

# Patch the wall

Spatial Experiment-Master Thesis

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# 1. Introduction

## 1.1. Background

In recent years, digital fabrication has become powerful tool for architects to process and implement design and construction. However, in some countries, architects lack sufficient support to achieve their intentions in digital fabrication. Since it needs high degree of cooperation with customized production, but from some precedents[Fig1-6], we architects are investigating possible ways to combine digital design with vernacular craft strategy and local material in their projects, which are able to perform a good quality and local spirit.

In China, although the country has experienced fast development during last decades, there are large amount of projects still undergoing with the limitation of “low-budget”, “low-tech” and “short-period”. Paradoxically, due to the development, China starts to lose its own memory in vernacular architecture since most historical buildings were replaced by new but non-feature buildings. Ther efore, bringing back the local memory becomes another issue of discussion in Chinese architectural discourse.



Fig

Fig1~3. Bian Lin(2017)In Bamboo.[image]Available at:<http://www.archi-union.com/index.php/Home/Projectshow/index/pageid/2/id/59>

Fig4. Dornob Staff(2008)Hand-Crafted by Robots: Unbelievably Curved Brick Walls.[image]Available at:<https://dornob.com/hand-crafted-by-robots-unbelievably-curved-brick-walls/>

Fig5. Shengliang Su, Han Chen, Bian Lin, Yucheng Hu(2017)Shanghai Chi She/Archi-Union Architects.[image]Available at:<https://www.gooood.cn/chi-she-shanghai-by-archi-union-architects.htm>

Fig6. Shen Zhonghai(2017)Lanxi Curtilage.[image]Available at:<http://www.archi-union.com/Homes/Projectshow/index/id/46>

## 1.2. Project Research

To explore intersections between digital fabrication and vernacular architecture, I selected an ancient wall in Xichang, China as case study[Fig7]. This wall has been standing there for centuries, the appearance itself shows different layers from different ages[Fig8]. In the early 70s and 80s, people demolished parts of the wall because of political reason. Recently, local government realized that the relic of this wall has potential to become a tourist attraction, and start to restore it. Thus the approach of this project to restore one damaged part with contemporary method, which could integrate vernacular traditions and tectonics with contemporary architectural design and construction. My objective is to draw on the masonry tradition that characterizes regional architecture to catalyze new aesthetics in object and space. By using architectural design as a means to introduce a new layer to the wall, the project supplements the historical wall with an architectural form that expands the vernacular tradition of brick masonry, yet introduces expression and spatial vocabulary that utilizes the possibilities that emerge with new technologies in structure, material, and construction.



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8

Fig

Fig7~8. Made by author



## 2. Early Research

### 2.1. History of the relic wall in Xichang

Regarding of the history of the relic wall, it's inevitable to go through the history of Xichang city, since this wall thrives with the city's evolution and expanding. Although it was abandoned because of the emergence of a modern new town, it also draws the attention from nowadays' urban planners due to its certain character and memory of this area. Therefore, the narration of the history of this wall below will partially be accompanying with the city's history.

There used to have two distinctive stages of ancient Xichang city. The first stage is from early Tang Dynasty (around 626-649AD), then because of a long lasting war between two powerful realms and the city was a battlefield so it was gradually abandoned, till the end of this dynasty (around 873-907). However, there has mere records and remains of the wall in that period. The second stage is from Ming Dynasty, and there has an accurate document about the wall. it was established in 1388 AD with a square form, each side had equal length of 1200m. The northern and western sides of this wall were built on the remains from Tang Dynasty. The height of this wall is 11m and the core of it used rammed

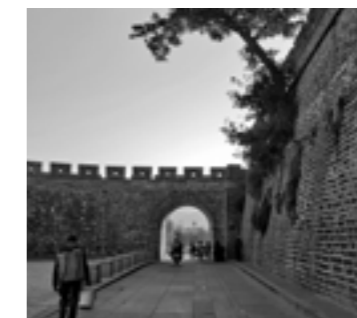
earth, then covered by stones and bricks. Then, after being through the changes of dynasties, the wall was renovated around 1662AD.

Since modern times, from early 70s to 80s, people tore down part of this wall for the sake of either politic reason or economic excuse. In recent years, local government realized the relic of the wall has the potential to be a tourism attractor which is included in the overall urban policy of old town rehabilitation.

Now, the ancient wall remains in the middle of the city, it cuts through the old town and new town, dividing two contrast time-space by its existing.[Fig9-10]



Fig 9



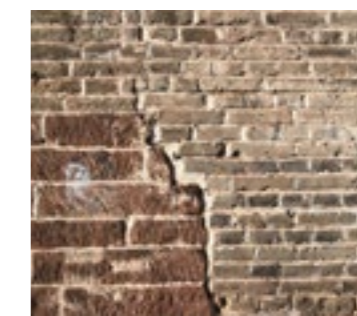
10



11



Fig 12



13



14

Fig9~14. Made by author

## 2.2. The concept of wall

The definition of wall is various under different circumstances, for generally speaking, a wall is a structure that defines an area, carries a load, or provides shelter or security.<sup>1</sup> However, in terms of urban planning or architectural field, the concept of wall could provide different interpretation regarding certain context. According to Richard Sennett<sup>2</sup>, he explains the concept by going through the understanding of borders and boundaries. By making analogy to ecological system, he states,

“In natural ecologies, borders are the zones in a habitat where organisms become more inter-active, due to the meeting of different species or physical conditions. The boundary is a limit; a territory beyond a particular species does stray. So these are two different kinds of edge... This spatial distinction in natural ecologies relates to a difference in the structure of cells themselves. It is the difference between a cell wall and cell membrane, the cell wall's function being that of a container holding things in, the membrane being at once porous and resistant, letting matter flow in and out of the cell, but selectively, so that the cell can retain what it needs for nourishment. This is

an ambiguous distinction at the cellular level, in part because cell linings can sometimes switch function; again a wholly-sealed wall would cause the cell to die.”

After this explanation, Richard mentions the traditional walls perform an unlikely instance of the border/membrane, since besides the function of defense, various events happening on both sides of the wall, such as commercial activities, heretics, foreign exiles and other misfits etc. In this sense, in social practice, “such walls functioned as border/membranes, both porous and resistant”.

Whereas, then, the author criticizes modern urban planning is a closed boundary even though there were less solid walls. For instance, highways could be considered as invisible walls which cut through cities which mark off the territories separating the rich from the poor, or race from race.

To sum up, considering walls from border and boundaries provides an enlightened perspective while in urban planning and architectural design. Moreover, it also gives an insightful angle to deal with public space referring to porous and resistant.

<sup>1</sup> Wall [online] Available at: <<https://en.wikipedia.org/wiki/Wall>>

<sup>2</sup> Sennett, R., 2018. *The Public Realm*. [online] Available at: <<http://www.richardsennett.com/site/senn/templates/general2.aspx?pageid=16&cc=gb>>

### 2.3. The theory of tectonics

For understanding the concept of tectonics, there are several authors hold various statements about that. Such as Eduard F. Sekler, he explains the concept by putting three elements in comparison, which are “structure, construction, tectonics”<sup>3</sup>. He defines the distinction between “construction” and “structure” by bring up a simple experiment of substitution, then he states “‘construction’ carries a connotation of something put together consciously while ‘structure’ refers to an ordered arrangement of constituent parts in a much wider sense.” Then he continues on explaining tectonics,

“When a structural concept has found its implementation through construction, the visual result will affect us through certain expressive qualities which clearly have something to do with the play of forces and corresponding arrangement of parts in the building, yet cannot be described in terms of construction and structure alone. For these qualities, which are expressive of a relation of form to force, the term tectonic should be reserved.”

Furthermore, when it comes to the value of tectonics, Eduard provides a strong argument that through tectonic architect

could give a visible strong statement of artist’s intangible concept, which could be realized through construction and given visual expression through tectonics. In his brief summary after discussion of three related concepts from different cases or architects, he again put a statement that architects could control tectonics expression other than structure and construction as completely as their intention.

If we look further into the a more subdivision explanation of tectonics. In Gottfried Semper’s book <Style in the Technical and Tectonic Arts >, in Chapter Seven “Tectonics (Carpentry)” there are 4 main purposes of tectonics from his statement<sup>4</sup>,

The tasks of tectonics can be generalized as follows:

1. The frame with the corresponding filling;
2. The lattice, a complicated frame;
3. The supports
4. The structure, an integration of the supports with the frame

Moreover, from Lebbeus Woods’s introduction of his studio, we could see his explanation of tectonics<sup>5</sup>, he brings the consideration of human scale into tectonics as well, human

3. Eduard F. 2013. *Structure Construction, Tectonics*. [PDF] Available at: <[https://610f13.files.wordpress.com/2013/10/sekler\\_structure-construction-tectonics.pdf](https://610f13.files.wordpress.com/2013/10/sekler_structure-construction-tectonics.pdf)> [Accessed 2 February 2019]

4. Gottfried Semper, 2004. *Style in the Technical and Tectonic Arts*. [e-book] Getty Research Institute. Available through: Scribd website <<https://zh.scribd.com/document/140952006/Style-in-the-Technical-and-Tectonic-Arts-Gottfried-Semper>>

5. Lebbeus Woods, 2012. *Four IDEAL HOUSES: First Year Studio 2012* [online] Available at: <<https://lebbeuswoods.wordpress.com/2012/05/14/four-ideal-houses-first-year-studio-2012/>>



scale relates with elements which used by human beings, such as stairs, windows, doors and etc. Because those elements are not merely indicate the size of people, but are necessary for people to inhabit the building and are therefore integral with it. From another perspective, tectonic elements used to construct a building. Still, building are not made out from a single material but are assembled with many pieces by human beings. Therefore these parts are visible and also accomplish the relative size of a person, in a word, human scale.

