Landscapes of Light:
An Investigation of Light-driven Forms in Northern Climates and Cultures

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Abstract

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This is a study of light: an investigation into the ability of light to not only illuminate, but also to awaken a deeper sense of the existence of the natural world. Universally, light is an essential aspect of life: it provides illumination, a core quality of human existence. Without illumination, we cannot visualize spatial qualities of our physical surroundings. It plays a particularly poignant role in high latitude locations where sunlight is often scarce, the sky grey and dark, and the climate cold and wet. And yet light also plays another role in our world, and perhaps one that is equally as important as those aforementioned: that of the intangible. It holds meaning about abstract notions such as beauty, spirituality, and otherness.

The questions asked in this thesis came about during travels to Japan and Scandinavia to study architecture. In cities like Copenhagen, Stockholm, Tokyo, and Kyoto, light has a powerful effect within the built environment: when natural light is so scarce, it must be harnessed effectively in order illuminate man-made environments. Through the study of Nordic and Japanese case studies, physical models, and charcoal drawings, this thesis investigates how building form can manipulate light in various ways to create varying spatial experiences. From these investigations, this thesis defines 4 Qualities of Light in northern climates and cultures and explores them through the design of a cultural event center on Seattle's central waterfront.

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To my thesis committee, Ken Oshima and Peter Cohan: Thank you for taking this journey with me, and for your guidance and support during our travel studios to Copenhagen and Japan, and throughout the making of this thesis.

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And finally, to my family: Your love and support have sustained me during this long adventure. Thank you for reminding me that there is a world and life outside of architecture, and for making it such a wonderful place to be.

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1. Introduction

Layers of green, blue, and grey define the Pacific Northwest as shimmering lakes and rivers, soaring evergreens, and snow-capped peaks connect the Pacific Ocean and Cascade Mountains. For those who can endure its seemingly endless days of rain and clouds, the Pacific Northwest is a special place. Many people move to and stay in Seattle for its direct connection to several different natural environments: water, mountains, and forest. Here, nature is worshiped; people often drive several hours every weekend—and some weekdays—to enjoy the benefits of hiking trails, snowy mountains, and accessible bodies of water. The green spaces within Seattle are cherished as havens to gather for recreation, sport, and solace from the ever-growing city.

Figure 1. The colors of the Pacific Northwest on Bainbridge Island.

Nature is the most sacred space of the Pacific Northwest because it is universally revered; nature was sacred for the native peoples who first lived here, and it still is for the modern urbanite of Seattle today. Here in the Pacific Northwest, nature does not include just forests, mountains, and water, but also daylight. In such an overcast climate, light is a coveted aspect of nature since daylight is subtle and diffuse, casting soft shadows most of the year. The rare sunny days enliven both the green nature and the people who live here, and this unmasked sunshine is just as precious as the natural green spaces that surround us. Daylight's subtle changes coincide with time of day, season, climate, and weather. Light keeps us informed of where we are within time and place, and is an integral part of the natural environment.

Today, Seattle has an extensive system of greenways and parks within its city limits. Landscape architects Olmsted Brothers designed a system of 37 parks that today is regarded by many park planners across the United States to be one of the best designed and preserved in the country. Despite Seattle's strong emphasis on nature in regards to green spaces and parks, its people and infrastructure are still fundamentally separated from the natural environment. This separation will only grow as Seattle becomes denser and larger, which will have a negative impact on human wellbeing. A connection with the natural environment is essential for emotional, physical, and mental human health. This connection not only depends on what we typically think of as "nature"—being outside with plants, animals, and water—but also on

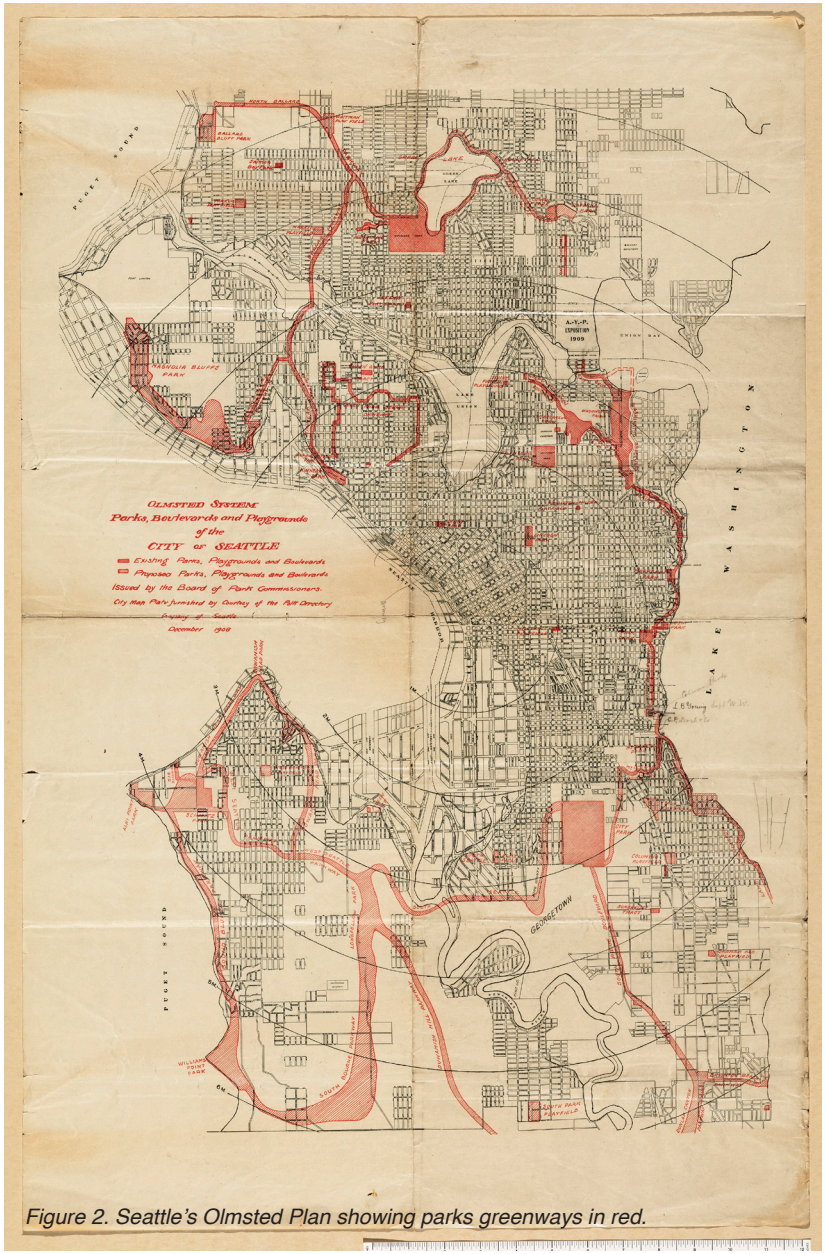


Figure 2. Seattle's Olmsted Plan showing parks greenways in red.

Figure 3. Edmonds, Washington on a clear day in August.

natural light. People who live in northern climates are well aware of this because they suffer from lack of sunshine; when direct sunshine is so rare, its importance is emphasized by its constant absence. Yet many people are unaware of the power of light to transform the spaces they inhabit everyday by connecting them with the natural world.

This thesis investigates natural light in architecture as both a necessity for physical human well-being and also its powerful ephemeral qualities. This thesis proposes that architecture is a influential tool that can manipulate light and shadow, forming evanescent experiences that constantly change over minutes, hours, days, and months. More than just providing for us physically, architecture has the ability to harness natural light to pique the emotional and mental stimuli that nourish our humanity.

The framework for this investigation is a study of the design sensibilities of Japan and Scandinavia, cultures with similar climate and landscape conditions to the Pacific Northwest that have mastered architectural techniques for integrating a building within its natural environment through daylighting.[1]

In Japan, many cities have sprawling, natural havens that are not only embedded within densely populated areas, but seamlessly integrated within buildings. This is a reflection of the importance of nature

1 While Japan and Scandinavia are not the only design-focused regions that highly value these natural forces, they are two that share important living conditions with Seattle: northern latitude, climate, daylighting conditions, and natural resources. This thesis does not intend to ignore other influences, but instead focus on these two that are meaningful within the context of the Pacific Northwest climate and architecture. This is especially true since immigrants from Scandinavia and Japan were integral resources in the development of infrastructure and culture of the Pacific Northwest as we know it today. From these two design sensibilities, we can learn lessons that will help to inform an architecture that not only responds to our natural and built environments in a contemporary way, but also a celebration of Pacific Northwest culture as it stands today and as it transforms in the near future.

Figure 4. Collage of two paintings: Shōrin-zu byōbu (Pine Trees screen) by Hasegawa Tōhaku, and Dust Motes Dancing in the Sun Beams by Vilhelm Hamershoi.

within traditional and modern Japanese cultures. In both traditional and modern Japanese architecture there exists a strong connection between the built environment and nature; instead of being seen as opposing forces, nature and man are coexisting, interdependent elements. This fluid mental framework provides a platform for nature—natural light, air, plants, and materials—to be inherently integrated within architecture and urban planning. The inherent connection of architecture and nature that defines Japanese design is supported by the role of natural light as a medium to illuminate, define spatial boundaries, and connect indoors and outdoors.

Scandinavian architecture highly values natural light as a core design element. Nordic architects have been seminal influences in the innovative explorations and discoveries of how a building can be designed so that the scarce natural light permeates every space. Through daylighting, Nordic design emphasizes its connection with the natural environment in which it is placed: the coast, mountains, forests, and plains of Denmark, Norway, Sweden, and Finland. A land with similar geographical and topographical landscape, the Pacific Northwest can continue to draw inspiration from Nordic examples in order to further celebrate our natural environment.

University of Washington travel studios to Japan and Scandinavia opportuned visiting and studying many buildings that became the foundation for the research for this thesis: case studies in Nordic and Japanese design that use building form to harness light in various ways. From these case studies, this thesis defines 4 Qualities of Light and proposes their use as a framework for understanding how

Figure 5.Tokyo, Japan.

Figure 6. Collage of images from Copenhagen, Denmark: Copenhagen canals (left) and the Maritime Youth House by BIG Architects (right).

building form can manipulate light to create different experiences: Filtered Light, Diffused Light, Sculptural Light, and Absence of Light. In order to explore these types of light, this thesis proposes a series of civic spaces located on Seattle's waterfront. Instead of being defined programmatically, these spaces are defined by quality of light and can be used for various activities based on the spatial and illuminance needs of the user and that provided by a space.

Through the design of this Cultural Event Center on Pier 48, this thesis explores intuitive ideas about the ephemeral characteristics of light, and discovers how light and architecture can shape human experience of the natural world in which we live.

Figure 7. Seattle, Washington on an overcast day in May.

2. The Pacific Northwest

2.1 CLIMATE AND CULTURE

With a latitude of approximately 47 degrees north, Seattle is one of the most northerly-located cities in the United States. At such a high latitude, its summers enjoy 16 hours of daylight and its winters endure just as much darkness. The sunniest month, July, sees an average of ten clear days; throughout the year, Seattle averages just 55 clear days.[2] And so it is not surprising that Seattleites celebrate light, flocking to parks and beaches to expose their sun-deprived bodies to

2 Moody, Fred. “Oyster Light in praise of Seattle light”, The Weekly, Jan. 21-Jan 27, 1987, Seattle: Seattle’s news magazine, Cover page.

the rare presence of sunshine. This culture not only cherishes sunlight, but also the Pacific Northwest overcast gloom. After a particularly clear summer, Pacific Northwesterners can be heard lamenting the lack of rain and anticipating the dreary drizzle that October will soon bring.

Like the Pacific Northwest, Scandinavia and Japan have varying landscapes and climates that range from ocean to mountain. While most of Scandinavia is colder and harsher than the Pacific Northwest, they share dark winters, diffuse daylight, and landscapes of ocean, mountain, and forest. On the other hand, most of Japan shares the Pacific Northwest's temperate climate but has opposite wet and dry seasons; in Japan, winters are dry and cold and summers are hot and humid, whereas Pacific Northwest winters are wet and cold and summers are warm and dry. Yet still, Japan and the Pacific Northwest share a culture of rain, dim light, and combination of ocean, mountain, and forest. So while each of the three regions has their differences, there are core similarities that connect them.

While the Pacific Northwest does not share the severe climatic conditions of Scandinavia in terms of snow, wind, and necessity for sufficient thermal insulation, it does share the limited light qualities. Proximity to the Pacific Ocean makes the Pacific Northwest's temperate climate much milder than the extremes of cities at lower latitudes, such as Toronto and Boston. This maritime climate brings clouds that settle over the region, covering it in layers of grey that diffuse the sun into a dim, ethereal light. Although Seattle may not receive as much

Figure 8. Seattle, WA on a clear afternoon in January.

Figure 9. Seattle, WA on an overcast afternoon in January.

Figure 10. Hasegawa Tōhaku, Shōrin-zu byōbu (Pine Trees screen)

condensation as other cities such as New York, its near-constant cloud covering, accompanied by a permeating wetness of moisture and drizzle, gives the perception that it always rains in Seattle. This overcast gloom produces a particular kind of light, diffused by moisture-saturated clouds and air. Unlike the sharp shadows rendered by clear skies, Seattle's moist overhead covering yields an almost shadowless world of light characterized by a soft gradient of dim to dimmer. Surrounded by endless layers of grey water, blue mountains, and green forests, Seattle's natural beauty has always been revered as sacred by its human inhabitants. While European and American conquests may have destroyed the Native settlements that arguably established a more symbiotic relationship between humans and nature than exists today, it is no question that the current Seattleites regard their natural environment to be precious.

Despite climatic differences, the northern latitudes and overcast skies of Japan, Scandinavia, and the Pacific Northwest result in unique conditions of quality and quantity of natural light. In such northerly climates, light is a scarce and highly-valued natural force. Japanese architect Tadao Ando explains,

> I see light as being the same as nature. In the Church of Light, the light enters directly and the light embraces all the believers there. It is a form of expression for a people that have existed with nature. [...] In Nordic architecture—with [Swedish architect] Gunnar Asplund as an example—there is a lack of light. The architects are very painstaking in their treatment of light. The light in Japan is not very strong either, so when it comes to using light Nordic and Japanese architecture have something in common.[3]

3 *Kochuu: Japanese Architecture, Influence & Origin*. Dir. Jesper Wachtmeister. Perf. Tadao Ando, Toyo Ito, Sverre Fehn, Kristian Gullichsen. Solaris Filmproduktion, 2003. DVD.

Figure 11. H. Sohlberg, Winternight in Rondane

"Here in the North," describes Christian Norberg-Schulz, "the sun does not rise to the zenith but grazes things obliquely and dissolves in an interplay of light and shadow. The land consists not of clear massings and distinct spaces; it disperses as fragment and repetition in the boundless."[4] Norberg-Schulz goes on to characterize Scandinavia as "a world of moods, of shifting nuances, of never-resting forces, even when the light is withdrawn and filtered through an overcast sky."[5] He speaks of the natural landscape of the north as a web or thicket whose tight, dense interweaving nature is both closed and limitless.

The same dichotomous characters—limited and limitless—are also seen in the overcast sky as clouds enclose the earth, but also disintegrate into endless shades of white and grey. Nordic landscapes are defined by such tensions between opposing forces: shadow and light, forest and mountain, sky and sea, closed and open. In Seattle, these same tensions reign dominant in both landscape and weather. Mountains and oceans meet, woven together by dense forests and relentless hillsides. The diffused sky fades into the horizon as layers of grey clouds blends into the muted blues and greens of oceans, mountain, and forest. Even in the urban setting of the city, these interactions are present. "Nordic modernity," writes Finnish architect Juhanni Pallasmaa, "is generally characterized by a human scale,

4 Norberg-Schulz, Christian. *Nightlands: Nordic Building.* London, England. The MIT Press. 1996. pg. 1

5 Ibid. pg. 2

subtle interplay with nature, preference for natural materials and crafts [...]"[6] With this architectural and cultural emphasis on nature and light, is not difficult to imagine how Nordic and Japanese settlers felt at home in the blurred weaving of water and land of the Pacific Northwest.

2.2 INFLUENTIAL IMMIGRATION

In the late 19th century, after Seattle was founded as a city in 1851, many different cultures began immigrating to the Pacific Northwest. Two significant immigrant groups are those from Asian and Nordic countries. For many Scandinavians, the fishing and timber industries were a significant attraction as familiar ways of life and traditions, and as more Scandinavians moved out West, there were communities that preserved languages and customs. By the 1890's, nearly 25% of immigrants were from Nordic countries.[7] These strong Nordic heritages continue today, marking the Pacific Northwest with a lasting visible presence in terms of Nordic architecture, culture centers, and people.

Due to geographical ease, similar climate, and location on the coast, many Asian immigrants moved to the Pacific Northwest. Asian immigrants provided the Northwest with a much needed labor

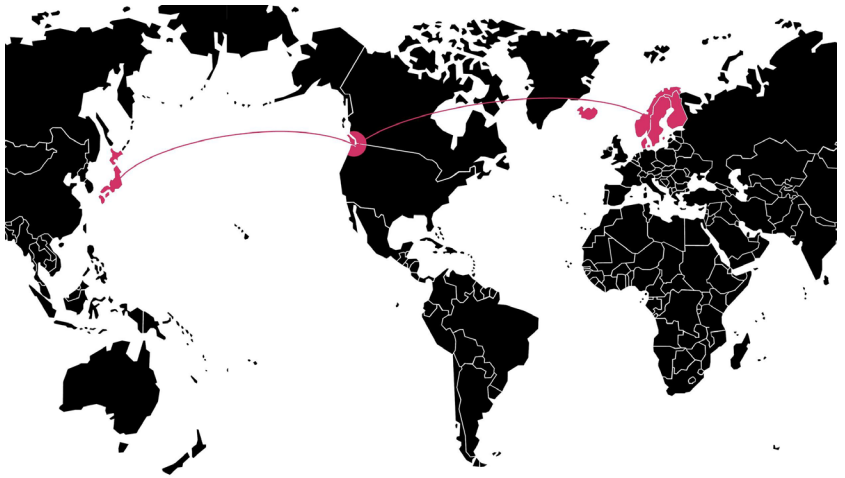


Figure 12.The Pacific Northwest in relation to Japan and Scandinavia.

source for mining and railroad development. "Indeed, without Asian labor this region would have remained isolated, undeveloped, and poor well into the twentieth century. Asian immigrants helped to create the transportation links, industries, and wealth that made the Pacific Northwest."[8] After the Chinese Exclusion Act of 1882, the Japanese population continued to grow, establishing communities in the Pacific Northwest. From about 1900 until the 1942 Japanese internment, Seattle's Nihonmachi (Japantown) was expansive and centered around 6th Street and South Main Street. Nihonmachi was crippled as nearly 7000 Seattle residents of Japanese descent were interned.

There were many other influential immigrant groups to the

6 Pallasmaa, Juhani. "The Northern Dimension: Between Universality and Locality." Modern North: Architecture on the Frozen Edge. By Julie Decker. New York: Princeton Architectural, 2010. p. 30. Print.

7 "Nordic Influence in Pacific Northwest Cities." Museum of the City. Retrieved from http://www.museumofthecity.org/project/nordic-influence-in-pacific-northwest-cities/. Accessed 15 May 2017.

8 Klingle, Matthew W. "A History Bursting With Telling: Asian Americans in Washington State." Center for the Study of the Pacific Northwest, University of Washington Department of History. Retrieved from http://www.washington.edu/uwired/outreach/cspn/Website/Classroom%20Materials/Curriculum%20Packets/Asian%20Americans/Asian%20American%20Main.html. Accessed 15 May 2017.

Pacific Northwest, and this thesis does not seek to disregard the importance of their impact. Yet due to the undeniable architectural influence of Japanese and Nordic architecture, this thesis focuses its attention on those, especially because of the architectural needs shared by the Pacific Northwest, Japan, and Scandinavia: daylighting, climate, and natural materials. Additionally, their sensibility of design reflects a sense of place, culture, and people that is inspirational and effective; there is much to learn from Nordic and Japanese examples that integrate indoors with outdoors, public and private, urban and human scales in unique ways.

Figure 13. Photo collages showing procession from outdoors to indoors in Ryoan-ji Temple in Kyoto, Japan.

2.3 A SEPARATION OF HUMANS FROM NATURE

Yet there is an inherent conflict that lies within this love of the Pacific Northwest's natural environment; how does a rapidly expanding urban center such as Seattle address the relationship between humans and nature? With the advancement of technology and infrastructure, people and nature have become more and more at odds. As cities such as Seattle grow, people improve their living conditions through housing developments, water lines, roads and streets, and farming. These human benefits have corresponding implications: dried up creek beds, paving of natural habitats, redirection of waterways, and the pollution of the oceans and forests that initially drew people to the region. "Nature thus permeates the city," writes Matthew Klingle, Bowdoin College Associate Professor of History and Environmental Studies, "co-evolving with humans who aspire and struggle to control it, blurring any clear sense of where the biological ends and the cultural begins"[9]. And so the Pacific Northwest faces the ubiquitous task of needing to preserve natural environments. These environmental issues have become severe political, societal, cultural, and architectural issues. While nature might not be a moral force in and of itself, its coexistence requires humans to make moral choices—to save the salmon, to dam rivers, to cut down trees.

The conflict between humans and nature stems from the attempt of people to dominate natural forces, which are often perceived as uncontrollable and threatening. In his book *Emerald city: An environmental history of Seattle*, Klingle argues that this dissonance results from an incorrect understanding of history based on the separate categorizations of nature and people. A cultural mindset based on a historical framework that incorrectly juxtaposes nature and culture will only do us harm. So Klingle urges us to search for and grow from a history founded on the intertwining of nature and culture. This new historical approach sees the world as unpredictable and uncertain, "as an impure and imperfect product of human actions and environmental processes through time."[10] Once we recognize and revere this fundamental connection between the two as the definition of our world, Klingle argues, only then can we develop a sustainable and equitable society. "We need a new ethic of place, one that has room for salmon and skyscrapers, suburbs and wilderness, Mount Rainier and the Space Needle, one grounded in history. We alone are responsible for the splitting nature from culture, and for injuring it and ourselves as a result."[11]

In our Western culture, one root cause of this split of nature and culture is our constructed view of man-versus-nature. Often, humans attempt to dominate natural forces because living nature cannot be controlled as can steel, wood, or concrete. Natural environments are

9 Klingle, Matthew. (2008). *Emerald city : An environmental history of Seattle* (Lamar series in western history). New Haven: Yale University Press. (pg 9)

10 Ibid. (pg xiii).

11 Ibid.

constantly changing and growing, which is seen to be a detriment to the human environment. But nature and man can coexist together. Japanese architect Kisho Kurokawa remarks:

> The thinking in Europe that has played the most significant part is dualism—from Aristotle to Kant, to Descartes and Catholicism—in thinking that, nature is in opposition to architecture. Thus, in building, nature is conquered. In the space between those opposites, there maybe something of even greater importance. So, according to Buddhism, people cannot live, separated from nature. There is a clash of interests – how can we live in harmony with nature?[12]

Kurokawa highlights an important distinction between two cultures of thought: European dualism inherently puts opposing forces at odds with each other whereas Japanese beliefs necessitate a connection with nature for the survival of man. According to Swedish architect Svere Fehn, "We [Scandinavians] do not manage enhancing nature as well as the Japanese do. It just doesn't work. We do not have Zen, nor the peace of mind to observe an almond tree in bloom, nor a flower that opens. We have much too nervous a religion!"[13] If Fehn is right, those of us whose culture is founded on European religions, like Christianity, have a constructed mental framework that does not intuitively lend itself to the spiritual contemplations of the natural environment.

While the contemporary culture of the Pacific Northwest is not united by a single religion, the city as we know it today is founded on the religions of the protestant European founders; the western dualism that has severed man from nature still permeates our city today. Yet at the same time, the people of the Pacific Northwest are united by the appreciation of the nature in which we live—mountains, oceans, and forests. How can this dualism be reconciled?

Another cause of this division is the rise of consumerism and materialism. "A shallow corporate architecture or routine pragmatism, reduced to mere visual imagery, has often replaced architecture that is rooted in place, tradition, and fundamental existential experiences."[14] As globalism and industrialization have changed the way that we conceive of culture and distance, it has also changed need to design regionally-focused architecture based on the traditions and culture of place. While extended cultural consciousness is a beneficial result of globalization, the modern rejection of architectural regionalism is detrimental. Pallasmaa states,

> But the domination of materialism and the elimination of the spiritual dimensions of life altogether represent a form of cultural erosion from within, one that can have disastrous consequences [...] This situation makes the architect's duty clear: our task if to defend the autonomy and authenticity of culture and human existential experience.[15]

While this duty to defend authenticity and human existential experience

12 *Kochuu: Japanese Architecture, Influence & Origin*. Dir. Jesper Wachtmeister. Perf. Tadao Ando, Toyo Ito, Sverre Fehn, Kristian Gullichsen. Solaris Filmproduktion, 2003. DVD.

13 Ibid.

14 Pallasmaa, Juhani. "The Northern Dimension: Between Universality and Locality." Modern North: Architecture on the Frozen Edge. By Julie Decker. New York: Princeton Architectural, 2010. p. 34. Print.

15 Ibid.

is not possible in every architectural project, Pallasmaa emphasizes the importance of the architectural ability to uphold traditions of place and culture on a deeper level. And in the Pacific Northwest, whose landscape has seen a variety of cultural groups and people from Native Americans to European and Asian settlers, a common cultural value is that of the natural environment. Even in the Pacific Northwest, where people are united by a coherent love of the outdoors and reverence for the natural environments that surround them, natural forces fall second to the built environment. Yet, despite human domination of natural elements, nature[16] still forms an essential part of the culture in Seattle. As a defining and unifying quality of the Pacific Northwest, it can and should be integrated and celebrated within the growing city.

2.4 BIOPHILIC CITIES

Harvard myrmecologist and conservationist E.O. Wilson developed a critical insight that people need daily contact with nature to be healthy and productive, and indeed have co-evolved with nature. This concept is integral in biophilia, a term Wilson popularized in the late 20th century to describe the magnitude of the hard-wired human need for connection with nature and other forms of natural life.[17] Wilson defines biophilia to be "the innately emotional affiliation of human beings to other living organisms. Innate means hereditary and hence part of ultimate human nature."[18] As hereditary, this need for connection with nature and other living organisms has developed over centuries as humans have co-evolved with their natural environments. Wilson writes,

> For more than 99 percent of human history people have lived in hunter-gatherer bands totally and intimately involved with other organisms. During this period of deep history, and still further back they depended on an exact learned knowledge of crucial aspects of natural history... In short, the brain evolved in a biocentric world, not a machine-regulated world. It would be therefore quite extraordinary to find that all learning rules related to that world have been erased in a few thousand years, even in the tiny minority of peoples who have existed for more than one or two generations in wholly urban environments.[19]

Humans, even those who live their entire life in urban environments, need to interact with natural elements on a daily basis. Professor Tim Beatley, Department of Urban and Environmental Planning, School of Architecture at the University of Virginia, argues that a biophilic city is one that highly values and cares for its pre-existing nature and seeks to develop a nature-oriented infrastructure. "At the simplest level, though,

16 Here it is important to emphasize the meaning of "nature," because it can have many different implications. For example there is a difference between "wild nature" and "constructed nature," but both are still natural products of this earth. This thesis continues to rely on the previous definition of "nature" as natural forces in relation to the built environment: harmonious physical and visual connections between indoors and outdoors by means of daylighting, air ventilation, views to the outside, use of local materials, and a tangible connection with the outdoor environment. This includes constructed and pre-existing plants, landscape, air, and daylight.

17 Beatley, Tim. *Biophilic Cities: Integrating Nature into Urban Design and Planning*. Island Press. 2010.

18 "Biophilic Cities: What are they?" Biophilic Cities Project. http://biophiliccities.org/what-are-biophilic-cities/. Web. Accessed 7 June 2017.

19 Beatley, Tim. *Biophilic Cities: Integrating Nature into Urban Design and Planning*. Island Press. 2010.

a biophilic city is a city that seeks to foster a closeness to nature—it protects and natures what it has […], actively restores and repairs the nature that exists, while at the same time finding new and creative ways to insert and inject nature into the streets, buildings, and urban living environments."[20] Yet this concept of urban biophilia extends beyond architecture and infrastructure to a people's desire and willingness to learn about their surrounding natural environments: plants, animals, habitats, etc.

Seattle has an abundance of green spaces already built into its infrastructure: parks, trees, and landscaping. Yet there is a danger of losing this focus as Seattle is growing in size and shape. As of May 2016, Seattle grew by 2.3% from 2014 to 2015, ranking it the 4th fastest growing city in the United States. Census data show that 2.3% population growth to be about 15,000 people, pushing Seattle's population to 684,451 in 2015.[21] Still, the Puget Sound Trend shows that this is not the first time the city has experienced large and rapid growth rates. "'In general, these rapid population changes have occurred over two to three years before settling back to a steadier rate of change,' the [Puget Sound Trend] report says. 'If that trend continues, we can expect another year or two of heightened population growth.'"[22] As the city hustles to build enough housing and other amenities for its growing population, there must be an effort made to uphold our connection with the natural environment.

While it is not financially nor bureaucratically feasible to change code and policy in order to ensure easily accessible parks and green spaces, green roofs, green walls, and rain gardens, we can utilize currently unused spaces to strengthen our urban connection to the natural environment. As previously established, Seattle has many urban green spaces and a public appreciation for nature. Yet, there is still much we can do to focus on mental and emotional connections to nature. For Seattle, the most relevant natures are water and light: care for the Puget Sound and an appreciation of the unique daylighting conditions that define the visual character of the Pacific Northwest.

2.5 PLACE: A PRODUCT OF SPACE AND TIME

In this discussion of place, in particular of the Pacific Northwest, Scandinavia, and Japan, the word can be used in many different ways. So what is place? How is it established and why is it important? So far this thesis has described place in terms of climate and nature. Climate refers to weather conditions over a period of time, and nature to the physical landscape, vegetation, and resources. Together, these two

20 Beatley, Tim. *Biophilic Cities: Integrating Nature into Urban Design and Planning*. Island Press. 2010.

21 Guy, G. B. (2016, May 19). U.S. Census: Seattle now fourth for growth among 50 biggest U.S. cities. Retrieved from http://www.seattletimes.com/seattle-news/data/us-census-seattle-now-fourth-among-50-biggest-us-cities/. Accessed 7 June 2017.

22 Nickelsburg, Monica. (2016, July 12). Seattle region's population growing at historic pace, making biggest annual gain in a century. Retrieved from https://www.geekwire.com/2016/seattle-regions-population-growing-historic-pace-making-biggest-annual-gain-century/. Accessed 7 June 2017.

factors determine the character of a place and how people interact with it: human ideas, customs, and social interaction are all impacted by climate and nature. While places are first experienced through physical interactions with one's environment, we form conceptions of place through our physical and emotional experience of space.

