

Take Shelter in the Sun

*Church by the Blue Lagoon:
A Study of Light, Orientation and Identity*

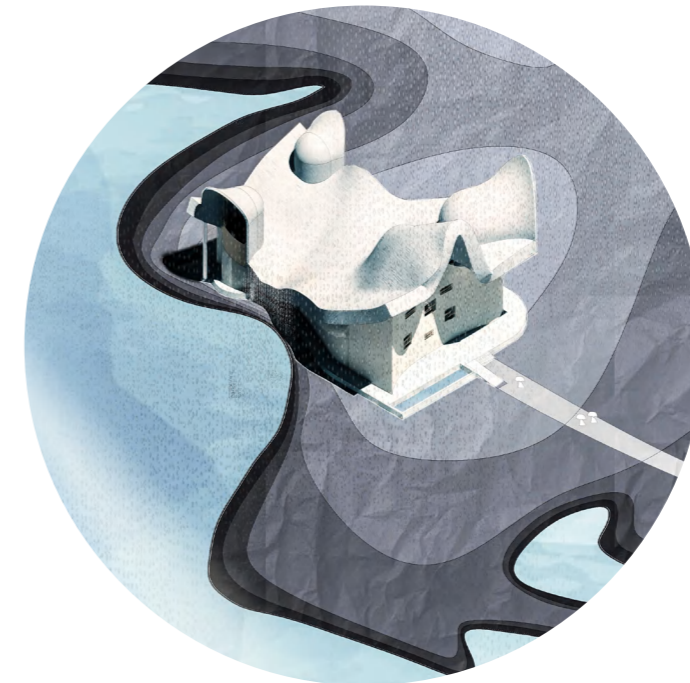
Xinzhi Chang

*Thesis submitted to the faculty of the Virginia Polytechnic Institute and State
University in partial fulfillment of the requirements for the degree of
Master of Architecture
In
Architecture*

*Kevin W. Jones, Chair
James R. Jones
Aki Ishida*

*September 29th, 2020
Blacksburg, Virginia*

*Keywords:
Light, Orientation, Time, Identity, Church*





Take shelter in the sun

Xinzhi Chang

ABSTRACT

For humans, architecture is a shelter for dwelling. People seek protection and a sense of belonging in their surroundings. Architecture should reveal the time passage, changes in weather and the character of the place in order to make a place for people to dwell. Sunlight, as an abstraction of the sun, can be received by architecture and connect the place with the universe. This thesis explores how to apply sunlight research as a meaningful tool in architecture design. The research focused on two criteria: orientation and identity. Orientation and identity are the two elements that make a location into a place and make a space into a room.



Take shelter in the sun

Xinzhi Chang

GENERAL AUDIENCE ABSTRACT

This project is a church located by the Blue Lagoon in Iceland. Light and color are used as means to reveal the movement of the sun and express local memory. The thesis focuses on how sunlight can be introduced into a room and the atmosphere that can be created. As a result, the church is able to tell about its surroundings and make people comfortable.



TABLE OF CONTENTS

Introduction **Project Overview** **Orientation & Time** **Identity & Representation** **Construction** **Conclusion** **Images Cited**

orthogonal system
time machine

refreshing morning & fading dusk
aurora: a cryptic illustration of space
transient daylight during winter

site condition
roof development
structure



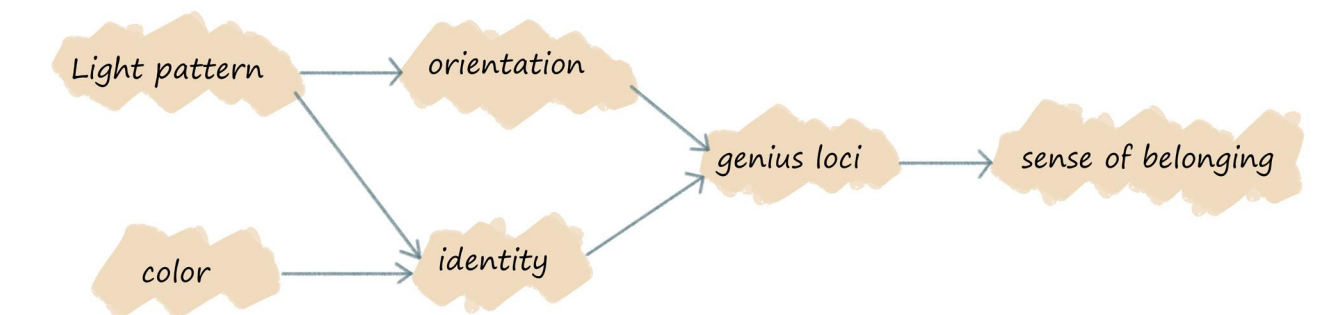
INTRODUCTION

Humans have a desire to form a connection between themselves and their place on the earth. Orientation and identity help us achieve this connection and impart a fundamental sense of both order and poetry.

Orientation is closely related to cosmic order. The trajectory of the sun gives people a primary sense of direction. Architecture, standing on the ground and taking shelter from the sky, should be pliant and respectful to the physical and spiritual manifestation of the sun. The sun speaks with light, which strictly follows physical laws and provides a sense of orientation. Orientation can be used to define a work of architecture, forming a conversation between the artificial work and the universe.

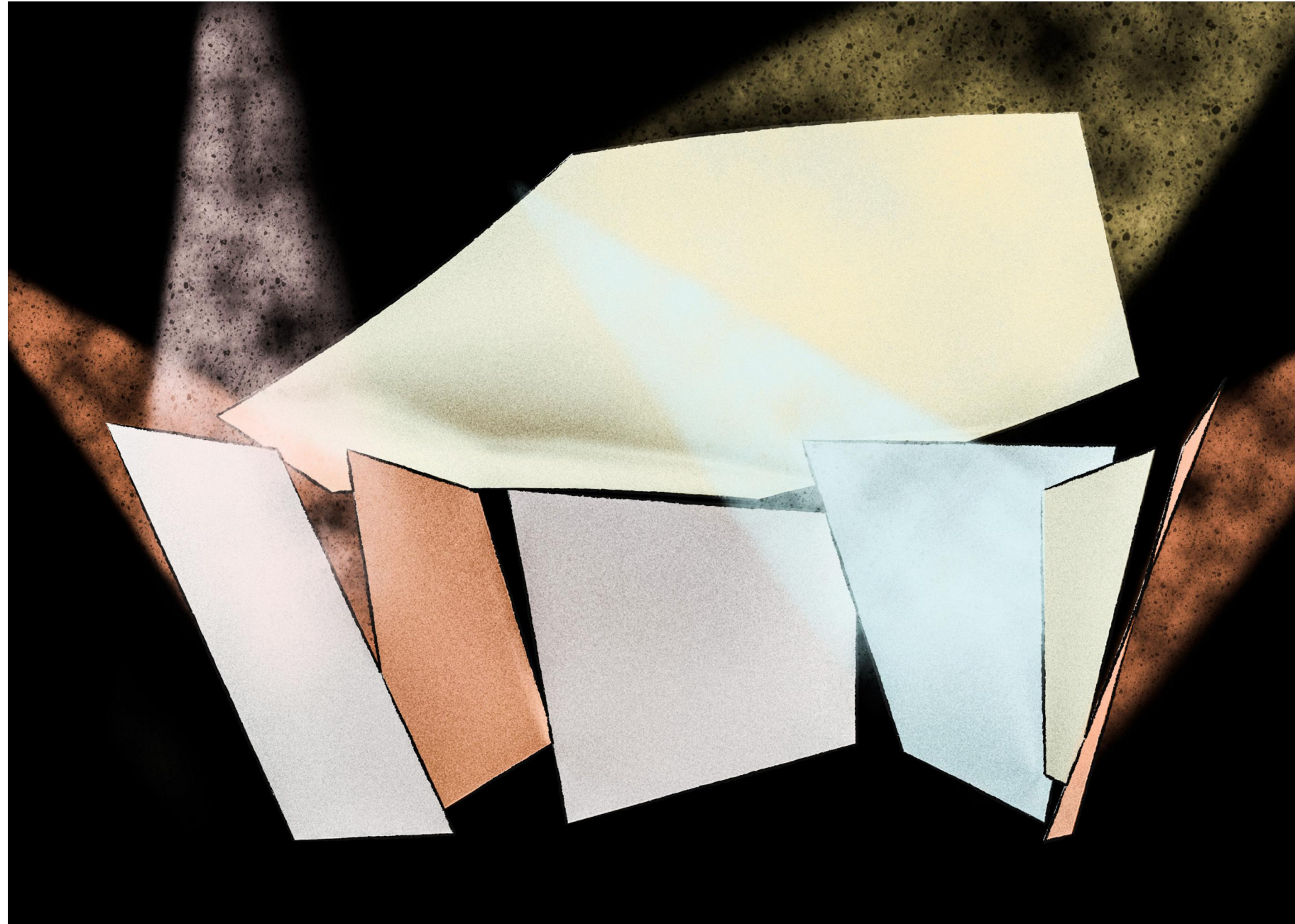
Identity is informed by local memories. When Icelanders gaze at the colorful water shrouded by an expanse of clouds, or experience the brilliant north light, or there is a snowfall and everything recedes into reticence, these moments of delight which bespeak the change of seasons make the place into a distinct world. In Christian Norberg-Schulz's words: "*In general, nature forms an extended comprehensive totality, a 'place', which according to local circumstances has a particular identity.*"¹ When architects are able to discover the character of a place and represent it in the work, architecture can form a psychological relation with the location.

Sunlight, with an absolute virtue of combining orientation and identity together, can serve as a compass in the design of architecture. This thesis explores the role of light in architecture, and how it can bring a sense of orientation and identity to people and place. Through the design of a church, light and color will be used to commemorate the circle of life and genius loci.

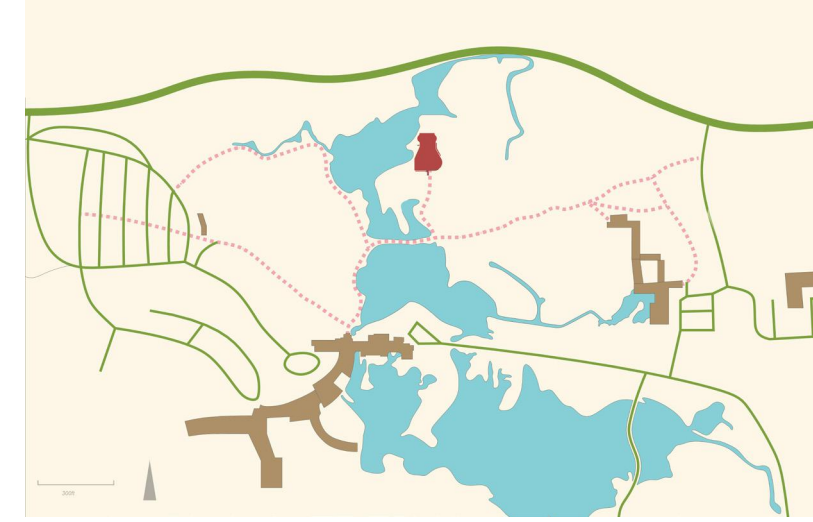


¹ Christian Norberg-Schulz, *Genius Loci: Towards a Phenomenology of Architecture* (New York: Rizzoli, 1979) p.10

This is a church with seven stages for light. Each stage will be activated during different time period, generating unique spacial qualities inside the church.



PROJECT OVERVIEW



Located by the Blue Lagoon, the church takes on an ethereal and somber dignity with seven stages prepared for light. Two of them (a&b) are at the north end of the church and are used as sacristies. Prayer mats will recede into the shadow when a piece of light washes over the wall, forming a place for meditation and reflection. Another, (c), faces towards the northeast, receiving morning light on summer days. When the green glow suffuses the empty, thick wall, it brings the happiness of the morning. One of them (d) faces southeast, receiving sunlight at 8:00 am on Easter Day. A powerful background would show up behind the choir when light reaches this stage, contributing to the solemnity of the occasion. Light stage (e) faces due south, serving as a timing device. All consciousness of time is revealed when light penetrates through the darkness and throws a colorful brilliance to the surface of the ground and the opening. The next one (f) faces northwest, receiving dusk light in the summer. With a deeply religious meaning of sacrifice, the red light bespeaks the coming of dusk. The four stages (c, d, e, f) are activated one by one on summer days, with people immersing themselves in the sense of reincarnation. The last stage (g) is at the top of the south wall. This stage is prepared to catch the touching moment of the transient winter daylight. The overall design of the church is about the power of sunlight and how it can make for people a place to dwell.



1. Sacristy 2. Narthex 3. Confession 4. Choir 5. Altar 6. Mechanical Room

ORIENTATION & TIME

ORTHOGONAL SYSTEM

The right angle is the essential and sufficient implement of action, because it enables us to determine space with an absolute exactness.²

The laws of gravity seem to resolve for us the conflict of forces and to maintain the universe in equilibrium; as a result of this we have the vertical. The horizon gives us the horizontal, the line of the transcendental plane of immobility. The vertical in conjunction with the horizontal gives us two right angles, There is only one vertical, one horizontal; they are two constants. The right angle is as it were the sum of the forces which keep the world in equilibrium. There is only one right angle; but there is an infinitude of other angles. The right angle, therefore, has superior rights over other angles; it is unique and it is constant. In order to work, man has need of constants. Without them he could not put one foot before the other. The right angle is, it may be said, the essential and sufficient instrument of action because it enables us to determine space with an absolute exactness. The right angle is lawful, it is a part of our determinism, it is obligatory.³

The orthogonal system is fundamental to our sense of orientation and ancient timing devices. The four primary directions: north, east, south, west, are constructed based on an orthogonal plan. The pointer of a sundial is facing due south, which casts a shadow on the dial to create a coordinate system.

² Le Corbusier, *The City of Tomorrow and Its Planning* (New York: Dover Publications, 1987) p.13

³ Le Corbusier, *The City of Tomorrow and Its Planning* (New York: Dover Publications, 1987) p.46



Image 1

In the field of art, Piet Mondrian felt an affection for orthogonal systems. In his discovery, the orthogonal system provided the most accurate and elegant expression of the world. There are certain characters in his work. First, they don't have boundaries, which weakens the existence of the frame. Second, the black geometry he uses to divide the picture is part of the composition. Their widths are carried out of proportion. Finally, the colors he chooses are three primary colors.

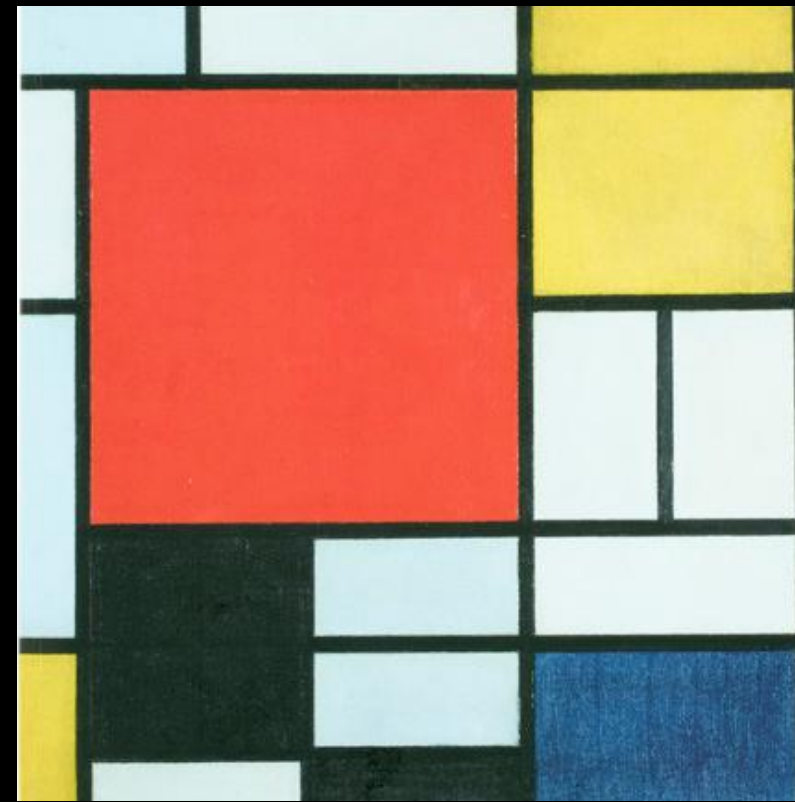
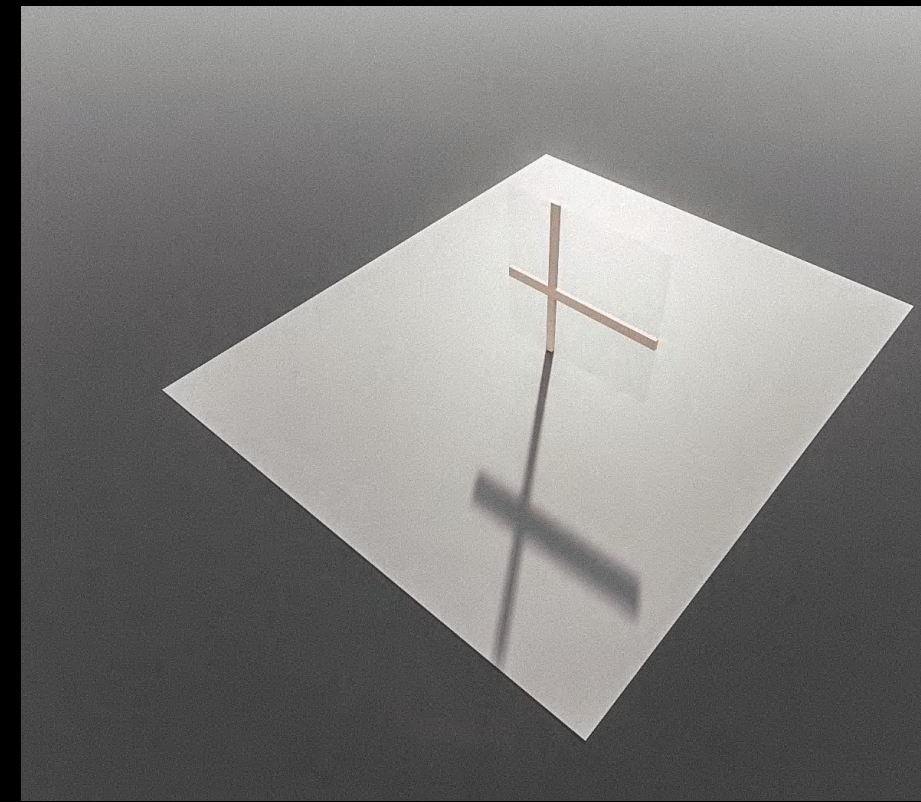


Image 2



His work forms a bridge between the world of art and the idea of a timing device. Window mullions, designed with Mondrian's theory, are working precisely as a timing device. While gazing at the shadow of one single angle of the frame, it goes from acute, to right, and to obtuse in the end. It's transformation explains the time during the day.



Image 3

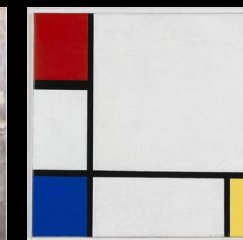


Image 4

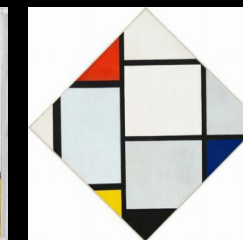
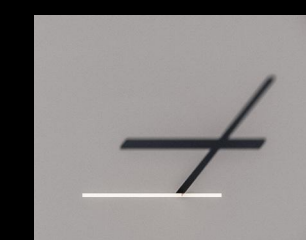
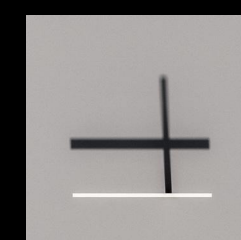
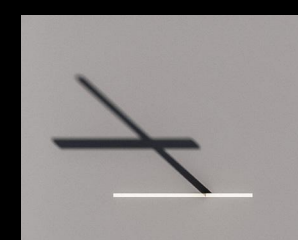


Image 5



The orthogonal system was applied to the design of Ronchamp Chapel, turning the chapel into a *time machine*⁴. The pattern of stained glass and the floor are facing directly to the south, and are controlled by a strict orthogonal geometry. When sunshine passes through the window, it falls on sidelong surfaces and the floor, throwing light patterns on the receiving surface. The light pattern, which is created by the stained glass, is working like a pointer and reflecting the movement of the sun. Receiving surfaces, which are constructed following an orthogonal plan, are working like a dial so that Ronchamp sits in its site as an amplifier of relations, connecting its genius loci to the universe.

4 Jordi Safont-Tria, Sanford Kwinter and Steven Holl, *Color Light Time* (Zurich, Switzerland: Lars Muller, 2012)



Image 6

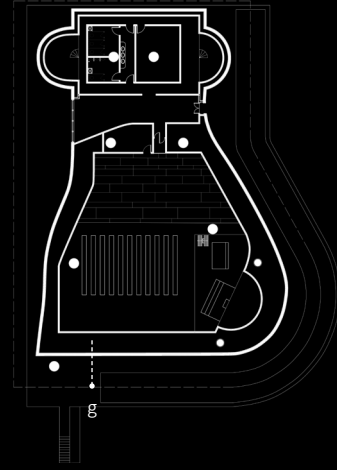


Image 7



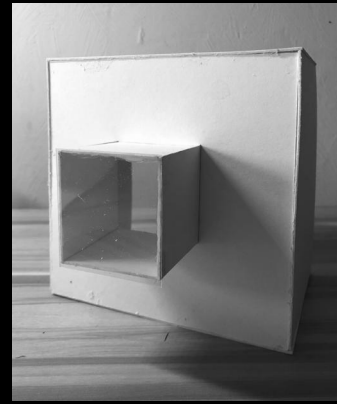
Image 8

LIGHT STAGE G: TIME MACHINE

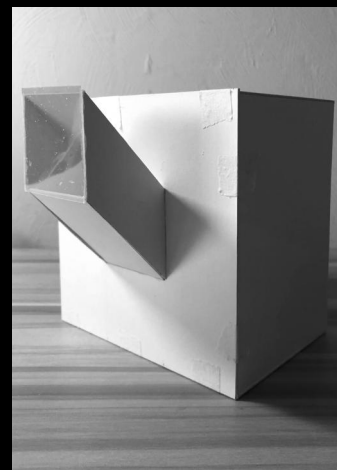
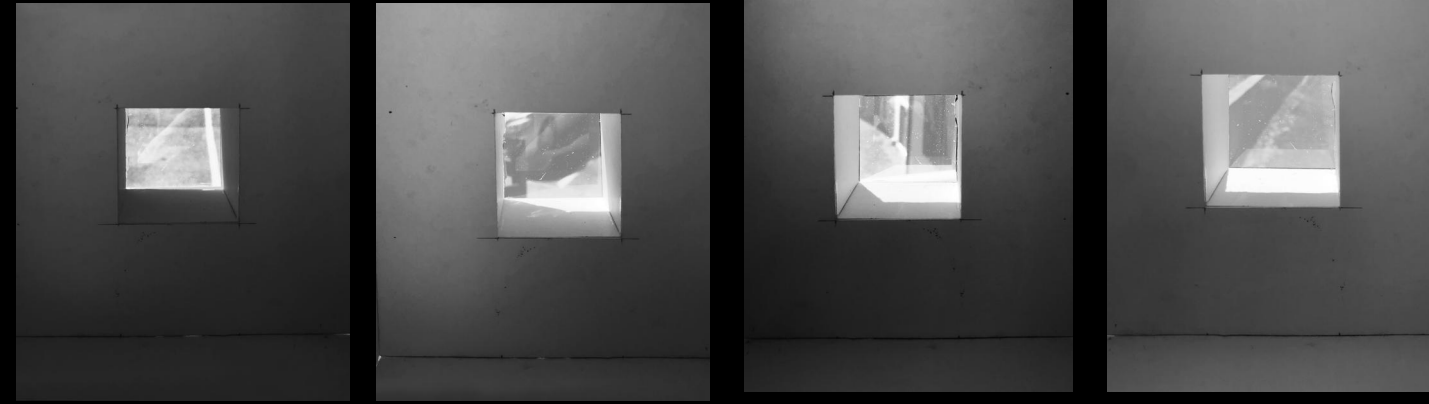


Ronchamp Chapel stands as evidence of how a pleasant awareness of time would be formed if Mondrian's work had been developed in architecture. Similar to the practice of Ronchamp Chapel, the south wall of this project serves as a timing device. Openings on the south wall invite daylight into the church and leave its trajectory, forming a time machine. The next step was exploring the best way to make these openings on a wall with thickness. After making several window models, the incline of a window's side surfaces was found to have a large influence on the result. The research continued with three models, opening with four straight surfaces (model1), opening with inclined bottom and top surfaces (model2), opening with inclined bottom and side surfaces (model3).

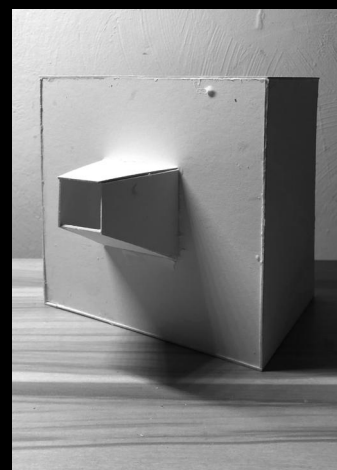
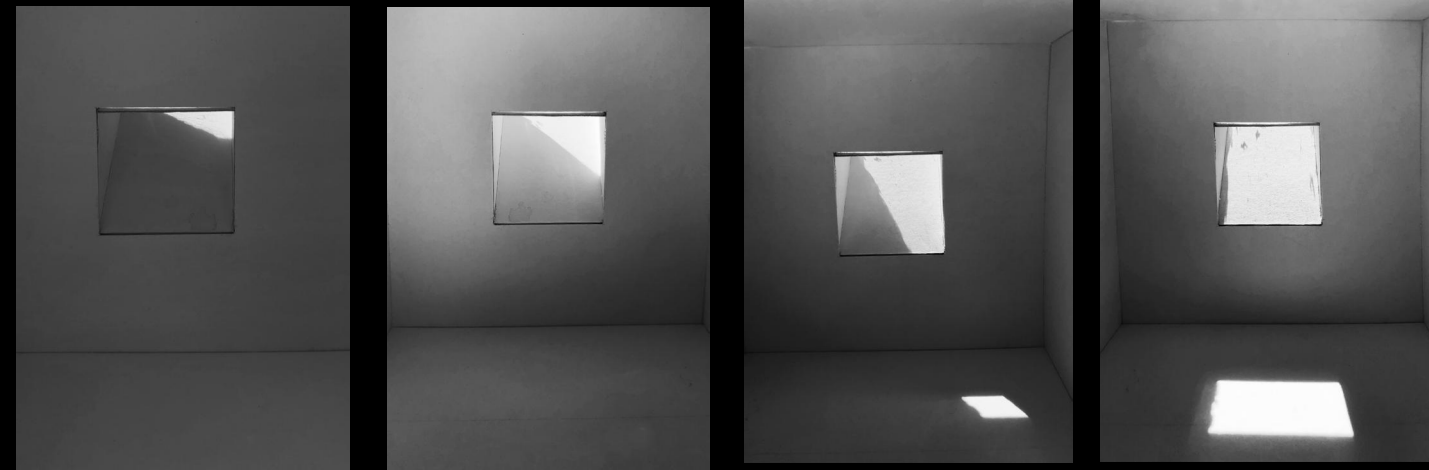
In the first model, the light pattern and its movement are hard to differentiate. In the second model, the light pattern is much more clear on the bottom surface. Also, tilting the bottom surface made sunlight fall on the ground more easily and made connections with indoor arrangements. In the third model, the light pattern was clear on both bottom and side surfaces. Moreover, it resulted in a more dynamic change. Inclining one side surface of the opening intensified the moment of sunlight on that surface.



