LIGHT AS A NARRATIVE OF PLACE: EXAMINING THE HUMAN EXPERIENCE OF DAYLIGHT IN PUBLIC BUILDINGS IN NORTHERN CITIES

by

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ABSTRACT

This thesis will explore how architecture and daylight can be used as a narrative to create a human experience reflective of place. This will be explored through public buildings in large metropolitan cities in Nordic countries. This region is of interest because of the latitudinal realities which emphasize dramatic annual and daily differences in lighting conditions. By exploring the experience of the built environment in this region, the intuitive and learned skills of Architects can be understood and we can begin to explore how they deal with daylight by manipulating volume, temporality, materiality and the aperture. The goal of this thesis will ultimately be to test through the design of a public building in Rinkeby, Stockholm, how intentionally shaping daylight can be a design driver that seeks to bring together the light which so specifically shapes the northern climate and the people that inhabit that region.

GLOSSARY

Aperture: The device through which daylight enters space. Ex, a window, skylight, screen.

Altitude: The angle between the object and the observer's local horizon. For visible objects it is an angle between 0 degrees and 90 degrees.

Azimuth: The direction of a celestial object from the observer, expressed as the angular distance from the north or south point of the horizon to the point at which a vertical circle passing through the object intersects the horizon.

Incident Light: A ray of light that strikes a surface. The angle between this ray and the perpendicular or normal to the surface is the angle of incidence.

Luminosity: The perceived light by an observer in a space often thought of as light in a space.

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CHAPTER 1: INTRODUCTION

Thesis Question

How can architecture and daylight be used to create a poetic human experience reflective of place?

Daylight and Architecture

The role light plays in the built environment has a unique duality: it speaks to the poetic and the tectonic. It has both qualitative and quantitative attributes and our relationship to it as humans has been intrinsic to our existence since the beginning of time. The beauty of light is that we have a unique ability as Architects to shape apertures that directly affect the human perception of space.

The way light is perceived by humans has always been based on place. We understand that extreme changes in our perception of light are influenced by geography, meteorology, changing seasons, and time of day. Scandinavia is unique in that its urbanity lies in relatively extreme latitudes where daylight can vary from nearly non-existent to overwhelmingly present. There is also a rich history of architects in this region developing a methodological system for designing spaces that speaks to people through the medium of daylight, connecting them to place.

As society continues to urbanize, the metropolis will continually become an epicentre for humans to exist. In these cities, public space is the social condenser that removes us from our sometimes insular physical and digital lives. As a typology, public space can exist in the realm between our working lives and our domestic lives and it has the unique opportunity to speak to us about our place and our culture. Rem Koolhaas, defines a social condenser as "the programmatic layering upon vacant terrain to encourage dynamic coexistence of activities and to generate through their interference, unprecedented events."[1] Public space offers interactions that enrich and enliven our existence both on a personal and communal level.

This thesis seeks to examine how architecture and daylight can offer a narrative of place.

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1 Rem Koolhaas, *Content* (New York: Taschen, 2004), 73.

Gernot Böhme emphasizes that "as an architect, you sometimes take for granted the fact that you are the author of atmospheric conditions, without taking the user into account."[2] The goal of this thesis is to begin to understand one of those atmospheric conditions, namely daylight, as a tool to speak to users about place. If one infers that the modulation of daylight in space is one method with which the Architect has to speak to people about place, then this thesis will explore how the modulation of daylight in a public space in the northern city of Stockholm can speak to a demographically diverse neighbourhood about both the diversity of light experiences from the multiplicity of regions represented, and the light equally characteristic of the region they currently find themselves. It will also explore how architecture can be used as an educational tool to inform people of the relationship of space, time, and light.

2 Gernot Böhme, *Atmospheric Architectures: The Aesthetics of Felt Spaces* (Chichester: Wiley Academic Press, 2005), 22.

CHAPTER 2: ARCHITECTURAL TOOLS FOR MOLDING AND MANIPULATING LIGHT

Introduction

One of the aims of this thesis is to better understand the way in which architecture interacts with daylight and to do so, one needs to understand the tools of the architect and the parameters within which that dynamic relationship exists. Instead of examining that relationship through the lens of existing daylight metrics which can typically be divided into two categories, namely task-plane illumination and discomfort-glare metrics, Siobhan Rockcastle and Marilyne Andersen from the EPFL in Lausanne argue that the field of daylight study in architecture is lacking in how it assesses the "human preference toward the field-of-view that does not currently account for spatial and temporal diversity of lighting effects from an occupants perspective."[3] Their research explores how the categorization of the composition of light and shadow and its strength and variability over time is a vital metric for exploring the relationship of daylight and architecture and how that affects the users of that space. This research has been an important launching point for this thesis as it begins to quantify a topic that has been often cast in a phenomenological light. I aim to take this research and begin to explore the way in which it can inform daylight design and how it speaks to the ability of the Architect to mold and manipulate light. I also will explore the cultural and embodied memory implicit in the modification of light in space and examine how the design of a building which places the modification of daylight as a priority instead of an afterthought can serve as a marked change in the design process.

The following diagrams in this chapter will study how a hypothetical space, located at 59 degrees north latitude, the same as Stockholm, can explore categories like aperture, temporality, materiality, and volume. The studies use a rotated volume that allows different apertures to be tested and learned from. They also use alternating program to offer variation. These studies are carried out using Rhinoceros, a 3D modelling software and V-Ray, a rendering plug-in to simulate light and materials.

3 Siobhan Rockcastle and Marilyne Andersen, "Celebrating Contrast and Daylight Variability in Contemporary Architectural Design: A Typological Approach" (presentation at LUX EUROPA, Krakow, Poland, September 17-19, 2013), 6.

Temporality

One of the unique aspects of designing with daylight involves the way in which light is a transient and impermanent aspect of an often fixed and permanent built environment. We can only begin to understand it by examining the effects of light on a space over the course of a day and over the course of the year. The way in which it changes in altitude, azimuth, and intensity are key factors in taking a preliminary examination of daylight and the built environment. "While spatial diversity can be analysed within a static image, temporal diversity (resulting from daylight) requires a multitude of images taken throughout the year to help designers evaluate the strength and diversity of contrast-based perceptual effects over time."[4] It is only through the examination of light in space over time that architects can truly design with daylight in mind. The temptation of capturing the atmosphere of a space in a minute or a moment can be great, especially as it applies to architecture, but it is only through a comprehensive understanding of the way in which light is transformed in space over time that allow designers to fully grasp this dynamic and rich relationship. Juhani Pallasmaa states that "we have the mental need to experience the reality that we are rooted in the continuity of time, and in the man-made world it is the task of architecture to facilitate this experience."[5] It is therefore essential that we facilitate that need through the study of how light works in space over time. It is also an opportunity to remember that architecture and the aperture act as a marker of time. It can be an opportunity for the architect to remind an inhabiter of a space that we exist in this continuum of time and can use light as a tool to fixate on the impermanent, the ephemeral.

The following studies explore how light changes in space over time and how different apertures alter the temporality of light in a space. One can see how qualities like colour tone, incident light angle, and shadow contrast drastically differ throughout the year. Using three different test apertures, namely high, medium, and low contrast and variability and a fixed location of 59 degrees north latitude where Stockholm is located, one can begin to learn from the changes in time of day and time of year and design with temporality in mind.

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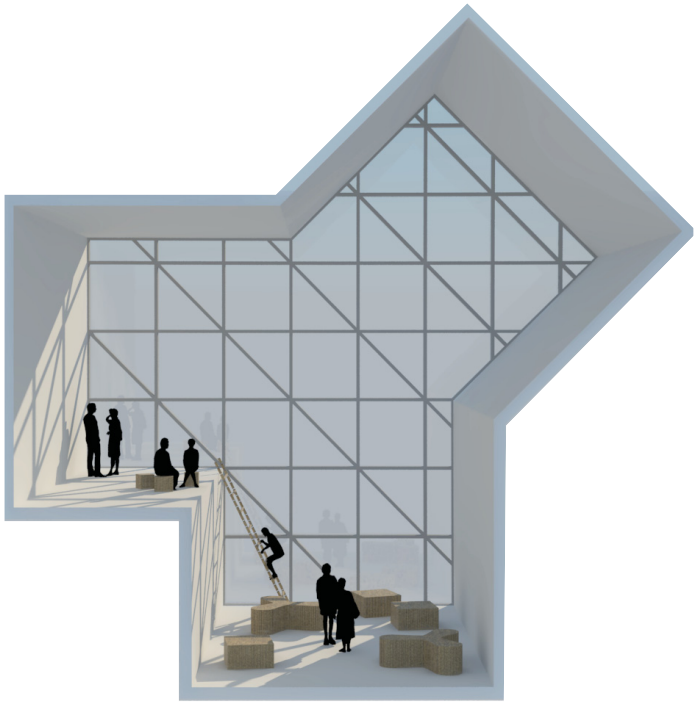
4 Siobhan Rockcastle and Marilyne Andersen, "Celebrating Contrast and Daylight Variability in Contemporary Architectural Design: A Typological Approach" (presentation at LUX EUROPA, Krakow, Poland, September 17-19, 2013), 5.

5 Juhani Pallasmaa, *The Eyes of the Skin: Architecture and the Senses* (New York: Bloomsbury Academic Publishing, 2005), 22.

Figure 1: Temporality: High Contrast, High Variability. Exploring the way time affects the experience of daylight in space over the course of one day and over the course of a year, specifically looking at summer and winter solstices and spring and fall equinoxes. These example spaces use the geographic location of Stockholm at 59 degrees north latitude on a cloudless day, looking south, as a basis for the study. The aperture is composed of clear glass and large dynamic openings which let in side light. The form of the space is a fixed volume that is rotated and alternates program for variation. The study uses the 3D modelling software Rhinoceros and the rendering software V-Ray to simulate light at specific moments.



March 21: 15:00

June 21: 15:00

Figure 2: Temporality: High Contrast, High Variability. Zooming in on two specific examples from the previous matrix, one can see how the colour, angle and intensity of light differ at the exact same time but on different days of the year.

Figure 3: Temporality: Medium Contrast, Medium Variability. Exploring the way time affects the experience of daylight in space over the course of one day and over the course of a year, specifically looking at summer and winter solstices and spring and fall equinoxes. These example spaces use the geographic location of Stockholm at 59 degrees north latitude on a cloudless day, looking south, as a basis for the study. The aperture is composed of clear glass and horizontal 6" deep louvres which shade the light. The form of the space is a fixed volume that is rotated and alternates program for variation. The study uses the 3D modelling software Rhinoceros and the rendering software V-Ray to simulate light at specific moments.

December 21: 12:00

March 21: 12:00

Figure 4: Temporality: Medium Contrast, Medium Variability. Zooming in on two specific examples from the previous matrix, one can see how the colour, angle and intensity of light differs at the exact same time but on different days of the year.

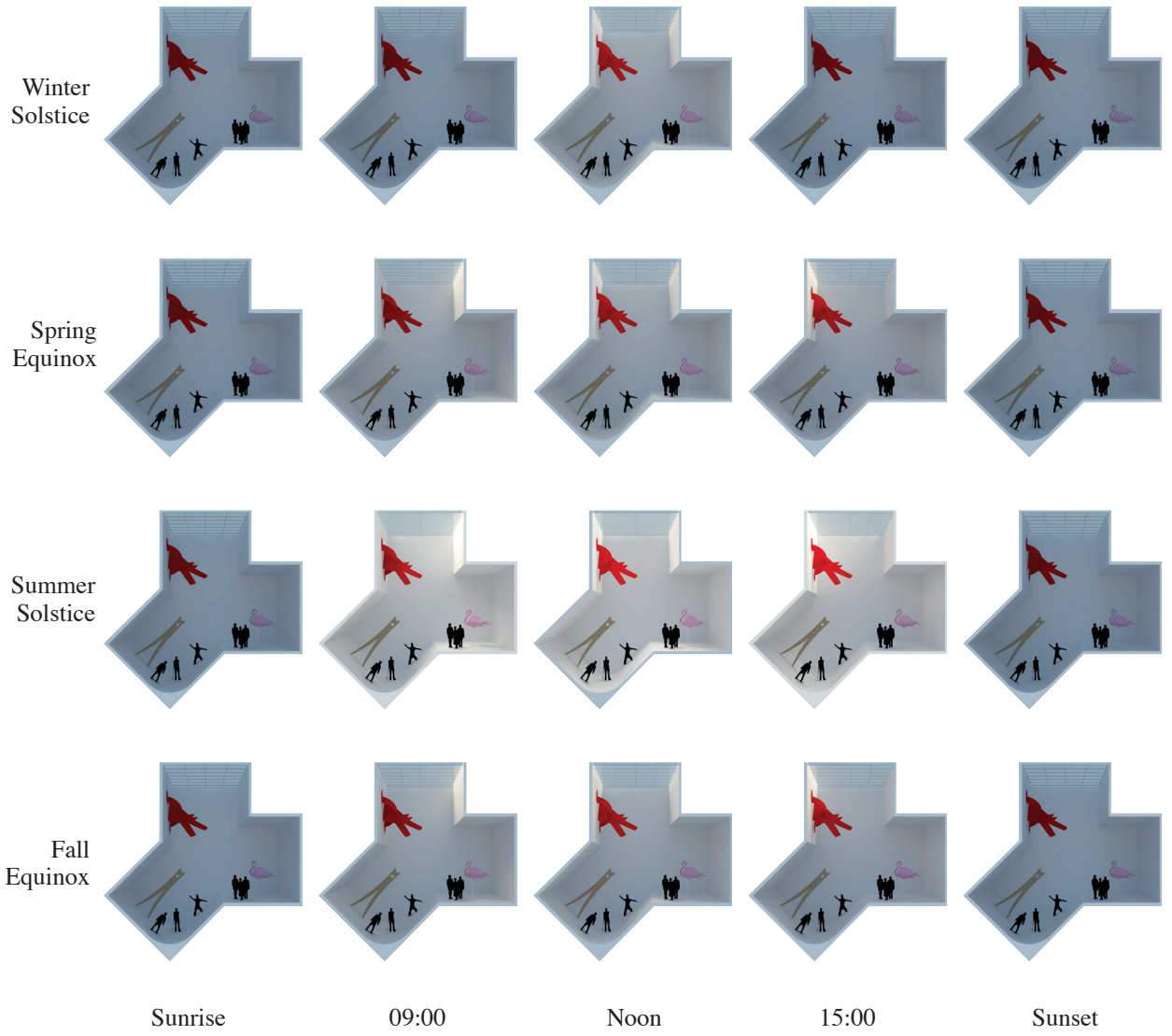


Figure 5: Temporality: Low Contrast, Low Variability. Exploring the way time affects the experience of daylight in space over the course of one day and over the course of a year, specifically looking at summer and winter solstices and spring and fall equinoxes. These example spaces use the geographic location of Stockholm at 59 degrees north latitude on a cloudless day, looking south, as a basis for the study. The aperture is composed of two layers of diffuse glass which allows diffuse top light in. The form of the space is a fixed volume that is rotated and alternates program for variation. The study uses the 3D modelling software Rhinoceros and the rendering software V-Ray to simulate light at specific moments.

December 21: 12:00

March 21: 12:00

Figure 6: Temporality: Low Contrast, Low Variability. Zooming in on two specific examples from the previous matrix, one can see how the colour, angle and intensity of light differs at the exact same time but on different days of the year.

By testing lighting temporality in built space with these three categories of aperture at five different times of the day, over the four extremes of lighting conditions namely the equinoxes and solstices, it becomes clear that temporality in built space is intrinsically connected with the way in which an aperture allows or disallows variability over the course of the day. This connection proves as invaluable when exploring how to elicit both programmatically appropriate daylighting for spaces, and whether that lighting aligns with regionally similar qualities of light, or differs from it. It firmly places the intent of a malleable and changing entity like daylight in the hands of the architect.

Volume

While light might be ephemeral and intrinsically temporal, one of the greatest attributes that conveys its existence is the volume of the space in which it inhabits. James Turrell hints at this by saying that his "central aim in the perception of light is in giving it a thingness. It exists just as a physical object has presence. I make thingness of perception by putting limits on it in a formal manner."[6] One of the techniques of formally putting limits on light is by understanding and controlling the volume within which it inhabits. Whether a space is drum-like and rotund like the Stockholm Public Library by Gunnar Asplund, reflecting light in many directions, or billowing and cloud-like, similar to Bagsværd Church by Jørn Utzon, which gently curves light down to the church alter, the way Architects address volume is key in understanding how light is shaped. We understand that primary, secondary, and tertiary reflections of light are directly controlled by the volume of the space within which light is housed. Many standards for glazing use volume as a ratio to determine good practice dimensions for windows and making sure sufficient light will enter the space. Beyond these preliminary calculations for designing with daylight, we can begin to explore how different volumes function and how the perception of light in space is altered by the relationship between volume and light. We can move beyond the empirical and explore the integral. Steven Holl states that "space is oblivion without light. A building speaks through the silence of perception orchestrated by light. Luminosity is as integral to its spatial experience as porosity is integral to urban experience."[7] This luminosity which is the proper term for what we often think of as the visual perception of light, is directly controlled by the volume which houses that light. The following studies explore how the same aperture with varied volumes offer different experiences of light in space.

6 James Turrell, Richard Bright, and Paul Schütze, *Eclipse* (Berlin: Hatje Cantz Publications, 1999), 39.

7 Jakob Schoof "Designed for All Senses: the Architecture of Steven Holl," *Daylight & Architecture* 27, no. 1 (2017): 22.

Figure 7: Volume: Exploring the way volume affects the way we experience light in space.

Materiality

Light and materiality have an important relationship with each other. While volume plays a key role in the way light is perceived, materiality holds an equally vital place in molding light and space. “Materials are key to understanding light in architecture because they directly affect the quantity and the quality of the light. Two qualities of materials - their finish and their colour - are most important in this regard.”[8] These two qualities, Professor Marietta Millet of the University of Washington argues, are the major determining factors in how materials interact with light. The finish of a material determines the way in which light is reflected. With a textured surface, light is scattered and diffused and with a more glossy finish, light, like a mirror, is more directly reflected. When examining the colour of a material, we can narrow the field to the value of that colour. Millet states that a “white wall reflects approximately 82 percent of incident light, a yellow wall 78 percent, a dark green or blue wall seven percent [and] coloured surfaces lend some of their hue to the light that is reflected.”[9] This is extremely important factor when discussing how materials begin to influence light in space.

We can input architectural materials like wood, stone, or steel into these categories. A piece of light Baltic Birch with no finish might reflect 75 percent of incident light, warming it with its slightly tan colour. It’s matte finish would offer no reflection and scatter light in a more diffuse way. In the same way a dark green marble might only reflect seven percent of incident light while offering a highly polished finish and reflections similar to that of a mirror.

It is only through understanding how the materiality of a space effects the quality of light in that space that we can explore how light will react. Architects can begin to elicit specific qualities of light based on even the most subtle material choice.

The following studies explore three categories of material finish: matte, satin and gloss, and nine colour values in gradient scale from nearly white to nearly black. Any material could fit into these categories by determining its colour value and its finish.

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8 Marietta Millet, *Light Revealing Architecture* (Chichester: Wiley-Academic Press, 1996), 38.

9 Ibid., 42.

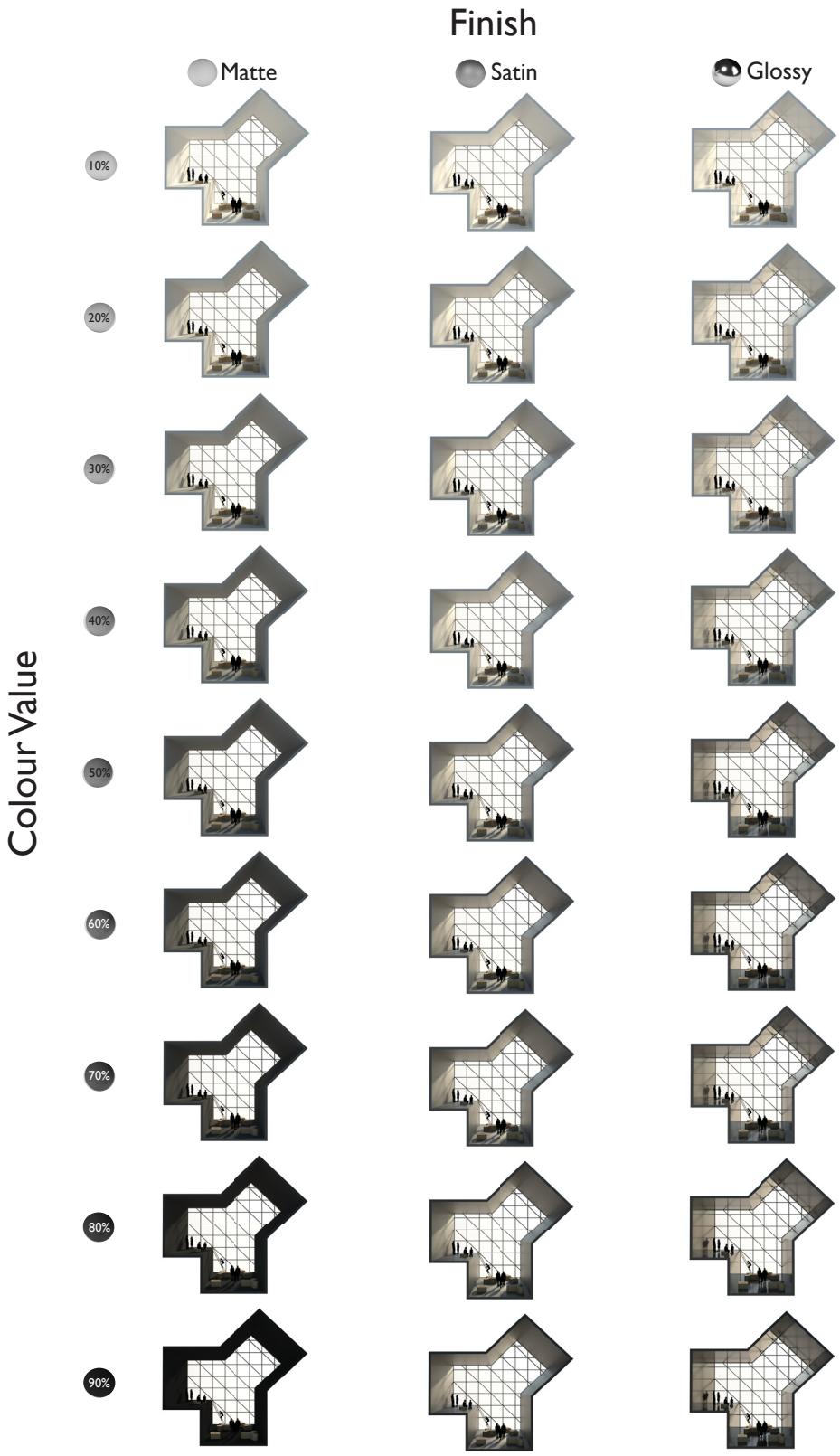


Figure 8: Materiality: Exploring the way colour value and finish influence light in space. Consistent light source with varied colour value and varied finish.

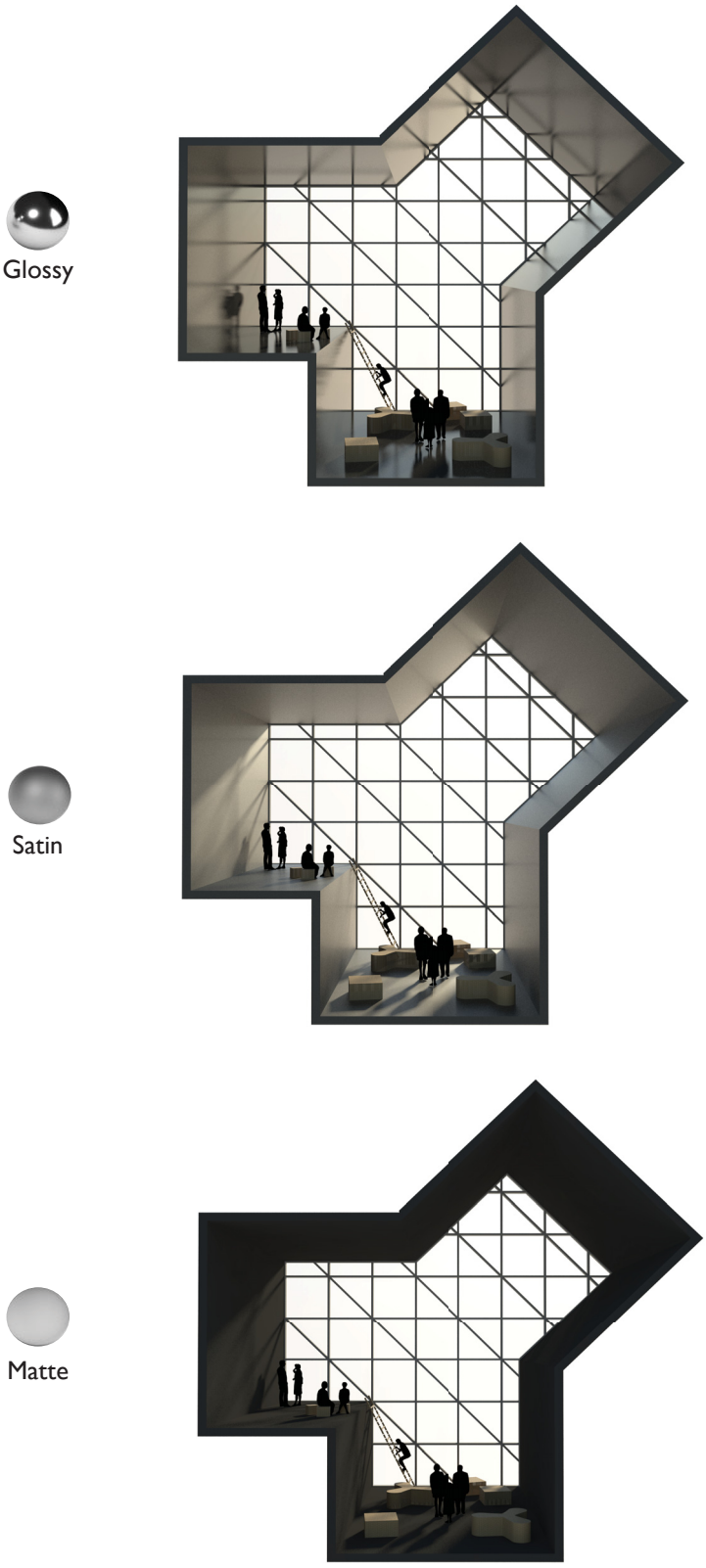


Figure 9: Materiality: consistent 80% colour value and light source, varied finish. Exploring the way colour value and finish influence light in space.