Dependent on and defined by light, our physical surroundings provide us with the framework for the setting in which we live. Materials give an even more tangible understanding of an environment, providing an haptic experience that complements the reflection, refraction, and absorption of light. When taken into account, these defining experiential factors—light, topography, vegetation, and materiality—result in an architecture that is immanently connected with the daily customs and needs of its people.[23] This is why light plays such an essential role. Light illuminates whatever it touches, defining spatial depth, color, texture, and boundaries. It characterizes a space, altering it in both mood and appearance as the quality and quantity of daylight transforms with time of day, change of seasons, and varying weather conditions. All of these are dependent on climate, making climate a determining factor in both architectural needs and human customs.

While light plays a primary role in visually understanding the spatial quality of environment, it also elicits a deeper response. The power of light lies within its ability to affect the spirit of a person, that is, the intangible feelings and intuitions that we experience as emotional beings.

And yet we cannot purely speak of light, but also of shadow for the two are interdependent; light cannot exist without shadow, nor shadow without light. They not only allow us to see where we are going and what we are doing, but also give character to a space that makes us feel a certain way. Light transforms a space to give it distinct character based on climate, weather, time, and location. Henry Plummer, Professor Emeritus at the University of Illinois at Urbana-Champaign, describes:

> These mysterious phenomena not only illuminate architectural form but also give it emotional depth, while keeping us tuned to the universe outside as well as the world hidden within us. Without the atmospheric presence of daylight, buildings might be able to support our bodies but they would never be able to sustain our spirits—something we require as human beings.[24]

Different uses of lighting and materials can make a space feel calm and peaceful, or oppressive and unsafe, or simply just dull. Throughout different daylighting conditions, the experience of a single environment varies drastically.

Place also depends on the people who inhabit it. Does a place still exist if the people who defined its spatial and emotional framework no longer are there? Klingle describes place as "the stuff of memories,

23 Norberg-Schulz, Christian. *Nightlands: Nordic Building*. London, England. The MIT Press. 1996. Pg 49.

24 Schielke, Thomas. "Light Matters: Heightening The Perception Of Daylight With Henry Plummer (Part 1)." ArchDaily. 3 May 2015. http://www.archdaily.com/626181/light-matters-heightening-the-perception-of-daylight-with-henry-plummer-part-1/. Accessed 18 May 2017.

or all the sensory delights and fears connected to particular locations in time."[25] On one level, this implies that place is a product of space and time. Yet on another more personal and subjective level, place is developed by our sense of belonging or not belonging; place is established through experience and memories built over time in a particular location. These experiences yield an emotional response, forming either a connection to or rejection of that space. This is why light is such an key defining factor of place; the daylighting and climate conditions directly influence how we experience, understand, and remember a place. Perhaps this personal experience of place is one of the defining factors of culture—a group of people come together in a space, connected by time and memory: ritual. "Place is an escapable product of change over time." Thus, argues Klingle, "Place is history."[26]

As a result of this inherent emotional and experiential framework, people become fiercely attached to certain places, fighting the inevitable change that time brings. In this way, while place is dependent on climate and nature, it cannot not exist without people and culture to define it. This is what differentiates place and space; place is an human construction of experience and memories, and space is a physical construction of natural climate and environment. "The decisive role of cultural factors," argues Pallasmaa, "arises from the fact that buildings are not solely rationally constructed shelters against the threats of the physical world; they are also mental and metaphysical constructions that reflect the existential sphere of traditions, myths, beliefs, and ideals."[27] So while climatic needs are necessary to create site-specific place, place is also a product of historical processes, influences, and aspirations that define a people's beliefs, traditions, and ideals. Without these collective and personal experiences, place is just space.

Today, Seattle is a fusion of many cultures and ethnicities; people are moving here from around the world for the booming tech industry, access to the outdoors, and urban living rich in art, food, theatre, and music. Despite the many differences we may have, an underlying love of the Pacific Northwest's natural beauty connects us. A strong culture of recycling, composting, spending time outdoors, exercise, and biking defines the Pacific Northwest, driven by Seattleites' passion for natural preservation. How can this passion be brought into Seattle's dense urban fabric? This densification is necessary in order for our city to grow and thrive, but at the same time we—as a city—need a moment to pause and reflect on what is important to us: places of nature. As we seek to find a moment of pause within the growing and transforming of Seattle, it is important to consider the place and space of the Pacific Northwest as this thesis draws inspiration from the design sensibilities of Japan and Scandinavia.

25 Klingle, Matthew. (2008). *Emerald city : An environmental history of Seattle* (Lamar series in western history). New Haven: Yale University Press. (pg 4).
26 Ibid.
27 Pallasmaa, Juhani. "The Northern Dimension: Between Universality and Locality." Modern North: Architecture on the Frozen Edge. By Julie Decker. New York: Princeton Architectural, 2010. p. 29. Print.

Figure 14. Photo collage. Kyoto, Japan.

Figure 15. Louisiana Museum in Humlebaek, Denmark

3. A Northern Experience

"**Light is an essential quality of life and architecture.** The extreme contrasts of the seasons, the extended days in midsummer and the almost constant darkness in midwinter, all sensitize people to light and its surprising variations. **Light is a delight and a gift."**

-Juhani Pallasmaa

"**Light is the origin of all being.** [...] Light is, rather, tremulous motion—out of its ceaseless transformation, **light continuously reinvents the world.**"

-Tadao Ando

3.1 LANDSCAPES OF LIGHT

Throughout Scandinavia exist a vast variety of landscapes. Denmark's soft, open landscape contains modest trees and knolls. Its gentle plains flow into the blue and grey ocean, where water seamlessly melds into sky. On the other hand, Denmark's northern neighbor Norway, is a land of mountains, divided by valleys and fjords. The vertical expanse of such a mountainous landscape merges

earth with sky. Swedish landscape is the inverse of the Norwegian; whereas Norway is one rock sliced by fissures, Sweden is a continuous landscape interrupted by mountain and hill. At the coast, water breaks up this continuous mainland, establishing the weave of water and land that characterizes the Swedish landscape. The Finnish topography, defined by the importance of the water that borders it, is an endless abyss of forest and vegetation: a place of play between wood and rock that obscures the cohesive expanse of the sky.[28] Yet while these landscapes differ greatly, they share a quality of subdued light that has defined their architectural traditions and aesthetic. The extreme scarcity of light in winter paired with the endless daylight of summer has resulted in unique lighting conditions in Scandinavia. In these Nordic extremes, light has been, and continues to be, a source of architectural inspiration and identity. "In the dark abyss of winter, daylight is critical for emotional and physical well-being, and architects have responded to this by playing with white materials to reflect light into a building."[29]

Japan is another a world of muted light. In a generally temperate climate similar to that of the Pacific Northwest, the abundance of trees and clouds filter light into a fragile luminosity. In his book Light in Japanese Architecture, Henry Plummer uses terms like "painted shadows," "cloudy translucence," and "woven air," not only qualifying natural light but also highlighting the importance of its interaction with traditional building materials. Painted shadows remembers the darkness created by the blurred boundaries formed by the gentle refraction of Japan's diffuse daylight. These inhabitable shadows, ubiquitous in traditional Japanese architecture, are less popular in contemporary architecture.[30] Cloudy translucence refers to the use of shoji screens illuminated by diluted light, creating a luminous glow that pulls light into dark interior spaces.[31] Woven air is a result of the need to screen walls and opening to simultaneous protect from natural elements, but also to circulate air and light through a space.[32] These interplays of daylight and materiality describe ways that Japan's natural environment has shaped its architecture and culture.

The unique conditions of northern climates results in various architectural responses based on materiality, light, and structure. Yet once a building is built, the materiality and structure are static; they do not shift and alter in character, quality, or strength throughout a minute, day, week, year. On the other hand, light does change, and it does so moment by moment. Any small change in the exterior environment has a powerful effect on the light inside a building. For example, a cloud passing overhead replaces the sun's illuminance with a few moments of shadow. A breeze moves through the trees outside, and their branches

28 Norberg-Schulz, Christian. *Nightlands: Nordic Building*. London, England. The MIT Press. 1996. Pg 49.
29 Plummer, Henry. (2012). *Nordic light : Modern Scandinavian architecture*. New York: Thames & Hudson. Pg 40
30 Plummer, Henry. *Light in Japanese Architecture.* Tokyo, Japan: A+U Pub. 1995. Pg 102.
31 Ibid. Pg 138.
32 Ibid. Pg 174.

shift the pattern of light on an interior surface. Every minute, the sun hits the earth at a different angle, changing imperceptibly through an hour. On a clear day, the morning sun gives a space different color, direction, and amount of light than does the afternoon sun. On the other hand, on an overcast day, the subtle change in light from morning to afternoon is often imperceptible.

Light quantity and quality changes drastically from season to season in northern climates. On the winter solstice in Seattle, the noon sun only reaches about 18 degrees off the horizon. On the summer solstice, the sun peaks at about 65 degrees off the horizon (see Fig. 18). In comparison, Tokyo's lowest sun angle is about 30 degrees and its highest is 77 degrees. In Helsinki, the lowest sun angle is 6 degrees and its highest is 53 degrees.[33]

Light is a defining factor in culture and architectural space. It not only creates space, but also allows humans to be conscious of their relationship with nature. "For such reasons," says Ando, "I view as profound the role of natural light, which can speak to us—at any point in our built environment—with remarkable immediacy of 'place' and 'time.'"[34] There are several techniques in which Japanese and Nordic architects have used to form space with light, based on various materials, constant movement of the sun, change in weather, and

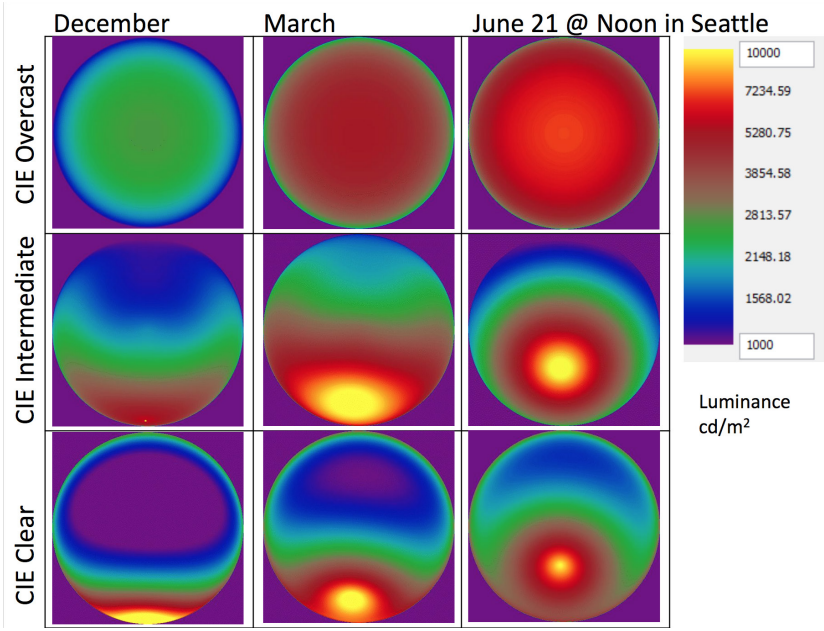


Figure 16. Diagram courtesy of University of Washington Professor Mehlika Inanici.

the ability to control light through architecture. In the words of Tadao Ando,"The creation of space in architecture is simply the condensation and purification of the power of light."[35] Light gives, with each moment, new form to being and new interrelationship between things, and in doing so connects a space's human inhabitants with the reality of the natural world outside.

33 NOAA Sun Calculator. Retrieved from https://www.esrl.noaa.gov/gmd/grad/solcalc/azel.html. Accessed. 15 June 2017.

34 Co, Franceso Dal. "Light." *Tadao Ando: Complete Works*. London: Phaidon Limited, 1995. pg 470. Print.

35 Ibid.

Figure 17. Collage of photographs from Ryon-ji Garden in Kyoto, Japan.

Within seconds, the sun emerges from behind a cloud at Ryon-ji Garden. On the left, the sun is hidden by clouds, covering the garden in a soft blanket of diffused light. On the right, the sun transmits the external natural environment into the garden through patterns of light and shadow.

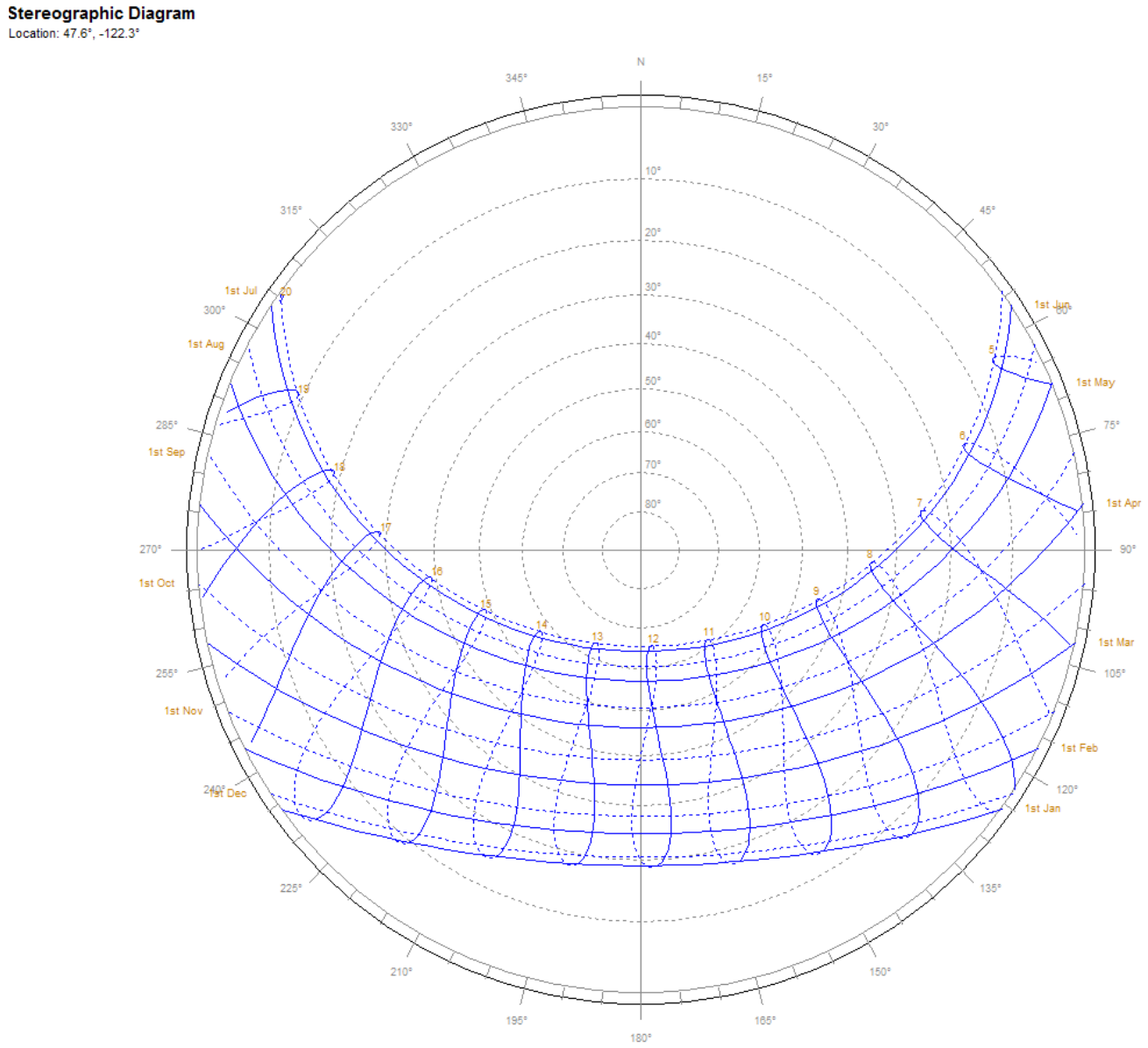


Figure 18. Stereographic Diagram showing sun path, altitude, and angles in Seattle, WA.

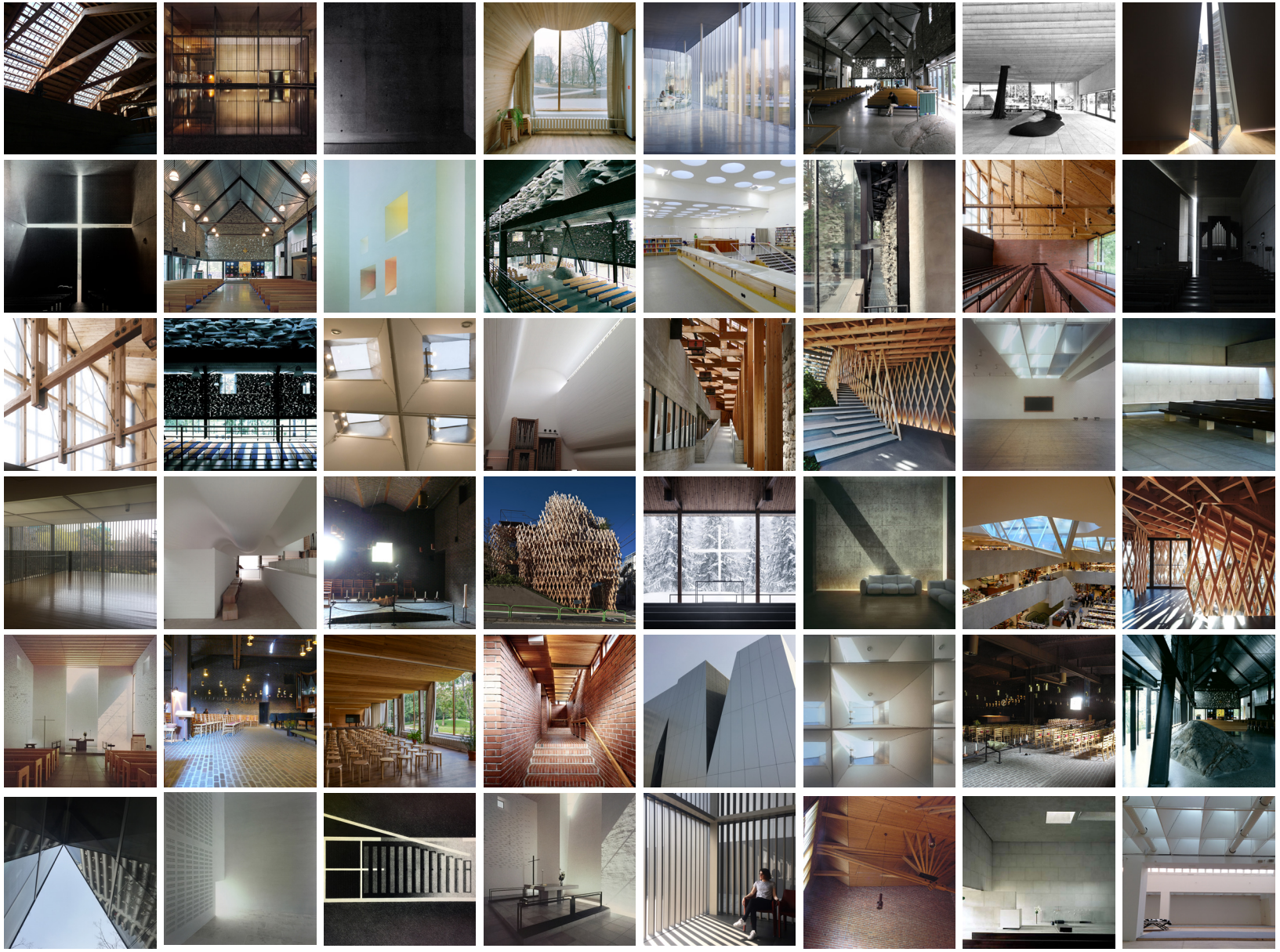


Figure 19. Diagram of case studies in Japanese and Nordic design.

QUALITIES OF LIGHT

While traveling in Japan and Scandinavia, the buildings visited and studied are examples of how architectural form manipulates light. Through the study of these buildings, this thesis proposes 4 categories that describe different qualities of light: Filtered Light, Diffused Light, Sculptural Light, and Absence of Light. These Qualities of Light provide a framework for understanding the relationships between architectural form, material, and natural light.

This chapter explores each Quality of Light, examining the way each case creates different experiences of light with varying building form and material.

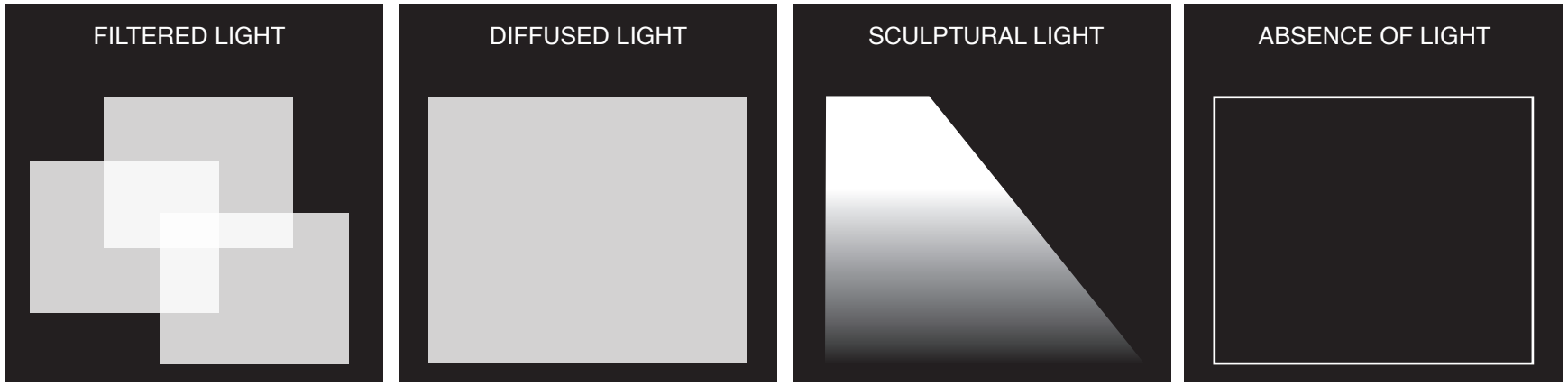
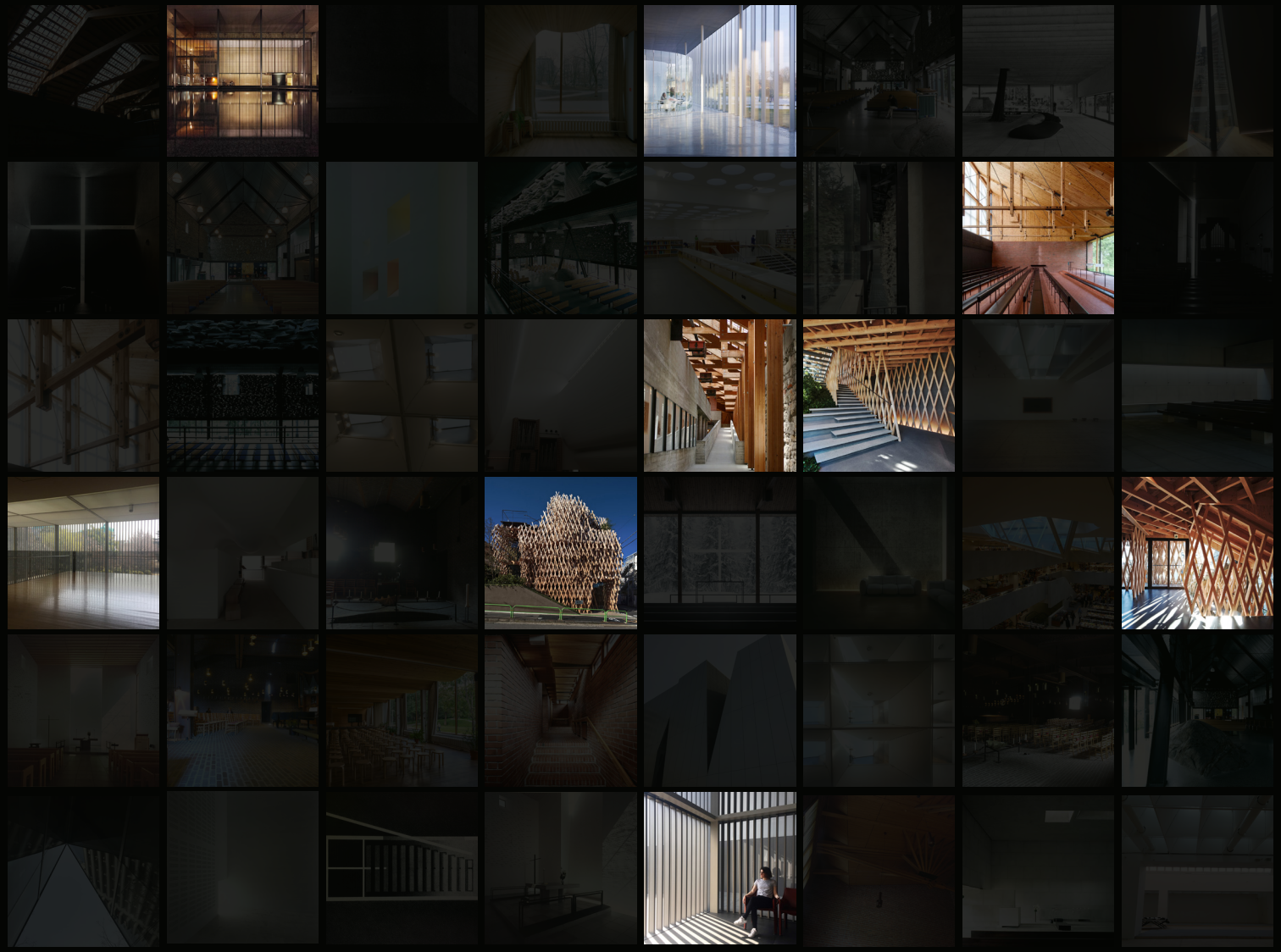


Figure 20: Diagram of Qualities of Light.



3.2 FILTERED LIGHT

Definition: The sifting of natural light through layers of forms or material.
Technique: Layered materials and form reveal and conceal light and view.
Result: Layers of transparency that dissolve light into varying levels of intensity.

A traditional building material that Scandinavia, Japan, and the Pacific Northwest share is wood, due to prevalent resources. The tectonics of this material were often obscured in the darkness of rafters where light could not reach. But today, natural light often reveals and displays this structure.

The Nordic tradition of heavy stone masonry contrasts the lightness of a tectonic wood frame. A contrast between light and shadow can emphasize the character and nature of each material, and in doing so abstract the natural world outside: just as trees grow from the earth, so does a wooden frame extend from a stone base.

Traditional wood construction techniques lend themselves to a strong connection between exterior and interior. Norberg-Schulz remarks that "Nordic built work does not stand as an independent body but opens toward the environment, simultaneously absorbing it within."[36] This fluid connection between indoor and outdoor is also a defining characteristic of Japanese architecture. Japanese architecture blurs the boundaries between indoor and outdoor spaces, with thresholds defined by cantilevered platforms and overhanging roofs. These thresholds create spaces that are neither wholly indoors nor outdoors, but instead a mixture of both. Even when outdoors, in a controlled and omnipresent Japanese garden, one gets the feeling of being indoors. The trees act as overhanging roofs, floating above head and protecting from rain or daylight.

36 Norberg-Schulz, Christian. *Nightlands: Nordic Building*. London, England. The MIT Press. 1996. Pg. 197

Interior spaces of traditional Japanese buildings evoke the qualities of the natural forces that make them, an experience that relies on materiality. When inside a traditional Japanese house, the cold wood and tatami mat mimic the play between rock and moss that one experiences in a Japanese garden. The daylight filters through shoji screens as it would trees and clouds, resulting a dim and fragile illumination. The air infiltrates the boundaries of the house, mimicking the exterior atmosphere. These materials and experiences speak to the distinct climate and landscape of Japan; the spatial qualities created from Nordic light and materials are unique to the climate and landscape of Scandinavia. The similarities in daylight and climate connect the two to each other and to the Pacific Northwest, as well as the authenticity to natural forces.

> While every culture builds its landscape to some degree, few have transmuted their skies in architecture so beautifully as Japan. Traditional wood buildings in this country remember the genius loci of terrain and forest, but also 'gather' in a Heideggerian sense their damp skies and soft, peaceful light.[37]

These interior spaces—not quite inside nor outside—are cool, quiet, and peaceful. Like being in a forest on a cloudy day, these traditional Japanese buildings are not only made from natural forces, but recall them which such clarity that they could easily be mistaken for the authentic elements of tree and sky themselves.

37 Plummer, Henry. *Light in Japanese Architecture*. Tokyo, Japan: A+U Pub. 1995. Pg 138.

Figure 21. Otaniemi Chapel.

Otaniemi Chapel

Espoo, Finland
Heikki and Kaija Siren

The simple rectilinear building is bounded by 3 concrete walls on the south, east, and west sides. The north wall is entirely glazed, encased by a thin black frame. This glass wall seems to disappear, dissolving into the forested exterior that makes up the altar of the chapel, and also frame the natural altar. Outside of the building, just beyond the glass, is a thin white cross framed by the trees that surround the building. The diffuse northern light dissolves into the building, falling gently onto the brick floors, walls, and wood ceiling.

The brick walls stop about halfway up the walls; on the east and west, the walls continue in vertical wood slats. An elegant truss system of wood members and steel bracing rises up away from the altar to meet the southern translucent opening. The contrast of the southern illumination above and shaded brick below emphasize both the lightness of the wood truss ceiling and the heaviness of the brick masonry.

Left: Figure 22. Otaniemi Chapel structure.

Below: Figure 23. Otaniemi Chapel interior flow seamlessly into exterior.

Left: Figure 24. Sunlight patterns in SunnyHills.
Right: Figure 25. Wood lattice structure in SunnyHills.

SunnyHills

Tokyo, Japan
Kengo Kuma

The Tokyo SunnyHills store evokes the bamboo baskets of Taiwan, where its famous pineapple cakes originate. The wood lattice facade provides structural support for vertical and contortion loads. From outside, it appears to be a thick forest of wood that obscures the building interior. Yet from the inside, sunlight filters through the latticed web, an abstraction of dappled shadow on a forest floor. The shadow of the structural members falls on the floor, shifting with the time of day and dissolving as clouds obscure the sun.

The Hedmark Museum

Hedmark, Norway
Sverre Fehn

The Hedmark Museum is another example of a solid concrete and stone foundation that supports a wooden frame. This frame opens up to large skylights that light up the wooden beams and trusses, highlighting them against the solid mass of the concrete and stone below. In the darkest places, for in this museum darkness is another big player, these skylights are bright moments of relief that contrast the black shadow. Here, not only is the wood roof structure celebrated, but the layers of mullions and thing beams filter the daylight into play of dappled light and shadow.

Figure 26. Skylights. Photo courtesy of Peter Cohan.

Figure 27. Natural light illuminates a hallway, highlighting the wood framing and concrete and stone walls.