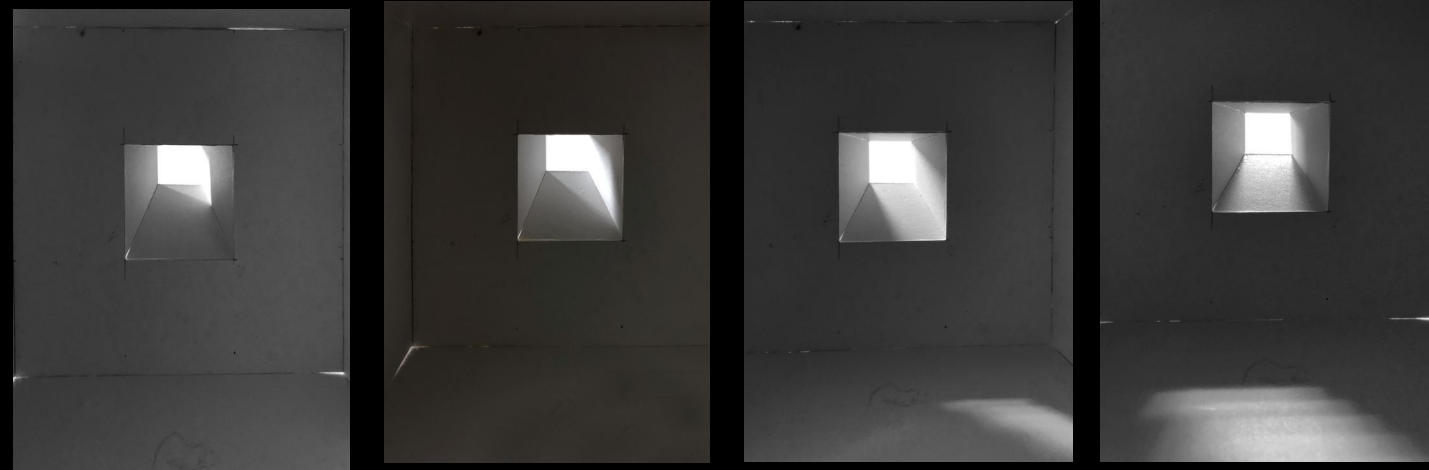
model 1



model 2



model 3



The function of south openings can be shown through the process model. Sunshine enters through those openings, falling on the ground and the sidelong surface. The trajectory of its shape lets the people inside be aware of the time passage. It also closely connects the sun to the location of the church.

IDENTITY & REPRESENTATION

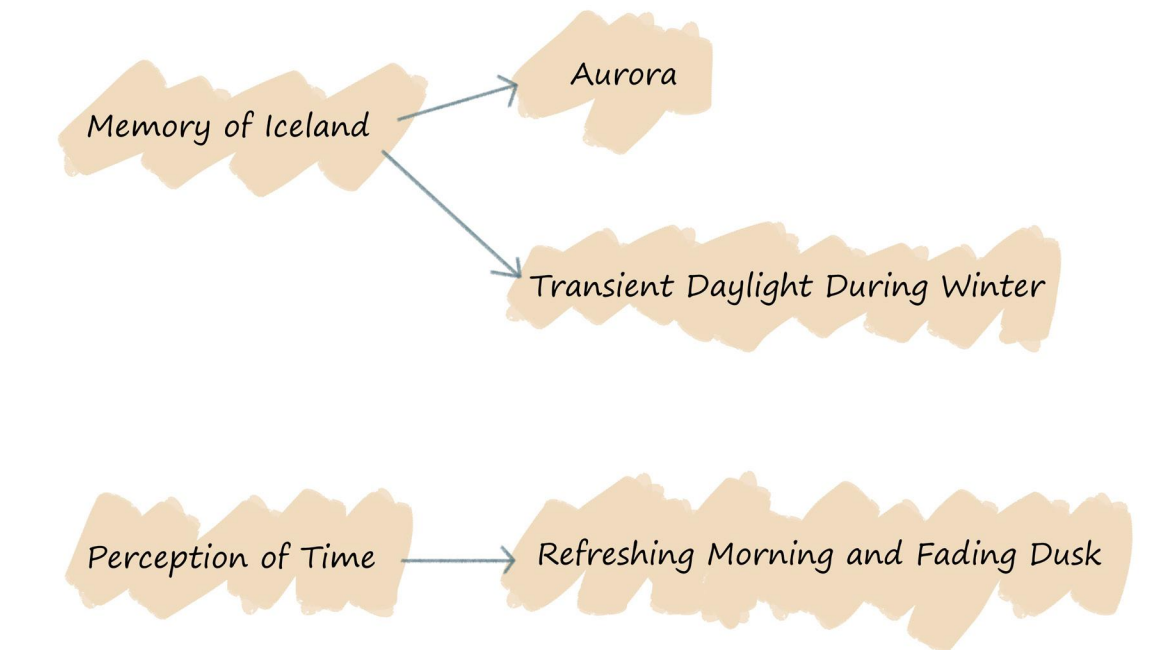
*Architecture represents a means to give man an "existential foothold". Man cannot gain a foothold through scientific understanding alone. He needs symbols, that is, works of art which "represent life-situations".*⁵

*Man "receives" the environment and makes it focus in buildings and things. The things thereby "explain" the environment and make its character manifest. Thereby the things themselves become meaningful. That is the basic function of detail in our surroundings.*⁶

The core of "dwelling" lies in identification of oneself within an environment. A "genius loci" is formed when a space develops a distinct character which makes it unique and meaningful to local people, becoming a "place". As architects, our task is to help people to dwell. That is to say, we need to visualize the character of the place and bring identity to our work.

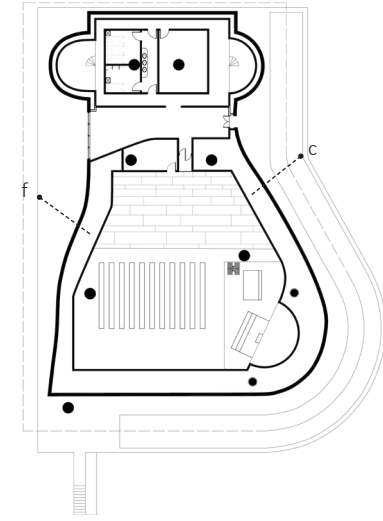
⁵ Christian Norberg-Schulz, *Genius Loci: Towards a Phenomenology of Architecture* (New York: Rizzoli, 1979) p.5

⁶ Christian Norberg-Schulz, *Genius Loci: Towards a Phenomenology of Architecture* (New York: Rizzoli, 1979) p.16



In the design of the church, light and color are used to represent people's perception of time and their memory of Iceland as shown through the experience of aurora and transient winter daylight. Colored light is applied to the project as a way of evoking people's perception of time.

LIGHT STAGE C&F: DAILY MEMORY OF MORNING AND DUSK



We all have had the experience of admiring a splendid sunrise and sunset. Morning glory and dusk glow were introduced into the design through colored light, carrying the memory of morning and dusk. Green represented the refreshing quality of morning as well as a sense of vitality. Red represented fading dusk, the connection between daylight and night. It also represented death and blood. The wall replete with colored light, like a narrow room, conjuring in its stead the aura of morning and dusk.

For the first version, a strip of colored glass was used to dye the light, but the result was far from pleasing: the strip of colored glass was incongruous on the side of the church (image 10). Compared with leaving the dazzling colored glass exposed in sight, hiding the color inside of the wall would be more reasonable. The side of the inner wall facing outside was made into a colored reflector. A normal glass window, placed at the opening, and weaken the presence of the colored wall inside, allowing these walls to harmoniously meld into the other parts of the church.

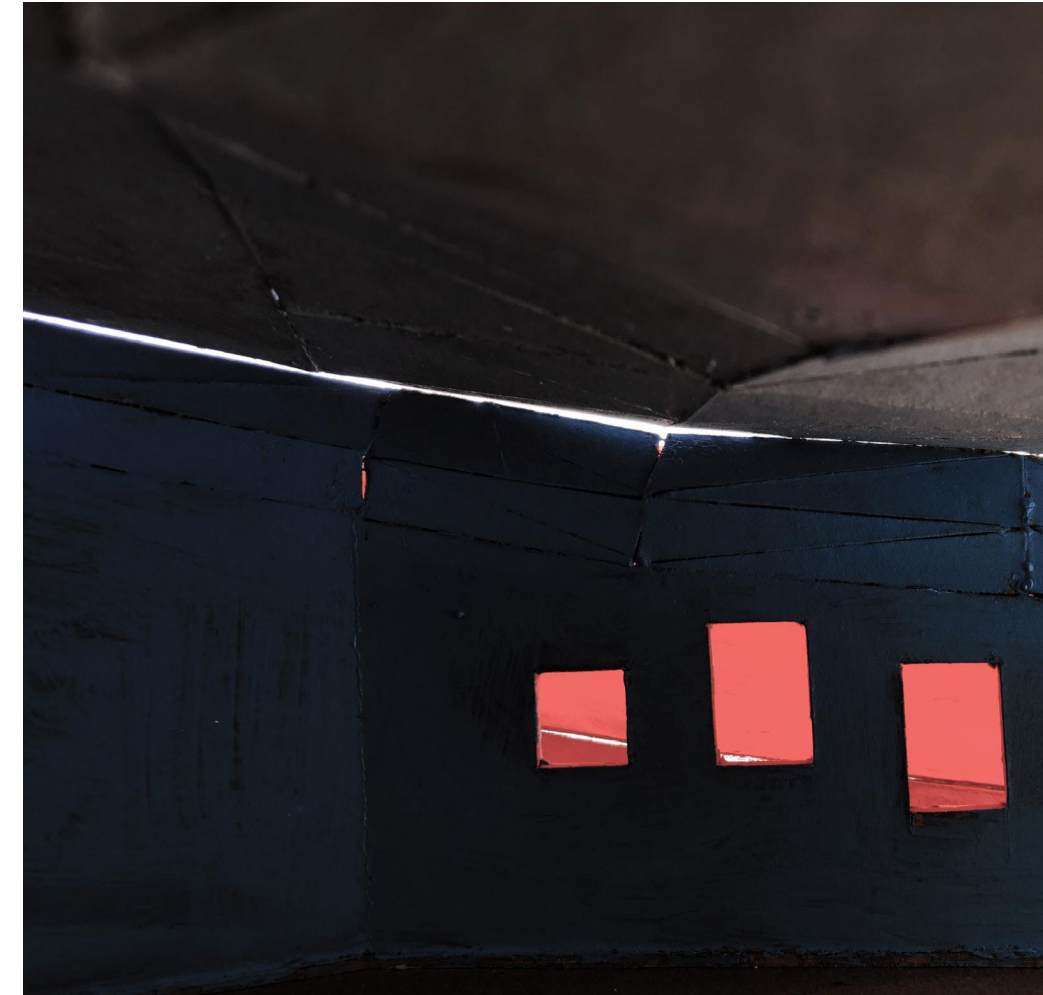


image 9



image 10

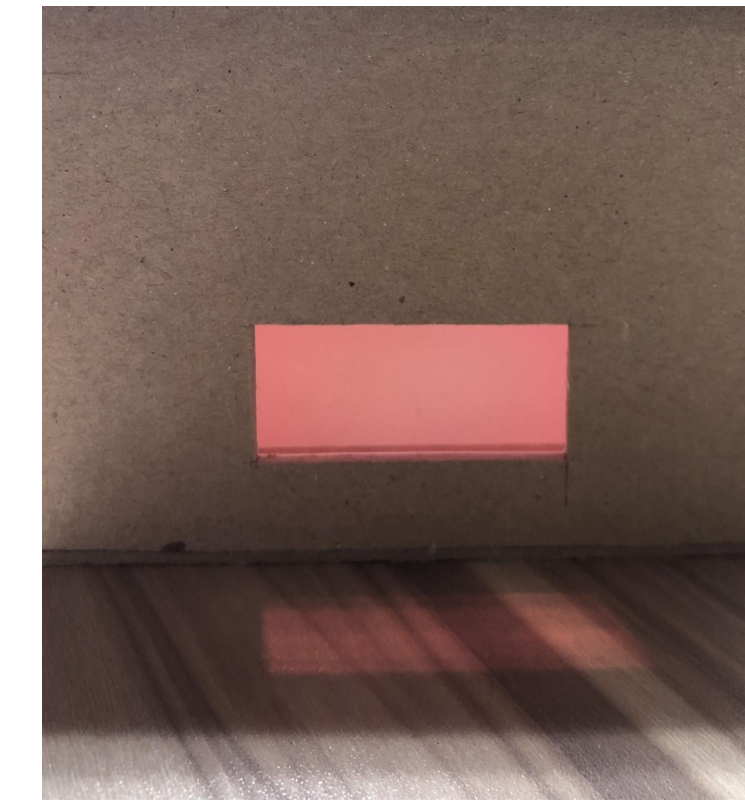
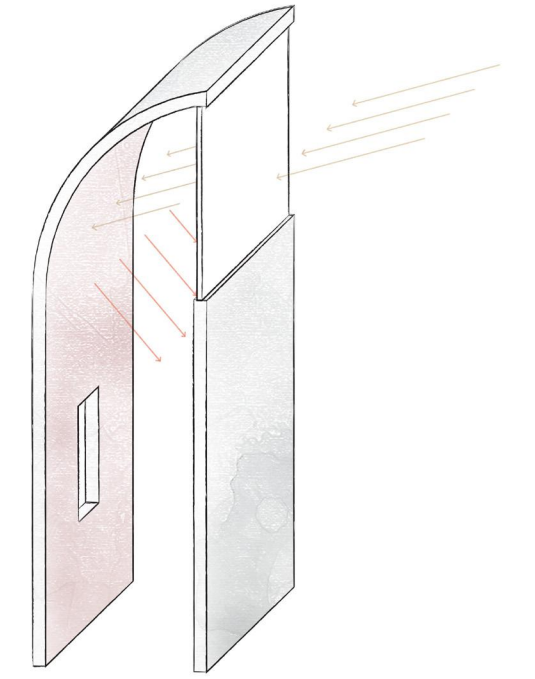
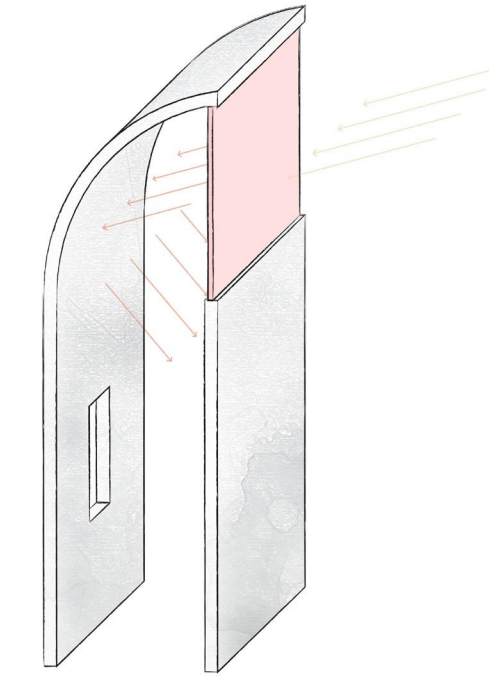


image 11

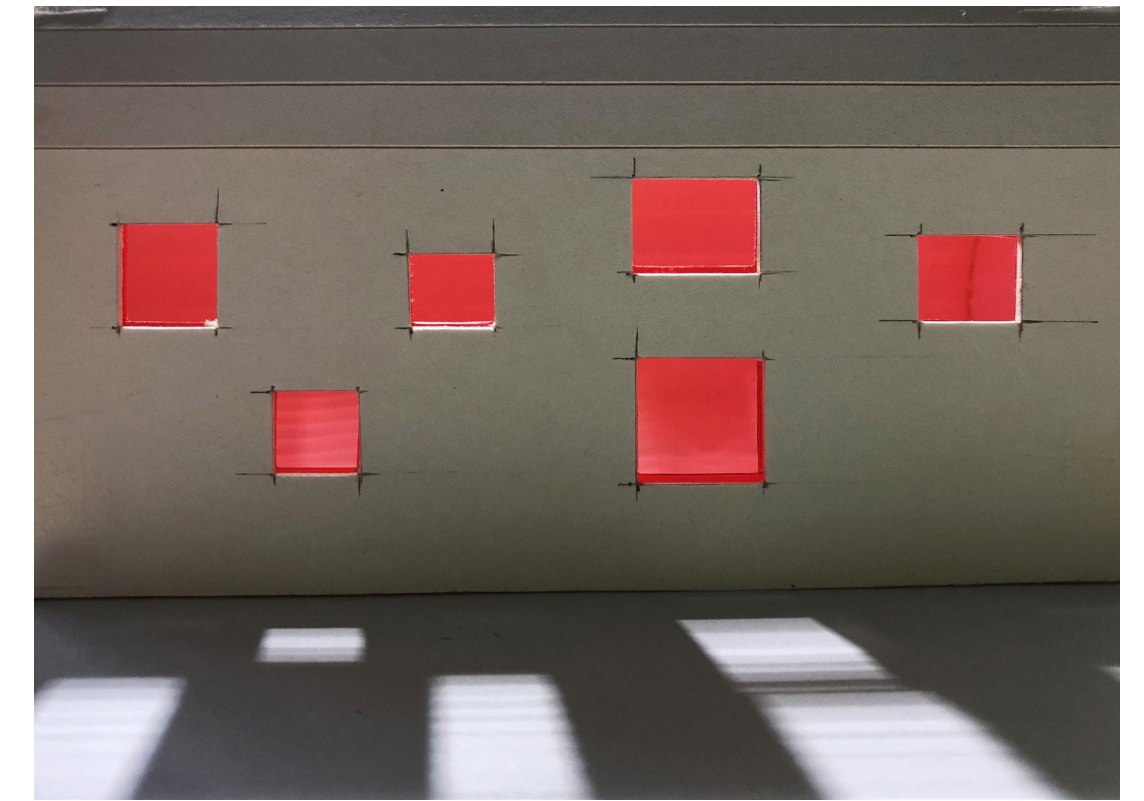
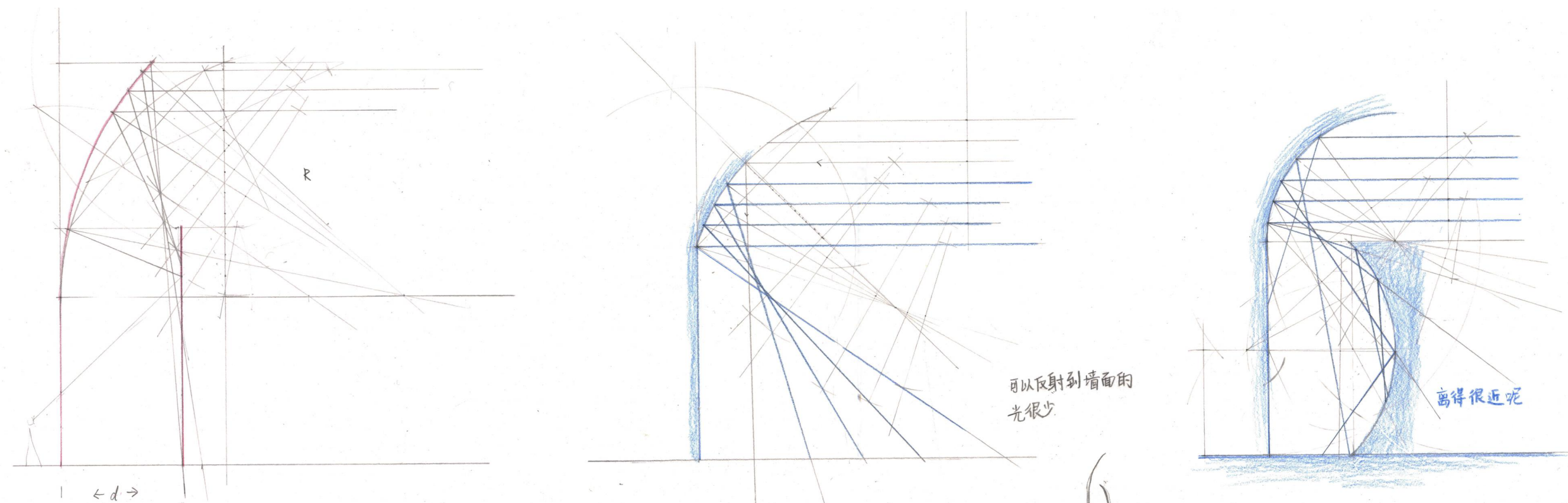
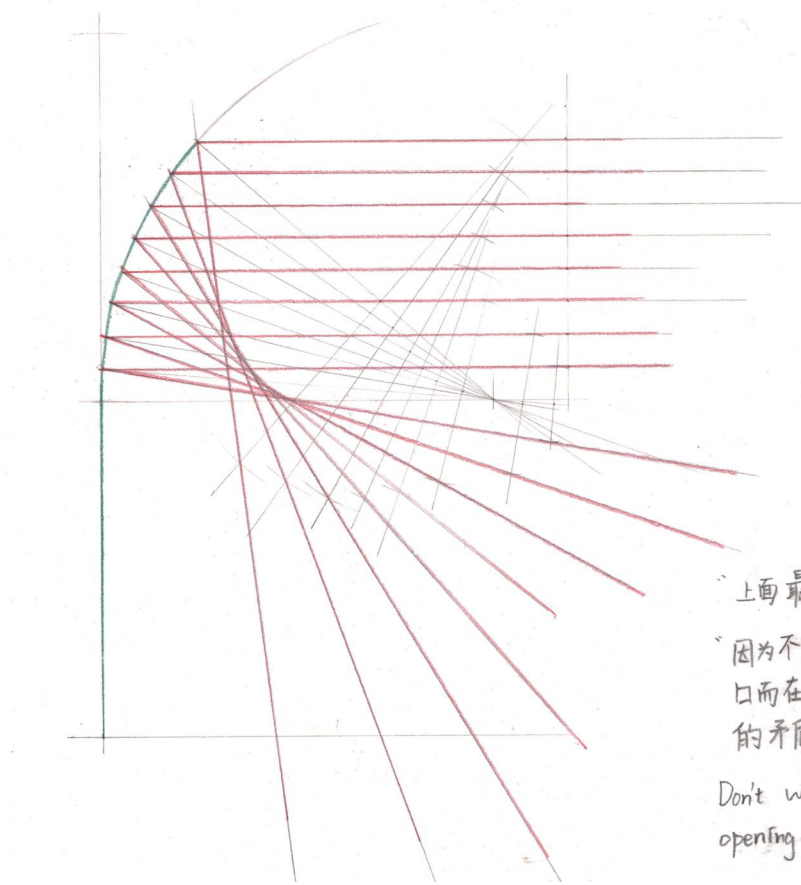


image 12

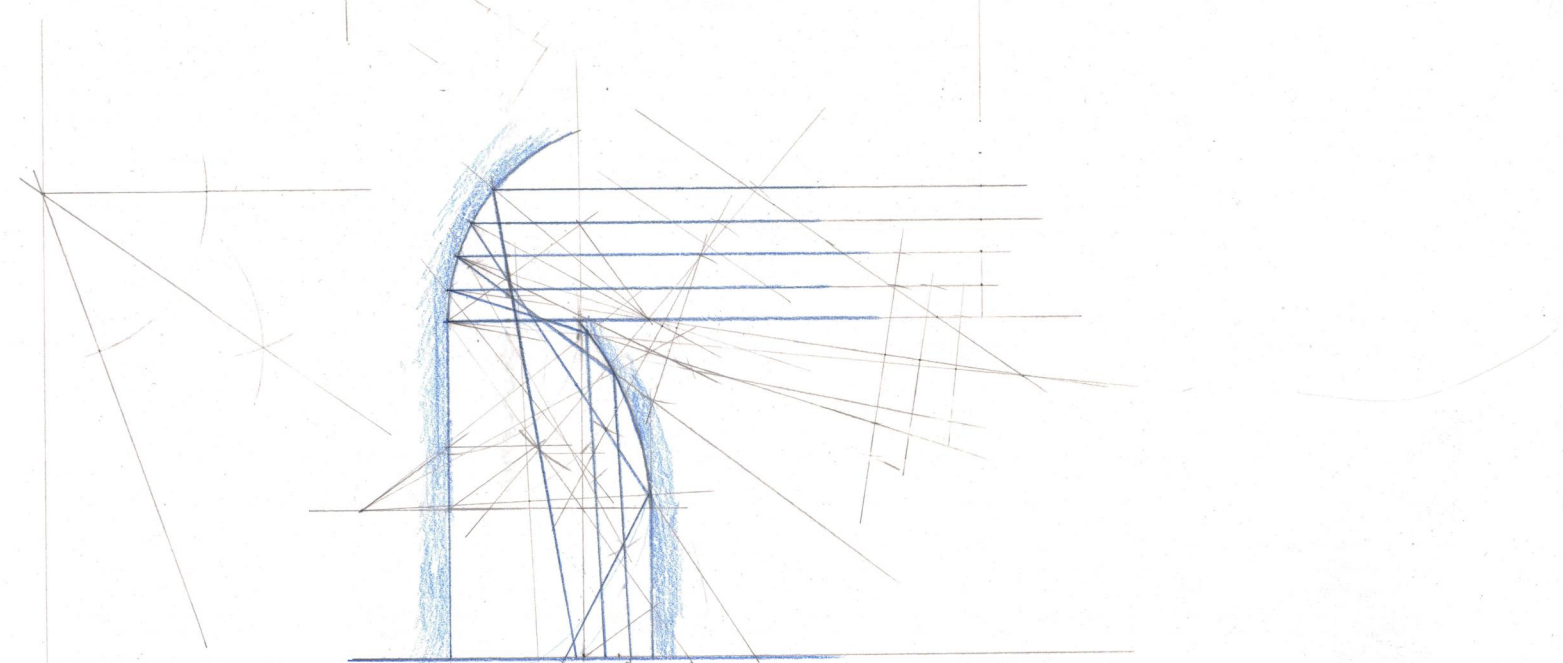
Image 11 is the model with a colored glass window and image 12 is the model with a colored reflector. Both of them are able to generate a mellow soft room bathed in colored light.



when d is too small comparing to R → very bright edge. dark bottom



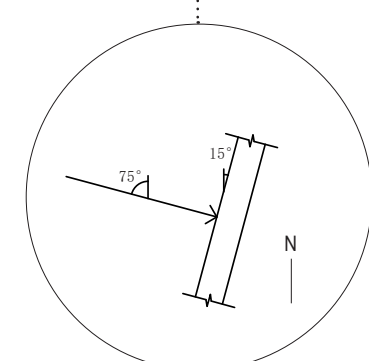
上面最亮”和“因为不想暴露洞口而在下面开窗”的矛盾
Don't want the opening be exposed



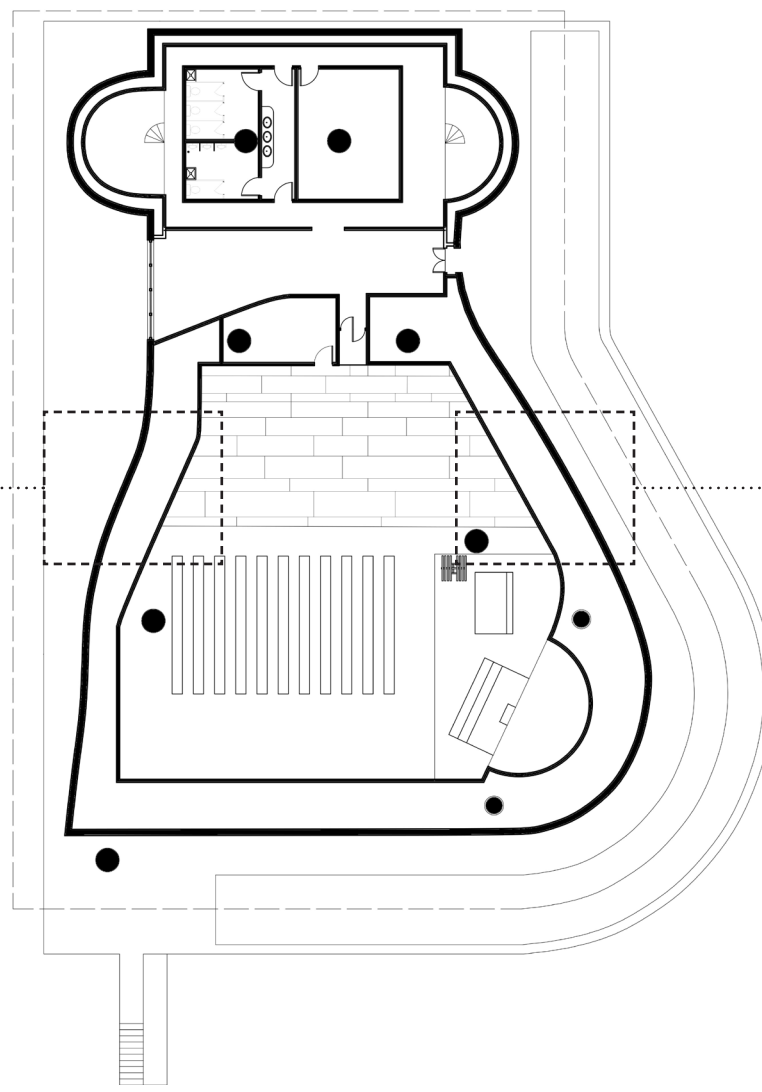
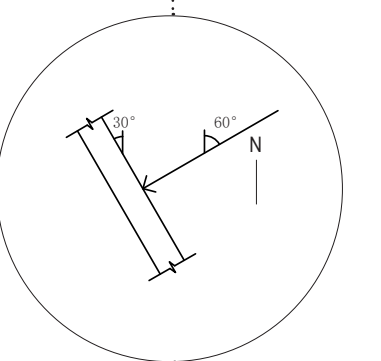
光线只是经过“凸出的”墙房间这样好不好?
如果墙下面也是弯的?
被反射的光比较弱
只有给一个承接面才有可能被呈现出来

Sunshine only pass through the wall room.
Weak reflected sunshine can only be shown when it hits a surface.