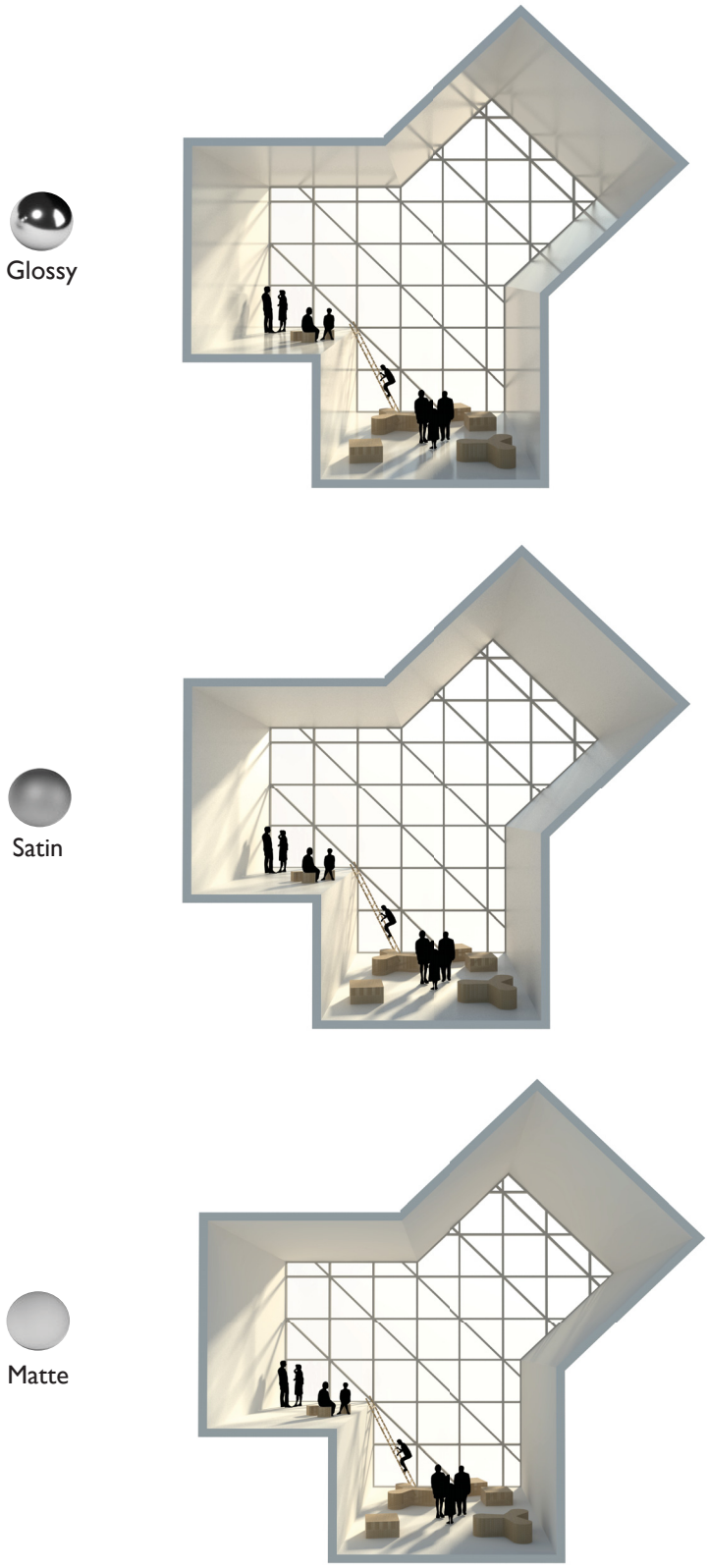


Figure 10: Materiality: consistent 10% colour value and light source, varied finish. Exploring the way colour value and finish influence light in space.

Aperture

The aperture is one of the most interesting aspects of how light enters architectural space. Whether a window, skylight, or screening device, the aperture is one of the areas where architects have the most control and directly test iterations to examine different outcomes. The exact composition of light and shadow within a space can be explored through understanding how light changes over time and how the device through which it enters a space is designed. The aperture, in a vernacular sense also has regional characteristics which directly relate to the type and quality of light in a given geographic and climatic location.

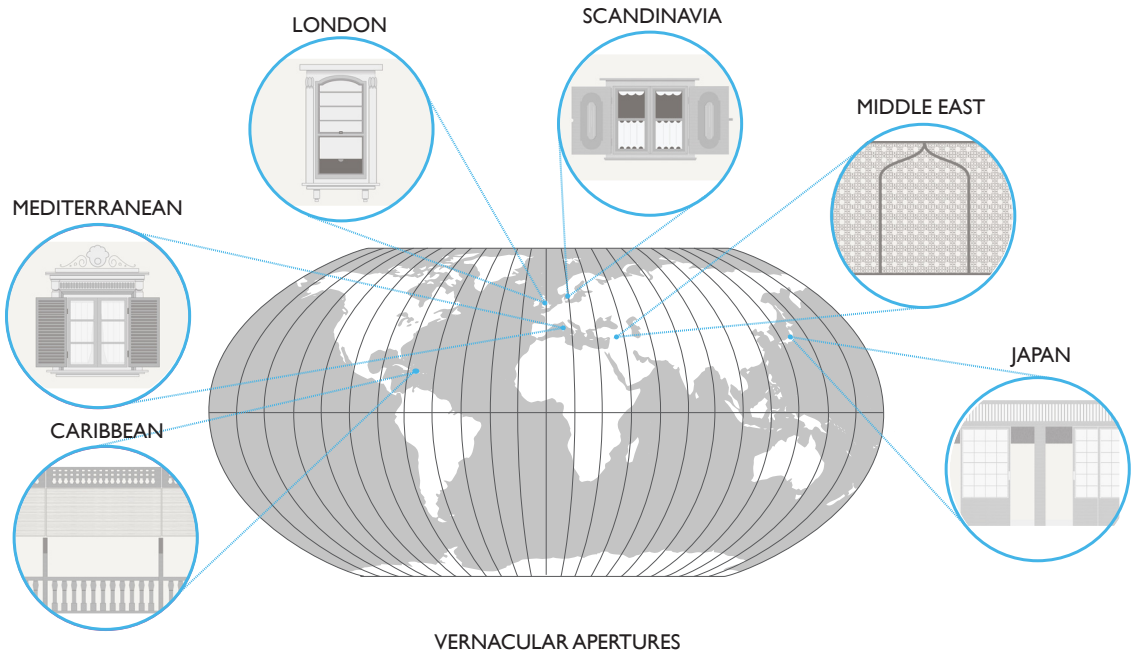


Figure 11: Vernacular Apertures; Graphics by Francesco Anselmo and John Mardaljevic for Daylight & Architecture, Issue 19.

The aperture also carries with it many important lessons about the culture and climate from which it was developed.

> Vernacular windows offer many surprises, because the invisible, evolutionary architect who has created their designs is the local community. This 'architect' often responds to the environmental challenges and physical circumstances with inventiveness, uses simple tools and local materials, but also shapes his creations according to the culture, beliefs, customs and myths of the community itself.[10]

We can begin to understand through the built aperture the intent of the architect for the

10 Francesco Anselmo and John Mardaljevic, "Vernacular Windows," *Daylight & Architecture* 19, no. 1 (2013): 26.

created atmosphere. Even in the vernacular examples, the intended effect on the ephemeral is realized through the amalgamation of the constructed and permanent aperture.

The following categories of apertures were developed by researchers Siobahn Rockcastle and Marilyne Andersen from the Ecole Polytechnique Fédérale de Lausanne in Switzerland. By studying international examples of daylight in Modern Architecture (Figure 13), they began to explore how to categorize the spatial qualities of daylight based on a scale ranging from low contrast and variability to high contrast and variability. It becomes valuable to categorize these typologies of light so as to better understand the way architects deal with light in space. Studying these apertures and defining the qualities of light they elicit brings a systematic approach to a more phenomenological aspect of light in space.

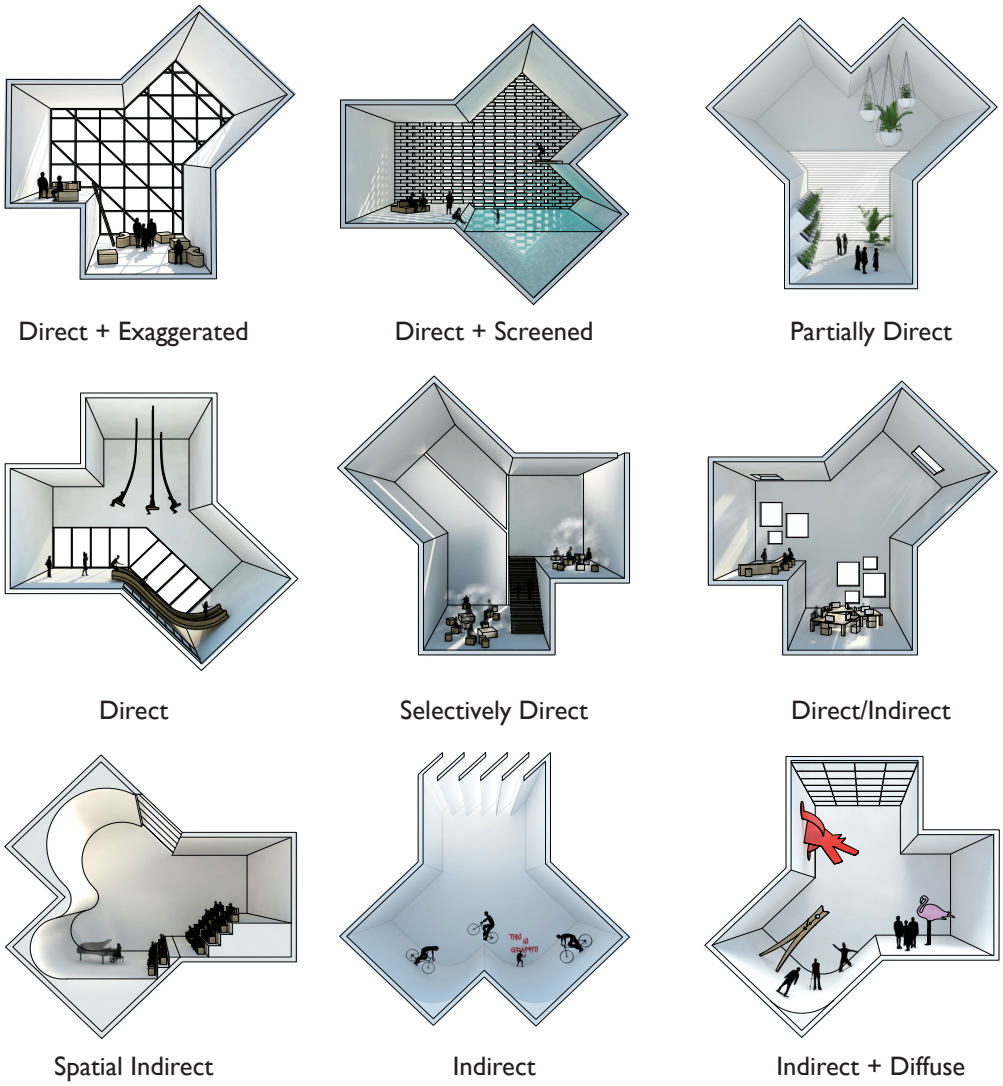


Figure 12: Aperture; Exploring the way architects control how light enters space.

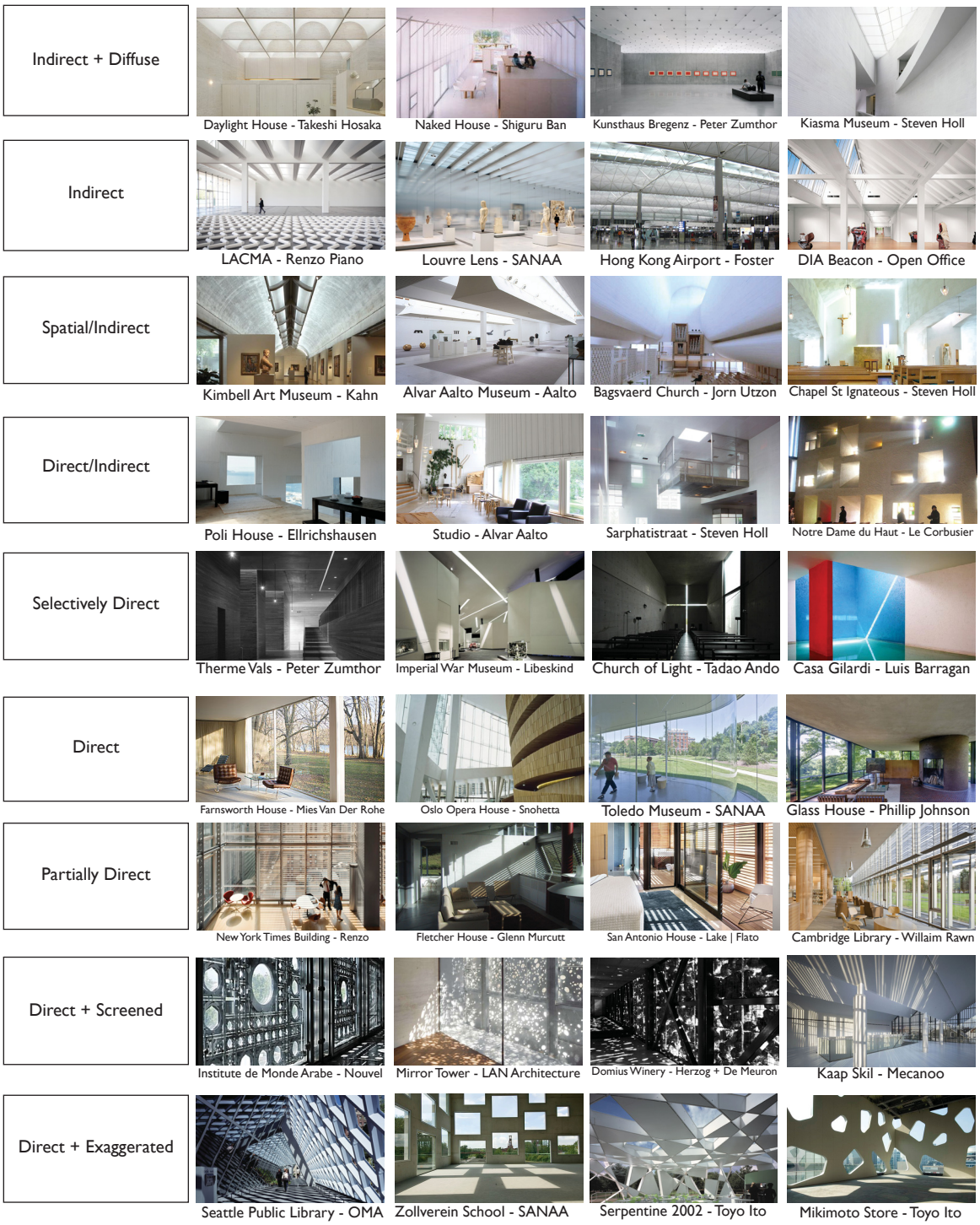


Figure 13: Aperture; Exploring examples of modern architecture in public buildings looking at how light is used by examining the inputs of variability and contrast by Siobahn Rockcastle and Marilyne Andersen,.

Conclusion

It is through tools like the aperture, materiality, volume, and understanding of temporality that architects can begin to shape the light that enters space. And that light has the power to speak to the inhabitants of the space about place, often through replication of existing regional lighting conditions. One of the most interesting aspects of lighting design and architecture is the subtlety of it. Architects design with light and often have intention for a desired lighting condition that a user may never fully articulate. They will, however, understand how a space made them feel, even if the exact qualities might be ineffable. Knowledge of the tools that shape light in space allow us to design with an understanding of their geography and climate, but also speak to the intended users metaphorically, using these tools as the mouthpiece of that narrative.

CHAPTER 3: NORDIC LIGHT

Introduction to Region

The discussion of the regional qualities of light in Scandinavia can be explored through two avenues: namely the scientific and the phenomenological. The first using meteorological and solar studies to understand the characteristics of available light in the region and the latter exploring the interaction of that specific quality of light and the architecture and apertures which transform that light into space.[11]

The topic of Nordic Light has been explored by many architects and theoreticians and there can be a tendency to define it as "not only the light at higher latitudes, but the set of all the design and technology processes that relate to the choice of the arrangement of apertures in relation to the variability of the light."[12]

The focus of this thesis has been to explore the relationship between the climatic conditions and the role of the hand of the architect in determining the outcome of the atmosphere of the spaces they create. My initial exploration took place with first hand research in Norway, Sweden, Finland and Denmark in 2016. By exploring public buildings by architects like Jørn Utzon, Steven Holl, Sverre Fehn, Gunnar Asplund, and Alvar Aalto in person and by examining the methods and mode of design by studying qualities like volume, materiality, temporality, and the aperture, I was able to gain a greater understanding of the tools architects have in relation to daylight. It also became clear that a greater understanding of the climatic conditions can lead to a more intentional translation of daylight in space.

Architects like Steven Holl have mused on light in the north."The sun is very low in winter, casting long horizontal shadows, and it is very precious because many days are cloudy. In summer, on the other hand, there is twilight until 10 p.m. and there is this impressive chiaroscuro of the sky."[13] Barbara Gherri compares what gives both the architecture and daylight of this region its specific and characteristic qualities.

> Aware of the profound changeability of Nordic light, Scandinavian architects from Aalto to Fehn have experimented with luminous solutions and material textures that developed the amount of natural light in constructed spaces, playing on the size of apertures, the colours

11 Nanet Mathiasen, "Nordic Light and its Relation to Daylight Apertures in Nordic Architecture" (PhD diss., Aalborg University, 2015), 16. http://vbn.aau.dk/files/224454133/Nordisk_Lys_Nanet_Mathiasen.pdf.

12 Ibid., 16-17.

13 Jakob Schoof "Designed for All Senses: the Architecture of Steven Holl," *Daylight & Architecture* 27, no. 1 (2017): 22.

> and spatial articulation. The obsessive search for light has produced outstanding examples of architecture in which each element is aimed to maximize the amount of incoming light through diffusing elements that direct diffuse radiation in distance and depth.
>
> If you build in Greece, it is the light itself that creates your architecture. Just scratch the surface of marble with a fingernail, that scratch remains visible while up there, under the northern light, it wouldn't. These factors mean that our architectural world has no shadows [. . .] each material has its own shadow. The shadow of stone does not resemble that of a brittle autumn leaf. The shadow enters the material and radiates its message. [14]

Gherri articulates so well the way that regional climatic daylight conditions temper the lens through which we view our worlds. What is more, she implores, is that the great architects of this region have always been on a search to monopolize, mold, and articulate this light and in doing so, have developed a language of building specific to the region. This goes beyond simple vernacular responses to architecture and begins to develop a vocabulary of building with daylight specific to this region.

Case Study: Bagsværd Church - Jørn Utzon

Figure 14: Bagsværd Church Hallway, Concrete Texture, and Sanctuary

The first case study building I explored was Bagsværd Church by Jørn Utzon. This Lutheran Church in the suburbs of Copenhagen is an interesting study in daylighting. When one first approaches the building, the exterior form in its plainness, gives nothing away to the curvaceous and sensuous spaces within. The two main uses of aperture can be seen in the hallways which are top-lit and the sanctuary which has a large north-west facing clerestory

14 Barbara Gherri, *Assessment of Daylight Performance in Buildings: Methods and Design Strategies* (Ashurst, UK: WIT Press, 2015), 38.

window. The hallways encircle the sanctuary and provide a completely diffuse, even light through the use of a translucent glass skylight. In the sanctuary, the sinuous roof allows light to enter from high above the ground and the orientation of the opening means mostly indirect light enters the space, especially in the greatest time of use, the morning. In both the hallway and the sanctuary, diffusion techniques are also applied through the choice of materials. In the sanctuary, textured board-form white concrete both reflects the light greatly because of its colour value and scatters the light in many directions because of the textured finish. The same can be said about the hallways in which precast concrete panels and matte-finished light beach wood serve as diffusing materials in the space. Utzon's understanding of volume may be one of the greatest tools at play here.

The hidden-from-the-exterior undulating curves of the sanctuary mold and bend the light into the space, sending it from high above the church goer to illuminate the alter. The effect is scintillating as light is gently moved along every inch of the curved surface, creating depth, and dimension. The volumetric masterwork by Utzon allows us insight into how the architect can use the architectural tools that allow us to mold and manipulate daylight, namely volume in this case study, to offer a narrative of place. Utzon, fresh from returning from working on the Sydney Opera house, uses totally different materials and alters light in a way that will speak to the regional characteristics of the North.

Figure 15: Examining the materiality of Bagsværd Church by Jørn Utzon built in Copenhagen, 1976 and located at 55.7° N.

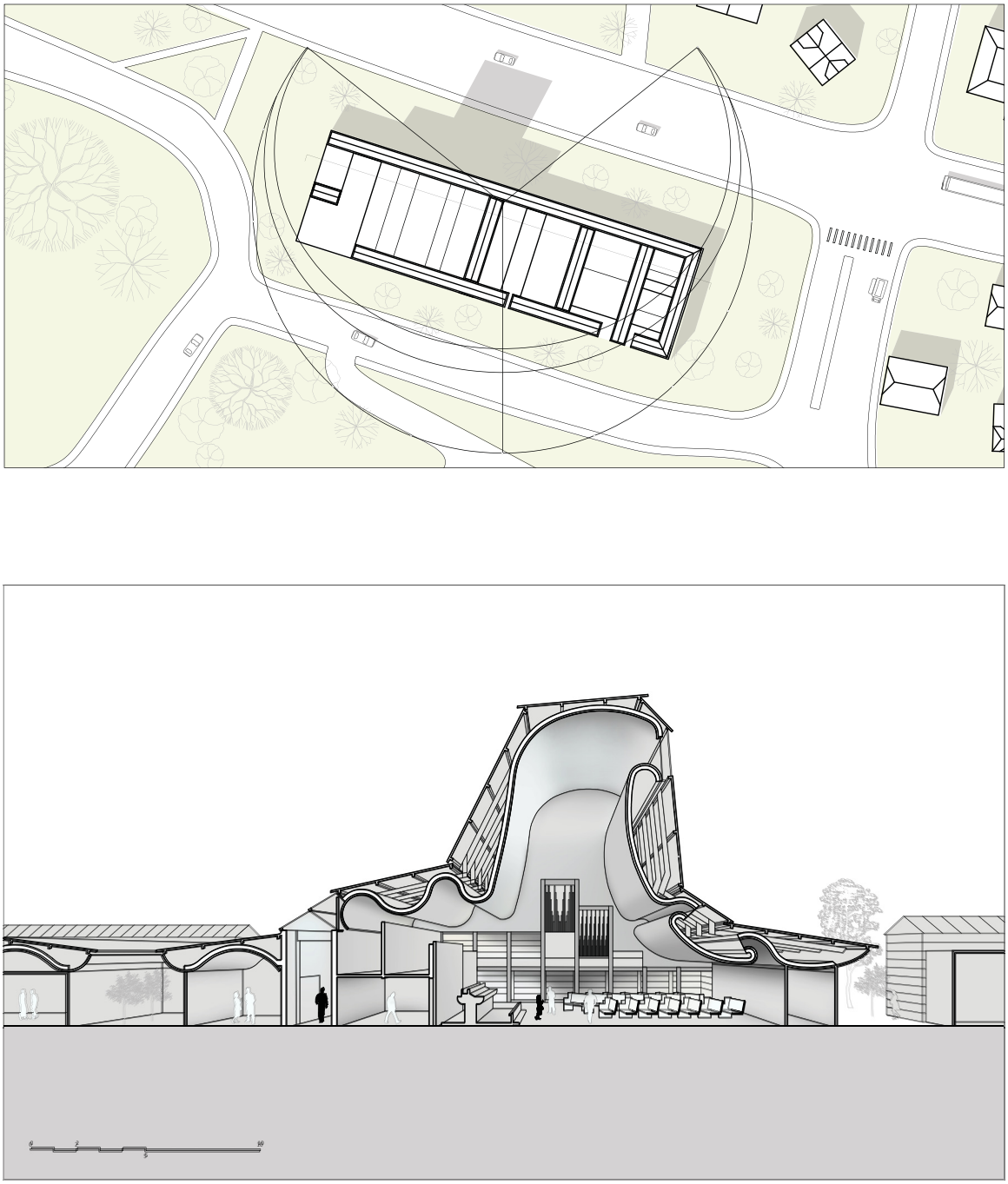


Figure 16: Examining Bagsværd Church by Jørn Utzon built in Copenhagen, 1976 and located at 55.7° N. This study explores the building through plan and section, exploring volume and aperture of space. Base section by Paul Lewis, Marc Tsurumaki, and David J. Lewis, *Manual of Section*.