## 2.4. Precedents

### 2.4.1. CoBLOgó Factory

This factory is located in São Paulo Brazil, and the design strategy is a combination between high-tech digital tools and local low-tech construction method. The high-tech part contains parametric design, environment simulation and digital fabrication, which is a guidance for later low-tech construction by local workers. [Fig15]

The intention of this project is to proposal a modern industrial identity with an economical, environment-friendly and novel design. The façade on southern and western side is built by using digital design and fabrication which in reference to the traditional Brazilian “cobogo” shading screen. It controls the filtration of indirect sun-light through the operable windows, while also prevents hot temperature from exterior spaces. Additionally, the interior space will have a play of shadow and light because this façade [Fig16].



Fig.15

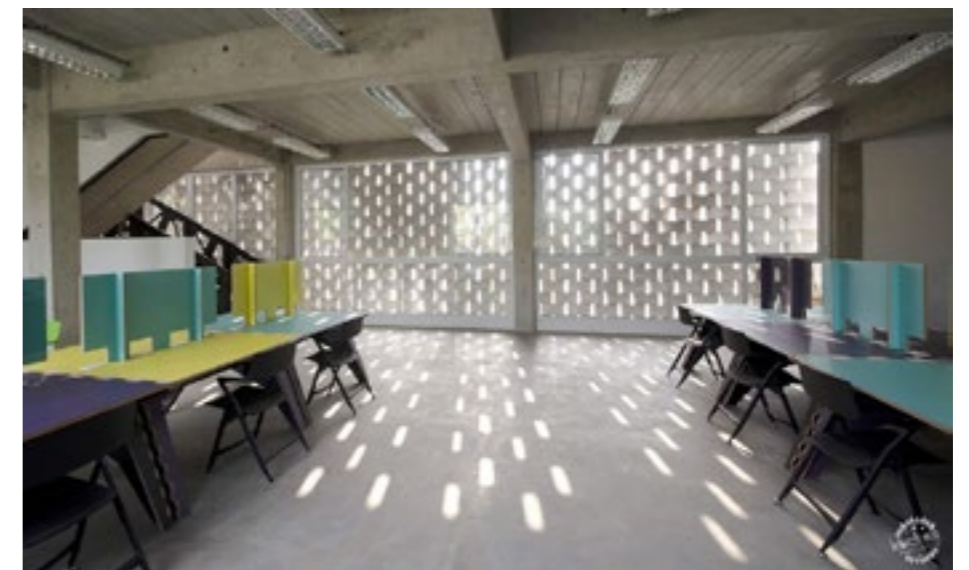


Fig.16

For digital design, the parametric scripts defined the gradations of various blocks with different angles, which related with their distance from different “attraction points”.

For construction, in order to mount those concrete blocks on site, architects team used comb-like “guides” to position the blocks, which were made by laser-cutting corrugated cardboards.[Fig17]

Theses guides were placed on a moveable wood stand and track system that were fabricated of plywood using the CNC router.

The concrete block mason only had to position the blocks against the guides and add vertical reinforcing bar in every other block, attached to the bottom and top concrete slabs, to obtain structural stability.[Fig 78]



Fig.17

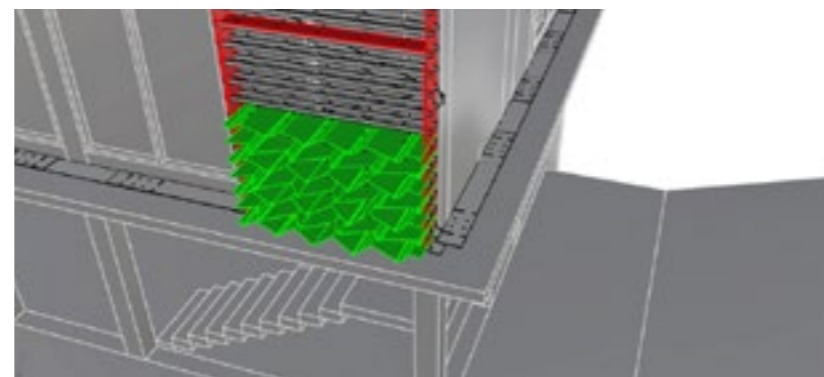
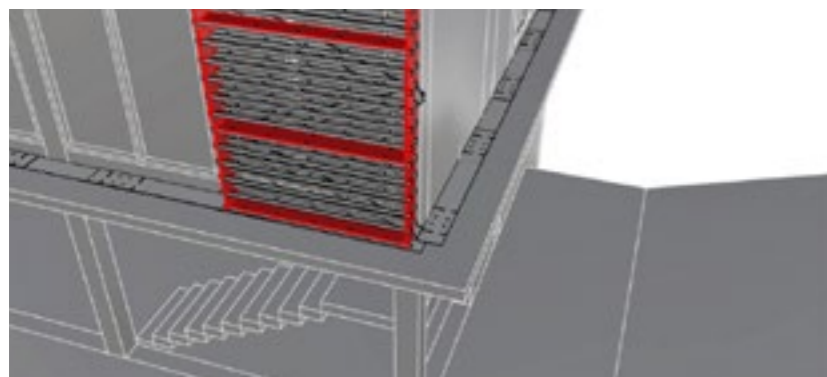


Fig.18



## 2.4.2.Songjiang Art Campus

The Songjiang Art Campus is located in Xinqiao Town, a suburb of Shanghai. The concept of this project is to respond the local culture and context and create a new urban space. The area of this project faces a problem that the rapid development during recent years has made it lost its cultural memory. In addition, many public spaces are seldom used and the green pars are lack of social activities. Therefore, the overall planning of this campus considered integrating the whole system with pedestrian and green lands, relationship with neighborhood, responding to landscape and archiving traditional Chinese scenery of garden, lake and laneway.[Fig19]

For construction of architectural unit, especially in the tectonic respect of fabricating the brick wall, the architects team used digital strategy to design a non-linear pattern and then used traditional stretching and header brick laying method to build it. The steps are showing below on [Fig20].



Fig.19

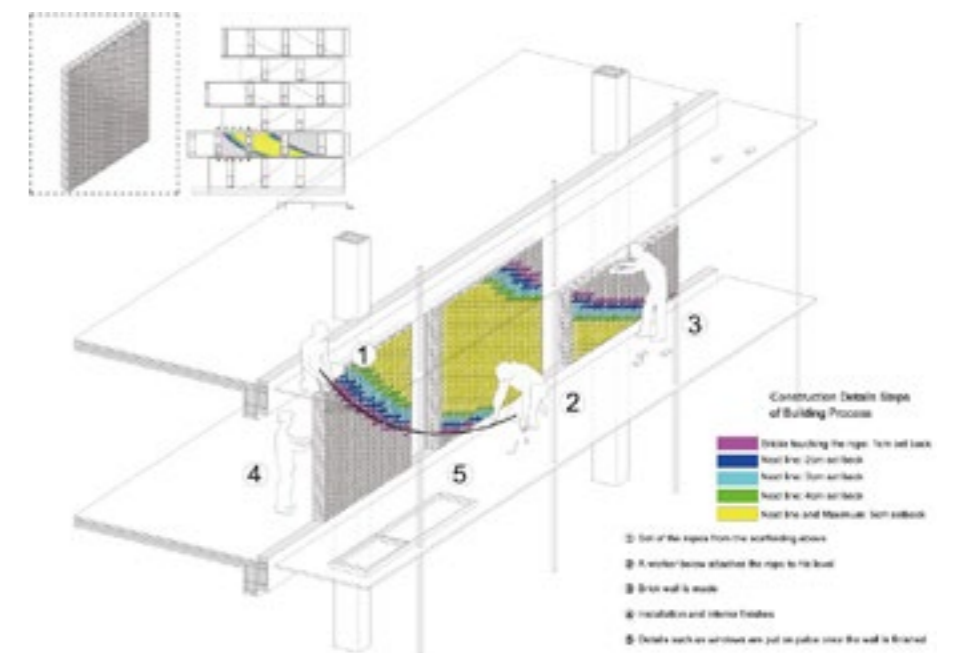


Fig.20

### 2.4.3.The PAUSE

This project is an installation designed by Ashari Architects in Iran. It's a pavilion built from a cube that holds a suspended brick volume, in order to enrich the feelings when people are stay or wander in this construction. From architects, "PAUSE tries to revive the feelings that we have been ignoring. Feeling of brick texture tactile; hearing the sound of our steps on the metal sheets, looking at the sky which we pass under of it every single day without any attention to it, not even trying to pause to enjoy it." [Fig21]