Night Song Begin



Sunrise



When opening a window in a hollow wall, there should be a space immersed in colored light, instead of a dark space with a bright edge. The wall was developed in such a way as to evenly color the space with light.

Easter Day has a special meaning to Christians, so the walls of the chapel are oriented based on the direction of sun on this special day. The hollow wall containing red light faces northwest, receiving sunlight when the night song begins on Easter Day. The hollow wall containing green light faces northeast, receiving sunlight when the sun rises on Easter Day.

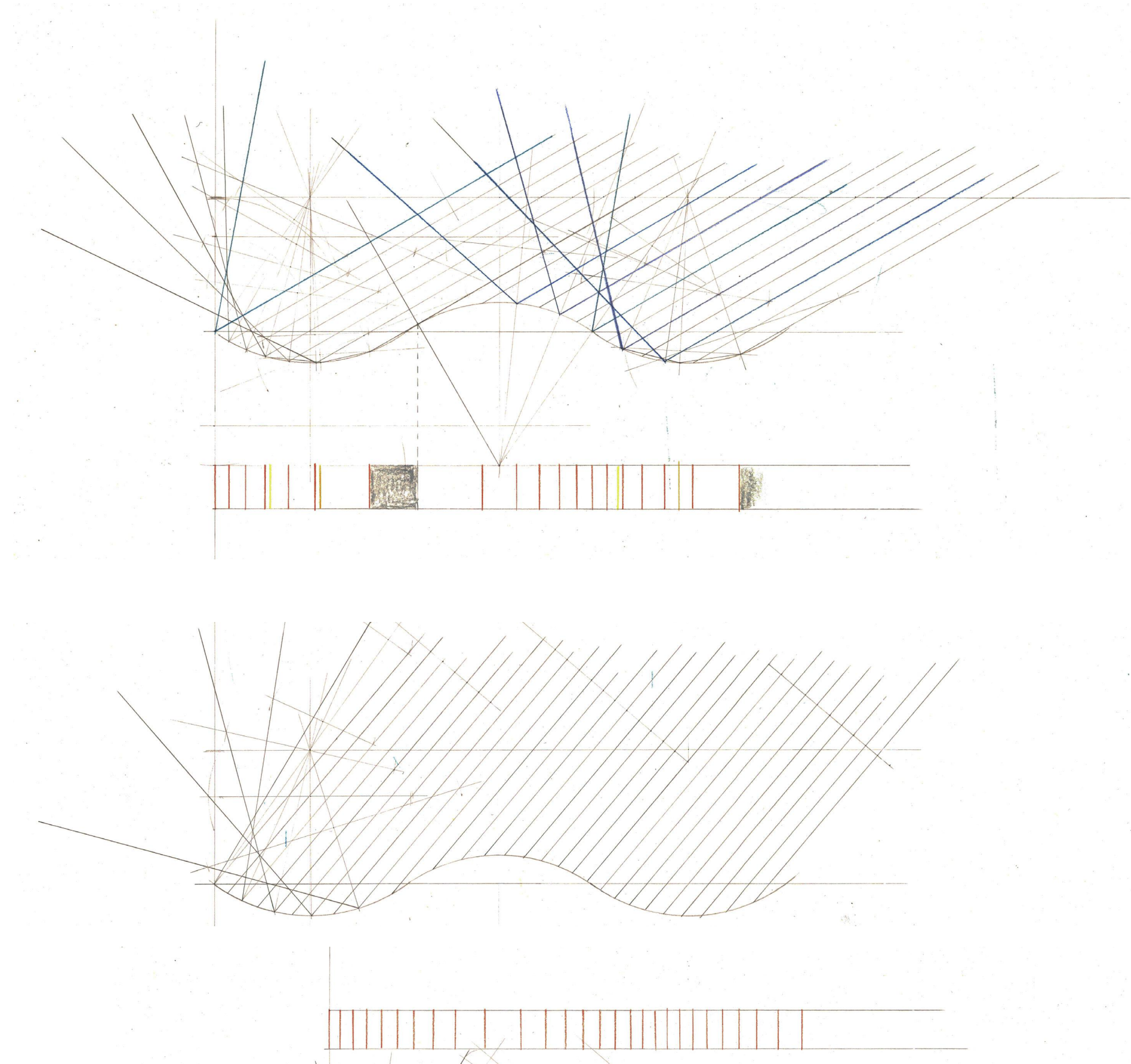
AURORA: A CRYPTIC ILLUSTRATION OF SPACE

The aurora is a dramatic phenomenon in Iceland. Auroras are the result of disturbances in the magnetosphere caused by solar wind. They are always there in the sky, but are only visible under particular conditions. Auroras always fill people with a sense of the divine and thankfulness. Local people are grateful for the north light because when the magic light comes out during the polar night, they can slightly see the landscape and tell where they are. The aurora guides them home.

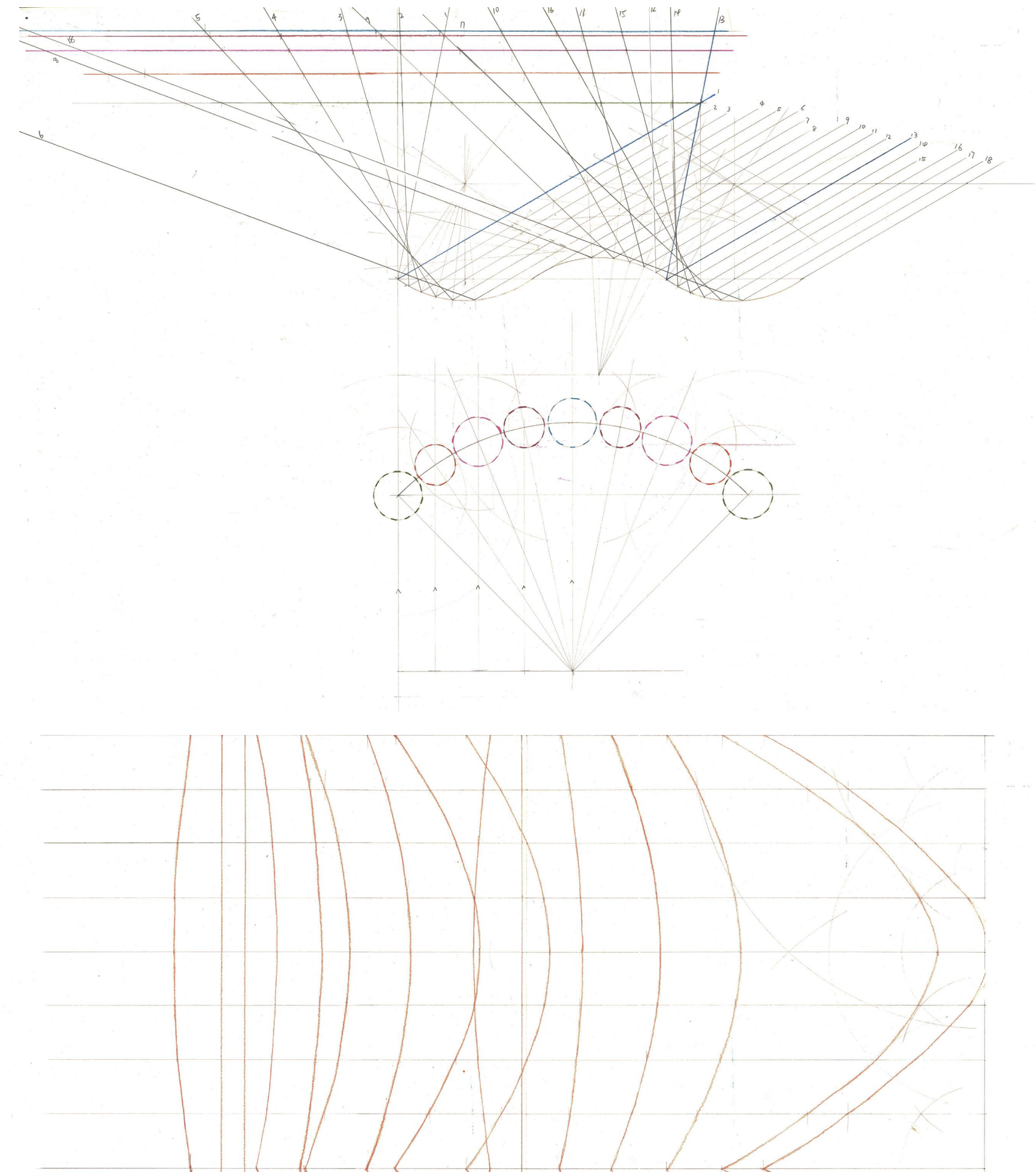
The aurora gets its beauty from its colorful and dynamic appearance. But the reason the aurora is so palpably felt and evoke a sense of respect - is the way they illuminate the landscape in the darkness. When a person walks into a large room formed by the landscape and the sky, he doesn't know about it since it's completely dark. Then, aurora comes to light up the sky and reveal the shape of the ground. This experience is different from the daylight where everything is clearly seen. However, while being embraced by the darkness and exposed to the aurora, people can get a feeling of a room, a "shelter". This is an essential reason for us to introduce daylight into our room. When light is experienced within cavernous darkness, every nuance of light and shading could be caught, telling the shape of the space to the people in the shadows. The Pantheon is a good example of this, with qualities of both mystery and depth experienced at the same time. When sunshine enters through the oculus, it leaves a piece of light and describes the shape of the vault. The light moves and changes across the vault, giving a pure expression of the form. Just like when Icelanders look up at the north light, when people look up at the dynamic oculus of the Pantheon, they get a sense of the space around them.



START: STUDYING THE SHAPE OF AURORA

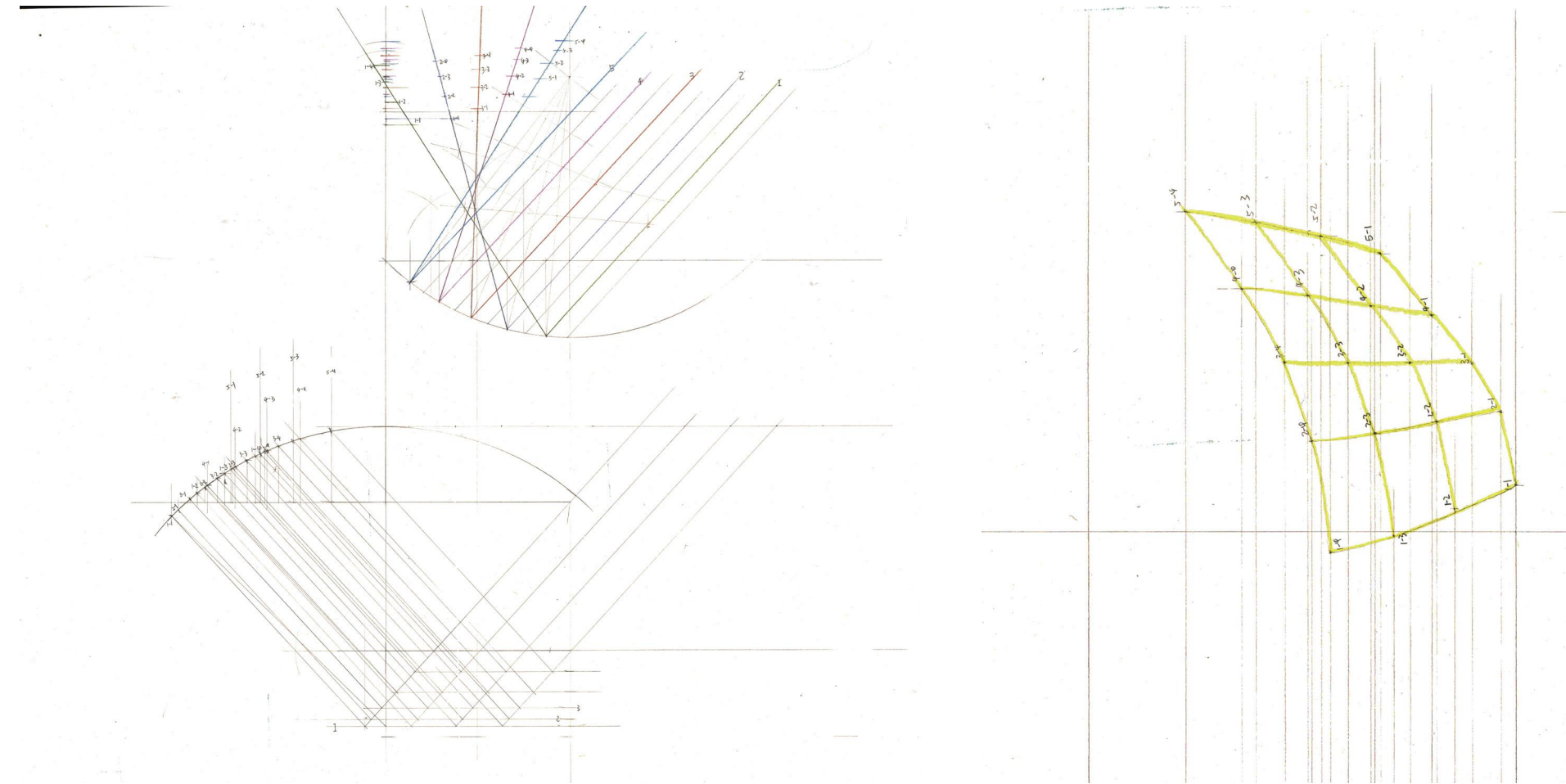


Aurora reminded me of waving ribbons and I undertook studies attempting to replicate this with light. When sunshine strikes a curved surface, it transforms shadow and light into ripples and makes the surface visible. However, the movement of the light pattern caused by the change of sunshine direction was too weak.

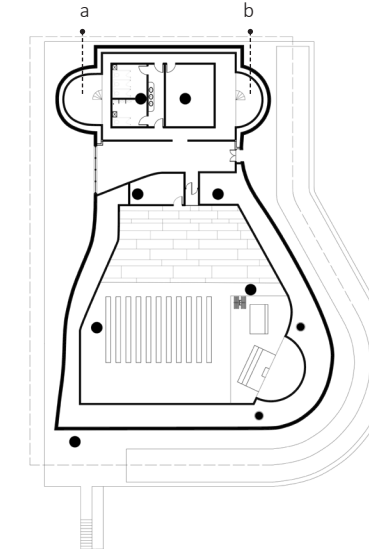


Based on geometric principles, reflection can intensify the movement of light pattern generated by a change of sunshine. There are two curved surfaces formed by arcs. These two boards are placed perpendicular to each other, and when light is introduced they create wave-like patterns.

The light pattern changed its shape according to the movement of sunlight. This change was more profound compared with the last experiment.

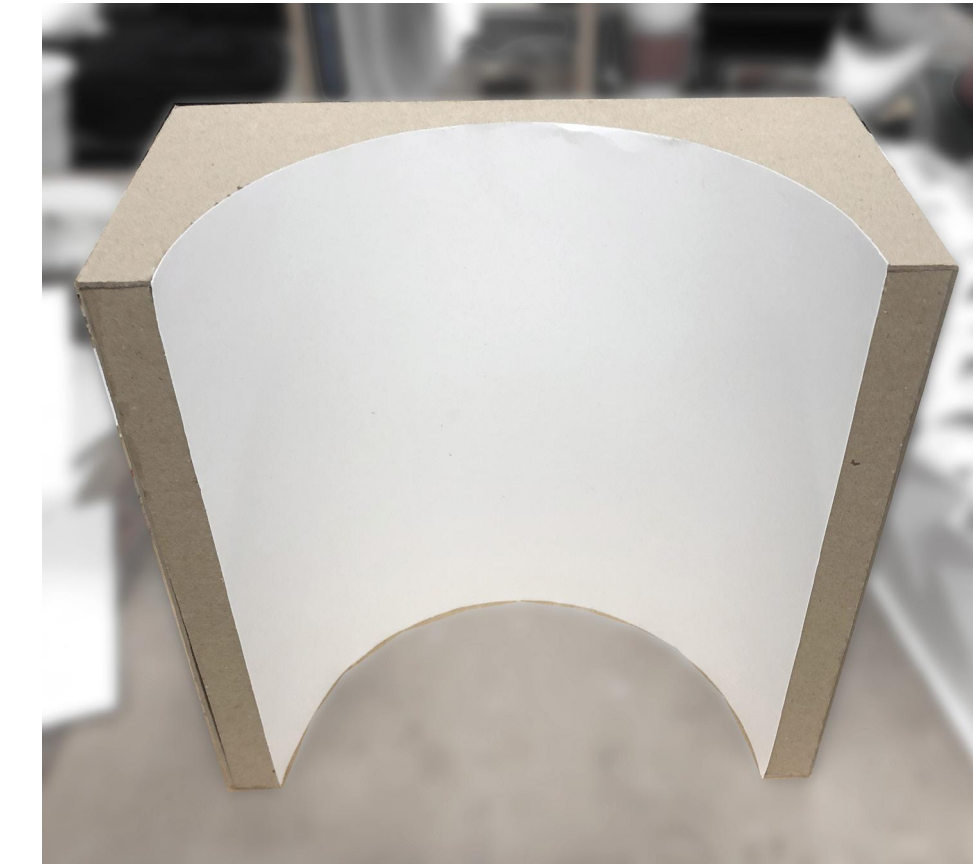


LIGHT STAGE A&B:SACRISTY

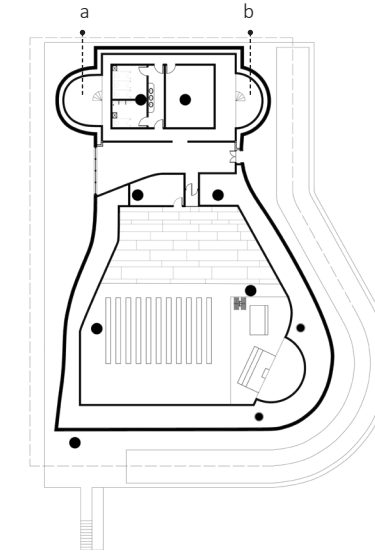
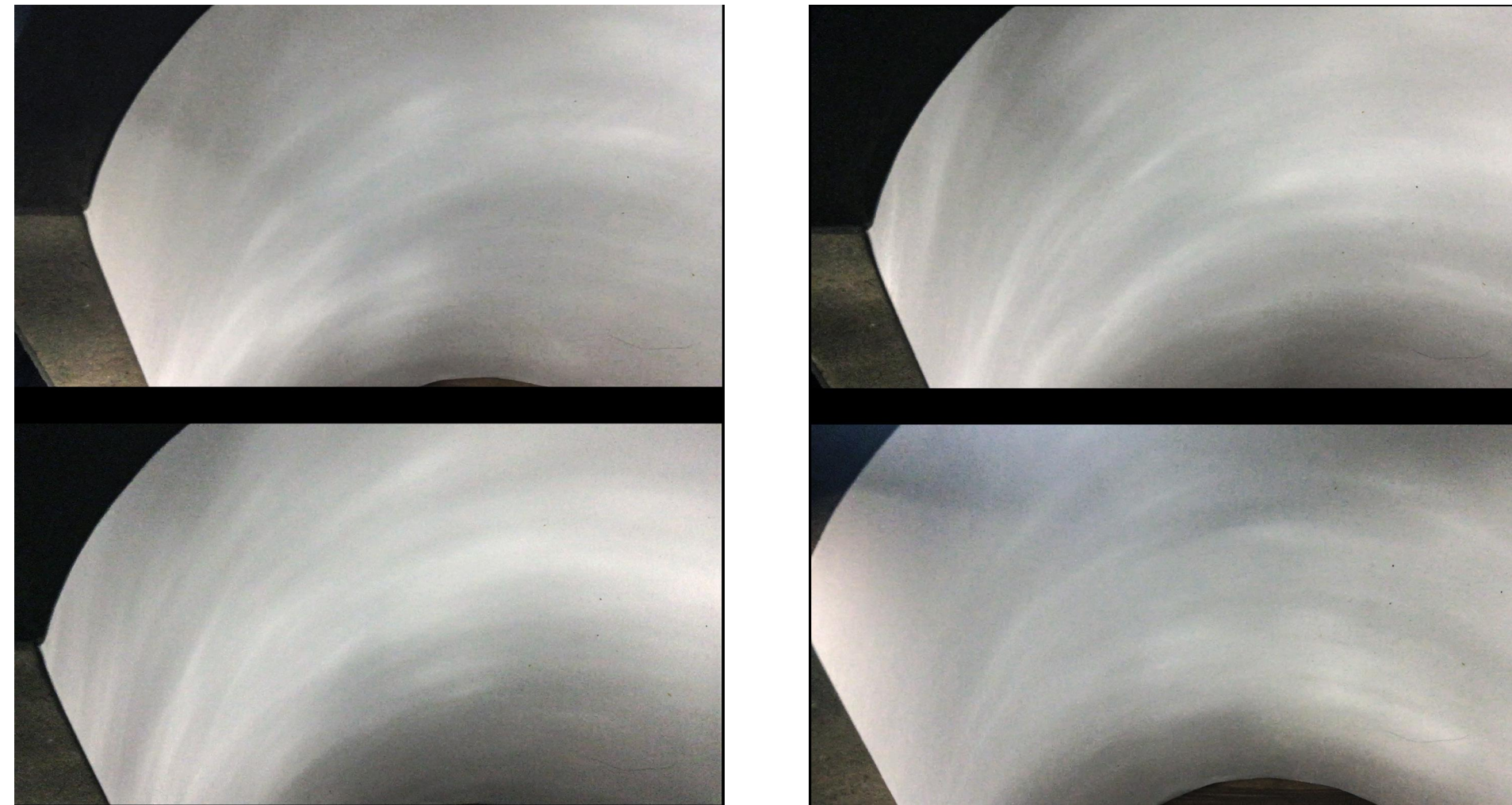


Drawings themselves provide the scientific law and order behind the phenomenon, but in order to get a real sense for the atmosphere, models are irreplaceable.

Having gotten a general idea of the first combination, I was then trying to explore the possibilities of the light pattern generated. The first receiver got a cylindrical surface, and the first reflector got a surface gradually changed from a circle at the bottom to a straight line at the top.



After doing research with the model, the light possessed a unique quality. I recorded the movement of light and shadow when sunlight changed its direction. The whole shape of the light stayed almost unmoved. Only the brightest piece drifted across the curved wall, hanging over a tranquil and quiet space.



When the sun is moving in a horizontal plane, the light pattern changes from image 14 to image 15. When the sun is moving in a vertical plane, the light pattern changes from image 14 to image 16.

The light created a space which evoked a feeling of protection, meditation and was applied to the design of sacristy. Prayers are hidden in the shadow, watching sunlight falling on the wall which is decorated by the stations of the cross (image 17).

The two sacristies are located in the north end of the church, one is facing east and the other is facing west. The servant space separates them from each other, creating a feeling of enclosure.



image 14

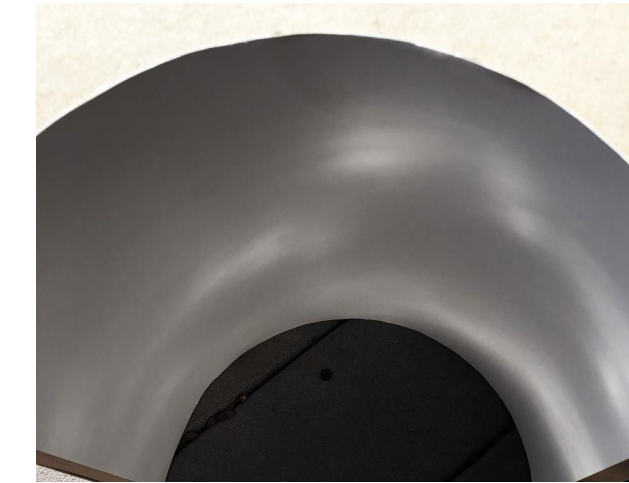


image 15



image 16

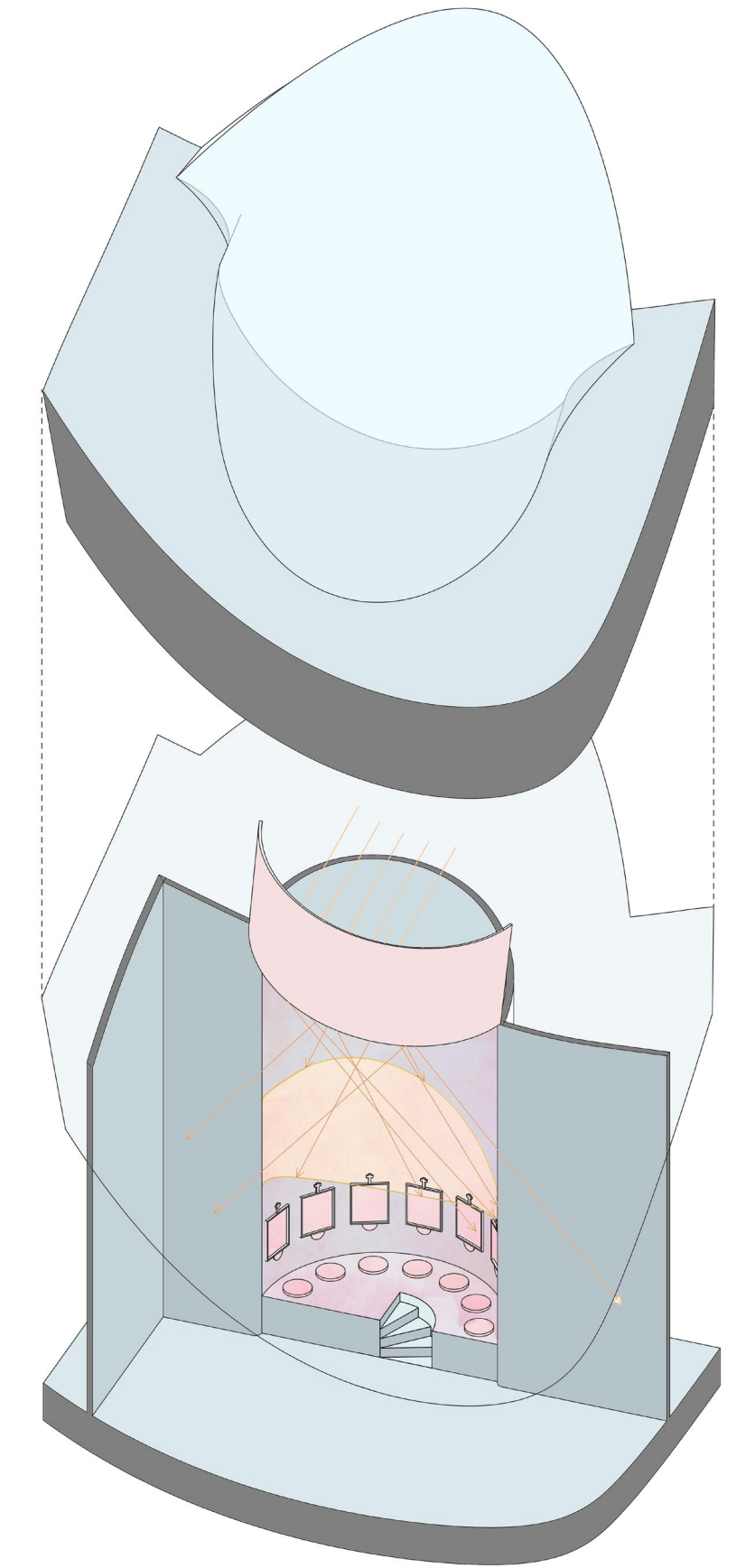


image 17

LIGHT STAGE D: STAGE BACKGROUND WITH A VENERABLE AURA

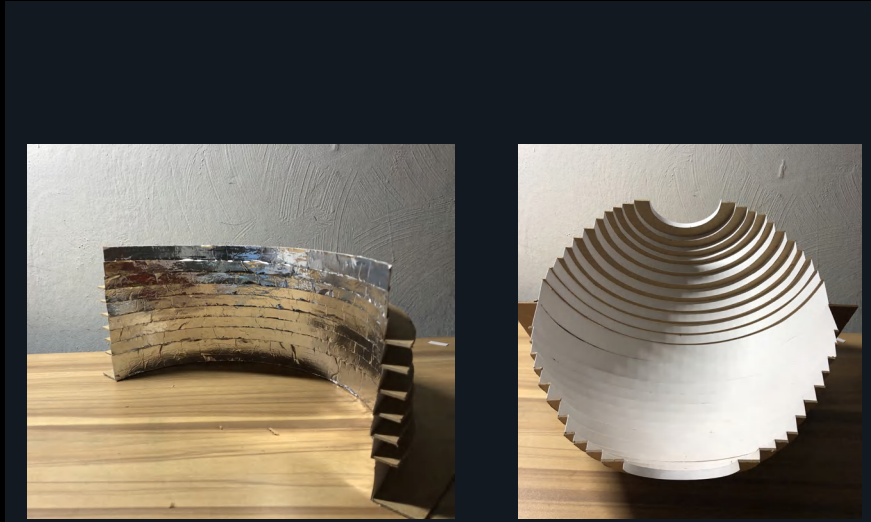
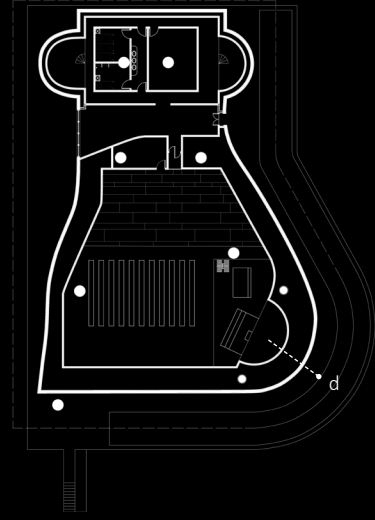


image 18



image 19

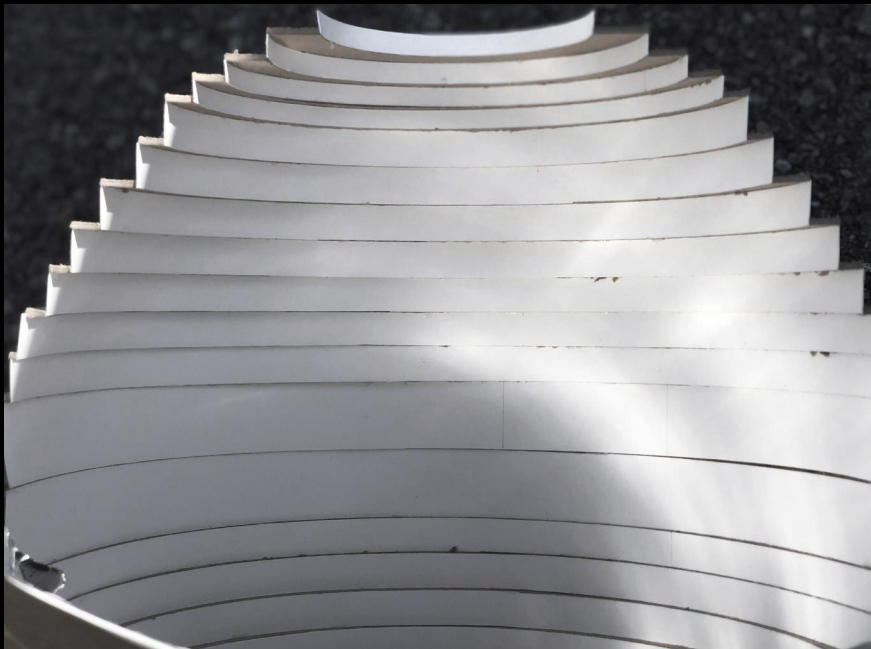


image 20



image 21

When light is reflected by a curved surface and received by a spherical surface, a beautiful light ring emerges. The light ring is enfolding a central space and moving across it, creating a gentle place with a sense of ceremony. It could be used as the stage setting for the choir.