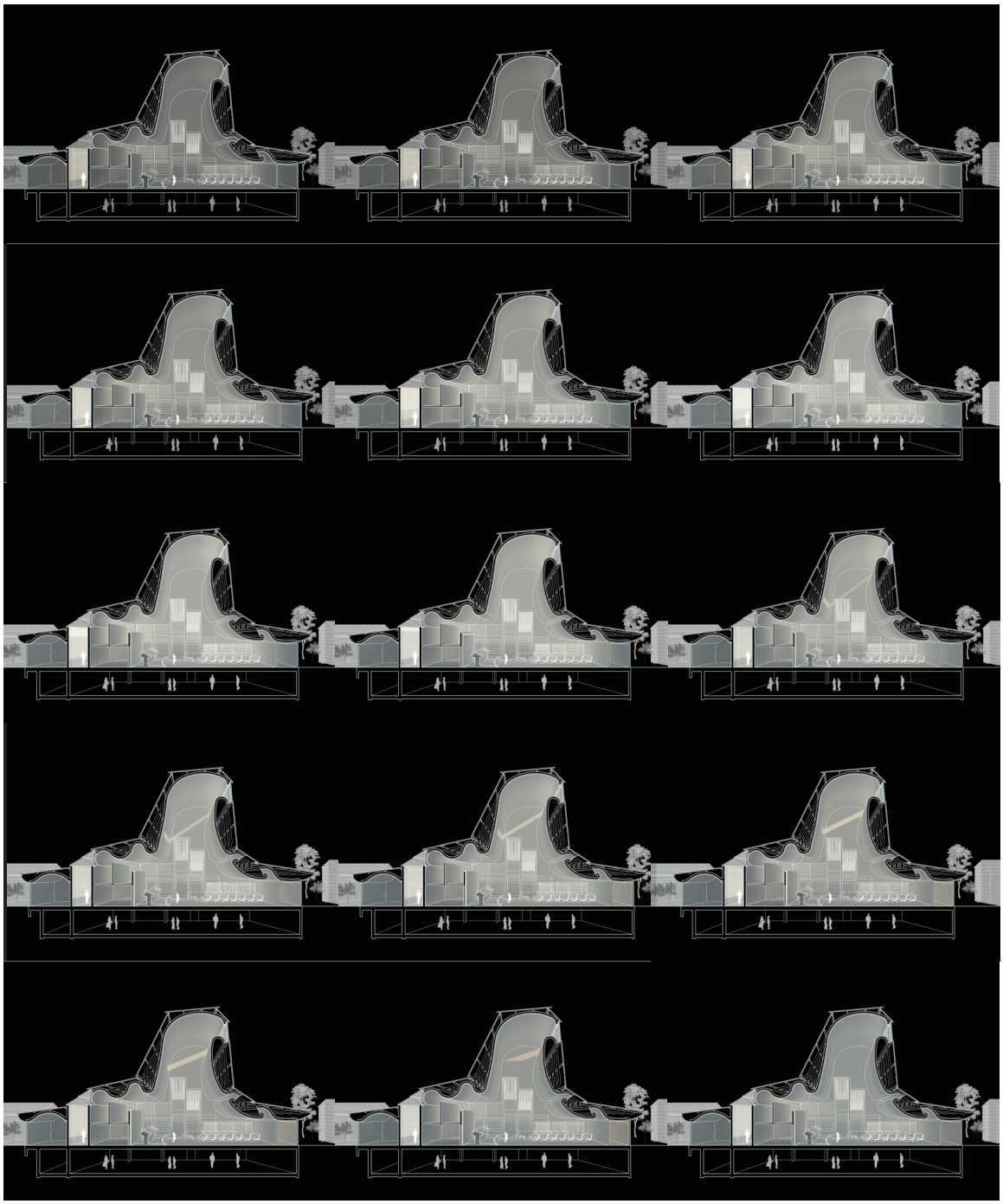


Figure 17: Examining the Bagsvaerd Church by Jørn Utzon built in Copenhagen, 1976 and located at 55.7° N. This study explores the building through temporality. Base section by Paul Lewis, Marc Tsurumaki, and David J. Lewis, *Manual of Section*. Study uses the 3D modelling software Rhinoceros and the rendering software V-Ray to simulate light over the course of one day, August 18, 2016, the day I visited.

Case Study: Kiasma Museum of Contemporary Art - Steven Holl

Figure 18: Kiasma Museum of Contemporary Art

Steven Holl's Kiasma Museum of Contemporary Art in Helsinki uses many methods for designing with daylight specific to the north. Holl, long a master of designing with daylight, particularly creates a dynamic space which tests multiple methods of allowing light into space. The atrium, where circulation takes place, is composed of a top-lit void between a curved portion of gallery spaces and a straight portion of gallery spaces. The resulting collision of these masses, thus the name Kiasma, is completely shadowless. Holl uses a layered system of translucent glass to diffuse all light entering the space. While the characteristic Nordic light is often already diffuse, Holl takes it a step further making sure the space will feel both silent, shadowless, and dramatic.[15] Materially similar to Asplund's Bagsværd Church, Holl uses a white, board-form concrete which both reflects light based on colour value, and diffuses based on finish and texture The dark finish of the floors acts as an absorbing material and juxtaposes the source of light bound by roof and walls.

While the atrium serves as the focal point for daylighting in the museum, Holl also acknowledges the typical side light that the Nordic region is known for in designing the gallery spaces. On the west side of the gallery, a large reflecting pool is used to capture and reflect light back into the spaces. On the east, scooped skylights pull indirect light into gallery spaces where different shading and diffusing techniques are available to modulate incoming light. The approach to lighting in Kiasma is also interesting in that Holl creates

15 Steven Holl, "Kiasma Museum of Contemporary Art" accessed Jan 21, 2018. http://www.stevenholl.com/projects/kiasma-museum.

this consistent lighting condition in the atrium but has a more adaptable lighting approach in the gallery spaces that responds much more sensitively to the time of day and the time of year. Kiasma has been an essential study for this thesis in understanding the relationship between the climatic and geographic limitations of designing with light in the north, and the role of the architect to transform that light in space. Holl knows of this characteristic diffuse, weak light and creates this massive atrium that takes that light to severity. This shadowless, even light subtly speaks to users about place and culture.

Figure 19: Examining the Kiasma Museum by Steven Holl built in Helsinki, 1998 and located at 60.2° N. This study explores the building through plan and section, exploring volume and aperture of space. Base section from Steven Holl Architects

Figure 20: Examining the materiality of Kiasma Museum by Steven Holl built in Helsinki, 1998 and located at 60.2° N.

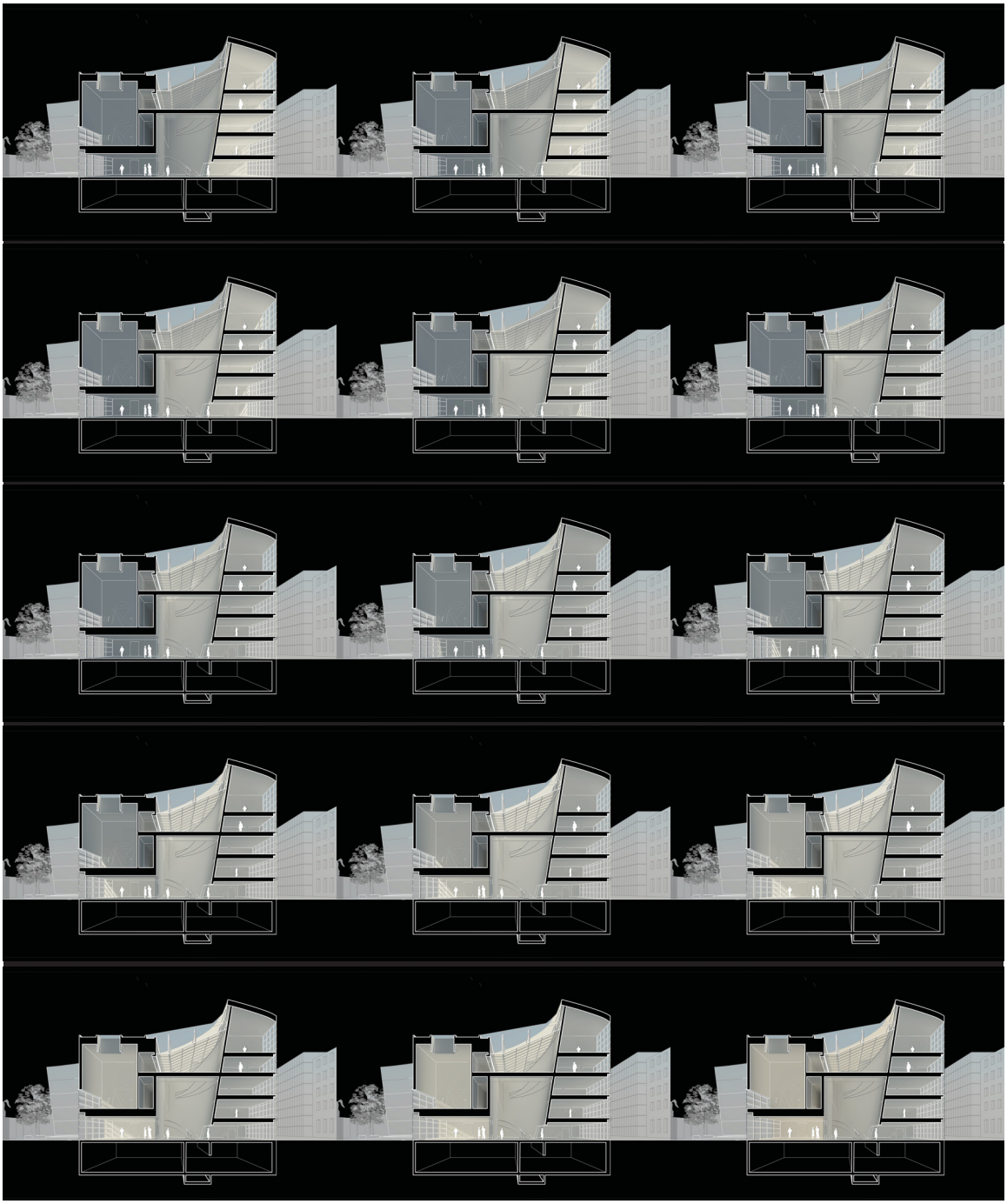


Figure 21: Examining temporality in the Kiasma Museum by Steven Holl built in Helsinki, 1998 and located at 60.2° N. Base section from Steven Holl Architects. Study uses the 3D modelling software Rhinoceros and the rendering software V-Ray to simulate light over the course of one day, August 23, 2016, the day I visited.

Case Study: Finlandia Hall - Alvar Aalto

Figure 22: Finlandia Hall: Exterior and Interior

Alvar Aalto's Finlandia Hall does not contain a large, daylit internalized space as the other three case studies do; however, there are numerous small moments that point to his masterful understanding of design with daylight in the north. Finlandia Hall serves programmatically as a performance centre and governmental institution. Clad in white marble, the exterior tiles are curved in section, looking similar to a woven basket. The simple and subtle curvature catches light and gently bends it across the semi-reflective surface. On the interior, the public spaces are divided in a north-east, south-west direction. The north-east side has tall repetitive vertical windows which allow light to reach deep into the spaces. Alternately, the south-west facing spaces have horizontal short windows which have an added layer of louvres shielding from the southern, often horizontal northern light. Aalto also uses numerous, extremely deep light wells or skylights that bring diffuse top light into many of the central spaces of the complex.

Figure 23: Finlandia Hall; Materiality

Figure 24: Examining Finlandia Hall built in Helsinki, 1971 and located at 60.2° N. This study explores the building through plan, section, materiality, and temporality. Base section by Richard Weston in *Alvar Aalto*.

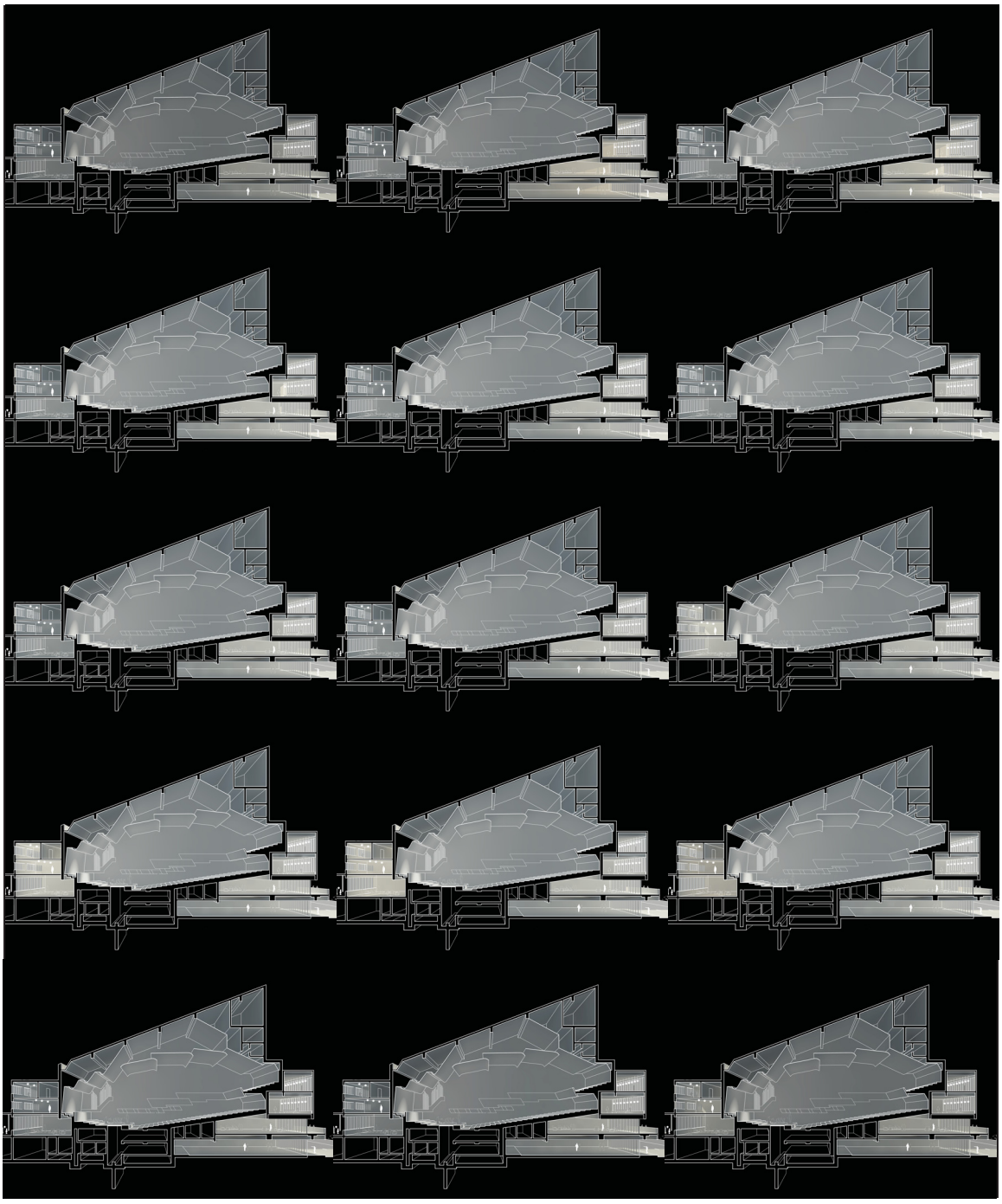
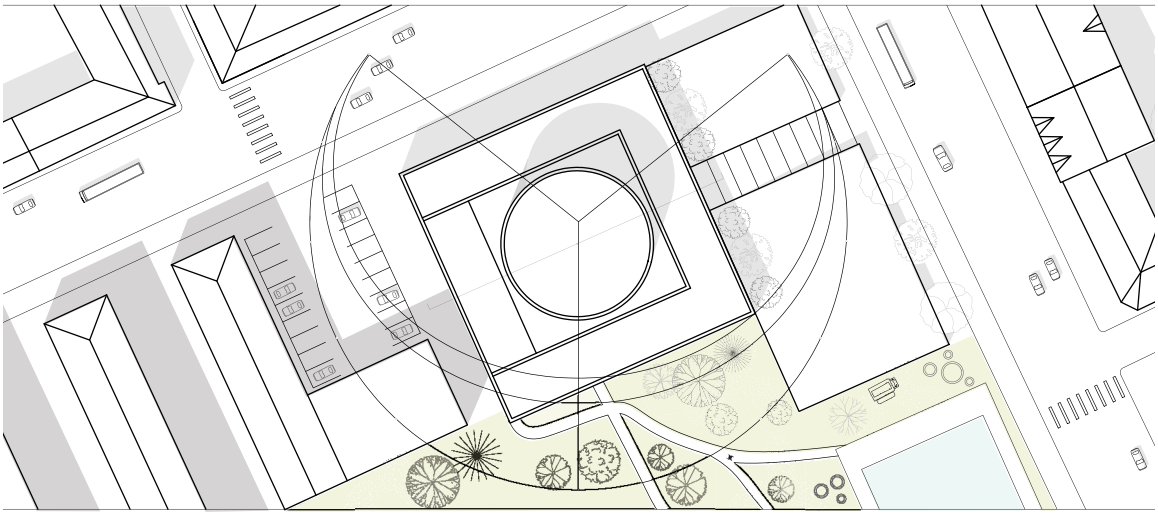


Figure 25: Examining Finlandia Hall built in Helsinki, 1971 and located at 60.2° N. Base section from Richard Weston in *Alvar Aalto*. Study uses the 3D modelling software Rhinoceros and the rendering software V-Ray to simulate light over the course of one day, August 15, 2016, the day I visited.

Case Study: Stockholm Public Library - Erik Gunnar Asplund

Figure 26: Stockholm Public Library

Erik Gunnar Asplund's Stockholm Public Library from 1928 is a unique space. Both monumental in form and democratic in layout, the use of daylight by the architect marks the space as important in the dialog of Nordic light. One enters the library through the dark entry, with tall windows allowing light to bounce off the reflective glossy dark wood. Entering from below, stairs take you into the rotunda which is grounded in three tiers of books. The space, Pantheon-like in form, has tall windows puncturing the top of the volume and allowing side light instead of top light to illuminate the white, textured stucco drum. The use of side light is important, as it speaks to the regionally characteristic direction of light entering most spaces horizontally instead of vertically. Asplund is very aware of this and in both the main library room and the subsequent study spaces, tall windows placed at high locations allow light to penetrate the spaces deeply with direct light, a valuable resource for light starved Scandinavia. As aforementioned, Asplund's use of material is also noteworthy. He chooses dark polished wood to house the tomes of the library which grounds the space and directly juxtaposes the textured white stucco drum of the rotunda, reminiscent of the celestial, the sublime. The dark absorbs the light but the finish reflects the image of the user while the white reflects the incident light but the texture scatters the reflected image diffusing the light and creating an even, milky atmosphere.



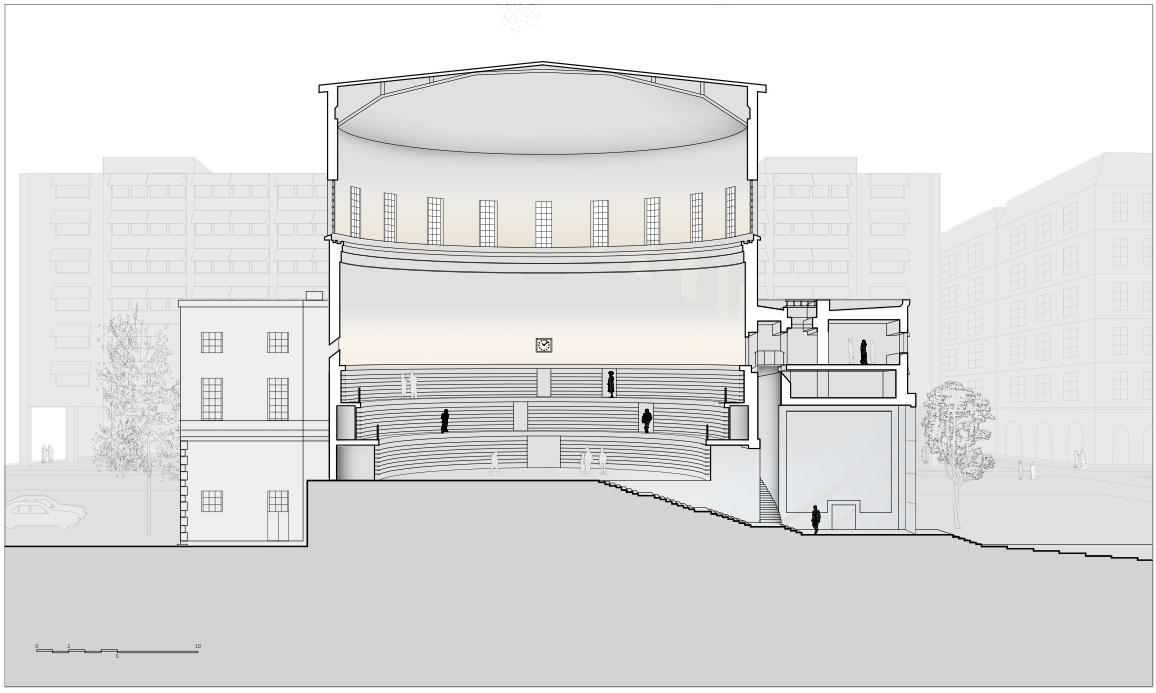


Figure 27: Examining the Stockholm Public Library by Erik Gunnar Asplund built in Stockholm, 1928 and located at 59.3° N. This study explores the building through plan, section, materiality, and temporality. Base section from Erik Gunnar Asplund, Public Library, MoMA Archive.

Figure 28: Stockholm Public Library; Materiality.

Figure 29: Examining the Stockholm Public Library by Erik Gunnar Asplund built in Stockholm, 1928 and located at 59.3° N. Base section from Erik Gunnar Asplund, Public Library, MoMA Archive. Study uses the 3D modelling software Rhinoceros and the rendering software V-Ray to simulate light over the course of one day, August 15, 2016, the day I visited.

Conclusion

Through these case studies, one can see that the hand of the Architect has a great role to play in the transformation of daylight in space. Each of these case studies showcase architects that have a unique grasp on the type and quality of light characteristic to the region, and through the interplay of materiality, volume, temporality, and the aperture, mold and manipulate that daylight in ways which speak to the characteristic light of the region: a call and response of sorts. This has led me to believe that the way in which architects transform light in the built environment has the power to use light as a narrative of place. One that can, through the power of translating that light into space, create a meaningful and poetic user experience.

CHAPTER 4: LIGHT AND THE APERTURE - TRANSLATION OF LIGHT

Case Study: The Nordic Pavilion - Sverre Fehn

Sverre Fehn's Nordic Pavilion, located in the Venice Biennale garden, is an incredibly important example of designing with daylight. Fehn uses two alternating 1.05m deep by 5cm wide beams made of white cement, white sand, and white Italian marble to diffuse and scatter all direct light.[16] These beams span the length of the pavilion and the depth of the two beams "together distil the heady, warm Mediterranean light into its 'Nordic' variation: at once shadeless, uniform and bright. It is a light that is definite, but familiar."[17] James Taylor-Foster paints Fehn's method in an important light.

> In this sense, it is a building in possession of its surroundings – accepting its direct context while tentatively suggesting another, distant world. Fehn did not seek to mimic a Nordic vernacular – the Pavilion is not an act of mimesis in the conventional sense. He sought to rewrite something hitherto indescribable: the sense of a 'Nordic' architecture for the Venetian climate and situated in the uninhabited, uniquely fragmented context of the giardini of la Biennale di Venezia.[18]

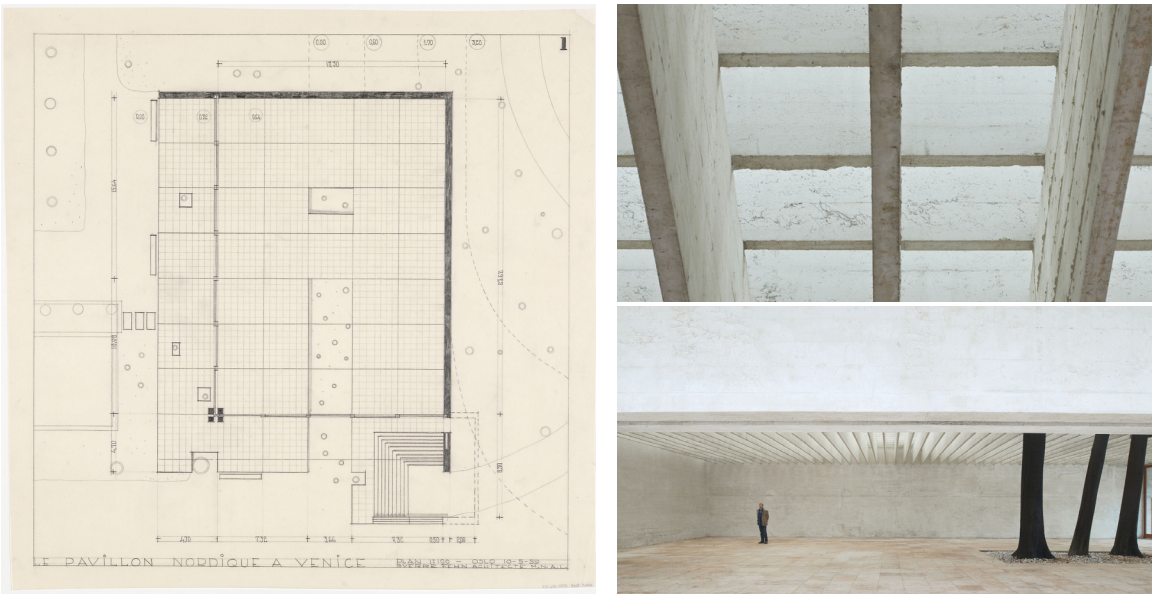


Figure 30: Nordic Pavilion;
Drawing from Nasjonalmuseet Digital Archive.
Photographs by Åke Eson Lindman.

