olson holds integral values for framing the landscape in all his designs as well as the relationship between interior and

<sup>5</sup> Kundig, Tom. *Tom Kundig: Houses 2*. New York: Princeton Architectural Press, 2012. Page 10.

exterior spaces through the active incorporation of light in space. For example, to further integrate his design into the landscape, the use of a translucent window where the seams are hidden from view giving the illusion that there is no glass at all, he terms the system “Magic Window”, as seen in Figure 1.2.<sup>6</sup>



Figure 1.2 – Jim Olson’s “Magic Window”, seamless connection to exterior  
<https://www.olsonkundig.com/projects/cabin-at-longbranch/>

Carlo Scarpa, an Italian architect who focused on the ideas of materials and landscape through a multitude of typologies such as Venetian, Japanese, and modernism. His innovations are perfected to the finest of details through systems

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<sup>6</sup> Olson, Jim. *Jim Olson. Art in Architecture*. Edited by Matt Anderson. Bellingham, WA: Whatcom Museum, 2013. Page 59.



Figure 1.3- Museo Canoviana, the windows occupy the void corners  
<http://pinosy.com/media/396950154637714790/>

of joints, fixtures and furniture. The most applicable project being “*Brion Tomb and Sanctuary*” and “*Museo Canoviana*”, reference can be found in Figure 1.3.

Shigeru Ban, a Japanese architect known for his innovative work with

various materials such as paper. One of the most important themes carried throughout his work is the idea of “Invisible structures”, instead of overall emphasizing structural elements he incorporates them into the design. He terms the idea of continuity throughout different spaces of a structure through the idea of “Universal Floor”, as seen in Figure 1.4; in a way the term applies to the idea of transforming ideas in the interior of a spaces, having the capability of moving walls, exemplified in his project “Nine Square Grid House”. In reference to building edge, Ban states, “A buildings skin can transform its color, texture, and even its structure as it fluctuates between one state and the next.”<sup>7</sup>

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<sup>7</sup> McQuaid, Matilda. *Shigeru Ban*. London: Phaidon, 2004. Page 184.

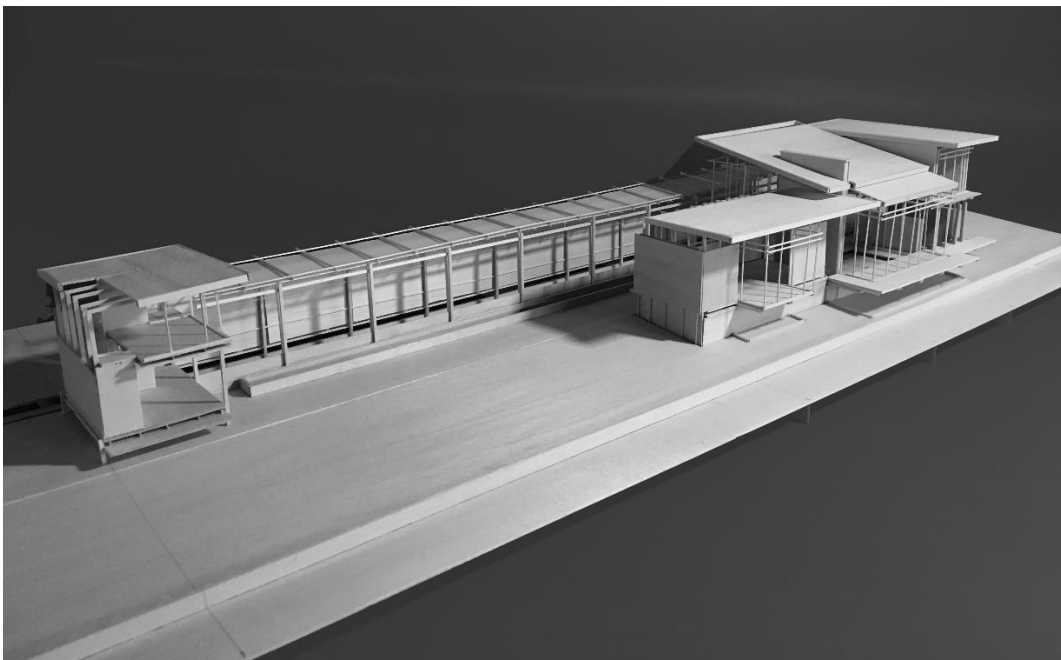


*Figure 1.4 – The “Universal Floor” contains no permeant walls and single movement of space, this project is known as the Nine Square Grid House  
<https://www.thoughtco.com/interiors-japanese-houses-of-shigeru-ban-177319>*