When the sun is moving in a horizontal plane, the light pattern changes from image 19 to image 20. When the sun is moving in a vertical plane, the light pattern changes from image 19 to image 21.

At first, I was thinking to make a box and wrap the sphere in order to guarantee the darkness. This was proven to be redundant in later studies.

After the former experiment, I thought as long as the middle of the light pattern was in an appropriate place, the rest of it would turn out to be a light ring no matter how I placed the reflector and the receiver. At the beginning, I only studied the section cut through the center trying to increase the light direction range it could receive (image 22). I didn't realize that this light ring could only be achieved under an extremely strict condition until I made the model (image 23). In this model, the shape of the receiving surface and the reflective surface were exactly the same with the former experiment. However, the light pattern was different and lost the ability to form a place with a sense of ceremony.

There are five factors that might influence the light pattern. They are the distance between the receiver and the reflector, the height of the reflector, the radius of the reflector's bottom, the size of the reflector and the tilting angle of the reflector. Their influence on the light pattern can be shown through the later study individually.

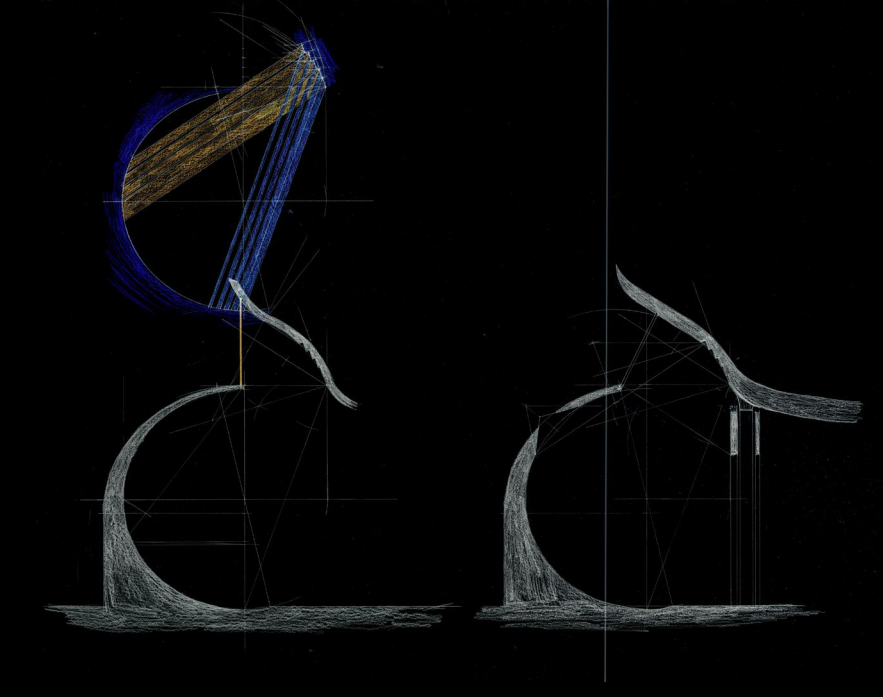
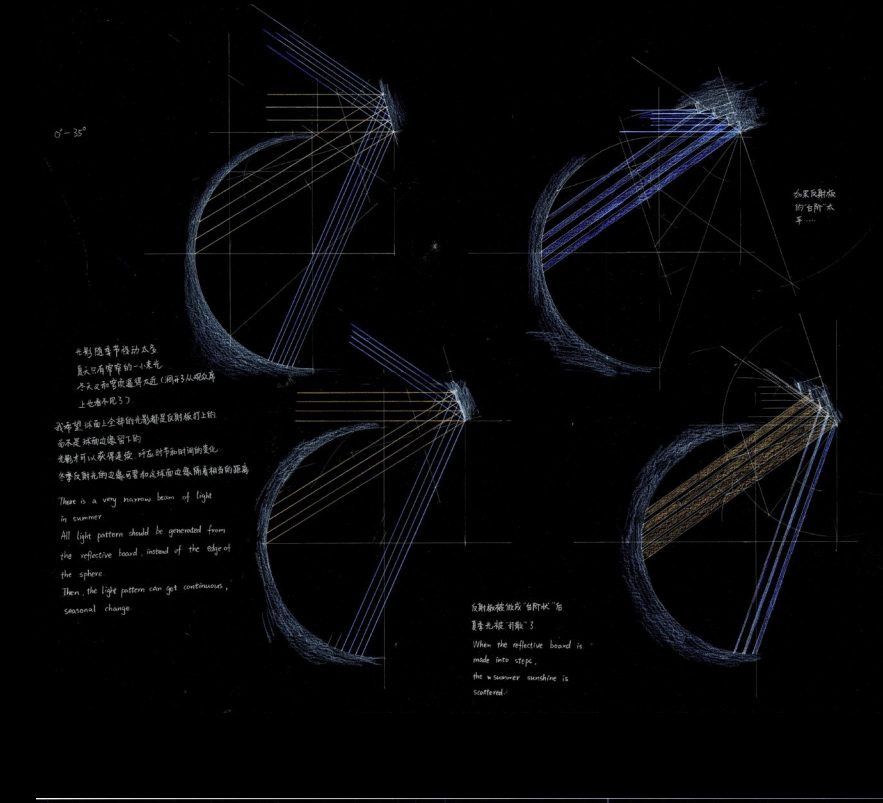
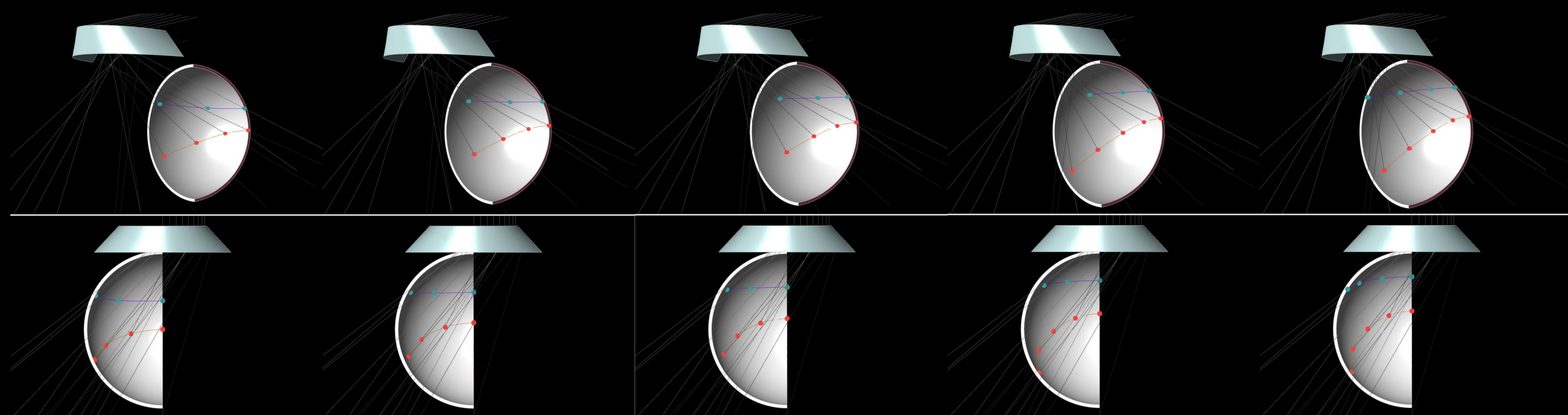


image 22

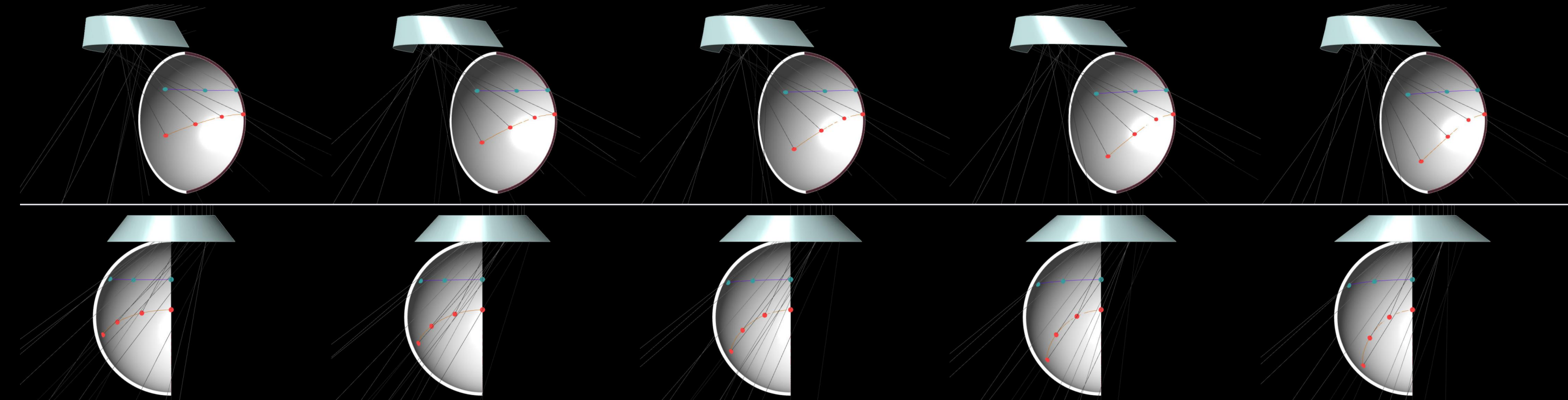


image 23

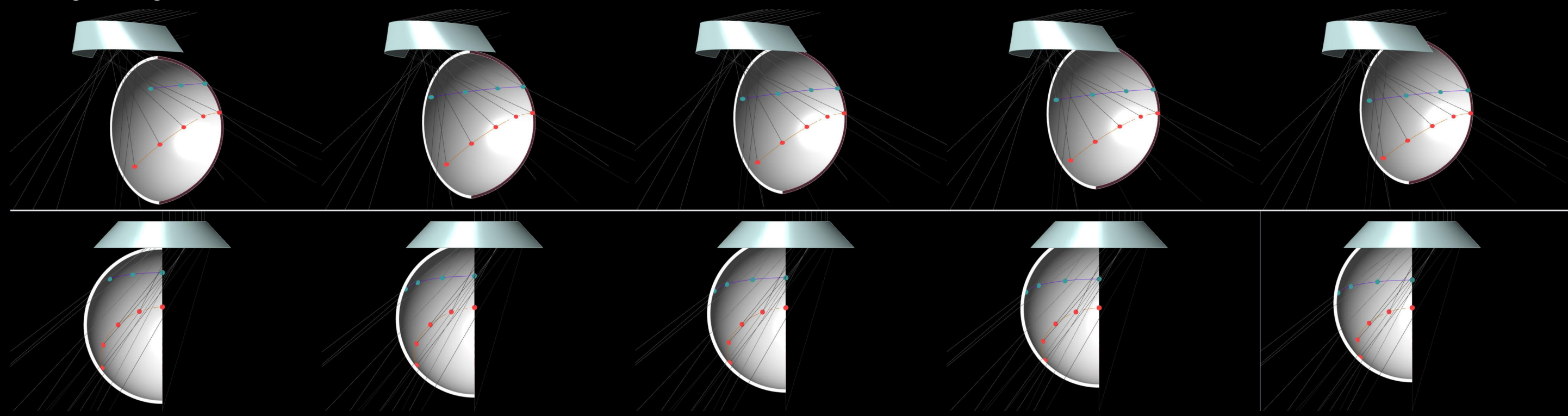
change the distance between the reflector and the receiver



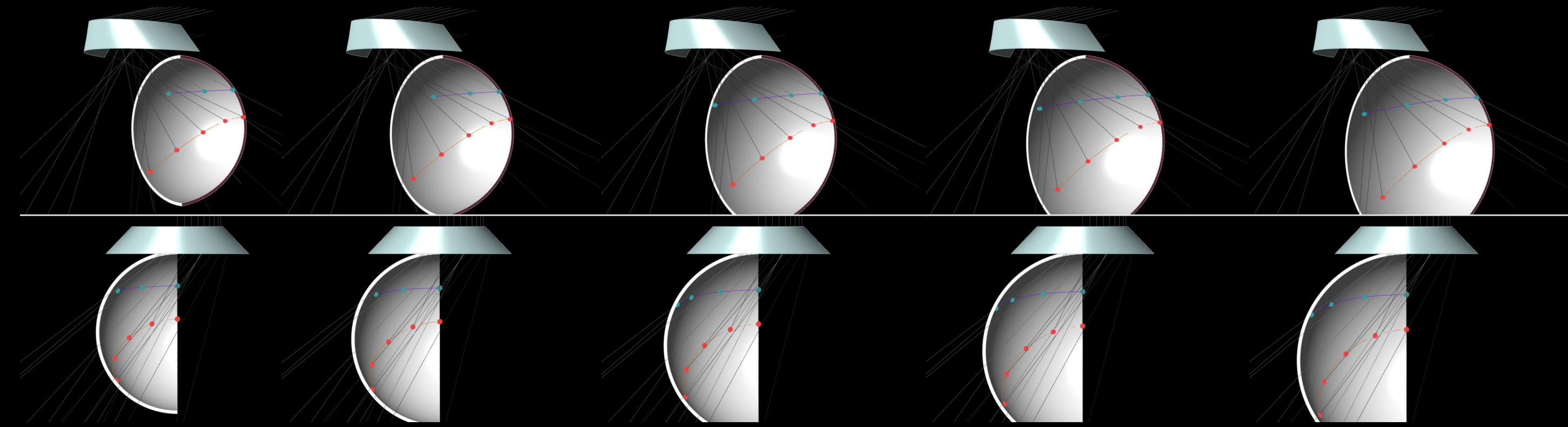
change the radius of the reflector bottom



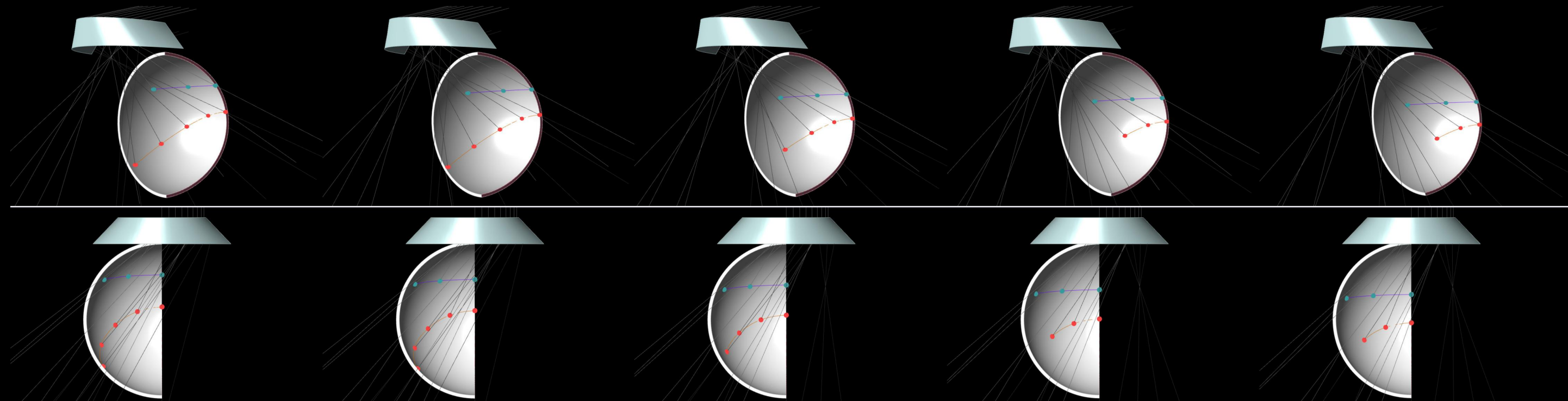
change the height of the reflector



change the size of the reflector



change the tilting angle of the reflector



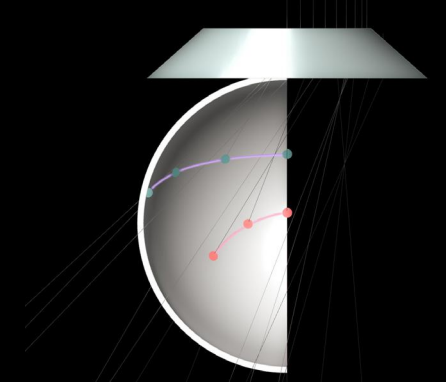
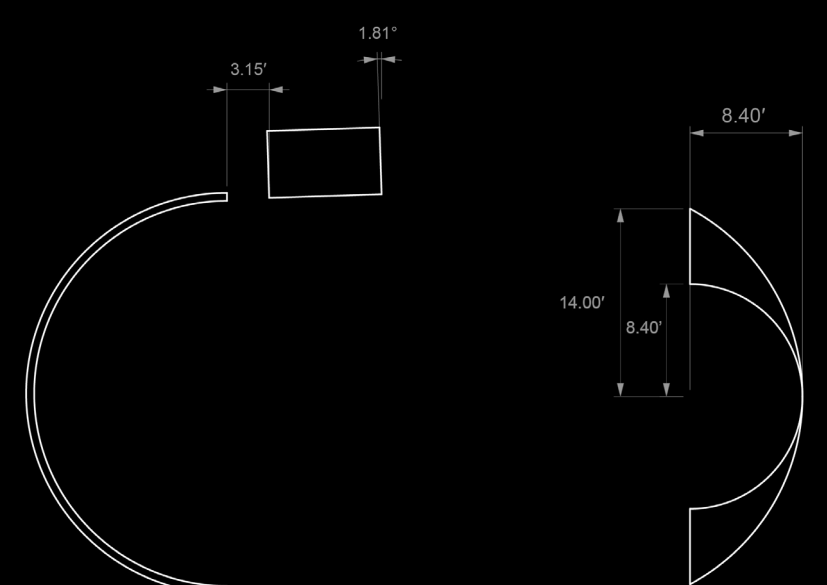
the size of the reflector → the light pattern stays the same

the shape of the reflector → bending the light pattern downwards

the distance between the reflector and the receiver → bending the light pattern downwards

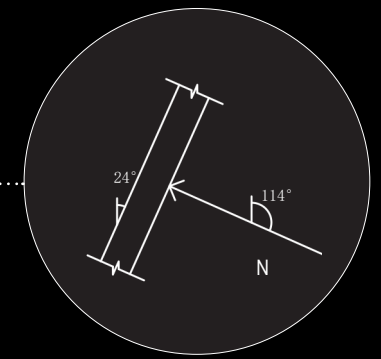
the tilting angle of the reflector → adjusting the place of the light pattern

the height of the reflector → adjusting the place of the light pattern



After adjusting the five elements and the range of sunlight direction they could receive, the design of the device was determined.

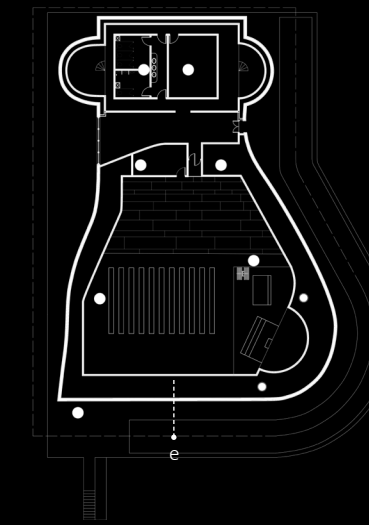
High Mass Begin



The background for the choir faces southeast, receiving sunlight when the high mass begins on Easter Day.



LIGHT STAGE E: TRANSIENT DAYLIGHT
DURING WINTER



The daytime on the winter solstice is only three hours. The sunlight is warm orange and comes from the direction of the horizon. In order to celebrate this moment which seems more precious during the cold, dark winter, this scenery is abstracted and represented in the design.

In this model (image 25), a seam is left between the roof and the south wall so that sunshine could come through this seam and light up a large area of the roof. But the result is disappointing. This model shows that the relationship between the roof and the wall is too weak. Also, when the fluctuation of the roof is too flat, the light result is unclear. So, instead of using the roof as a platform with a flat fluctuation, I would rather use it as a passage to make the result more distinct.



image 24



image 25



image 26



image 27

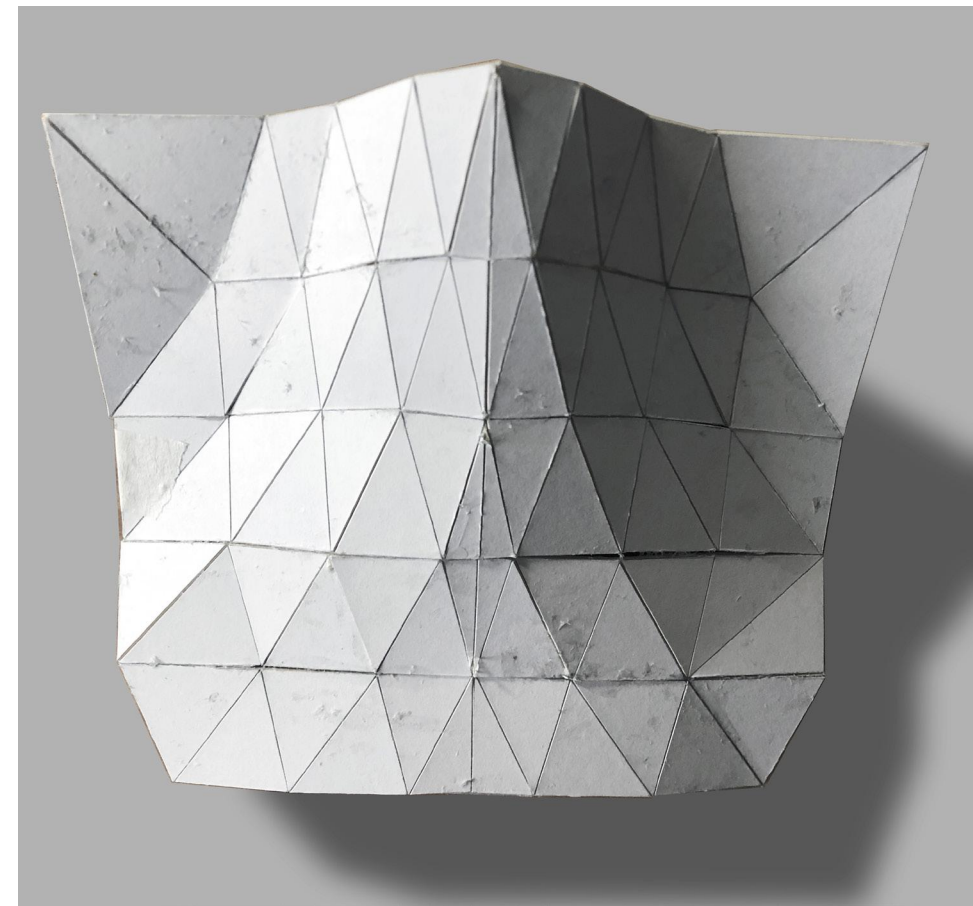


image 28

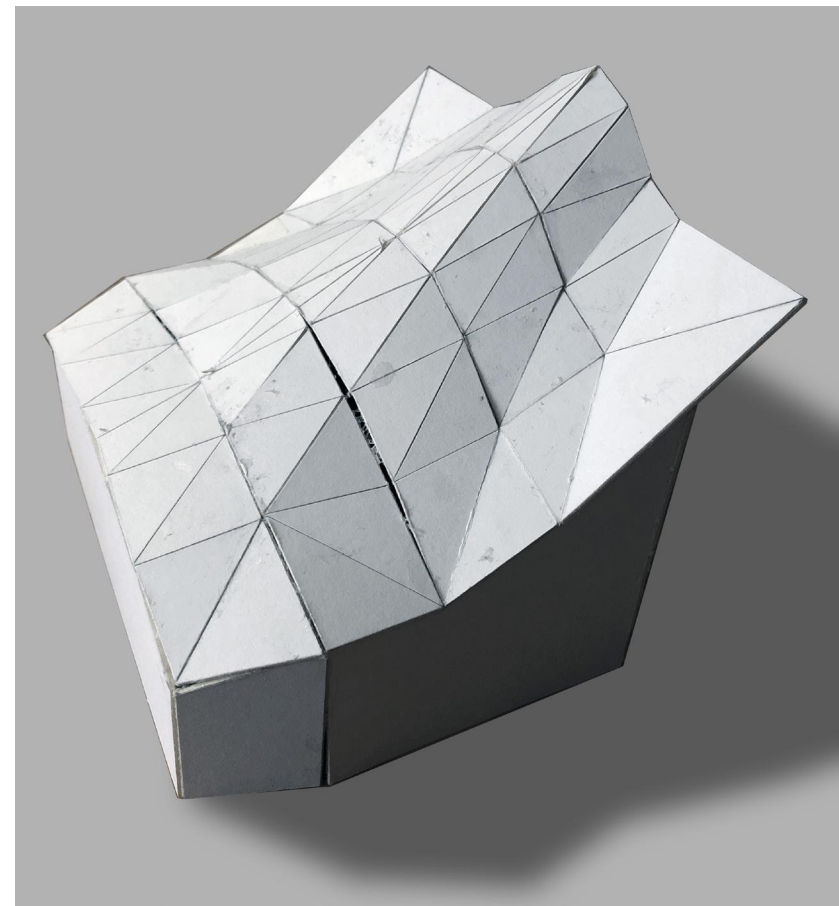
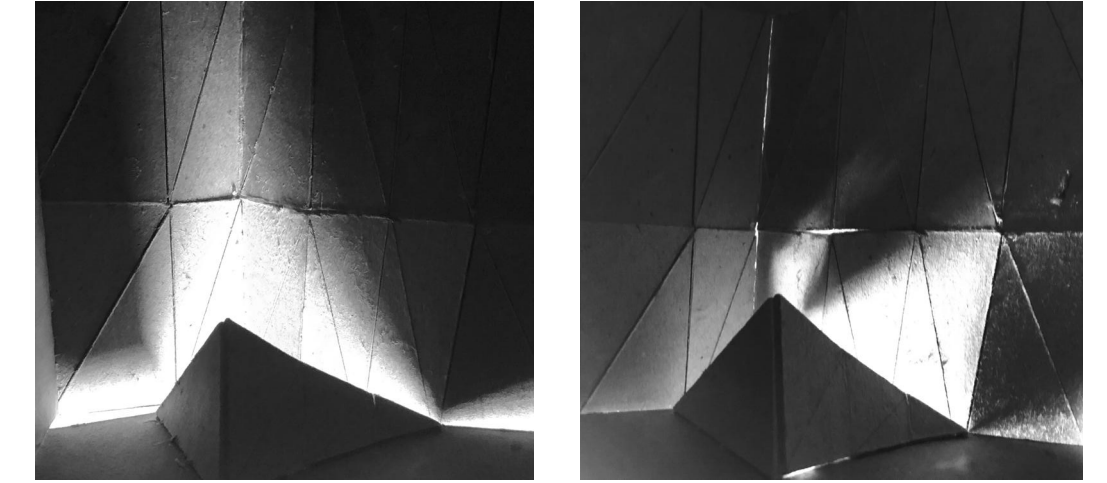