16 James Taylor-Foster, "AD Classics: Nordic Pavilion in Venice / Sverre Fehn," *ArchDaily,* last modified March 30, 2016. https://www.archdaily.com/784536/ad-classics-nordic-pavilion-in-venice-sverre-fehn.

17 Mark J. Neveu, "On Stories: Architecture and Identity" *Arkitektur N: The Norwegian Review of Architecture 02 (2008): 5,* accessed March 26, 2018, http://digitalcommons.calpoly.edu/cgi/viewcontent.cgi?article=1038&context=arch_fac.

18 James Taylor-Foster, "AD Classics."

Taylor-Foster describes Fehn's methods as being specifically of the place in which the building is located, but evoking a sense or memory or familiarity with another place. Fehn is doing this through the medium of daylight and with the unique intent of manipulating that Mediterranean light to transform into that of another region.

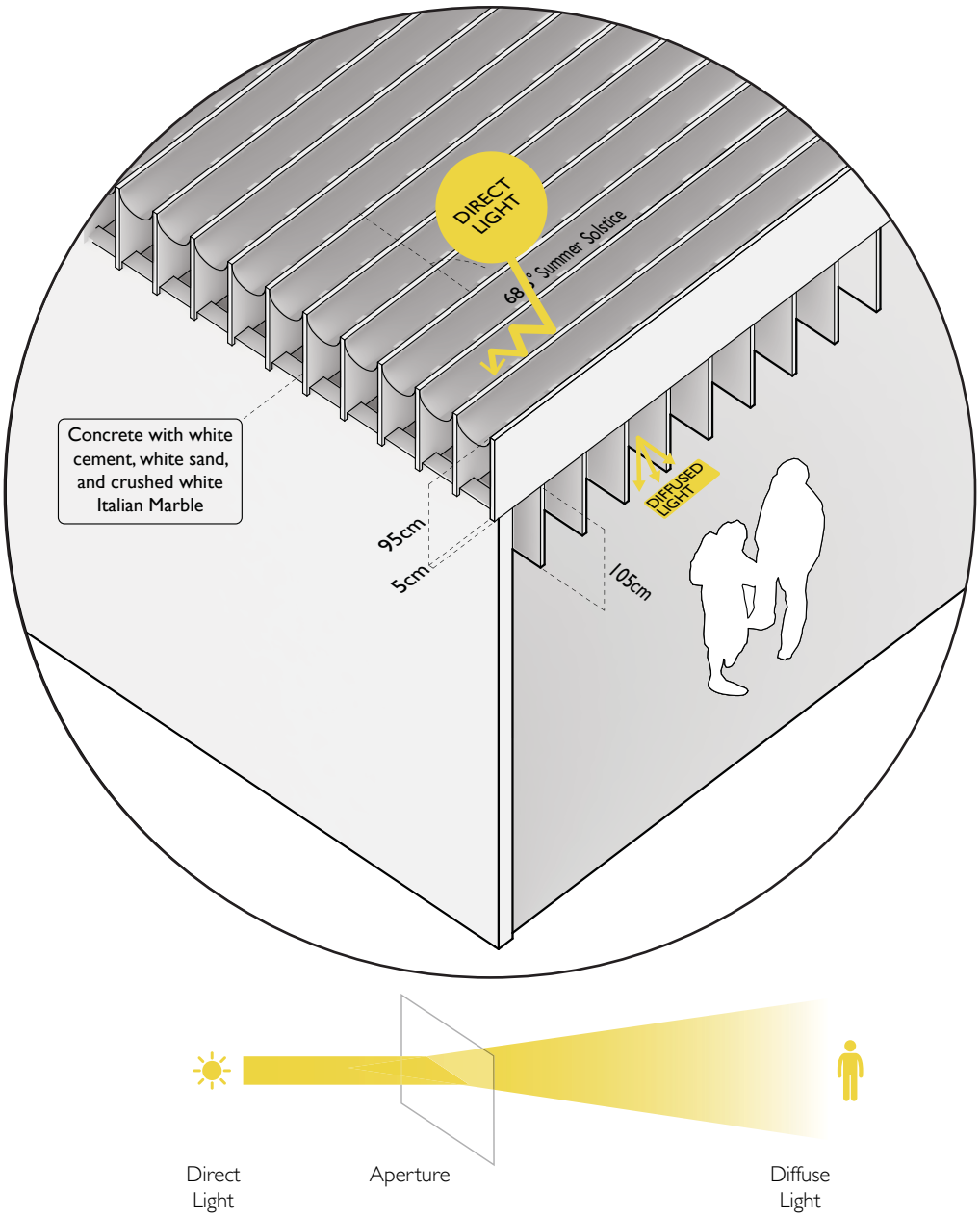


Figure 31: Nordic Pavilion Light Diagram

Case Study: La situazione antispettiva - Olafur Eliasson

Olafur Eliasson's situazione antispettiva, roughly translates to 'the anti-spectival situation', and references the multiplicity of perspectives a viewer gets when inside the installation.[19] Eliasson takes the viewer from having one perspective at one time to at once having many perspectives at the same time. The installation is remarkable in this sense, but also in how it deals with natural light. Installed in the Danish Pavilion, with its diffuse light, Eliasson, through the use of stainless steel hexagonal kaleidoscopes, focuses the diffuse light into a more direct beam. "Once inside, the viewer is confronted with multiple fragmented reflections of herself, other visitors, the surrounding space, and distorted splotches of light."[20] Eliasson uses natural light as a part of the exhibit, and through the transformation of light and the emersion in his installation, creates a unique, transformative atmosphere.

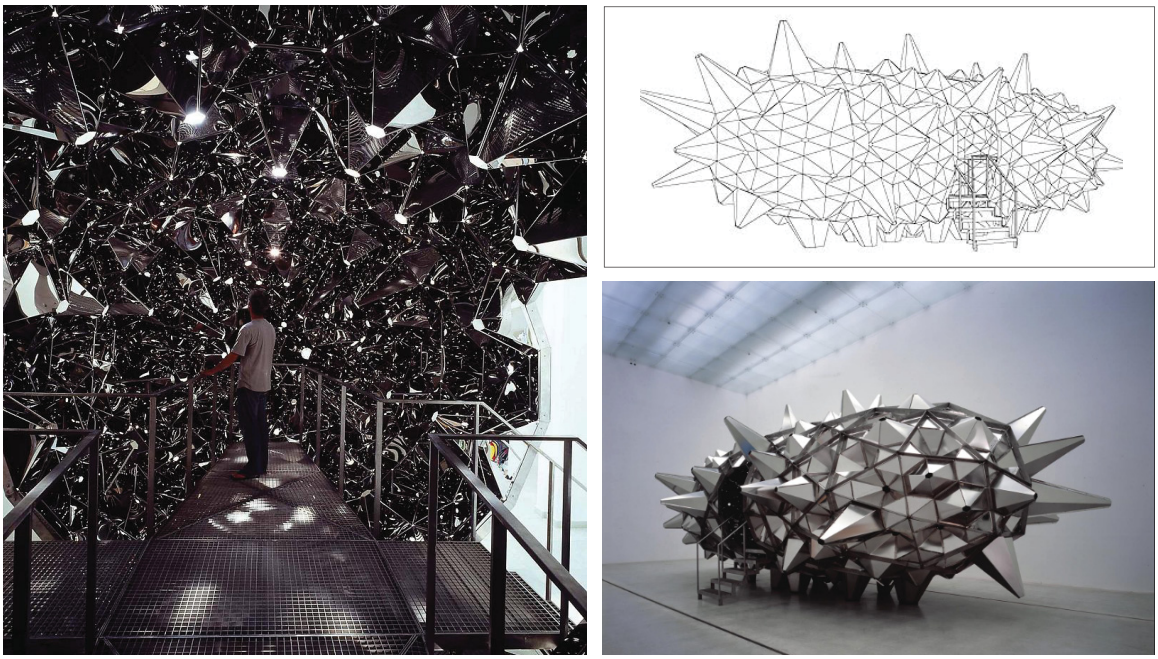


Figure 32: La situazione antispetiva, Olafur Eliasson;
Drawing by S. Greiner for ArtEngineering GmbH.
Photographs by Shigeo Anzai for Olafur Eliasson Artwork Archive.

19 Olafur Eliasson, *Studio Olafur Eliasson: An Encyclopedia* (Cologne Taschen, 2008), 233.

20 Ibid., 233.

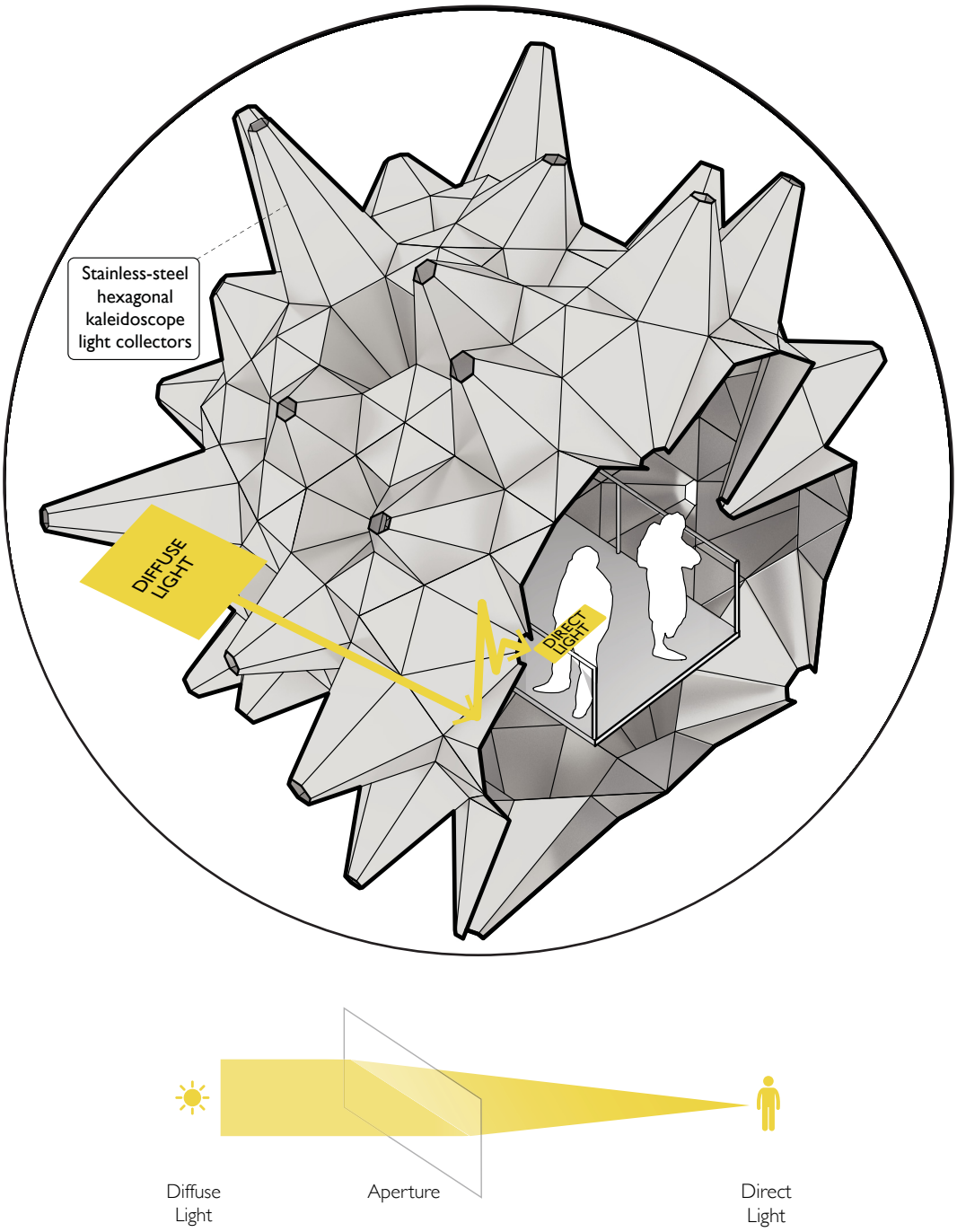


Figure 33: La situazione antispetiva, Olafur Eliasson. Light Diagram.

Translation: Walter Benjamin

Both the situazione antispetiva and the Nordic Pavilion are important examples of the modulation of daylight in space. They function conversely but execute a similar translation of daylight. What's unique, especially in the case of the Nordic Pavilion is Sverre Fehn's intent behind the modulation of light. Fehn is not looking to create a replication of Nordic light, rather a building grounded very much in Venice, but suggesting that of another, Nordic region. His design creates an atmosphere that is tangible, yet ineffable. Walter Benjamin discusses this topic of translation, namely literature, in an applicable way to the idea of a translation of light.

> A translation, instead of imitating the sense of the original, must lovingly and in detail incorporate the original's way of meaning, thus making both the original and the translation recognizable as fragments of a greater language, just as fragments are part of a vessel. The translation must let itself go, so that it gives voice to the intention of the original not as reproduction but as harmony, as a supplement to the language in which it expresses itself, as its own kind of intention.[21]

This presents the translation of light as a new creation, liberating it from a carbon-copy to a complementary modulation, referencing that of the original, but existing in its own context, its own language. This is an important distinction, but not one that liberates from the intent of the original translation. The importance of looking at these converse examples of architecture by Eliasson and Fehn is exemplified through the transformation of light they achieved. While creating very different light qualities, both allude to the fact that the way in which architects manipulate daylight goes beyond the exterior climatic conditions and can elicit completely converse experience of light than expected. This is an important launching point in that it cements the ability of light to elicit a sense of place, and offers the opportunity for architects to use light in surprising and unconventional ways to communicate to users about place.

21 Walter Benjamin, *The Task of the Translator* (Cambridge, Harvard University Press, 1996), 260.

CHAPTER 5: DESIGN

Design Principles

After having studied existing public spaces in the Nordic region, examining their use of materials, understanding of regional and climatic realities that influence the quality of daylight, the desire is to create a public space that explores how architecture and daylight can be used to create a poetic human experience reflective of culture and place. By exploring the tools architects have which allow us to modulate and understand the transformation of light, namely aperture, volume, materiality, and temporality, a design can begin to explore these tools with an understanding of place to speak to a community in that region. It is through this lens that a site selection can begin.

Site Selection

Using the previously mentioned design principles, this set forth the intent to test how light can provide a narrative of place in the north, utilizing the tools architects have to manipulate light. In choosing a site to test these light design tools, a suburb in Stockholm with an extremely diverse and new population to Northern Europe became of interest. Rinkeby (Figure 34) is a neighbourhood which contains just under 20,000 inhabitants around 89% of which are first or second generation immigrants.[22] Their recent movement to this region proves as an interesting study in how a regional quality of light, one which might speak to those that have grown up in the region, might not provide a holistic daylighting experience for those new to the region. The research for this site contained both a study of the suburb in a formal sense (Figures 35-38), and an exploration of the demographic make-up of the neighbourhood and the disparity of light experienced from one's previous home to ones new home (Figure 39-44). Through understanding which qualities of light typify this region, one can begin to explore how a more diverse approach to quality of light could be adopted to be more in tune with both the diversity of the program and the diversity of the neighbourhood.

22 Olle Johnselius, "Welcome to Rinkeby-Kista" (Rinkeby Kista District Council Report, Stockholm, 2015), 2.

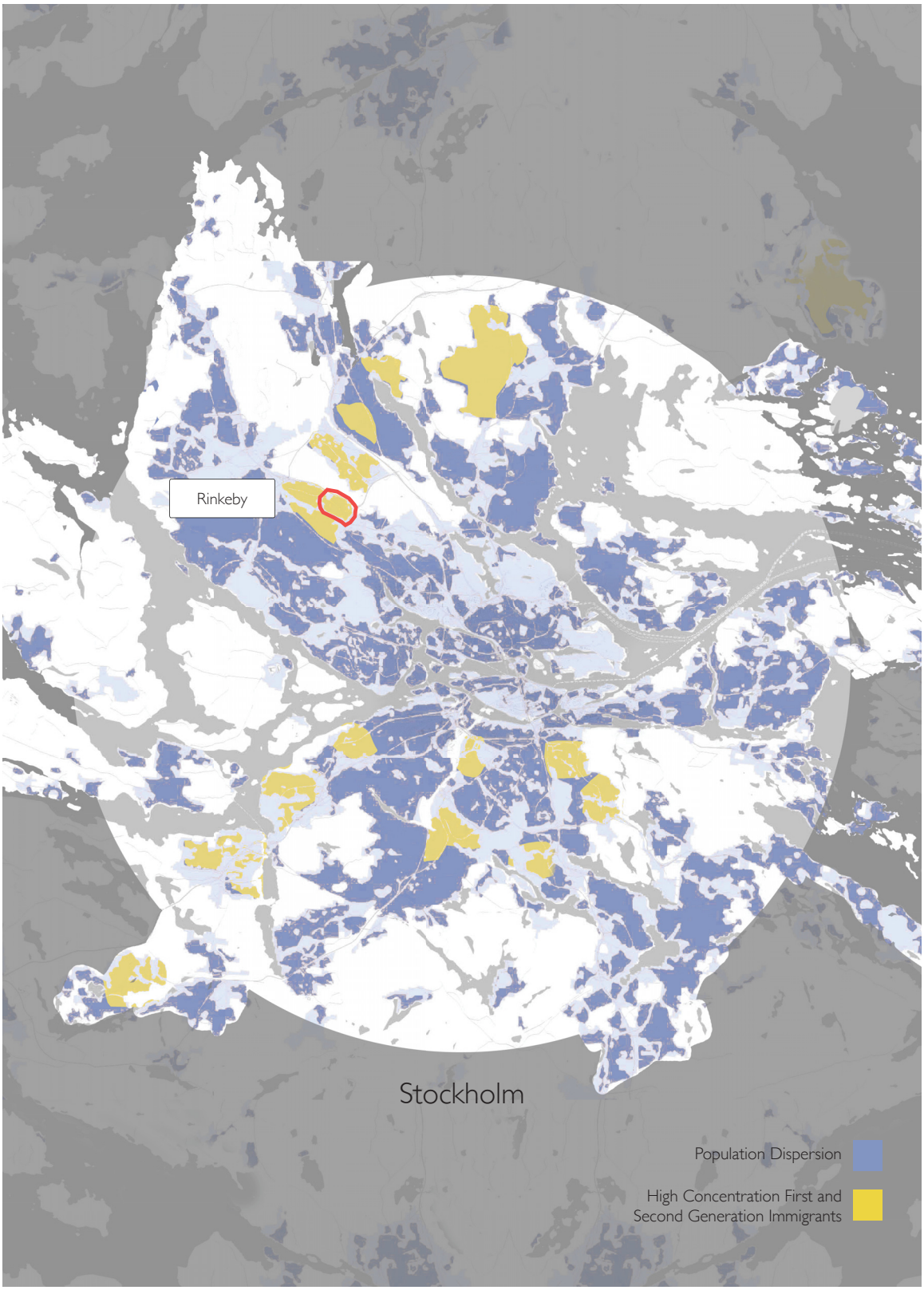


Figure 34: Map of Stockholm Highlighting Rinkeby. Data from Rinkeby Kista District Council Report www.stockholm.se/rinkeby-kista.

Figure 35: Map of Rinkeby highlighting potential site. Background image from Google Earth.

Figure 36: Map of Rinekby highlighting zoning.

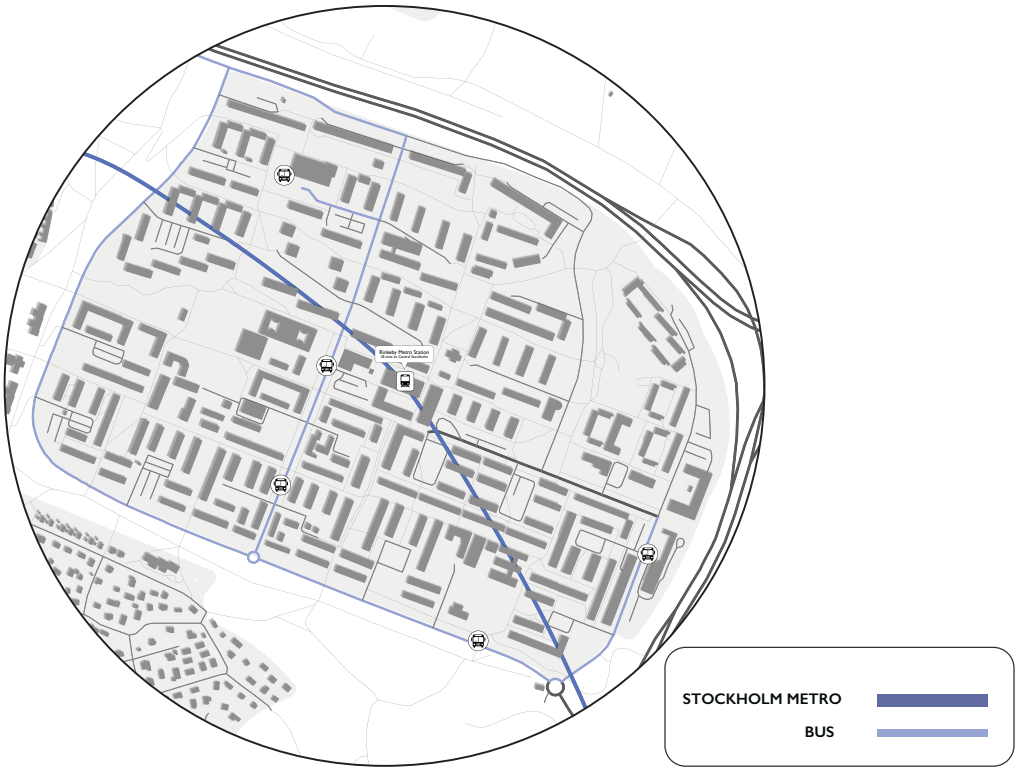


Figure 37: Map of Rinekby highlighting public transportation.

Figure 38: Map of Rinekby highlighting roadways.

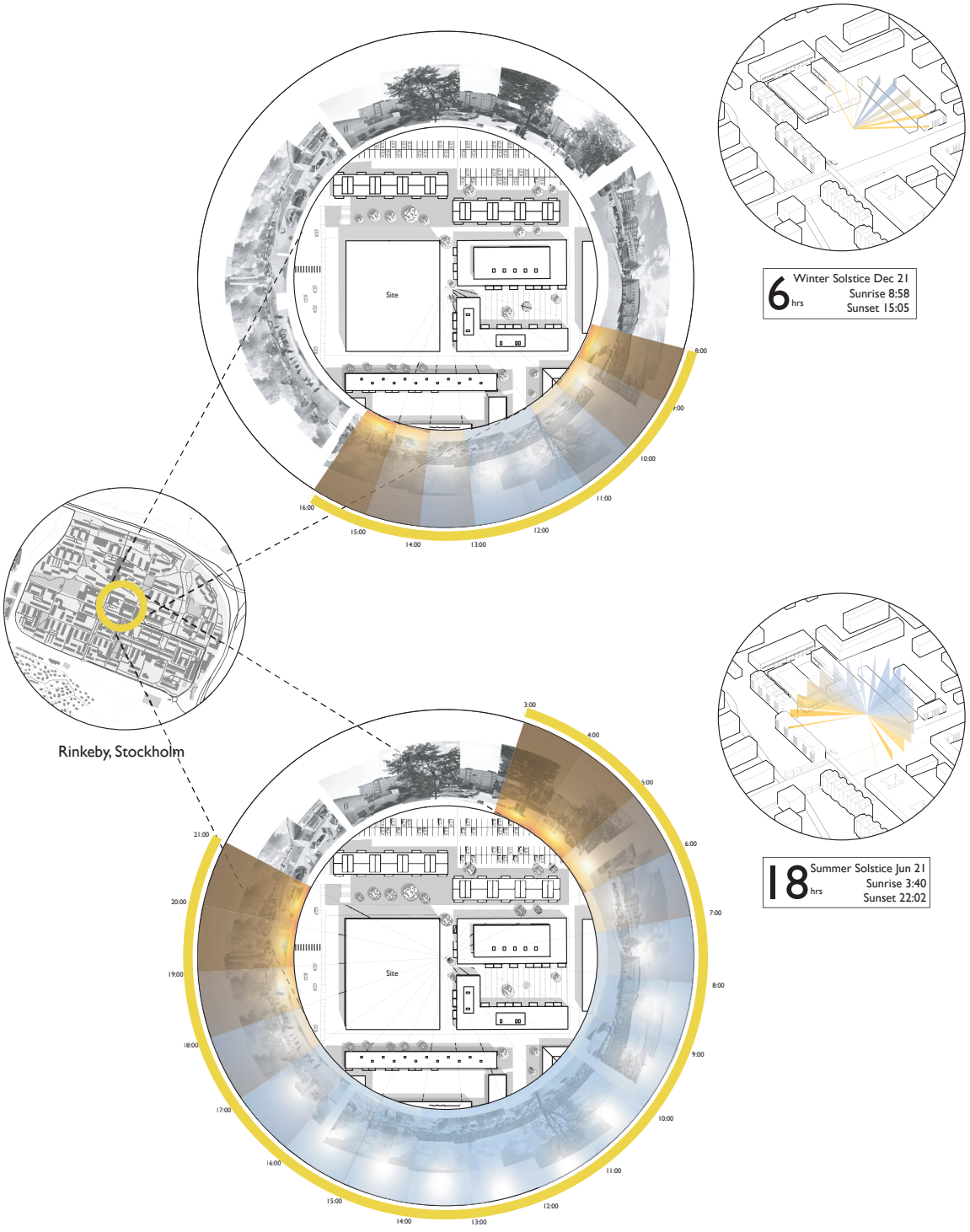


Figure 39: Map of site in Rinkeby examining extremities of daylight between Summer and Winter Solstice.