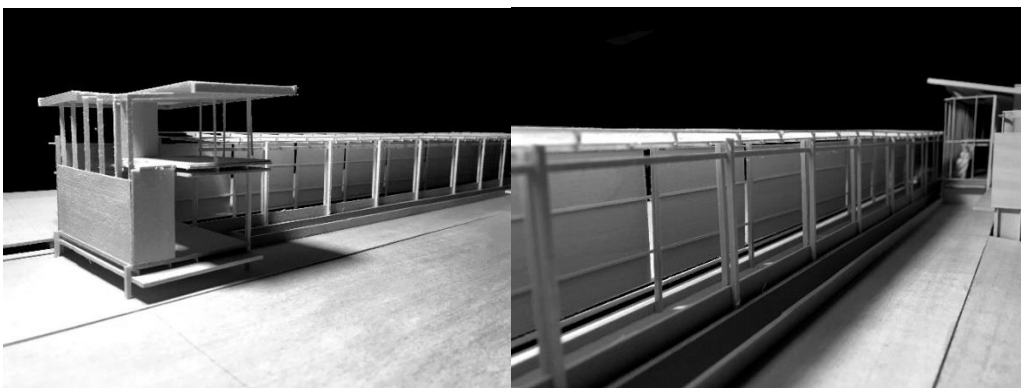
### **1.3 The House Project**

One of the main drivers that initiated the investigation of edge in the environment was the first project of Design 8, The House Project. To begin Design Studio 8, Professor Martian Gundersen exposed the ideas of domestic architecture through the applications of site and program in the development of houses. The program was determined by a fellow classmate in which provided the role of the client to influence the spatial organization of the house. The client was interested in a retreat from everyday life, a house that offered one of his main interests’, golf. Using the process of golf in terms of architecture drove the program of the house.

The main spaces of the program such as the double height living room, sunk down into the earth to represent the core of family with a fire place to emit the warmth of the space; followed by a kitchen and a loft space leading to the private bedroom. These main living quarters and private office are separated by a long processional breezeway that emits light from the above translucent screen and the sound of flowing water from the built stream that runs alongside, apparent in Figures 1.5 through 1.7.



*Figure 1.5 – 1.7 , Images of The House Project, showing the main living spaces and a private study (bottom left, Figure 1.6) separated by a large processional breezeway (bottom right, Figure 1.7). Pictures taken by Kristen DeMarco, March 2019.*



A quote made by Ban, that effectively describes the function of the house, “The surfaces respond effectively to circumstances around them: they offer protection and light but can disappear when desired.”<sup>8</sup>

The house truly embodies the idea of the built structures position within a landscape. The strong presences that lies transverse in the site and stretches across the landscape to integrate itself into the surrounding nature. The elongated gesture enhances the building to breath with the surrounding conditions, marking the landscape while improving the land that it encroaches. The translucent edges that the house embodies allows a sense of permeability for the nature to be invited into the interior. Looking back onto this project I pictured the building envelope having the ability to be operable and kinetic in the sense that the edges would be ever evolving with the surrounding climate conditions and transforming with the seasons.

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<sup>8</sup> McQuaid, Matilda. *Shigeru Ban*. London: Phaidon, 2004. Page 185.

## 2. Methodology

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### 2.1 Edge Typologies: Operable, Frame, Absence

After researching and becoming familiarized with the range of defined edges practiced throughout architecture, a sense of common place came from three core ideas when approaching edge. These core ideas in the simplest of terms are coined as Operable, Frame and Absence. These words transform the perception of architecture and the division between interior and exterior spaces. After finalizing the house project, to reinvigorate the edges with the ideals of kinetics I choose the smallest module of the structure, the private office at the end of the processional breezeway, to redefine those edges with the core defining words to drive the approach through a series of multimedia drawings.

Operable edges, otherwise known as Kinetics, are a series of physical motions that exhibit the evolution of position relative to time. The diagram expresses a sense of spatial extension and compression either beyond or within the architectural edge, as seen in Figure 2.1. These changes in spatial scale is a direct result of the transformation of edge. The edge of the space evolves with the movement of the element, not only effecting the experience of the occupant in the interior but also softening the physical line between the architecture and its context. A sense of symbiosis is

created where the architecture emerges from the landscape and the landscape embraces the transformation of the built form.<sup>9</sup>