image 29

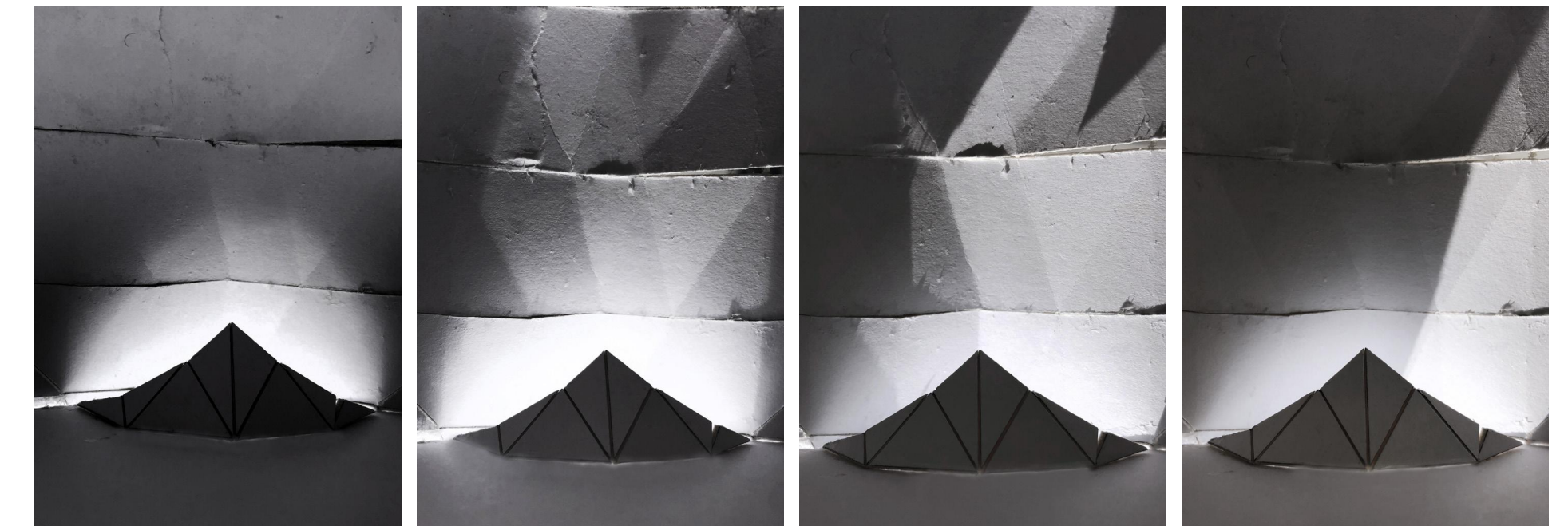
Image 26 and 27 show a roof model with a straight light passage. In image 28 and 29, the undulation of the roof model is large at the opening and gets smaller inside. These two roof models were used in the later research.

In group 1, the light passage was straight. When comparing these photos with image 25, the flaw of straight passage was easily exposed. With a straight passage, if the fluctuation was too flat (image 25), the light result became unclear. If the fluctuation was too large (group 1), when the direction of the sunlight changed a little bit, the pattern was broken easily.

In group 2, the undulation of the roof was large at the beginning to invite as much sunshine into the space as possible. Then, it got more and more flat to provide a large platform for the rotation of sunlight. The result of the model was much more satisfying.



group 1



group2

To reach the best result in winter, the inclination of the roof opening should respond to the direction of the winter sun. But the roof has a function of generating a waterfall in front of the entrance on rainy days. Then it cannot be as flat as winter sunlight. In order to satisfy both purposes, the longitudinal section (image 34) of the opening was developed as a convex form. Moreover, the height of the south wall was based on the line linking the roof edge and human eye. Then people's vision will be blocked and the impact on the south wall will be minimized.

The whole shape of the light passage follows former research (image 28 & 29). The change of the transection from image 31 to image 33 is also based on roof drainage. But after the change of the longitudinal section and transection is made, the light pattern generated also changes (image 35-38).

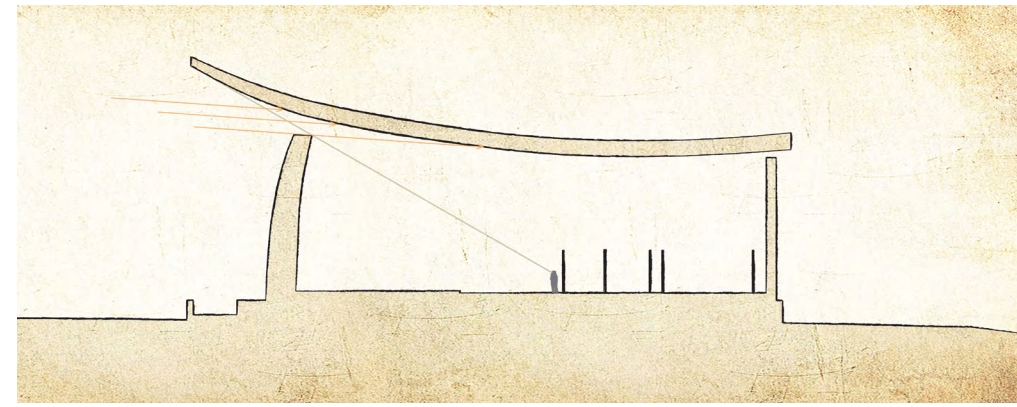


image 30

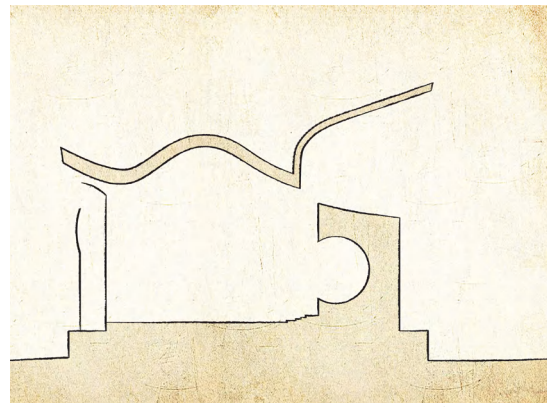


image 31

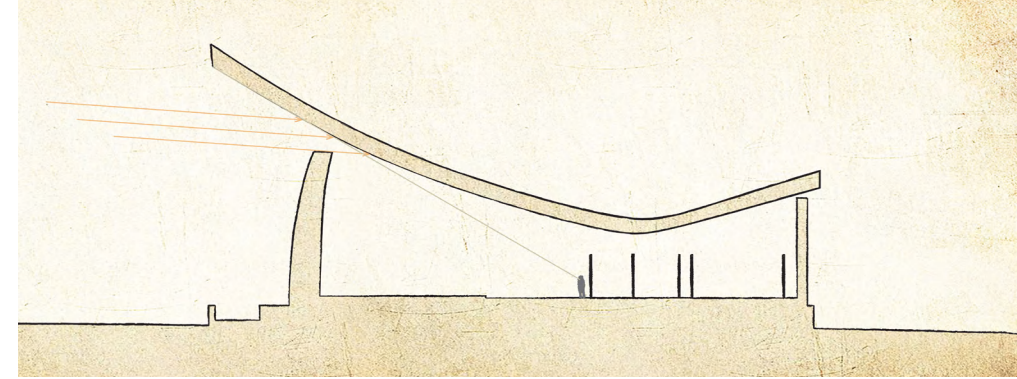


image 32

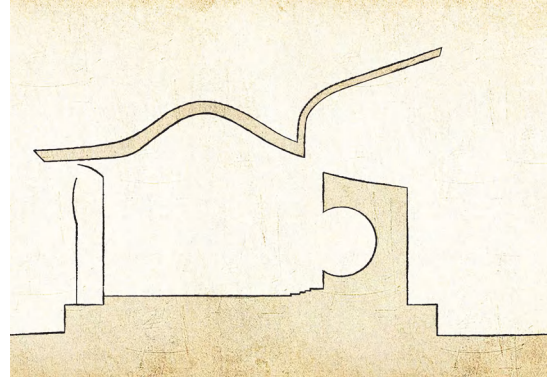


image 33

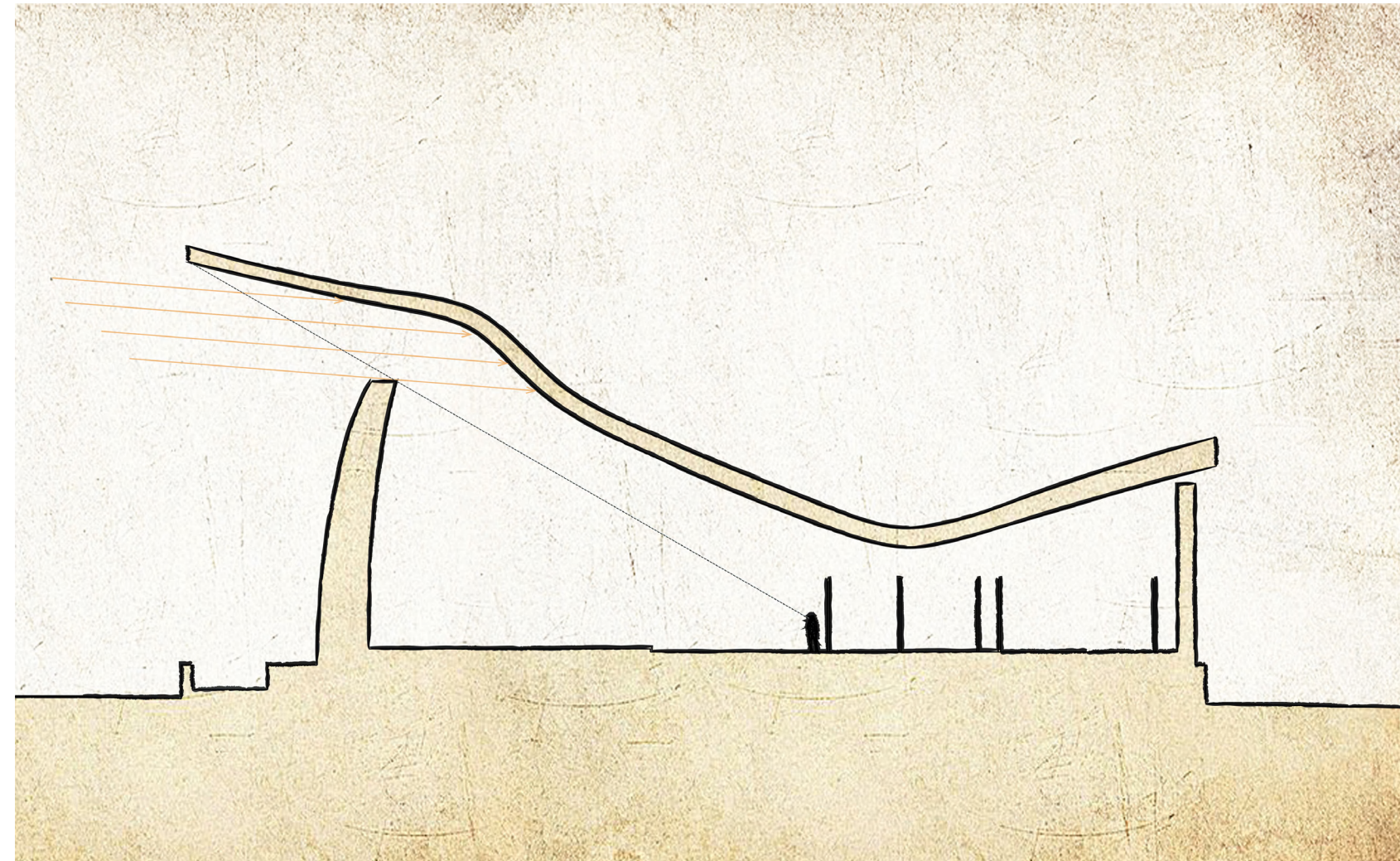


image 34



image 35

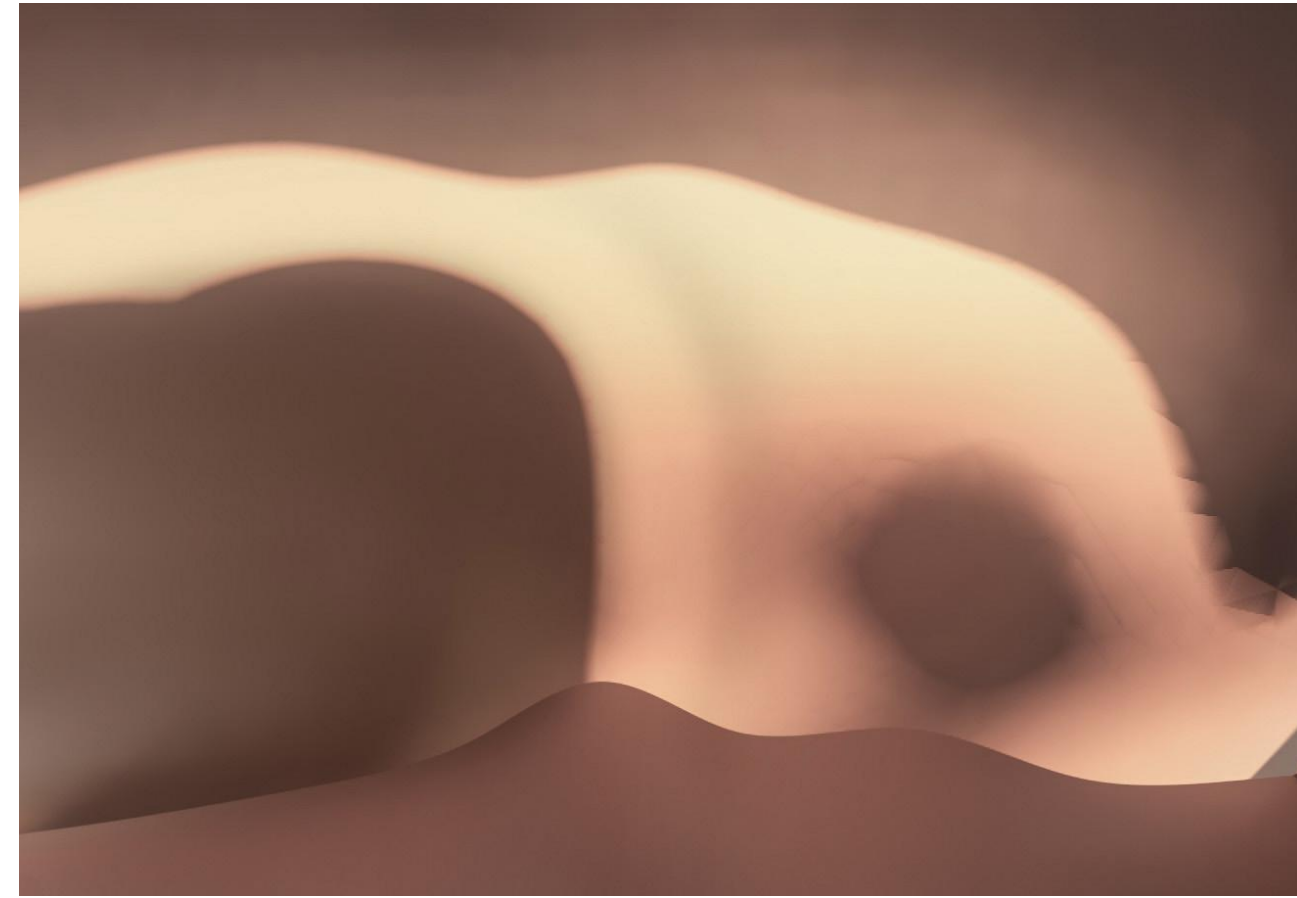


image 36

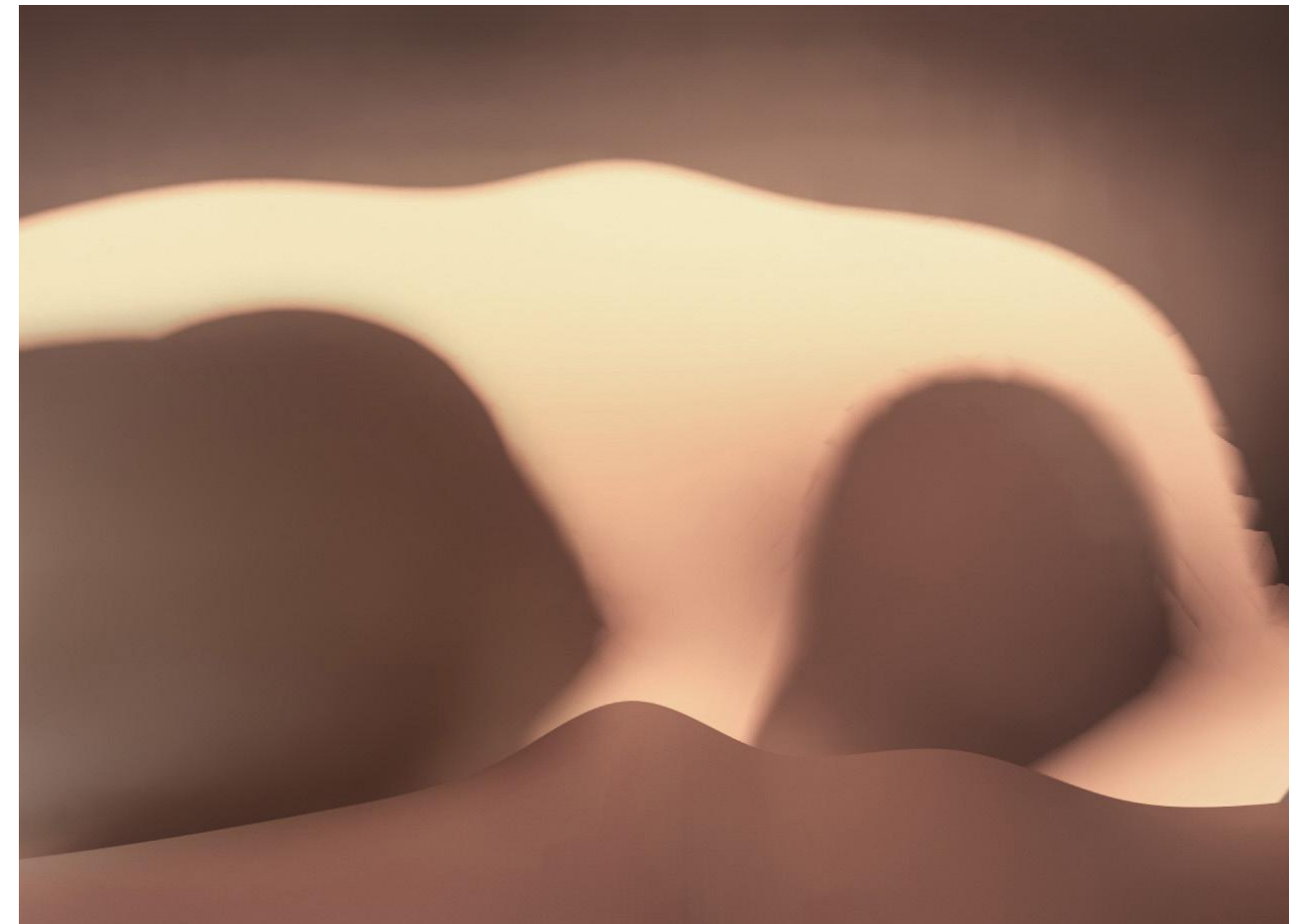


image 37

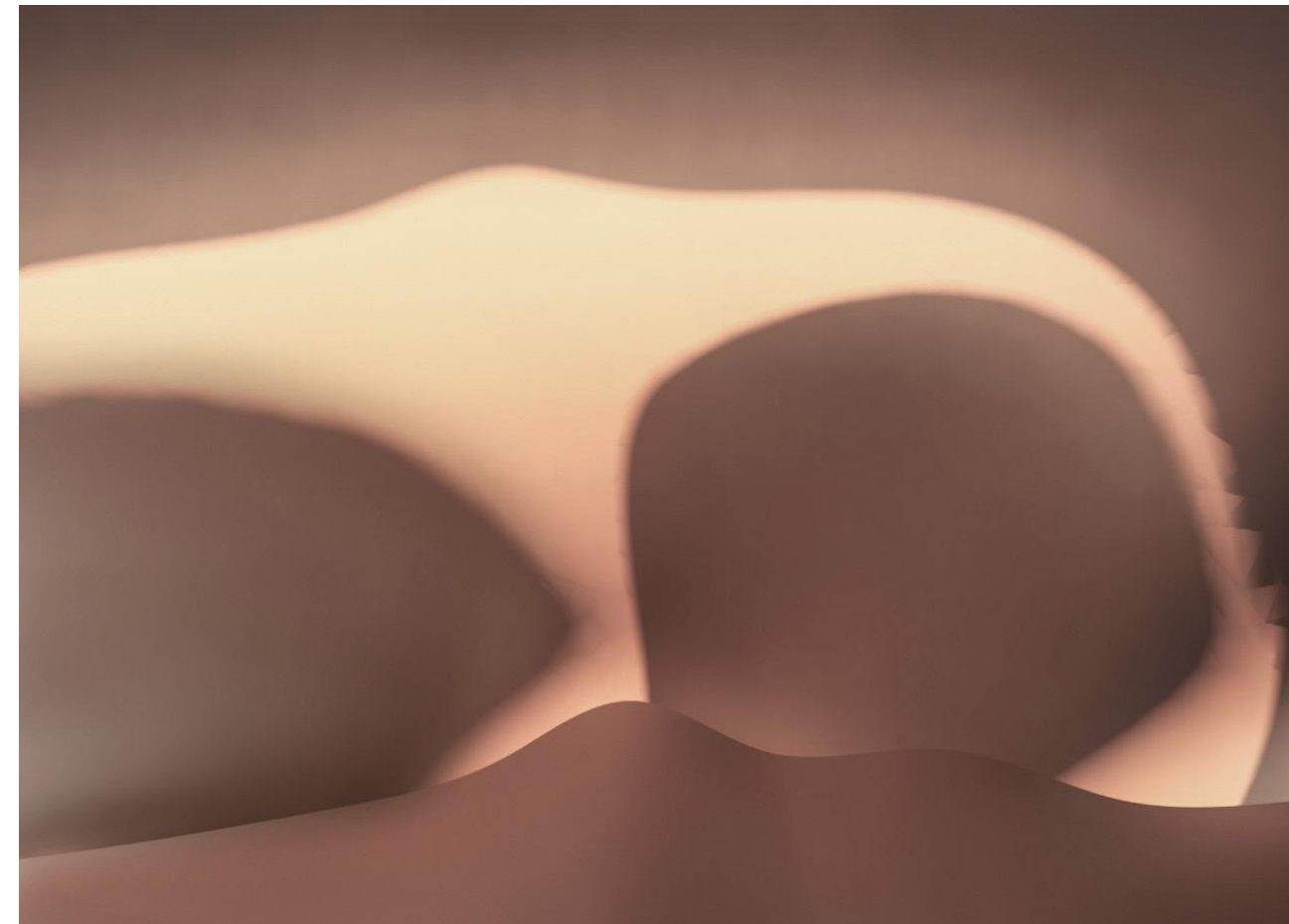


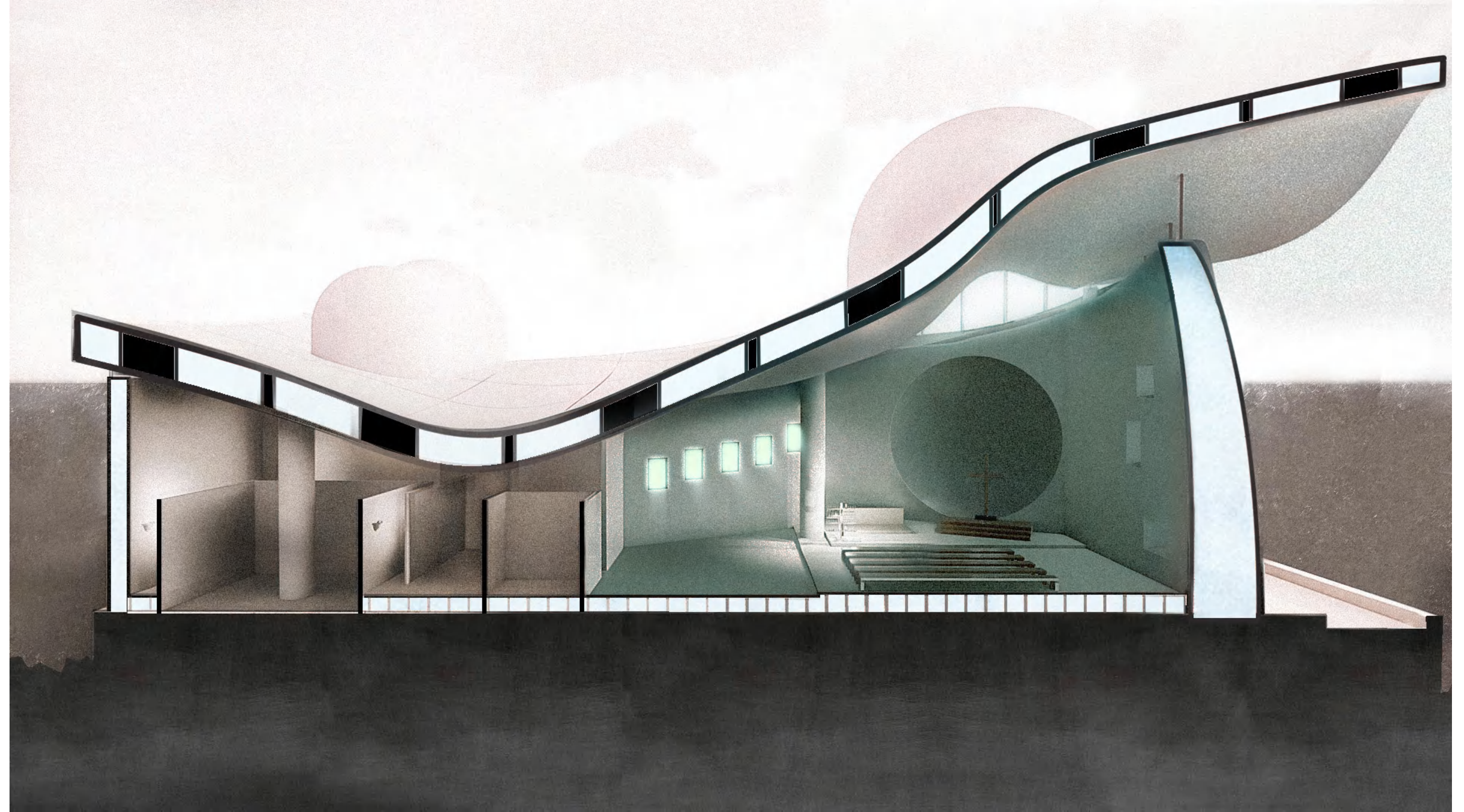
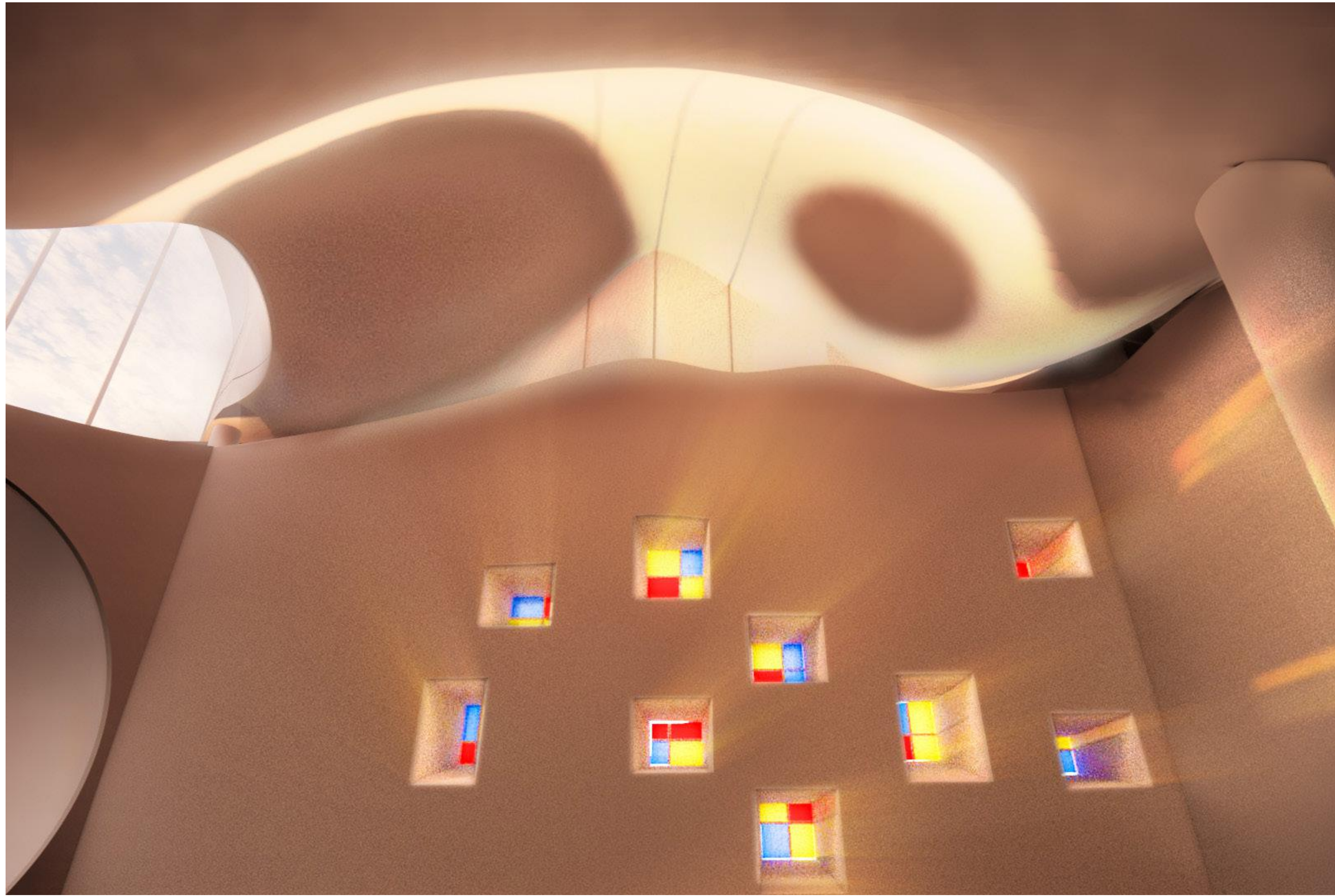
image 38