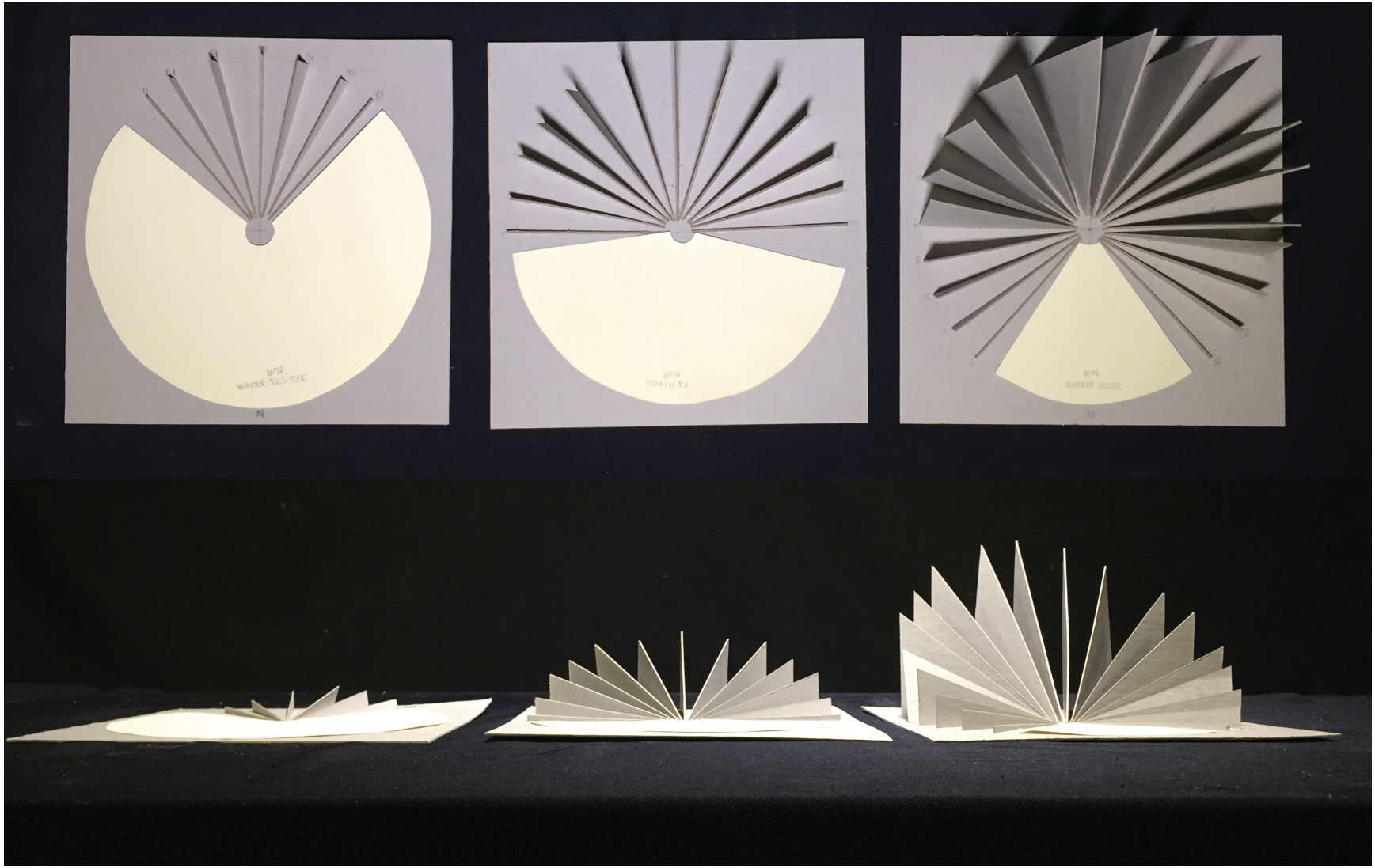


Figure 40: Models of light angle for Stockholm on Winter (left) and Summer (right) Solstices and the Equinox (centre).

Daylight is a powerful tool that has a great ability to affect the social climate of space, especially that of public space. The social role of light also becomes important in examining its parameters.

> Light has the ability to alter human experiences of space, and to define sensations of intimacy and exclusion. This network between light and the person or thing that perceives it, shapes the atmosphere in which material and social relationships are created or manifested. That relationship which is realized through the built environment may be very different depending on the cultural position of the space. [23]

This unique role light has in forming the experience of space in a social way led me to explore the types of light more characteristic of public spaces in the regions people that settled in Rinkeby might be more comfortable with. In Figure 41, one can see that the demographics of Rinkeby are very different from that of Stockholm proper and in further examination in Figure 42, one can see just how diverse Rinkeby is. I explored three main latitudes that offer a generalized view at length of day and intensity of light, namely 10-20° N, 30-40° N, and 40-50° N. This study can be seen in Figures 43-46. These newcomers to Rinkeby, often used to a more standard 12 hour day of sunlight, come to the city of Stockholm which drastically differs in that it receives just six hours of nearly horizontal light on its winter solstice and 18 hours of light on its summer solstice (Figure 39-40).

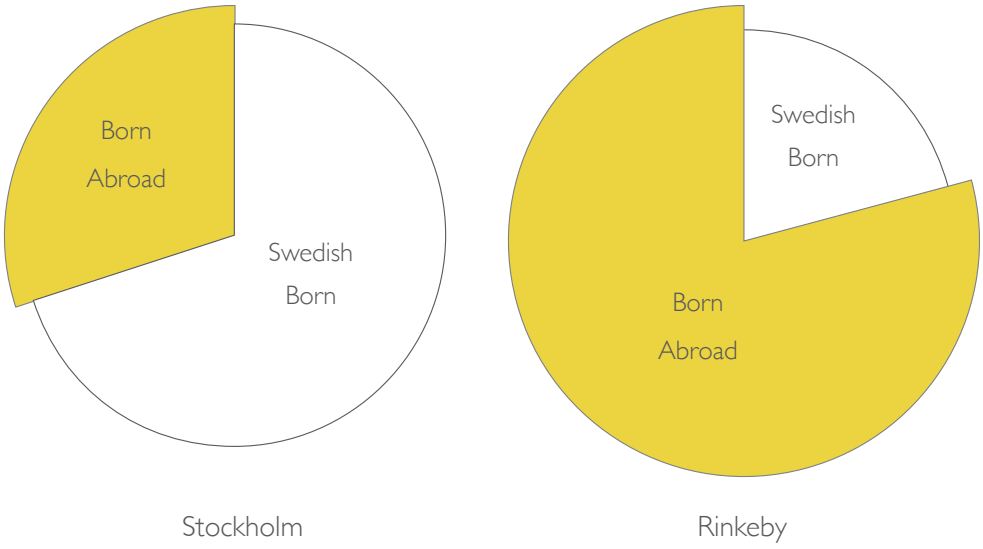


Figure 41: Comparison demographics of Stockholm proper and the neighbourhood of Rinkeby defining "born abroad" as first and second generation immigrants. Adapted from Rinkeby-Kista District Council Report.

23 Mikkel Bille and Tim Flohr Sørensen, "An Anthropology of Luminosity," *Journal of Material Culture* 12, no. 3 (2007): 274.

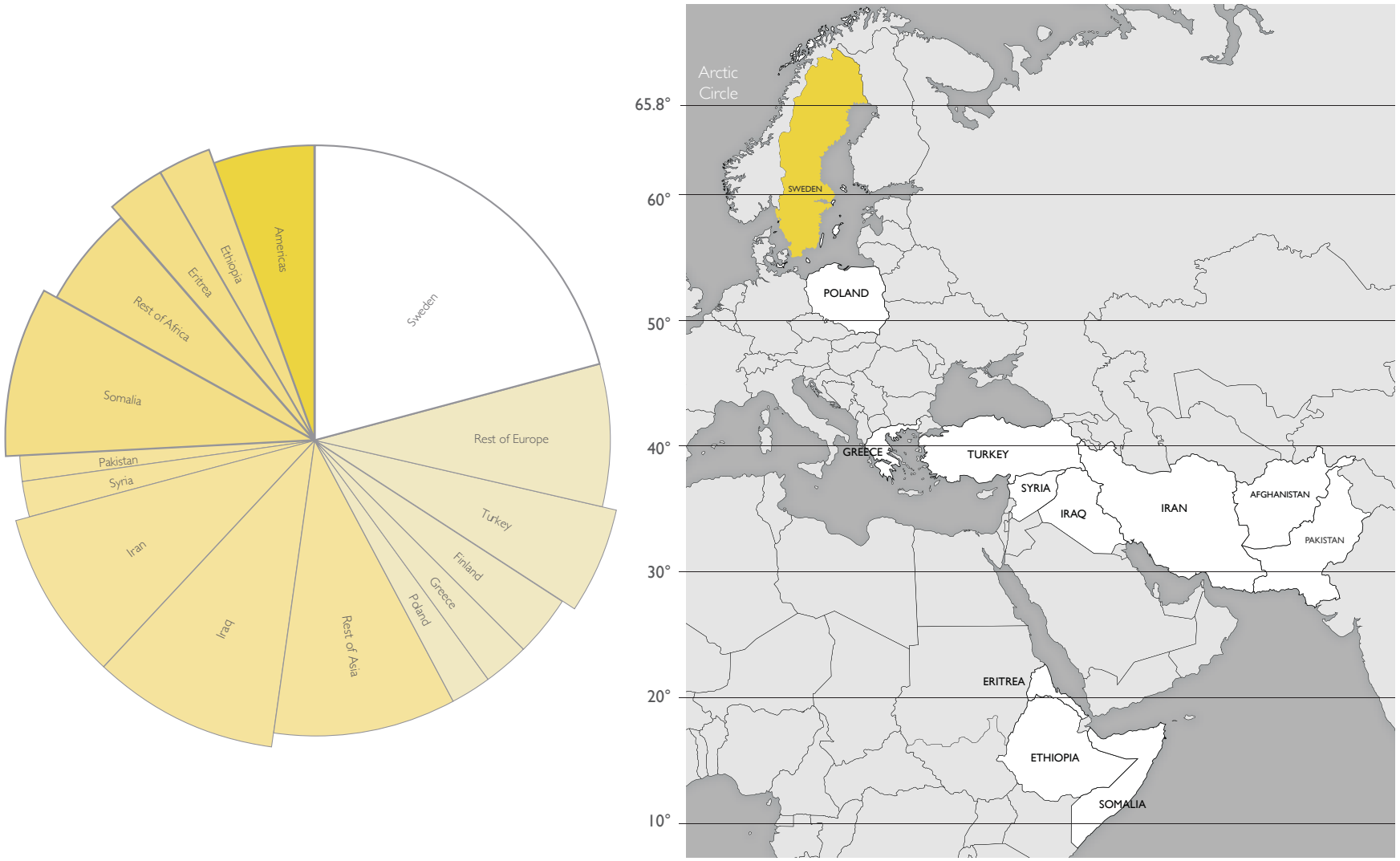


Figure 42: Chart showing country of origin for residents of Rinkeby. Adapted from Rinkeby-Kista District Council Report.

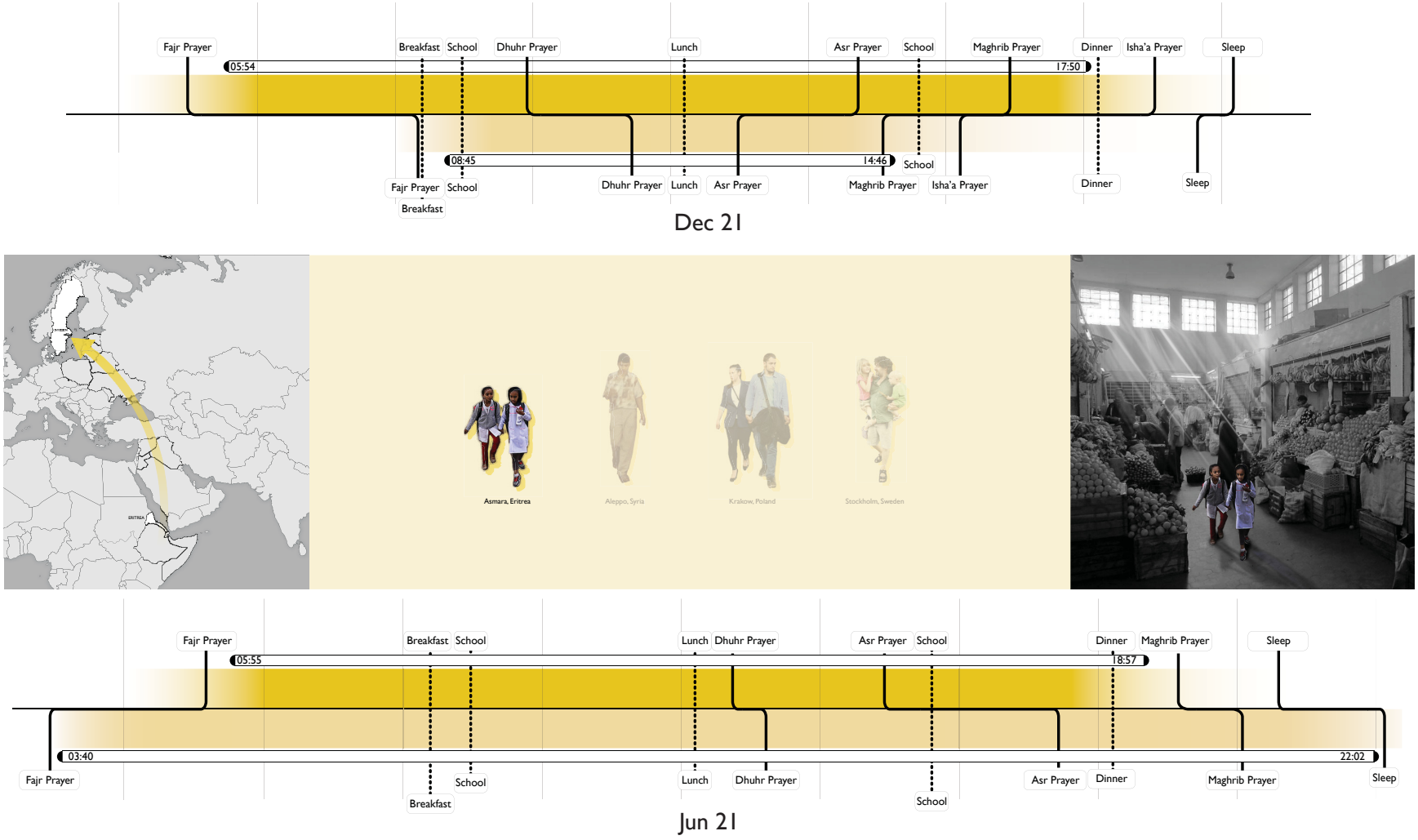


Figure 43: Exploring the disparity of light on both Solstices for newcomers to Stockholm from Asmara, Eritrea at 15.3° N. The top bar showing the length of day in Asmara, the bottom half, Stockholm; photograph by David Stanley.

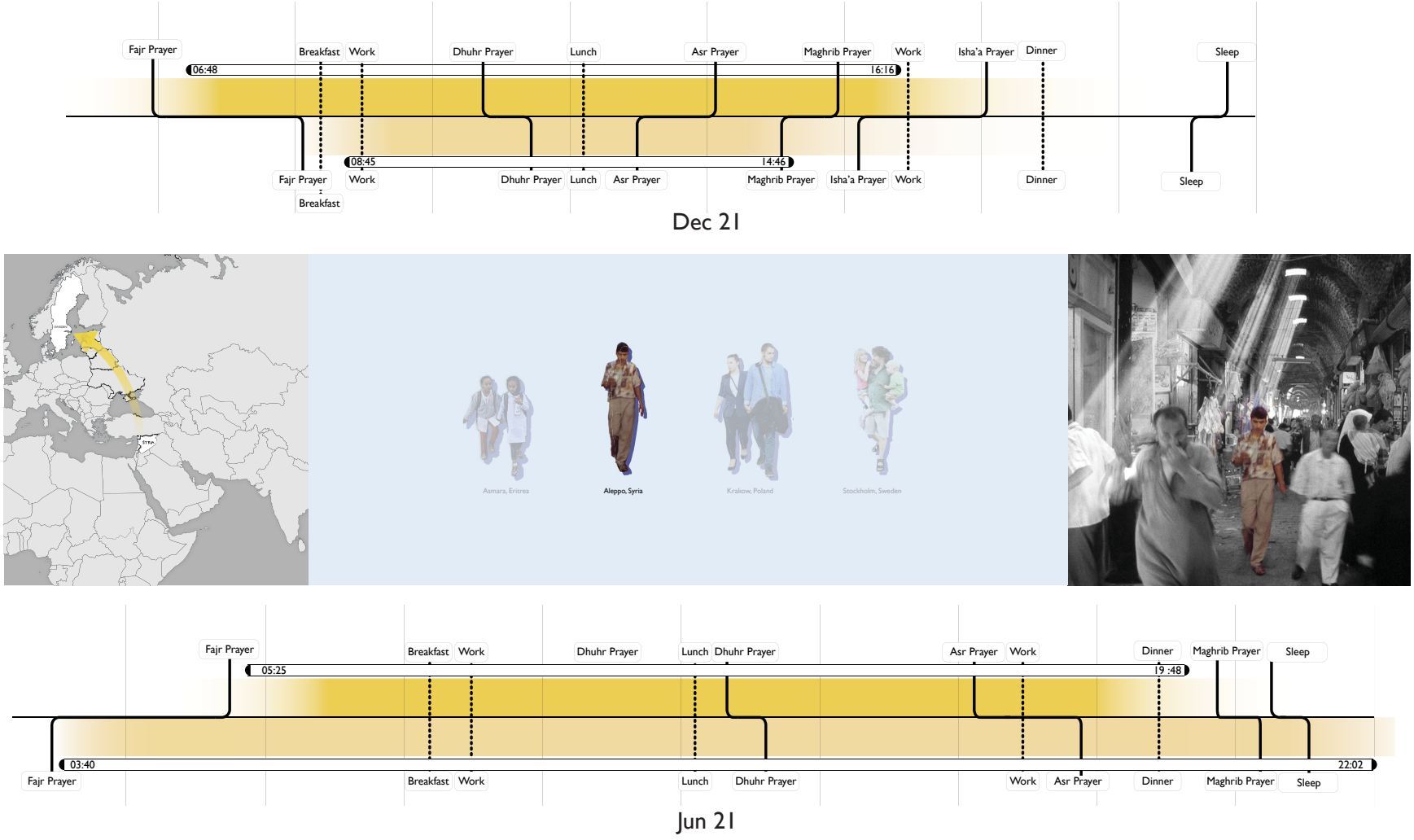


Figure 44: Exploring the disparity of light on both Solstices for newcomers to Stockholm from Aleppo, Syria at 36.2° N. The top bar showing the length of day in Aleppo, the bottom half, Stockholm; photograph by Fulvia Spada.

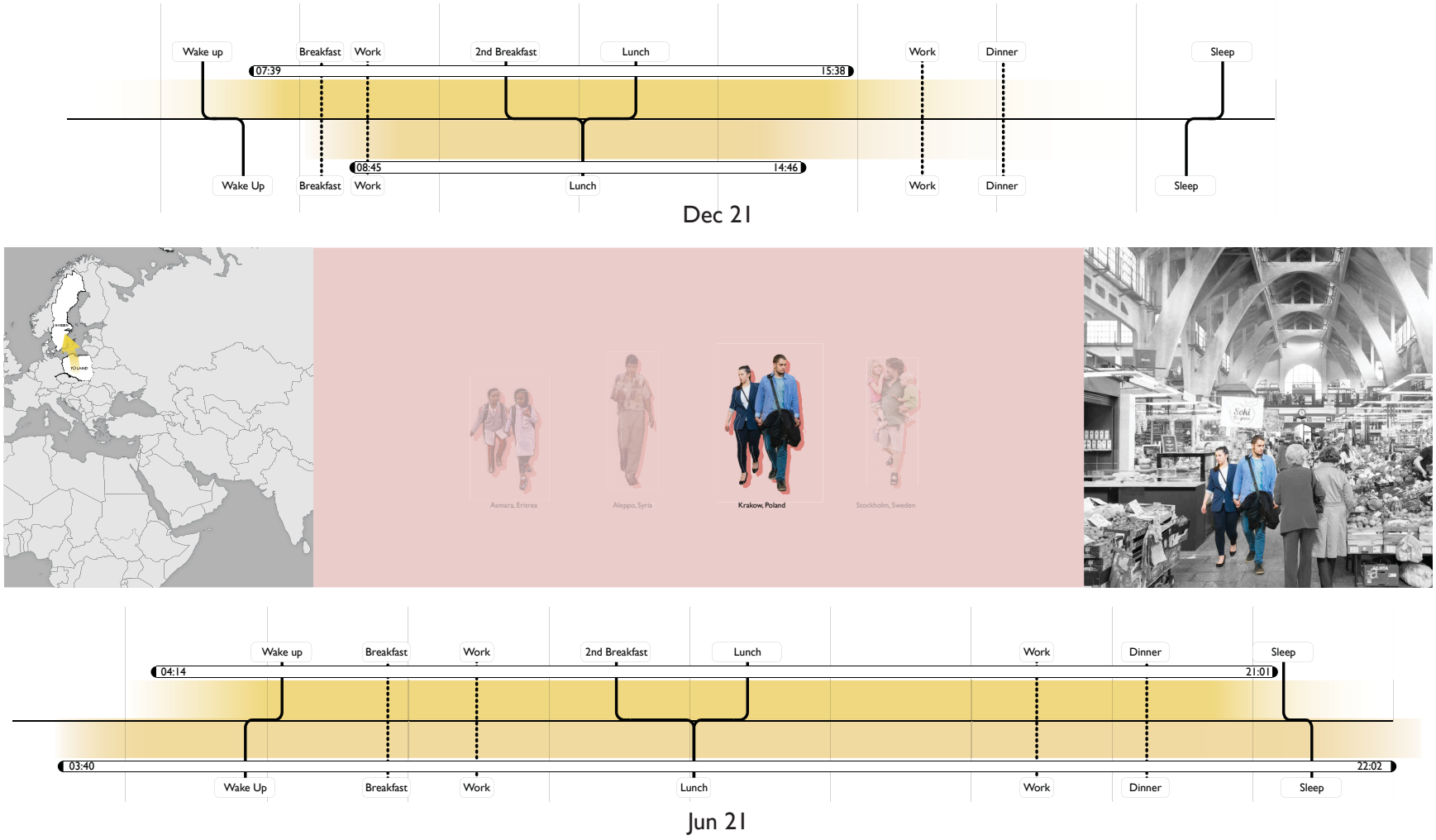


Figure 45: Exploring the disparity of light on both Solstices for newcomers to Stockholm from Krakow, Poland at 50.1° N. The top bar showing the length of day in Krakow, the bottom half, Stockholm; photograph by Panek.