Dybaeker Church
Silkeborg, Denmark
Regnbuen Arkitekter

These materials have another character—an unpolished roughness that catches light and pools of shadow. The inherent push and pull of a brick wall plays with the light that skims across it, producing a textural quality that changes with time of day and quality of light. In Dybkaer Church, the walls are painted white bricks. The bricks of the wall behind the altar are subtly irregular so that very slight changes in daylight produce different visual experiences. On a clear, sunny day, the irregularities of the wall are emphasized by sharp shadows. On an overcast day, the filtered daylight is softer, caught in graduated shadows on the wall's imperfections.

Figure 28. Direct sunlight grazes the brick wall at the altar of Dybaeker Church.

Figure 29. The deep clerestory windows create a repetition of light that leads toward the altar, where a volume of light descends from above.

Figure 30. View looking outside from upper mezzanine.

Figure 31. Sunlight is filtered through structural mullions in the double-height foyer.

The Gallery of Horyuji Treasures

Tokyo, Japan

Yoshio Taniguchi and Associates

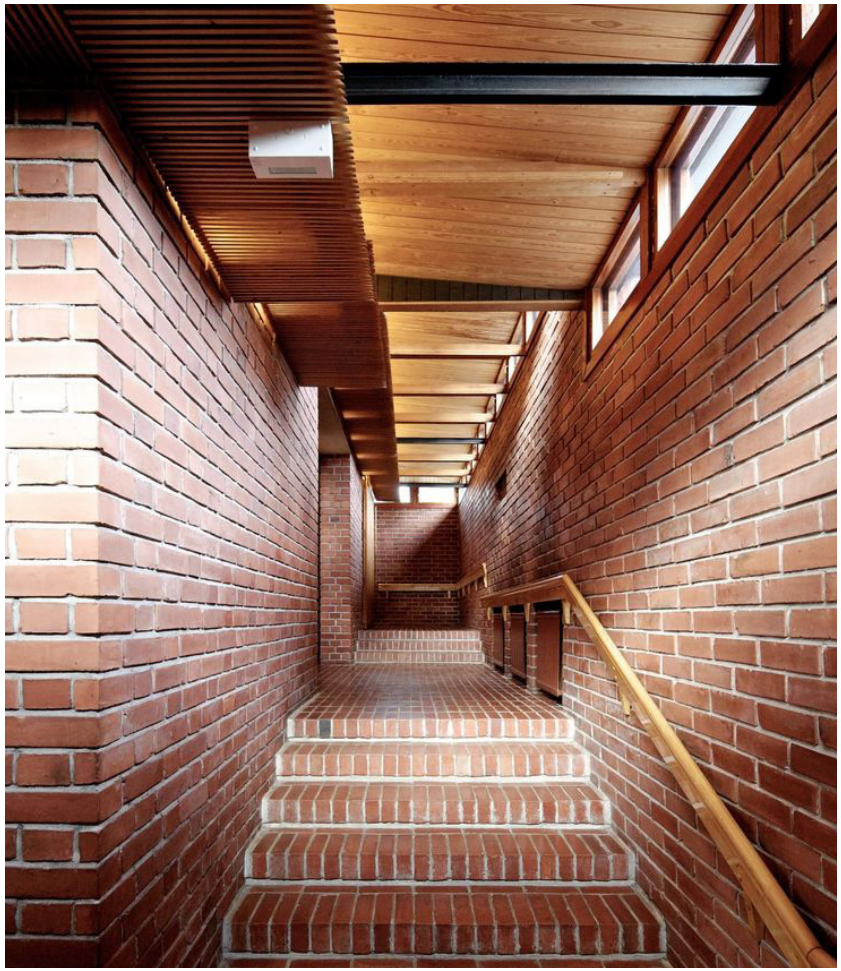
The barrier between outdoors and indoors disappears; the only separation is a rigorous wall of structural mullions that filter light and view from the water outside onto the concrete and wood floors within. On the entry level, the concrete floor catches the shadowed repetition of the fin-like columns, accentuating the structural pattern. On the mezzanine level, the glossy wood floor mimics the play of light and shadow, reflecting color and shade as would a watery surface. As one enters into the museum, the filtered light dissolves as the rich darkness of the exhibits envelopes the user. The shadowy depths are not to be avoided, but to be inhabited and explored as moments of reflected and direct light guide one through the galleries.

Above: Figure 32. Ceiling wood beams and trusses of inner council hall.
Right: Figure 33. Procession through brick hallway from day lit exterior into town hall.

Säynätsalo Town Hall

Säynätsalo, Finland
Alvar Aalto

In the Säynätsalo Town Hall, a winding hallway circulates around the central council room. This brick hallway orchestrates a journey from the day lit exterior to the dark interior, leading the body and eyes through space that slowly restricts light. The mass of brick seems to be carved away by the clerestories windows, the brick walls pushed apart by lateral wood boards illuminated by the bright daylight. The obscured source of light comes from above, giving the impression



of being in an underground cave. Once into the inner council hall, the engulfing darkness is lifted up by clerestories that illuminate the spider-like wood trusses above. The carefully admitted daylight emphasizes the materiality and structure of the brick floor and load-bearing walls on top of which floats the tectonics of wood beams and trusses.

Mortensrud Church

Oslo, Norway

Jensen & Skodvin Arkitektkontor

Left: Figure 34. Light filters through stone wall lifted by a wall of glass.
Right: Figure 35. Window, mullion, and column detail.

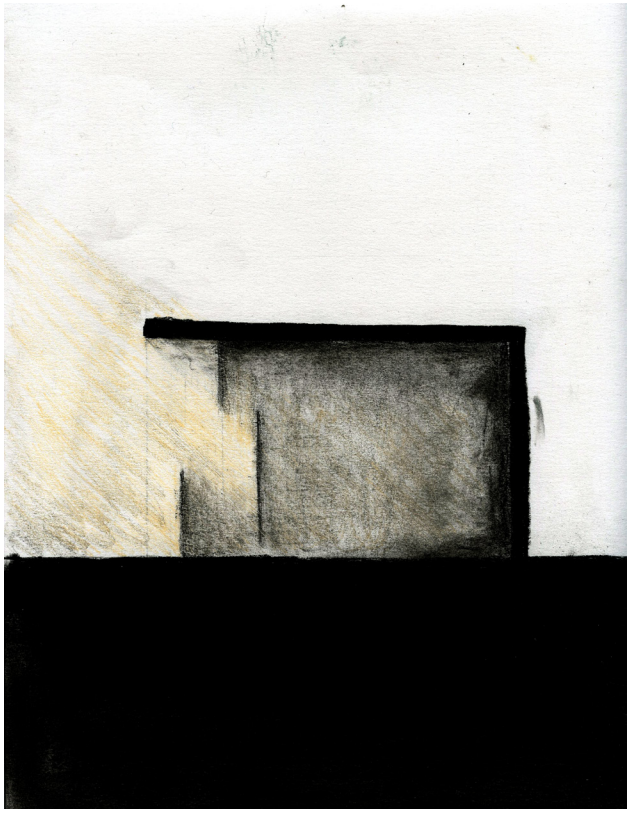
Built on a tight budget, Mortensrud Church was designed with conventional Norwegian techniques and materials. A metal frame lifts the building off the ground, allowing views out to the trees and landscape through a glazed perimeter wall. On top of the metal frame sits a structural stone wall. Instead of mortar, the stones are stiffed with horizontal steel plates between columns every meter.[38]

Upon entering the church, a heavy darkness floats overhead, distinguished by specs of light that glitter through the stone. The absence of mortar allows light to filter through the stones, revealing the method of construction. The light that enters from the void underneath the stone wall exposes the rigor of the steel columns and beams, which juxtapose the random sparkle of the stone. Daylight reflects off the metal roof, distinguishing its physical lightness from that of the heavy stone wall.

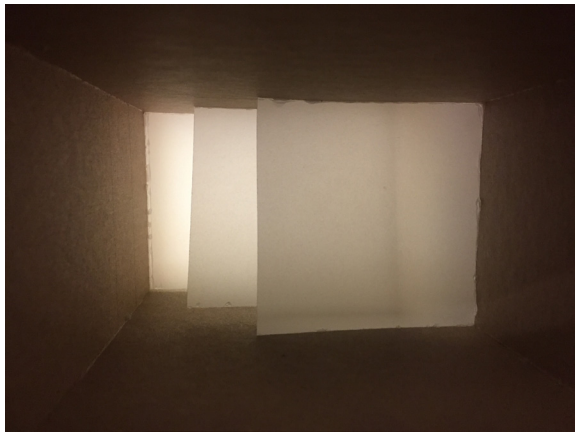
38 *"Mortensrud church / JSA" 31 Aug 2011. ArchDaily. Retrieved from https://www.archdaily.com/1929/mortensrud-church-jsa/. ISSN 0719-8884. Accessed 15 May 2017*

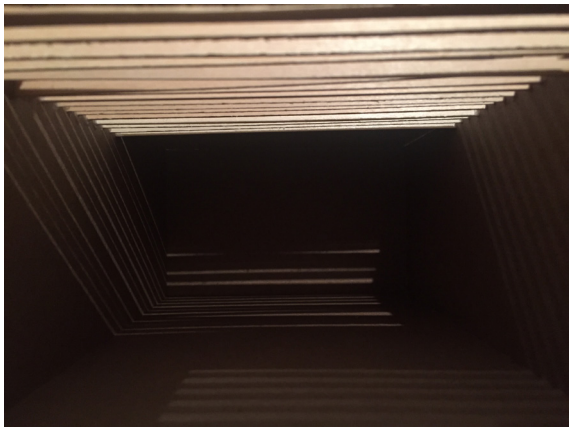
Physical study models and charcoal drawings were made to further explore each Quality of Light. These studies were an essential step in this thesis, and many of these models and forms evolved throughout the quarter to the final developed design.

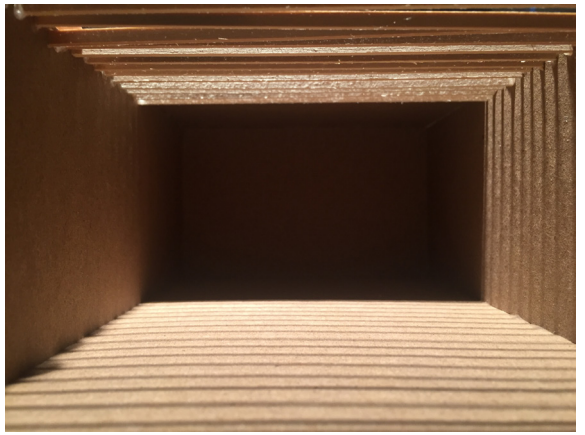
Figures 36 and 37 explore filtered light through layers of translucent material. Figures 38, 39, and 40 investigate how form can filter light.

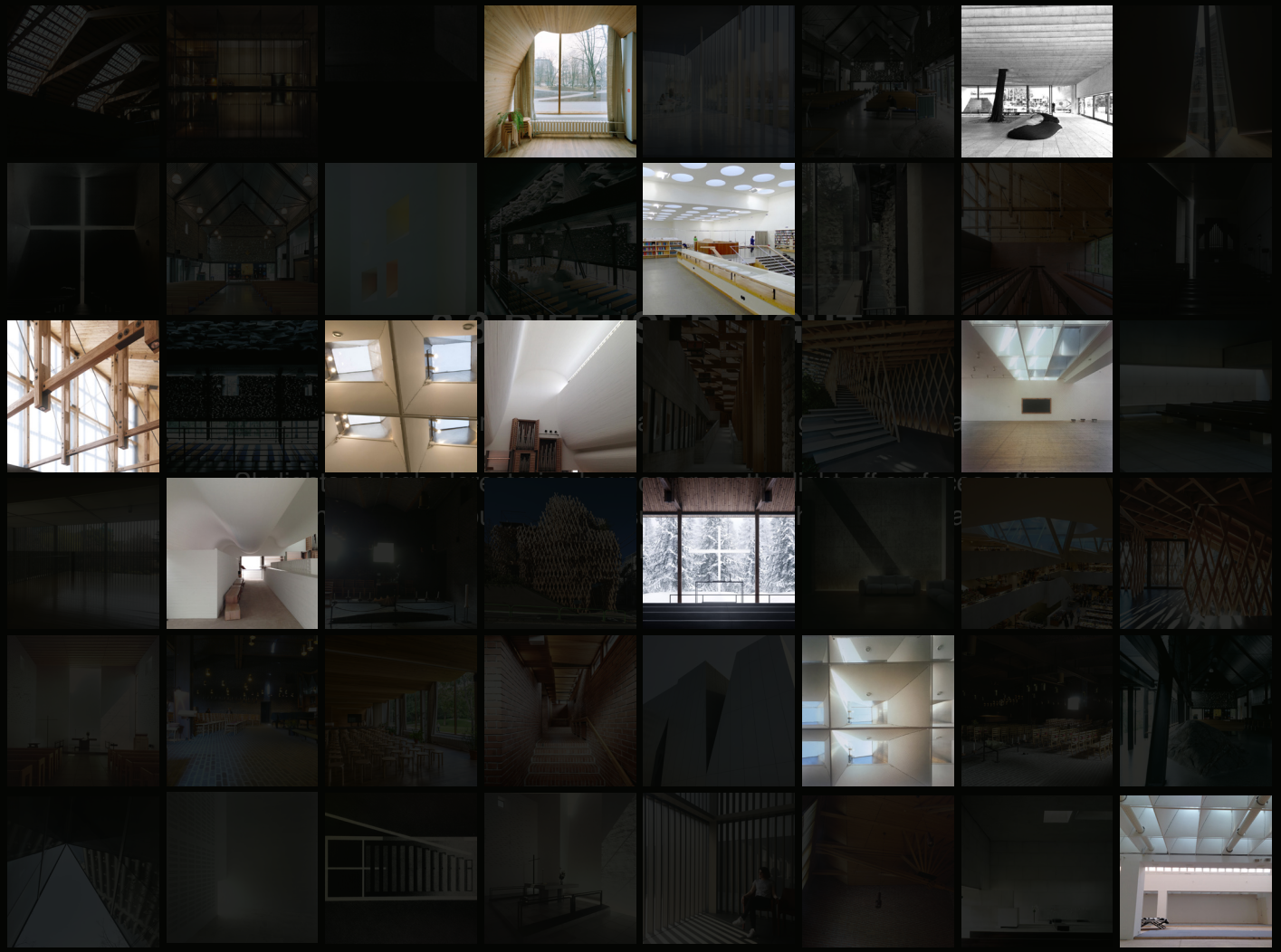


Clockwise from top left:
Fig. 36. Charcoal drawing of Filtered Light
Fig. 37. Charcoal drawing of Filtered Light
Fig. 38. Filtered Light model photo
Fig. 39. Filtered Light model photo
Fig. 40. Filtered Light model photo









3.3 DIFFUSED LIGHT

Definition: The even distribution and softened glow of natural light.
Technique: Skylights or high clerestories bounce or scatter light off surfaces, often obscuring the light sources of the sun and sky.
Result: Evenly distributed natural light.

In northern climates, natural light is most often filtered through clouds and condensation. Lacking the strong rays of southern climates, this diffusion of light eliminates shadows by smoothing contrasts into a continuous gradient. This even light is well-suited for places like museums and libraries, where people need to see without glare and direct light. During most of the year, this naturally diffused light is welcomed without hesitation, its fragile dimness maximized for illuminance. In order to gain the most of this limited resource, Scandinavian architects have learned to shape a building based on access to daylight. "The simplest technique that satisfied these needs," explains Plummer, "was the molding of the building's overall mass in response to the course of the sun, stretching and folding the envelope into carefully directed channels that would behave as funnels."[39] In doing so, building form reflects the north's low winter sun angles to maximize heat gain and even distribution on overcast days.

Besides building orientation and form, the ability to bounce diffused light into a space depends on materials and color: smooth, reflective, and light-colored surfaces will spread the weak light throughout the space more effectively than will a rough and dark material.

Yet on clear days, when the sun shines directly through windows and openings, the experience of these spaces is completely different. The direct light replaces the even diffusion with sharp shadows and defined sun angles. In some spaces, this sparkle and play are celebrated; in others, the glare is high levels of luminance make the space nonfunctional. In such situations, direct sunlight can be diffused by building form in order to achieve the same effects as a northern cloudy climate.

39 Plummer, H. (2012). *Nordic light : Modern Scandinavian architecture*. New York: Thames & Hudson. Pg 204.

Bagsvaerd Church
Copenhagen, Denmark
Jorn Utzon

In Jorn Utzon's Bagsvaerd Church, a white concrete ceiling billows up, curving and swirling toward the altar. The white produces an ethereal quality, which not only reflects daylight down into the space but also represents the heavenly. The high, clerestory window brings light into the building, bouncing it off the curved ceiling into the space below. The undulating ceilings collect light and redistribute it throughout the room.

This diffused light eventually reaches the concrete—either painted white or left bare—gathers the light into an ambient glow that creates a calm, contemplative space.

Figure 41. Light collects in the undulating curves of the concrete ceiling.

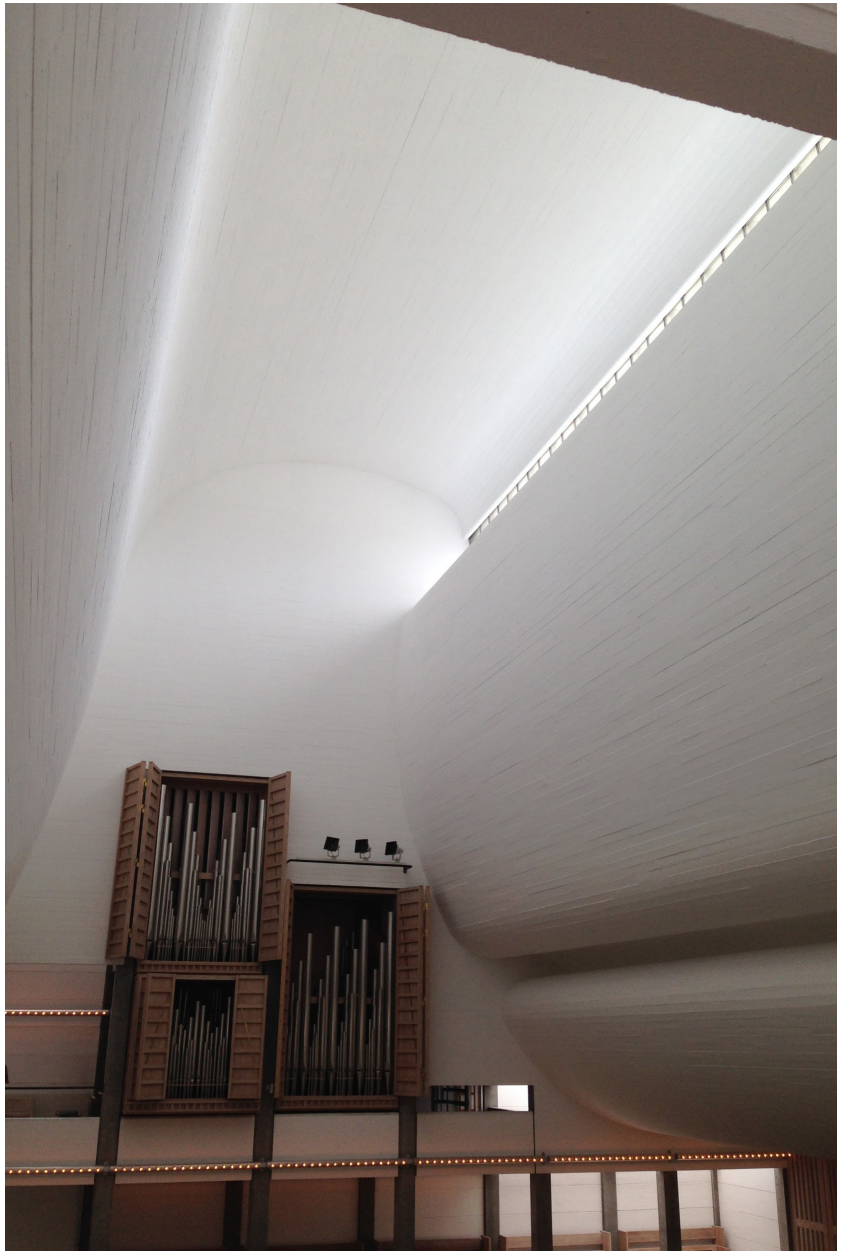
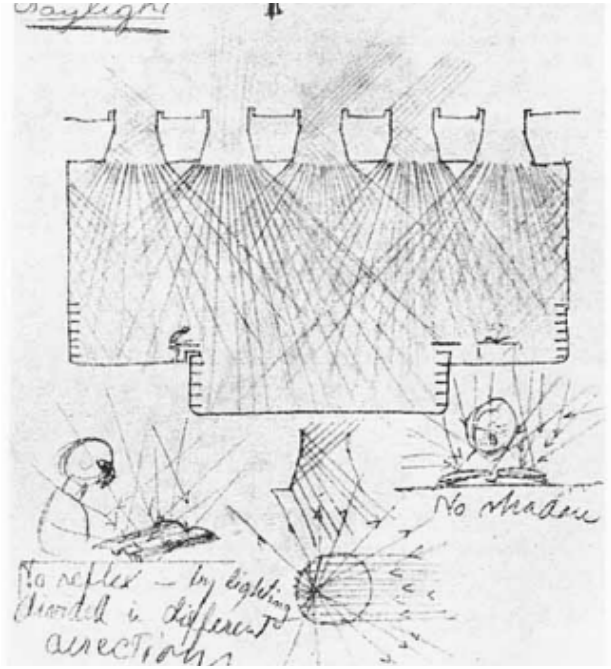


Figure 42. Curving concrete walls bring the light from the clerestory windows down toward the altar.



Left: Figure 43. Looking toward the central circulation desk.
Right: Figure 44. Diagram of the paths of light rays.

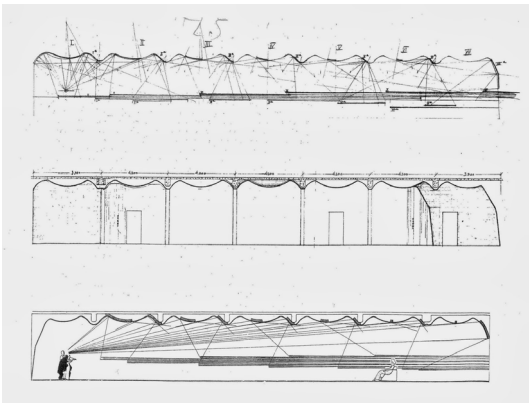
Viipuri Library

Vyborg, Russia
Alvar Aalto

Finnish architect Alvar Aalto was innovative in his explorations of architecture as an optical instrument. A master of architectural form and light, Aalto's influential forms convert natural light from just an illuminating substance into a medium that defines spacial quality and character.

In Viipuri Library, Aalto's study of skylights yielded a simple yet revolutionary solution to attain even distribution of natural light, diagrammed in his sketches below. In the same way that physicists draw flowing light, Aalto used spreading lines to study the paths of incident rays, showing how radiation was caught within the apertures and then widely dispersed to land even on surfaces below.[40] The drums were shaped to catch every sun angle, from winter to summer solstice, so that no direct light could reach the building interior. With this technique,

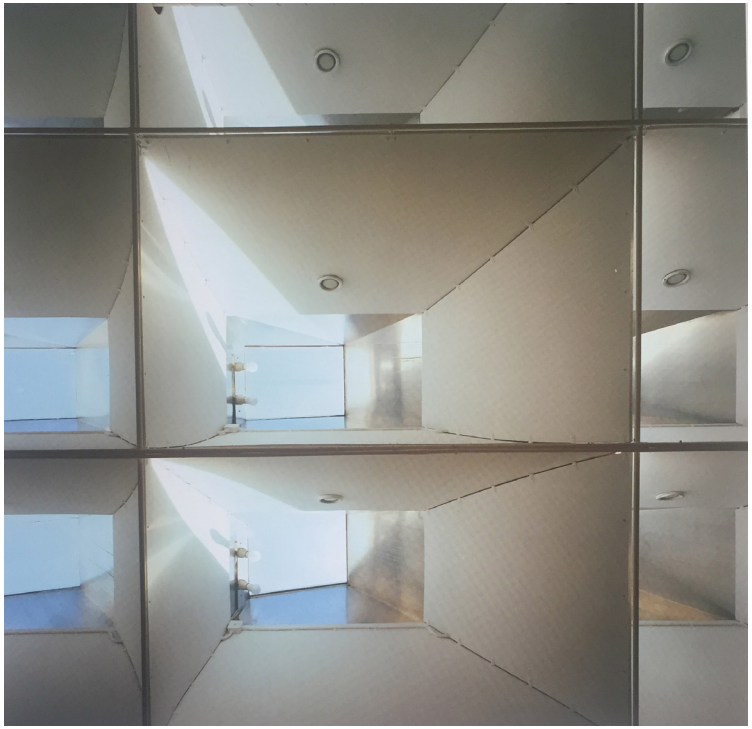
40 Plummer, H. (2012). *Nordic light : Modern Scandinavian architecture*. New York: Thames & Hudson. Pg 205



Left: Figure 45. The restored lecture hall.
Right: Figure 46. Trajectory of sound in the lecture hall.

Aalto was able to optimize light distribution for the library. Aalto further enhanced the visual perception of even distribution by rounding the interior edge of the light well and thus softening the contrast between the inside of the light well and the surface of the ceiling.

The auditorium space was designed with a similar tactic for sound, but the sinusoidal ceiling also catches light. As shown below, the sinuous roof surface is shaped to direct sound waves for an even distribution. As an auditorium with different lighting needs, the natural illumination comes from floor-to-ceiling windows. The wooden roof catches the light as it curves, creating a rhythmic procession that leads the eye toward the stage at the end of the room.



Left: Figure 47. Konsthall on an overcast day in March.
Right: Figure 48. Light bulbs in baffled skylights.

Malmö Konsthall

Malmö, Sweden
Adam Caruso

In the Malmö Konsthall the baffled skylights produce a similar quality of diffused light as the skylights in Aalto's Viipuri Library. The baffles are angled to catch all angles of sunlight throughout the day and year, resulting in an even distribution of light on both overcast and clear days. Inside each baffled skylight are two small light bulbs that either mimic daylight when light is nonexistent, or supplement it when it is weak. Adjacent to this top-lit space is a taller area lit by clerestory windows. This allows for varied program that needs taller ceiling height and more direct side light.

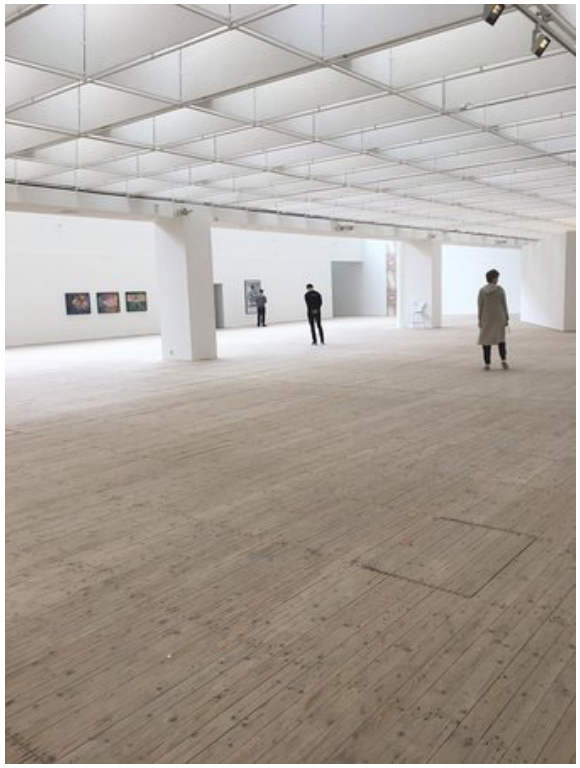
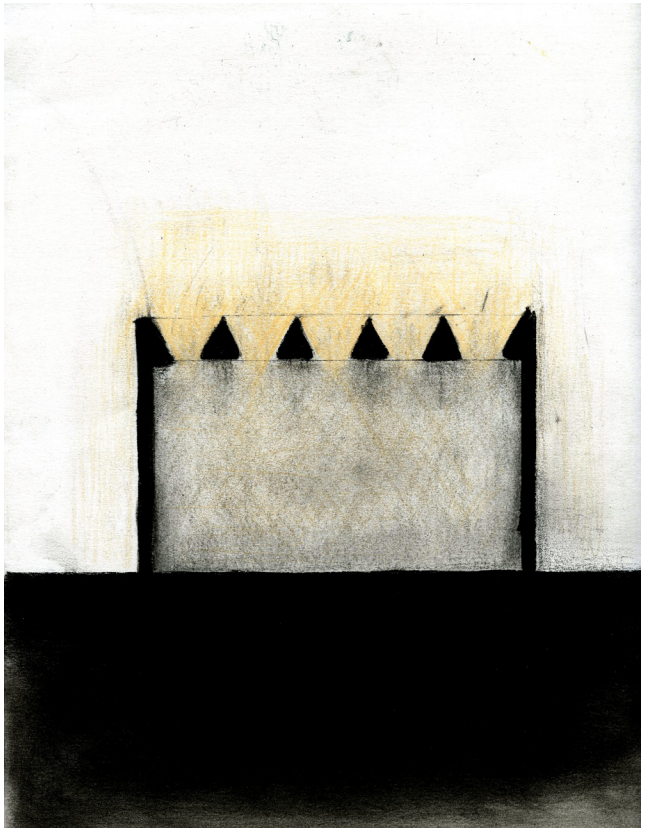


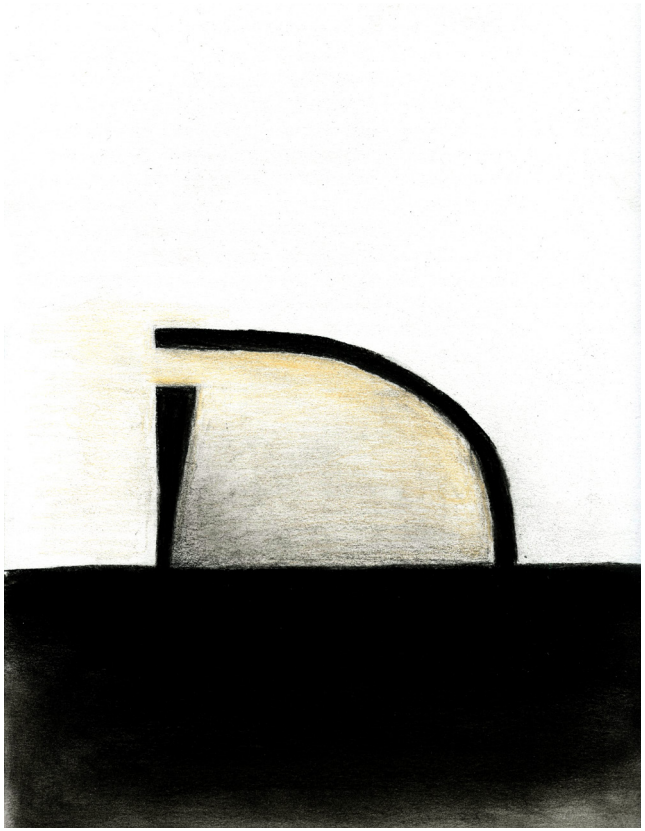
Figure 49. Diffused light in the gallery on an overcast day.