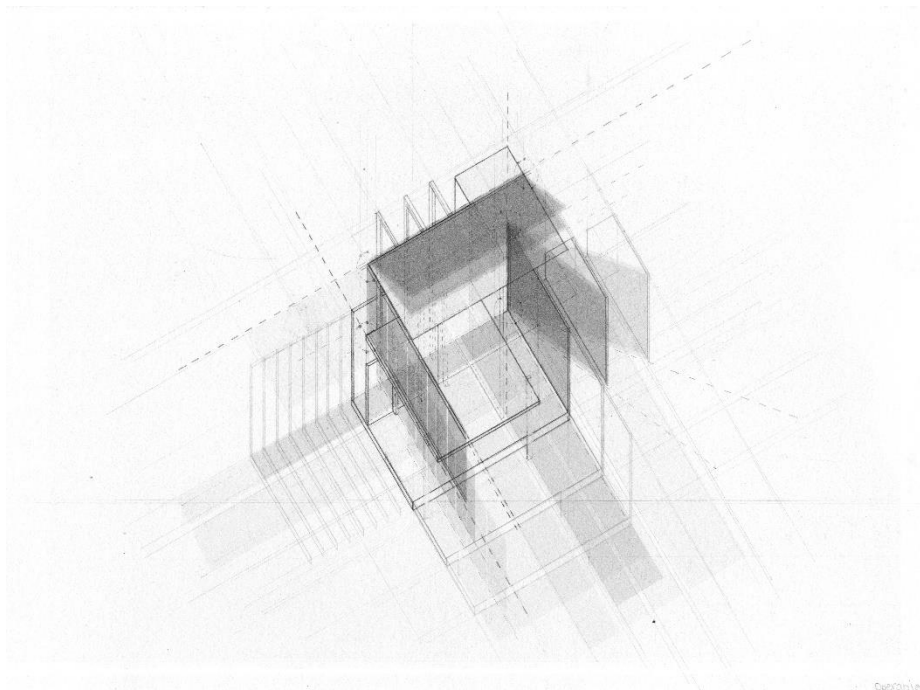


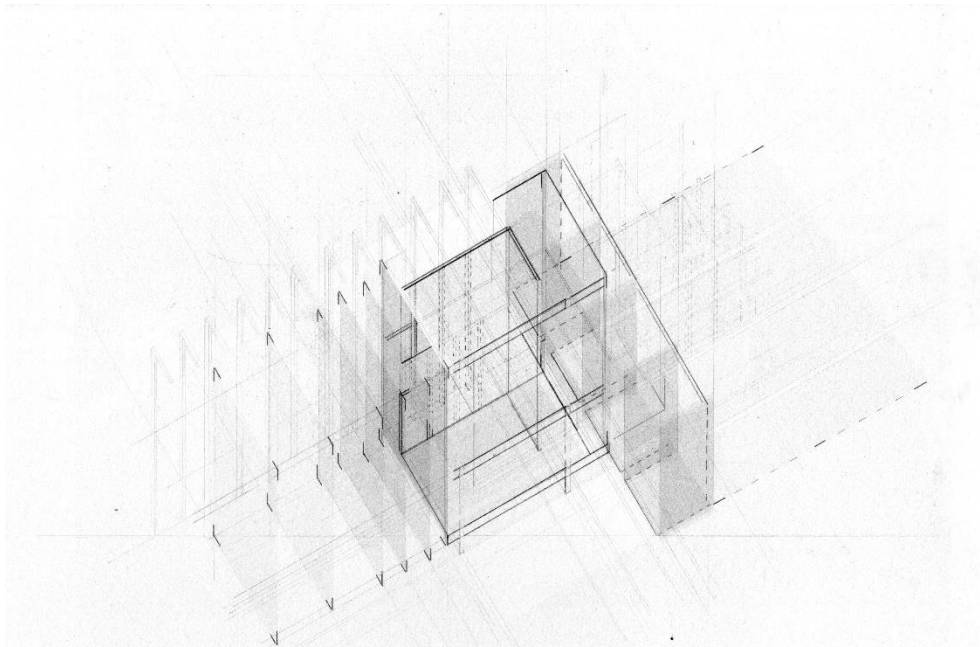
Figure 2.1 - Operable Edges Diagram, displays the range of motion of kinetics causing the extension of space beyond a fixed edge. Original work, Feb.2019.

Frame edges embrace the idea that the environment is the epitome of architecture. Whether it be the extension of structure towards focal points in the landscape or the intentional placement of the building upon a site to replicate or challenge the site, framing edges using the environment as its elite program. The diagram intends to define the framed edge through the progression of space beyond the physical edge, as seen in Figure 2.2. Using the preconceived house elements to define the physical building edge and create focal points within the given frames; As you move between frames the view has evolved in perspective. The repetition of frame from the given

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<sup>9</sup> Goldberger, Paul, and Oscar Riera Ojeda. *Olson Sundberg Kundig Allen: Connecting Architecture Art Craft in Twelve Residential Projects*. New York: Monacelli Press, 2001. Page 7.