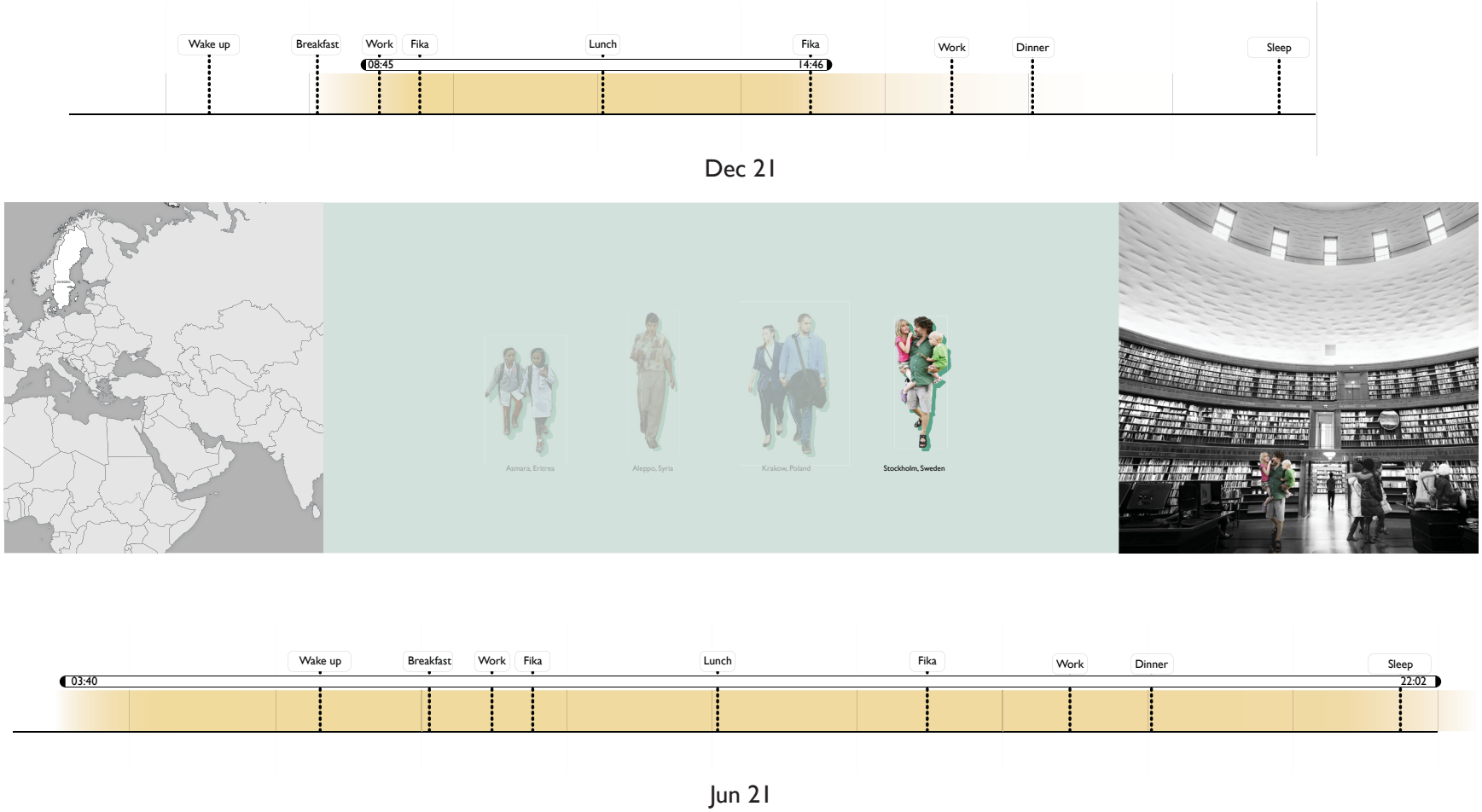


Figure 46: Exploring the existing quality of light in Stockholm and how the average day shifts from the longest day on Jun 21 to the shortest day on Dec 21.

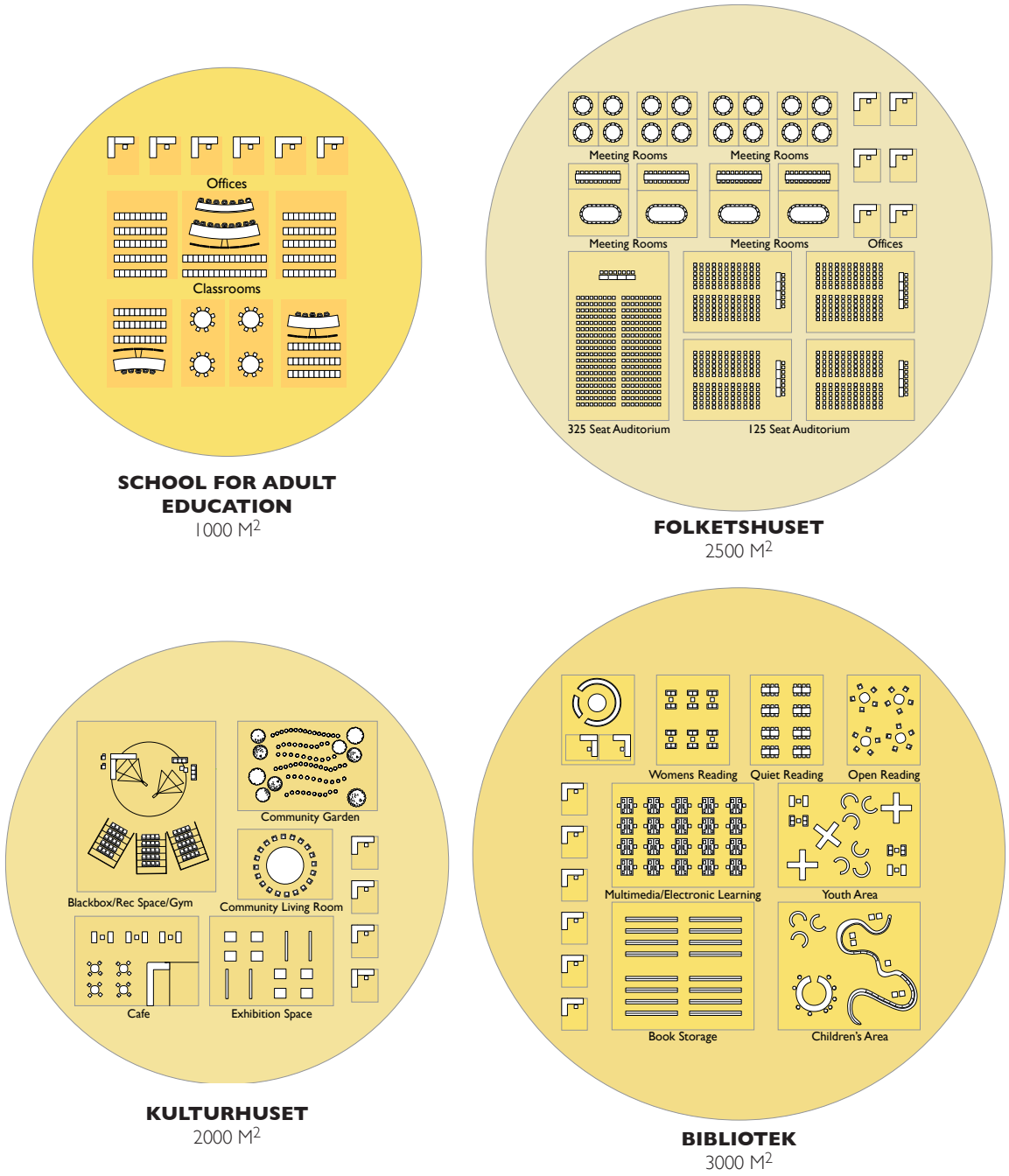


Figure 47: Proposed Program from Existing Need. Adapted from Rinkeby-Kista District Council Report.

Program Development

The suburb of Rinkeby is in the process of rebuilding its Folkets hus, or peoples house.[24] The current facility is in disrepair but is used consistently by the community. Its location is

24 Johanna Edstrom, "30-tal föreningar hotas av Rinkeby Folkets hus skuld," *Mitti Hela Stockholm* last modified November 23, 2016, https://mitti.se/nyheter/miljonskuld-folkets-rinkeby.

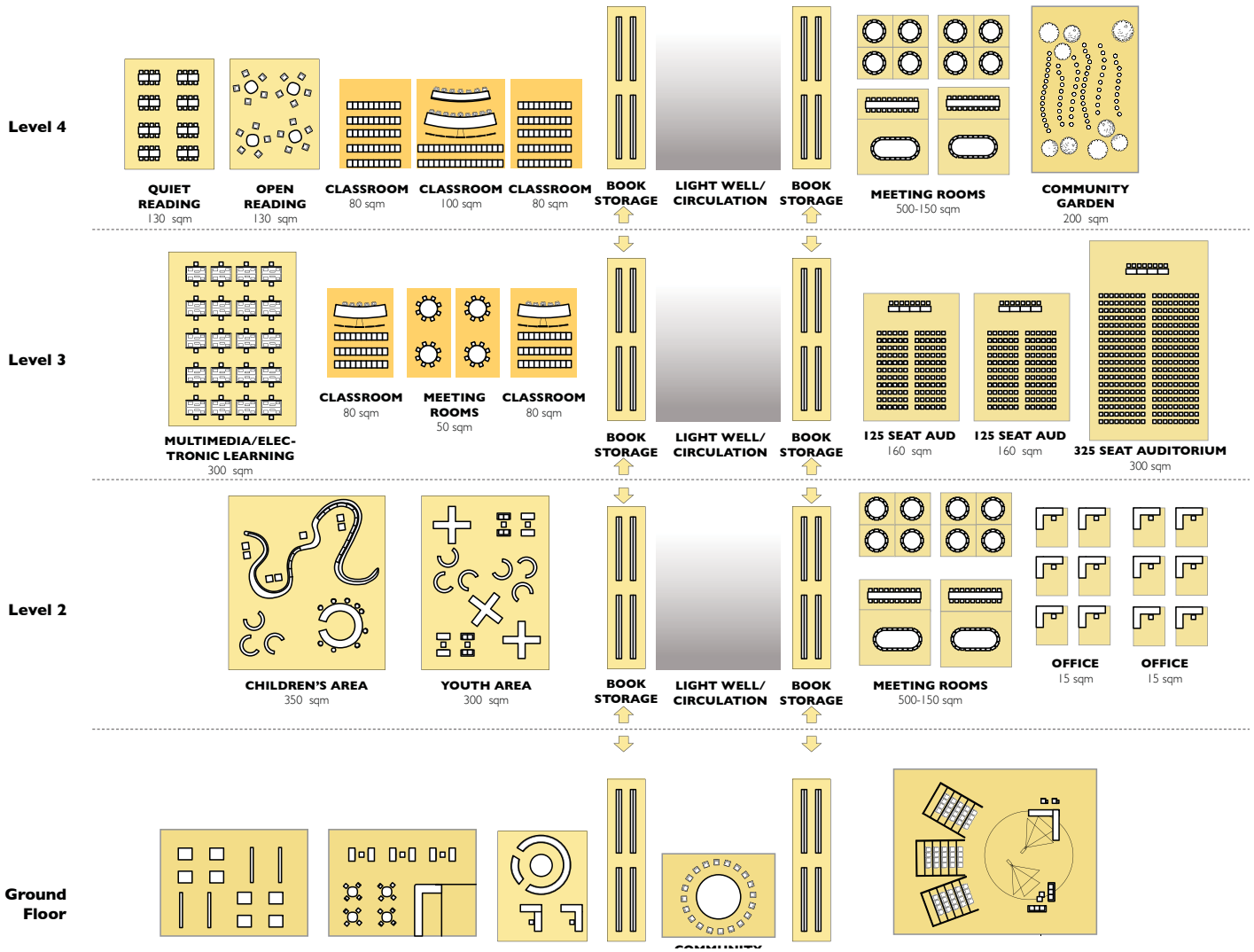


Figure 48: Program Layout Around Regional Light

central to the community and can be seen labeled in red in Figure 35. The building houses community programs, a library, space for adult education and a small allotment for cultural space. This design proposes an expansion of the Folkets hus, giving more space for the growing and diverse neighbourhood to meet together and have a more robust social public space. These four programs have been explored and compared with similar precedents to determine approximate spaces needed and can be seen in Figure 47. Figure 48 attempts to diagrammatically lay out this program around a central community living room that provides a more typical, characteristic Northern approach to daylighting. Off of that main living room, the spaces provide diverse lighting experiences which coincide with a diverse program. The main living room becomes an internalized version of the public square

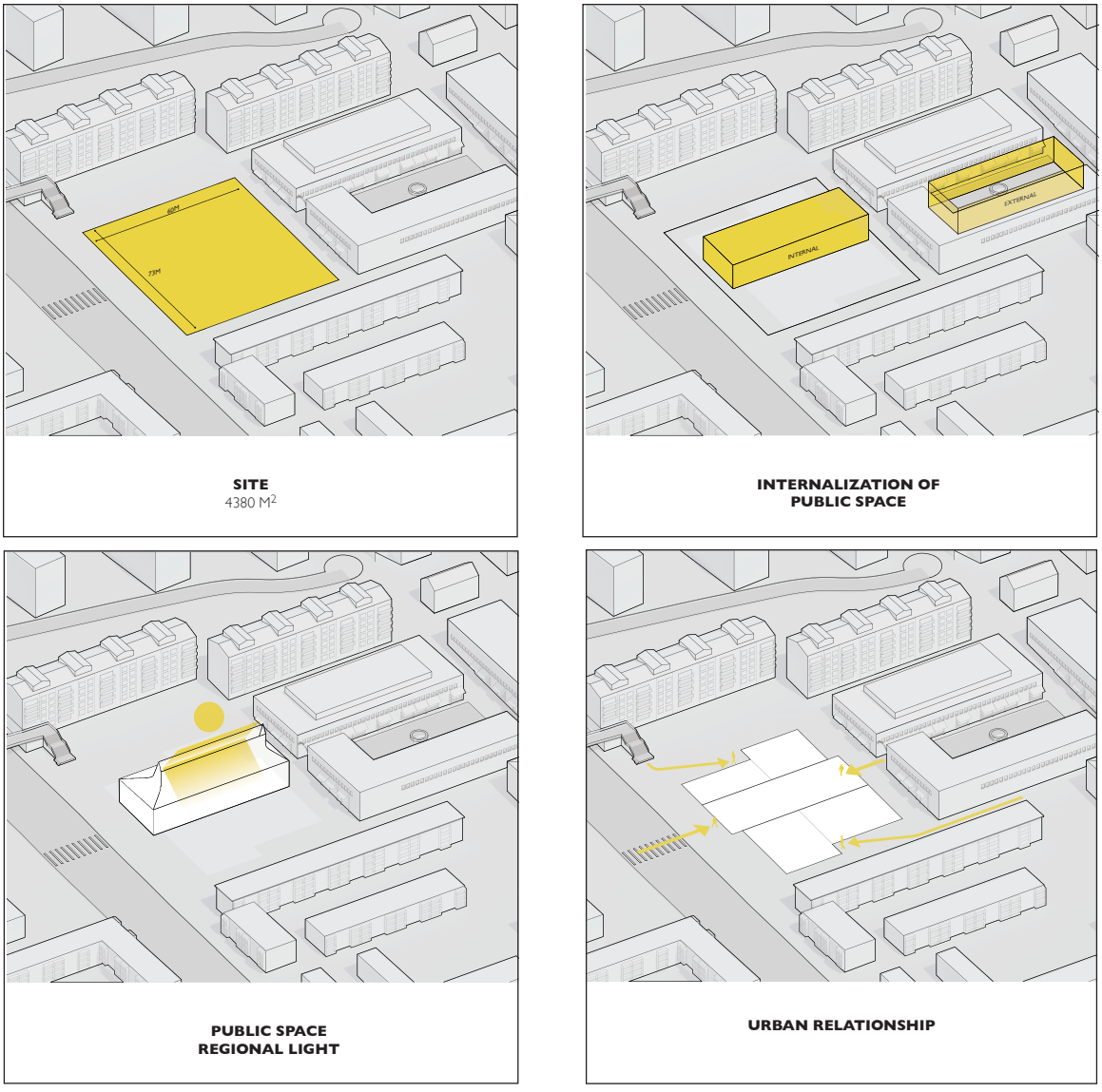


Figure 49: Building Diagrams

which sits adjacent to the Folkets hus. The internalization of a main public space is very typical of this region, and can be seen in the case studies like Bagsværd Church, Kiasma Museum of Art, or the Stockholm Public Library. This inward-looking space offers a room where community can gather, views are more controlled and focus inward, and light is characteristic of place. The program is organized around this internalized space with the ground floor housing the Kulturhuset program, the library program along Rinkebystråket, and the adult education and community meeting spaces directed towards the community square (Figure 49).

The circulation through the building attempts to offer light buffers between the spaces. On the ground floor, circulation passes through a thickened bookcase allowing a transition from darkness to lightness. To circulate vertically, four unique staircases rotate around a vertical light well, providing a diffuse lighting condition which differs from the rooms surrounding it. They deliver light to spaces and provide multiple vertical views through the building. These can be seen in diagram in Figure 49, 51 and in section in Figure 52. These light wells also allow the opportunity to provide natural light deeper into the building, and provide moments of unexpected light from different directions.

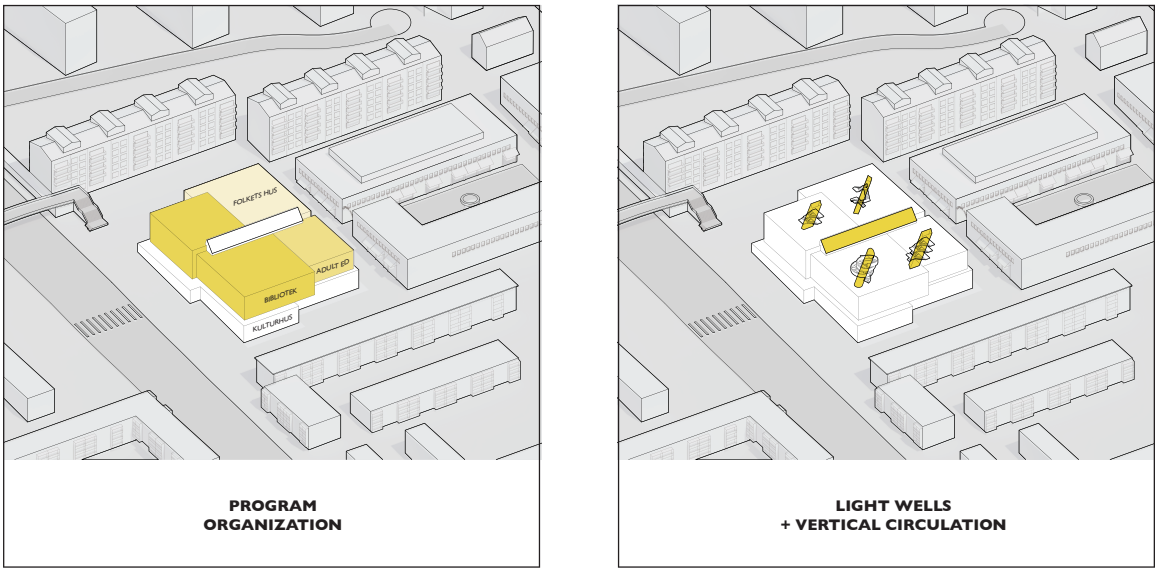


Figure 49: Building Diagrams

Design Strategy

The design attempts to address the need to both capitalize on as much low angle winter light as possible and also explore ways to provide a diverse lighting experience. The building centres around this large, open community meeting space which uses a spatial-indirect approach to diffuse light in the large space. Instead of diffusing light at the aperture, the volume and materiality serve to diffuse light providing a very characteristic, northern approach to daylighting. Other supporting spaces attempt to provide more diverse and varied experiences. By using the toolkit outlined in Chapter 3, and from studying precedents in Chapter 2, the idea is to create one central space which typifies the lighting approach in the region, and then explore how different methods of molding and modulating light can be used to compliment a diverse program which branches off of that space, thus creating a public building which is both grounded in its region but also speaks to the people and program which anchor it in place.

Material Palette

The main approach for this project has been to use three materials, namely wood, concrete, and glass to explore the material culture of place and how that interacts with daylight. These materials can be seen in vignette form in Figure 50. The concrete alternates between a smooth, polished concrete, and a rough, textured board-form concrete, the latter of which is used more predominantly for its light diffusion qualities. The use of white, textured concrete can be seen in all of the precedent studies as it attempts to capitalize on the horizontal light of the northern region. A lighter Baltic Birch has been used as a flooring treatment in many of the spaces as a subtle way to add warmth but maintain as much light reflection as possible. Wood has also been used as a wrapping technique covering the ceiling and walls in certain instances, providing a yellow glow throughout the day and embracing a sense of community and warmth. Lastly, glass has been one of the greatest tools to modulate light. Many different forms of glass have been explored, from diffuse channel glass, coloured glass, to clear and transparent glass. As a material so closely related to the modulation of light and the aperture, it has been one of the test subjects which attempts to provide a varied experience of light in space. These three materials, although basic in nature attempt to address ways of working with light that both harken back to typical, regional approaches of building in the north, and apply novel ideas which have learned from the precedent buildings and architects studied which allow a culture of materiality to address both people and place.