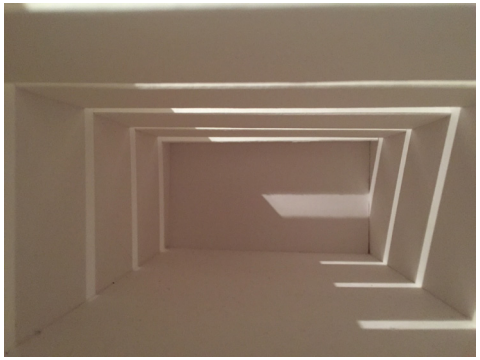
Figure 50. Diffused light in the gallery on a clear day.

Figures 51, 53, and 54 explore diffused light through long, slanted light wells. The repetition of the wells is displayed in the striped pattern of light on the ceiling, but as the light bounces off the slanted surfaces it reaches eye level in an even distribution.

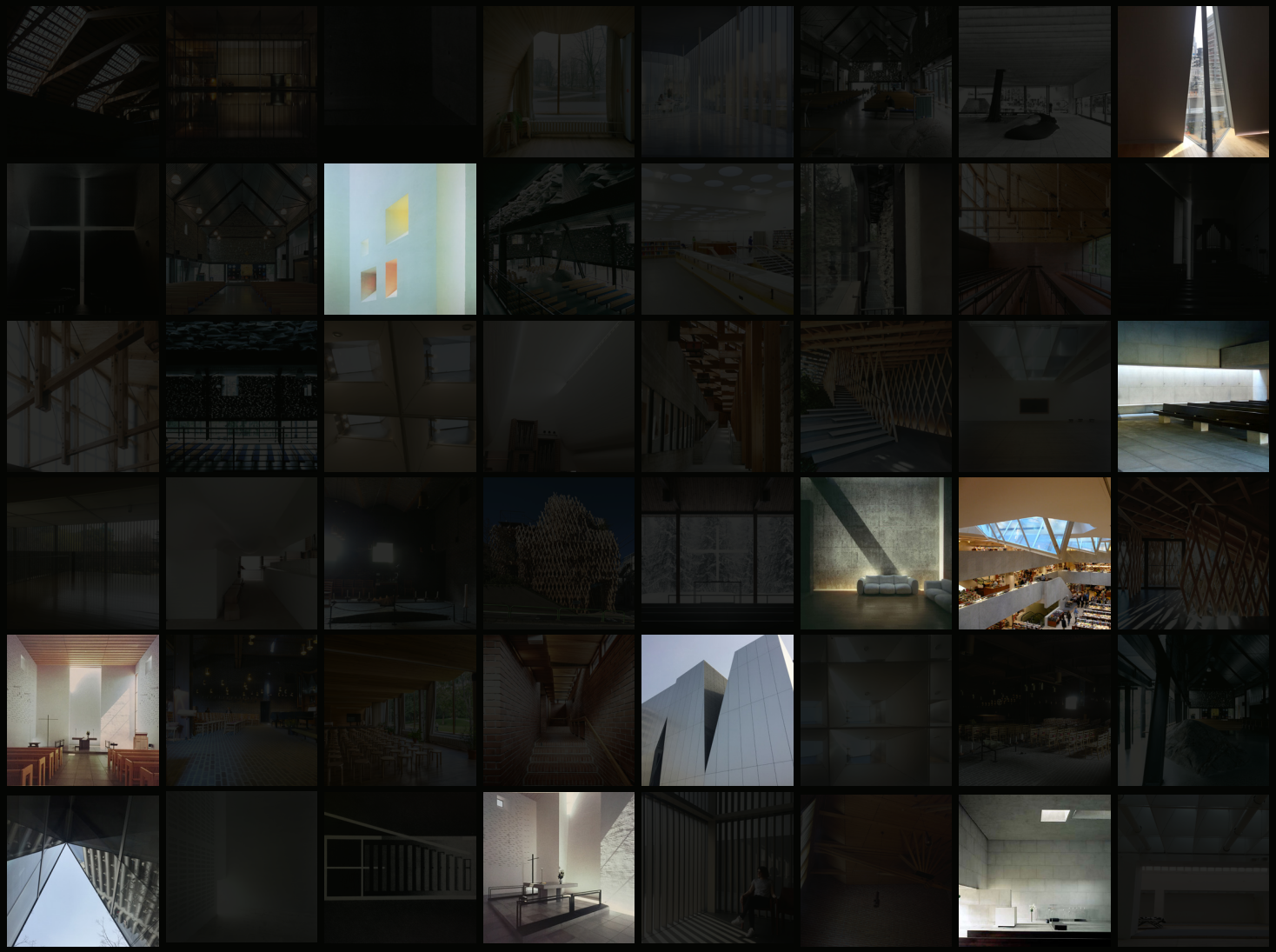
Figures 52, 55, and 56, investigate a curved ceiling form that catch light reflected off a light shelf. The result is a glow of light that dissolves into an even distribution.







Clockwise from top left:
Fig. 51. Charcoal drawing of Diffused Light.
Fig. 52. Charcoal drawing of Diffused Light.
Fig. 53. Diffused Light model photo.
Fig. 54. Diffused Light model photo.
Fig. 55. Diffused Light model photo.



3.4 SCULPTURAL LIGHT

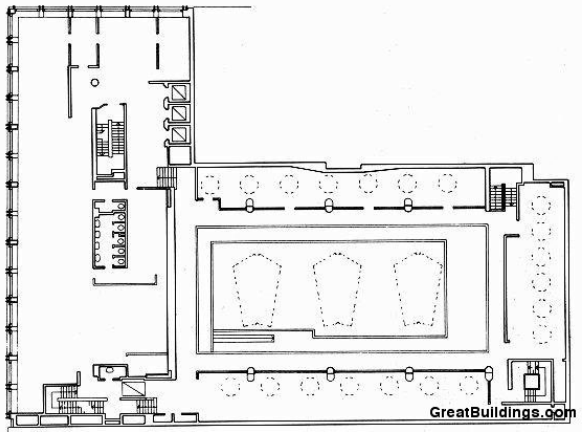
Definition: The molding of light into distinct volumes and shapes.
Technique: Large, channeled openings in thick walls or with deep apertures.
Result: Carved forms of light that create distinct shapes while scattering ambient light throughout the room.

When natural light is so scarce and fragile, so are the distinct volumes of light produced by direct daylight. Yet, with thick walls and deep apertures as wells that capture light, a building can create these volumes of natural light even on an overcast day.

Sharp edges between an aperture and the interior of the building will sculpt light into a distinct form, creating a volume of light that is at once empty and full. On the other hand, the surface of an opening that transitions smoothly into the building pulls the light with it into a soft cascade of light that dissolves into a building.

Additionally, some glass apertures literally carve into a space, bringing natural light with them. These light sculptures take the form of the angular glass openings, which are constant volumes of light in the space. However, as the sun moves throughout the sky the light they emit dances across walls and floors, creating ephemeral light sculptures that constantly change in shape and strength.

In all cases, building form manipulates light into sculptures and volumes that both illuminate and inspire.



Left: Figure 57. Skylights bring light into the bookstore. Courtesy of Peter Cohan.
Right: Figure 58. Plan of bookstore showing above skylights dashed.

Academic Bookstore

Helsinki, Finland
Alvar Aalto

Sculptures of light hang from the ceiling of Aalto's Academic Bookstore in Helsinki. Here, the light itself becomes an object on display, showcasing the various levels of brightness and shades of color that occur through the day and year. In this photo, the light from outside renders a cool blue against the yellow warmth of the interior electric lights. The dramatic skylights literally pull daylight into an otherwise cave-like space, embodying the conditions of the natural world above. Weather and time give these light sculptures a dynamic quality that is constantly changing, informing the inhabitants of the world outside. Here, light is not only a way to illuminate the bookstore, but also an object to observe and a connection with the obscured natural environment.

Church of the Light

Osaka, Japan
Tadao Ando

In this world of pitch blackness, a cross of light floats at the altar. The light fills the concrete void and becomes a physical symbol of nature. The shadows change in sharpness and direction with the time and weather, providing the inhabitants with a small connection to the natural world in this pure box of darkness. In this abstract space of floating masses, darkness, and light, the entire physical world disappears into a cosmic one of contemplation and reflection—all but the light of the cross.

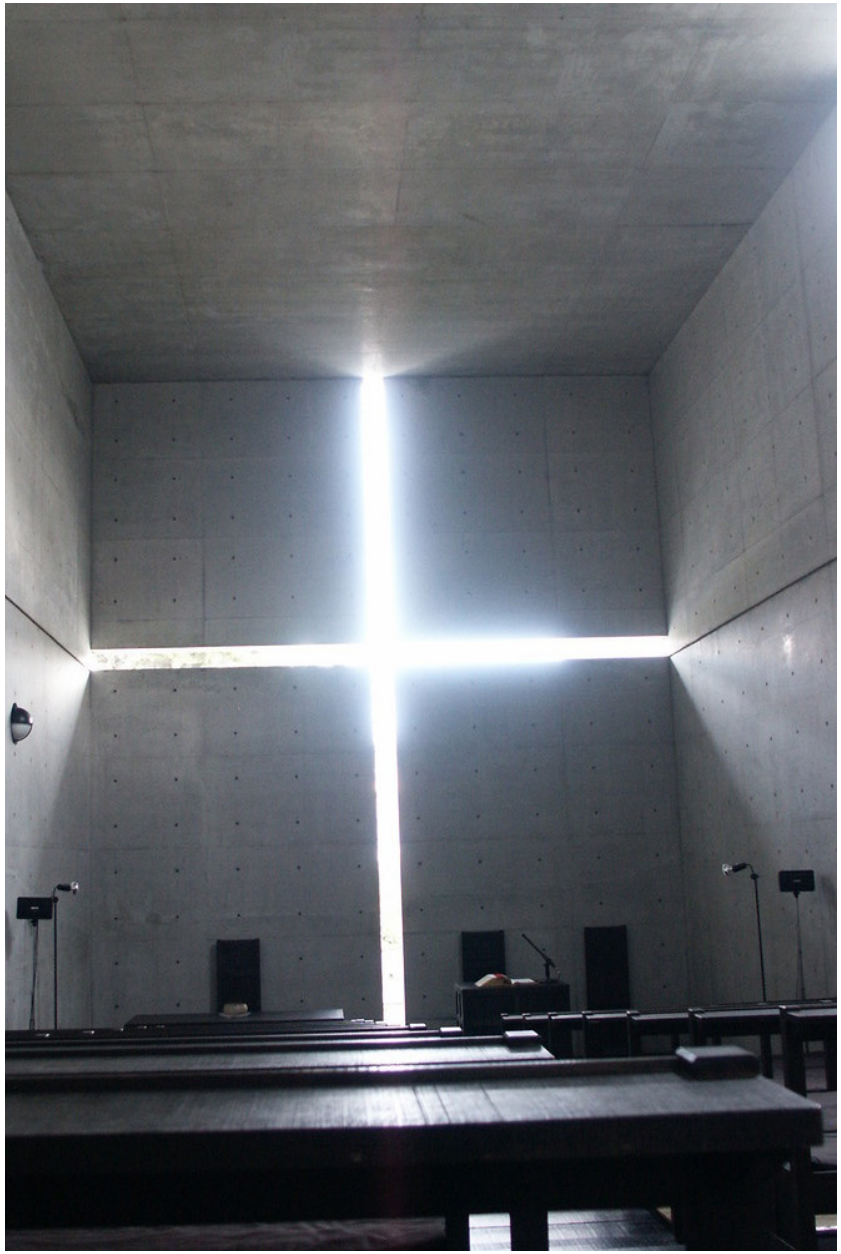


Figure 59. A cross of light defines the altar.

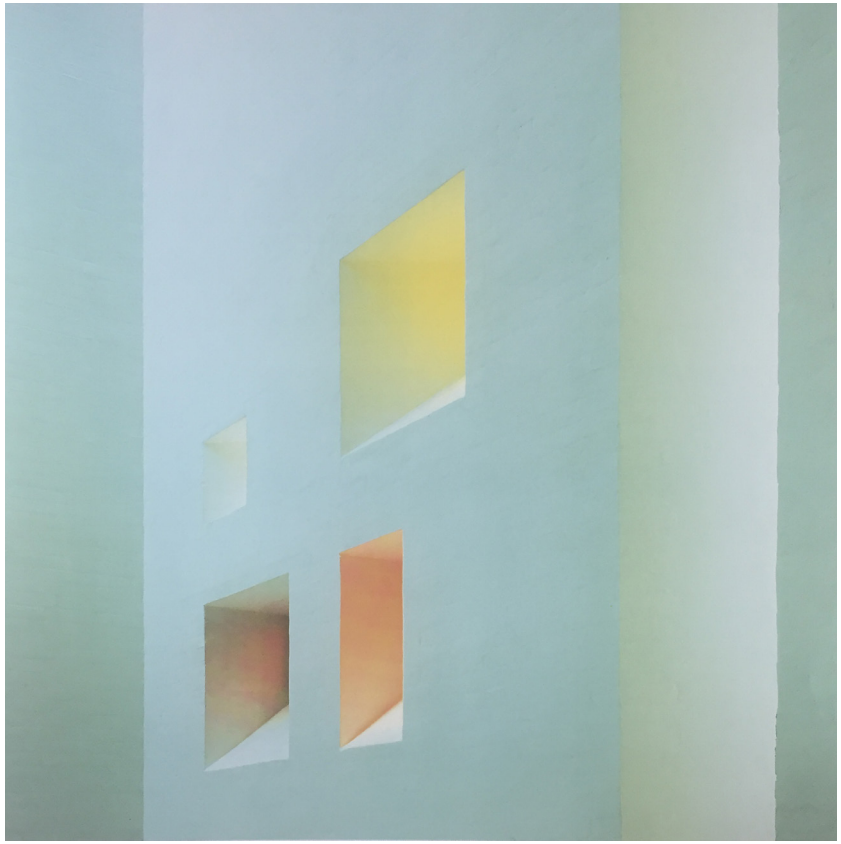
Left: Figure 60. Stone light well opens into a dark space.
Right: Figure 61. Deep penetrations bring light into the room.

The Holy Cross Chapel

Turku, Finland
Pekka Pitkänen

The Holy Cross Chapel is a pure volume of concrete with various light-carved openings. Besides the entrance, views to the outside are obstructed, the only connection being the light-filled voids and skylights. The thickness of the concrete diffuses the day light into a soft glow that contrasts the darkness of the interior. The matte concrete blocks are a subtle canvas dominated by color and intensity of light.

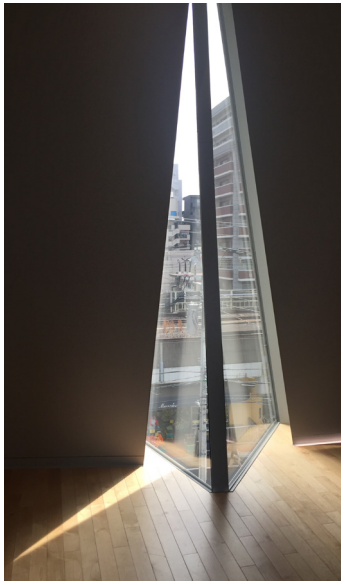
Openings in the stone walls and ceilings open up into the dark space, forming volumes of light that not only illuminate the darkness, but also create sculptural forms of light. Deep penetrations in the stone walls and ceiling create distinct forms of light.



Antvorskov Church
Slagelse, Denmark
Regnbuen Arkitekter

Left: Figure 62. A rectangle of light softly fades into the adjacent wall and floor while contrasting with the edge of the deep opening.
Right: Figure 63. Colorful volumes of light.

Antvorskov Church is a pure, white volume. Light fills the voids, the thickness of the walls concealing any light source and views to the world beyond. The edges of the voids create sharp boundaries between the light-filled voids and adjacent interior surfaces, while the daylight softly spreads to an ambient diffusion. In some places, the glass is colored but hidden in the depths of the wall so that the colorful diffusion is the only indication of material and outside world.



Left: Figure 64. Exterior metal facade reflects the color and light of the building's surroundings.
Above left: Figure 65. Angular slices of glass both frame and reflect the sky.
Above right: Figure 66. Light literally cuts into the building.

Hokusai Museum

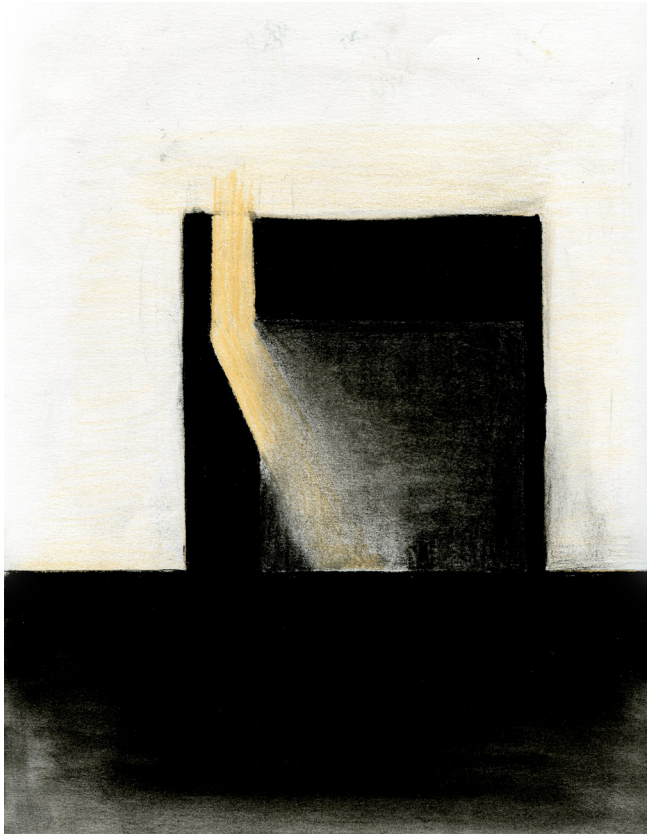
Tokyo, Japan
Kazuyo Sejima

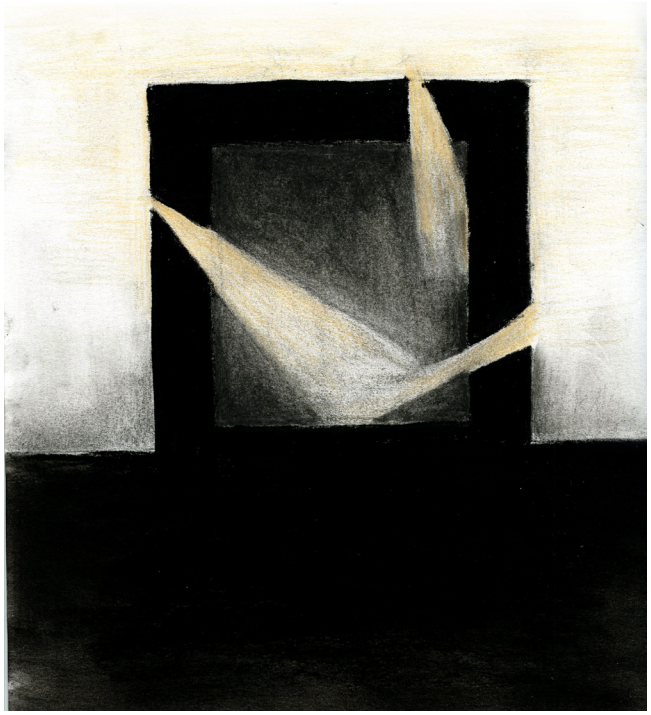
From the entirety of the exterior to the interior details, this museum is a play of light and reflection. Inside, light separates walls from floors and ceilings, and pierces the space in three-dimensional forms. These intruding windows project light onto the floor, sharply contrast with the darkness of the museum and resulting in objects of light that carve into the walls and floors, slicing into the interior with the movement of the sun and the changing weather.

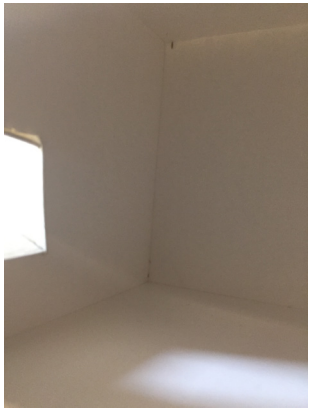
The entrance to the museum is a glassy cave that reflects its surroundings. Building reflections contort and move with the viewer, as the sky beyond stays constant. The exterior cladding of the building is another reflective surface that plays back the color and forms of its surroundings.

Figures 69 and 70 are photos of the study model that explores the section drawn in Figure 67, a deep light well with a slanted bottom to reflect light into the space. The result is a floating rectangle of light that appears on the floor and walls differently depending on sun angle.

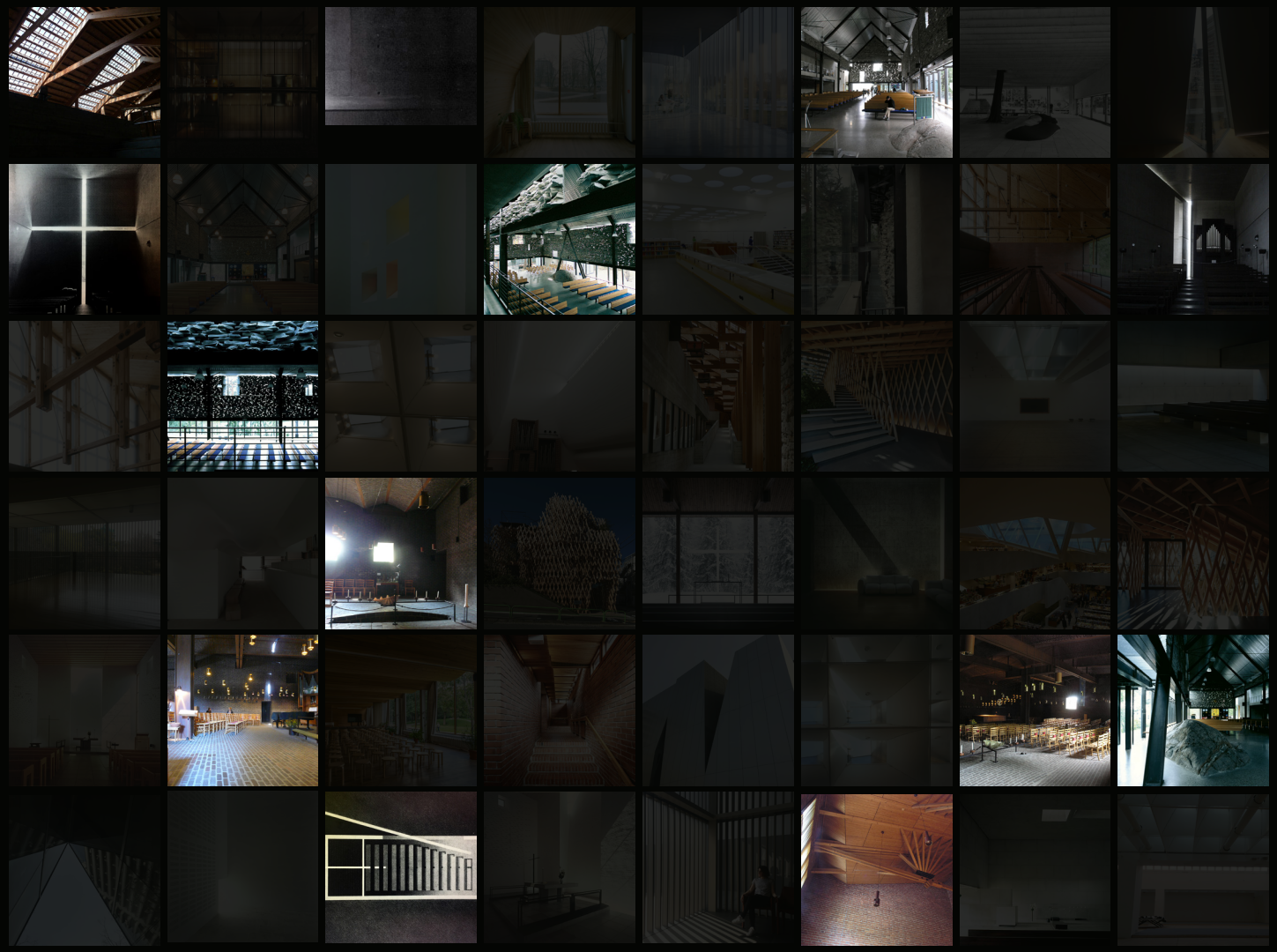
Figures 68, 71, and 72 study how angled cuts in deep walls create a similar effect as described above.







Clockwise from top left:
Fig. 67. Charcoal drawing of Sculptural Light.
Fig. 68. Charcoal drawing of Sculptural Light.
Fig. 69. Sculptural Light model photo.
Fig. 70. Sculptural Light model photo.
Fig. 71. Sculptural Light model photo.



3.5 ABSENCE OF LIGHT

Defintion: Palpable shadows defined by the contrast of distinct moments of light.
Technique: Relatively small openings, often in deep or recessed walls, connect dim interior spaces to a direct light source.
Result: Dark spaces accented by sparkles of light.

> "Light alone does not make light. **There must be darkness for light to become light—**resplendent with dignity and power. Darkness, which kindles the brilliance of light and reveals light's power, is innately part of light."
>
> -Tadao Ando

Without darkness, there is no light. Darkness emphasizes the brilliance and power of light. In fully light-saturated space, light is weakened; it is drowned out by the other light, and it is impossible to distinguish the afternoon sun shining directly on a wall from the reflectance of a skylight off the floor. The transition from light to dark forms boundaries and creates depth that would otherwise be imperceptible to the eye.

Whereas much of Nordic architecture focus on the emittance of daylight to brighten a dark space, traditional Japanese architecture uses light to form darkness. Well-lit interiors are important, of course, but the darkness holds an equally essential role. A richness of space is formed through the contrast between light and shadow. This is especially true for sacred, religious buildings. Plummer poetically describes; "shadows provide that eternal twilight which evokes an aura of sanctity. Dark space creates a frightening and irrational experience, that profound nothingness which makes man sense his smallness before the mysteries of divine power."[41] The contrast of light and dark make this ethereal experience possible, and many Japanese architects and lighting designers have mastered this relationship.

Kauro Mende, a Japanese lighting designer, speaks of designing with darkness. Instead of using light to create more light, Mende argues, the real power lies within using light to shape shadow because only then are light and shadow able to authentically express themselves.[42] The higher the contrast, the more dramatic the spatial experience. Graduated shadows can create a calm, peaceful procession from darkness to a pinnacle moment of bright light. This technique is often used in Nordic churches, where the brightest light comes from above the altar. On the other hand, in Japanese temples, the more sacred spaces are often the darkest; instead of bright light, heavy darkness represents the divine power of the spiritual realm. "The dim interior of an ancient temple, and by extension of every traditional Japanese space, provides a place where the lights are turned down so the soul can find rest."[43] The dim light that reaches the interior spaces, filtered through layers of clouds and trees, divides the space defined by darkness; in traditional Japanese architecture, shadows are inhabitable. The light that comes from the gardens outside anchors the divinity of infinite darkness to the daylit tangibility of the earth.

41 Plummer, Henry. *Light in Japanese Architecture*. Tokyo, Japan: A+U Pub. 1995. Pg. 106.

42 Mende, Kaoru. *Designing with Shadow: Lighting Design for Urban Environments and Architecture*. Tokyo: Rikuyo-Sha, 2012. Print.

43 Plummer, Henry. *Light in Japanese Architecture*. Tokyo, Japan: A+U Pub. 1995. Pg. 110.

Figure 73. Slices of light visually separate the ceiling from the walls, giving the appearance of floating surfaces. The contrast of the light accentuates the darkness.

Church of the Light

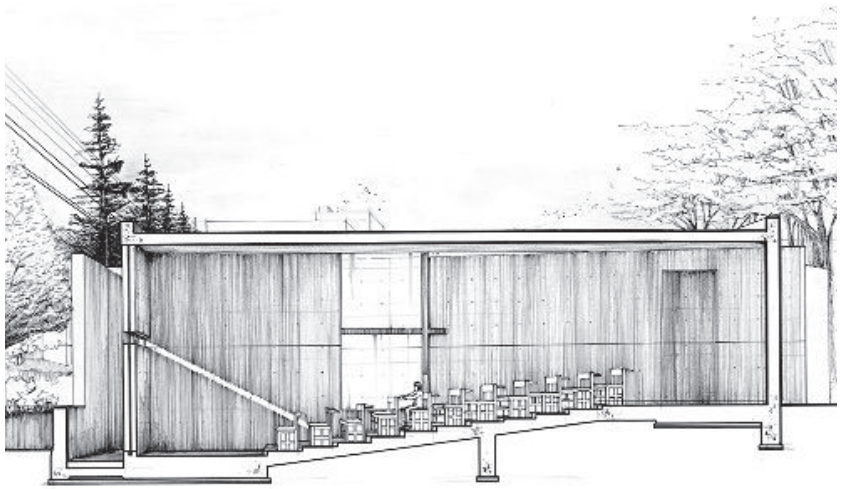
Ibaraki, Japan
Tadao Ando

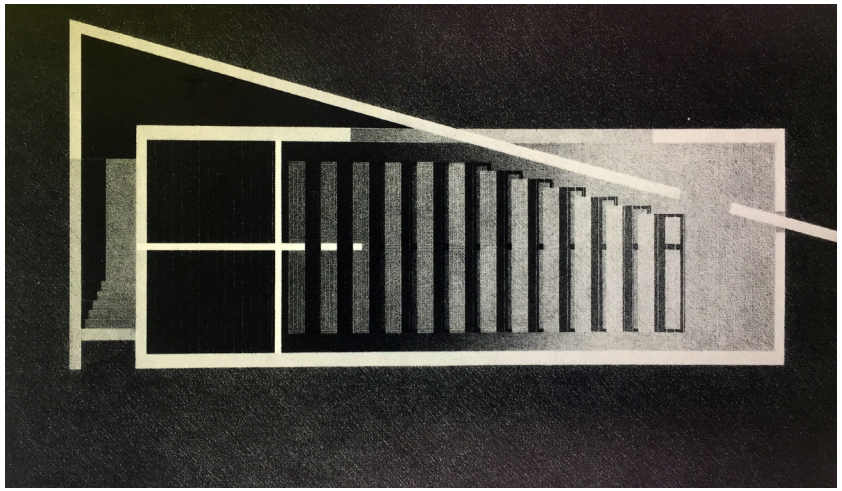
The inhabitable shadow and divine darkness of traditional Japanese architecture are not common in contemporary vernacular Japanese architecture. Yet their presence is alive in Tadao Ando's works, such as Church of the Light.