As to respect the maximum allowed space which is 4m X 4m X 4m, they decided to create a moving knot in circles of the space which generated as a circular volume in a cubic volume. By extruding the circle to create a cylinder and from cylinder to cone to create difference volume radiuses achieving the spatial diversity between the floor and ceiling and as a result drawing attention to the people above. [Fig22]

For construction of the hanging brick wall, all of those bricks are cut in half installed with the designed straps, and attached by mirrors. The density of the mirrors increases as the cone-shape



Fig.21



Fig.22

wall towards upper. Finally, to prevent the direct sun light and control the light the ceiling is covered by metal sheets. A hole has been cut out from the ceiling in order to push everyone's focus to the above space. [Fig23]

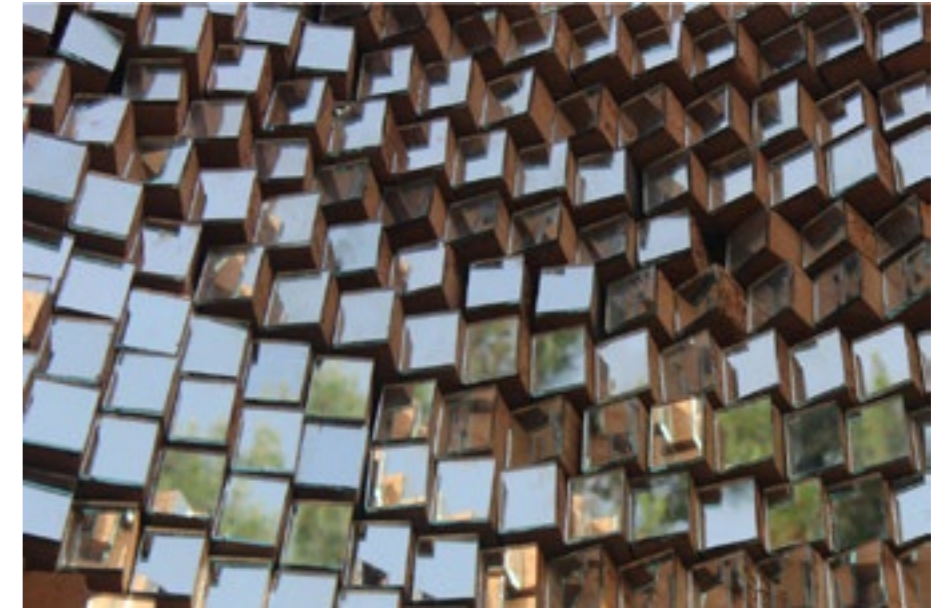


Fig.23



## 3. Local Tectonic

### 3.1. Local material<sup>6</sup>

Regarding of vernacular material using, we should focus on a wider area other than Xichang city. The city is located in south-west China, the whole area has the same environmental and geological condition, so the usage of material in construction is the same. Generally speaking, south-west China has a good environmental condition which is beneficial for production of multiple materials, such as wood, bamboo, rubble, stone, bricks and clay.

#### 3.1.1. Wood

The feature of wood in south-west China is enormous and multiple types of trees due to the subtropical climate with high precipitation and abundant rivers. The main tree used to construction is cedarwood, then this area also uses pine tree, cypress, alamo. These trees are majorly used in the structure of buildings.

#### 3.1.2. Stone

Lime stone, sand stone and shale stone are the major material in construction in this area. Local people usually use those low hardness and easy-exploration stones as the base of buildings.

This area has abundant resource of lime which could produce high quality quicklime. Additionally, by mixing clay and shale could produce black brick and tile. The mixing clay and sandstone is the basic material of rammed earth wall. Besides those stones, rubble is also an building material in south-west China.

#### 3.1.3. Bamboo

The application of bamboo in construction is wide-spread in this area. They are usually used as partition wall to separate space or mixed with clay to build a wall as building envelope.

#### 3.1.4. Clay

Due to various river system in south-west China, the clay has high nutrition with a red-purple dark color, which will perform a hard and stable condition after exposed under sun light for several days. Local people use this clay to build rammed earth wall or earth brick.

#### 3.1.5. Brick and Tile

Local brick could divide into two types, baking-free brick and vitrified brick. Baking-free brick is made of rammed earth and will be usually used in construction with a low height. Vitrified brick

6. Zhangbin., 2016. *Regional Expression of Local Materials in Modern Building Construction*. Master's Thesis. Southwest Jiaotong University. Available at: <<https://kns.cnki.net/KCMS/detail/detail.aspx?dbcode=CMFD&dbname=CMFD201701&filename=1016177105.nh&v=MTY0NTZQSVI4ZVgxTHV4WVM3RGgxVDNvVHJXTTFGckNVUkxPZlI1Um9GeURoVzcvUFZGMjZHTeSvR2RETxFwRWI=>>>

and tile are made of the mixture of clay and shale stone. And vitrified brick is usually used as building envelope. Additionally, because of the different temperature during baking, the brick will majorly appear in two different colors which are red and black.

### 3.1.6.Others

Grass straw could also mix with clay while building a rammed earth wall, or be used as the material on roof to cover the structure. Lime-sand mortar is another material in local construction, it is mixed by clay and lime-sand in certain proportion, which has a good performance in adhesion. What's more, sticky rice is also an original material of mortar, it is usually mixed with lime-sand in proportion and the mixture would boil in pot for hours to produce the mortar.[Fig24]



Fig.24

### 3.2. Local masonry in walls<sup>7</sup>

Local skills of masonry in Xichang have developed several types of walls, which could be categorized into brick wall, stone wall, rammed earth wall and bamboo-clay wall. The most common remain wall existing in contemporary time is brick wall, since it has a good quality to proof it from rain, wear and damage. Stone wall is mostly used along river or a place has height difference or around the corner of building, where needs it to perform as retaining wall. For rammed earth wall, it is a widely used wall in rural area because of its low cost or usually be used as the core of city's wall. And bamboo-clay wall could be seen as a feature from south-west China, where Xichang also sits in there, it uses bamboo weaving as keel and clay as insulated material to proof water, wind and heat. However, the bamboo-clay wall should be accompanied with support structure which is timberwork-system because it's not able to afford load from roof. The report below will introduce the building skills of each wall.

7.Yuxiang Zou.,2017.*Study on Tile Tectonics Technology of Dwelling Houses in Western Sichuan*.Master's Thesis.Southwest JiaotongUniversity. Available at: <<https://kns.cnki.net/KCMS/detail/detail.aspx?dbcode=CMFD&dbname=CMFD201702&filename=1017059066.nh&v=MDA2NTBSb0ZDbmxVTc9JVkYyNkdiTzIGOUhLeVpFYlBJUjhlWDFMdxhZUZdEaDFUM3FUclnNMUZyQ1VSTE9mWXU=>>>



### 3.2.1. Brick Wall

The work of building a brick wall has three steps,

First Step: Positioning, Snapping the line, Placing arrangement.

According to the width and length of a space, using carpenter's ink marker to point out the axis of wall, and then snapping the ink line to define the space by the thickness of brick. Then in order to maintain the accuracy, arrangement of placing bricks on site will perform by workers.

Second Step: Level-up, Verticality-finding

In order to maintain the levelness of brickwork joint later on, the uneven base of bricks should be cut or filed with lime-sand mortar to keep the levelness. Then, hanging the plumb thread by timberwork spanning over the wall to make sure the verticality. After hanging the plumb line, place a horizontal thread close to the wall for controlling the levelness of brickwork joint.

Third Step: Building, Measuring

When start building bricks, the horizontal thread should place at each layer till the top and simultaneously check the verticality. When it reaches certain height, using leveling ruler to if the brick wall is horizontally. [Fig25]



Fig.25

### 3.2.2.Stone Wall

The stone wall in Xichang usually uses processed stones which perform a rectangular or square appearance. The surface of those stones would be polished and cut to maintain a standard.

There are two steps of building a stone wall in Xichang area,

First Step: The main point of rectangular stone wall is being straight on each side, so a base thread and an overall height thread would be hanging before construction. The first layer of stones would be buried a half in the ground and be placed in header, then fill in lime-sand mortar, joint keeps in 2 centimeters, the layer of mortar keeps 1 centimeter thickness.

Second Step: After finish the first layer burying in the ground, then place the stones in stretching from the second layer, break joint should be used. Stone plates could also contribute to maintain the layer's levelness if it needs. [Fig26]



Fig.26

### 3.2.3.Rammed Earth Wall

Rammed earth wall is rare found in nowadays rural area, since most of them were demolished by rain. Whereas, it also has certain potentials to be widely used because it's eco-friendly and good heat-insulating property. There are seven steps of building a rammed earth wall,

First Step: Before ramming the earth, making proper earth with moisture content is the first step. So, choosing clean clay without organism and exposure them under sun, then add some water to make it be little soft. In addition, sticky rice mortar could put in those earth to make them more strengthen.