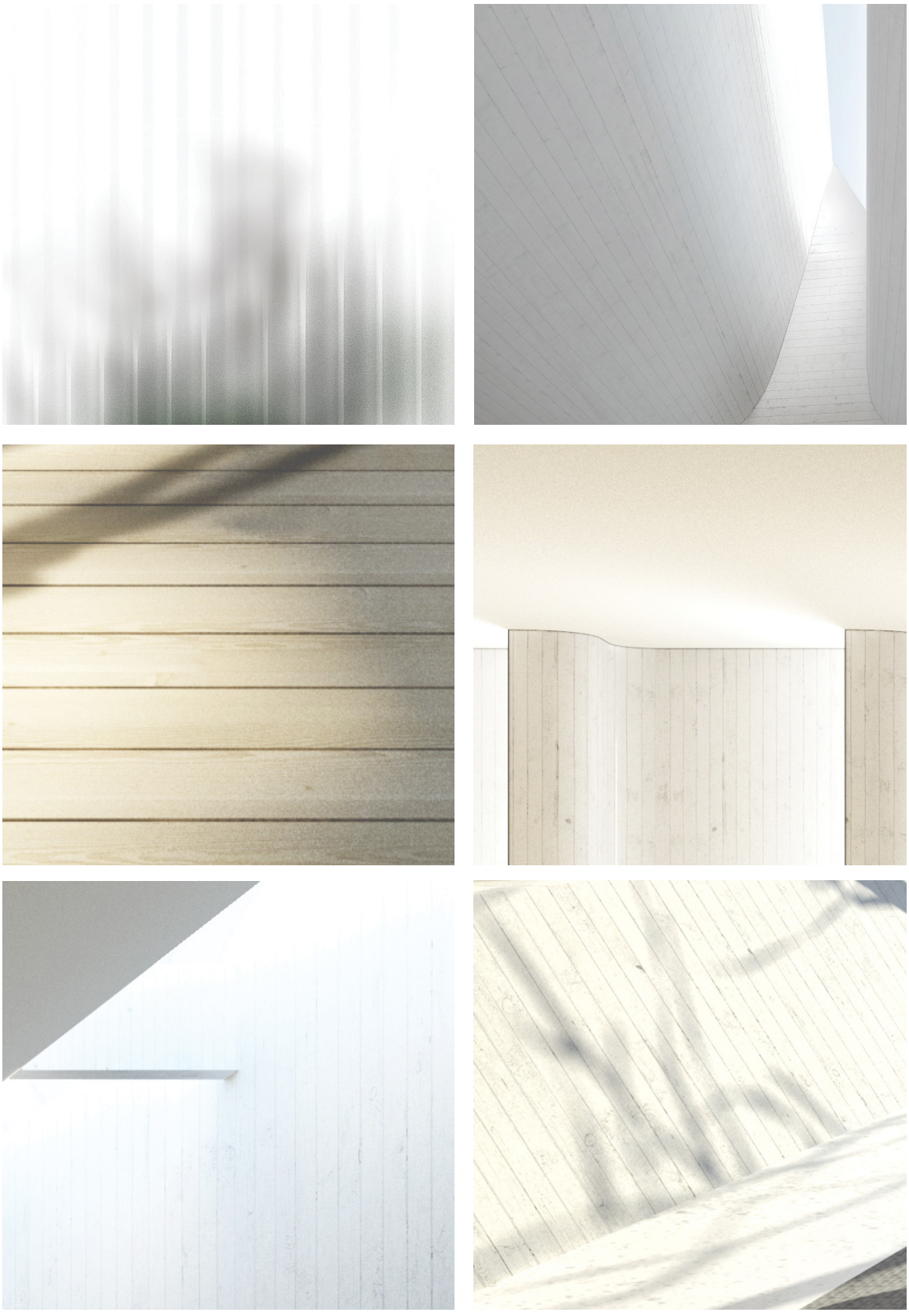


Figure 50: Light and Material Vignettes

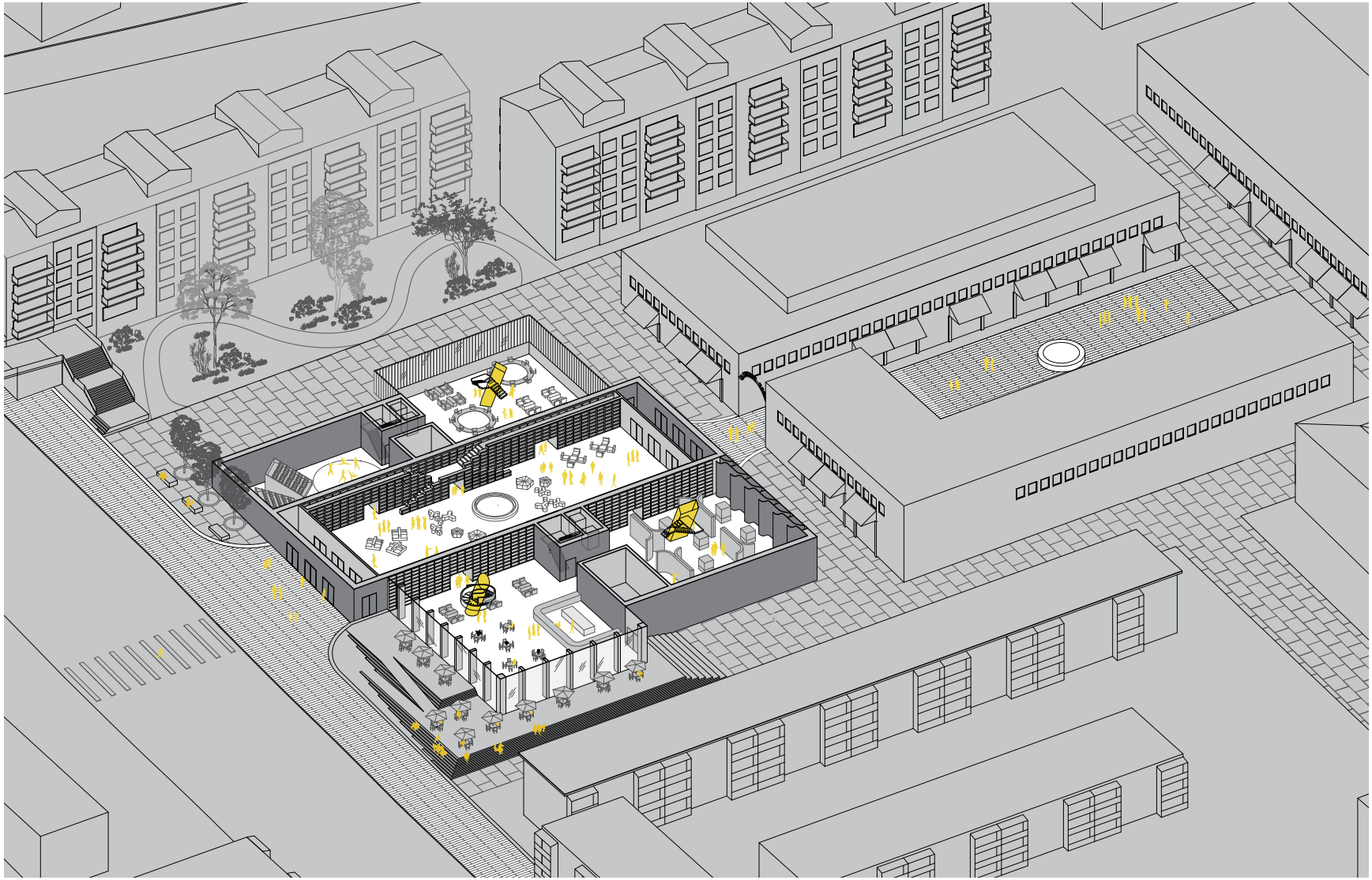


Figure 51: Ground Floor Axonometric

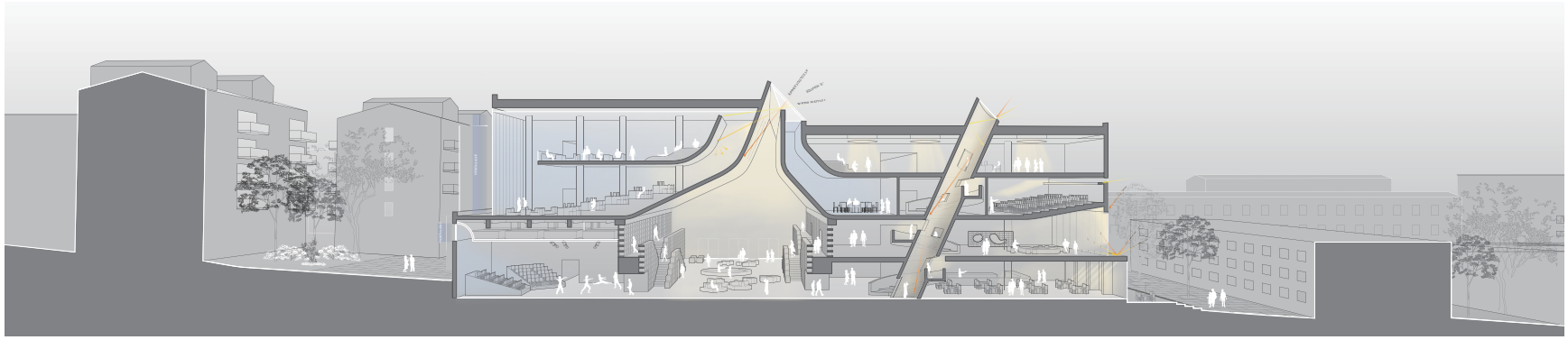


Figure 52: North-South Section showing daylight intent

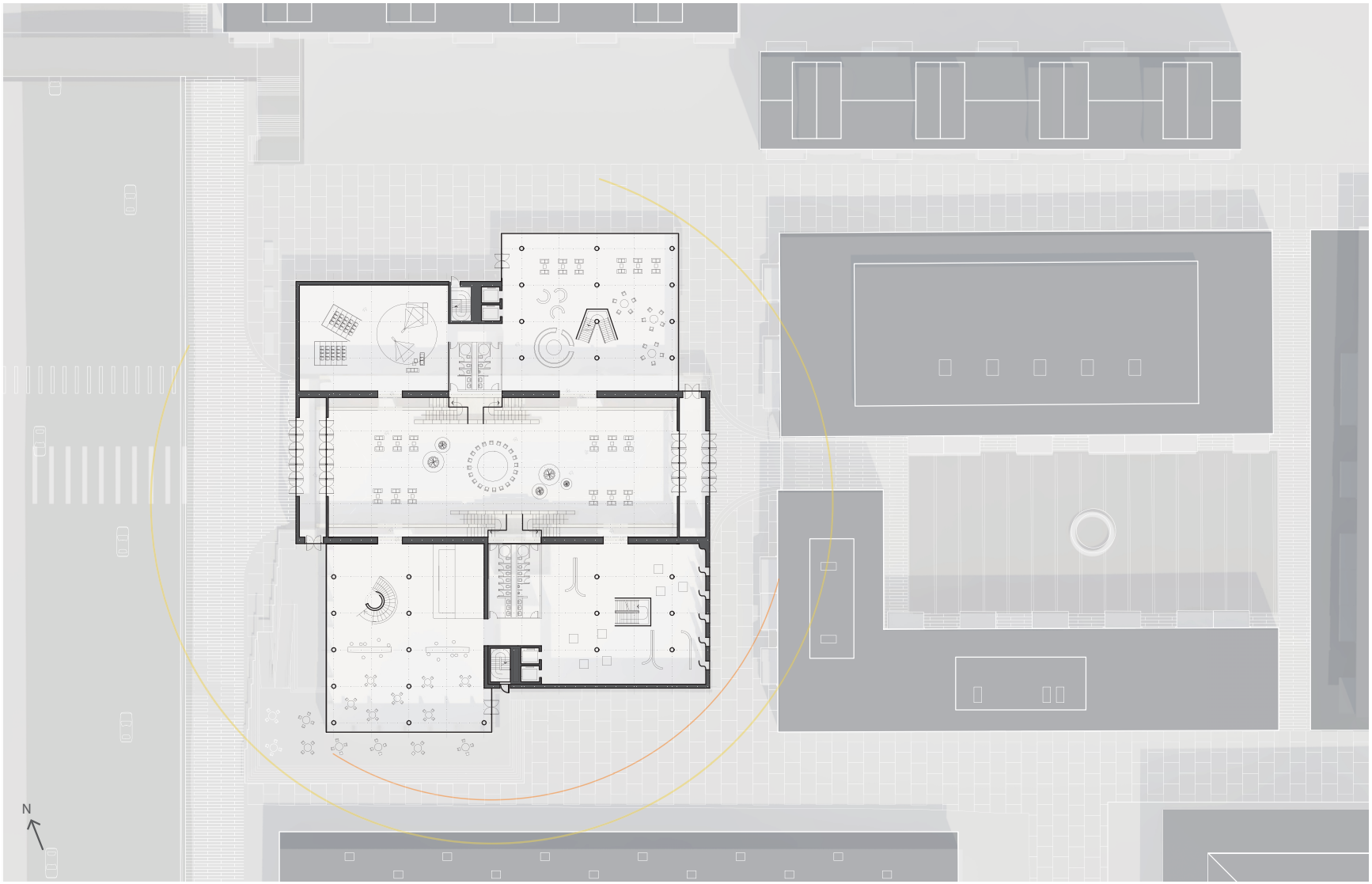


Figure 53: Ground Floor Plan

Urban Response

As can be seen in the axonometric in Figure 51, an effort was made to address the mainly pedestrian access points to the public building. Two minor indents allow pedestrian access from the two greenways along the north and south site boundaries. The main entries from across Rinkebystråket and the town square greet pedestrians by leading them to the main communal space. There were three main massing option approaches explored with many iterations considered. They can be seen in Figure 55 and were all driven by ways of modulating daylight. Ultimately, an approach of stacked boxes was chosen as it allowed light to be more directly modulated based on specific program. Each of the program boxes allow light and the aperture to be more intricately tuned to both the needs of the program and the specific light of the site.

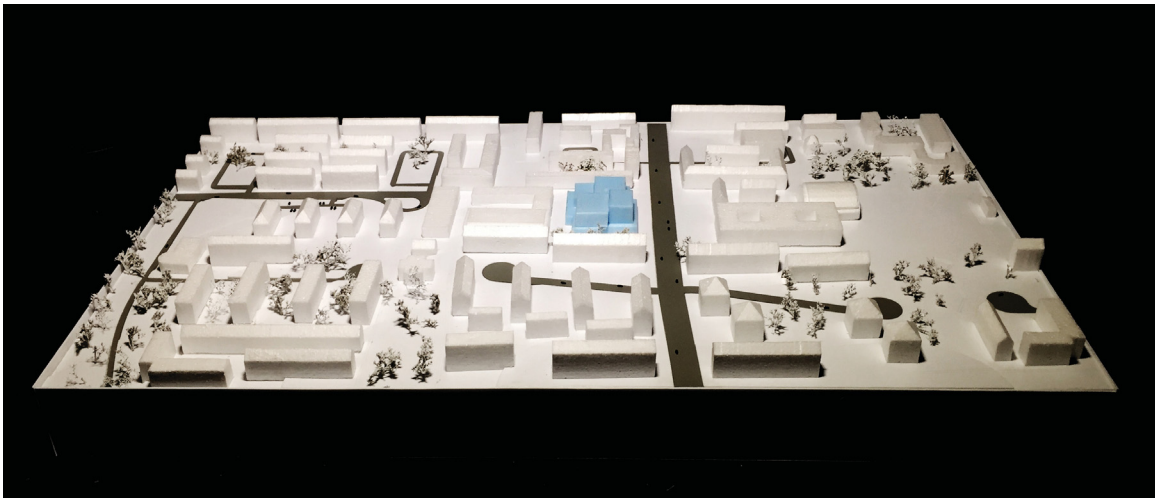


Figure 54: Site Model 1:1000

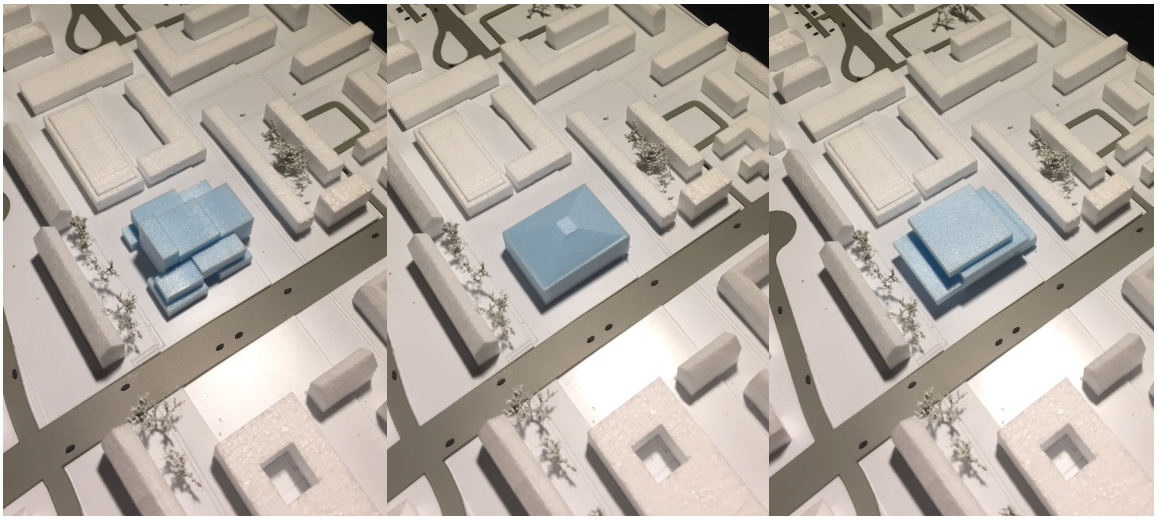


Figure 55: Site Model Iterations: Boxes, Uniform Curtain, and Shifted Slabs

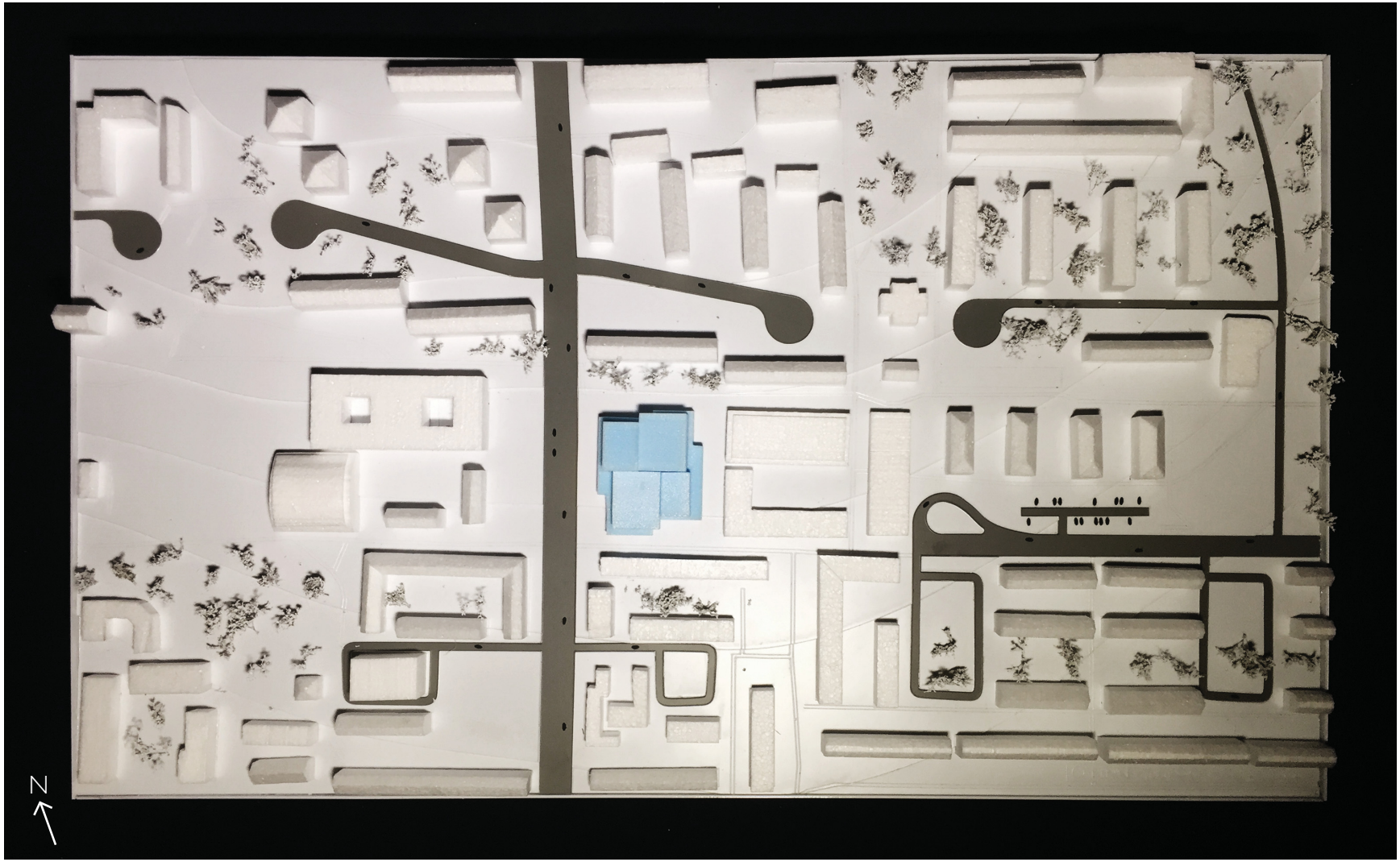


Figure 56: Site Model 1:1000

Rinkebystråket

As discussed in the Material Palette section, the main materials used in the building are wood, concrete, and glass. On the exterior however, those materials are solely glass and concrete. Wood is reserved as a tactile material on the interior to warm and invite human comfort. The exterior serves as a series of solid and void masses. In the day, this allows the reflection of daylight and the building to serve as a dichotomy of light and dark. In the evening, the role of the glass reverses and serves as a beacon of diffuse light, welcoming the community to the building. Just as the apertures and materials vary to allow daylight into the space, the same variation of glass serves the inverse role at night. Diffuse, channel-glass offers a hint at interior life and activity. Coloured glass provides animated light to the exterior, and clear glass offers transparency and comfort of activity for inhabitants (Figure 57-58).

Reading Room

The Reading Room features a north-east facing channel glass facade. This produces completely diffuse, atmospheric, even light perfect for reading and it attempts to capture the horizontal winter light and in turn mimic it in the diffuse quality of the aperture. The upper level of the space is pulled back from the facade, allowing the tall windows to let light penetrate deep into the space. As can be seen in the section (Figure 52), the upper floor also forms a bend, allowing direct light to pass through the atrium, reflect down and bring more changeable, direct, warm, south light to provide variation of natural light throughout the course of the day (Figure 59).

Community Living Room

As previously mentioned, much of the design of the building pivots off the main space which is an inward-looking, open, community meeting space. It uses a spatial indirect approach to diffuse light with a three meter tall opening attempting to collect as much of the horizontal winter light as possible and uses the curved, white-textured concrete to diffuse light in the space. The large sweeping roof rests on bookshelves, which one can pass through to access rooms off the main space, or traverse upwards to the second floor. The wood adds warmth and tactility to the space. The ground floor of polished concrete reflects light upwards both in colour value and in texture. It adds to the luminous quality of the space and overall diffuse, characteristic light of the north (Figure 60).

Figure 57: Rinkebystråket Day: Approaching the Building

Figure 58: Rinkebystråket Evening: Approaching the Building

Figure 59: Reading Room

Figure 60: Community Living Room

Community Meeting Room

The community meeting space uses the technique of supplying multiple sources of daylight. The east facing floor-to-ceiling windows offer warm tempered morning light and views over the main town square. It also offers diffuse top light as an alternate source of light, more constant throughout the day. This can be seen in section (Figure 52). Making use of the inverse shape of the main atrium space became a source of inspiration in providing alternate ways to bring unexpected light into spaces. Warm wood wraps the interior of the roof and wall, folding into a bench and providing warmth and tactility to the Community Meeting Room (Figure 61).

Children's Library

The Children's Library, located on the second floor of the building, facing south and receiving direct light for most of the day allows light to bounce off the lower slab edge and reflect onto the roof (Figure 62). The space uses a direct and dramatic lighting approach and provides a simplistic colour temperature experience through the use of coloured glass. The room changes from morning to night, warm to cool as the sun angle and direction change over the course of the day, and over the course of the year. The windows are pulled in, accordion-like, allowing colours to overlap and mix and provides a reminder of the unique relationship of light and colour. The roof gently folds open formed by the underside of the small auditorium above and collects reflected colours, providing a canvas for light to play (Figure 62).

Exhibition Room

The exhibition space attempts to allow a more selective amount and direction of light in. More horizontal light from the east hits the vertical curved wall openings. As the day continues, light from the south enters from above providing a warm, specific experience of light throughout the day. A clean roof plane provides a canvas for light to paint on. It changes drastically throughout the day. Baltic Birch wood lines the floor and provides a simple surface for light to catch the warm colour value and provide a clean backdrop for exhibition space to inhabit. (Figure 63)

Figure 61: Community Meeting Room: Overlooks Town Square

Figure 62: Children's Library

Figure 63: Exhibition Room

Auditorium

The auditorium is a south-east facing space with large, floor-to-ceiling clear glazed openings. It captures warm morning light and allows more diffuse indirect light throughout the rest of the day. It also unites the inhabitants of the space with the main square through a direct visual connection, providing a firm grasp of place. Much like the community meeting room, wood wraps the ceiling and provides warmth and tactility, emphasizing a sense of community through materiality.

Conclusion

The design strategy aimed to examine how a public space could adopt the approach of grounding a space in a typical, regional approach to daylight design, but also provide a diverse array of lighting options. Inhabitants of the space would be able to find their spot in the building, one that reflected light typical of a region far away or maybe one that fit a task like reading, playing, or gathering. By intentionally seeking to provide different light qualities, the design differs from a typical building that seeks to solely provide adequate light. It takes into account the users and their cultural understanding of light and attempts to modify, mold, and manipulate daylight in a way that will speak to them about place.