structure portrays a sense of spatial relationship from the interior towards the exterior. Jim Olson used framed edges as a core approach in most of his architecture endeavors due to his belief that the environment is the beauty that architecture is derived from; he states “My architecture tries to bring the outside and inside together by blurring the boundary between the two. I try to create vistas, focal points, and architectural frames to focus the eye on a beautiful landscape element or a piece of art.”<sup>10</sup>



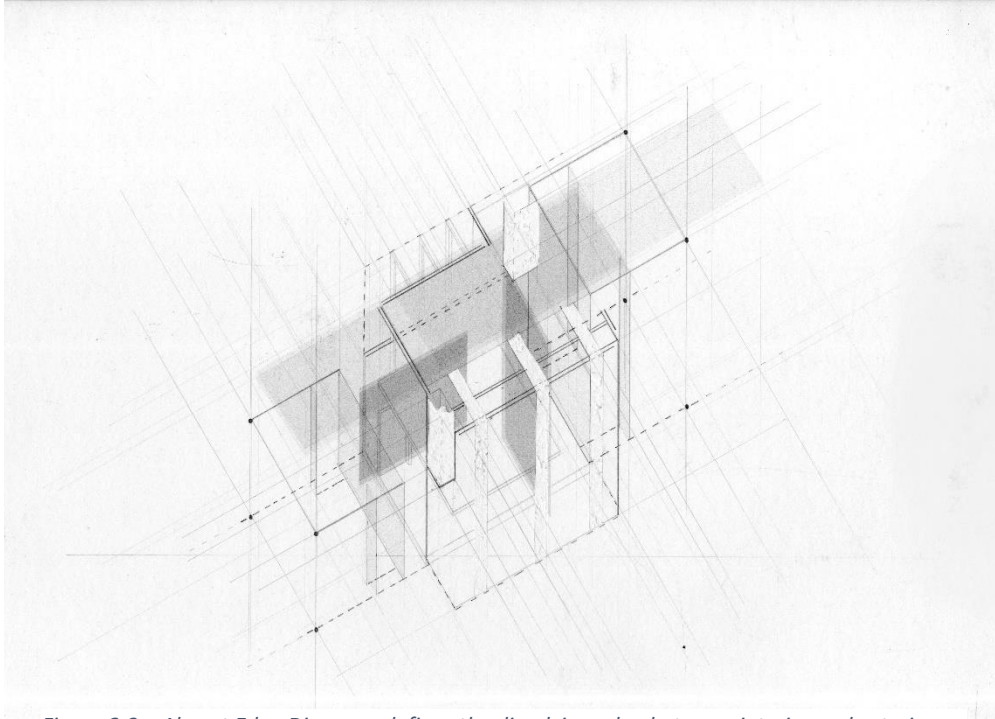
*Figure 2.2 – Frame Edges Diagram, defining the edges through a progression of space beyond the physical edge usually addressing an exterior focal point in the context. Original work, Feb.2019.*

Absent edges individually defined is the dissolving line between interior and exterior that is purposefully hidden to create a sense of unobstructed views. The diagram of absence edges questions the characteristics of edge occurring in a visible state or a state that is implied, as seen in Figure 2.3. The absence of edge as seen in Scarpa’s architecture projects seeks to turn

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<sup>10</sup> Olson, Jim. *Jim Olson. Art in Architecture*. Edited by Matt Anderson. Bellingham, WA: Whatcom Museum, 2013. Page 99.

a corner or better yet completely leave a corner or edge void, in turn to evoke the human perceptions of edge. Another architect who employs the ideals of absent edge is Jim Olson, he states “Hiding corners, light sources, and structure expands the perception of space. An indirectly lit, domed ceiling creates an illusion of infinity and a neutral setting...”<sup>11</sup>



*Figure 2.3 – Absent Edge Diagram, defines the dissolving edge between interior and exterior spaces. Original work. Feb.2019.*