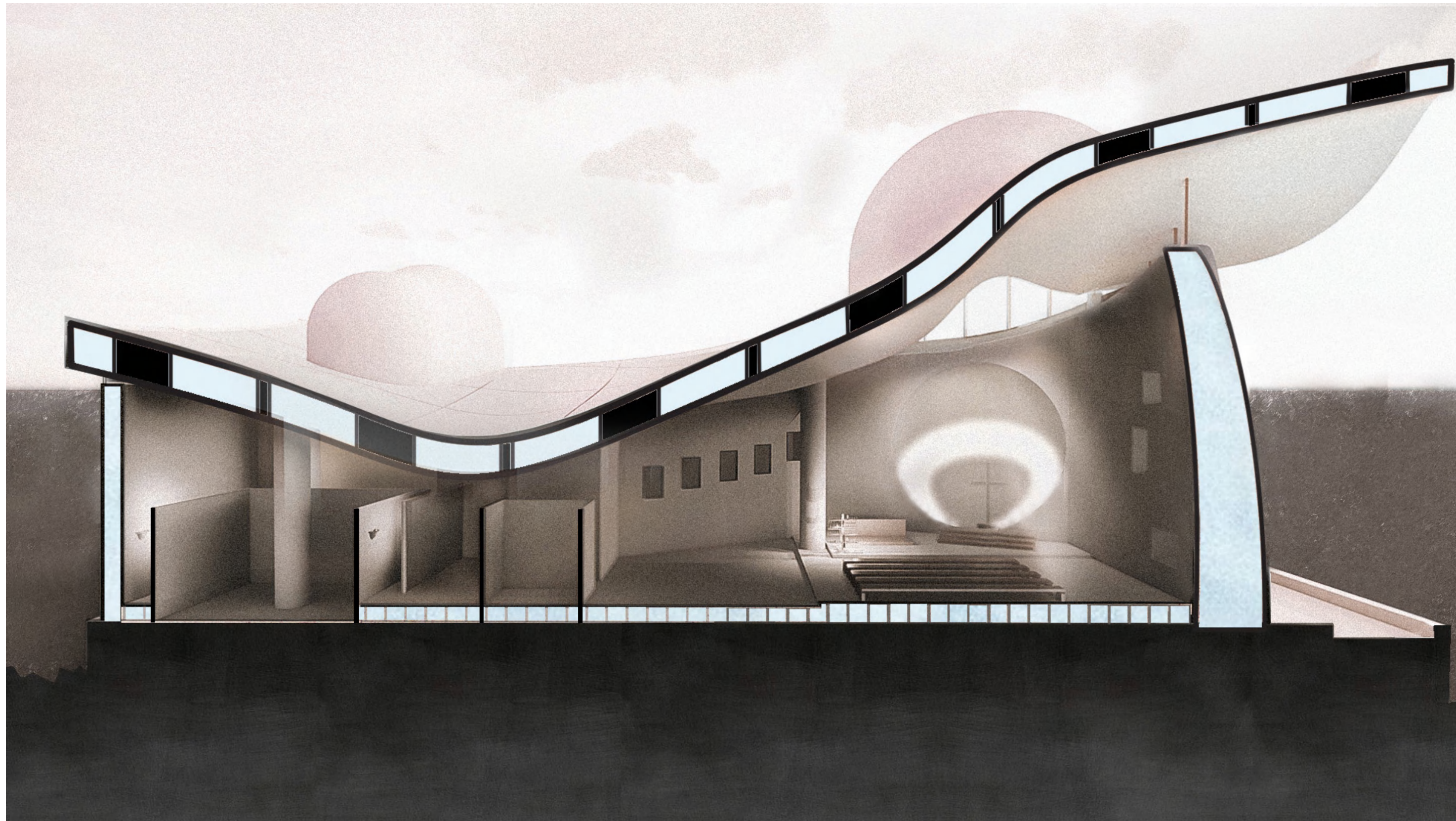
interior rendering during spring and autumn



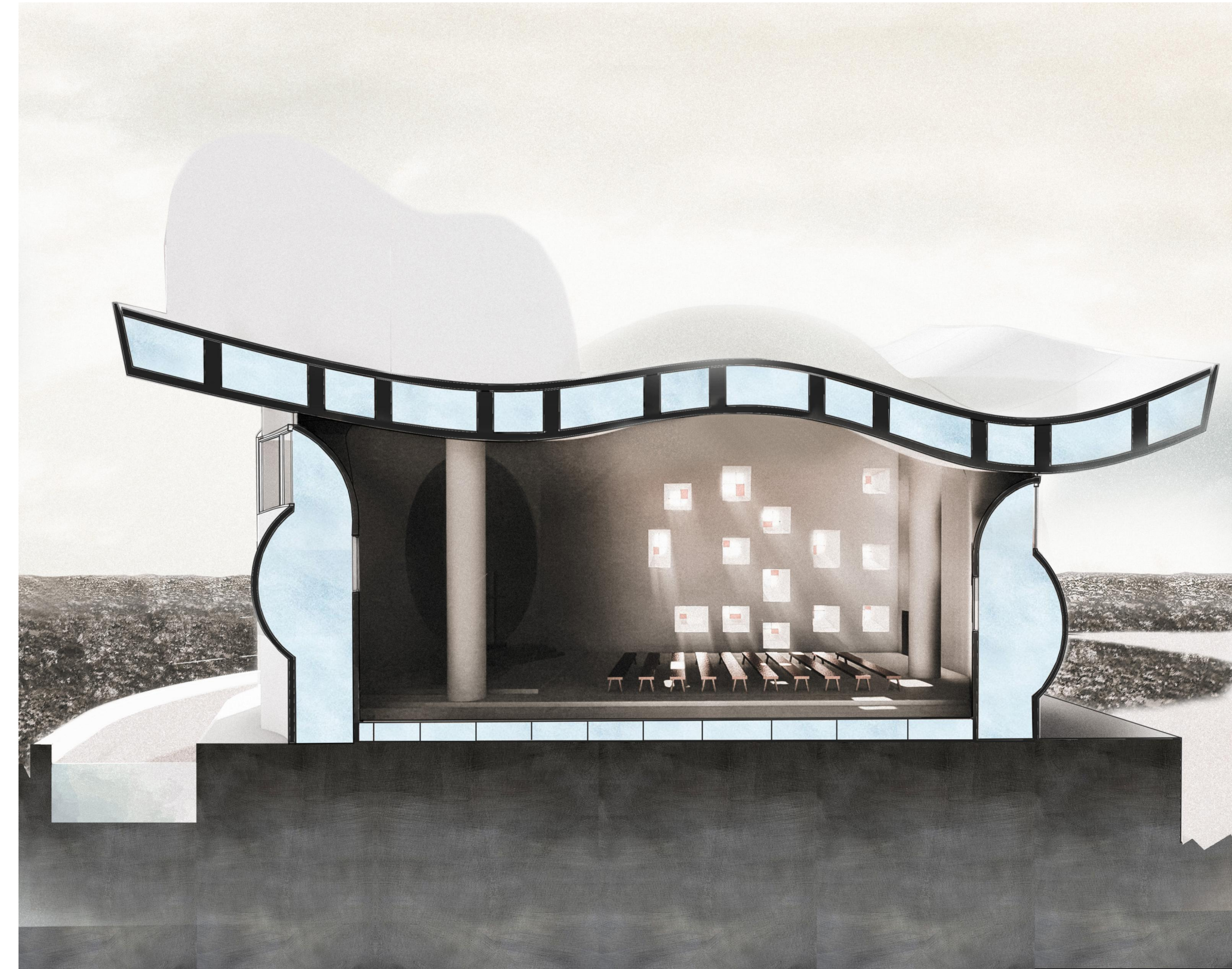
interior rendering during winter



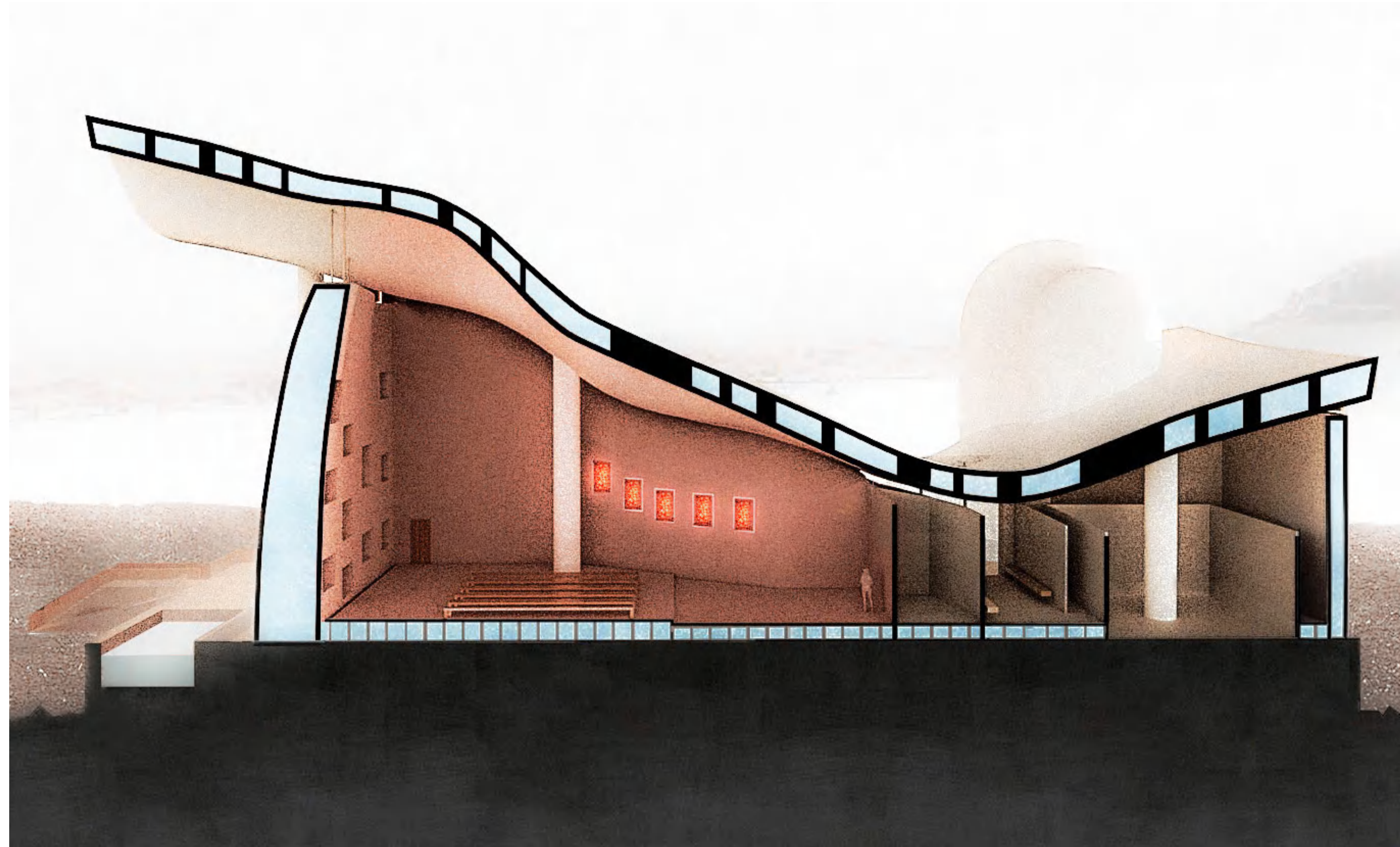
a section rendering when sunshine enters through the northeast wall