A modern master of light and shadow, Ando draws on the simple tools of darkness, natural light, and concrete to engulf the user in darkness accentuated with bright lines of light. This relationship between the pitch black and sparkling light form space rich in depth; "Once inside the church," describes Plummer, "the charcoal darkness is all-enfolding, broken only by radiant fissure in the concrete where light is allowed to leak through the shell."[44] The dazzling slits of light carve into the blackness, accentuating the strict contrast between the two. The limited amount of light makes its presence even more powerful as it slices through concrete slab and cracks the corners of the concrete box.

Smooth, flat concrete surfaces meet with smooth, curved concrete surfaces in sharp corners of complete darkness of the simple form. "There are few openings in this space," Ando explains, "since light displays its brilliance only against a backdrop of darkness. Nature—its

44 Plummer, Henry. *Light in Japanese Architecture.* Tokyo, Japan: A+U Pub. 1995. Pg. 123.





Above: Figure 74. Section.
Below: Figure 75. Plan.
Right: Figure 76. A cross of light floats behind the altar.

presence reduced to the element of light—takes on an extremely abstract character, and—responding to this abstraction—the architecture grows purer with the daily passage of time…"[45] In this architectural abstraction of light, of nature, Ando believes lies the sacred; through the engulfing darkness, illuminated by fissures of light reflecting off smooth concrete, a cross of light floats behind the altar—the ultimate abstraction of nature and the sacred.

45 Plummer, Henry. *Light in Japanese Architecture.* Tokyo, Japan: A+U Pub. 1995. Pg. 123.

St. Peter's Church
Klippan, Sweden
Sigurd Lewerentz

St. Peter's Church seems to be a solid mass puncture by bright forms of light from modest square windows on the south and west walls. Light slices the heavy ceiling mark the priest's journey from sacristy to altar. The interior darkness, emphasized by the high contrast of the glaring rays of light and dark material palette of brick and steel, seems to expand up and out as if creating inhabitable space. The darkness is limitless, grounded only by the floating light fixtures and squares of daylight that illuminate parts of the floor.

Even further accentuating this infinite darkness is the heavy steel cross in the middle of the nave: "Coming slowly into sight at the heart of the nave is a primitive cross of rusting steel, emerging like a cult object shrouded in darkness—a darkness that slows down space and time, and offers a matrix in which something miraculous might occur."[46] Without darkness, there is no light. Darkness emphasizes the brilliance and power of light. In fully light-saturated space, light is weakened; it is drowned out by the other light, and it is impossible to distinguish the afternoon sun shining directly on a wall from the reflectance of a skylight off the floor. The transition from light to dark forms boundaries and creates depth that would otherwise be imperceptible to the eye.

46 Plummer, Henry. (2012). *Nordic light : Modern Scandinavian architecture.* New York: Thames & Hudson. Pg

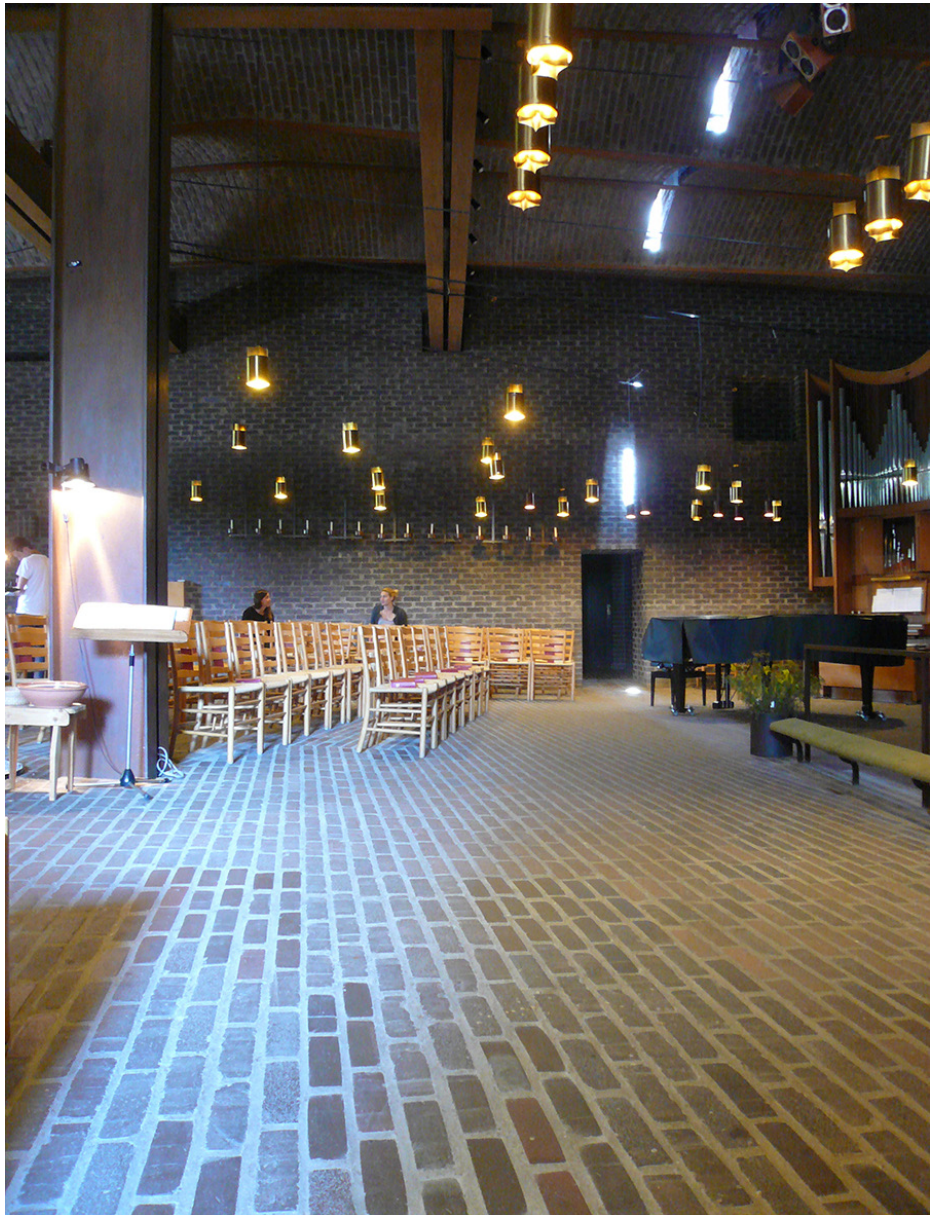
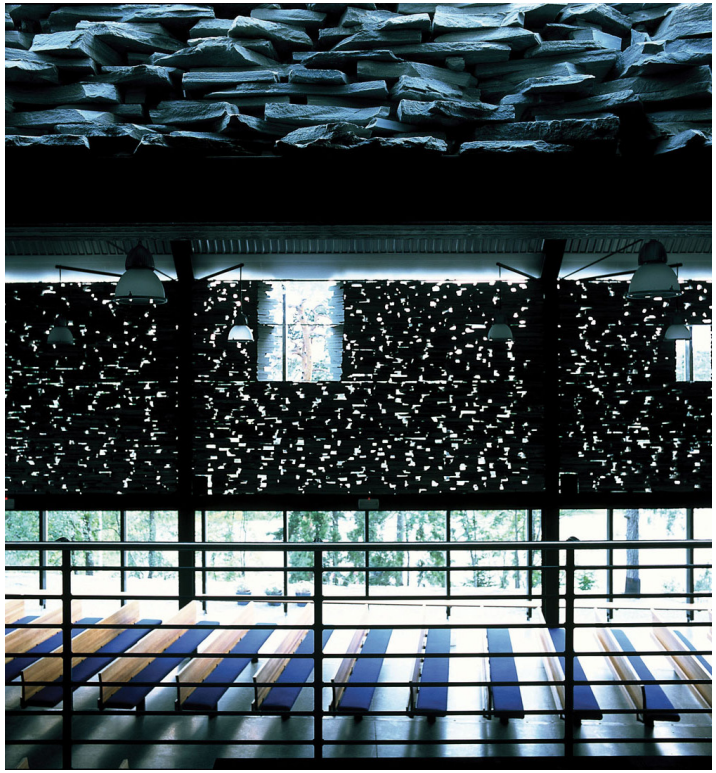


Figure 77. The dim interior is contrasted by incisions of light from the sides and above.

Left: Figure 78. Contrast between the bright windows and dark brick makes the shadows even darker and more powerful.
Right: Figure 79. The brick walls and ceiling disappear into an seemingly infinite shadow.



Left: Figure 80.The contrast from the small bursts of light shining from between the stones increases the depth of the shadow.
Right: Figure 81. The darkness of the stone enclosure is lifted by a bar of light.

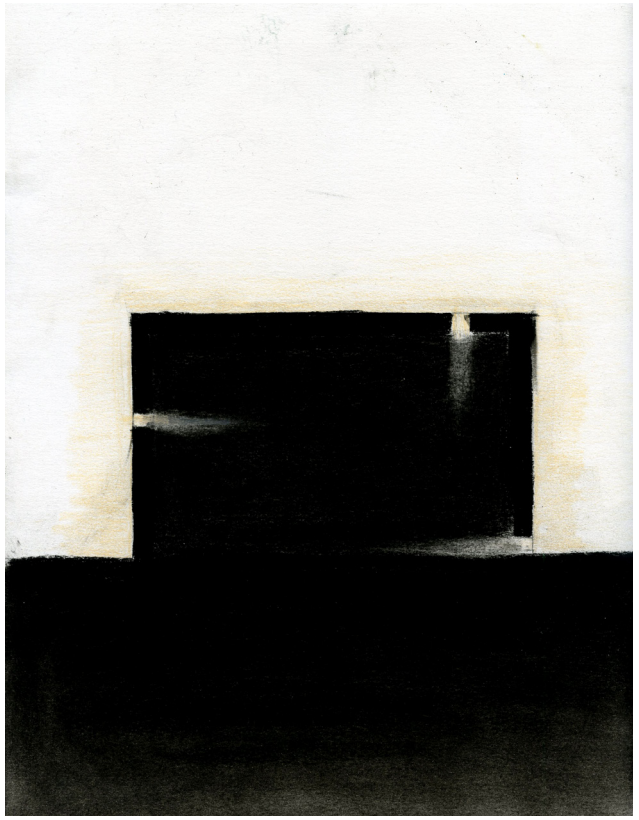
Mortensrud Church

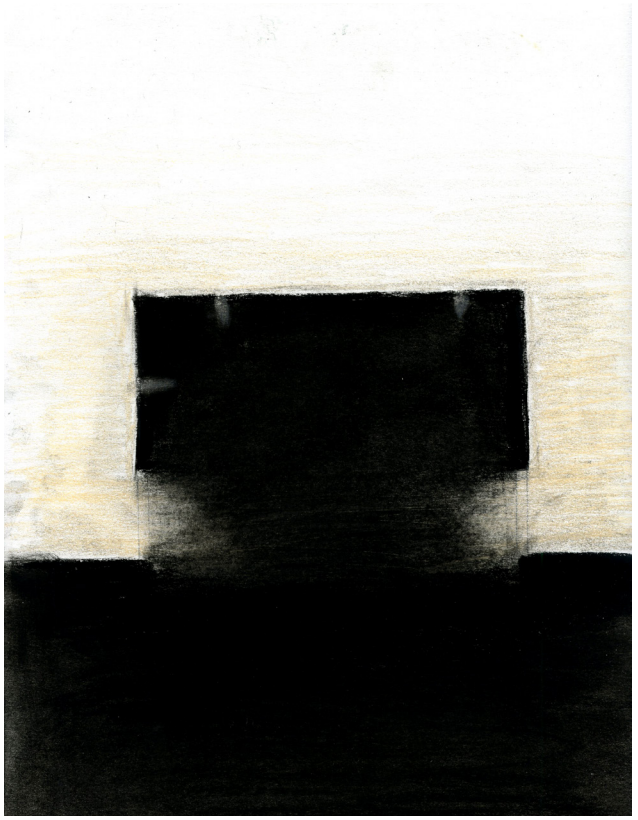
Oslo, Norway
Jensen & Skodvin Arkitektkontor

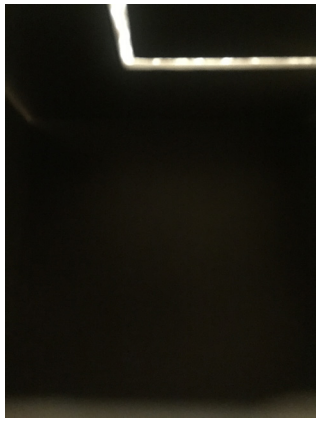
Upon entering the church, the brightness of the daylight dissolves into the chapel. Darkness engulfs the center of the chapel, bounded by the daylight reflected on the perimeter of the polished concrete floor. The stone walls, lifted off the ground, absorb all light except for the glimmer of daylight sparkling through the gaps between the stones. The heavy blackness floats above the chapel in an infinite expanse that extends from the natural forces of the world to a cosmic unknown of contemplation. The black steel contrasts against the light of day, anchoring the darkness to the earth.

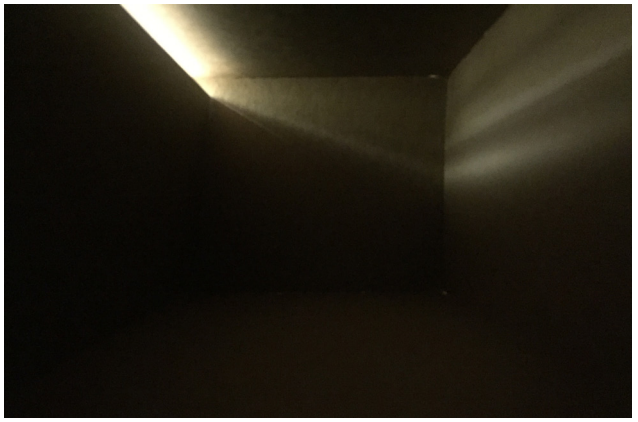
In Figures 82, 84, and 85 long, narrow incisions focus the eye on the slits of light, making the darkness appear infinite.

Figure 83 explores a similar concept as Figure 82, except with smaller incisions of light that come from above. In Figure 86, the wall on the left slants inward, letting a sliver of light into the box. As sun angle shifts, so does the reflection of light on the opposite wall.









Clockwise from top left:
Fig. 82. Charcoal drawing of Absence of Light
Fig. 83. Charcoal drawing of Absence of Light
Fig. 84. Absence of Light model photo
Fig. 85. Absence of Light model photo
Fig. 86. Absence of Light model photo

As humans, we need to live within nature for our emotional, physical, and mental well-beings. As people who live in a northern climate, we need sufficient light for our emotional, physical, and mental well-beings. Yet many people are unaware of the power of light to transform the spaces they inhabit everyday by connecting them with the natural world.

A mindful human relationship with nature can be strengthened through architecture. The role of architecture can enhance human awareness of the natural environment with daylighting, material, and form, as seen in the case studies above. They show that architecture is inherently both a reflection of the natural environment and also a physical and emotional mediator between humans and nature. It is possible for architecture to benefit human well-being by connecting people and nature through daylighting strategies. Through thoughtful daylight design, natural light can be used as a tool to strengthen human awareness of the natural environment and thus encourage a more conscious appreciation of its integral role in our lives.

This thesis applies the 4 Qualities of Light based on the strategies studied in these Japanese and Nordic case studies to inform an architecture that not only responds to the natural and built environments in a contemporary way, but also celebrates of Pacific Northwest culture as it stands today and as it transforms in the near future. By using the 4 Qualities of Light developed in this chapter, this cultural event center strives to connect its inhabitants with the natural environment through the ephemeral power of light.

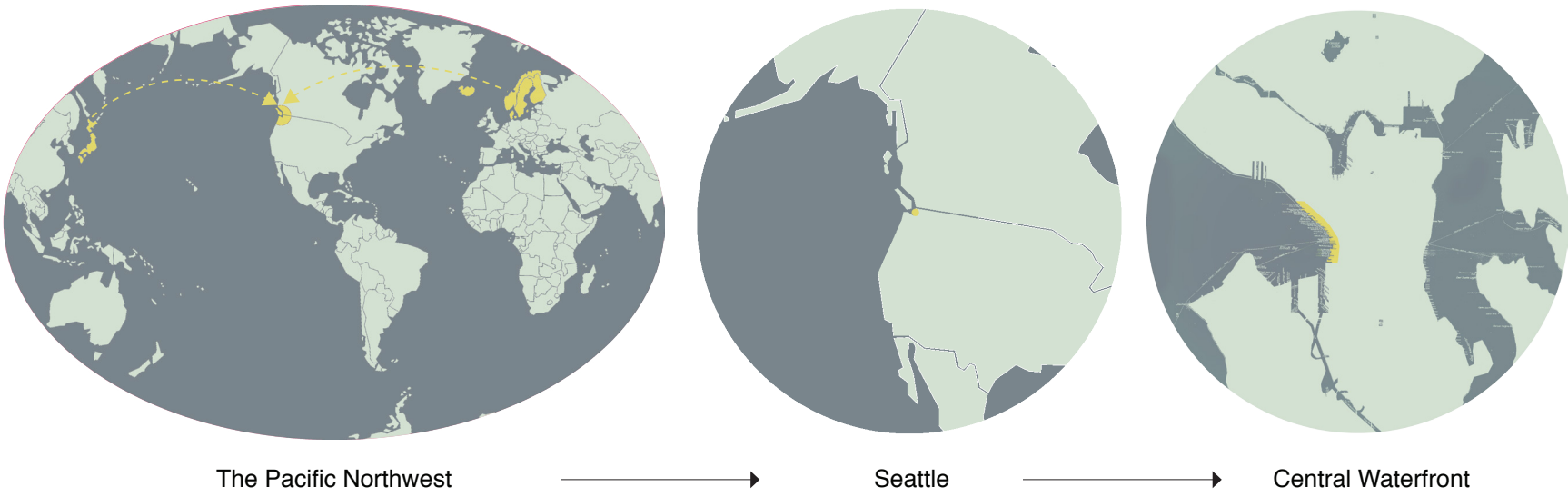


Figure 87. Site location diagram

4. Site and Program

4.1 A CITY ON THE EDGE OF WILDERNESS

In order to further explore these qualities of light, this thesis focuses on the design of a series of civic spaces on Seattle's central waterfront. The image on the left shows how Seattle's waterfront first looked when non-native settlers arrived in the mid-19th century. Despite vast change, this image still encapsulates the essence of Seattle: a city on the edge of a wilderness of ocean, mountain, and forest characterized by overcast skies and diffuse light.

Seattle has seen massive re-engineering since the mid-19th century when non-native settlers arrived. Since its settlement in 1851, Seattle's shoreline has been extended, hills flattened and moved, and

Figure 88. Salmon Bay Charlie's house at Shilshole with canoe anchored offshore, ca. 1905

rivers in-filled and re-routed. Even before that, Seattle experienced incredible geologic reformation from glaciers, earthquakes, tsunamis, and volcanic eruptions. The Seattle of today is essentially unrecognizable from its landscape even 150 years ago.

When new American settlers arrived to Seattle, it was a rugged landscape of water, beaches, forests, and hills. Native American settlements defined the inhabitable areas in bays and on flat ground. One important Duwamish village was called “Little Crossing Over,” which was in today’s Pioneer Square. In 1850, Little Crossing Over was located on the high point of a small peninsula jutting out into the Puget Sound. This area was the highest point in the area, and formed an island at high tide. At lower tides walkways made it accessible by foot, hence the name “Little Crossing-over Place.” Tribal elders report that once 8 long houses existed at this site, but by the 1850s only 1 remained.[47] Soon after Seattle’s re-settlement in 1851, Little Crossing-Over Place became the location of Yesler’s Mill, which established Seattle’s first intersection and began the in-fill of lagoon with sawdust from the mill. Still a topographical high point in Pioneer Square, this once-important place of crossings-over and intersections is today’s South Jackson Street, between 1st Avenue South and Occidental Avenue South.

Over the next 150 years, this area experienced even more physical and cultural change. As the shoreline extended farther out into

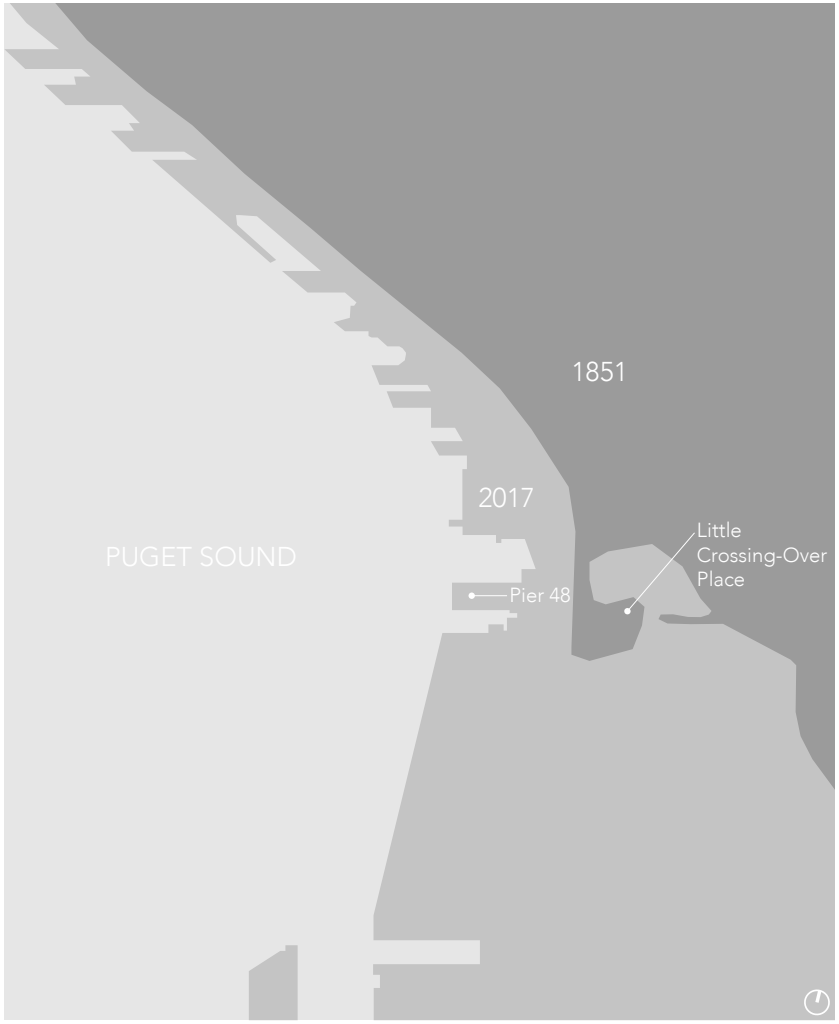


Figure 89. Seattle’s central waterfront in relation to Seattle’s shoreline in 1851.

47 “Waterlines.” Burke Museum of Natural History and Culture. 2009. Retrieved from http://www.burkemuseum.org/static/waterlines/index.html.

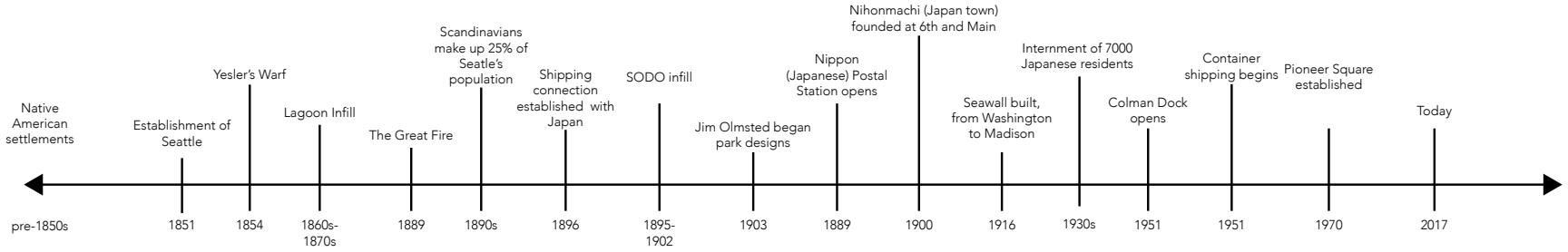


Figure 90. Timeline of Pioneer Square

the Puget Sound, Little Crossing-Over Place transitioned from a small Duwamish fishing village to Yesler's Mill, a business district, Skid Row, and currently a historical tourist neighborhood called Pioneer Square. Many different peoples and cultures immigrated to Seattle, taking part in its development. In the 1890s, Japanese immigrants began arriving in Seattle[48] and a regular shipping connection between Japan and Seattle formed. By early 1900s, Nihonmachi (Japantown) was established by 6th and Main Streets. Key civic services such as a post office served the strong Japanese community until the 1930s, when approximately 7000 Japanese residents were interned.[49] Despite this severe destruction of Japanese culture and civic framework, today the Japanese influence is evident in Seattle's cultural and physical fabrics through several Japanese parks and gardens, architectural influence, cuisine, and Japanese communities.

Perhaps the largest group of immigrants were the Scandinavians. As described in Chapter 2's Influential Immigrations," similarities in climate, landscape, and access to fishing and logging

48 Takami, David. A. "Japanese Immigration to the Puget Sound Region." History Link. Oct 1998.Retrieved from http://www.historylink.org/File/300. Accessed Sep 2017.

49 "Djidjila'letch to Pioneer Square: From Native village to Seattle metropolis." Burke Museum of Natural History and Culture. May 2012. Retrieved from https://www.youtube.com/watch?v=5z2q2mxRnns. Accessed May 2017.

drew Nordic immigrants to Seattle. By the 1890s, Scandinavians made up nearly 25% of Seattle's population. By the early 1900s, 8% of born Seattleites were of Scandinavian descent. Today, Ballard is the Nordic heart of Seattle and a capital of Scandinavian culture on the West Coast.

With a history that spans generations of many cultures, peoples, and character, Pioneer Square truly is the heart of Seattle. Even still, more development is yet to come.

Figure 91. Aerial view of the current Seattle Central Waterfront

4.2 WATERFRONT SEATTLE

Within the central waterfront, the site for this cultural event center is Pier 48, the southern-most pier. Chosen for its access to unobstructed daylight, Pier 48 is an ideal place to explore the qualities of light and design.

Additionally, the cultural event center fits into the concept for the re-design of Seattle's Waterfront. In 2012 the City of Seattle released design documents re-envisioning Seattle's central waterfront. The project, named Waterfront Seattle, spans from Pioneer Square to

Figure 92. Aerial view of the future Seattle Central Waterfront

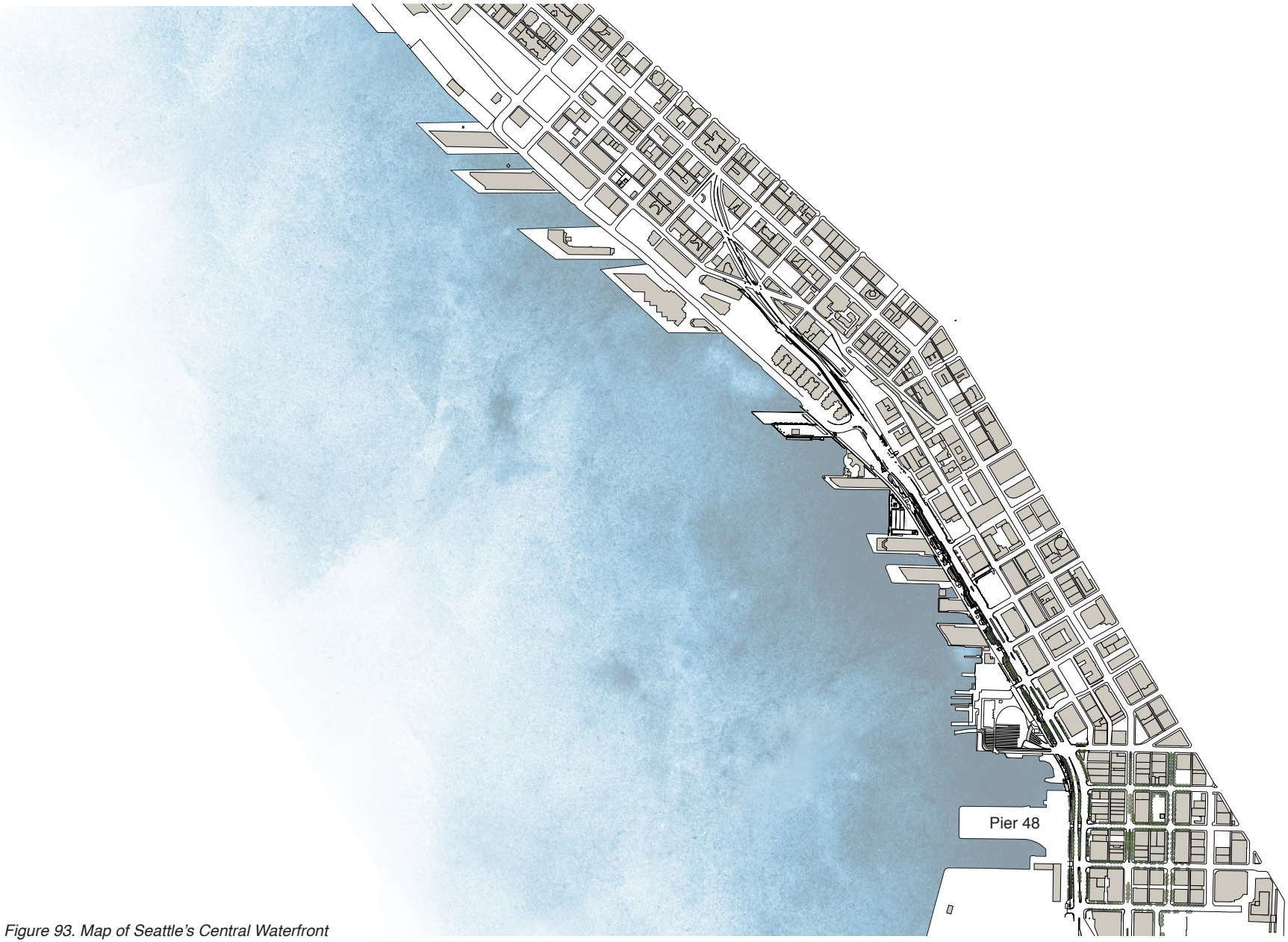


Figure 93. Map of Seattle's Central Waterfront

Belltown. A central element of this decade-long project is the demolition of the Alaskan Way Viaduct, which currently creates a visual and physical barrier between the city and the waterfront. After the removal of the Viaduct, Alaskan Way will become a pedestrian-friendly green street. This promenade, the heart of the project, is a continuous pathway defined by strong east/west connections between downtown and the waterfront and nodes of event-based activities. This new promenade will feature bike lanes, pedestrian lanes, native plants, a new Seawall, beaches, and other amenities in an effort to provide a "waterfront for all" that is easily accessible and readily used.

The Waterfront Project is defined by the following guiding principles[50] that explain its intent and goals. Citizens collaborated with the city of establish these principles, emphasizing that this project is truly by the people of the city and for the people of the city.

1. Create a Waterfront for all.
2. Put the shoreline and innovative, sustainable design at the forefront.
3. Reconnect the city to its Waterfront.
4. Embrace and celebrate Seattle's past, present and future.
5. Improve access and mobility.
6. Create a bold vision that is adaptable over time.
7. Develop consistent leadership–from concept to construction to operations.