Figure 64: Auditorium: Overlooks Town Square

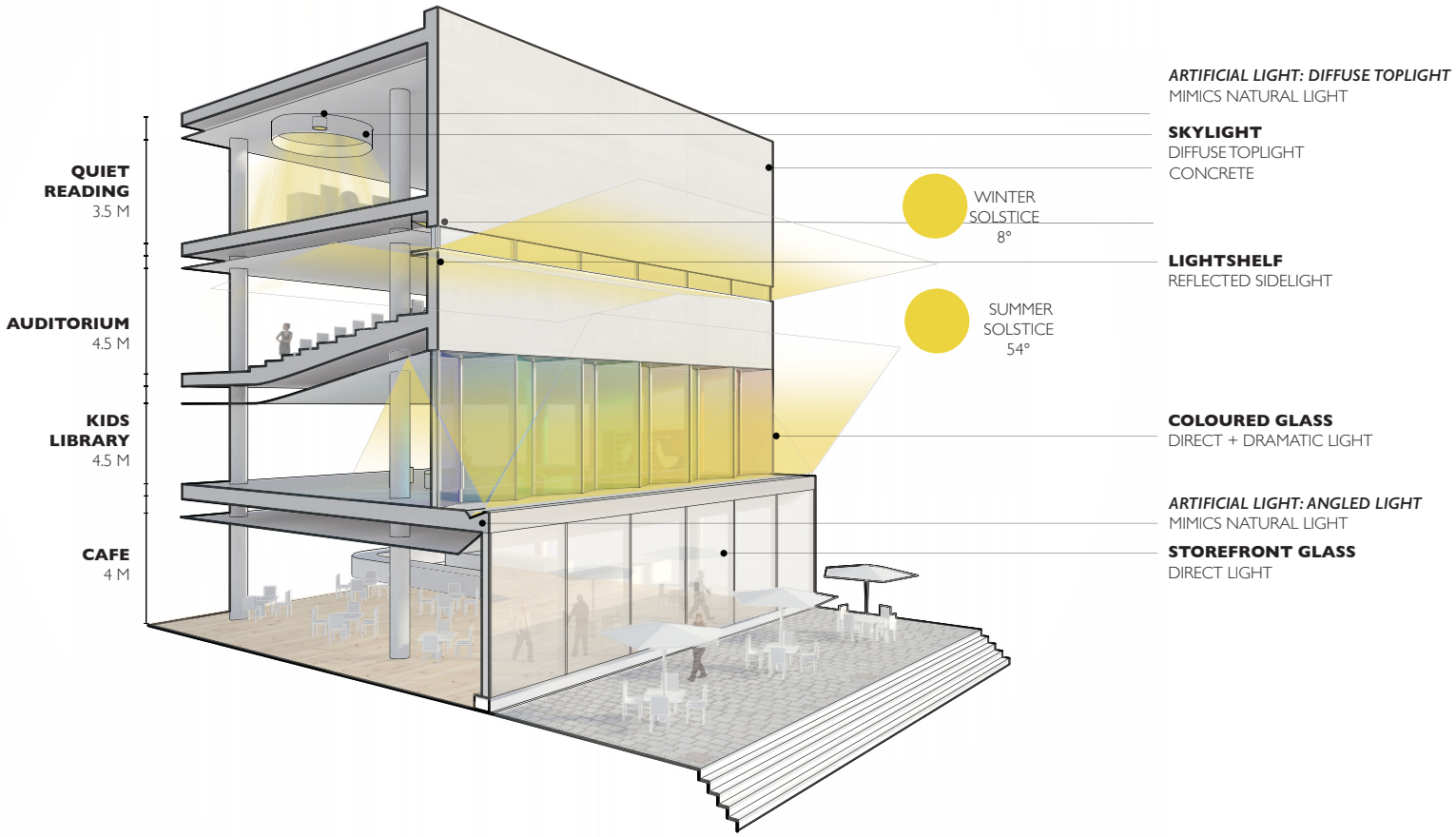


Figure 65: South Facade Detail Section

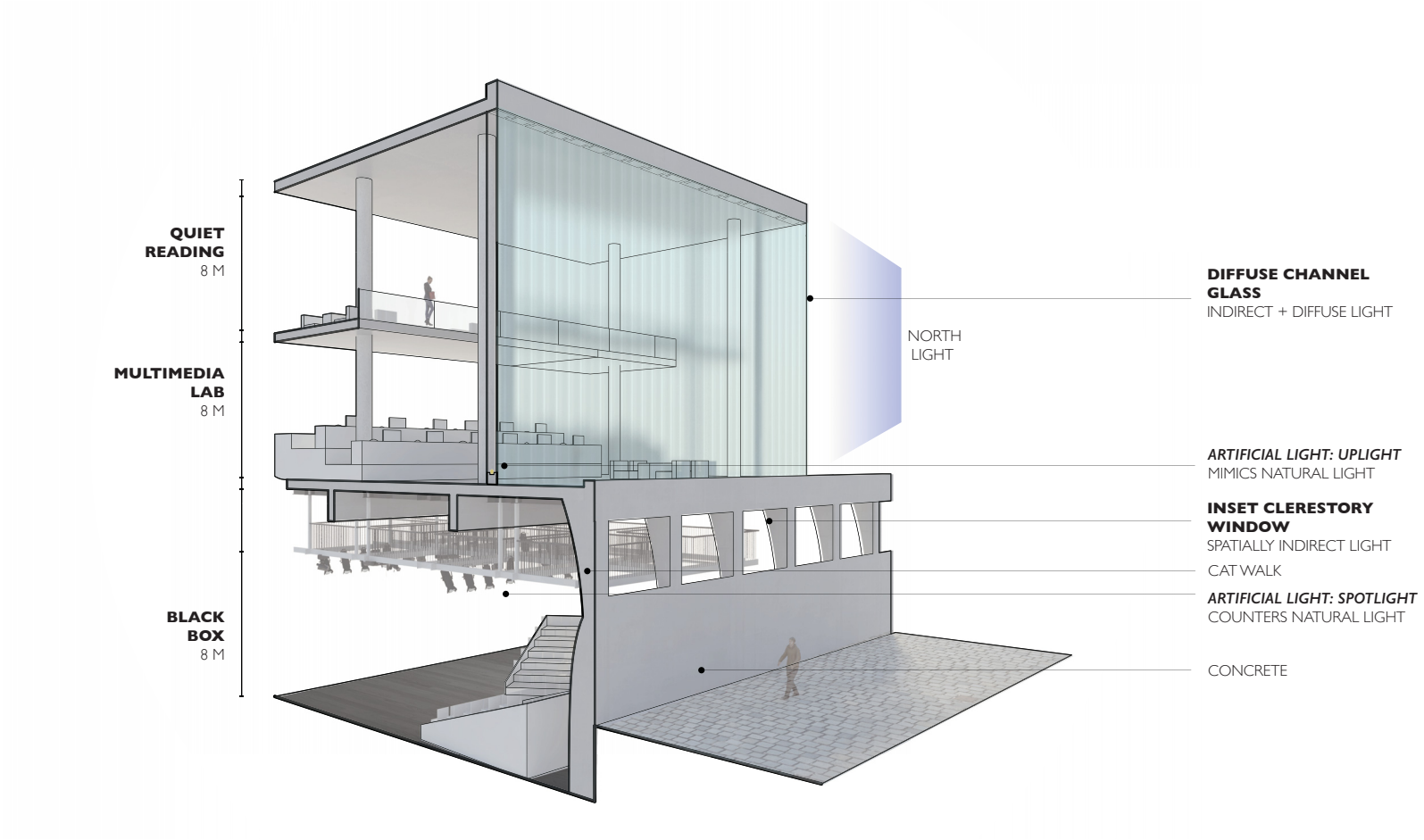


Figure 66: North Facade Detail Section

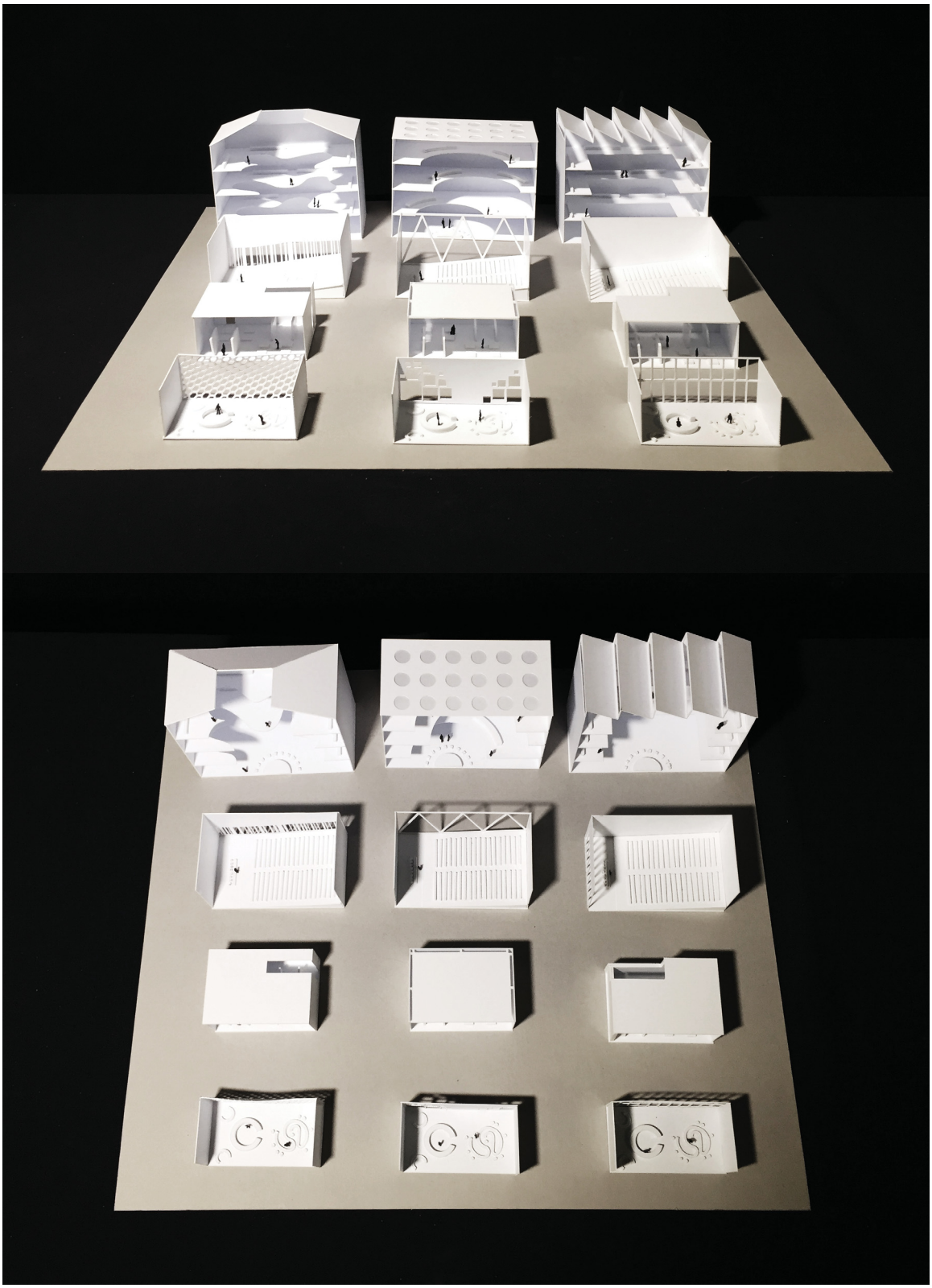


Figure 67: Lighting Model Studies, 1:200. Testing different methods for a spatially diffused light in four specific rooms of the building, namely Children's Library, Exhibition Room, Auditorium, and Atrium.

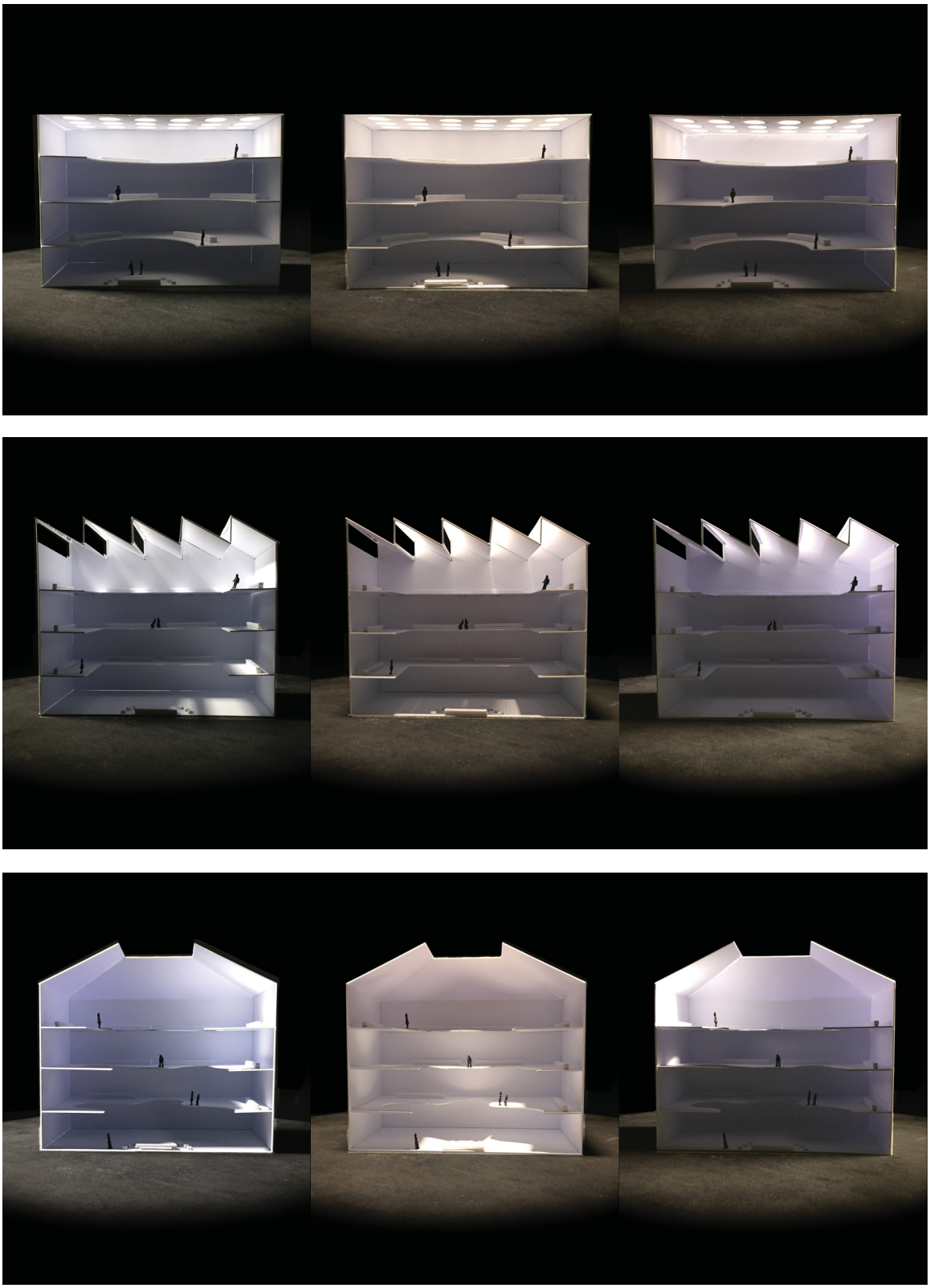


Figure 68: Lighting Model Study, 1:200. Testing different methods for a spatially diffused light in the Atrium of the building. Using a simulated morning light from the east, top light from above, and late afternoon light from the west.

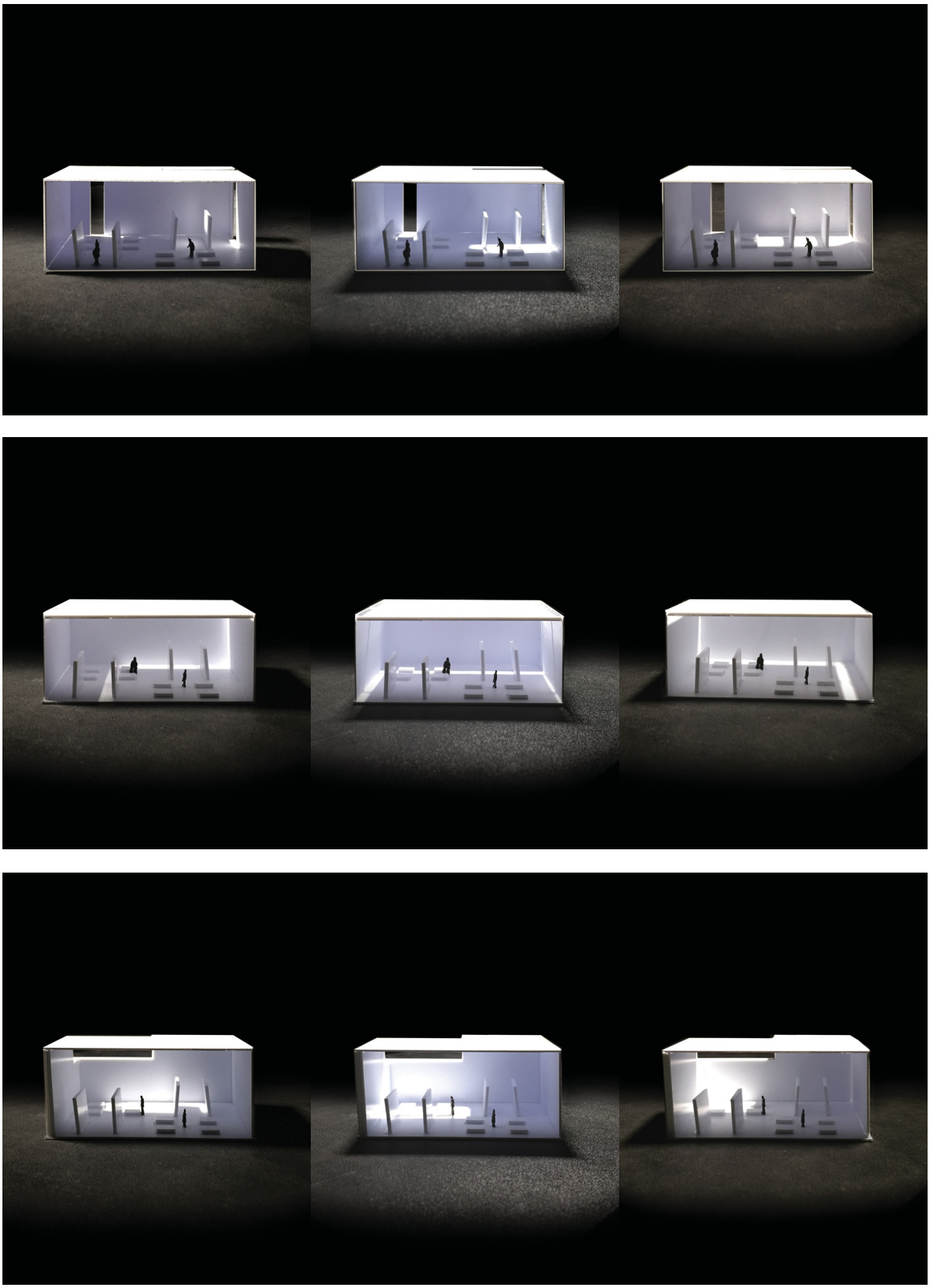


Figure 69: Lighting Model Study, 1:200. Testing different methods for a selectively direct light in the Exhibition Room on the ground floor. Using a simulated morning light from the east, top light from above, and late afternoon light from the west.

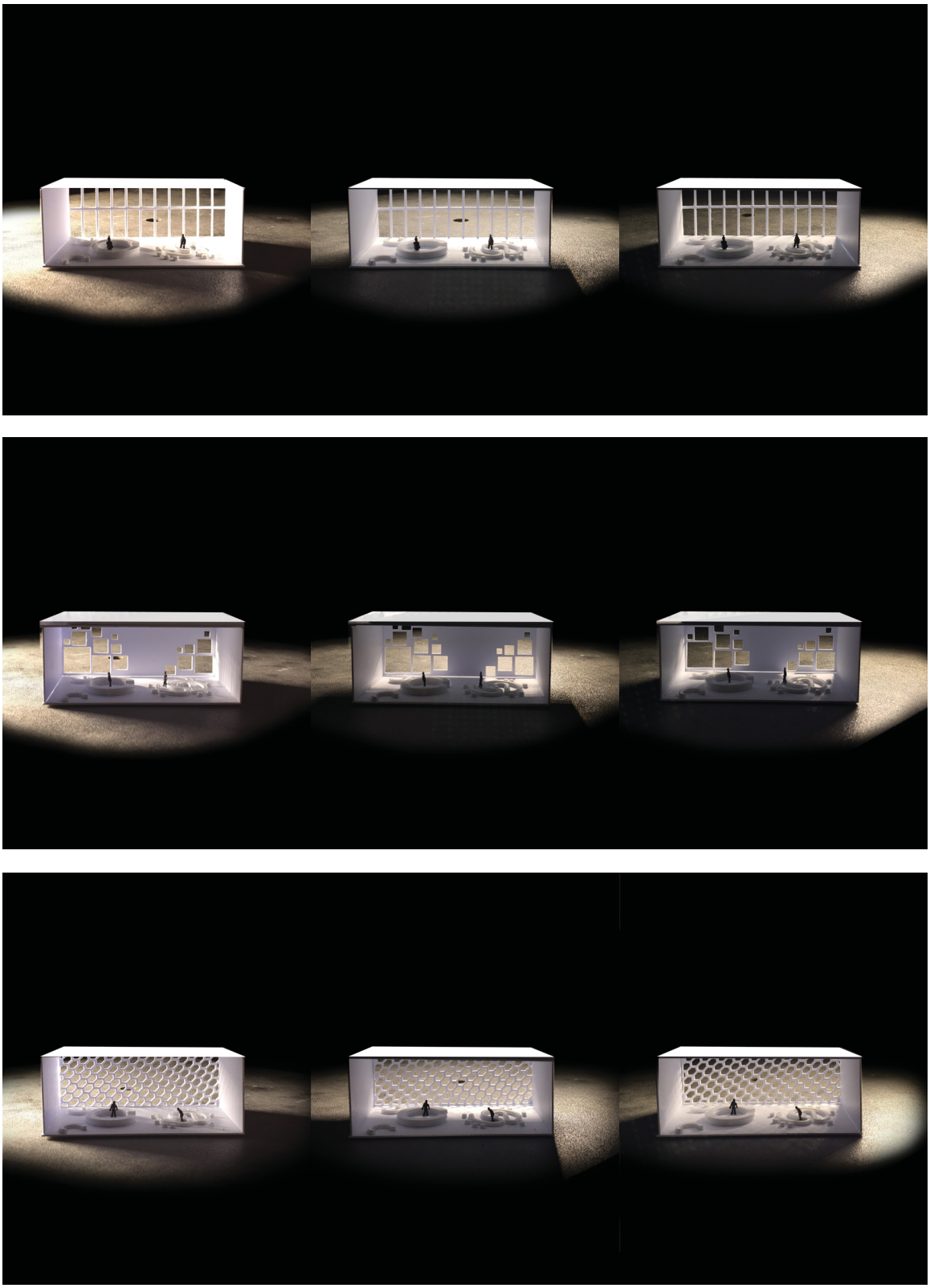


Figure 70: Lighting Model Study, 1:200. Testing different methods for a direct and dramatic light in the Children's Library. Using a simulated morning light from the east, top light from above, and late afternoon light from the west.

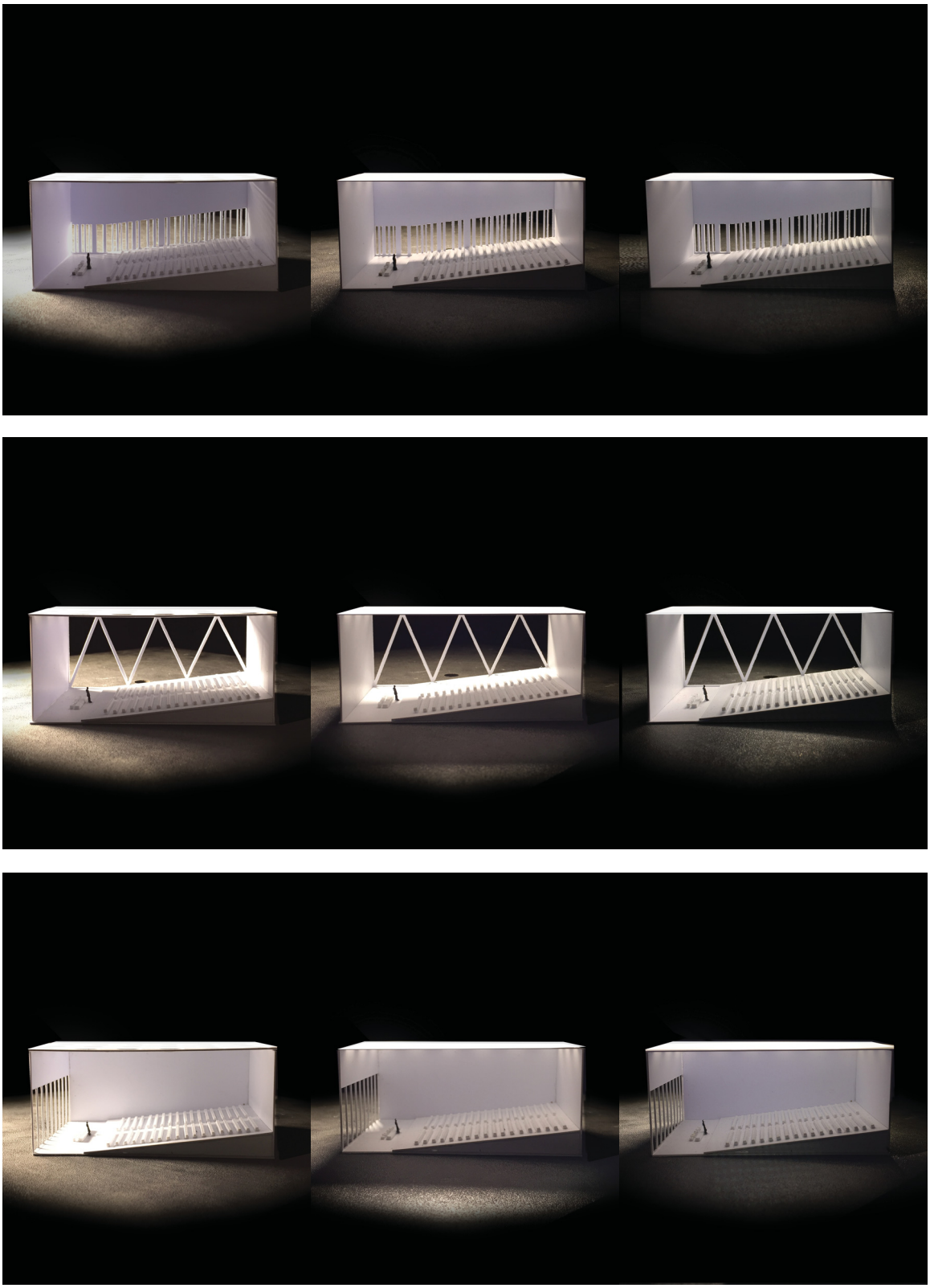


Figure 71: Lighting Model Study, 1:200. Testing different methods for direct light in the Large Auditorium. Using a simulated morning light from the east, top light from above, and late afternoon light from the west.

CHAPTER 6: CONCLUSION

The objective of this thesis is to develop a language of understanding how daylight is manipulated in space by architects in a way in which communicates a sense of place to the inhabitants of a space. This has been explored firstly through the study of the tools architects have that allow us to manipulate light in space: materiality, temporality, volume, and the aperture. Secondly it has been explored through extensive case studies in a region which has a specific language of designing with daylight, and thirdly it has been explored through the design of a public space in that region.

Through this process, a study of daylight in space has emerged that speaks to the profundity of meaning light holds for people and place. Daylight can be used as a powerful tool that has the ability to speak as a metaphor to people from different regions about the diversity of light that exists and bring them together through a program that unites a community's needs.

Contribution to Discourse

One of the aims of this thesis is to better understand the way in which Architecture interacts with daylight and to do so, one needs to understand the tools of the architect and the parameters within which that dynamic relationship exists. Instead of examining that relationship through the lens of existing daylight metrics which can typically be divided into two categories, namely task-plane illumination and discomfort-glare metrics,[25] this thesis has explored how light and shadow and its strength and variability over time is a vital metric for exploring the relationship of daylight and architecture and how that effects the users of that space. By exploring the relationship of light and space through the anthropological lens of how light is used as a tool of place making, this examines light as a material that has the unique ability to contribute to the making of a space.

Future Work

This thesis has examined daylight in Northern Europe, specifically Nordic countries. Scarcity of daylight has caused a unique body of work to have developed because architects have

25 Siobhan Rockcastle and Marilyne Andersen, "Celebrating Contrast and Daylight Variability in Contemporary Architectural Design: A Typological Approach" (presentation at LUX EUROPA, Krakow, Poland, September 17-19, 2013), 5.

had to battle with the task of amplifying minimal amounts of light. This relationship could be inverted in other countries where an abundance of natural light has led to a language of manipulating light in a way that shades and shields. The same study could be explored in any number of these regions, understanding how architects have realized vernacular forms of manipulating light, and translated them in a way that speaks to users about place. One could imagine a similarly extensive study taking place in Japan, Portugal, Chile, Australia, or any number of places with an equally rich discovery of the way in which light can speak to people about place through the built environment.

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