a section rendering when sunshine enters through the southeast wall



a section rendering when sunshine enters through the south wall



a section rendering when sunshine enters through the northwest wall

CONSTRUCTION

SITE CONDITION



footpath



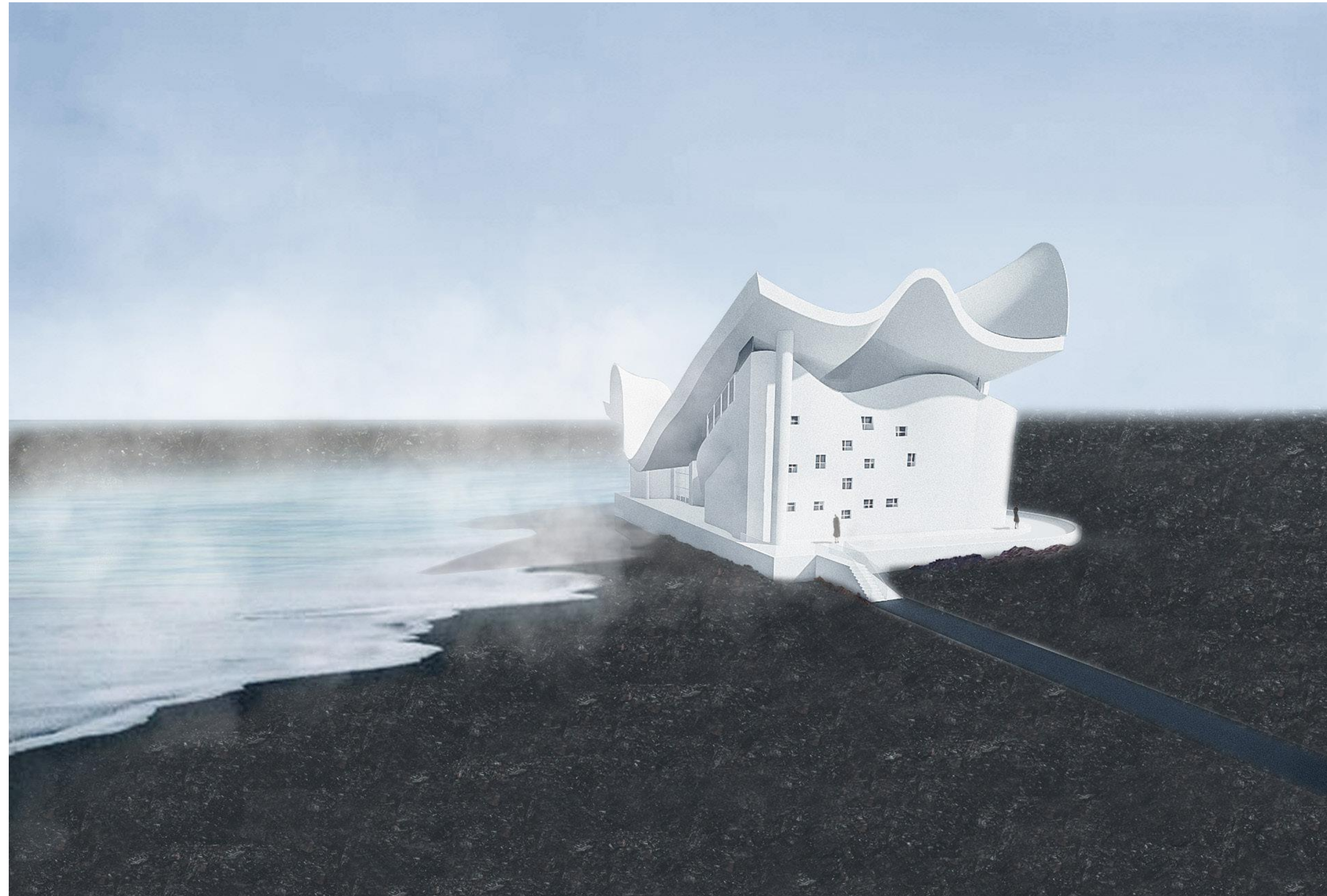
boundary between lagoon and land 2



boundary between lagoon and land 1



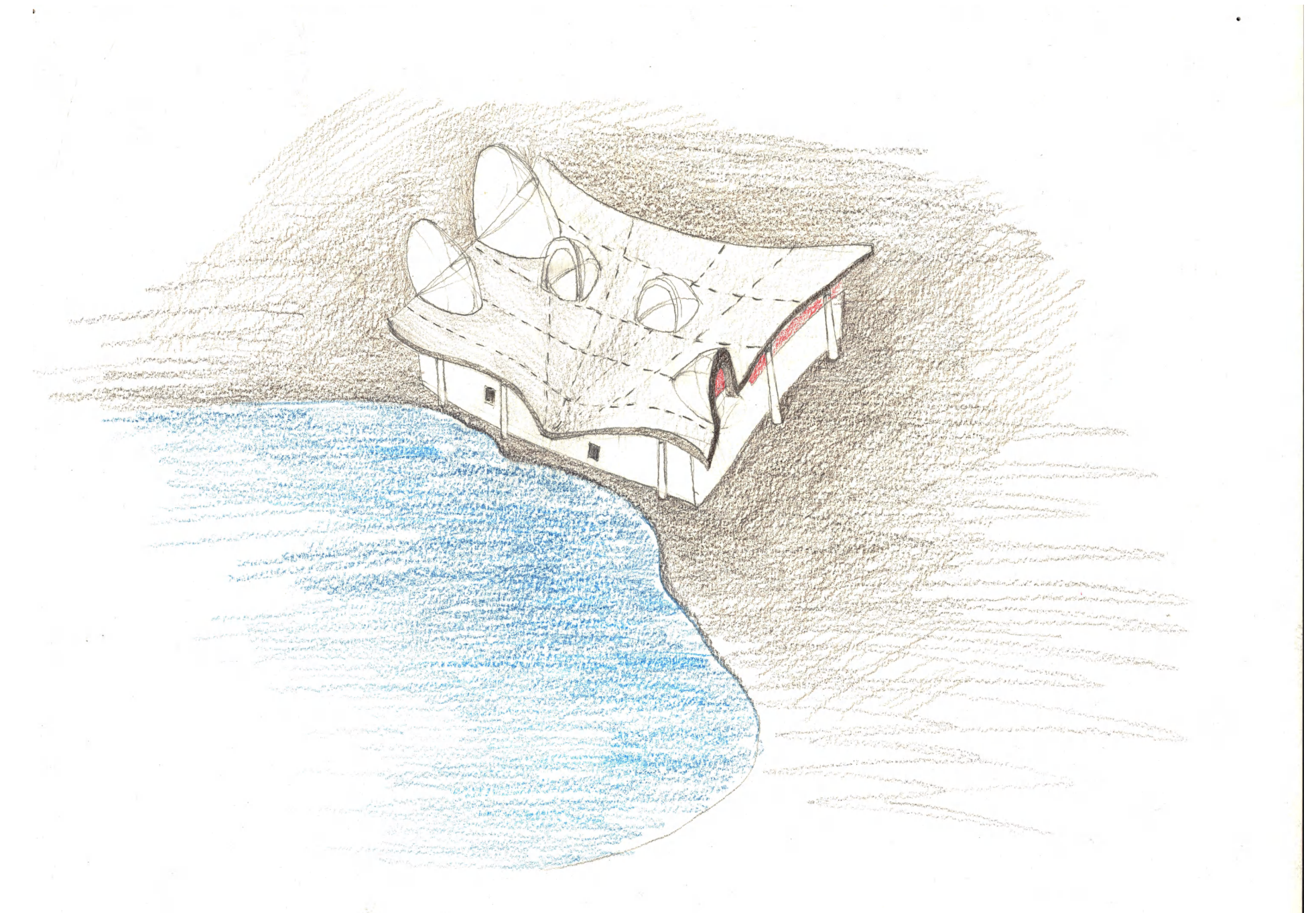
physiognomy



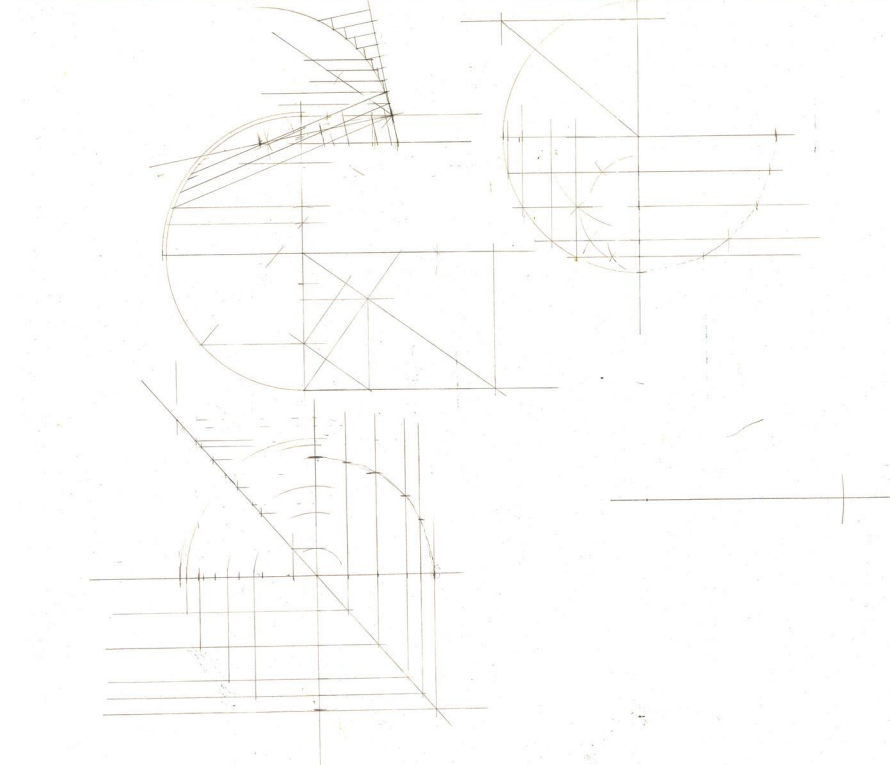
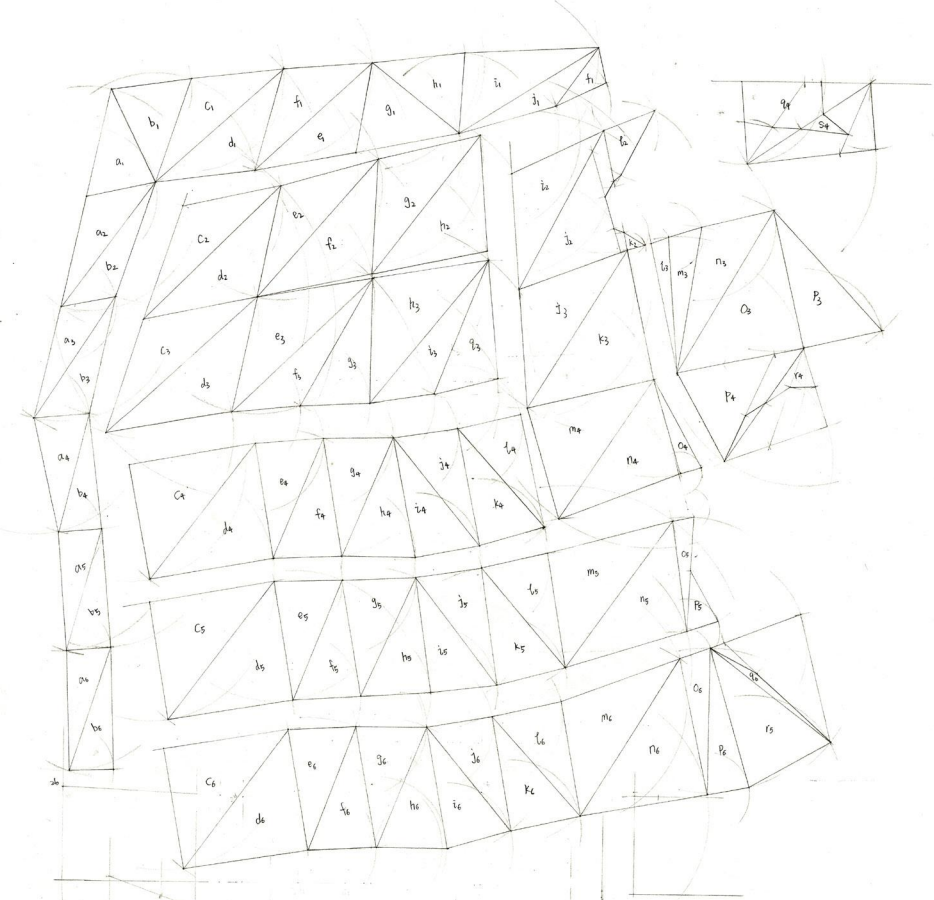
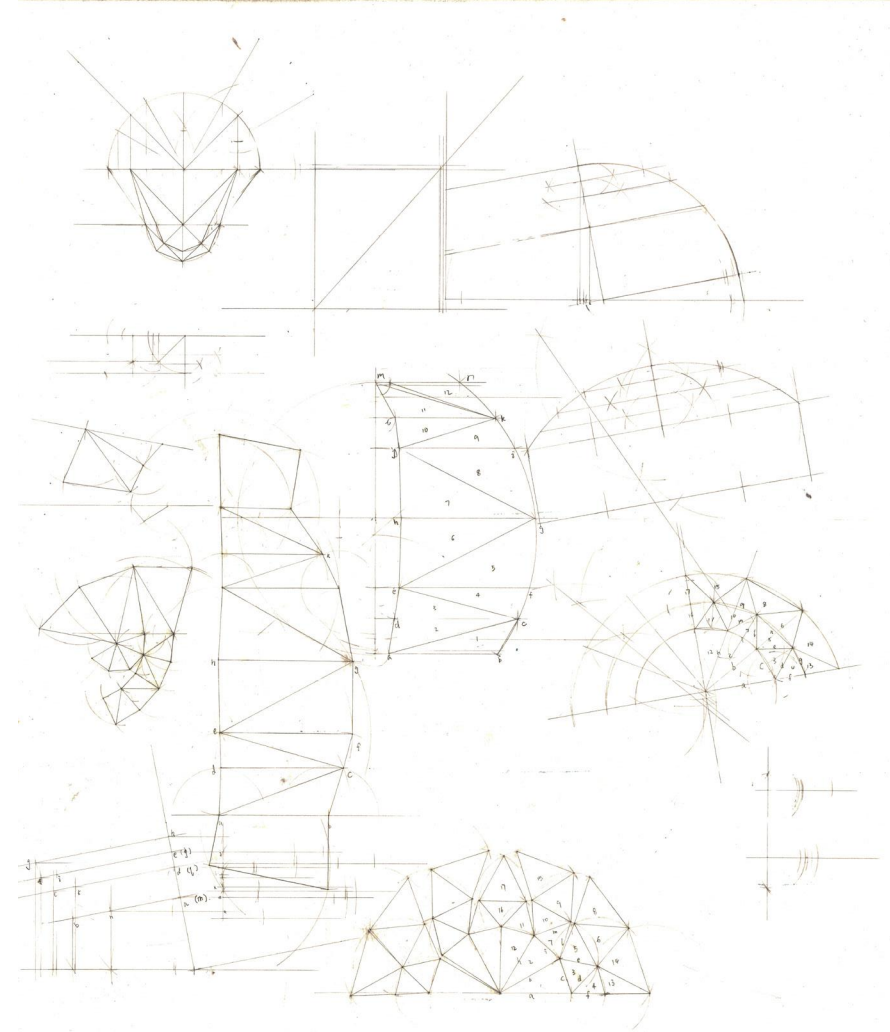
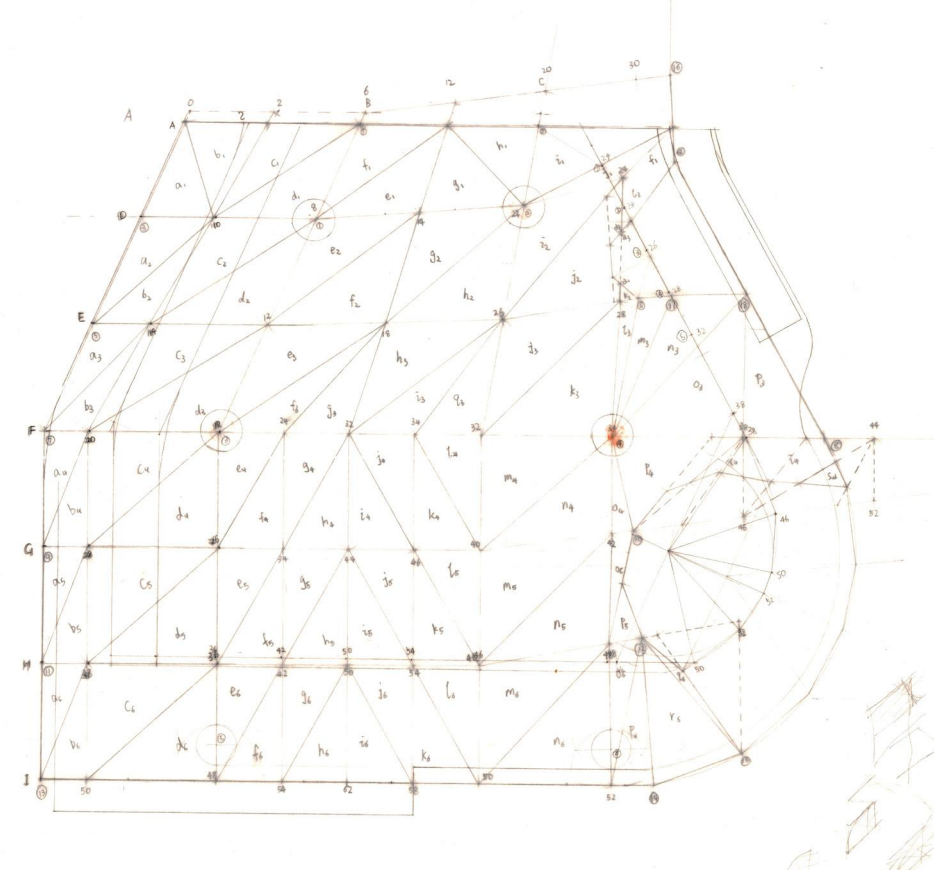
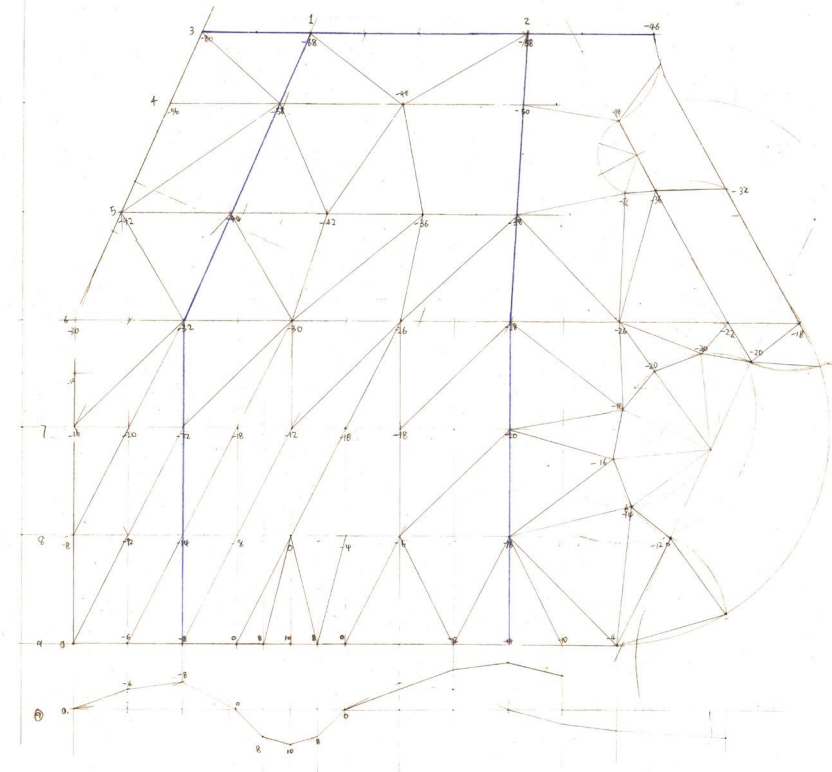
ROOF DEVELOPMENT

In the Genesis, God separates the dry land from the water after the creation of heaven and earth, light and darkness, and in other cosmogonies water is the primeval substance from which all forms come.⁷

Drainage is a problem that any architect should consider. For practical reasons, water is a threat to building materials. For philosophical reasons, drainage is a bridge between roof and the earth. Falling rain, as an abstraction of gravity, forms a mode of natural understanding and makes a connection between the sky and the earth. By telling where the water is running on the ground, the geographical structure of a place is revealed. Gravity is an invisible hand, making all sorts of interesting roofs across the world. In this design, the roof looks like the rolling topography on the site. Rain flows on the roof and falls down from the lowest place.



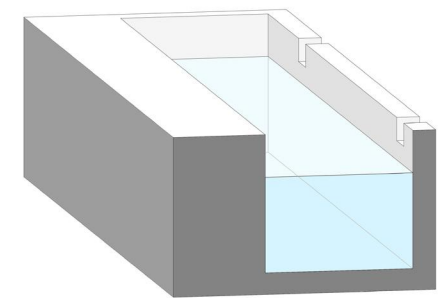
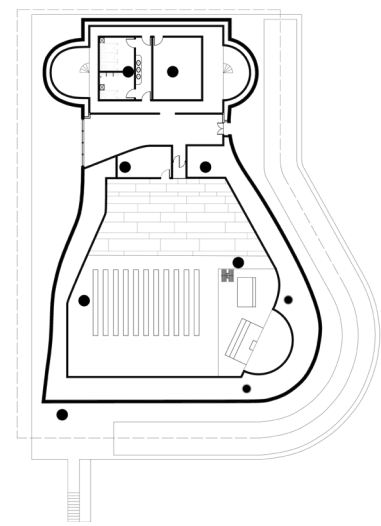
⁷ Christian Norberg-Schulz, *Genius Loci: Towards a Phenomenology of Architecture* (New York: Rizzoli, 1979) p.27, quoted in M. Eliade, *Patterns in Comparative Religion* (Cleveland and New York, 1963) p.188



The roof follows the research of light passage for winter daylight and the need for drainage. The lowest point of the roof faces the entrance. When it rains outside, the falling water from the roof reveals the weather to the people inside. The roof is laid out on a grid. After giving height to each point, the shape of the roof is roughly decided. This method made it easier to build the real model.



a view of the entrance on rainy days

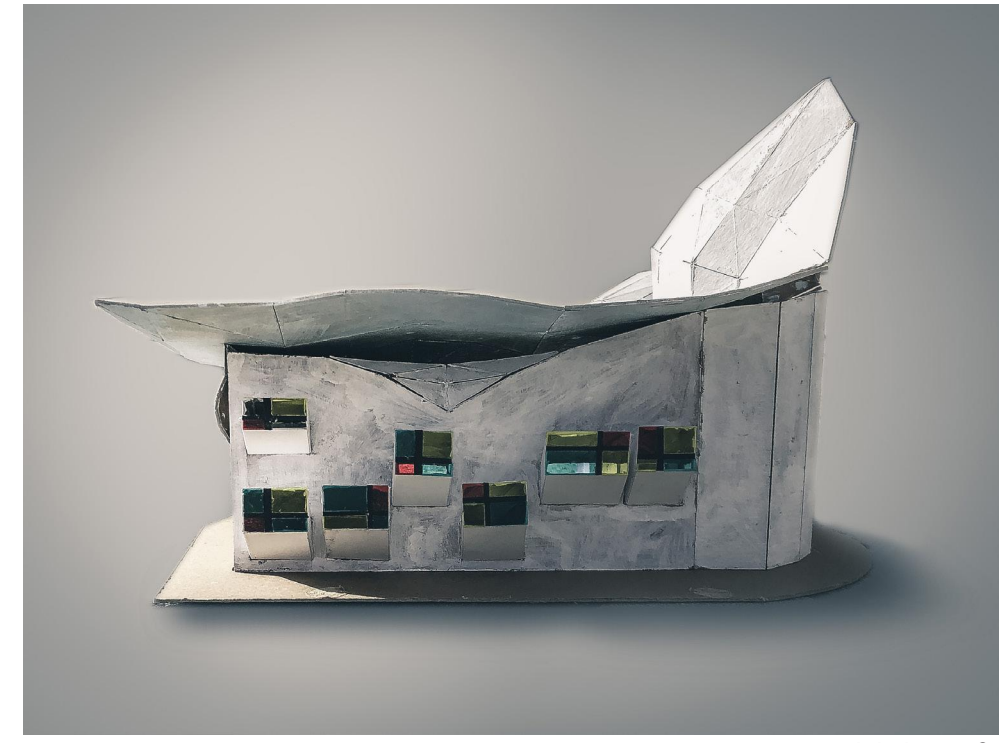


to prevent water expansion when it freezes

The chapel rests on a platform with small ponds built into it, inviting visitors to walk across and admire the removal of the roof.



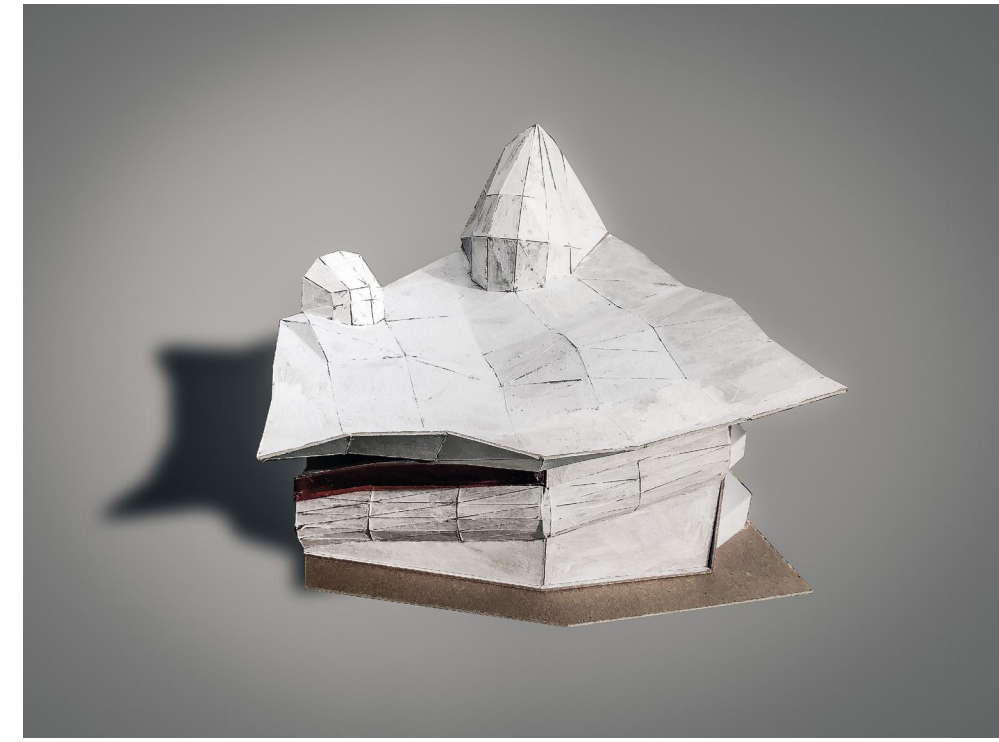
process model picture 1



process model picture 2

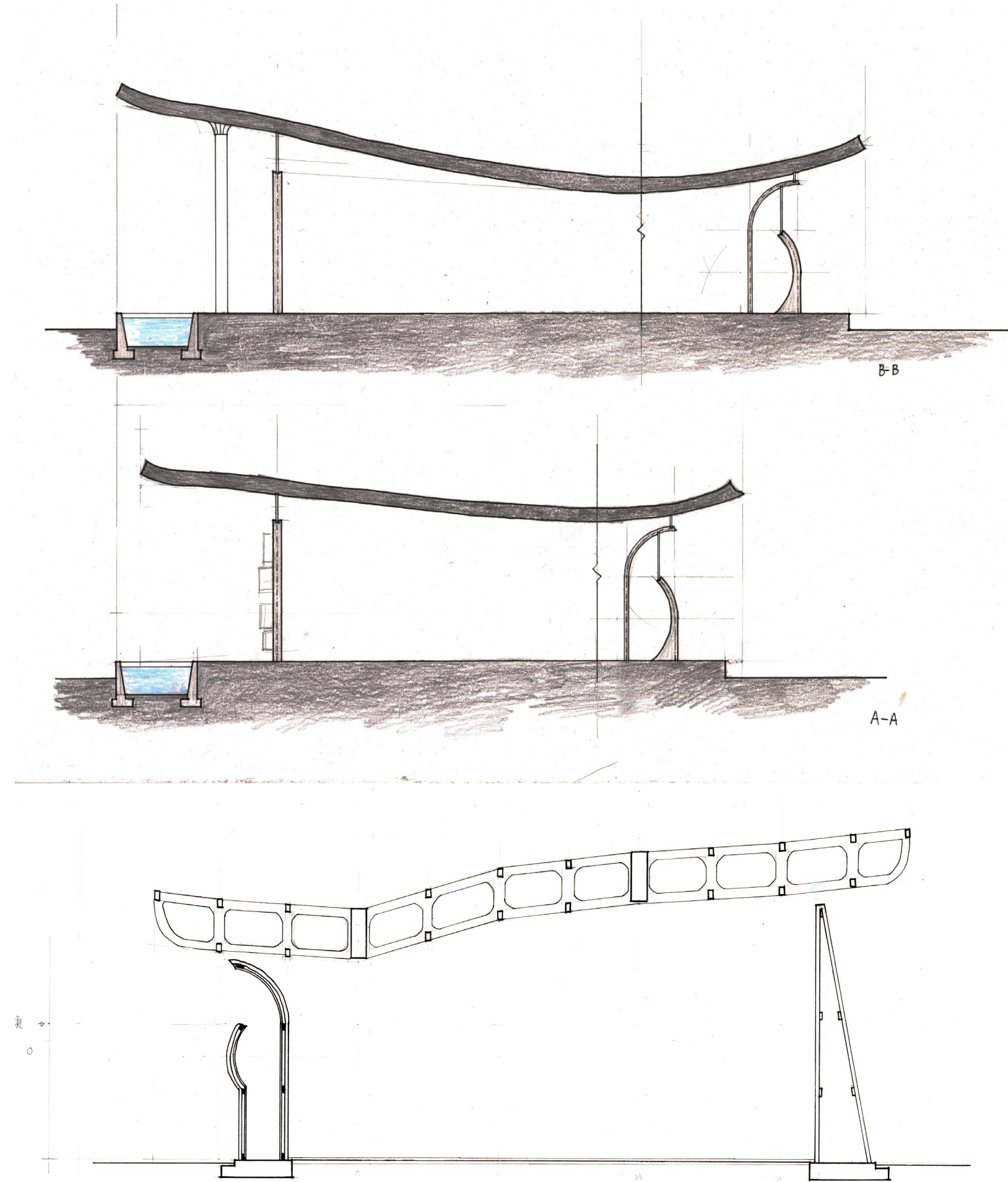


process model picture 3



process model picture 4

STRUCTURE



At first, the arrangement of structure followed the reference grid for the roof. To realize a larger span and reduce dead load, hollow beams supported on columns were selected. The walls were detached from the structural system-so that their shape wouldn't be limited by the need to be load bearing.

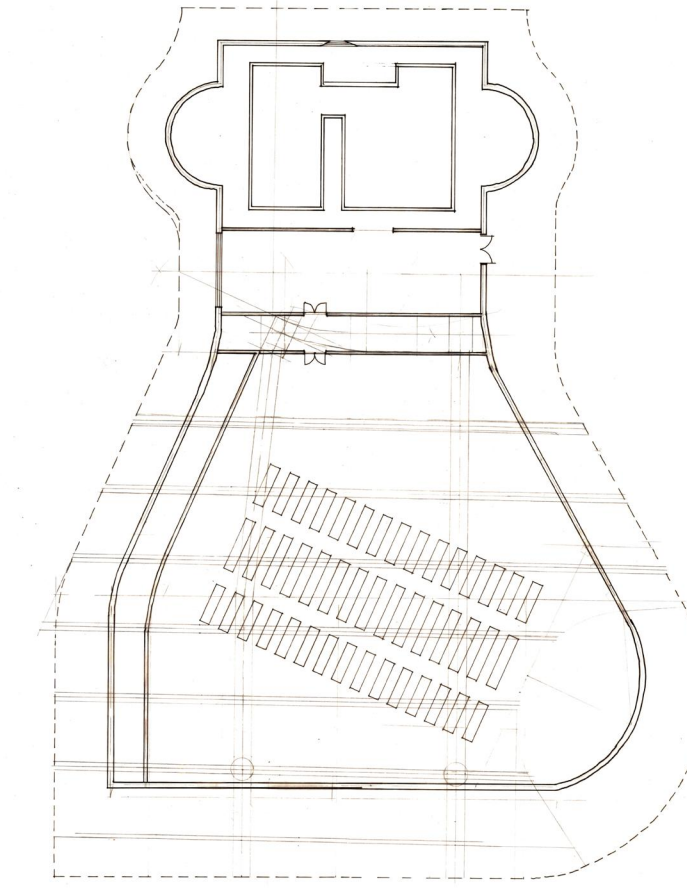


image 39

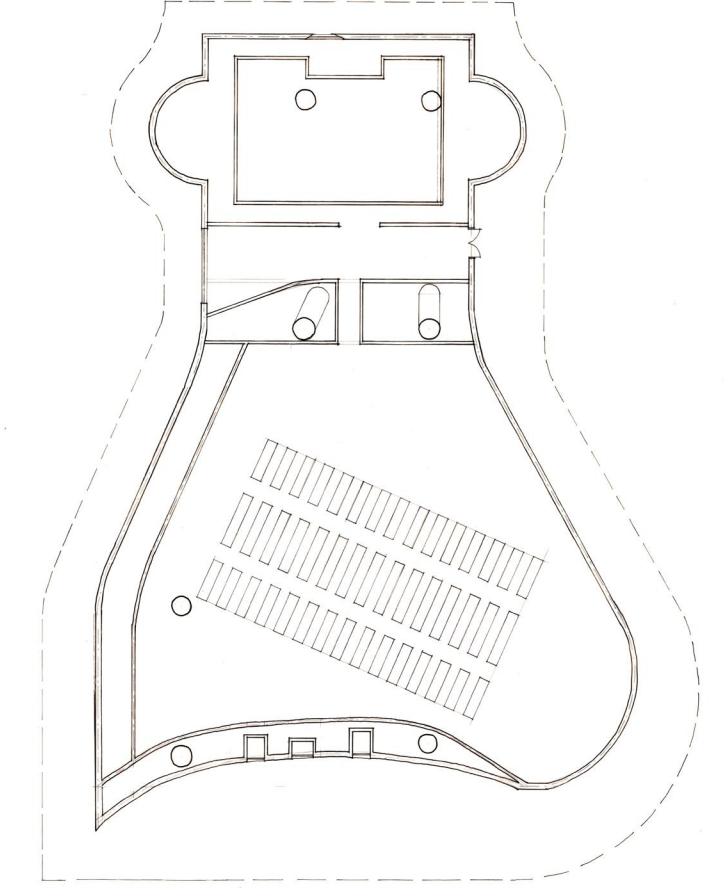


image 41

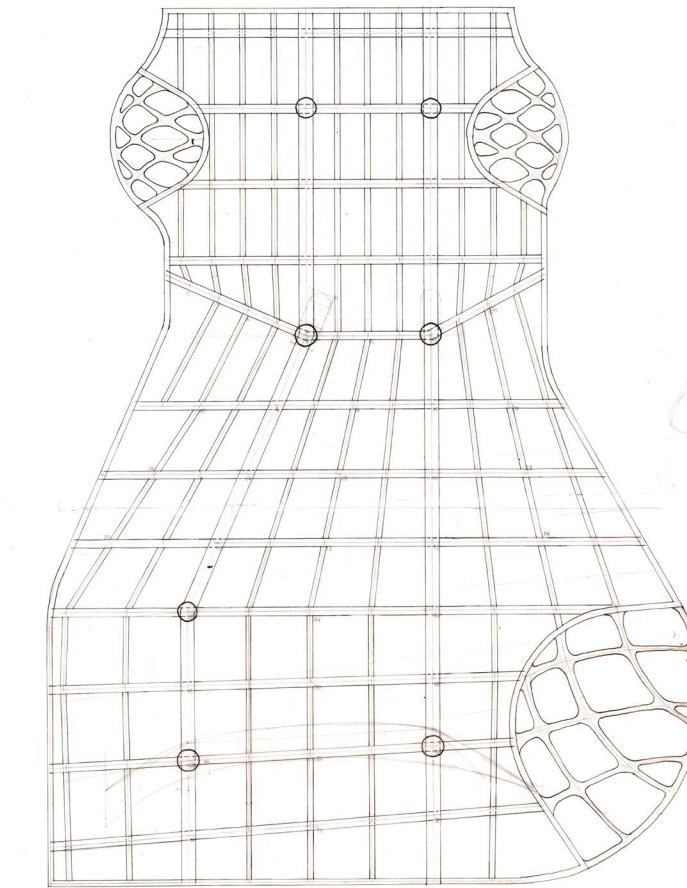


image 40

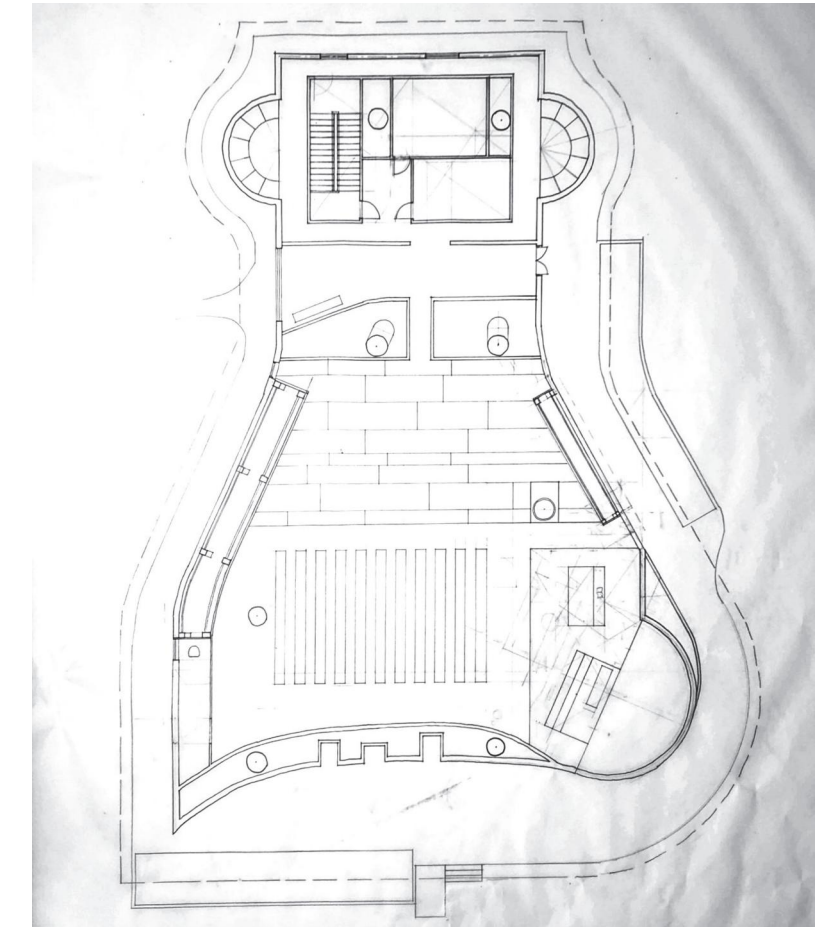
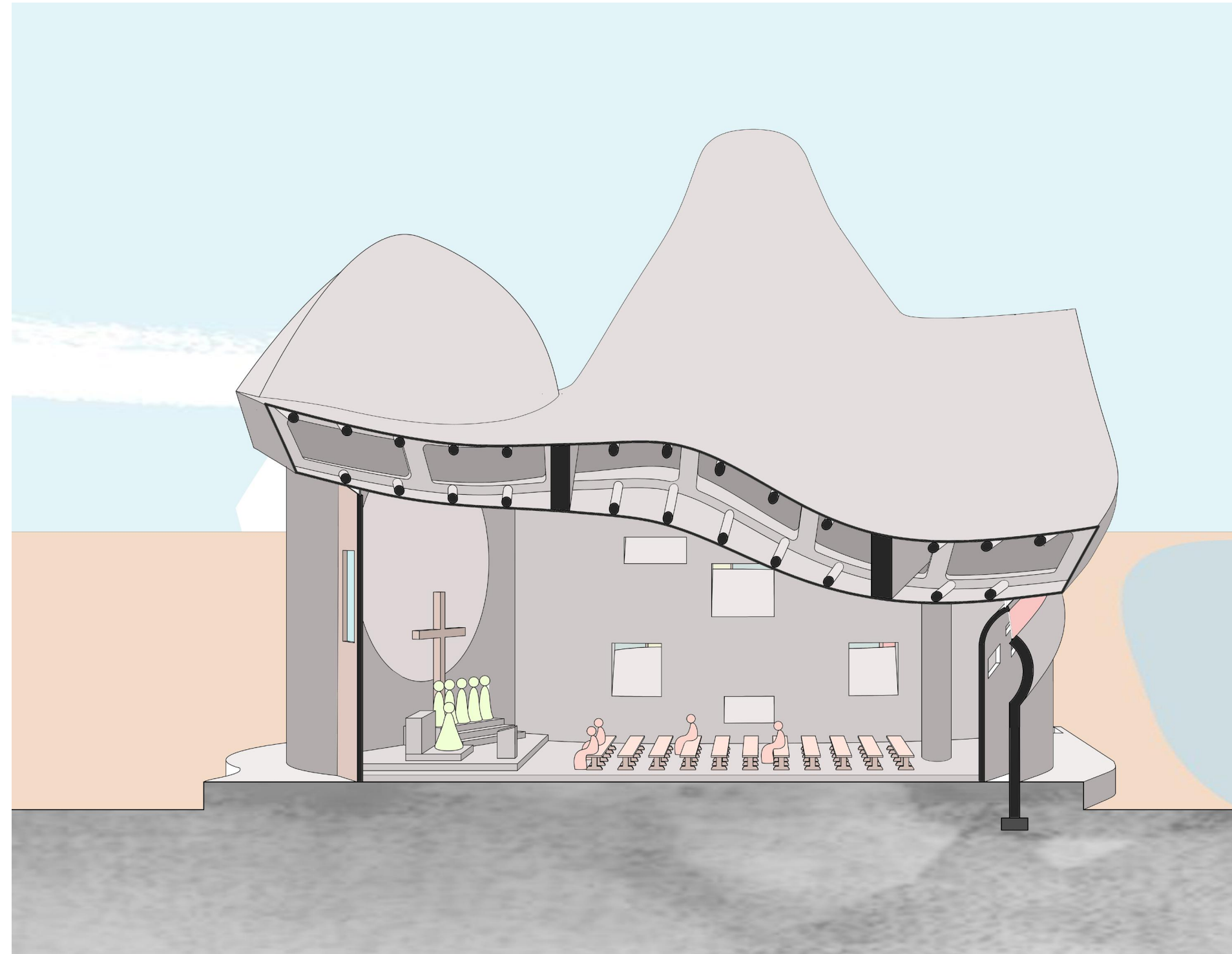