Second Step: Making the base of wall by using stones, the height of stones should keep at 60 centimeters, then hanging plumb thread on both ends of the wall, setting up timberwork mould[Fig27] along the wall which is enclosed and reinforced by skeleton inside.



Fig.27



Third Step: Pouring the earth into the mould, using pointed hammer to beetle the surface from both ends to the middle till certain degree, then changing to bigger hammer to beetle the surface again, but this time is from middle to both ends.

Fourth Step: Each time of ramming earth in mould should be rammed in layers, it usually has four layers in a mould. And being similar with brick wall, break joint is also used in different blocks of rammed earth.

Fifth Step: During the building process, grass straw and bamboo chip will be putted into the clay for enhancing the adhesive property. Besides putting those adhesive material, rubble from tiles and bricks will also be putted in for enhancing the stability of wall. Meanwhile, in placing ever three layers of rammed earth blocks, there should add two thin bamboo strips for overall adhesion, like ring beam in modern architecture.

Sixth Step: Building rammed earth wall is better in Spring and Fall, in order to avoid raining season. The building process would divide into two or three time, each internal time continues one week for drying the building earth.

Seventh Step: After finishing the volume of wall, workers could

use plaster to polish the surface. [Fig28]



Fig.28

### 3.2.4. Bamboo-Clay Wall<sup>8</sup>

Bamboo-clay wall could be seen as a feature from this area, it uses bamboo weaving as keel and clay as insulated material to proof water, wind and heat. However, the bamboo-clay wall should be accompanied with support structure which is timberwork-system because it's not able to afford load from roof.

There are five steps of building a bamboo-clay wall,

First Step: Choosing proper bamboo, which should be little aged bamboo because young bamboo is soft and not able to be a keel.

Therefore, selecting bamboo around 2 or 3 years old, separating it into chips with 8 to 10 centimeters width, then immersing in water is the process.

Second Step: Calculating the length of bamboo chips, using wider ones to weaving in horizontal direction and thinner ones in vertical direction.

Third Step: Using clamping piece to fix horizontal bamboo chips in certain pattern, then weaving vertical bamboo chips in horizontal ones. After finishing weaving, put the bamboo in the timberwork-system and fix the bottom by little chips.

Fourth Step: Selecting clean clay, adding hemp thread, grass

straw, bits of lime and mixing them like mud, then placing the mud for one night, it could be plastered on the weaving bamboo.

Fifth Step: After the mud dried, put plaster to polish the surface.

[Fig29]



Fig.29

8.Xie Jiayi.,2016.*Wall Constructions Research of Traditional Dwellings in the Linpan Region in the West Sichuan*.Master's Thesis. Southwest JiaotongUniversity. Available at: <<https://kns.cnki.net/KCMS/detail/detail.aspx?dbcode=CMFD&dbname=CMFD201701&filename=1016168831.nh&v=MDQ0NDhGdG5QcnBFY1BJUjhlWDFMdXhZUzdEaDFUM3FUclNNUZyQ1VSTE9mWXVSb0ZDbmxXNy9LVkYyNkdMSys=>>

Fig29.You Wu(2018) Chengdu:Linpan, island to coexist with nature.[image]Available at:<https://wemp.app/posts/94bd0a19-067f-4955-8d59-e05ab999eb30>

### 3.3. Local timberwork<sup>9</sup>

Timberwork in China has mutual norms and logic, so as to Xichang or south-west China. In spite of this area has same logic and composition of “mortise and tenon joint”, the structure is apparently different from other places in China. The report below will introduce the mutual concept of mortise and tenon joint, and introduce the wood structure system in this area, which called “tenon through” structure. [Fig30]



Fig.30

9.Li Chuangchun.,2016.*Western Sichuan timberwork residence investigation and building construction*.Master's Thesis.Xi'an University of Architecture and Technology. Available at: <<https://kns.cnki.net/KCMS/detail/detail.aspx?dbcode=CMFD&dbname=CMFD201701&filename=1016740661.nh&v=MDMxMTBSb0ZDbm1WTDNCVkyYkdmMUzhIdGZLcnBFYlBJUjhlWDFMdXhZUZdEaDFUM3FUclNNUZyQ1VSTE9mWXU=>>>

Fig30.Haiwang Liu(2017) Mortise and tenon joint, a technic lasting thousands years.[image]Available at:[http://www.naic.org.cn/html/2017/gjjy\\_0910/20960.html](http://www.naic.org.cn/html/2017/gjjy_0910/20960.html)



### 3.3.1. Mortise and Tenon Joint

The concept of connect these wood pieces is based on tenon and mortise on the ends of each wood work. By matching the protruding part with the hollow part, these pieces could be connected. This logic allows enormous wood pieces to assemble as a coherent large form. [Fig31]

### 3.3.2. Structure

The timberwork in south-west China (where contains Xichang city) most uses “tenon through” structure. Basically, the system uses beams to connect columns as support units, and puts purlines on the top of columns then use perpendicular beams to connect columns again to form a roof. Additionally, shorter columns will be used on some beams to transfer the load from top. [Fig32]

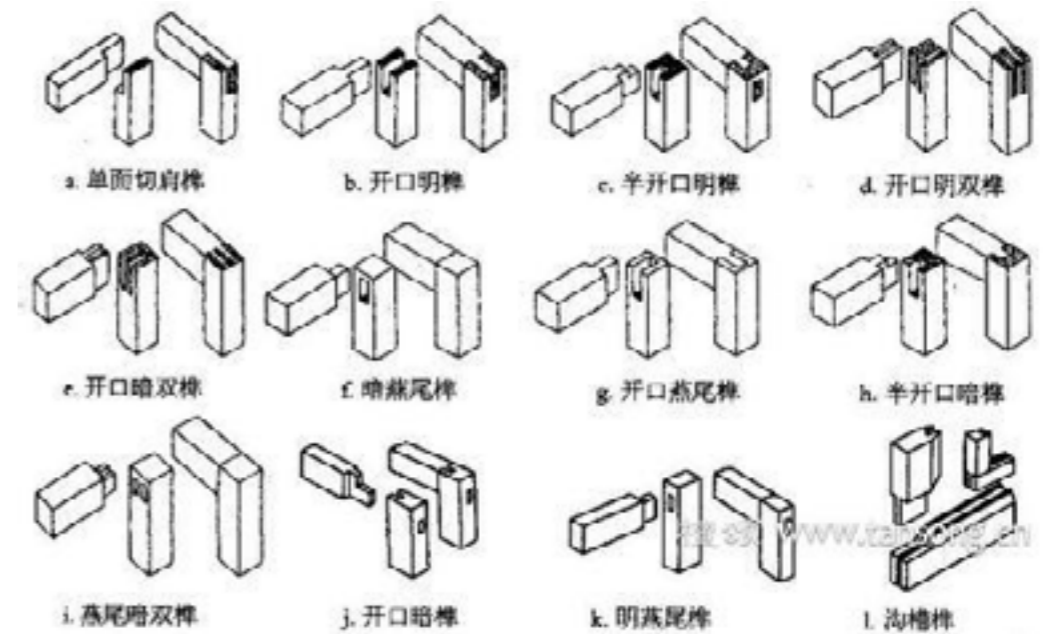


Fig.31



Fig.32

Fig31.Painting Pigment of Ancient Architecture (2017)Basic Knowledge of Mortise and tenon joint.[image]Available at:<https://www.weibo.com/ttarticle/p/show?id=2313501000014130821014478551&mod=zwenzhang&sudaref=www.google.com&display=0&retcode=6102>

Fig32.Bingbing Zhen(2017)Tenon Through Structure of Ancient Architecture.[Image]Available at:[http://www.naic.org.cn/html/2017/gjjg\\_0602/1110.html](http://www.naic.org.cn/html/2017/gjjg_0602/1110.html)

Besides being a support system like a frame structure, local timberwork also contributes a lot on the pattern of roofs. In the area, most of local buildings have sloping roof, which are mostly made from “tenon through” structure. According to the norms of tile in south-west China, which has 8 to 10 millimeters thickness, 200 to 250 millimeters length and 150 to 200 millimeters width, placing the purlines on top of columns should be every 1.5 meters. Purlines are covered with rosin for preventing corrosion and placed along a straight line. Each purline is connected by mortise and tenon joint. Then putting rafters on purlines according to the width of tiles, they are wood plates with same width. And the internal width between rafters is better around the  $\frac{1}{3}$  to  $\frac{1}{2}$  of the width of tiles. Then, the tiles could be put on the roof.

## Project Design





Sichuang Province



Xichang City



One damaged part of the relic wall



## Historical Reference

Focus on three aspects from traditional culture to search inspiration, which are typical topologies in local space; traditional architectural structure and local tectonics. Then use these elements/features as historical reference to process design.

Local Typologies in Space:



Alley

A narrow space as a path to connect destination, a threshold space in between interior and exterior, an informal space to hold people in.



Gate

A typical typology from original wall, a linear space to pass through, a directional space to suggest people the accessibility it has.

