DELIRIOUS ARCHITECTURE

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Architecture + Ecology
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FIRST EDITION

Contents

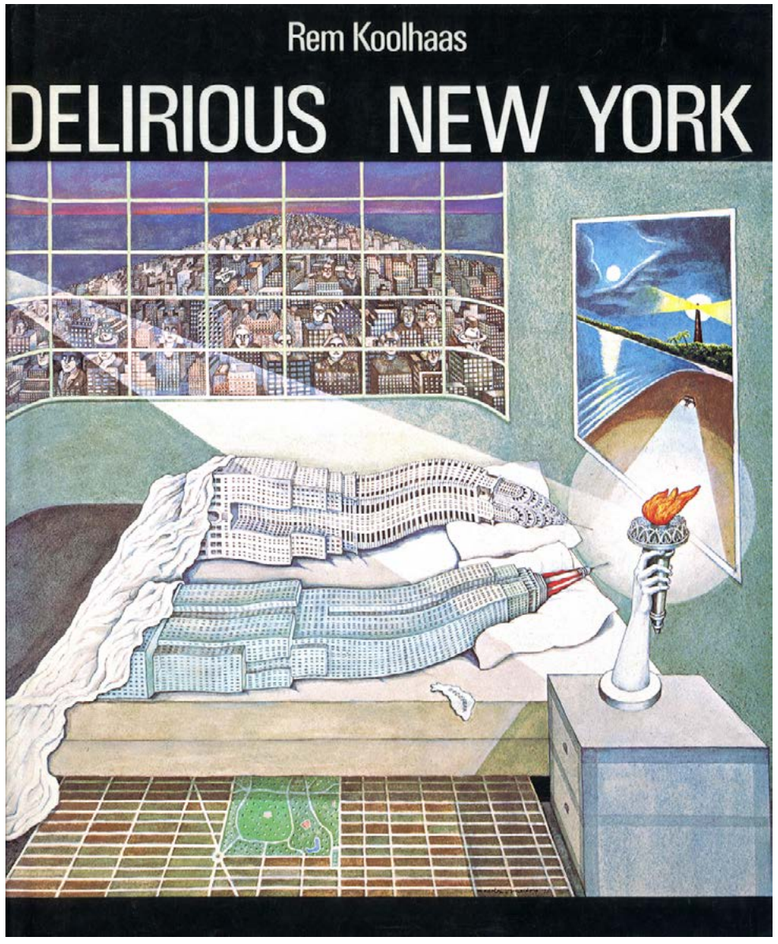


Figure 1. Rem Koolhaas, Delirious New York, 1978

Abstract.

In 1978, Rem Koolhaas published his famous book Delirious New York,(Figure 1) in which he believed that a new urban form was gradually formed in Manhattan's skyscraper forest in New York. It is totally different from any traditional urban form in the United States but created a unique style of its own. And the architecture itself, with the changes of the times, the advancement of science and construction technology and the continuous development of design concepts, is gradually changing and looking for its own new developing direction. From a practical point of view, the advancement of materials and construction techniques can make building stronger and more economical, but what can the architecture become besides this? For thousands of years, architecture has been used as a quiet box for most of the time, carrying all the behaviors operated by human inside or outside, but in current era, can architecture be more than just a place where behavior occurs, but more about behavior itself?

In the past one year at Cornell AAP, I have been exploring what other unconventional forms of architecture can become, even though some might seem to be crazy or delirious. Some of these ideas combine mechanical principles, and some combine ecological techniques, and some combine advanced materials. I believe that in the future society, architecture can not only provide a place for our actions, but also dominates our behaviors, architecture can be everything.

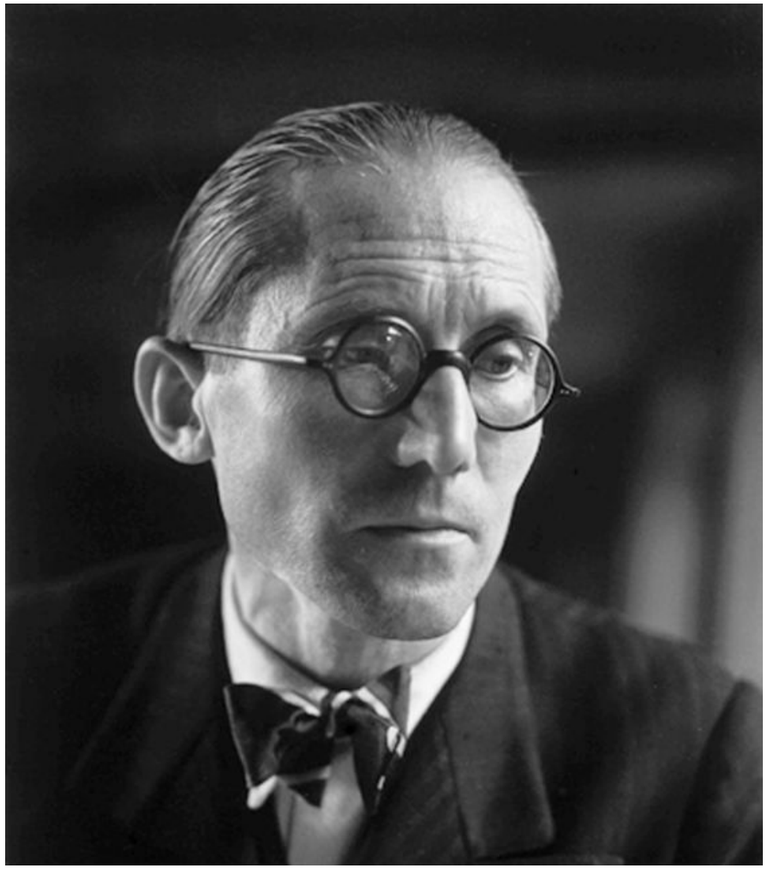


Figure 2. Le Corbusier, ***"A house is a machine for living in."***

I. A house is a machine for playing with

Le Corbusier once said that "*A house is a machine for living in*", (Figure 2)and this sentence is also regarded as a symbol of the indifference and boredom of modern architecture. But if consider it in another perspective, the machine could be full of change as well. With the development of human industrial civilization, the machine becomes more and more related with human beings. So perhaps the architecture machine today can not only be used for living, but also for entertainment, and a house could be a machine for playing with.

A. Interior Space as a Machine

First of all, the interior space of the architecture can produce plenty of fun and become a machine for people to play with. When think of the word "interior space", we usually have wooden floors or corner decorations in our minds, and we often consider the furniture and decoration separately from the building itself. However, I believe that they can become one thing that the walls inside the building itself can become everything we need in our daily lives.

In the first project, we were assigned to have a simple approach of the combination of architecture and robot. In my conception, the walls of the entire room could be made of a special rubber material that can change its hardness by changing certain parameter. (Figure 3) And there are sensors on both sides of the rubber to detect force. When a person sits or lies on a wall or the ground, the inner sensor will detect the pressure applied by the person, and then the other side will inject gas to resist that pressure.(Figure 4) When the pressure on both sides is equal, the rubber's hardness of this area will be changed and fixed. So the wall and the floor of this room can fit people perfectly whenever, and people can always find their most comfortable posture to relax.

In this simple design approach, I want to explore the adaptability of the architecture. Architecture will no longer stay in a constant state but change in real time with human's behaviors. Human will not only simply sleep and walk in an architecture but create the architecture itself at any time.

Project 1. Bed Room

Duration | 2018.07
Solo Work
Tutor | Axel Killian
Program | Design Approach

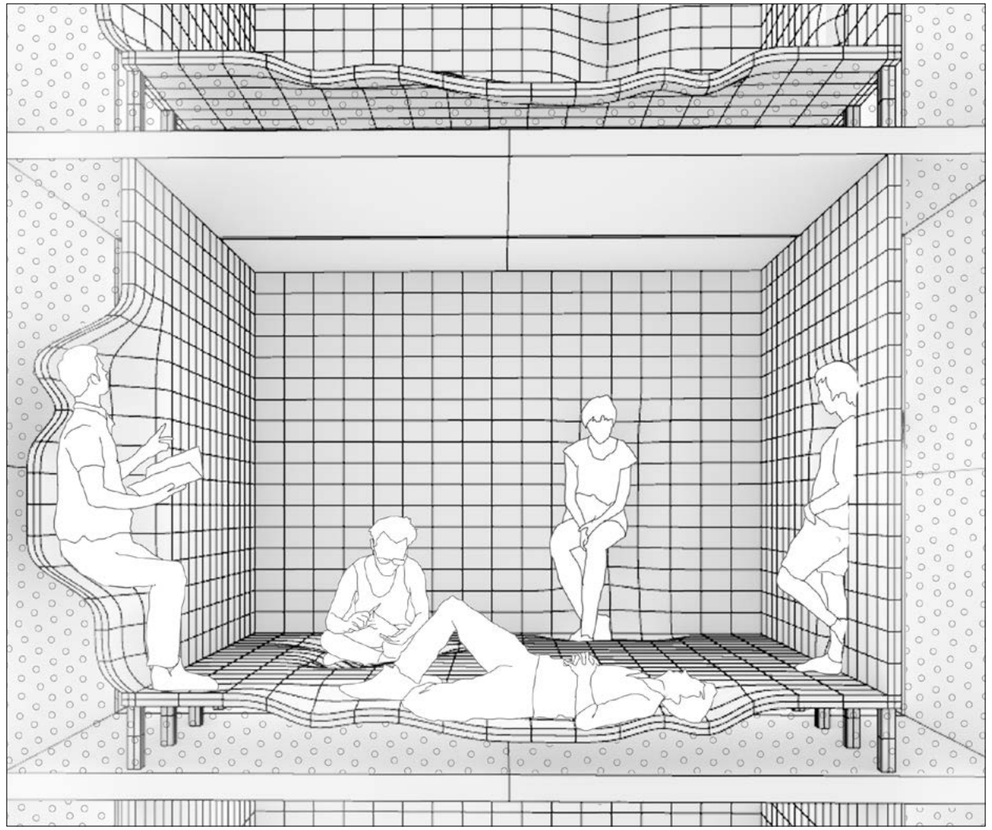


Figure 3. Collage of the project

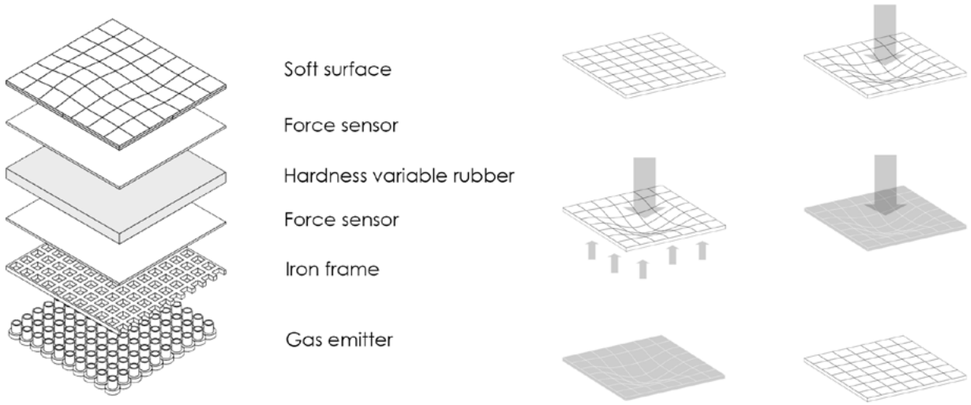


Figure 4. Layers of the structure of the wall and the mechanism principle

B. Facade as a Machine

Architecture façade, which has been considered as one of the most important components of a building since ancient times, is the most outside layer of an architecture to the surrounding environment. Our ancestors invented windows and doors to adapt to the changes required by the users. But can there be more changes besides those? During my summer semester's field trip to Abu Dhabi, I saw a famous building named the Al Bahar towers, whose façade consists of a large number of triangular structures that can be expanded or folded depending on the real-time conditions of the sun's light. This building is actually a bit familiar to me, because at I also made an attempt to build a dynamic building façade in the fall semester,.