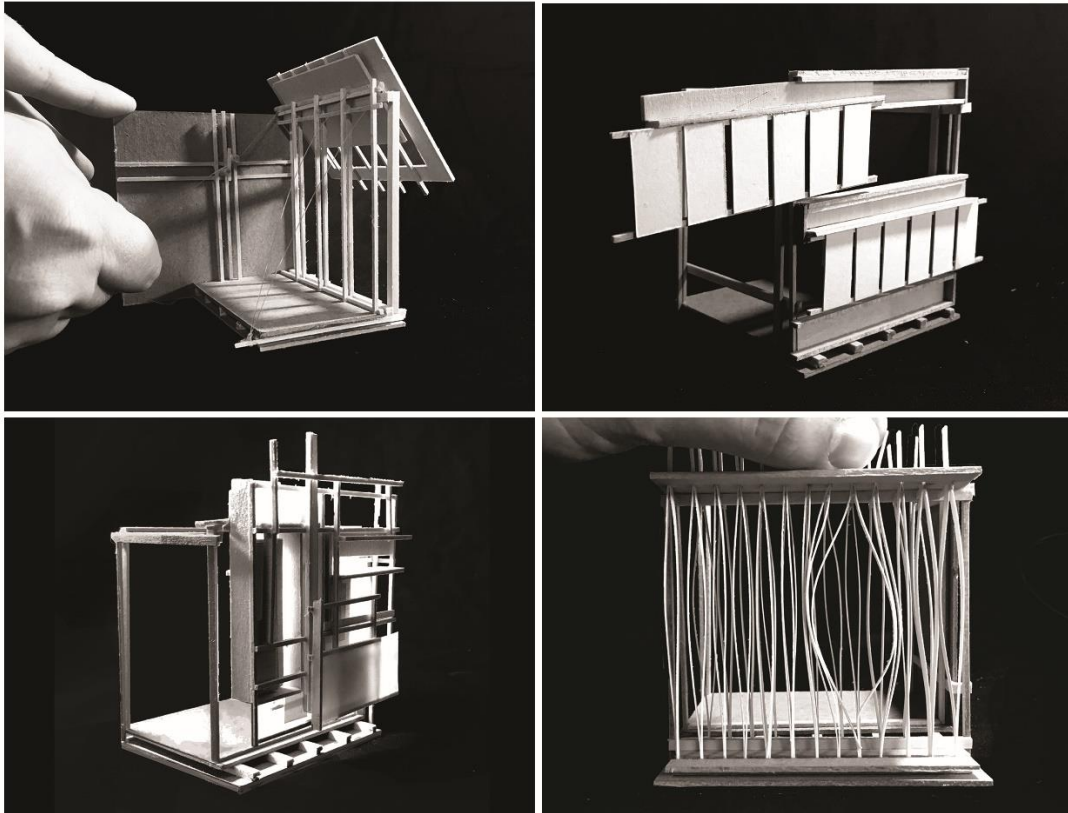
## **2.2 Kinetic Exploration**

As previously discussed, Kinetic architecture can be applied in a wide range of edge conditions, some characterized by physical movement and other through stationary evolution. The two categories of kinetics and screen will be the main categories of edge conditions I will be testing in the upcoming

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<sup>11</sup> Olson, Jim. *Jim Olson. Art in Architecture*. Edited by Matt Anderson. Bellingham, WA: Whatcom Museum, 2013. Page 71.

process, examples can be seen in Figure 2.4. I will be approaching the integrity of edge through a series of kinetic and screen applications whether it be categorized as structural and façade systems.



*Figure 2.4 – Kinetic and Screen Systems, the images characterized through physical motion or stationary evolution, seen in the bottom left image. Original work. Feb.2019.*

Kinetic systems can operate along various edges among a space, each position whether it be an overhead, structural wall, or façade creates a series of conditions with the occupant's senses. These systems could function in a variety of ways some that exist in a fixed state to control the overall architecture system based on evolving conditions, some may be temporary that are responsive to human interaction and lastly a system that is fixed but operates independently based on its own adaptation to the surrounding conditions. The opportunity for kinetics to hold intelligence

within a space is for them to physically reconfigure to meet the changing needs of the interior. The series of personalized joints that operate these kinetic systems are works of art at the finest details. Investigating these joints, I create a series of edge conditions that will range in motion. The focus of the edges finding innovative ways to create pulley systems, sliding membranes, and light louvers.

Screen systems operate as a layered membrane which can be composed from a variety of materials and techniques. Screens are characterized through a series of actions to bind, to cover, to enclose, and to captivate. Screens even though typically stationary operate as a kinetic system based on the animation of its effects relative to the position of the light source, time of the year or location within the world. Operating within or on the building envelope a screen challenges the fundamental definition of an edge, though an edge is viewed as physical separation from the interior to the exterior of spaces, a screened edge is environmentally sensitive. Nature influences these types of assemblies, much like how Jim Olson states, “tree canopies become trellises and courtyards feel like clearings in the forest- nature inspires architecture and architecture transforms nature.”<sup>12</sup> A screen amplifies the perception of the interior space through the ideas of light, sound, texture, and pattern, all of which are directly associated to the events of the primary context.

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<sup>12</sup> Olson, Jim. *Jim Olson. Art in Architecture*. Edited by Matt Anderson. Bellingham, WA: Whatcom Museum, 2013. Page 28.

### **2.3 Process through Edge Conditions**

Using the defined categories of Kinetics and Screen, I began to construct a series of edge conditions that range in movement whether through physically motion and human interaction or through the evolving effects of light conditions, can be seen in Figure 2.5. The resulting nine edges exemplify the multitude of dynamic movement and material options and how these choices effect the interior and exterior relationship. As seen in the Figure, the series of photos taken of each individual edge shows its effects with light and motion as well as its relationship with time. Even though the overall grid of images can be read as an assemblage of individual states it could also be read as a series transforming as a composite.