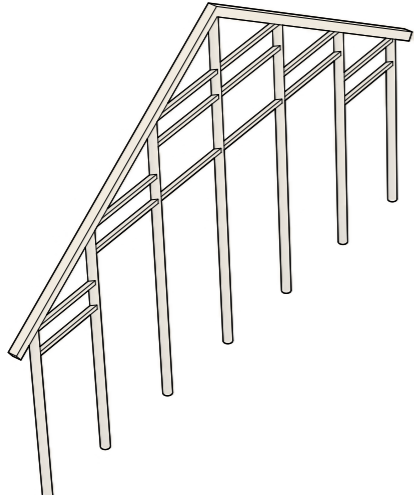


Round Wall/Plaza

A typical typology from original wall, a round shape protruding out from original wall then going back to it. Used to perform as defending function, yet in modern time, it used as a public plaza for citizen.

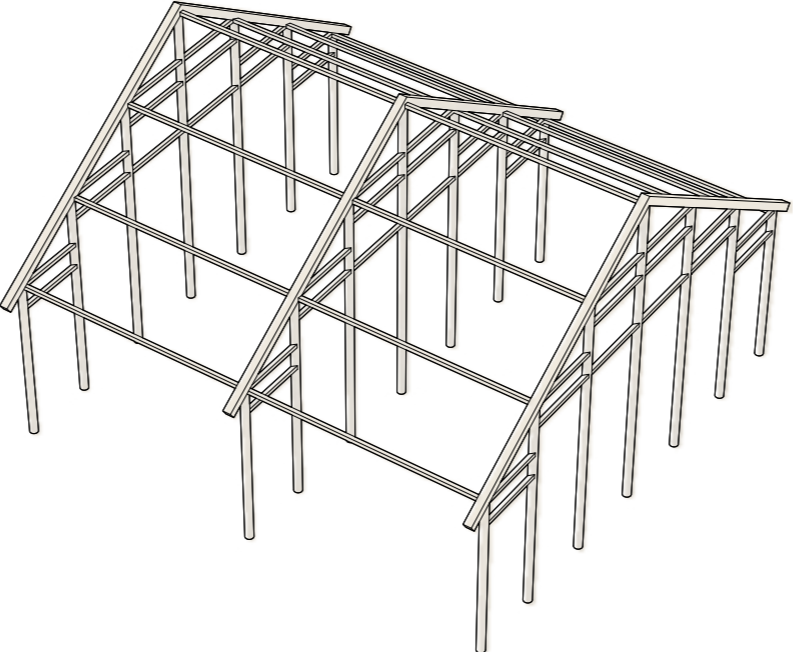


Traditional Structure/Tectonics of Architecture



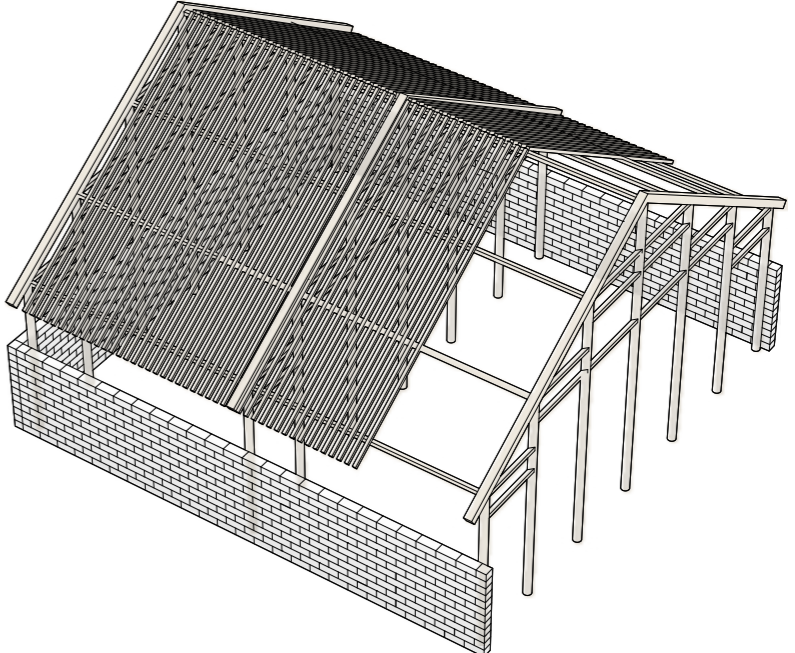
Tenon Through Structure

In local architectural tradition, "tenon through structure" used as a single unit with a complex of wood columns and beams, which is a support unit.



Expanding Space

By adding rows of unit along one direction, then connect units by straining beams, an expanded space could achieve.



Building Envelope

Then covering the space by brick walls and tiles, brick walls are building envelope or skin to define the distinction between interior and exterior, there are not load bearing.

Traditional Structure/Tectonics of Architecture



Bricklaying



Simple and straight forward way of bricklaying in traditional tectonics.



Making Mortar



Boiling sticky rice and mixing with lime-sand to make mortar in local tradition.



Company with commercial blocks and cultural buildings in the old town, this site has a good potential to gather people, to attract people walking by it. Additionally, accross the wall there will be a commercial street in the future, thus will give more possibility for people to stay along the wall either original part or the site of project.

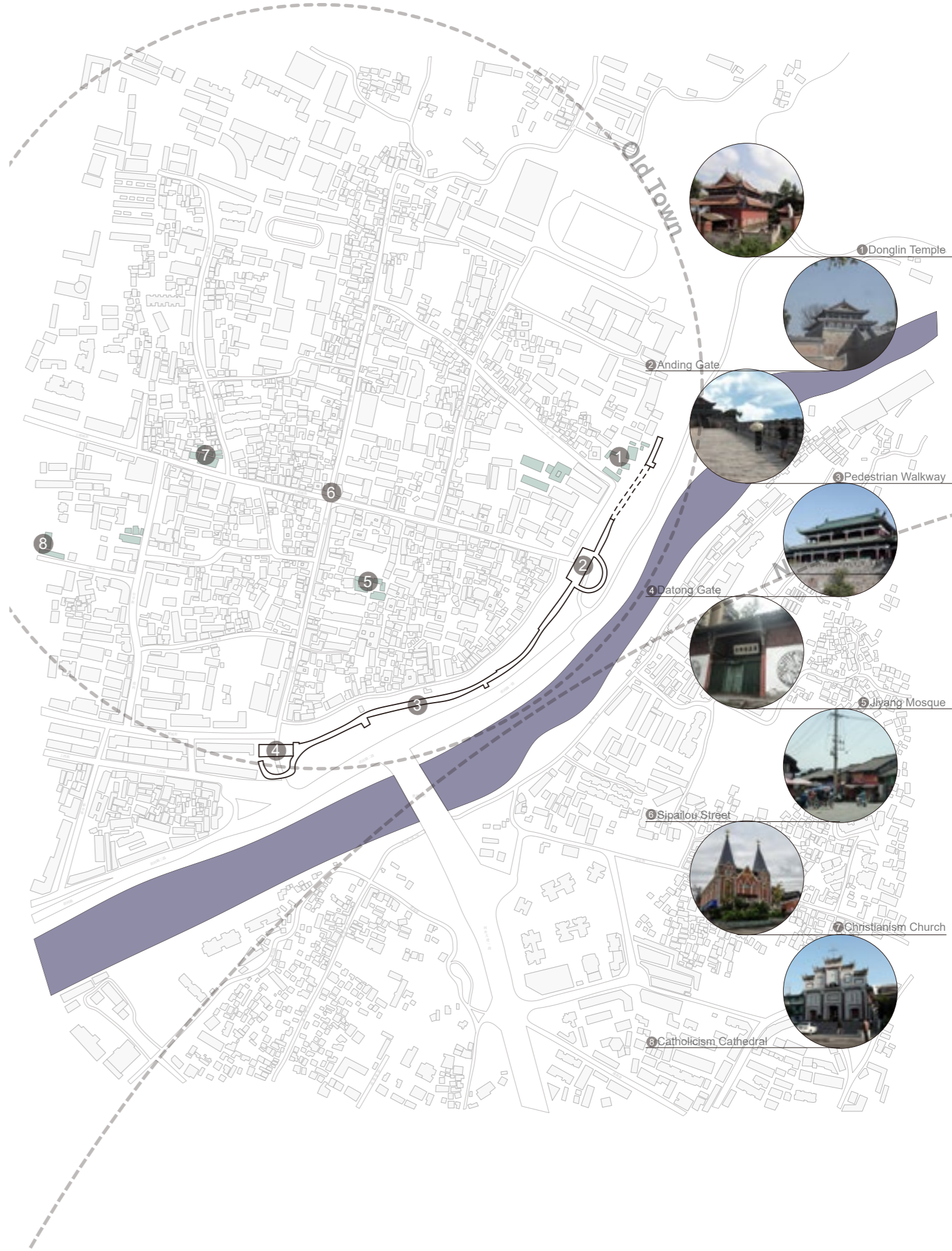


The site has a good accessibility for people to come, either by car and bus, or by walking on the pedestrian surrounding the whole relic wall. The site itself also has a good accessibility of walking to some cultural buildings in the old town, which are tourist attractions as well.