50 James Corner Field Operations, CH2MHill, Shiels Obletz Johnsen, Inc. "Design Summary: Concept Design and Framework Plan for Seattle's Central Waterfront." Waterfront Seattle, July 2012. Retrieved from https://waterfrontseattle.org/overview. Accessed September 2017.

Figure 94. Guiding Principles diagram

The Office of the Waterfront strives to meet these guiding principles at 3 scales: the city scale, the center city scale, and the waterfront scale. At each scale, the project connects to its context in unique ways and supports the project's guiding principles.

THE CITY SCALE

Figure 95. The City Scale

"At the city scale, the central waterfront can be seen as part of a larger ring circling Elliott Bay. The central waterfront needs to be connected to trails, neighborhoods and destinations along the shores of Elliott Bay, both north of Broad Street and south of King Street, to complete the journey around Seattle's Elliott Bay waterfront. Echoing Olmsted's Green Ring of parks encompassing central Seattle, the waterfront Bay Ring will provide a continuous public amenity that embraces Elliott Bay as the heart of the city."

-Office of the Waterfront

THE CENTER CITY SCALE

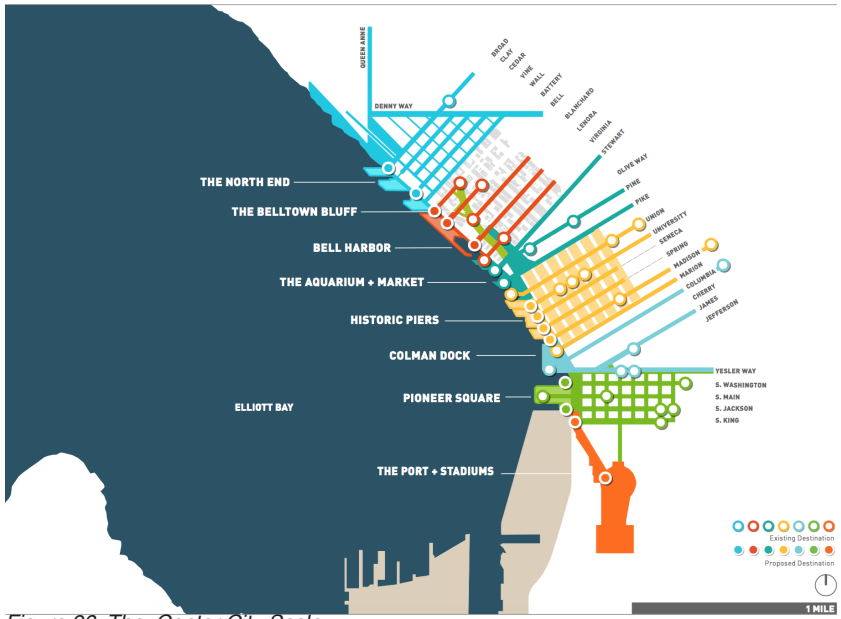


Figure 96. The Center City Scale

"At the center city scale, eight character zones [...] are defined by physical characteristics of the site, such as converging grid systems, topography, and urban form, as well as the cultural characteristics of the working waterfront and its adjacent neighborhoods. [...] Key east-west streets are identified as vital links between existing destinations within the center city and attractions along the waterfront. The removal of the viaduct and the re-orientation of the center city towards the water, will unify and open the central waterfront, establishing it as Seattle's front porch on the bay."

-Office of the Waterfront[1]

1 James Corner Field Operations, CH2MHill, Shiels Obletz Johnsen, Inc. "Design Summary: Concept Design and Framework Plan for Seattle's Central Waterfront." Waterfront Seattle, July 2012. Retrieved from https://waterfrontseattle.org/overview. Accessed September 2017.

THE WATERFRONT SCALE

Figure 97. The Waterfront Scale

"At the waterfront scale, the concept establishes a continuous public waterfront, connecting the Stadium District and Pioneer Square to Belltown, the Olympic Sculpture Park and Myrtle-Edwards Park. The continuous waterfront includes a new surface street, pedestrian promenade, and bike path. Overlaid on this urban fabric are a series of open spaces, ranging in scale from small and intimate to large and civic, which will draw visitors to the waterfront for a variety of events and activities throughout the year. These places relate to nearby existing destinations to form synergies of audience and program. Together, these elements create a dynamic urban district, filled with cultural, social and recreational activity on the waterfront."

-Office of the Waterfront[1]

1 James Corner Field Operations, CH2MHill, Shiels Obletz Johnsen, Inc. "Design Summary: Concept Design and Framework Plan for Seattle's Central Waterfront." Waterfront Seattle, July 2012. Retrieved from https://waterfrontseattle.org/overview. Accessed September 2017.

4.3 PIER 48

Pier 48 is located in the “Pioneer Square” waterfront character zone described in the center city scale description. As the southernmost part of Seattle’s central waterfront laying directly west of Pioneer Square, Pier 48 is a unique site. Not only does it have unobstructed access to daylight, but it is a physical extension of the heart of Seattle, Pioneer Square, into the Puget Sound. Pioneer Square and Pier 48 lay at an intersection between the central downtown Seattle area and the ambiguous area of industrial ports and sports arenas south of Pioneer Square. In the context of Seattle’s new waterfront project, this historic and vibrant site plays a key role in connecting various neighborhoods at both the center city scale and the waterfront scale.

Pioneer Square is dotted with small green spaces and its streets are full of trees. The new waterfront plan adds to this by turning Main Street and Washington Street into pedestrian streets with more trees and wider sidewalks. These two streets run east/west, ending at the edge of Pier 48. As Pier 48 extends into the Puget Sound, so does the character and life of the these streets. Through Pier 48, the city can literally extend into Elliot Bay.

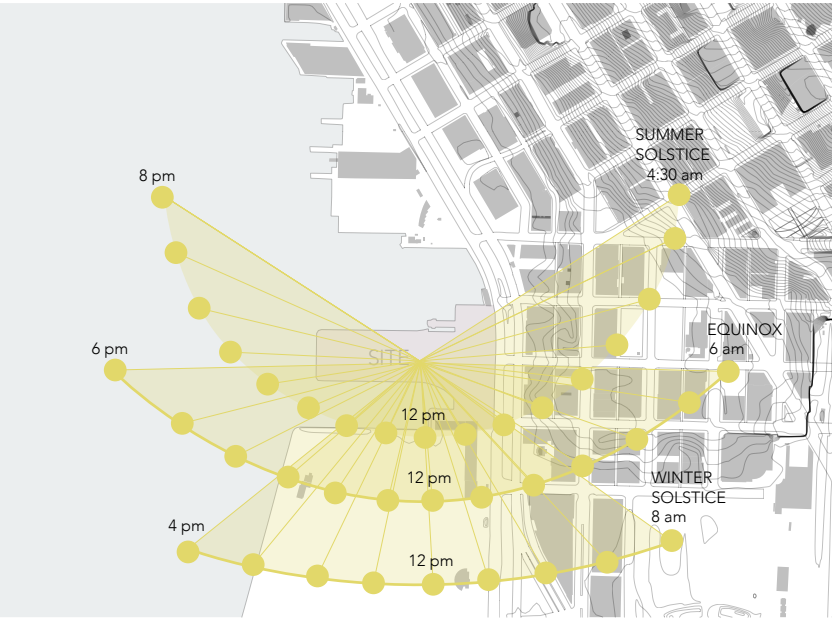


Figure 98. Sunpath diagram on the site.

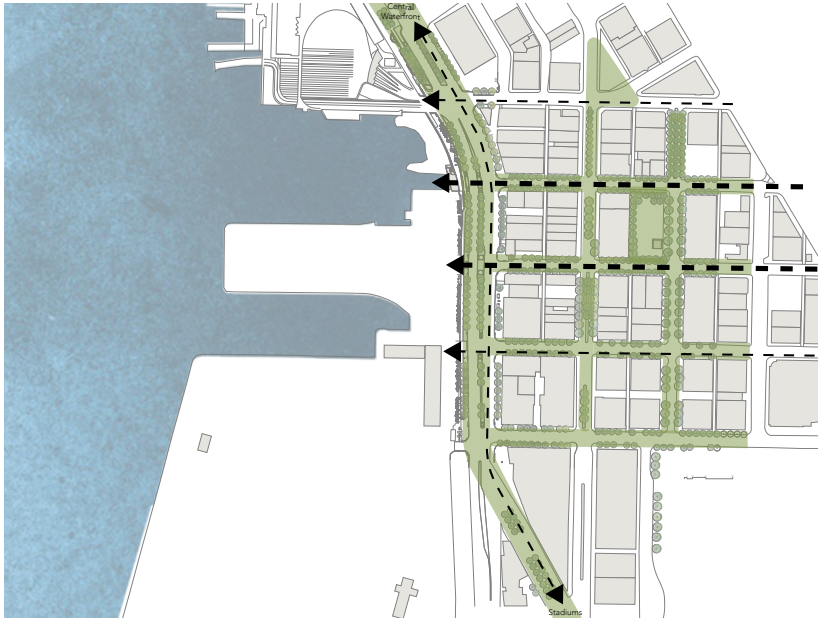


Figure 99. Diagram highlighting Pioneer Square’s east-west streets and green streets.

Built in 1935, Pier 48 functioned as a commercial facility until 1967 when it became a terminal for the Alaska Marine Highway System. Then from 1989 to 1999, the pier served as a ferry terminal for Victoria, BC. In 1993 Seattle grunge band Nirvana performed on of their final shows on Pier 48. Finally, Washington Department of Transportation (WSDOT) purchased the site in 1993 for the upcoming deconstruction of the Alaskan Way Viaduct[51] and demolished the decrepit warehouse in 2010.[52] Looking forward, the site has a more vibrant urban future.

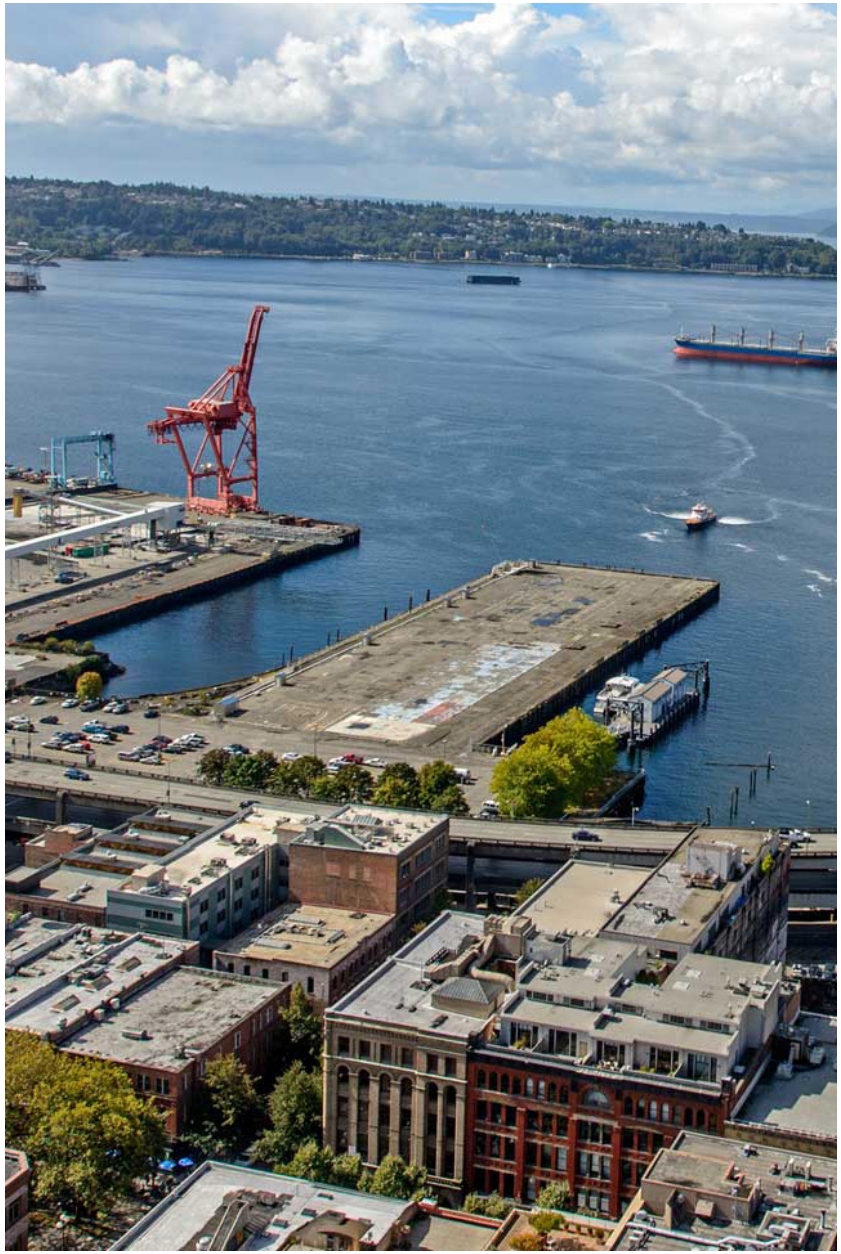


Figure 100. View of Pier 48 from Smith Tower.

51 Young, Kristen Millares. “Port takes step to sell Pier 48 to the state,” Seattle Post-Intelligencer, July 8, 2008. Accessed 16 June 2017.

52 Pacific Coast Architecture Database (PCAD), http://pcad.lib.washington.edu/building/15413/. Accessed 28 September 2017.

Figure 101. View of Pier 48 from the Ferris Wheel

Figure 102. View of Pier 48 from the ferry taxi to West Seattle

5. Design

5.1 MASSING

The massing of this cultural event center is driven by the concept of prospect and refuge: inwardly-focused Light Spaces—formed by the 4 Qualities of Light—define a path of circulation from the city to Elliott Bay and frame views looking outward. As shown in the diagrams on the left, the Light Spaces either are lifted above the pier or dive below in, leaving the pier to be shaped by a series of open pavilions that frame and filter views and direct movement toward the ultimate view at the end of the pier. On the second floor, the Light Spaces act similarly, shaped to direct movement and view between them toward framed views looking out at the city and the bay.

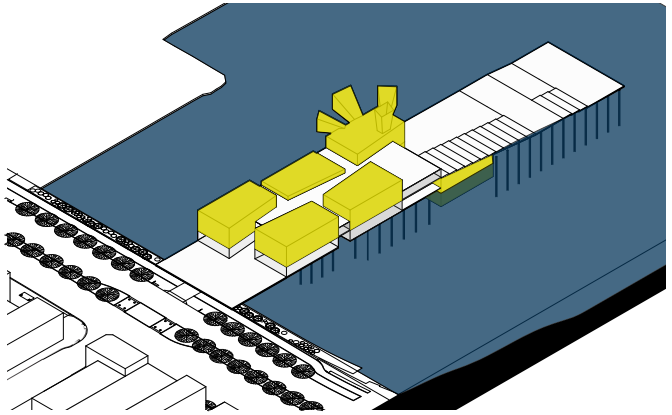


Diagram 1: Light Spaces rise above or dive below the pier.

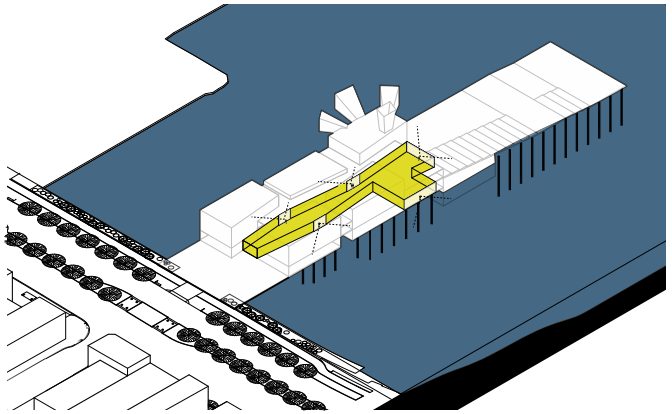


Diagram 2: On the pier, open pavilions direct movement out toward the end of the pier while framing views outward and filtering light.

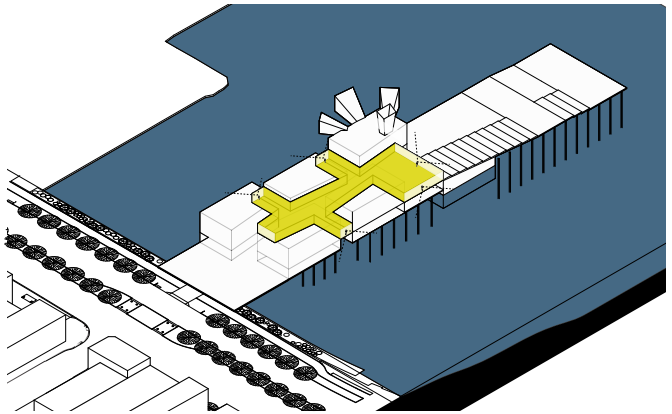


Diagram 3: Above the pier, the Light Spaces frame views out to the bay and the city.

Figure 103. Massing and circulation diagrams

5.2 PROGRAM

The civic spaces in the cultural event center are undefined in terms of program. Instead, each space is defined by a quality of light and can house various programs and uses based on the needs of the occupants and the light experience the space provides.

As shown in Figure 104, while a program may have a primary light need, there are secondary relationships between program and quality of light that create a web. So while a Light Space may be primarily inspired by a single quality of light, the building form often also produces one or more other types of light as well. Figure 104 also shows several civic and cultural programs that were considered while designing the Light Spaces, but their use is not limited to these.

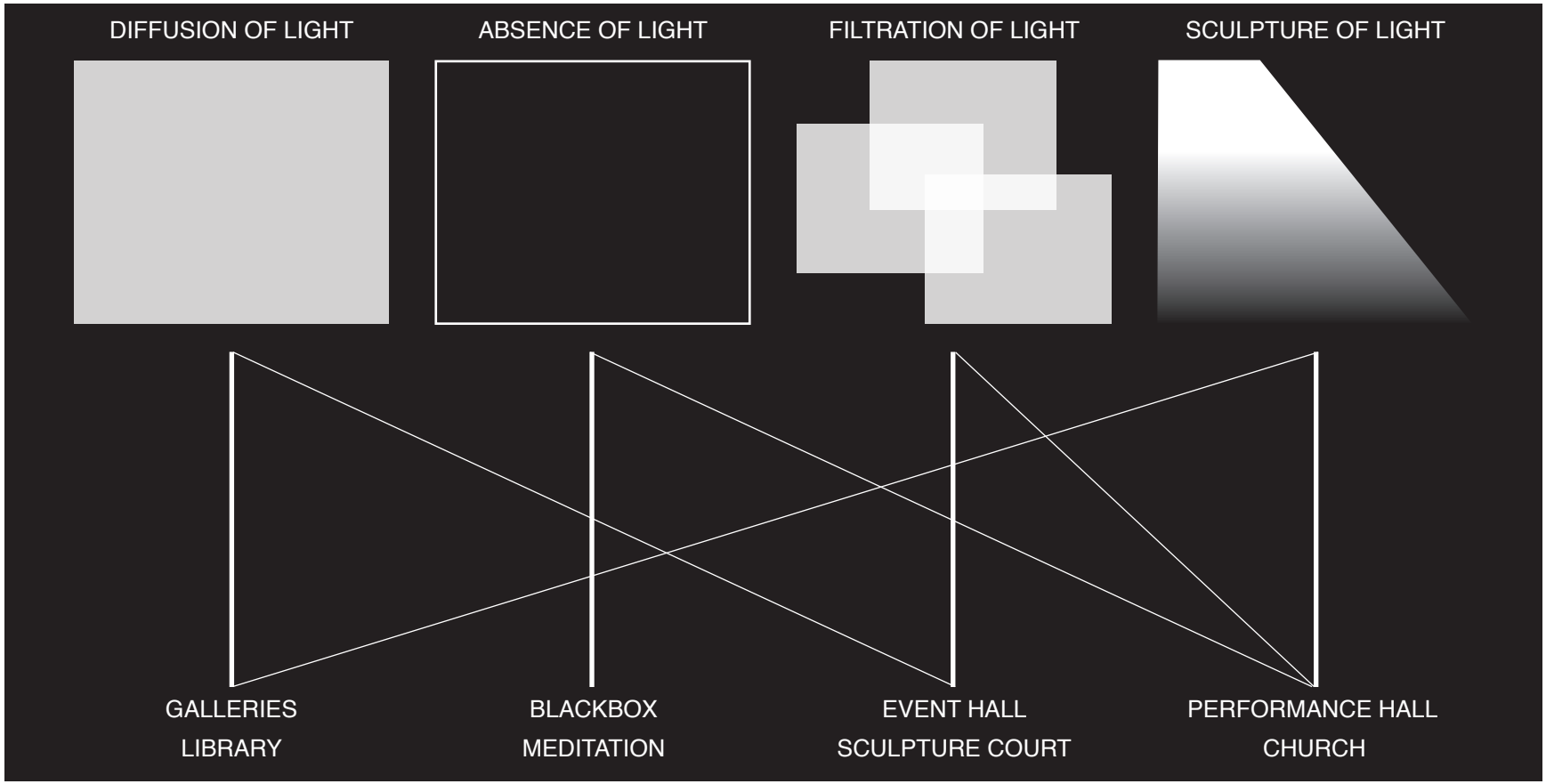


Figure 104. Massing and circulation diagrams

4.3 CULTURAL EVENT CENTER

Section 1, taken through the northern Light Spaces facing north, shows the procession from the city toward Elliott Bay. On the ground floor, the open pavilions contain various public programs such as a cafe, retail, or library. A system of structural mullions open these pavilions up to views and light, while each pavilion frames a view looking outward from the pier.

Above and below the pier, the Light Spaces house possible cultural and civic events such as a dance performance, an art exhibition, meditation, yoga, a classroom, a gala, or a lecture. These are simply programmatic suggestions that could inhabit these Light Spaces. In Section 1, the Light Spaces from right to left are Diffused Light, Filtered Light, and Absence of Light.

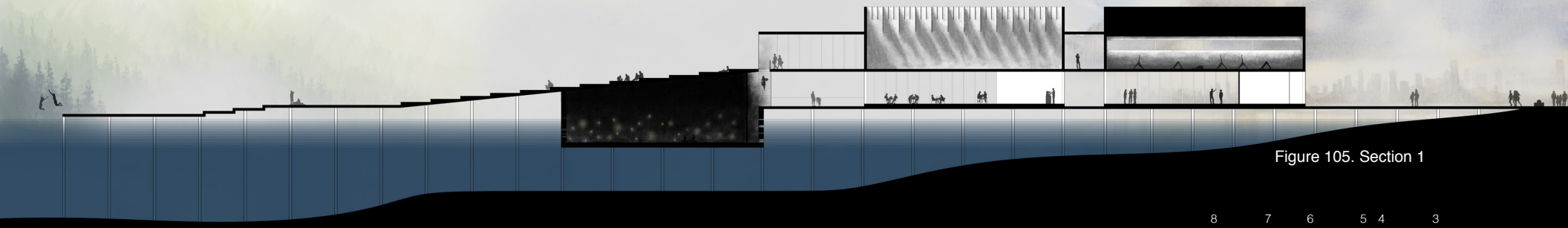


Figure 105. Section 1

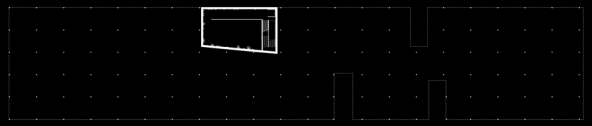


Figure 106. Sub-Pier Plan

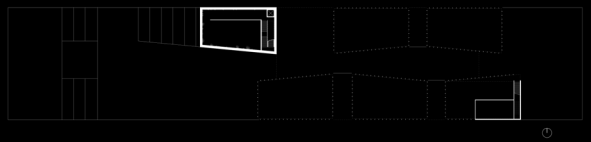


Figure 107. Pier Plan

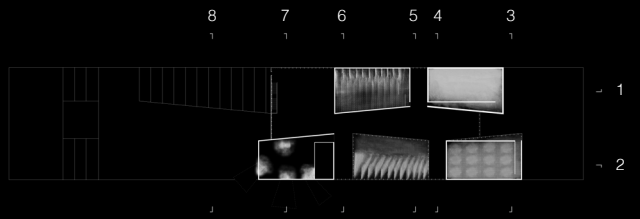


Figure 108. Second Floor Plan

In Section 2, taken through the southern Light Spaces facing south, the Light Spaces from left to right are Diffused Light, Filtered Light, and Sculptural Light. As the Light Spaces move from the city into the water, the quality and quantity of light is less. As the pier extends into Elliott Bay, the cultural event center dissolves into the water as the light dissolves into shadow.

Figure 109. Section 2

Upon entering the pier, the first Light Space encountered is Diffused Light. This Light Space, while primarily defined by Diffused Light, also produces Filtered Light in the summer months when sun angles are high. The slanted louvers block most of the direct southern sun, but not in June when angles are highest: then, light penetrates the space, forming volumes of light on the walls and the floors. Section 3 shows an art class occurring in this space.

Between the pavilions on the ground level, on a clear day one can see the view of West Seattle, Bainbridge Islands, and the Olympic Mountains.

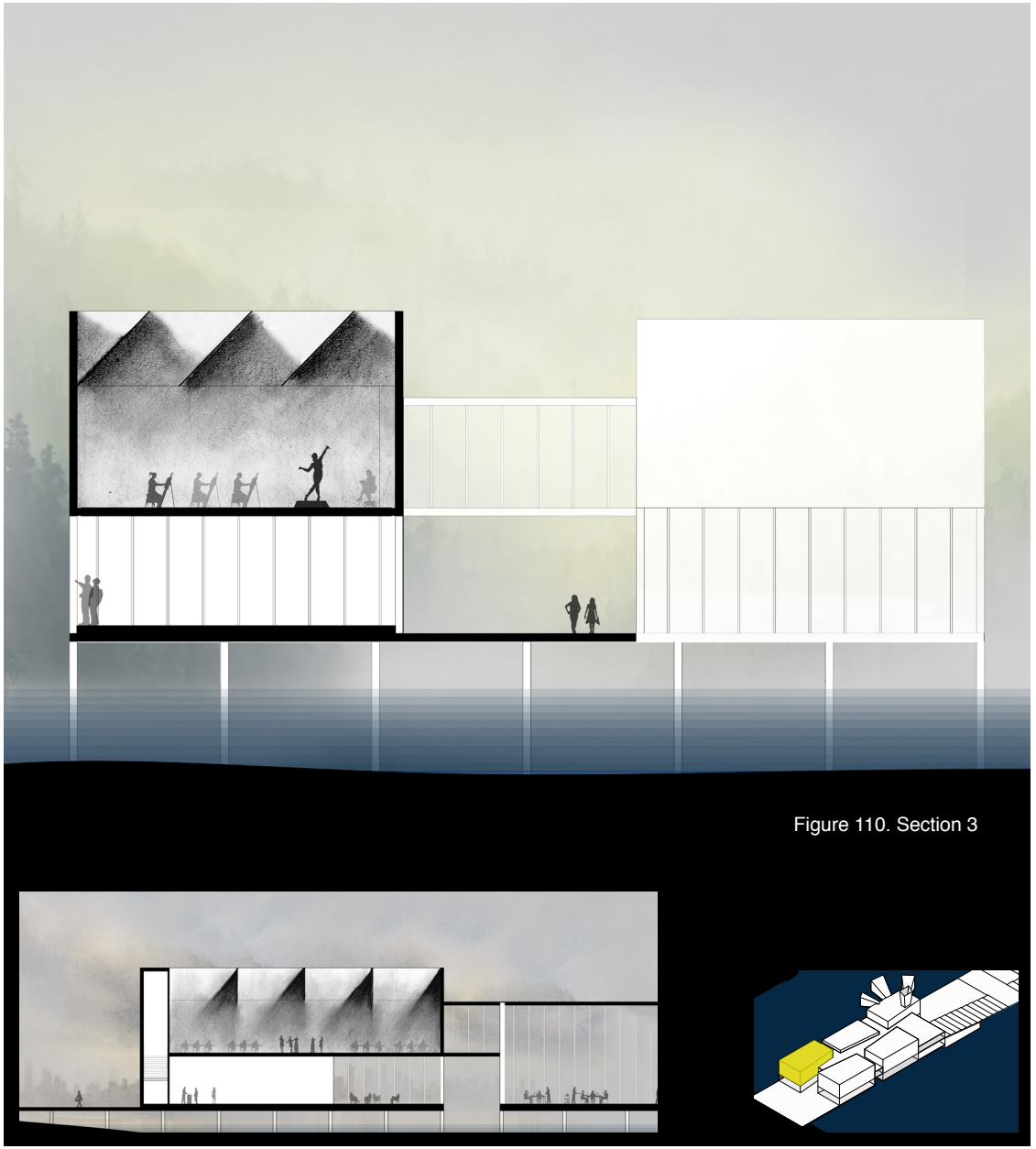


Figure 110. Section 3

Physical models help to better understand these Light Spaces. Using the Daylighting and Materials Lab at the University of Washington, these models were photographed on the heliodon to simulate various times of day on December 21, when sun angles are lowest, June 21, when sun angles are highest, and March/September 21, when sun angles are at equinox. Photographs in the cloud room simulated an overcast day, which is important due to Seattle's abundant clouds and rain. These photos give an visualization of how these Light Spaces would actually perform. Below and on the next few pages, the photographs show how the space changes seasonally and hourly.