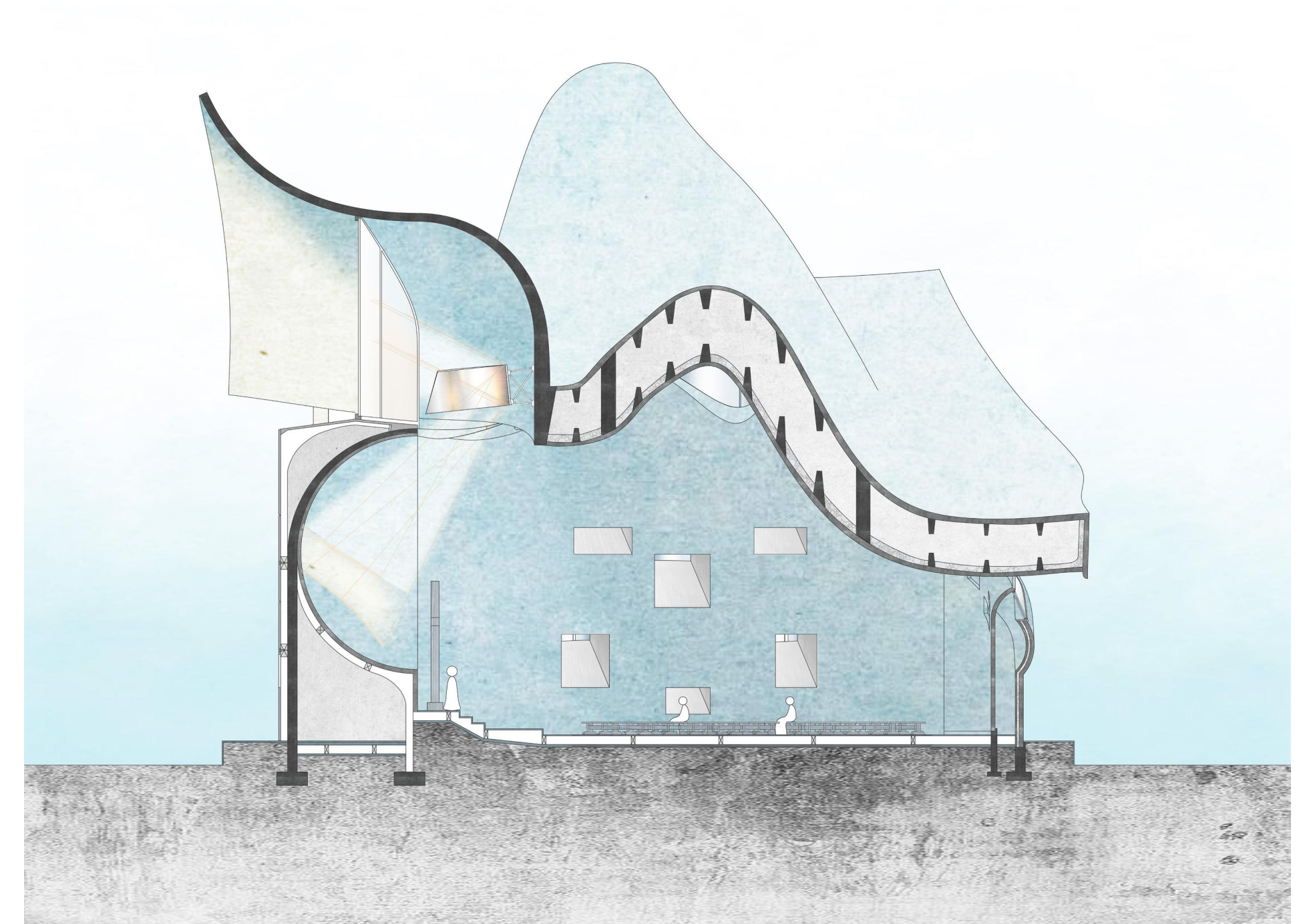
image 42

After determining the arrangement of the structure (image 39), I tried to change the shape of the wall and hide the columns inside the south wall. However, the plan (image 41 & 42) showed that the space left for sunshine was reduced. Later, I decided to separate the columns from the walls which were containing light, letting them perform their own functions.

In the first structure design, walls were made of cast-in-place concrete. However, the walls used as light containers were composed by two closely placed pieces. If they were cast on site, how should the mold be made? After being cast, how should the mold be taken out? Finally, how should the finishing be made? These problems made this scheme hard to continue.



Then, I used precast concrete to solve the problems brought by two closely placed walls. However, the wall was too high and had a complex shape. It was too difficult to use its own strength to bear its own weight. A steel frame was required, but then the structure system seemed disordered.



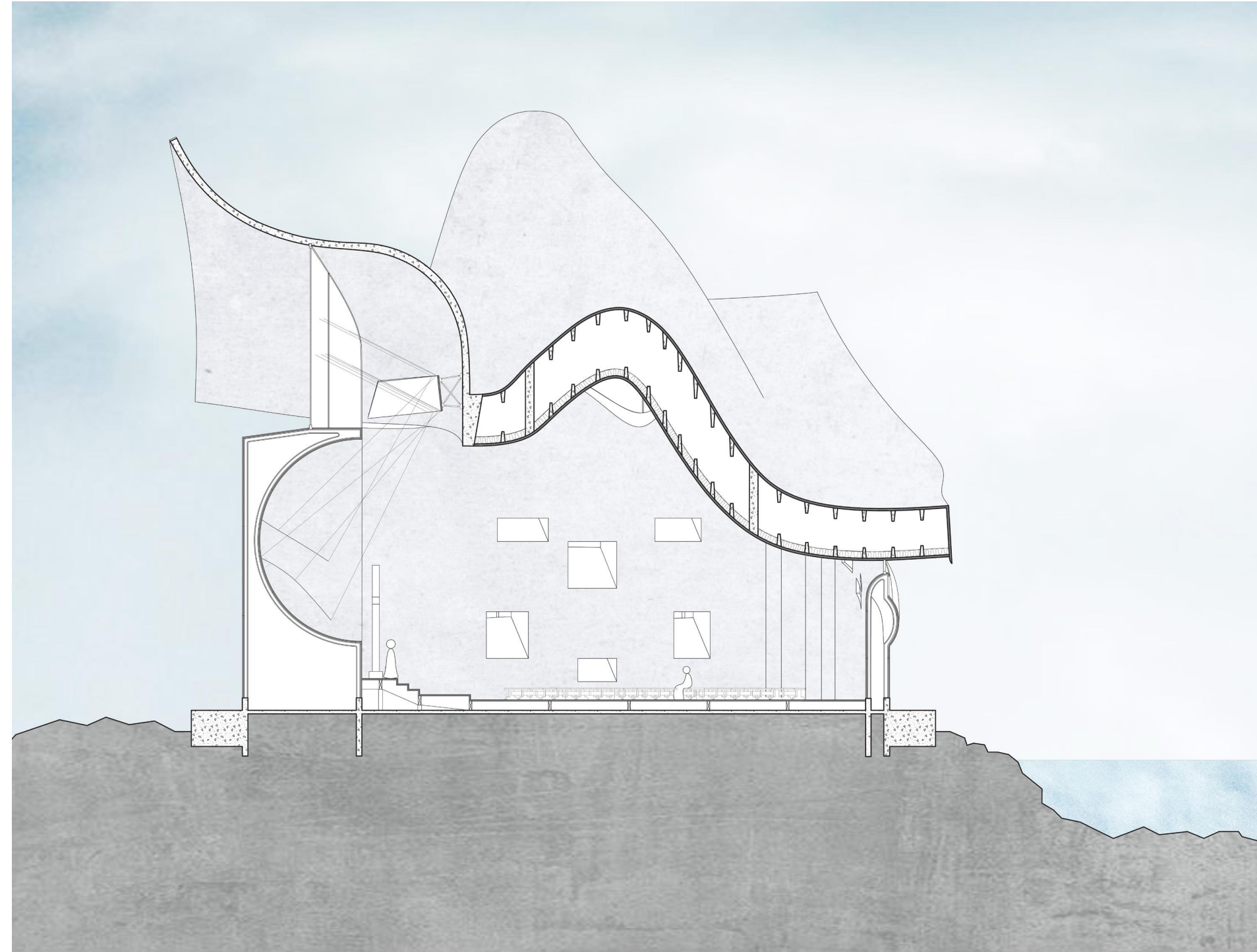
FLUTED WALL OF WHITE CONCRETE _INTERNATIONAL
BAROQUE MUSEUM



image 43



image 44



Later, I made all the walls into a hollow mass, supported by steel frames. Panels were attached to the frame on the outside. The panel was made of ferrocement. The metal mesh inside the ferrocement was 3D printed, so that this material could be easily made into any shape. It also got a fine texture, providing a wonderful platform for the light. However, the gap between panels was hard to cover. The wall stopped remaining one solid form.

The structure of the roof also required modification. I assumed it was made of cast-in-place concrete. The hollow beams and the tertiary beams that support the top and bottom surfaces made their corresponding mold impossible.

The construction system, specially designed for the MIB, used precast concrete walls and slabs that, in addition to being the structure of the building itself, give the final finishing. The slabs, composed of precast gray concrete tablets 7 cm thick, use recycled PET spheres to make them lighter; While the panels that make up the walls are formed by two plates of white concrete between 15 and 21 meters high and 36 cm thick that, once placed in place, were cast with gray concrete to form monolithic sandwich walls.⁸

⁸ Toyo Ito @ Associates, Museo Internacional del Barroco (Archdaily, 2016)

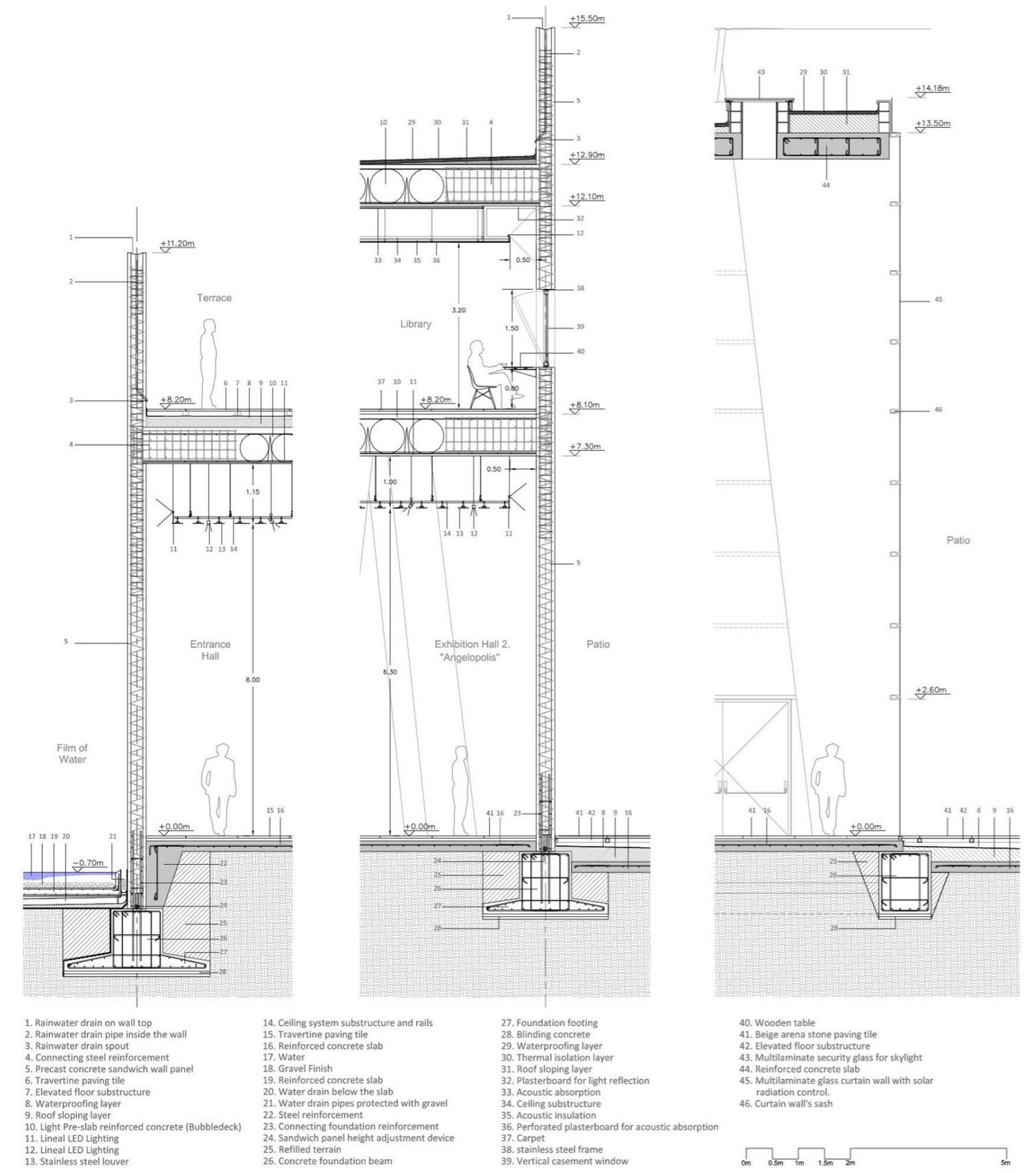
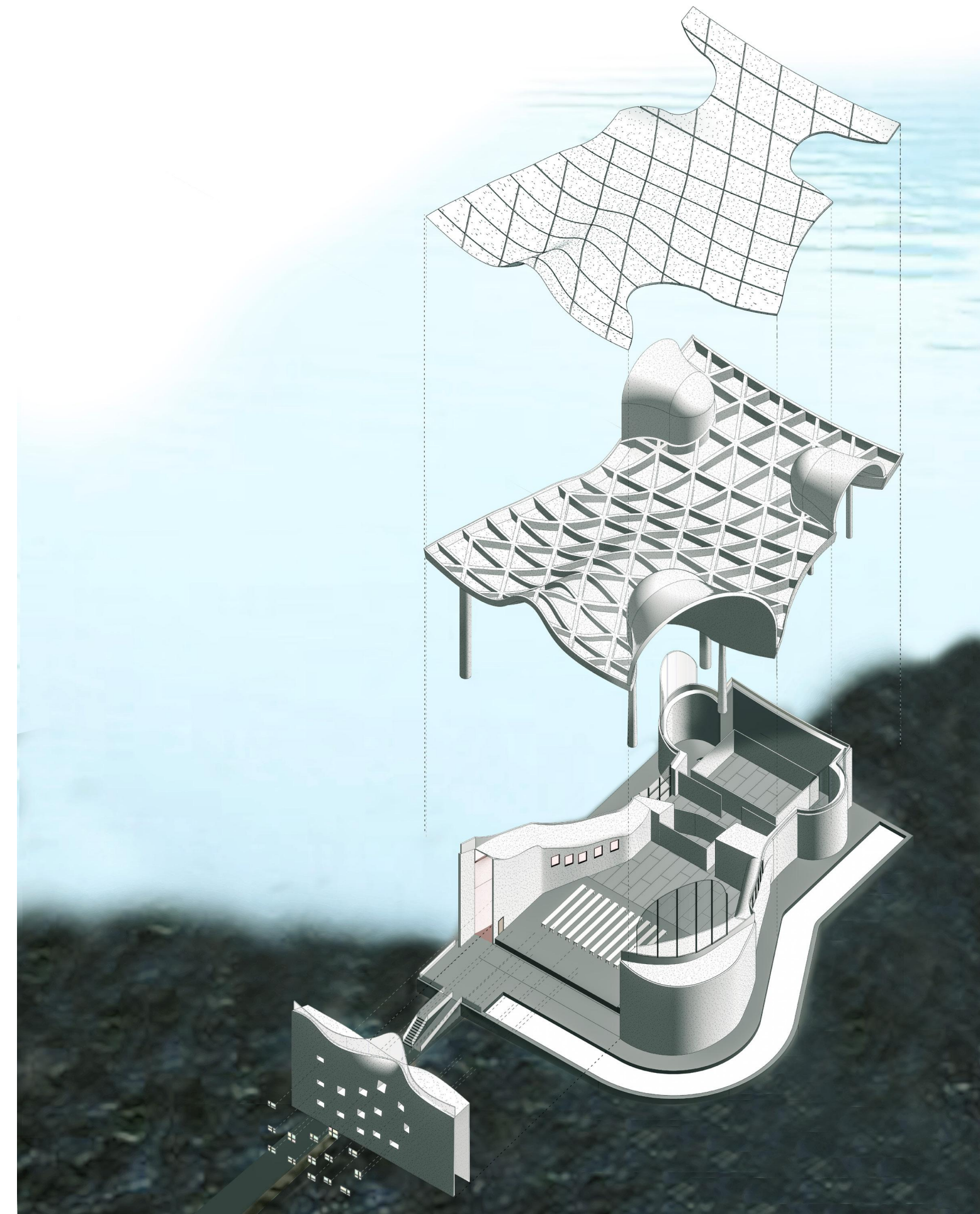
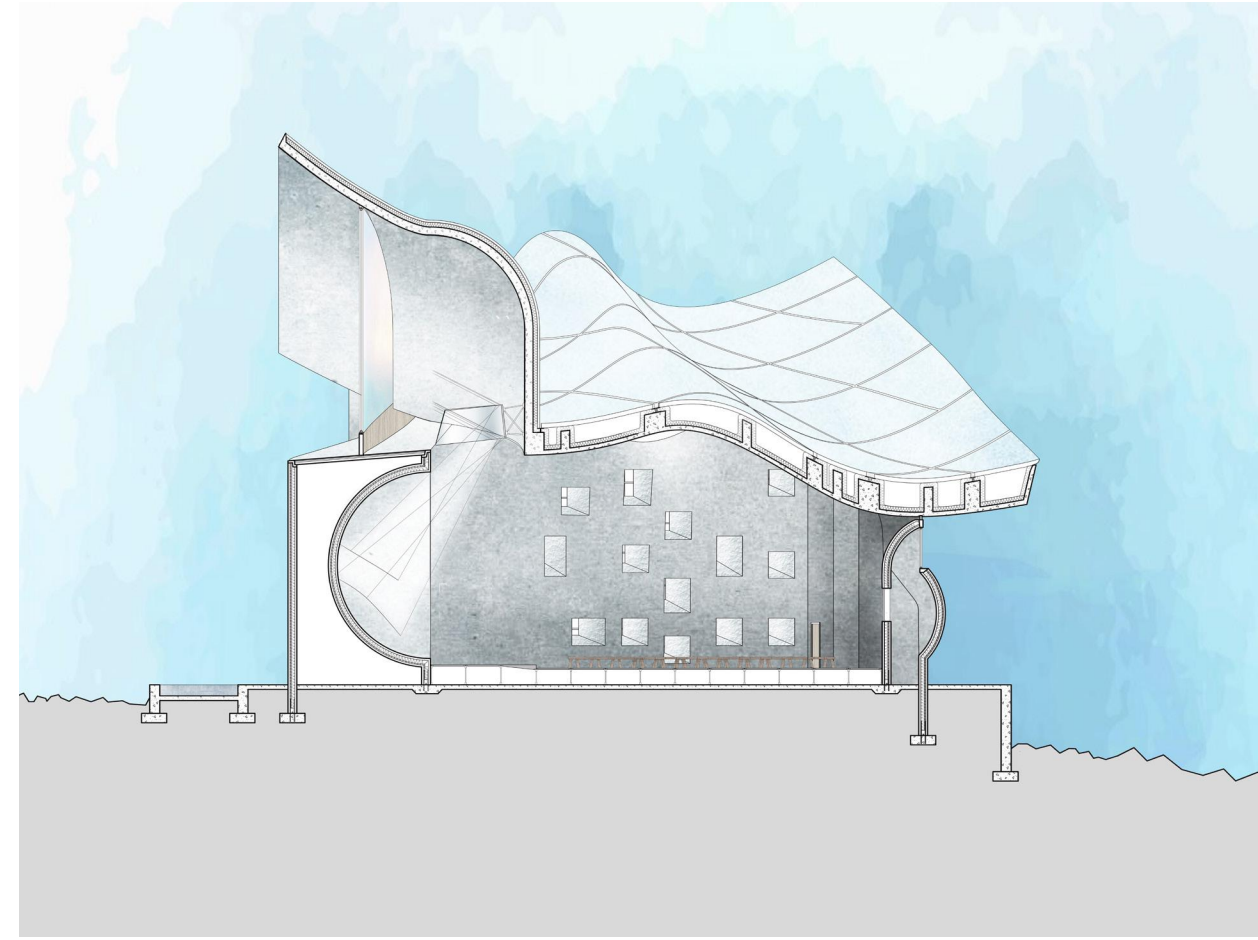
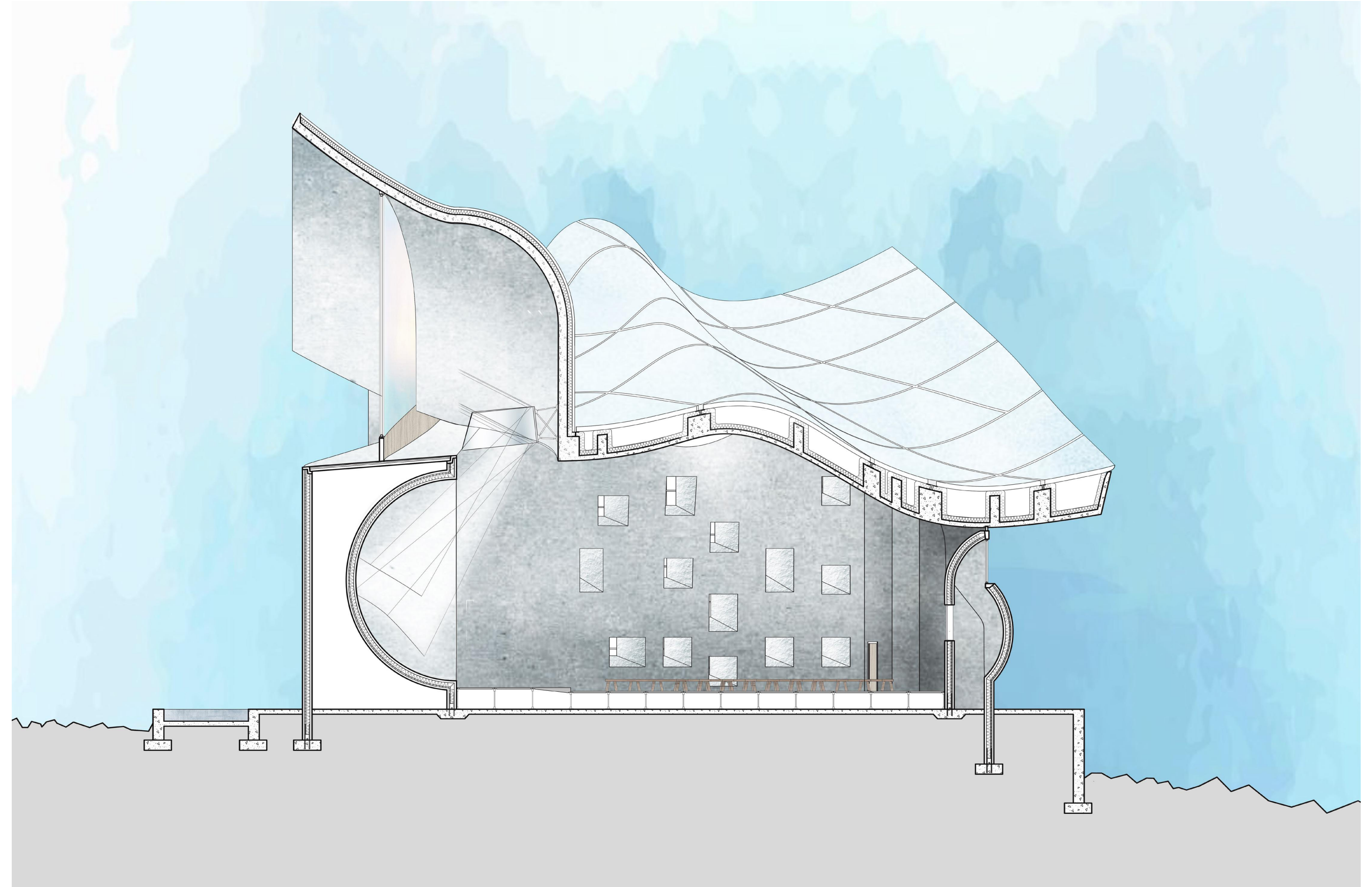


image 45



A sandwich wall panel solved former problems. The fluted concrete panel served both as finishing and mold. When being placed, grey concrete would be poured into the fluted panel and structurally connected with the foundation. Where there were two walls being placed closely with each other, they could still get a finishing with fine texture.

Beams, Columns and the bottom of the roof are cast together on site. Roof panels are attached on the top. The pattern of the roof panel will follow the pattern of the beam system which supports the rafters.



structure section

CONCLUSION

In making for people a shelter to dwell, light serves as a conceived order for architecture. Architects have taken up the intention of making a delightful experience inside their work, not only physiological, but also psychological. People seek a feeling of safety in their surroundings. They have a desire to know what is happening outside, like the change of weather and the passage of time. Sunlight gives us a poignant interpretation of the environmental situation. *The character of places is both determined by their spatial properties and by the way they receive light. Thus Louis Kahn said: "The sun was not aware of its wonder before it struck the side of a building", and "Of the elements of a room the window is the most marvelous."*⁹

Architecture is composed of half artistic feeling and half scientific order. Sunlight is the perfect tool to bridge poetry and technology, to answer the question of "where we are". I am grateful for this process, not only for the finished project, but also for a definite truth which can guide my work from now on. For orientation, there is no better solution than light to associate it together with buildings. For identity, there are many characters of a place that we can deal with, like climate, terrain, or even disasters like earthquakes. However, only the study of light can be applied to all projects as a creative adaptation and a permanent theme in architectural design. Though the environmental situation will vary from place to place, the behavior and power of light is the same everywhere on earth.

Architecture must provide a sense of orientation and support the development of identity. What most taxes the ingenuity of architects is how to discover and develop the identity of a place. Identity is closely related with local culture and environment. This is an area which requires the accumulation of knowledge and a sense of poetry.

⁹ Christian Norberg-Schulz, *Genius Loci: Towards a Phenomenology of Architecture* (New York: Rizzoli, 1979) p.198, quoted in Louis I. Kahn, *L'architecture d'aujourd'hui*: No 142 (Administration-Redaction, 1969)



IMAGES CITED

image 1: https://sucai.redocn.com/jianzhu_6809529.html

image 2: greatbigcanvas.com

image 3: allposters.com

image 4: [Piet_Mondriaan,_composition_No._IV,_with_Red,_Blue_and_Yellow,_1929](#)

image 5: [Piet_Mondriaan,_composition_No._IV,_with_Red,_Blue_and_Yellow,_1929](#)

image 6: <http://compendium.kosawese.net/ne/notre-dame-du-haut-ronchamp-cathedral/>

image 7: <https://www.flickr.com/photos/roryrory/2500992207/in/photostream/>

image 8: <https://www.architecturaldigest.com/gallery/notre-dame-du-haut-chapel-ronchamp-france-le-corbusier-lee-f-mindel-slideshow>

image 13: <https://fineartamerica.com/featured/northern-lights-over-snow-covered-robert-postma.html>

image 24: https://www.nationalgeographic.com/travel/countries/your-iceland-photos/#/december-daylight-iceland_41719_600x450.jpg

image 43: <https://www.archdaily.com/786104/museo-internacional-del-barroco-toyo-ito-and-associates-architects>

image 44: <https://www.archdaily.com/786104/museo-internacional-del-barroco-toyo-ito-and-associates-architects>

image 45: <https://www.archdaily.com/786104/museo-internacional-del-barroco-toyo-ito-and-associates-architects>