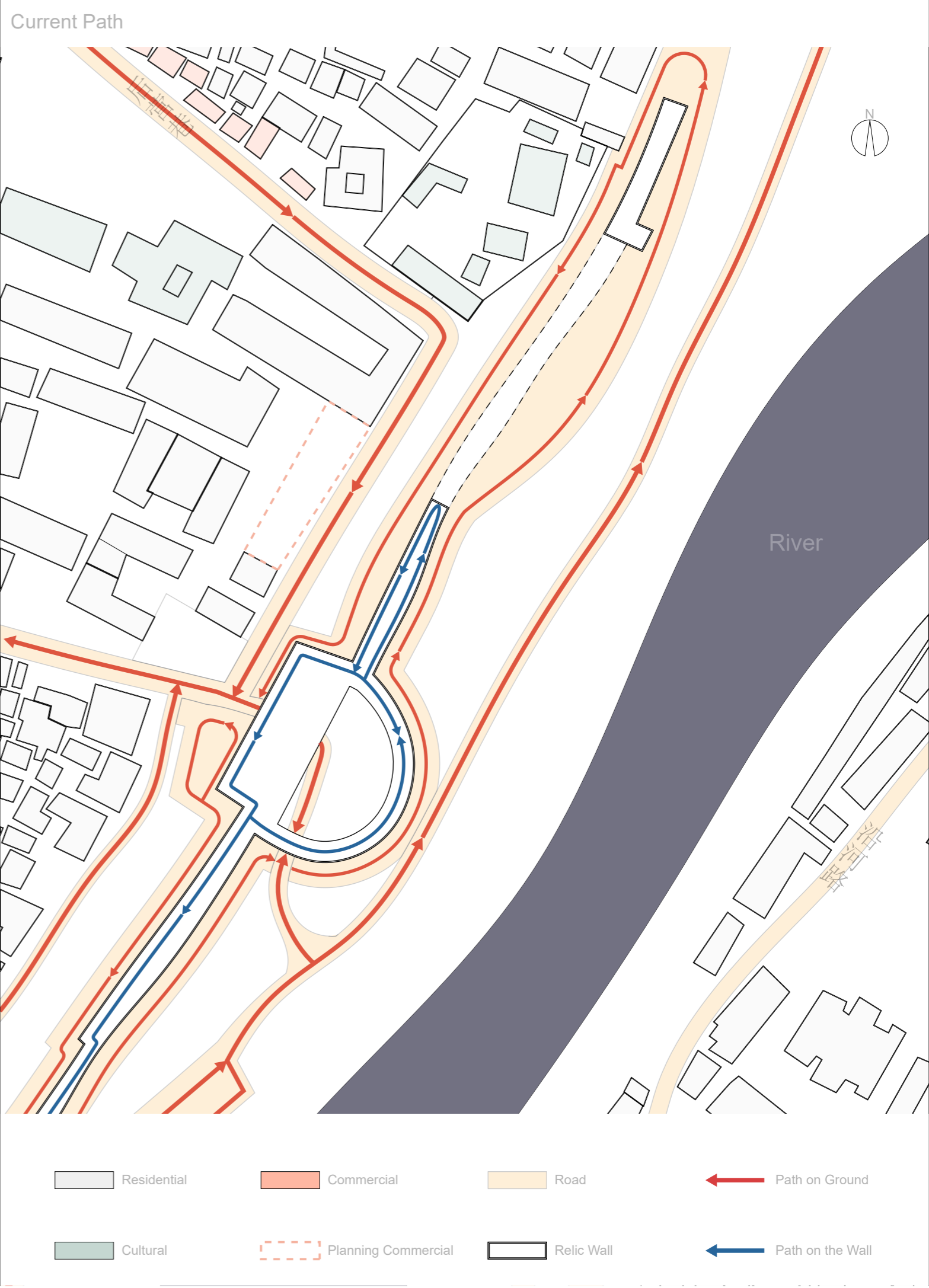
There are many types of historical features in old town, all of them are tourist attractions and staying open to citizen.



# Intervention

1:

Currently, the path on top of the original wall will end at some point, so people walking till there will turn back, thus the experience of walking is not sufficient. Plus, the path on the ground is not articulating especially near the cultural building where there is a temple.

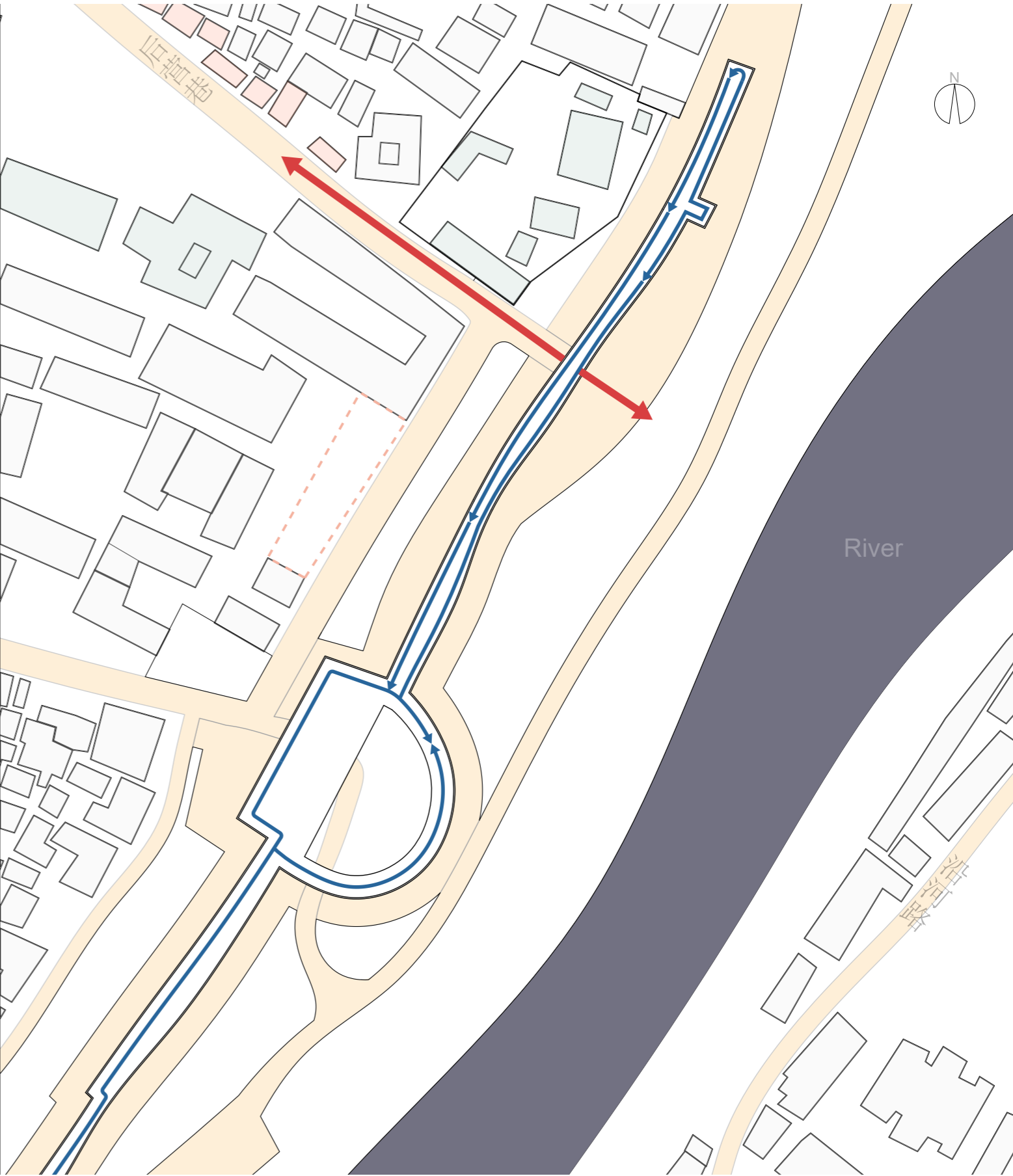


Intervention

2:

Firstly, patching the wall by following the original footprint of the relic wall. Then making an axis through the form in order to get connection between the old town and the natural part, such as river, also providing people the access of going through the wall and have the view of nature as well as the new town on other side.