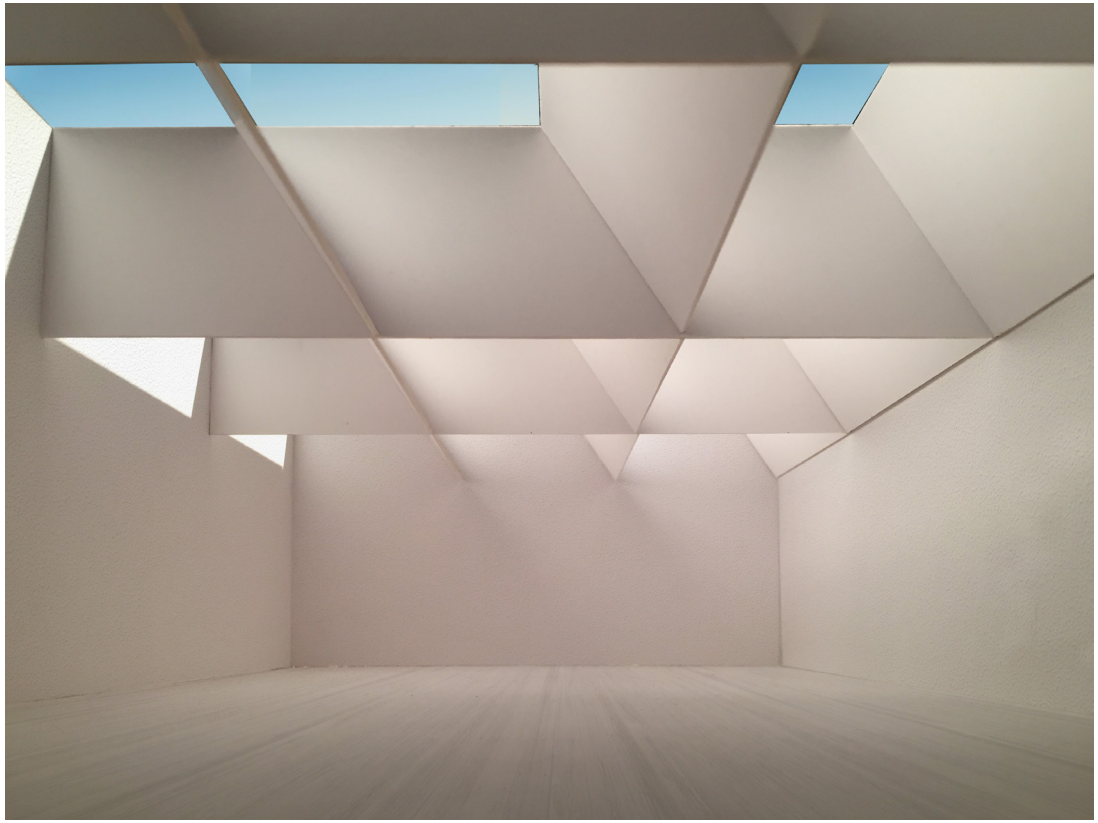


Fig. 111. March/September 21, 11 am: Louvers bounce all direct light, resulting in a diffused space.

Fig. 112. March/September 21, 11 am

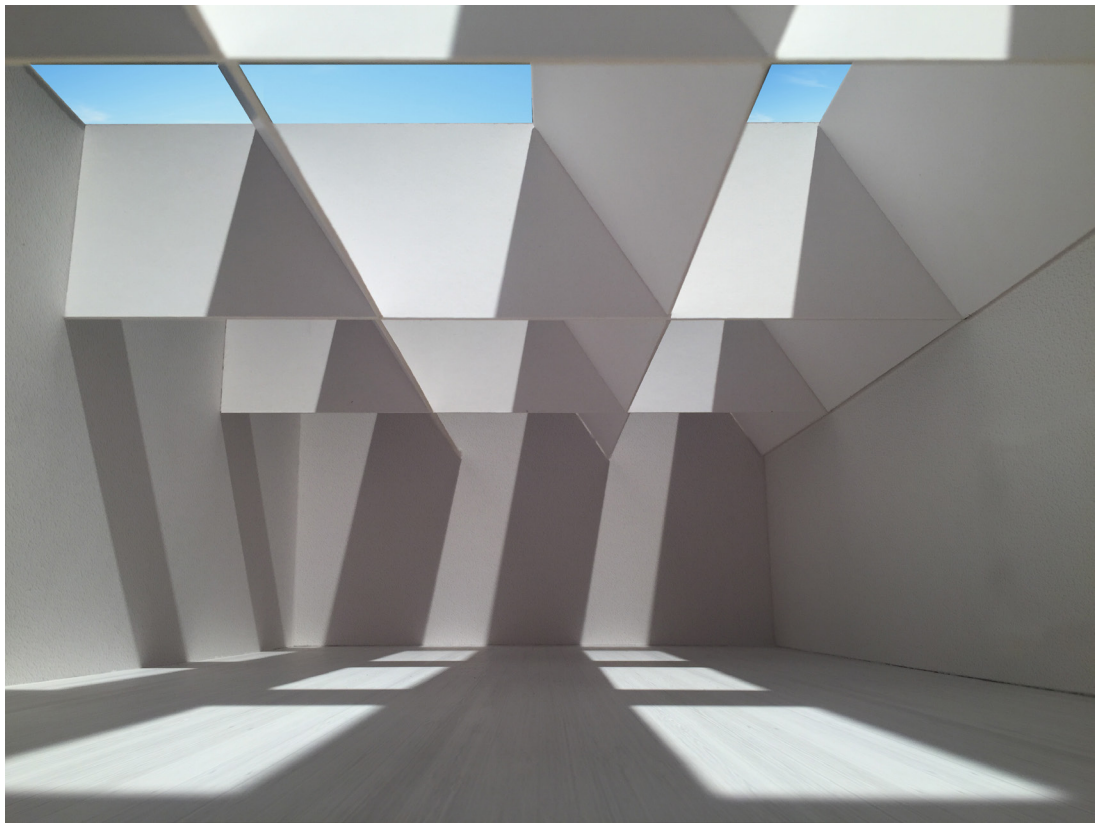


Fig. 113. June 21, 12 pm: High sun angles allow sun to penetrate the space, resulting in a pattern of light volumes on the walls and floor.

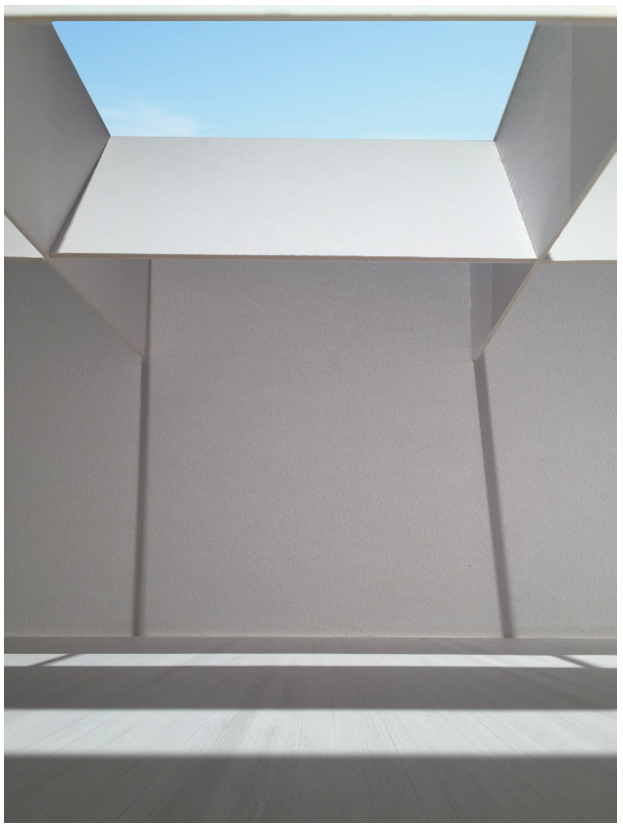


Fig. 114. June 21, 12 pm

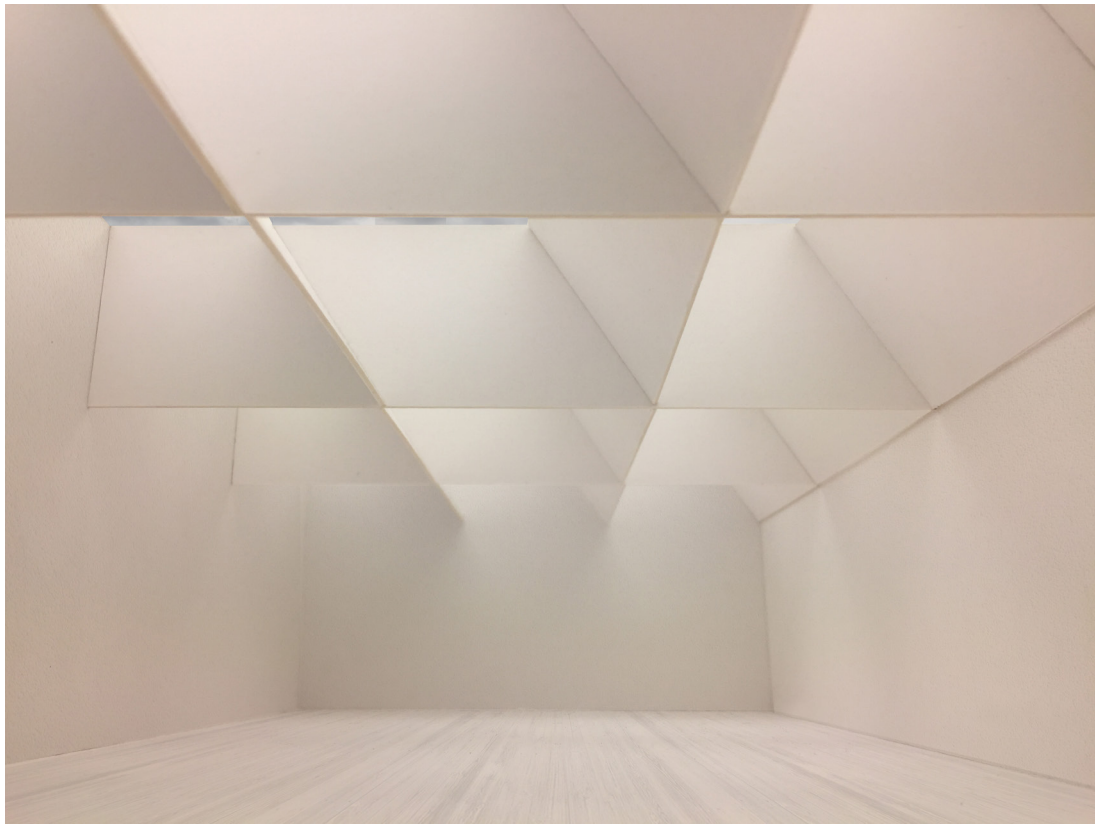


Fig. 115. Overcast: On an overcast day, the clouds diffuse all light and the entire space is illuminated in a soft glow.

Fig. 116. Overcast

The second Light Space encountered is Diffused Light, except for a single sculptural beam of light. One enters this space through a dark hallway that leads toward a beam of light. The ceiling of this hallway forms a shelf that bounces the southern light up into the curved ceiling. The curves catch light, pulling into the space. Windows on the northern wall let in the indirect northern light and views of the sky outside. Section 4 shows a dance practice happening in this space.

On the pier level, the pavilion is full with a gathering for young children and parents. The pier pavilions frame the view at the end of the pier, and also views out to the left. As light bounces off the water onto the surface above, light is experienced in yet another way. On the second floor, a walkway extends from the Light Spaces out toward a view of the city and water outside.

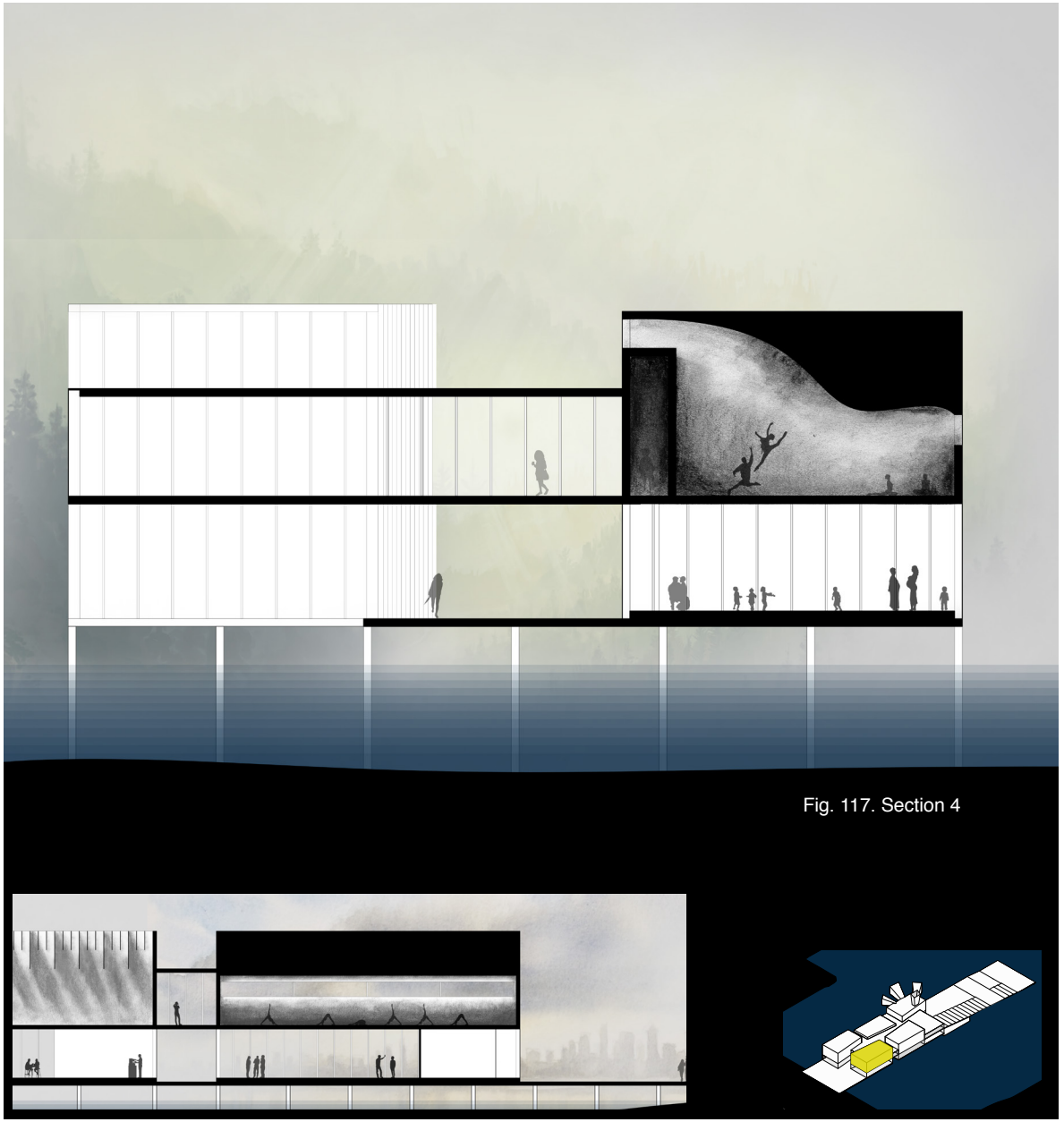


Fig. 117. Section 4

Fig. 118. March/September 21, 12 pm: A beam of light at the end of the entrance hallway.

Fig. 119. March/September 21, 12 pm: The light shelf and curved ceiling block all direct light, except for a single beam.

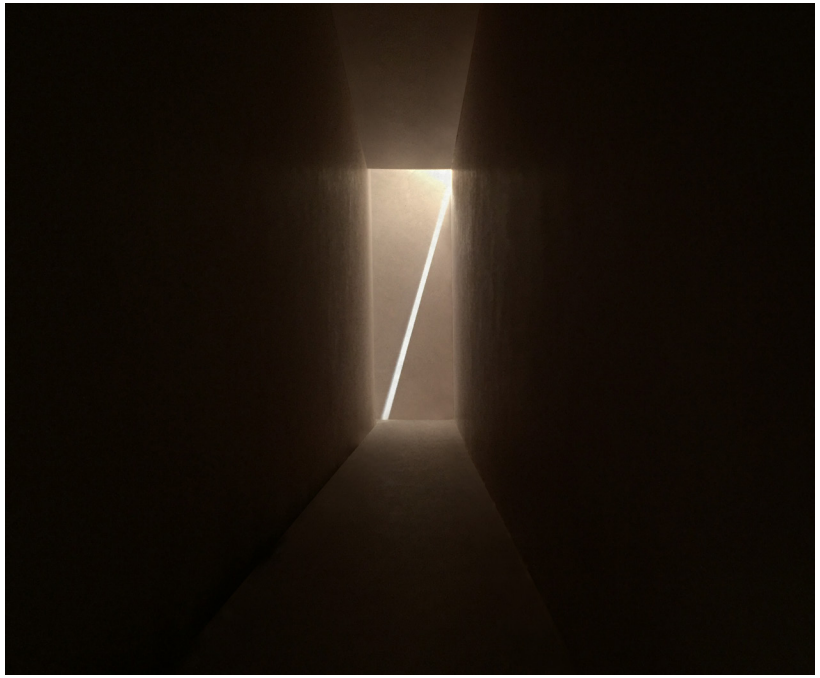


Fig. 120. June 21, 12 pm: The high sun angles are evident in the thin slice of light.

Fig. 121. June 21, 12 pm: Even at the highest sun angles of the year, this space still produces a diffused light quality.

Fig. 122. Overcast

Fig. 123. Overcast: On a cloudy day, the light is more evenly distributed throughout the room.

The third Light Space is Filtered Light. This space horizontally and vertically connects the event center, and is defined by a rhythm of structural mullions. These vertical fins, spaced 4’ on center, allow generous views and light to enter the space, while also concealing view and light. This experience changes as one moves throughout the room. In Section 5, this Filtered Light Space is a sculpture court. In the longitudinal section below Section 5, this space is used for a gala. Again, views are framed at the end of the pier and outward toward the city and the bay.

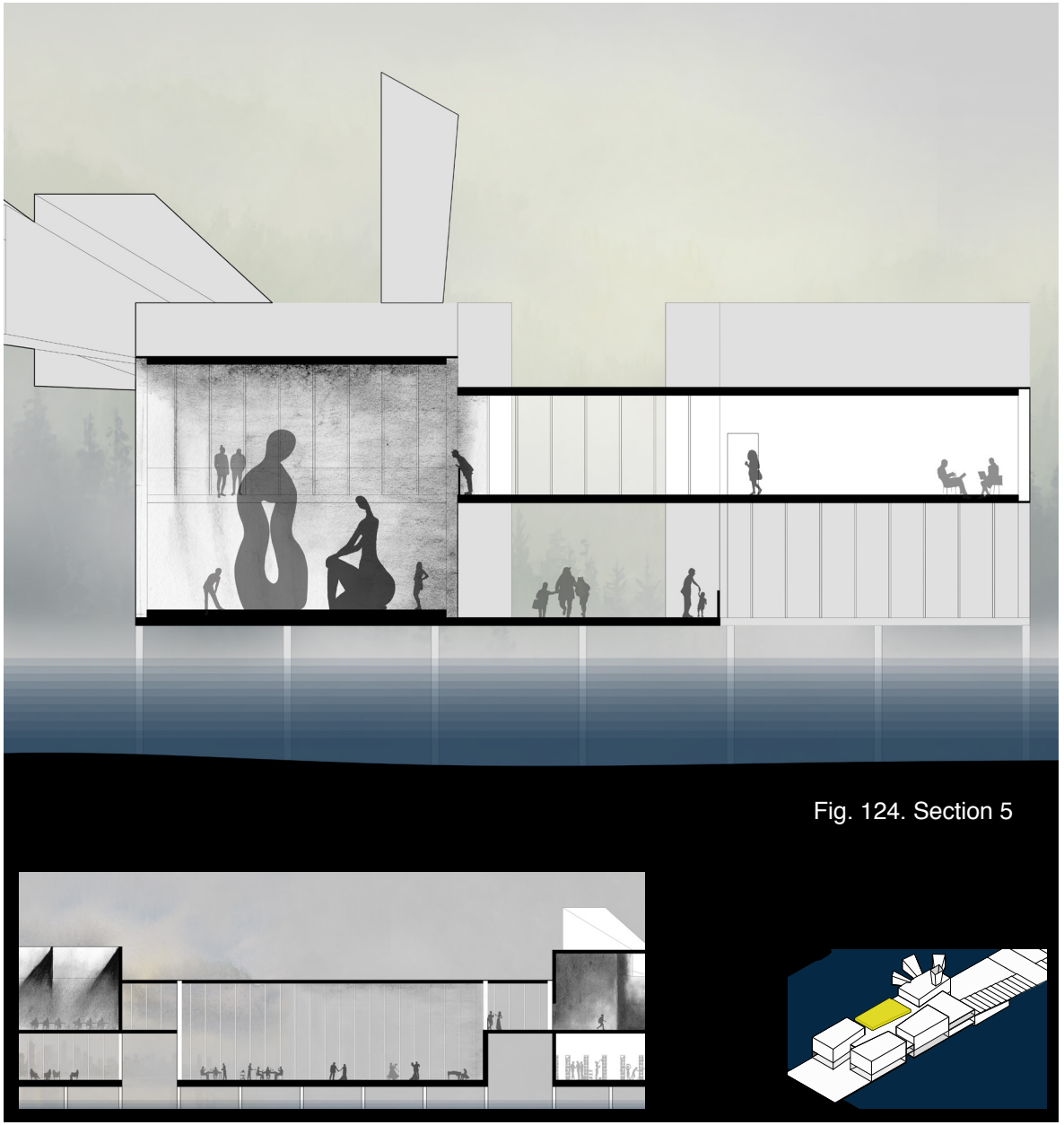


Fig. 124. Section 5

Fig. 125. December 21, 12 pm: Low sun angles penetrate the entire space with previous winter light.

Fig. 126. March/September 21, 1 pm: At the equinox, some sun filters into the space.

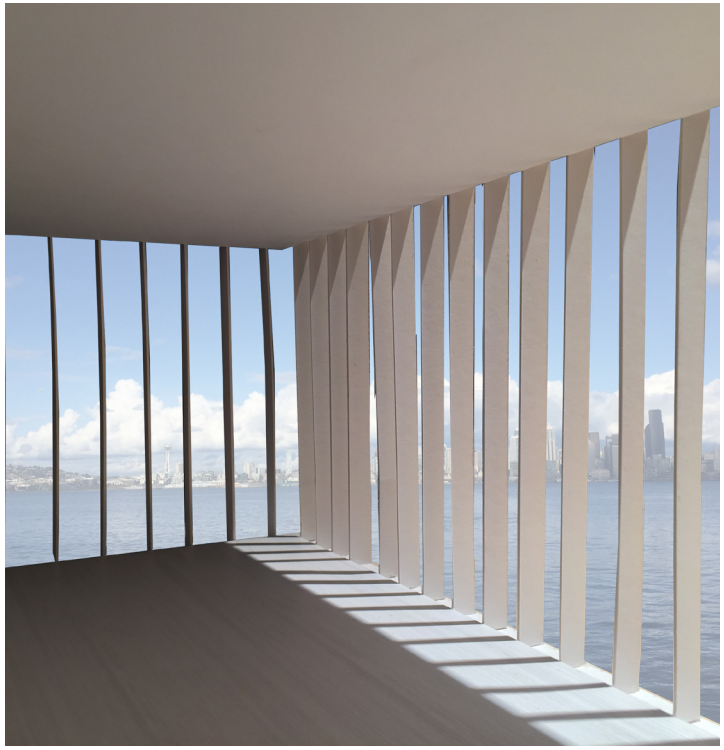


Fig. 127. June 21, 1 pm: The harsh summer sun is blocked.

Fig. 128. June 21, 1 pm

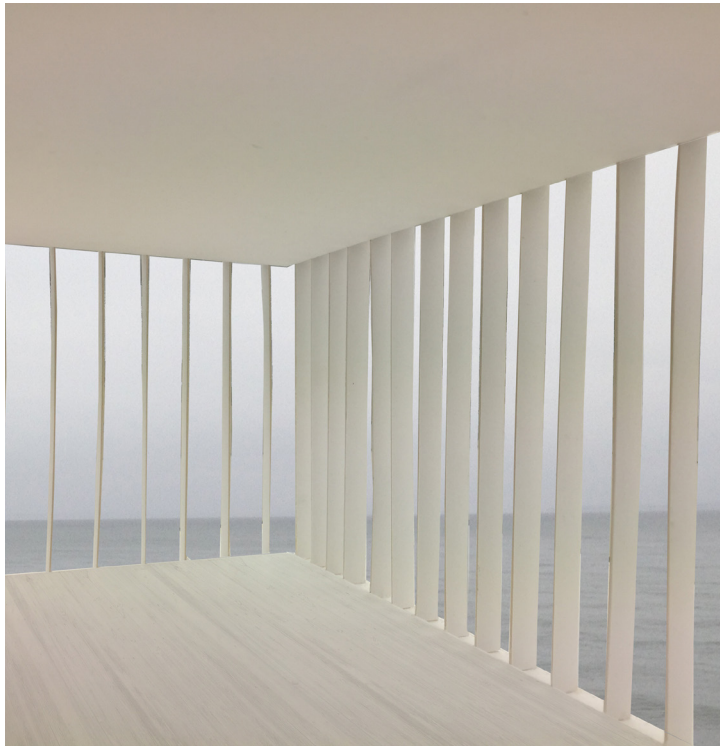


Fig. 129. Overcast: On a cloudy day the entire room is filled evenly with light.

Fig. 130. Overcast

Next, one encounters another Filtered Light Space. 10’ and 5’ deep vertical fins alternate, creating a layering of light and transparencies that varies throughout time of day and year. As the sun gets higher in the sky, more light fills the space. At lower sun angles, the fins block direct light completely and diffusing it evenly. In Section 6, this Filtered Light Space contains an art exhibition.

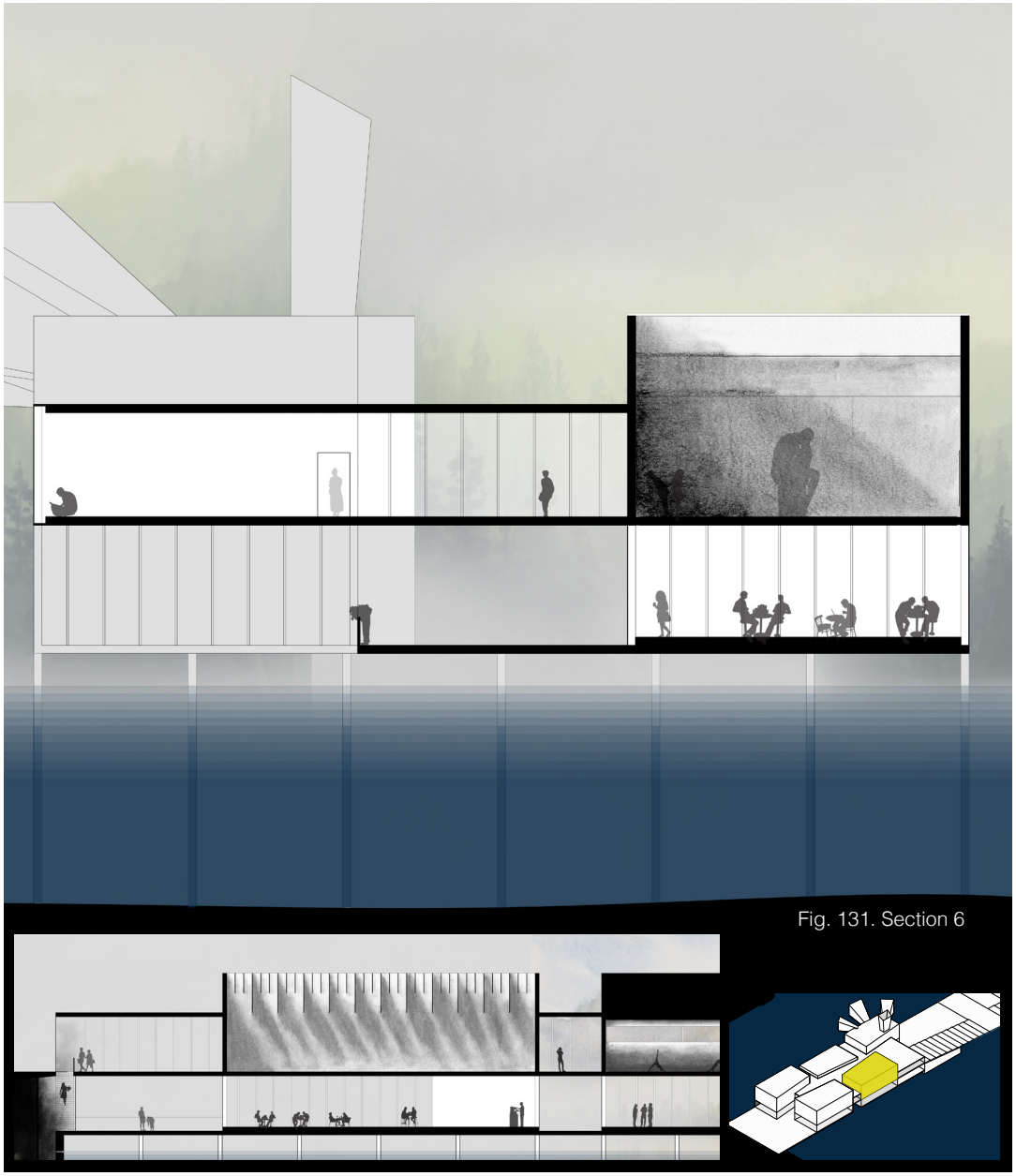


Fig. 131. Section 6

Fig. 132. March/September 21, 12 pm: Stripes of light fall onto the northern wall and floor, while the southern half of the room remains shaded.

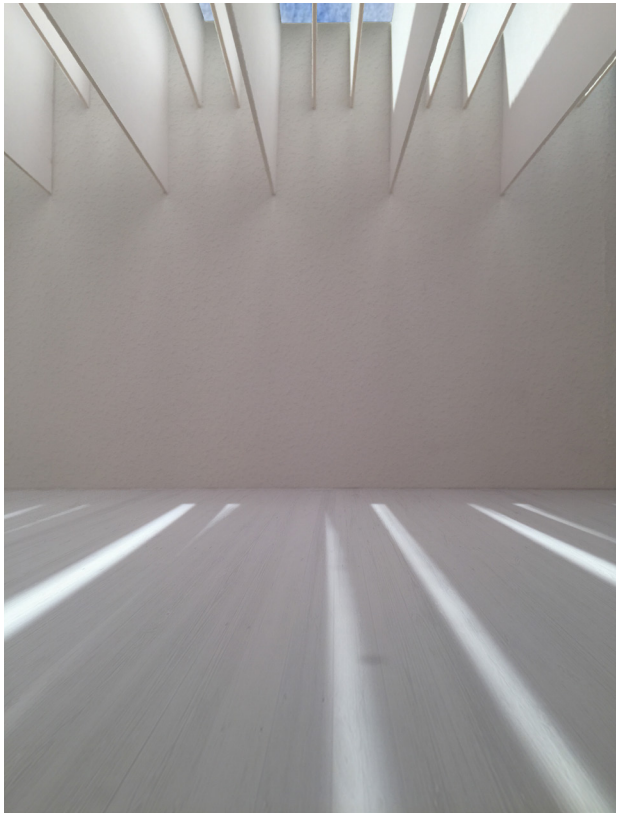


Fig. 133. March/September 21, 3 pm

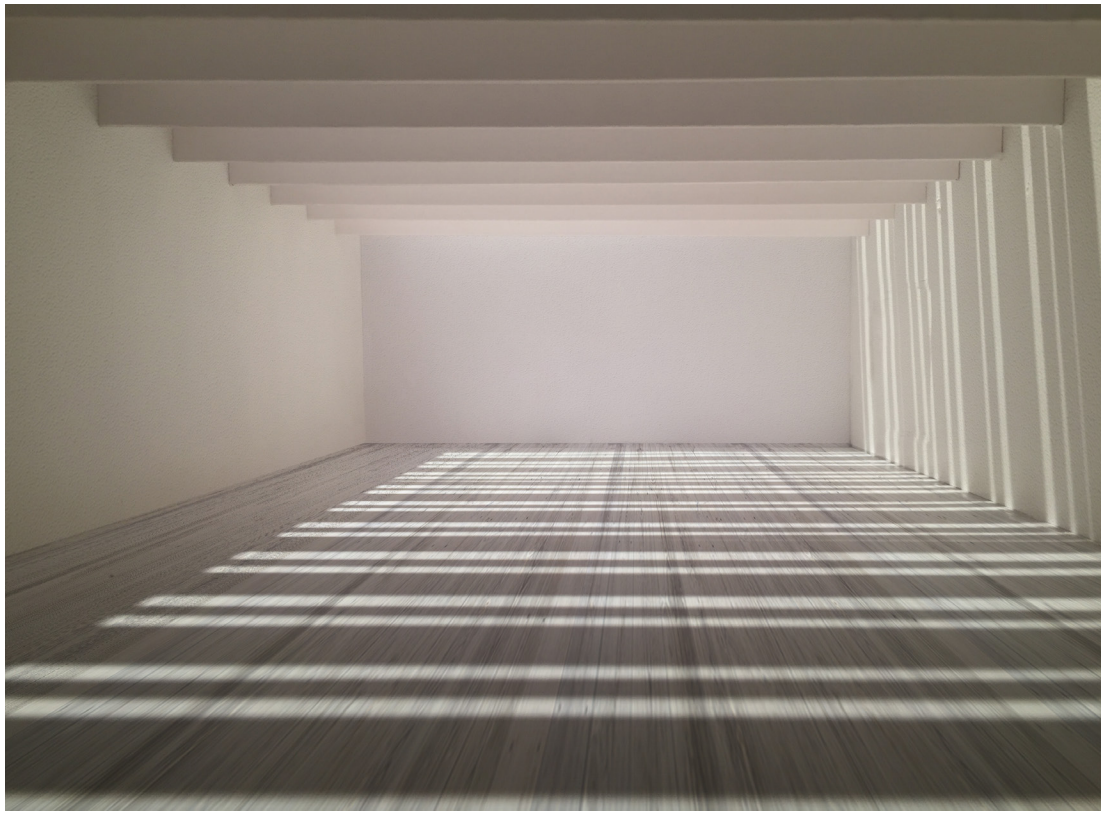


Fig. 134. June 21, 1 pm: The alternating depths of the fins is evident in the varying shadows on the floor and wall.