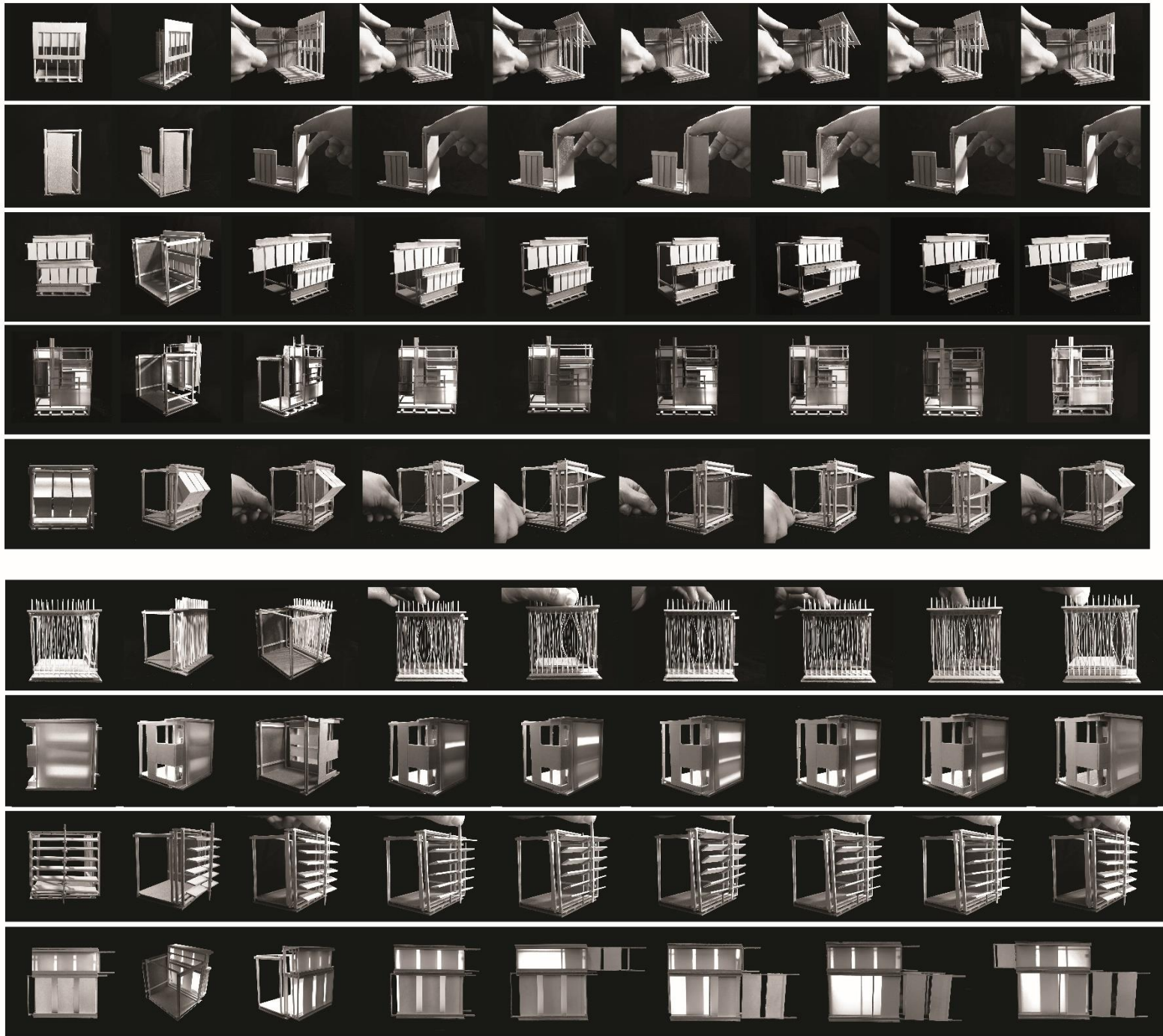


Figure 2.5 – Process through Edge conditions, a series of edges ranging from Kinetics to Screen, present a collection of motion and light conditions relative to its individual edge's relationship with time. Original work. Feb.2019.

### 3. SPECULATIVE SPATIAL APPLICATION

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#### 3.1 Bauhaus Diagram and Atlantic Center

Moving forward from the individual edge conditions is to incorporate a select few into a series of spatial moments that are separated through processional breezeway or boarder space, an idea that preexists from the house project. To spread the edges across the landscape is encouraged in the progression of this project, in hope of investigating the interaction between the evolving conditions of a site with the edges of built architecture.