Develop Axis



- Residential
- Commercial
- Road
- Path on Ground
- Cultural
- Planning Commercial
- Relic Wall
- Path on the Wall



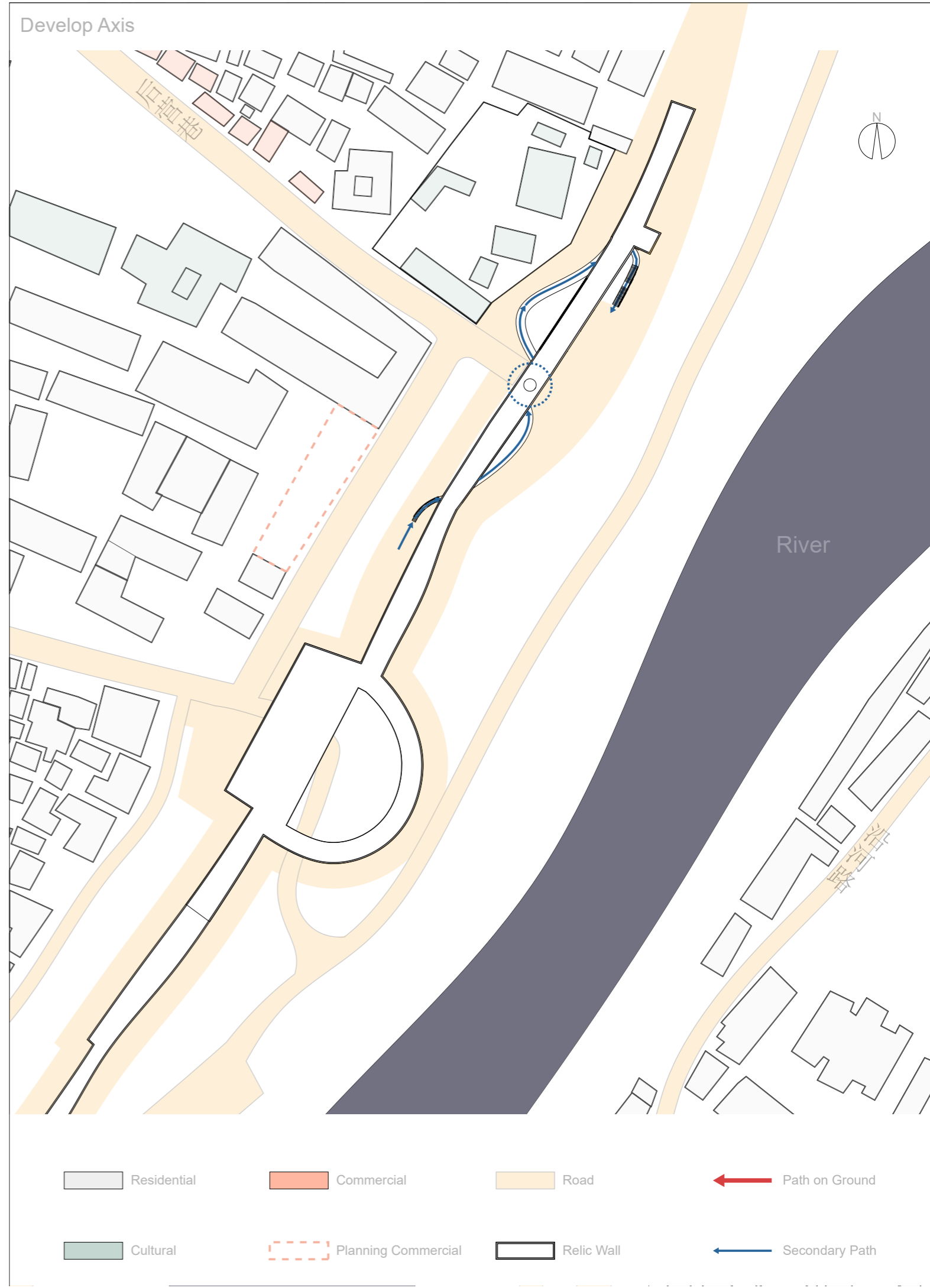
Intervention

3:

Then, adding a new path which going through the whole pathcing space, therefore, when people walking on the new path they could meet some changes as exterior veiw or interior space. In addition, connect the new path to top of the wall for enriching the walking experience.

The intervention form generated from the historical reference in typical typologies in space, which the round wall translated into round form offering different qulity of space, such as a platform and a yard. The platform on east side could have the veiw of nature and new town, the yard-form on west side could articulate the path on ground and get more closer to the culture building near it, have communication with context.

Making the center of this overall form as a spiritual/experience space, where is the new gate, like a stress point for this project. I want to people take a pause when they passing through, stay peace and maybe think about the history happened over this soil.

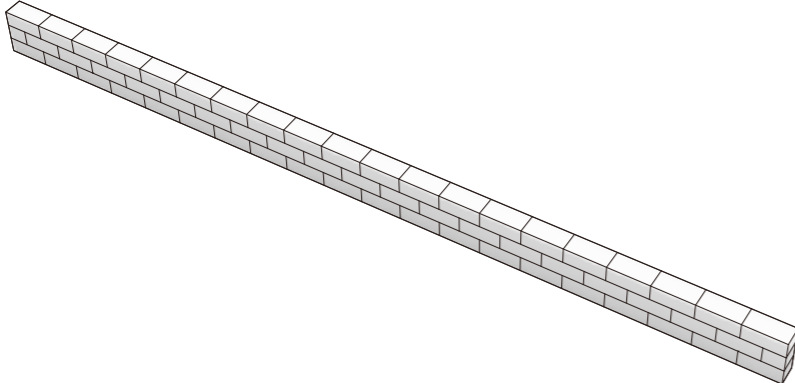




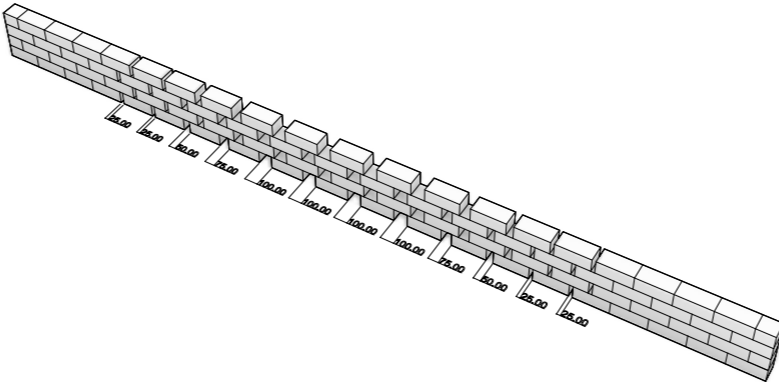
# Digital Brick Wall Development

After finishing intervention of form on site, I developed three types of brick walls in grasshopper. By using the local dimension of bricks, I try to seek more possibilities of brick wall regarding of contemporary parametric tool we have today. Then applying new walls on the form to search a new layer from the relic wall underneath the help of digital tool.

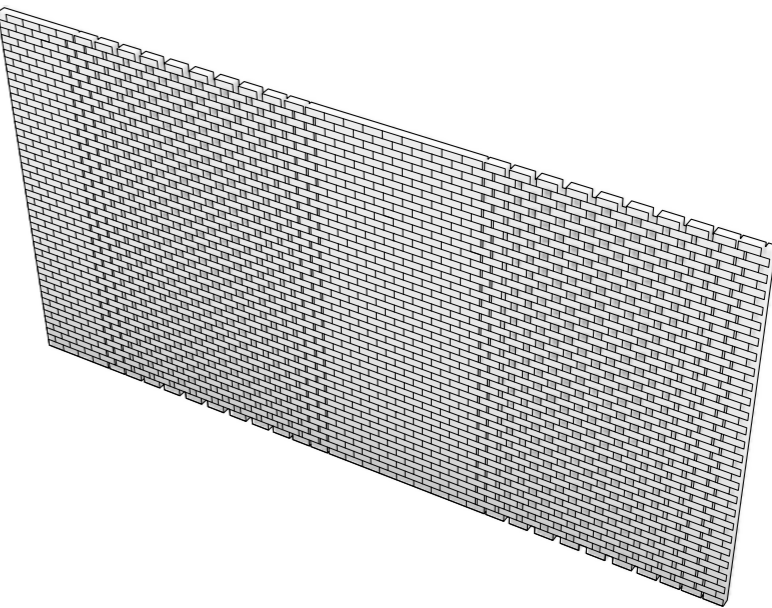
## Gradient&Translucent:Type A



Original pattern of bricklaying

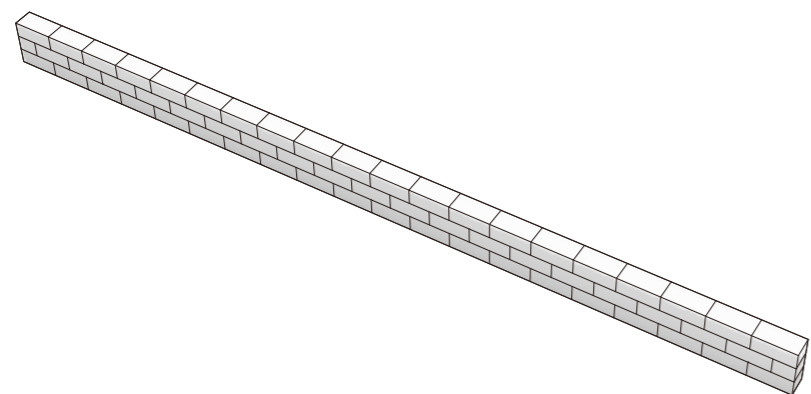


Moving bricks away horizontally;  
The gaps between them opening and closing gradually;  
Standardizing the distance:25mm,50mm,75mm,100mm

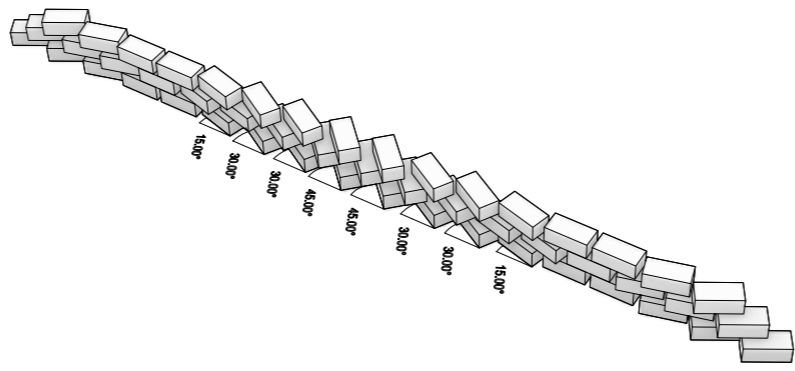


Final result of the wall will perform translucent effect while the gaps expressing in a rhythm.