In this project, we were trying to develop a kinetic pattern of building facade that come from origami. We were really intrigued how the paper can transform into a 3d structure from a 2d surface by simply folding. So we try to make the facade of architecture into a folding machine that can react to human interaction such as movement, light and shadow or other elements.

Project 2. Kinetic Facade

Duration | 2018.09 - 2018.12
Team Work | Coorperate with Yung Eun Yang
Tutor | Martin Miller
Program | Architectual Mechanism Research

Figure 7. Al Bahar Towers, Abu Dhabi

Figure 8. Final physical model of this project

After lots of preliminary investigations and experiments on physical models, we finally established a set of facade systems based on mechanical principles. (Figure 7 & 8) The final result is that we can control its expanding and folding by remote control. (Figure 9) But in our expectation, it can achieve the similar effects of the Al Bahar tower that could change itself according to certain factors in the external environment. From a large scale, it can change due to the brightness of the sun in real time to achieve energy saving.(Figure 10) On a small scale, it can also change according to the movements of people passing by, bringing more possibility of the interaction between architecture and people.(Figure 11)

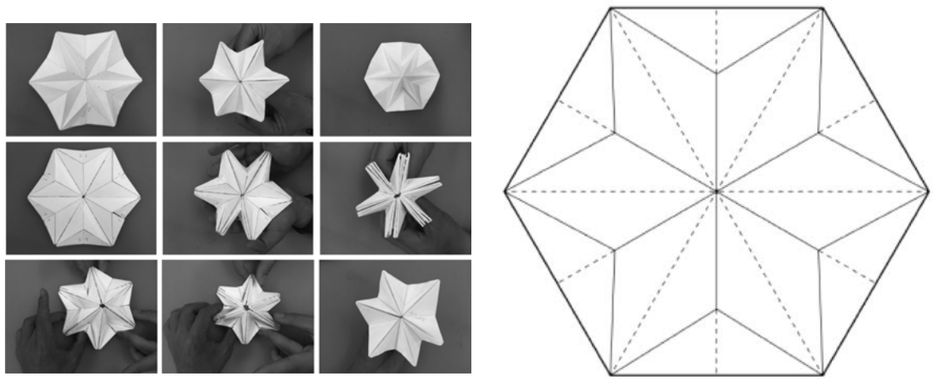


Figure 7. the origami research

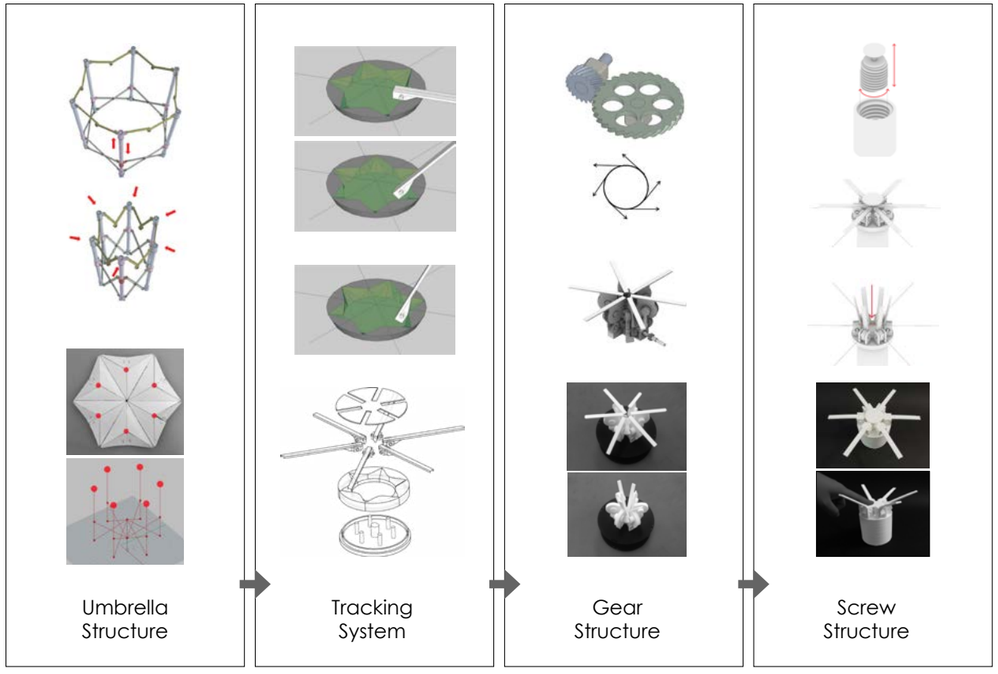


Figure 8. The mechanism research

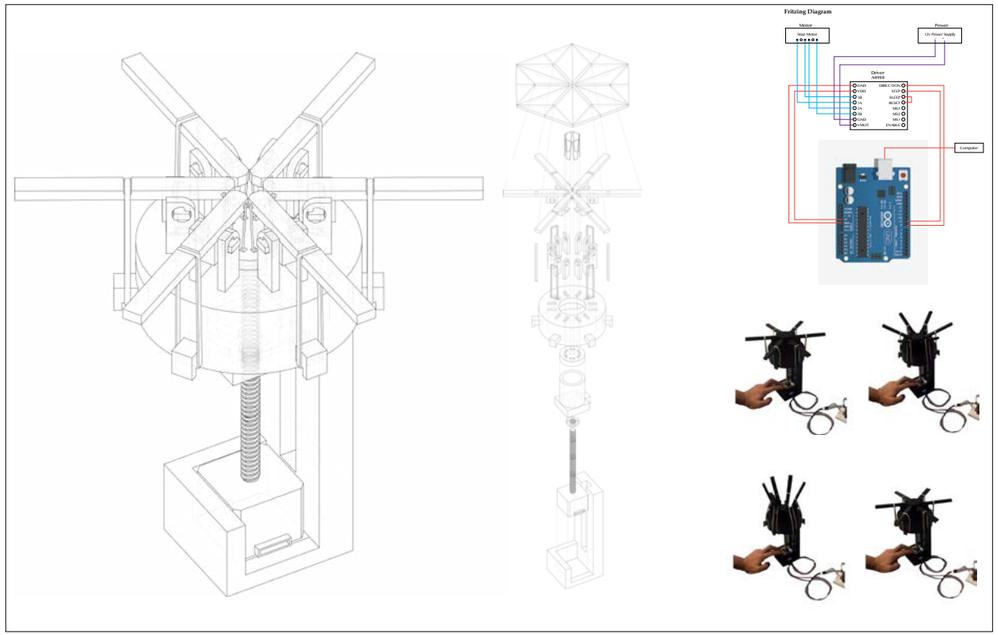


Figure 9. Final mechanism and arduino combined experiement

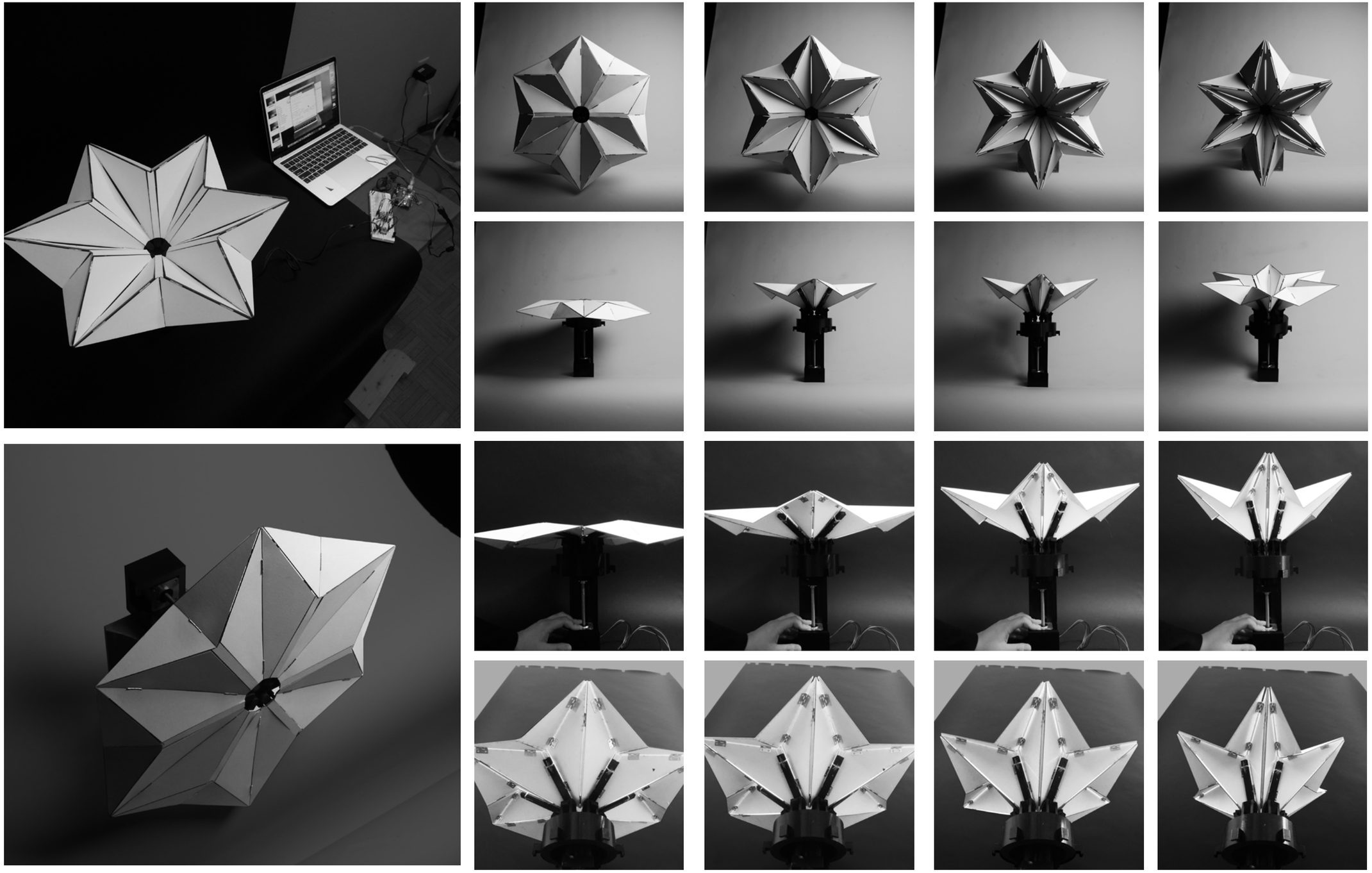


Figure 10. Final effection of the model folding

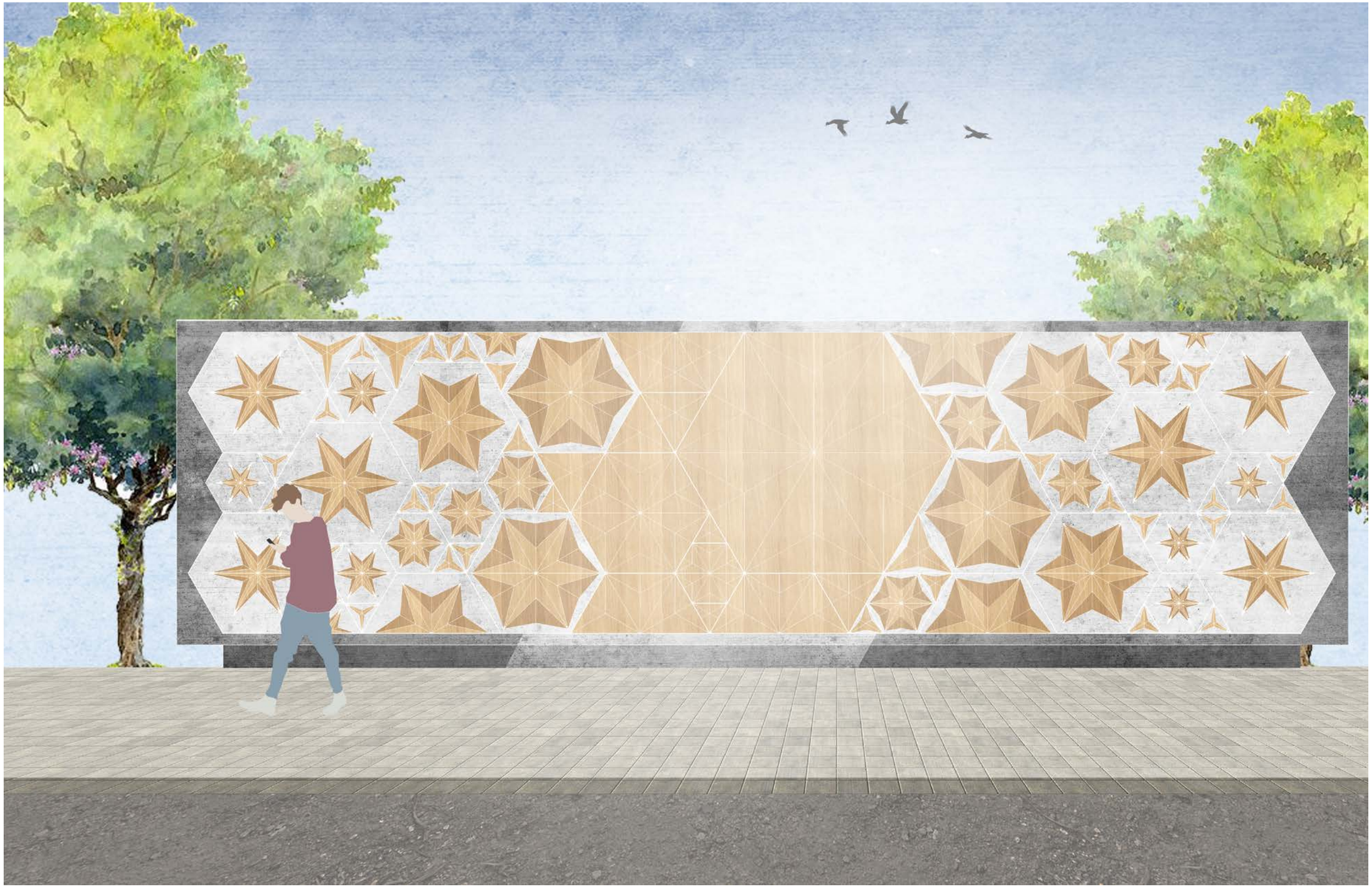


Figure 11. Final effection of the pattern in real project

C. Architecture itself as a Machine

Besides the two perspective in the projects listed above, the architecture itself can actually also be performed as anti-conventional form. As we all know, the living space inside some RVs and luxury cruise ships are almost the same as our usual house. The boundary between the buildings and the vehicle machines made in industrial lines is gradually disappearing. So why can't the building itself become an interesting machine? I think it is of course possible. For thousands of years, one of the biggest features of a building is that it need be fixed. Once the building is built, it will never be moved or very difficult to moved. Even the Mongolian yurt or the Inuit's igloo, the residents will stay in the built house for at least a few days after built. So what is the minimum time interval for residents to change their houses? My answer is, none. In my next project, I designed a building that can easily change the state of residence at any time.(Figure 12)