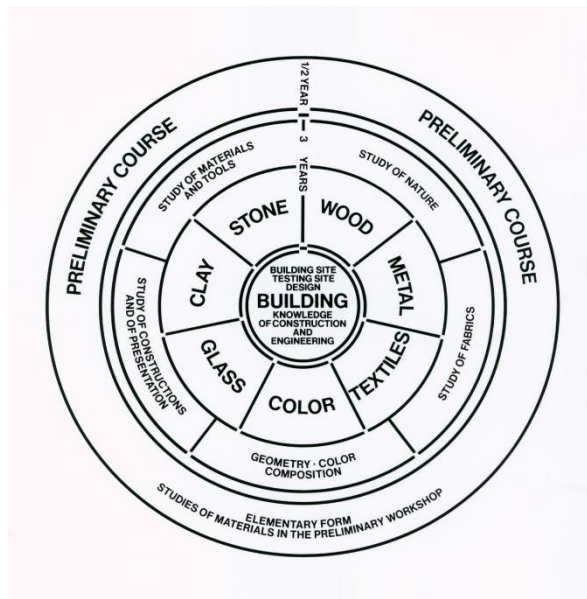


Figure 3.1 – Bauhaus Diagram, mapping the structure of education at the institute  
<https://www.lomography.com/magazine/189352-the-bauhaus-wheel-diagram>

To drive the program for these developing moments and the materiality of the edge conditions, I have found precedent in the Bauhaus Diagram, seen in Figure 3.1. The conceptual diagram shows the structure of teaching at the Bauhaus Institute, after the initial education, students choose a basis of materiality workshops found in the inner circle of the diagram.

Finalizing an overall concept, the resulting project will contain a construction of three studios based on the individual materials of wood, metal and textiles.

The precedent to the foundation of this evolving project is the architecture project called “*Atlantic Center for the arts*”, a nonprofit multidisciplinary artist facility located in New Smyrna Beach, Florida, pictured in Figure 3.2. The studio complex is composed of a series of studios ranging in functions such as a theater, painting and sculpture studio, dance and music studio and resident commons. This project exemplifies the intended quality of spaces and programs.

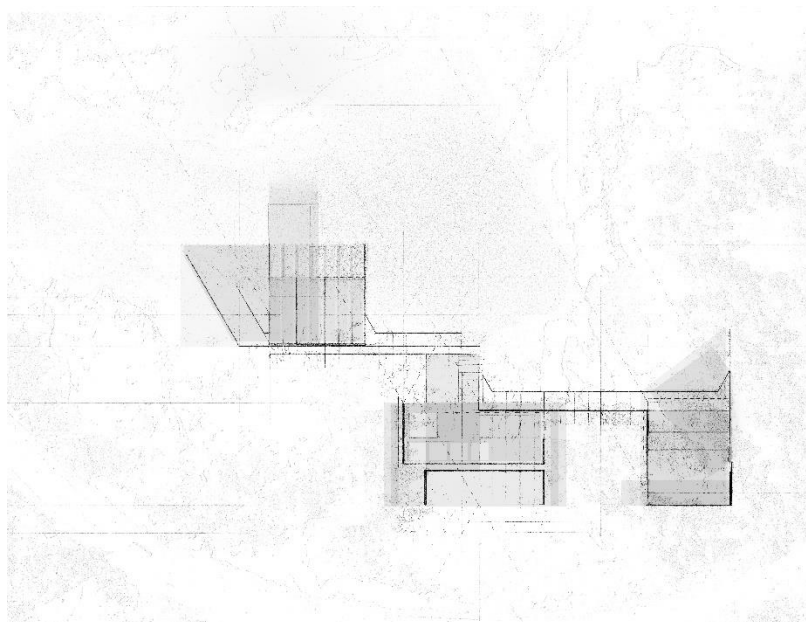


*Figure 3.2 – Atlantic Center for the arts, a complex of artist facilities spread through a site in New Smyrna Beach, FL. <https://atlanticcenterforthearts.org/facilities/studios-facilities-housing/>*