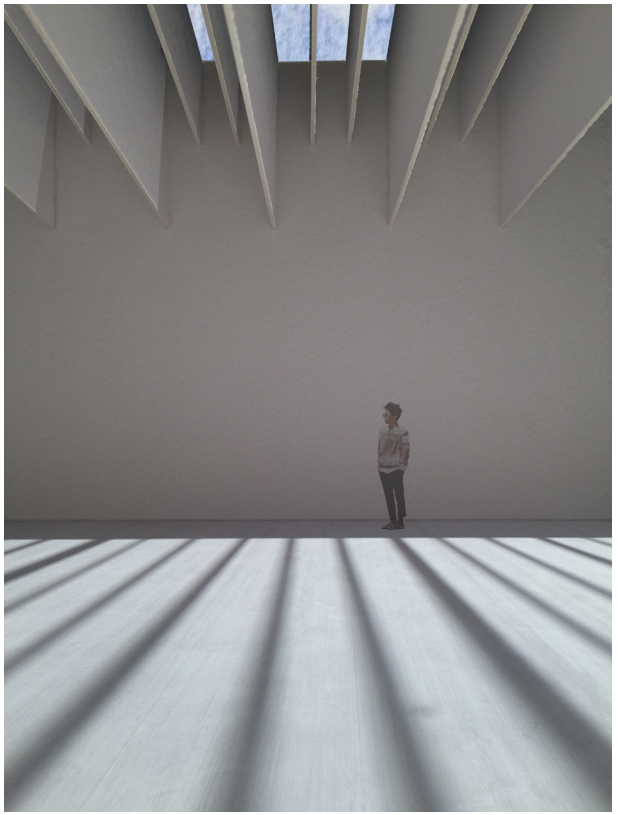


Fig. 135. June 21, 12 pm: The fins not only filter light, but also filter a view of the sky.

Fig. 136. Overcast: The fins accentuate the glow produced by a cloudy sky.

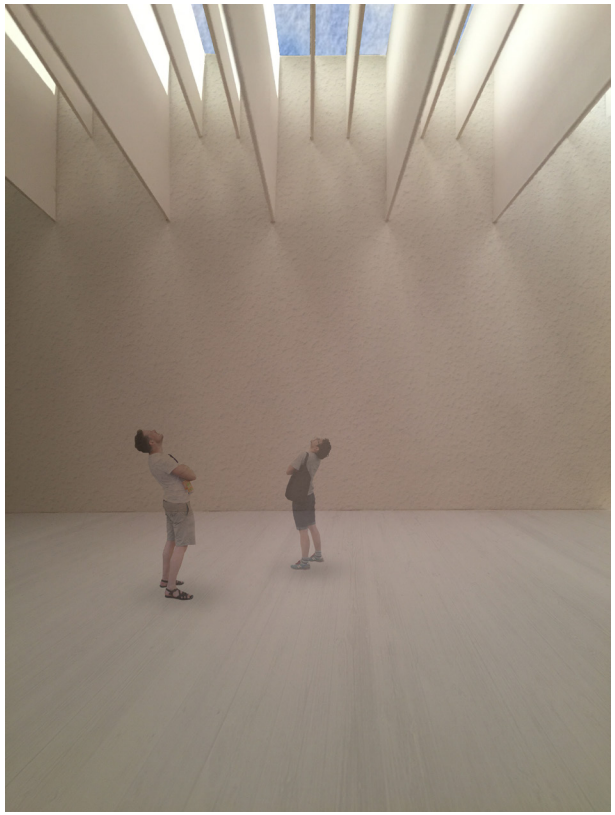


Fig. 137. December 21, 10 am: All sun is reflected from the room.

The penultimate Light Space is Sculptural Light. Four dramatic branches extend from the building, three of which are shaped by the sun angles in winter months: November 1 through February 28. One follows that path of the sun between 9 am and 10 am, another from 12 pm to 1 pm, and a third from 2 pm to 3 pm. These apertures bring the winter into the room, forming volumes of light shaped by the apertures and sun. During the other months, these branches block direct sunlight from penetrating the space and instead catches the light. The result is floating volumes of light. The fourth aperture catches only light from above, creating a channel of light that cascades down the north wall.

Section 7 shows a dance performance in the Sculptural Light Space. Below, the pavilion is a retail store and the pier extends out into increasingly larger areas with more gracious views.

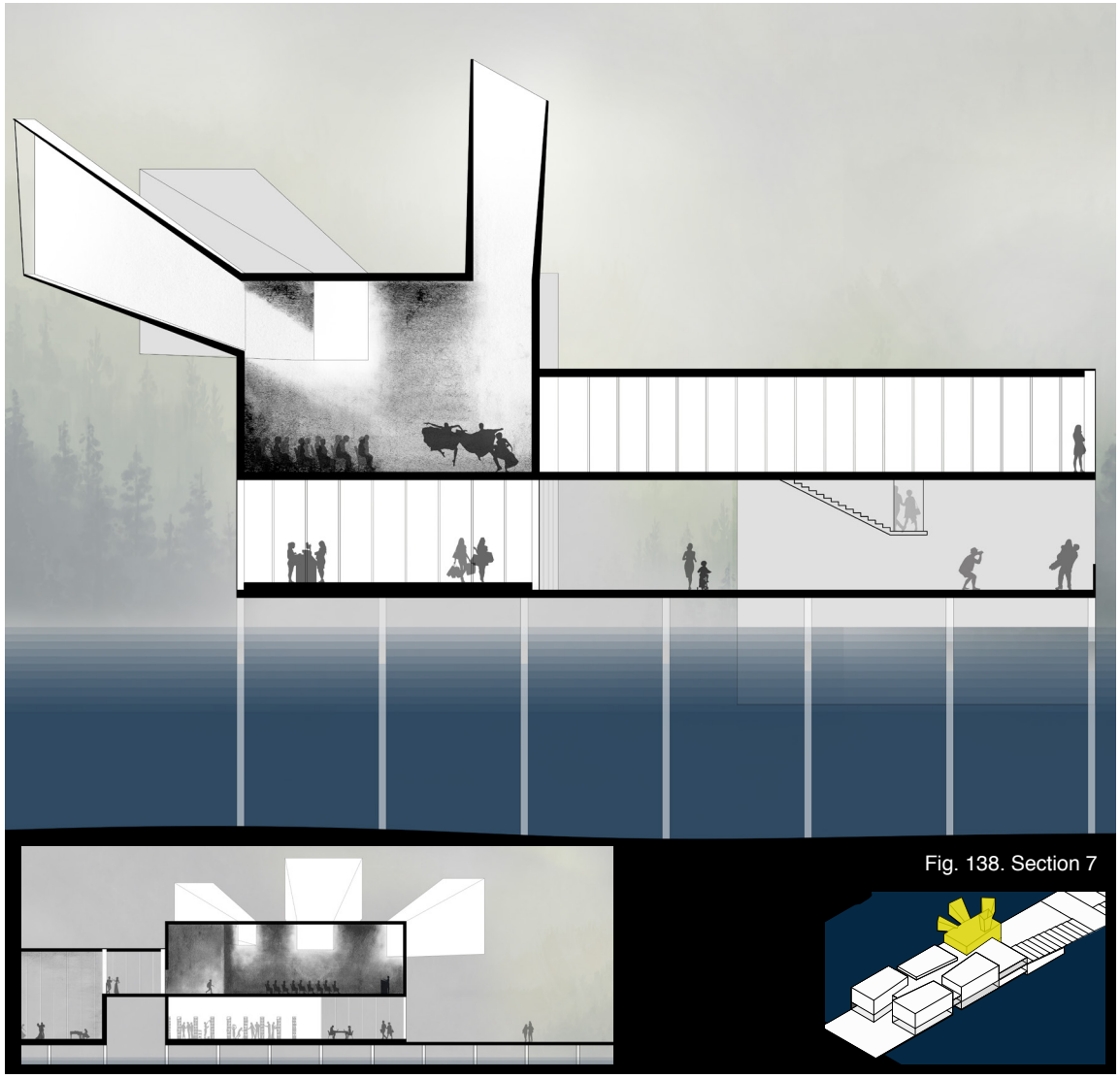


Fig. 138. Section 7

Fig. 139. Dec 21, 1 pm: Volumes of light float in space.

Fig. 140. Dec 21, 10 am: When not catching light, the apertures frame views of the sky.

Fig. 141. Dec 21, 3 pm

Fig. 142. June 21, 12 pm: All direct light is blocked from the room, and the sculptures of light float above head.

Fig. 143. Overcast: Volumes of light illuminate the space from above.

Fig. 144. Overcast

The final Absence of Light Space dives below the pier into the water. As one descends to a dark hallway, openings in the thick, concrete walls lead into the room. These windows coincide with the changing tide: at high tide, the windows are completely covered and water filters all natural light. At low tide, the water touches the bottom of the lowest windows, reflecting light into the room. These small incisions of reflected and filtered light contrast with the shadows, making the darkness seem infinite.

Section 8 shows a meditation class in this space, while the pier steps down to meet the water at high tide.

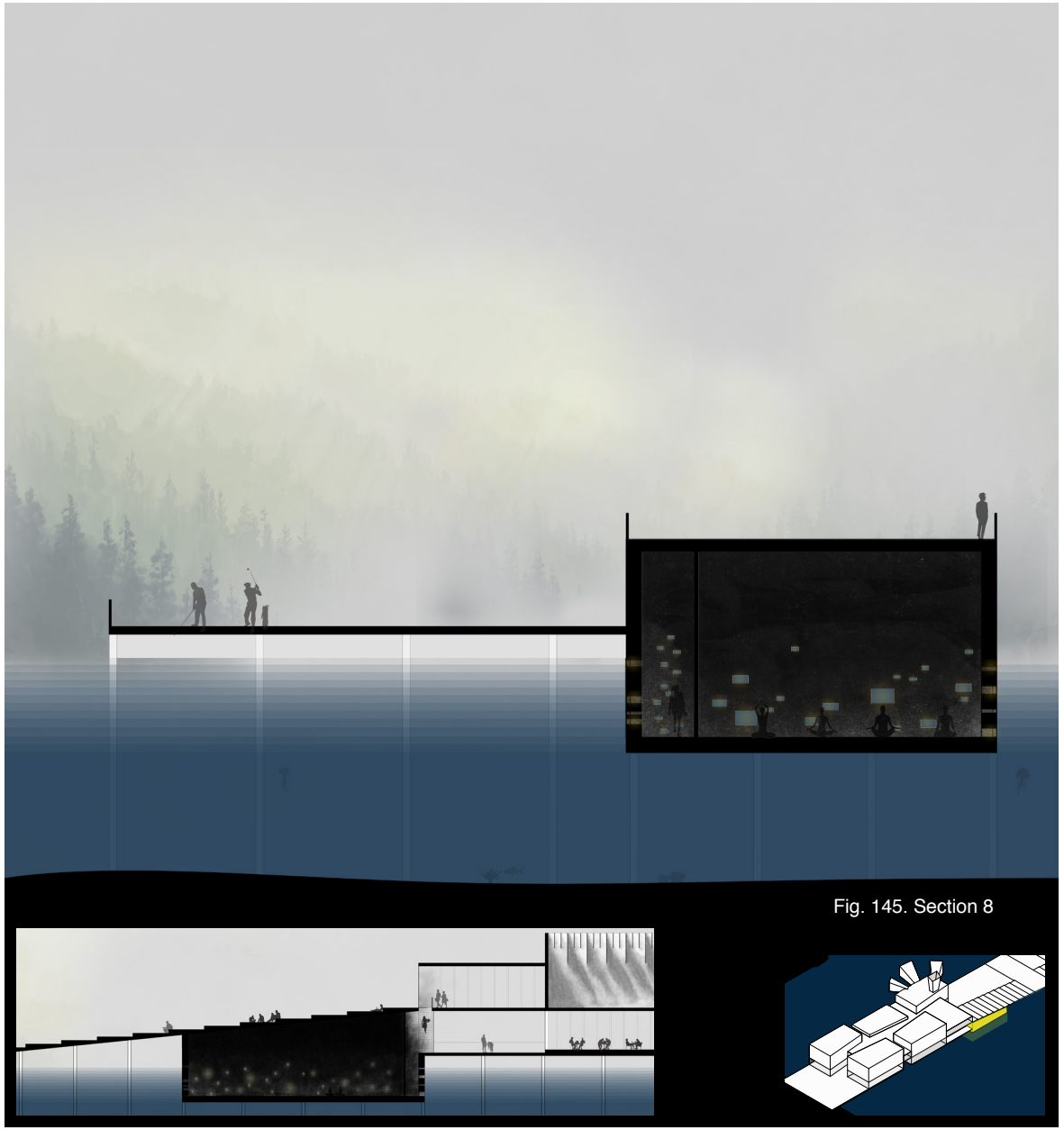


Fig. 145. Section 8

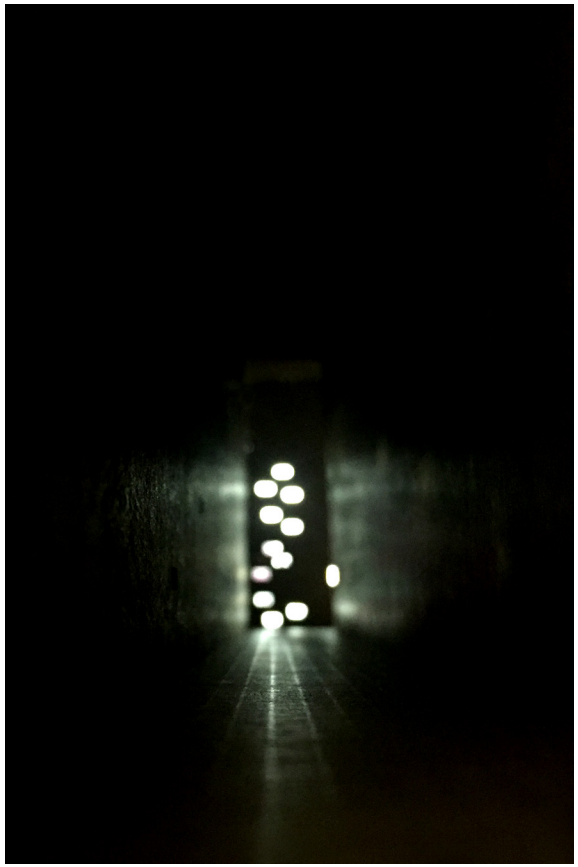
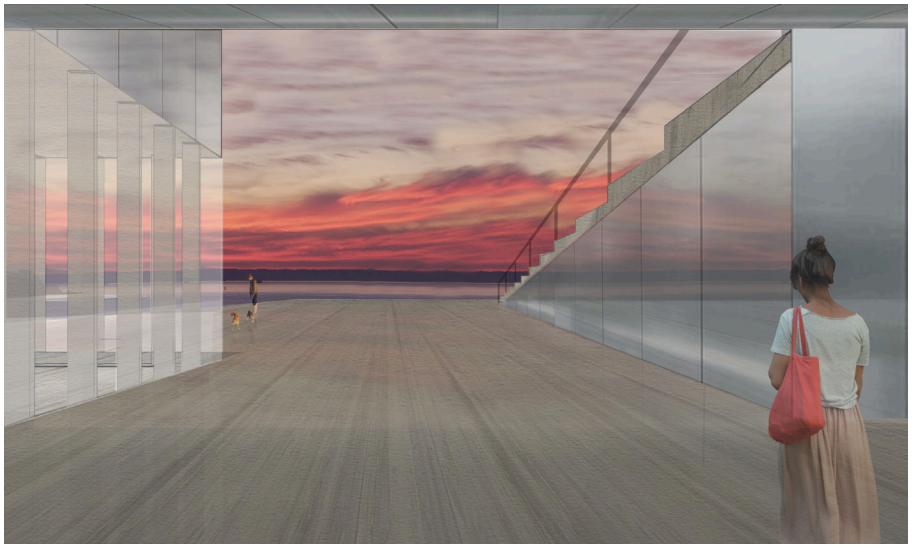


Fig. 146. Underwater: Light reflects off the water at low tide into the hallway.

Fig. 147. Underwater: Light filters through the water at high tide, emphasizing the darkness of the shadows.

Figure 148 shows the contrast to the internal nature of the Light Spaces: framed views looking outward. Together, prospect and refuge connect people with their natural environment through light, air, and views.

In Figure 149, the pavilions on the pier guide the user along the dock toward the end of the pier, where a view of Elliott Bay is framed by the final Light Spaces.



Above: Figure 148. On the second, floor the Light Spaces frame views looking outward. Below: Figure 149. On the pier, the Light Spaces and Pavilions open up to the final framed view of Elliott Bay, West Seattle, and the Olympic Peninsula.

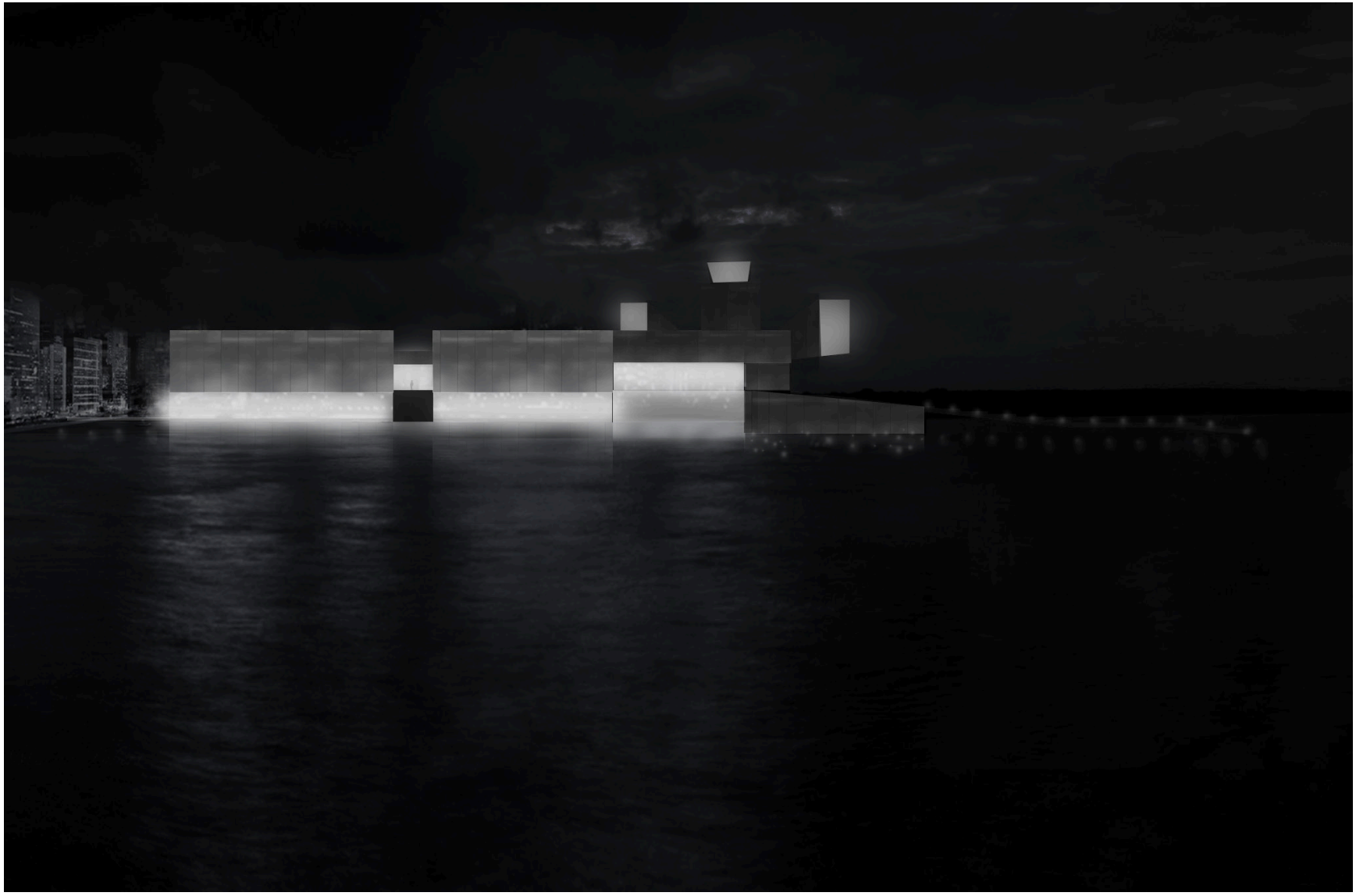
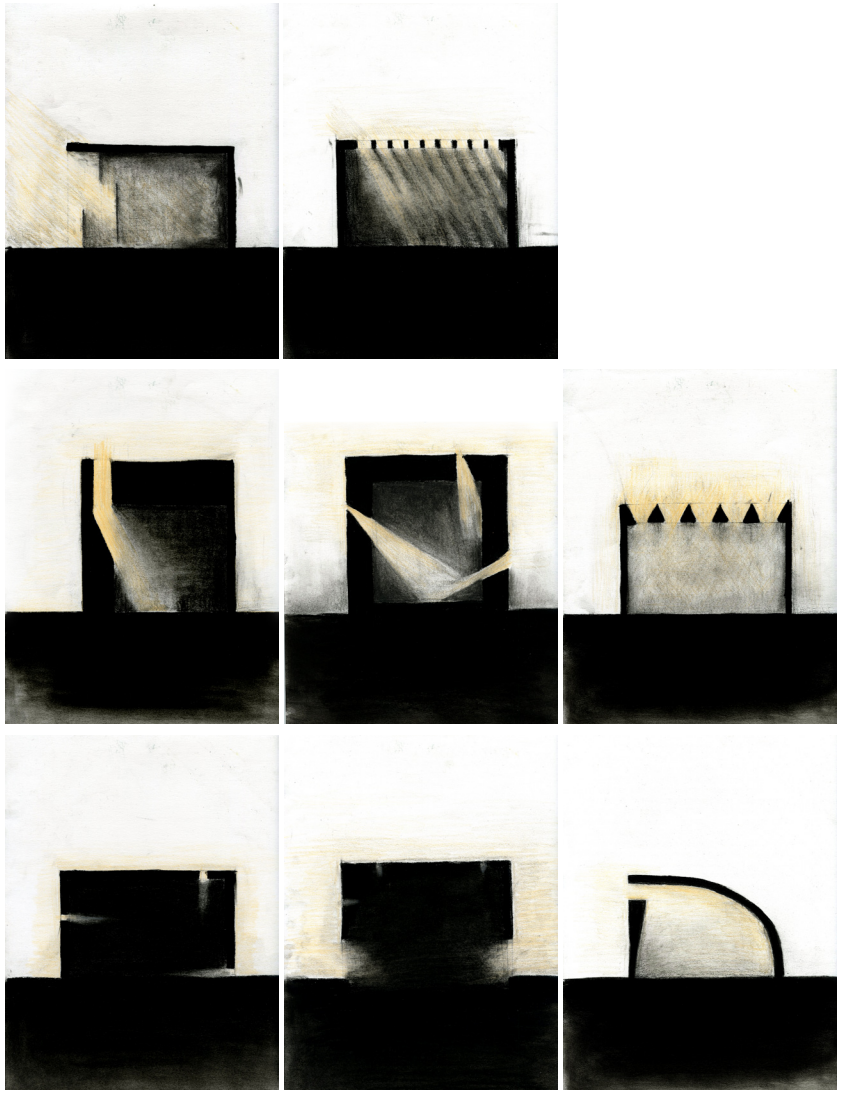


Figure 150. At night, one can experience the same qualities of light in a different way: the light of the pavilions illuminates the pier. Reflecting on the water and the sky, these glowing boxes seem to float out onto Elliott Bay.

6. CONCLUSION

This thesis explores intuitive ideas and concepts about light: of its necessity, but also of its embodiment of the ephemeral concepts of beauty, spirituality, and otherness. Simultaneously temporary and eternal, light is a driving life force that sustains us physically, mentally, and emotionally. As this thesis discovers, architecture is a powerful tool that can harness the richness of light and shadow to create unique experiences that constantly change over minutes, hours, days, and months. This thesis also uncovers the power that lies within architecture as not only a necessity that provides for us physically, but as that which can harness forces of nature to pique the emotional and mental stimuli that fuel and nourish our humanity.



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Works Cited

Beatley, Tim. *Biophilic Cities: Integrating Nature into Urban Design and Planning.* Island Press. 2010.

"Biophilic Cities: What are they?" Biophilic Cities Project. Retrieved from http://biophiliccities.org/what-are-biophilic-cities/. Accessed 7 June 2017.

Co, Franceso Dal. "Light." *Tadao Ando: Complete Works*. London: Phaidon Limited, 1995. Print.

"Djidjila'letch to Pioneer Square: From Native village to Seattle metropolis." Burke Museum of Natural History and Culture. May 2012. https://www.youtube.com/watch?v=5z2q2mxRnns. Accessed May 2017.

Fred, Moody. "Oyster Light in praise of Seattle light", The Weekly, Jan. 21-Jan 27, 1987, Seattle: Seattle's news magazine, Cover page.

Guy, G. B. (2016, May 19). "U.S. Census: Seattle now fourth for growth among 50 biggest U.S. cities." Retrieved from http://www.seattletimes.com/seattle-news/data/us-census-seattle-now-fourth-among-50-biggest-us-cities/. Accessed 7 June 2017.

James Corner Field Operations, CH2MHill, Shiels Obletz Johnsen, Inc. "Design Summary: Concept Design and Framework Plan for Seattle's Central Waterfront." Waterfront Seattle, July 2012. Retrieved from https://waterfrontseattle.org/overview. Accessed September 2017.

Kochuu: Japanese Architecture, Influence & Origin. Dir. Jesper Wachtmeister. Perf. Tadao Ando, Toyo Ito, Sverre Fehn, Kristian Gullichsen. Solaris Filmproduktion, 2003. DVD.

Klingle, Matthew W. "A History Bursting With Telling: Asian Americans in Washington State." Center for the Study of the Pacific Northwest, University of Washington Department of History. Retrieved from http://www.washington.edu/uwired/outreach/cspn/Website/Classroom%20Materials/Curriculum%20Packets/Asian%20Americans/Asian%20American%20Main.html. Accessed 15 May 2017.

Klingle, Matthew. (2008). *Emerald city : An environmental history of Seattle* (Lamar series in western history). New Haven: Yale University Press.

Mende, Kaoru. D*esigning with Shadow: Lighting Design for Urban Environments and Architecture.* Tokyo: Rikuyo-Sha, 2012. Print.

"Mortensrud church / JSA" 31 Aug 2011. ArchDaily. Retrieved from https://www.archdaily.com/1929/mortensrud-church-jsa/. ISSN 0719-8884. Accessed 15 May 2017.

Nickelsburg, Monica. (2016, July 12). "Seattle region's population growing at historic pace, making biggest annual gain in a century." Retrieved from https://www.geekwire.com/2016/seattle-regions-population-growing-historic-pace-making-biggest-annual-gain-century/. Accessed 7 June 2017.

NOAA Sun Calculator. Retrieved from https://www.esrl.noaa.gov/gmd/grad/solcalc/azel.html. Accessed. 15 June 2017.

Norberg-Schulz, Christian. *Nightlands: Nordic Building*. London, England. The MIT Press. 1996.

"Nordic Influence in Pacific Northwest Cities." Museum of the City. Retrieved from http://www.museumofthecity.org/project/nordic-influence-in-pacific-northwest-cities/. Accessed 18 May 2017.

Pacific Coast Architecture Database (PCAD). Retrieved from http://pcad.lib.washington.edu/building/15413/. Accessed 28 September 2017.

Pallasmaa, Juhani. "The Northern Dimension: Between Universality and Locality." *Modern North: Architecture on the Frozen Edge.* By Julie Decker. New York: Princeton Architectural, 2010. Print.

Plummer, Henry. *Light in Japanese Architecture.* Tokyo, Japan: A+U Pub. 1995.

Plummer, Henry. (2012). *Nordic light : Modern Scandinavian architecture.* New York: Thames & Hudson.

Schielke, Thomas. "Light Matters: Heightening The Perception Of Daylight With Henry Plummer (Part 1)." ArchDaily. 3 May 2015. Retrieved from http://www.archdaily.com/626181/light-matters-heightening-the-perception-of-daylight-with-henry-plummer-part-1/. Accessed 18 May 2017.

Takami, David. A. "Japanese Immigration to the Puget Sound Region." History Link. Oct 1998. Retrieved from http://www.historylink.org/File/300. Accessed 10 Sep 2017.

"Waterlines." Burke Museum of Natural History and Culture. 2009. Retrieved from. http://www.burkemuseum.org/static/waterlines/index.html. Accessed 15 June 2017.

Young, Kristen Millares. "Port takes step to sell Pier 48 to the state," Seattle Post-Intelligencer, July 8, 2008. Accessed 16 June 2017.