Project 3. Boxes on Slope

Duration | 2018.09 - 2018.12
Solo Work
Tutors | Dorte Mandrup, Mariane Hansen
Location | Kangerlussuaq, Greenland
Program | Architectual Mechanism Research

Figure 12. Collage of the fornt side of the project

In this project, the site was selected in Greenland, located in the Arctic. How to adapt buildings to climate in such an extremely cold environment is one of the biggest challenges. First, I conducted a detailed analysis of the local Indigenous people's residential strategy. For different seasons and temperatures, the local Inuit will choose different forms of construction types as their home, and different architectural forms will also last for a different time period, which is caused by different construction strategies. In the summer when the climate is relatively suitable, the houses of the Inuit are tents, which are usually made of animal skins. The construction speed is very fast, so they generally do not live in it for a long time, and may be demolished in a day or two. In the extremely cold winter, the Inuit people have two choices. One is the more conventional stone house. The construction is more complicated than tents, so people would live in it usually for several months to survive the winter. The other choice is the famous igloo. People directly get the building materials nearby, which is snow, then build a hemispherical igloo, usually lasts for a month or two. In the past, the Inuit people made a living by hunting, so they would choose different architectural forms according to the climatic conditions and the surrounding environment during their track of their prey.

This kind of migration in the form of residence makes me very fascinated. The user's living style is never fixed, and they can always choose the best choice for their situation. So I hope to create a building form that can imitate this that allows the users to change their living style according to the environmental climate and their own needs. At the same time, since our site is located on a hillside, I hope to use this slope to connect the platform on the top of the mountain with the sea at the bottom of the mountain, so that people can enjoy the vast landscape and beauty of the nature while changing the living conditions.(Figure 14)

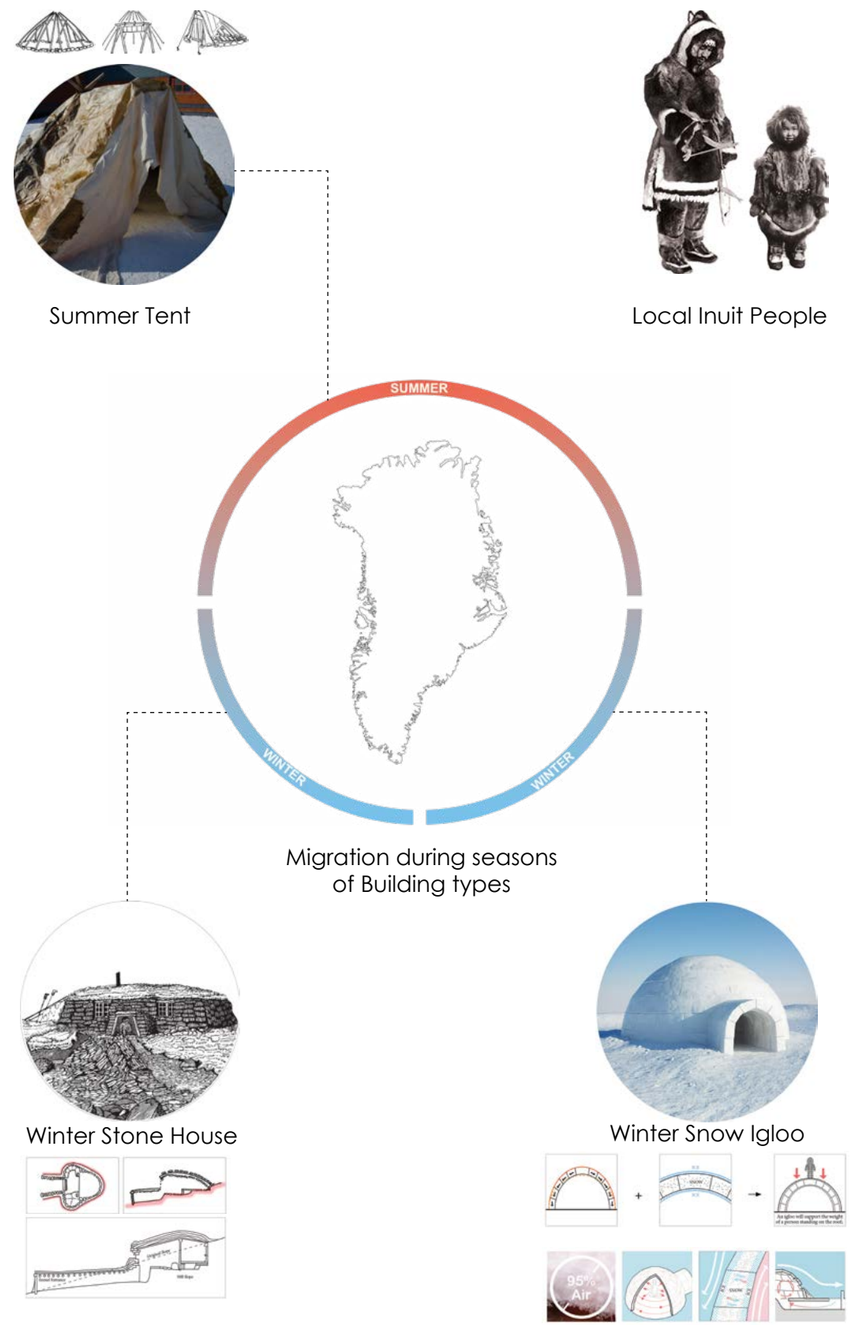
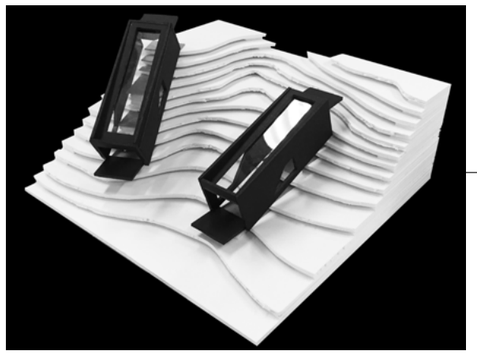


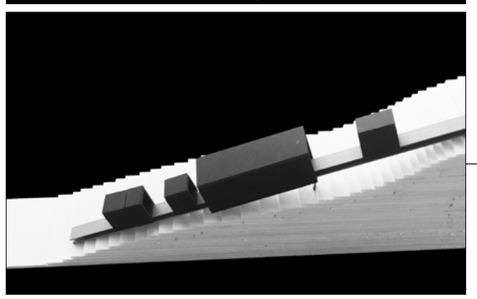
Figure 13. Research of the migration in building type of Local Inuit

Concept Development

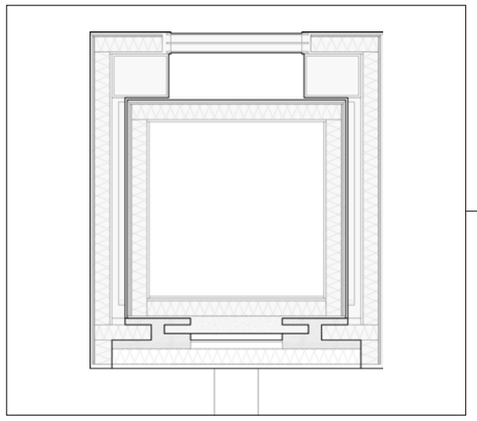
Step 1.
Building on slope with modified ground