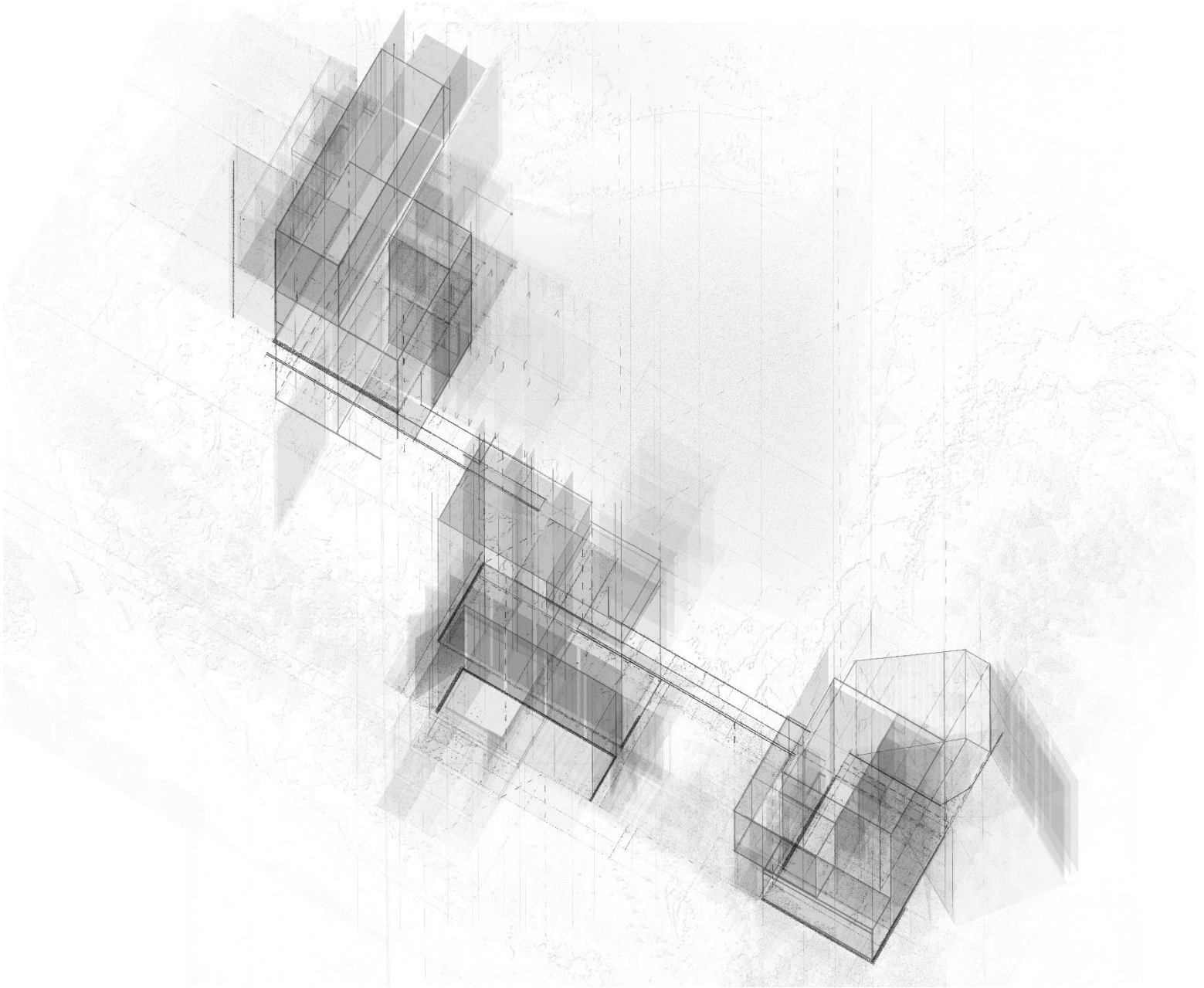
### **3.2 Procession through Moments**

The site for this design project is located near Tipsoo Lake in Mount Rainer National Park in Washington. In the spatial diagram found in Figure 3.3 and 3.4, displays the diagrammatic spatial organization of three studios compromised on individual programs and architectural edge aspects that are based around the materials of wood, metal, and textile. The spatial moments are composed in the context to frame the focal points of the surrounding mountainous profiles and timber clearings. The textile studio

elevated above the lake to blur the edge between permeable and solid ground. Following the processional boarder space comprised of a kinetic edge to the metal studio standing tall within the timber clearing. Lastly following the next processional kinetic space to the hidden wooden studio blending into the timber forest surroundings. The length of the project is integral to the interior spaces blending and breathing with the context. The selected edge conditions constructed earlier in the process, are chosen based on their visual and physical performance that can be derived based on program to appear like the architectural attributes of the material being applied. In conclusion, the final thesis will result in a construction of various edge conditions assembled within a context that will blur the physical separation between the built environment and the landscape. Employing Kinetics and Screens for the allowance of the dynamic interrelationship between interior and exterior spaces.



*Figure 3.3 – Diagrammatic Plan of the three studios at Tipsoo Lake in Mount Rainier National Park. Original work. March. 2019.*



*Figure 3.4 – Diagrammatic Spatial Organization, expressing the moment separated through processional breezeways; analyzing the edge conditions of the three studios based on their program of wood, metal, and textile relative to their position in the context. Original work. March. 2019.*

#### 4. REFERENCES

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