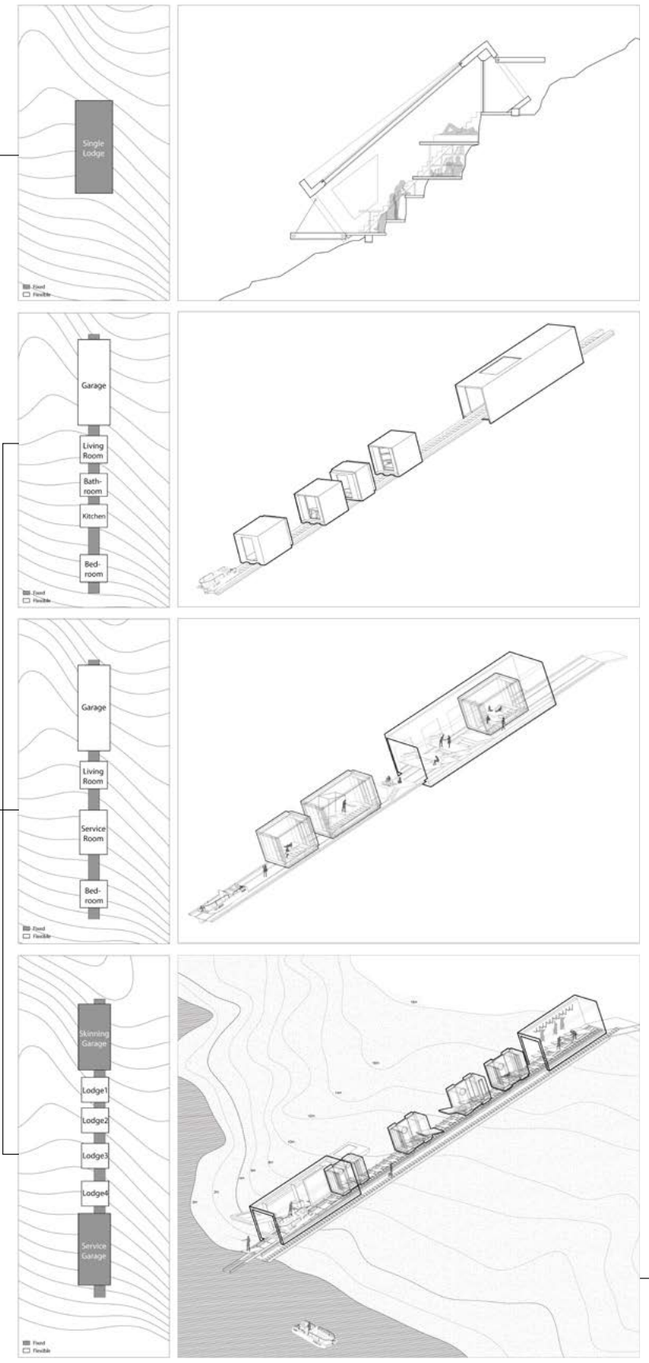
Step 2.
Building on slope with original ground



Step 3.
Boxes on a track above the slop that can move freely.



Step 4.
Further develop the details of each boxes.



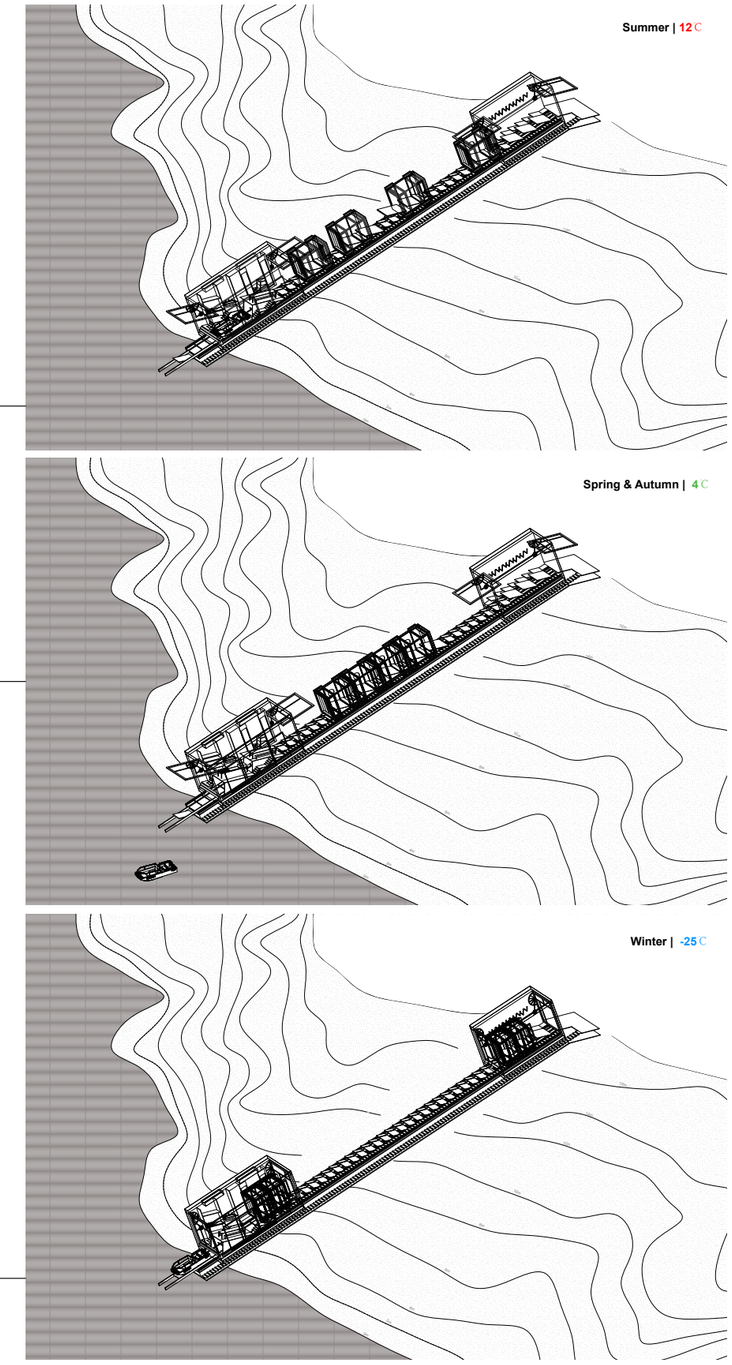


Figure 14. Concept and project development process

The final form of the architecture looks like a train. On the track parallel to the hillside, there are several small boxes that function as single-person dorms. Each box can be moved at will, and they can even be merged together to become a larger one.(Figure 15) At the same time, there are larger boxes similar to a shell that can cover these small boxes, which can instantly turn the outdoor space between the small boxes into indoor space. And in the winter, you can also put small boxes into the big box to provide additional insulation to resist extreme cold. In general, the building can change the shape according to the user's spatial requirements and the temperature demand at any time. Not only the boundaries of the indoor and outdoor spaces are blurred, but also the functions of the internal space of the building are not completely determined. There could be countless possibilities that can be combined at will.

At the same time, I also studied the feasibility of this idea. After studying the method that how the train climb the slope,(Figure 16) I concluded that the whole mechanical system can be completed by working together with the wheels and gears - the wheels are used to bear the weight, reduce the friction, and gears are used to control the action and work as a brake. And also in each box, I have designed a lot of internal structure that can constantly change itself to adapt to the different needs of users. I hope that in these seemingly simple boxes, people can get a completely different architectural experience.(Figure 17&18&19)

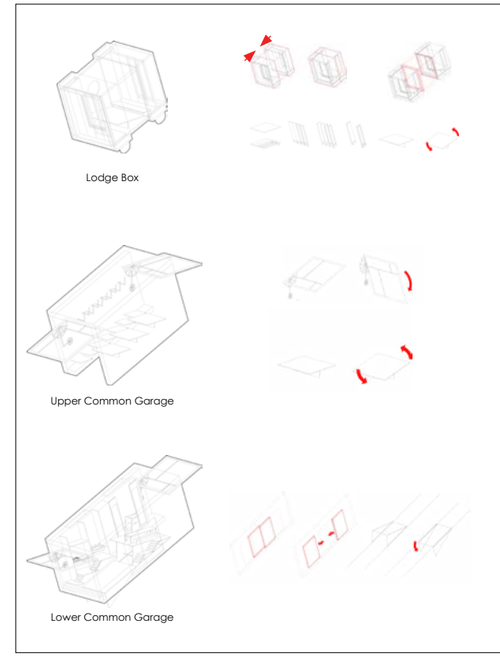


Figure 15. Mechanism in each box

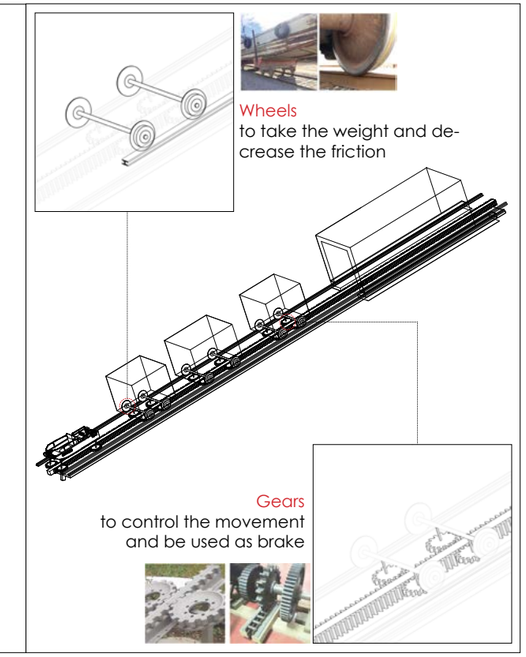


Figure 16. Mechanism in the track

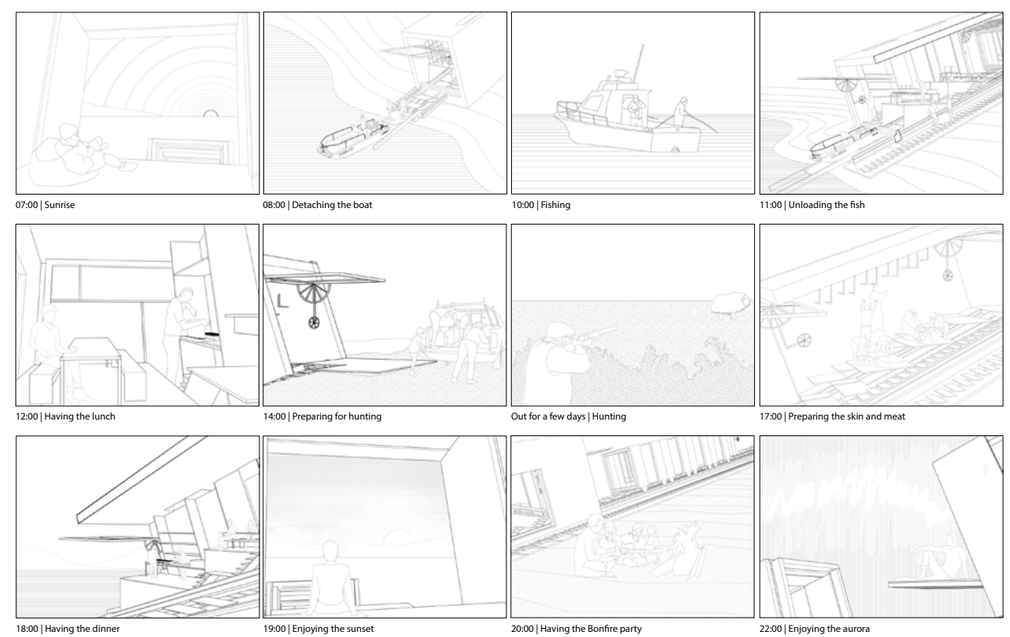


Figure 17. Activities happened in a day in the building

Figure 18. Section view of the small boxes

Figure 19. Render under the auora in the night

Figure 20. Johann Wolfgang von Goethe,
"Music is liquid architecture, architecture is frozen music"

II. Architecture is Frozen Music

Like Johann Wolfgang von Goethe's famous words, "architecture is frozen music", (Figure 20) the experience that people can get in architecture can be as whimsical as music. In the past, people mentioned that architecture like music might mean that architecture can have the elegant temperament of classical music. But in today, the variety of music genres could make the temperament of architecture become completely different. If the building is likened to music, each note can be considered as the various elements of the building, and each element can be mutated, turning the building into a completely different form. In the next projects, I am exploring what interesting experiences can be made when architecture is focused on certain aspects.

A. The Music of Plan

The Plan, as one of the most important elements in architecture, has been the foundation of a building for thousands of years. It can be said that there must be a plan when there is a building. In this project, we focused on creating a weird plan. We were asked to choose three famous classic plans, and then use these plans as a component to be combined to create a new plan by any possible means. (Figure 21) This is a very interesting topic since generally when we are planning the plan, the most important thing is whether the user's streamline is reasonable, and the function is arranged properly. In this design, rationality is first abandoned. We are not to make a reasonable or practical building, but to deconstruct the architectural plan itself and then reorganize and construct a new one from it.

After continually combination experiment, we finally got a plan that looked like a labyrinth, (Figure 20) which seemed cluttered but actually had a very clear logic implied. We then think that the function of this plan is defined as a maze, more precisely a market like a maze.(Figure 22) We hope that users can come to this market and enjoy the joy of being lost. On the three-dimensional level, the building becomes spheres in tangent that come from the form of circles in tangent in the plan. We assume that the background of this project occurs in a future cyberpunk city, and people can enter the building and enjoy getting lost in the maze.(Figure 23)

Project 4. LosMart

Duration | 2018.07
Team Work | Cooperate with Zijie Nie, Qingzhou Yan
Tutors | Michael Young, Kutan Ayata
Program | Future Market

Figure 20. the maze plan of this project

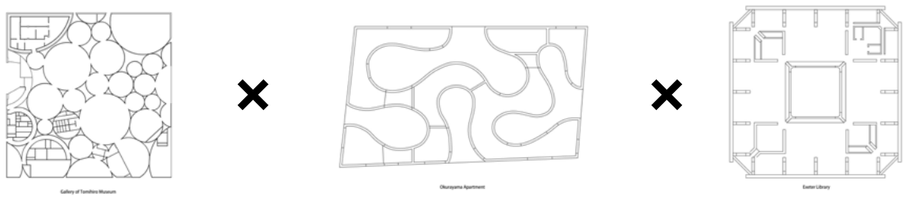


Figure 21. three prototypes of the classical plan

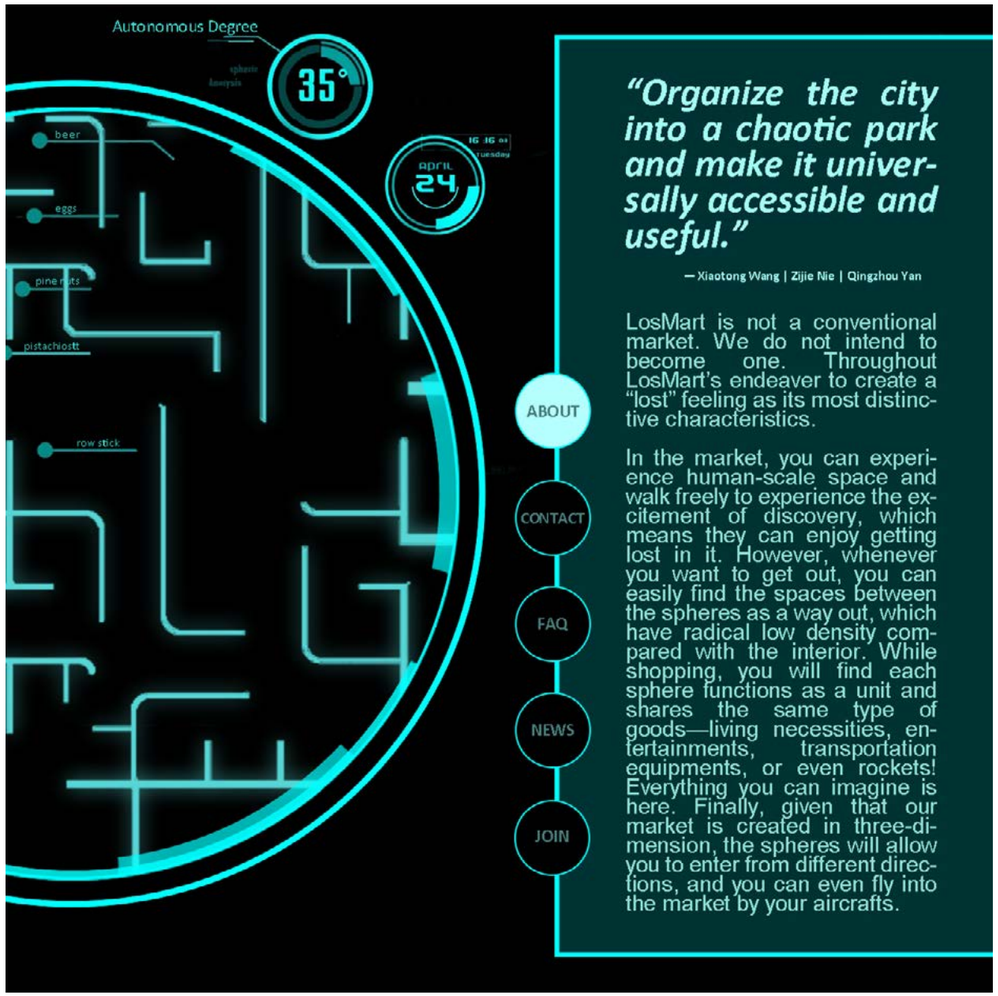


Figure 22. the advertisment of the project

Figure 23. the render of the elevation

B. The Music of Ecology

Development in technology have brought rapid changes in architecture that skyscrapers have risen in the city like a forest, and even all-glass houses can remain warm in winter. People have been benefited by countless conveniences from the advancement of technology. But at the same time, these technologies have also brought harm to our environment. Excessive consumption of energy and too much emissions of pollutants have caused great damage to the ecological balance. Therefore, how to arouse people's attention to ecological protection and develop technologies that convert waste into energy are particularly important.

In this project, our focus shifted to the study of ecological technology. We chose the field of waste to energy, and researched all the relevant information, (Figure 24) and finally concluded a complete garbage disposal process. By arranging all the functions in a tower-like landmark, we hope to attract all residents nearby to get to know the processes that take place here and realize the importance of renewable energy. At the same time, we use the heat generated in the waste incineration process and the water that condensated from vapor that used for electricity generation to create many related entertainment programs to attract people. (Figure 25) In this building, the ecology, which might seems a little abstract will have interaction with people at all time. It could show that the ecology is not just a technology, but also a part of our lives. (Figure 26)

Project 5. Waste to Energy

Duration | 2018.06
Team Work | Cooperate with Shixuan Sun, Yang Yang, Maitai Kunawong, Su Yeon Chi
Tutors | Tei Carpenter, Jesse LeCavalier
Location | Roosevelt Island, New York City
Program | Electrictiy Power plant

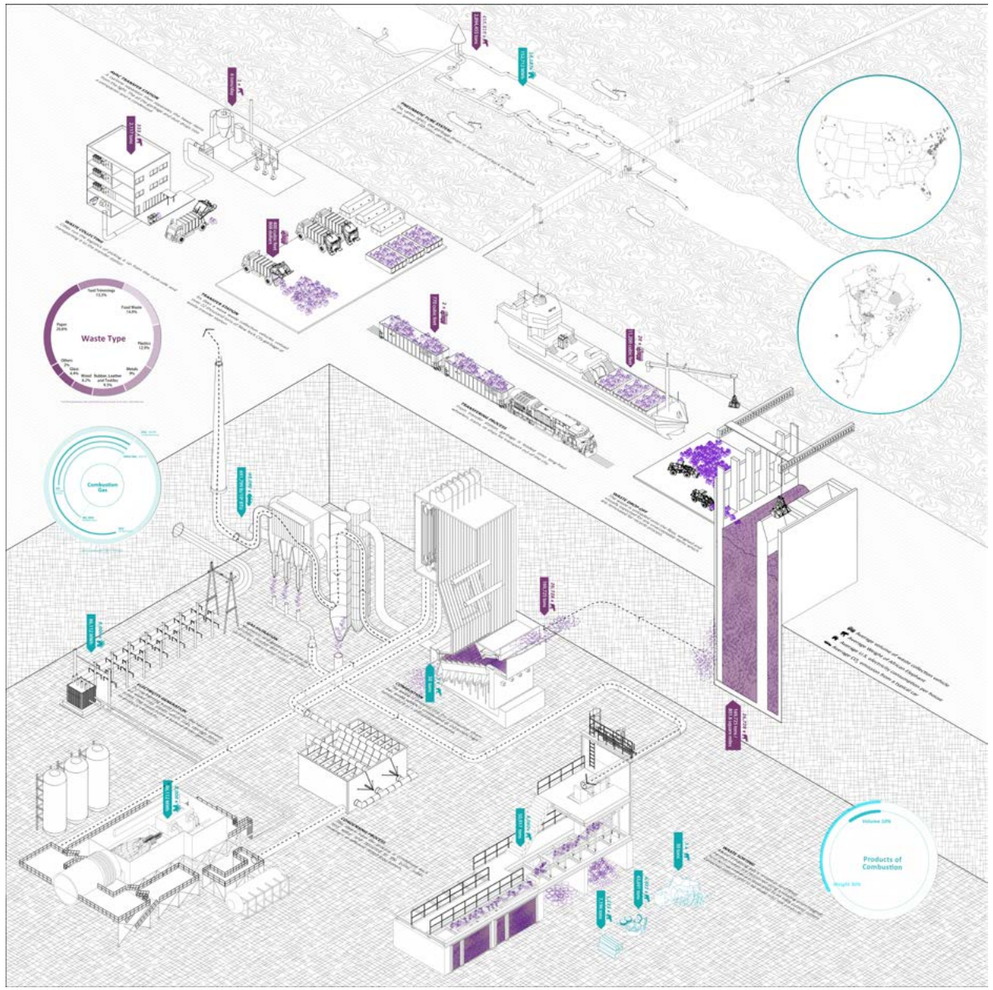


Figure 24. the procedure of the waste to energy strategy

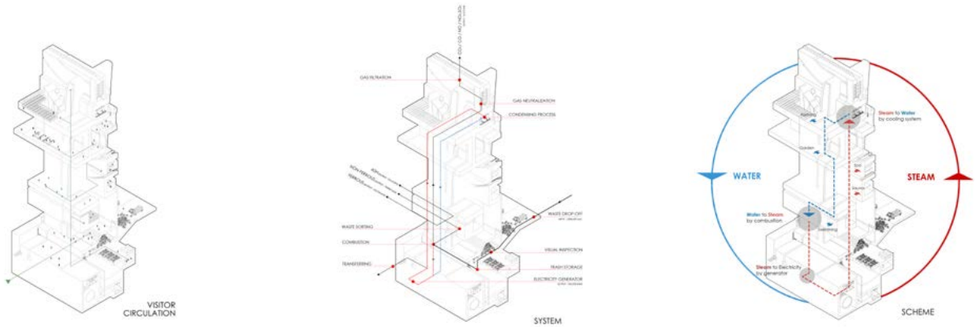


Figure 25. analysis of the program and flow

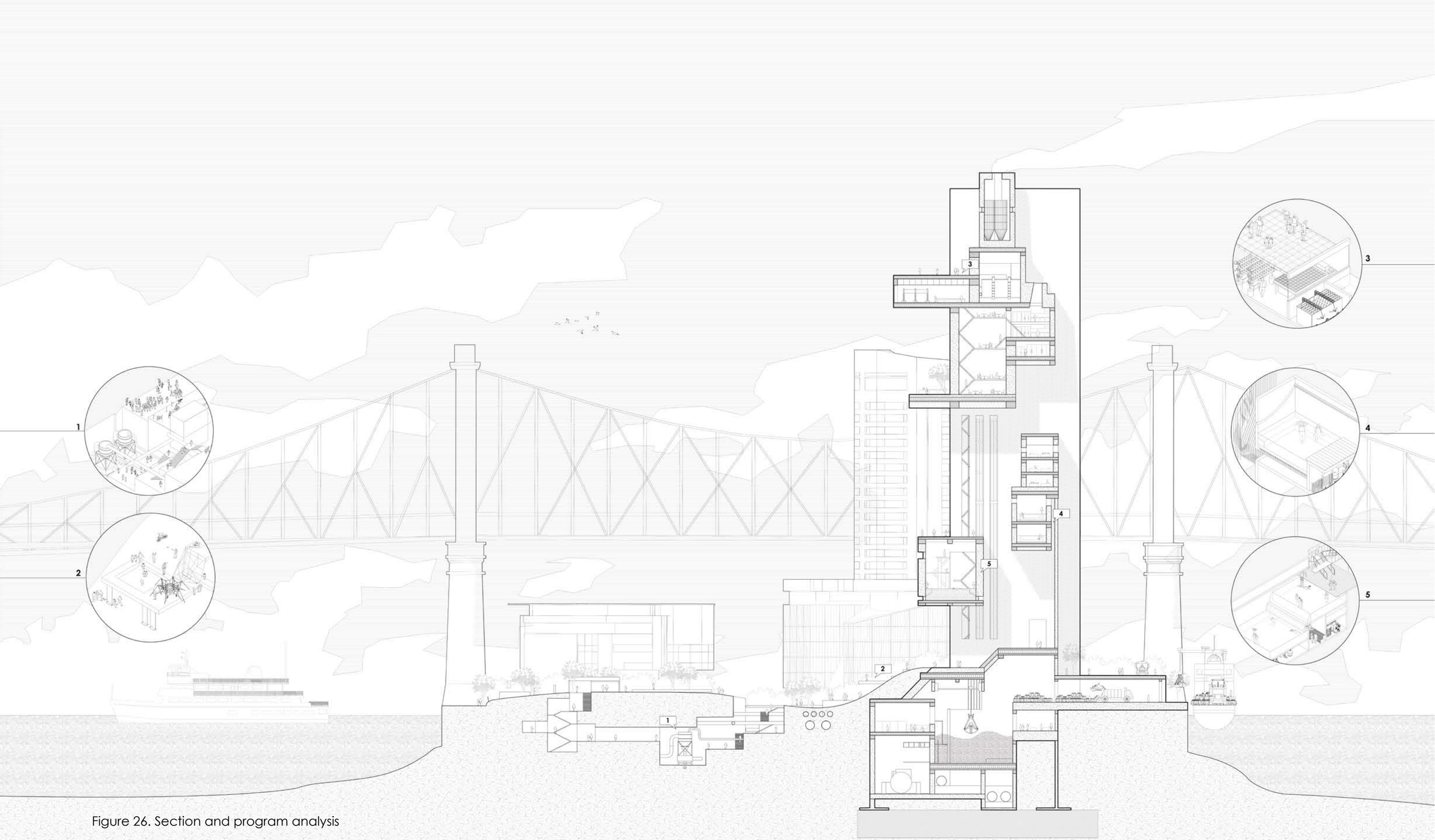


Figure 26. Section and program analysis

C. The Music of Material

In addition to building technology, design concepts and programs, material is also one of the most important components of architecture. The several significant advancements in architecture in human history are all highly correlated with the development of material, such as the emergence of concrete created important prerequisites for the rise of modernist architecture. How can materials keep changing in the next decades? Or what kind of space atmosphere could be produced through the different materials int the future? Perhaps the answer lies in nature. With the adaptation to environment, all the creatures have evolved numerous intricate structures. Today many of our science and technology are actually inspired by biological research, so is it possible that building materials can find its inspiration from nature?

In this project, we focus on exploring what amazing feature of biological phenomenon can be associated with architecture. Finally, we selected a specie called Darwin's Bark spider and delved into its web logic, trying to develop a new pattern that Inspired by it to create a new architectural experience.(Figure 27)

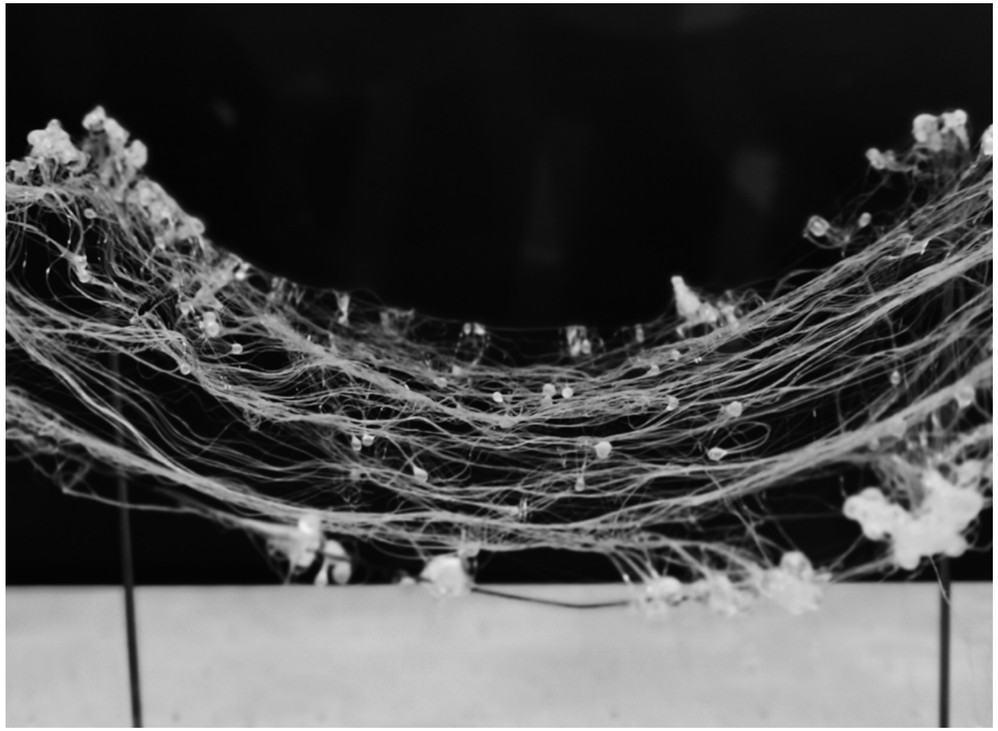


Figure 27. the silk-like material made by glue stick

Project 6. Matter Design Computation-Darwin Spider

Duration | 2019.02 - 2019.05
Team Work | Cooperate with Cun Zhang
Tutor | Jenny Sabin
Location | Abu Dhabi, UAE
Program | Digital Fabrication

According to our research, (Figure 28) Darwin's Bark spider can create the largest web in the world, with a maximum of nearly 3 square meters. The reason why the web is so huge is that it generally built above the river, so the span of the web will be very large, sometimes approaching 30 meters. At the same time, its silk is also the strongest biomaterial that human have found so far. Its toughness and extensibility are many times stronger than iron wire at the same density. Beyond that, there is also a very clear construction logic in its web. After finding the attaching points, it will quickly build a large frame and then fill the remaining structure. In addition, we also saw a very interesting experiment done by NASA. By exposing spiders to the smoke of drugs, they can produce erroneous webs that largely preserve the structure and construction logic but seems to add a lot of errors that cause the whole net to look more like a texture than a shape. This had also inspired us a lot, and we wanted to create a pattern similar to this one that comes from the spider web but is further abstracted as a prototype.

Next, we introduce two logics that transform the spider's weaving behavior into a pattern on the plane.(Figure 29)w For both patterns, we use a grayscale picture as the basis of the pattern. The grayscale of each pixel in the plane represents some conditions of this position in the environment. In the first pattern, we try to imitate the weaving logic of Darwin's Bark spider that randomly populated small spiders in the region, and then generate web structure line according to the gray level of the point where the spider is located, and then finally deleting the line which cover too much white area. The second method is based on the agent base logic that it only focuses on the rebound and pull interaction of the existing lines when spider weave the web. And whether the rebound will happen is also controlled by the gray scale base. The second effect is closer to the real situation, but the correlation with the grayscale image is relatively poor. We can't control the generation of the pattern very well. In the meanwhile, the first pattern looks more abstract, but the correlation with the grayscale image is very good that the relationship can easily be found. Both patterns are important to us and directly affect the translation to architecture in next stage.

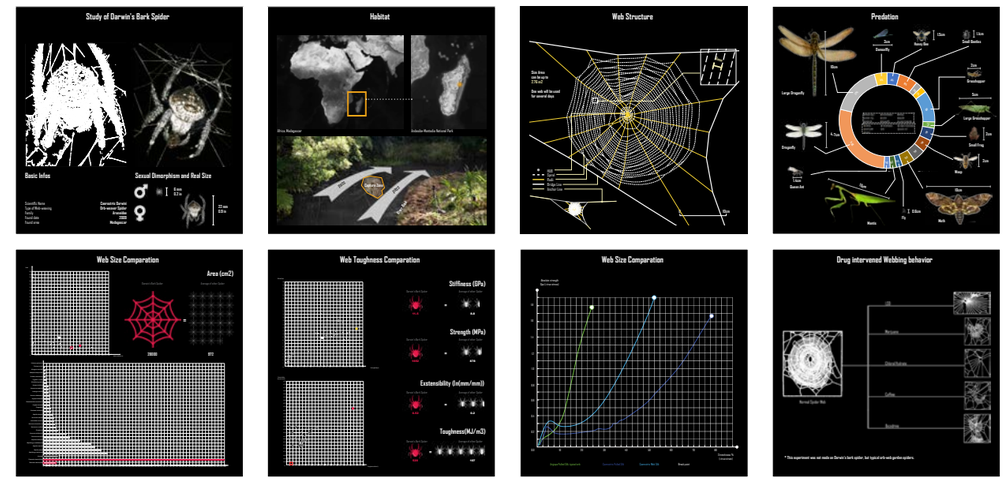


Figure 28. the research about Darwin's Bark spider

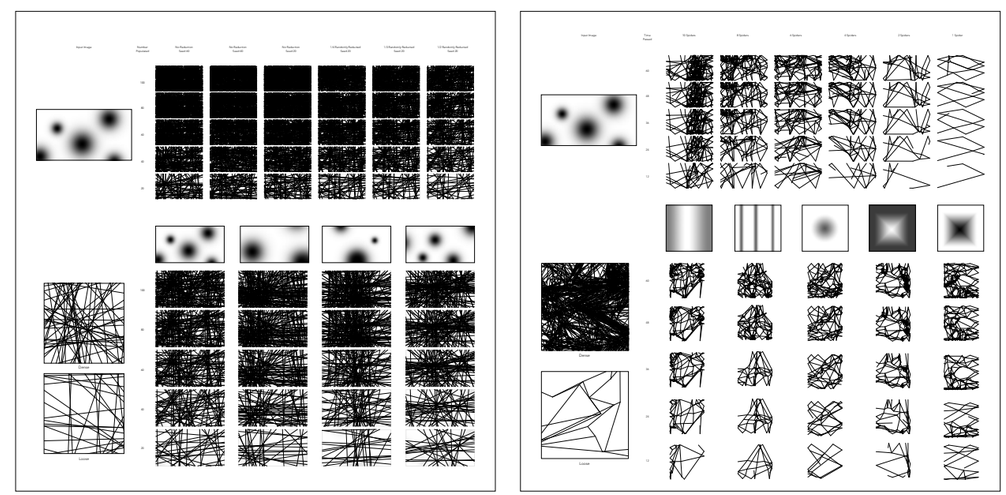


Figure 29. the pattern developed from
Darwin's Bark spider's weaving behaviors

Next, we did a lot of material testing to find a material that could match our pattern that full of interference in lines. Finally we selected the hot glue gun stick as the material. (Figure 30) The method we use it is mainly to pull the line out from a drop of glue after squeezing out. The process that the line generated from liquid to solid is as same as the spider. Besides, since it is still sticky after pulled out, if it encounters the existing line during the stretching process, it will pull the existing one a little bit. Under this condition, we only need to adopt the first pattern, which is easier to control the density with a clearer construction logic, but the effect of the second pattern can be eventually formed during the weaving process. In this case, with the same pattern weaving in multiple times, some very interesting results will be generated.

We finally got three successful webs as prototypes through experiments, we named them Canopy web, 3D web and Twisted web respectively. (Figure 31)Canopy web refers to a relatively even web surface generated by repeated weaving in a plane with the same horizontal height of each corner. This surface has the spider web texture and also the integrity, which is more suitable for being used as a large-span canopy; the second type, 3D web, refers to a web space that has a certain volume and is generated by repeatedly weaving in a three-dimensional space where the heights of each corner are quite different. The 3D web is more like a web forest which could bring the strange but interesting space atmosphere inside to visitors, which is more suitable for the area that interaction happens between people and architecture; the third one, Twisted web is actually a developed version of the Canopy web. After weaving a complete Canopy web, it will be twisted and applied to another frame, and finally a web that is keep changing in the three-dimensional space could be generated. It could be regarded as a wall in one segment, but then it will turn into a roof in another, which is more suitable for creating a fluid space. With these three prototypes, we finally created a very unique building group that could bring an unprecedented architectural experience to the visitors.(Figure 32 & 33 & 34) This exploration of materials also offers more possibilities for the development of the architecture in the future.(Figure 35 & 36 & 37)

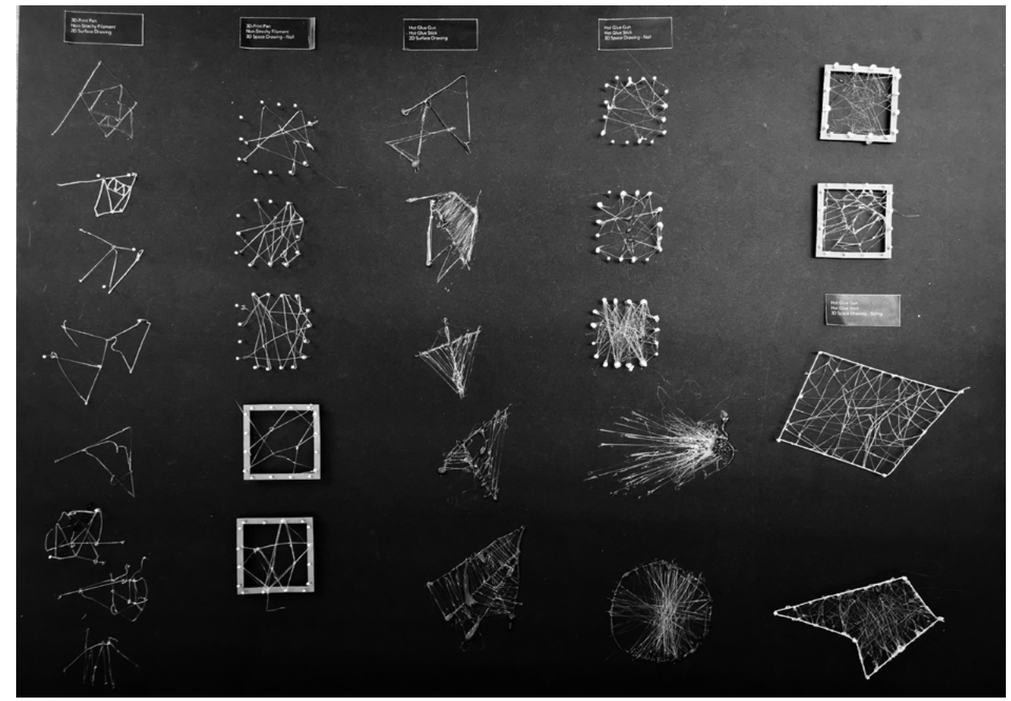


Figure 30. the material test of the hot glue gun's glue stick

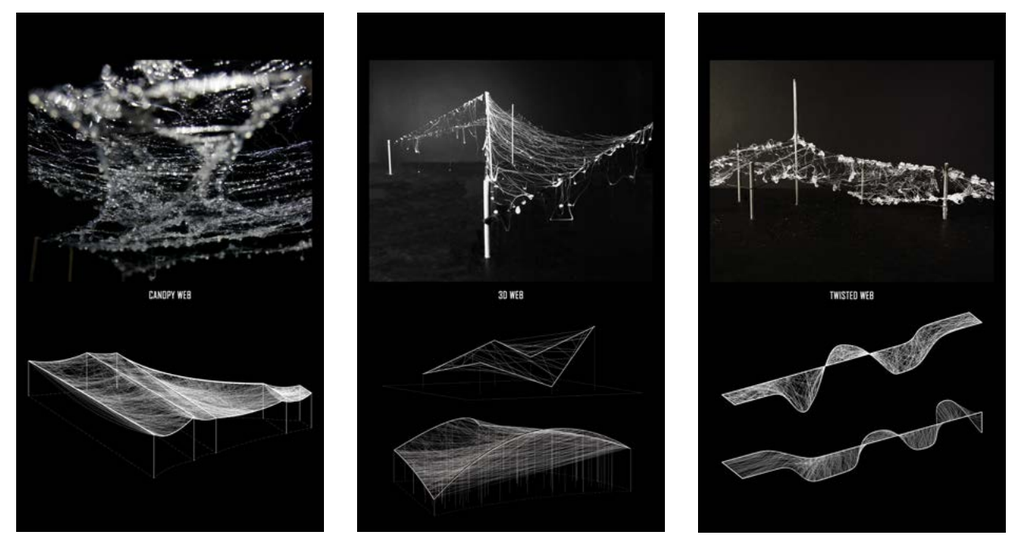


Figure 31. three prototypes of the web

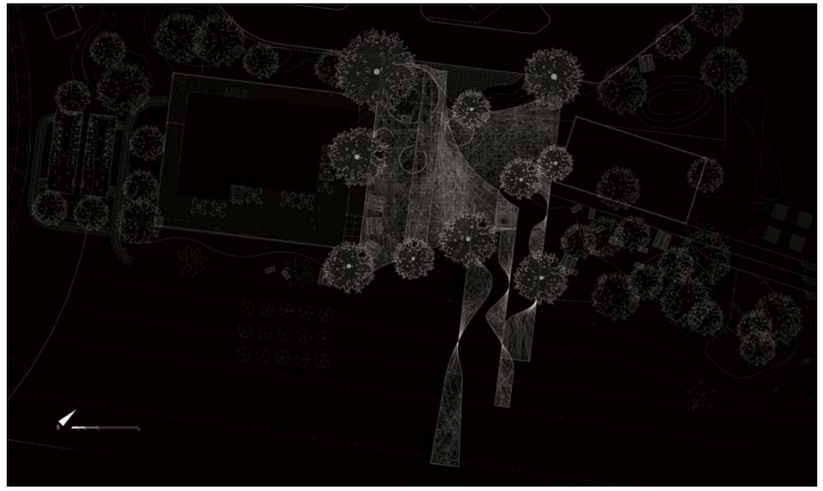


Figure 32. masterplan of the project

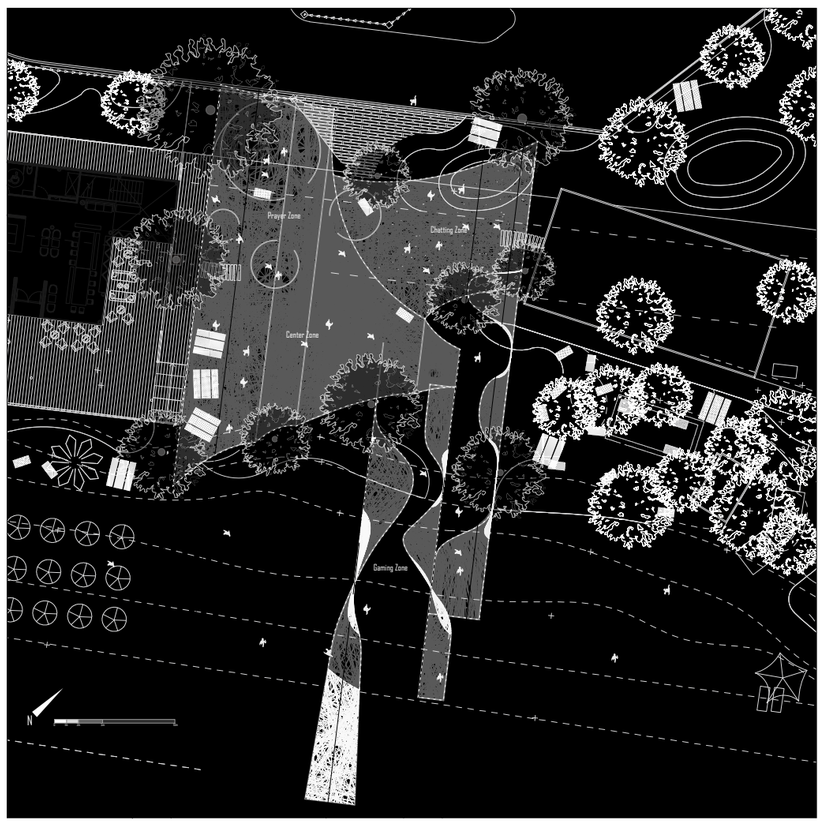


Figure 33. plan of the project

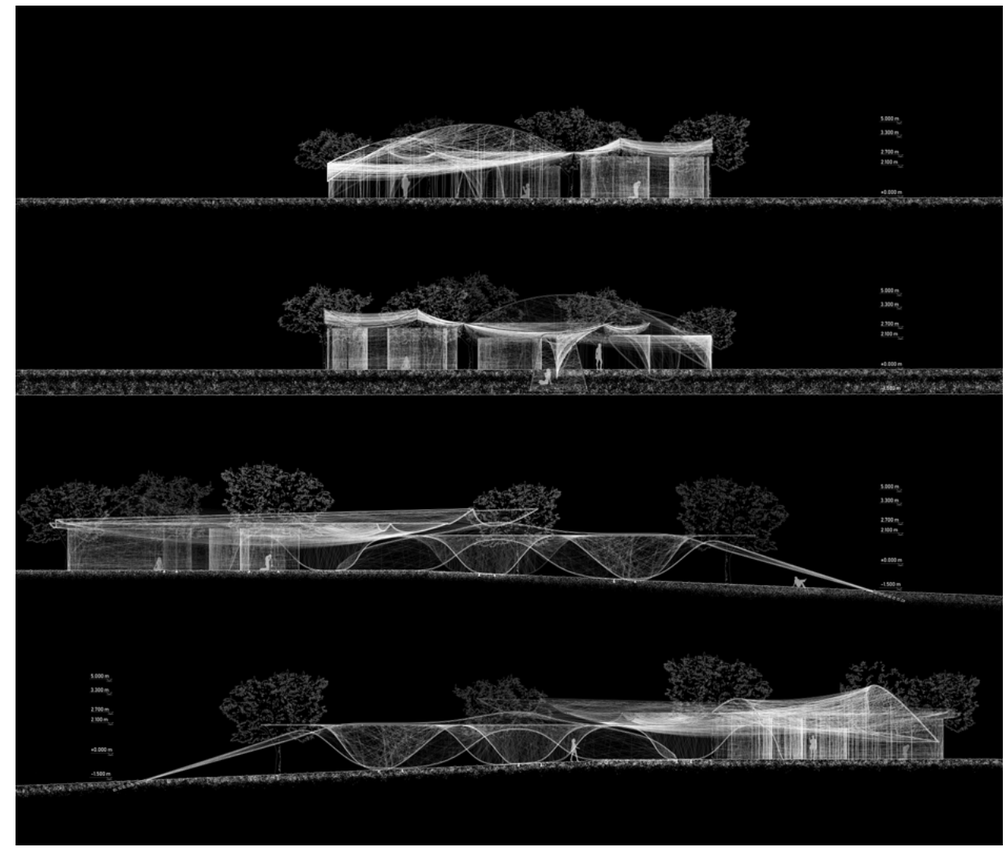


Figure 34. elevations of the project

Figure 35. collage of the 3D web in daytime

Figure 36. collage of the Twisted web in nighttime

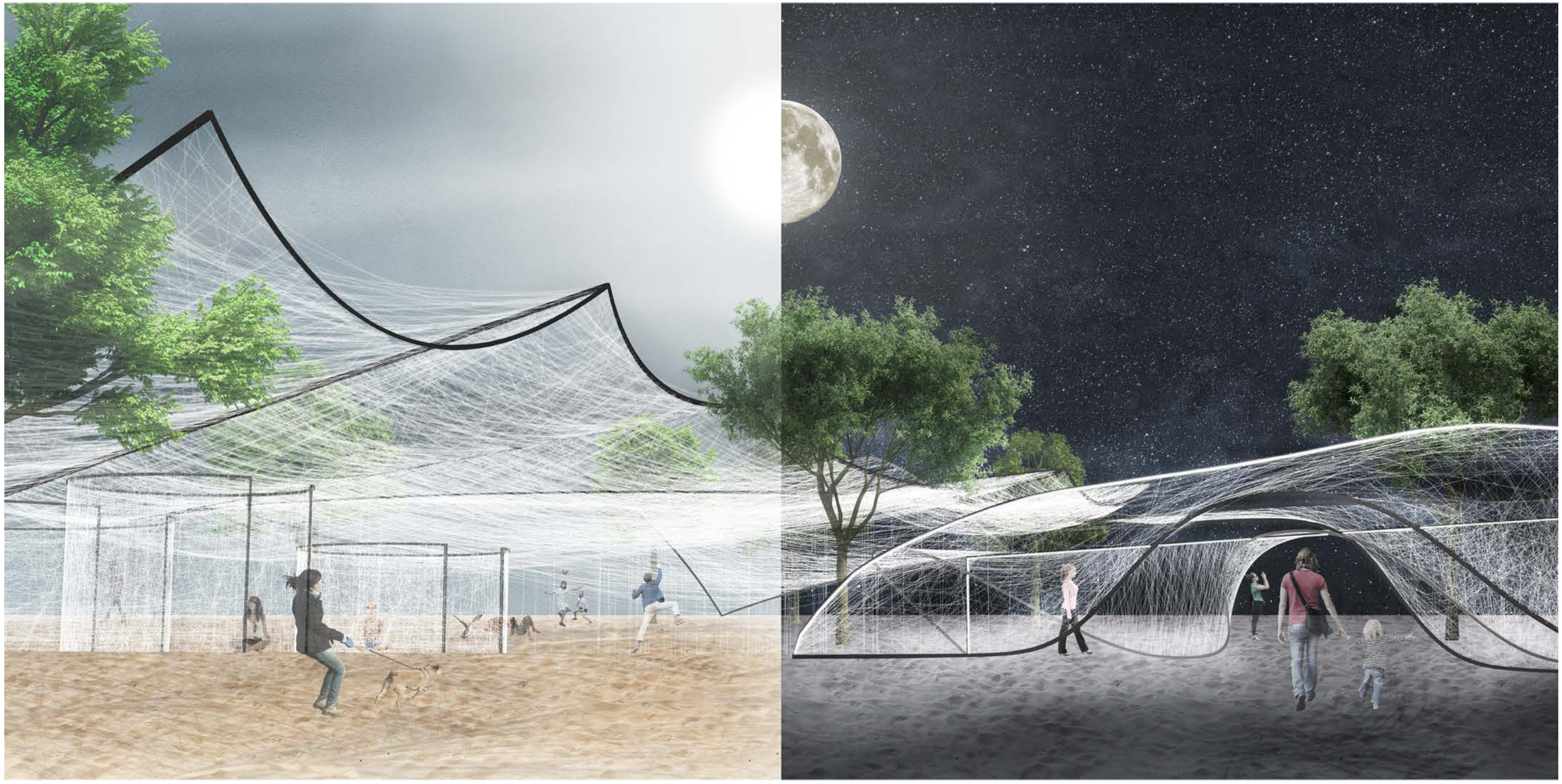


Figure 37. collage of the projects in comparison between daytime and nighttime

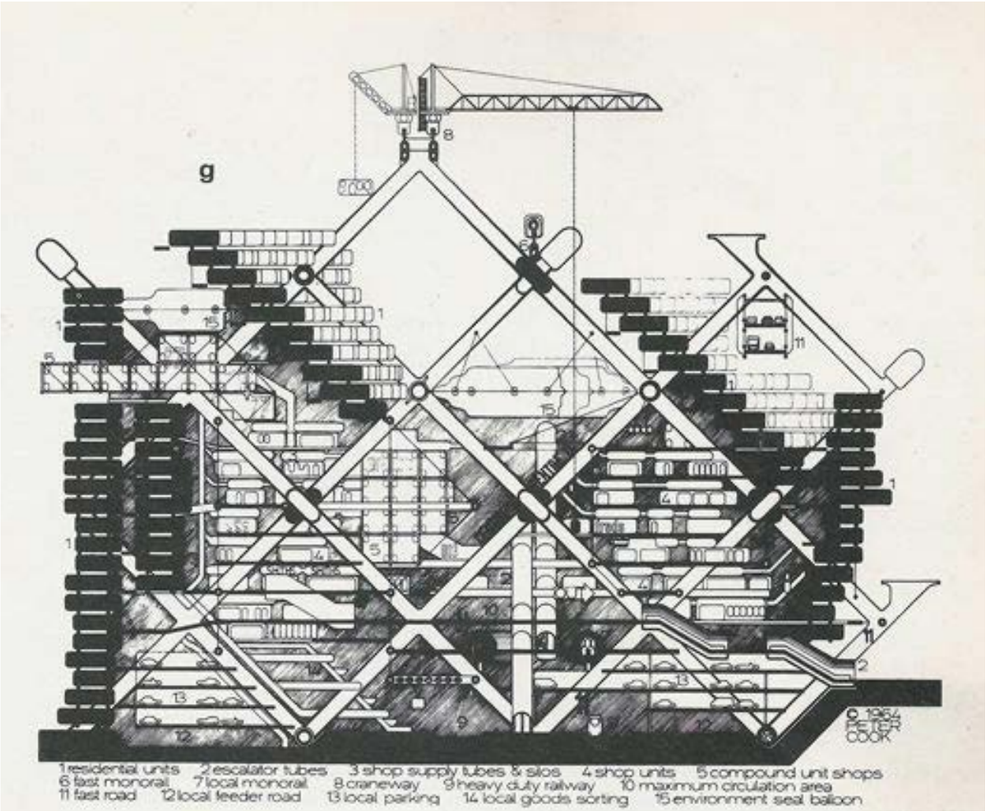


Figure 38. Archigram, Plug-in City, 1964

III. Conclusion

As one of my favorite architects group history, Archigram had created numerous ideas decades years ago that are still very interesting and crazy even in today.(Figure 38) In fact, crazy ideas are an important prerequisite for human development. It is those seemingly impractical ideas that have inspired people that there could be another possibility. The evolution of any creatures around world all starts from random mutations, and the nature will judge whether it works or not. And I believe that we also need more mutation in ideas to create more delirious architecture, which could eventually lead to a better future.

Bibliography

1. Rem Koolhaas, *Delirious New York: A Retroactive Manifesto for Manhattan*, The Monacell Press, 1978.

2. Le Corbusier, *Toward an Architecture*, Architectural Press, 1965.

3. The Skyscraper Center, *Al Bahar Towers*, The Global Tall Building Database of the CTBUH, 2019.

4. M Lee, GA Reinhardt, *Eskimo architecture: dwelling and structure in the early historic period*, University of Alaska Press, 2003.

5. Johann Wolfgang von Gothe, "Music is liquide architecture, Architecture is frozen music", Quote.

6. Covanta, *Waste to Energy procedure*, Covanta Official Website, 2019.

7. Ingi Agnarsson, Matjaz Kuntner, Todd A. Blackledge, *Bioprosepcting Finds the Toughest Biological Material: Extraordinary Silk from a Giant Riverine Orb Spider,* PLoS ONE, Volume 5, Issue 9, September 2010.

8. Matjaz Gregoric, Ingi Agnarsson, Todd A. Blackledge, Matjaz Kuntner, *Darwin's bark spider: giant prey in giant orb webs(Caerostris darwini, Araneae: Araneidae)?,* The Journal of Arachnology, 2011.

9. Matjaz Kuntner, Jonathan A, Coddington, *Discovery of the Largest Orbweaving Spider Species: The Evolution of Gigantism in Nephila,* PLoS ONE, Volume 4, Issue 10, October 2009.

10. Matjaz Gregoric, Ingi Agnarsson, Todd A. Blackledge, Matjaz Kuntner, *How Did the Spider Cross the River? Behavioral Adaptations for River-Bridging Webs in Caerostris darwini(Araneae: Araneidae),* PLoS ONE, Volume 6, Issue 10, OCtober 2011.

11. Matjaz Kuntner, Ingi Agnarsson, *Web gigantism in Darwin's bark spider, a new species from Madagascar(Araneidae: Caerostris),* The Journal of Arachnology, Vol. 38, No. 2, 2010.

12. Peter Cook, *The Plug-In City,* Archigram, 1964

Credits

3 ***Autonomous Architectural Robotic Scenario***
Tutor: Axel Killian; Solo Work; Duration: 2018.07, Summer Semester

5 ***Kinetic Facade: Crawling Skin***
Tutor: Martin Miller; Team Work: Cooperate with Yun Eun Yang; Duration: 2018.09 - 2018.12, Fall Semester

13 ***Conditions: Architectural Interventions in the Arctic: Kangerlussuaq, Greenland***
Tutors: Dorte Mandrup, Marianne Hansen; Solo Work; 2018.09 - 2018.12, Fall Semester

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