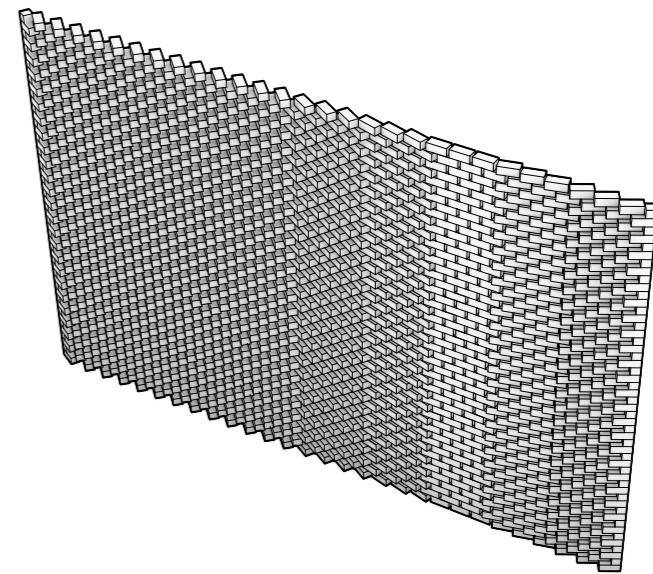
Rotation&Translucent:Type B



Original pattern of bricklaying

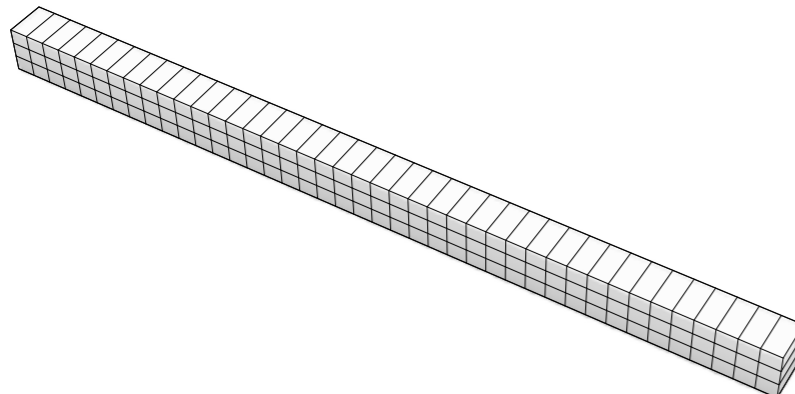


Rotating bricks along horizontal axis;  
The degree of angles changing gradully;  
Standardizing the degree :15° , 30° , 45°

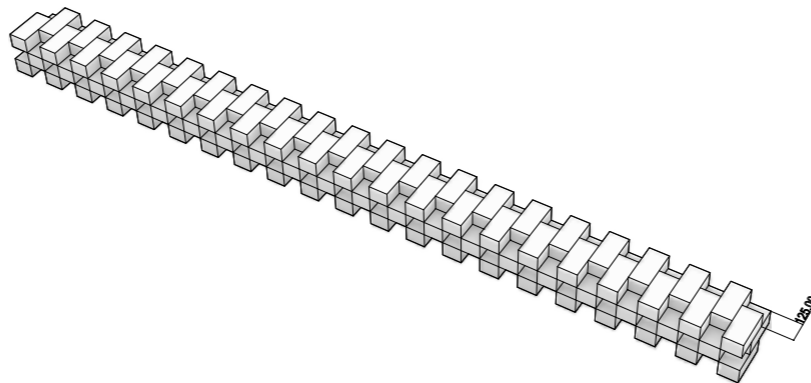


Final result of the wall will perform  
translucent effect as well as an interesting  
appearance.

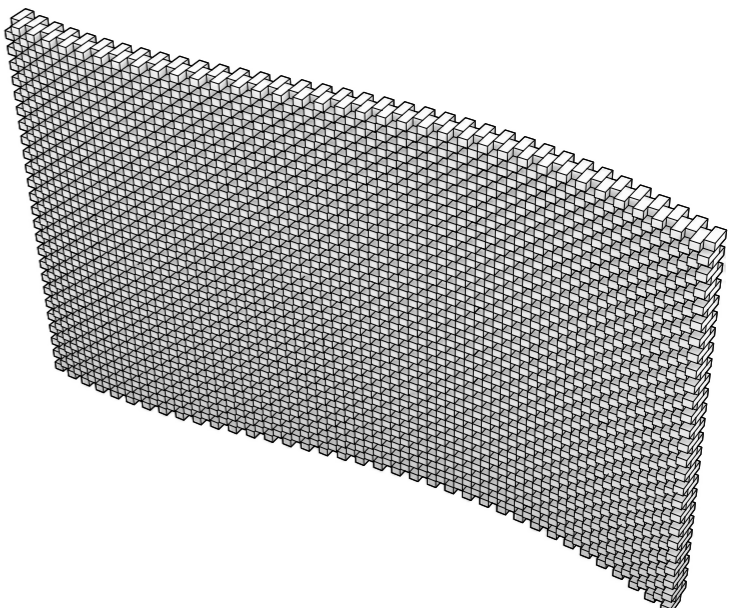
Offset&Shading:Type C



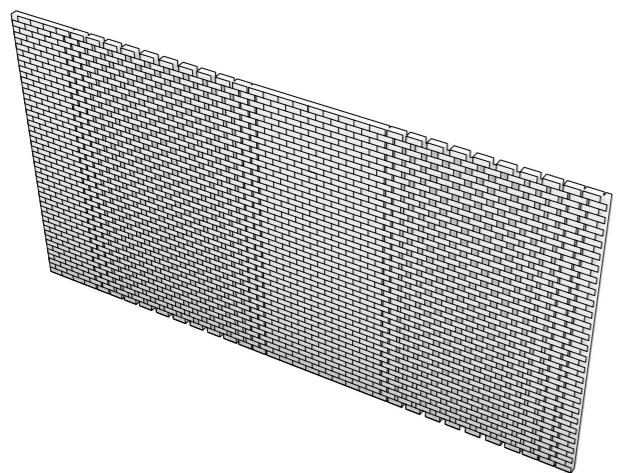

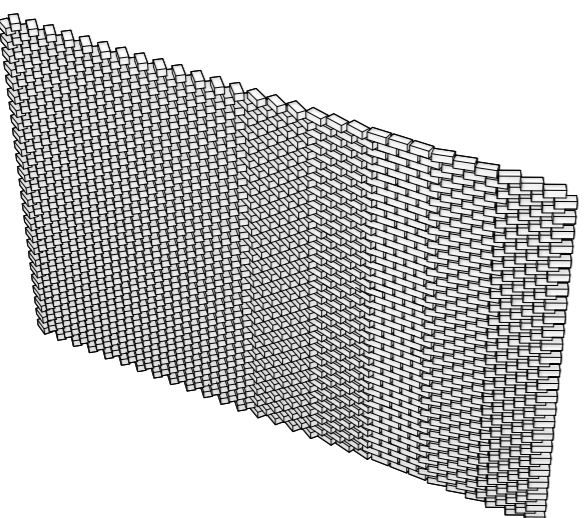

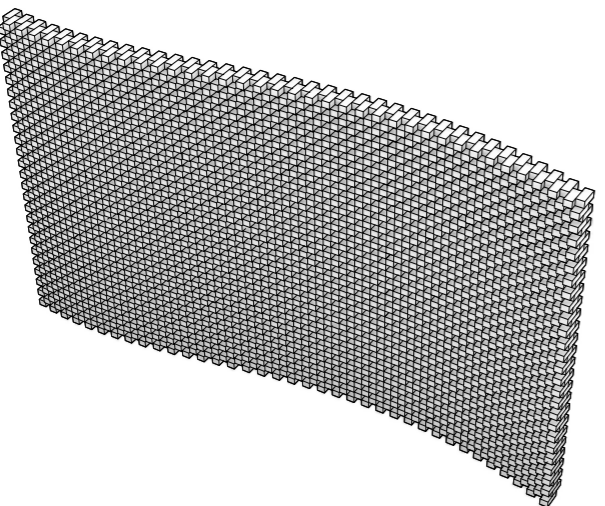

Bricklaying in header



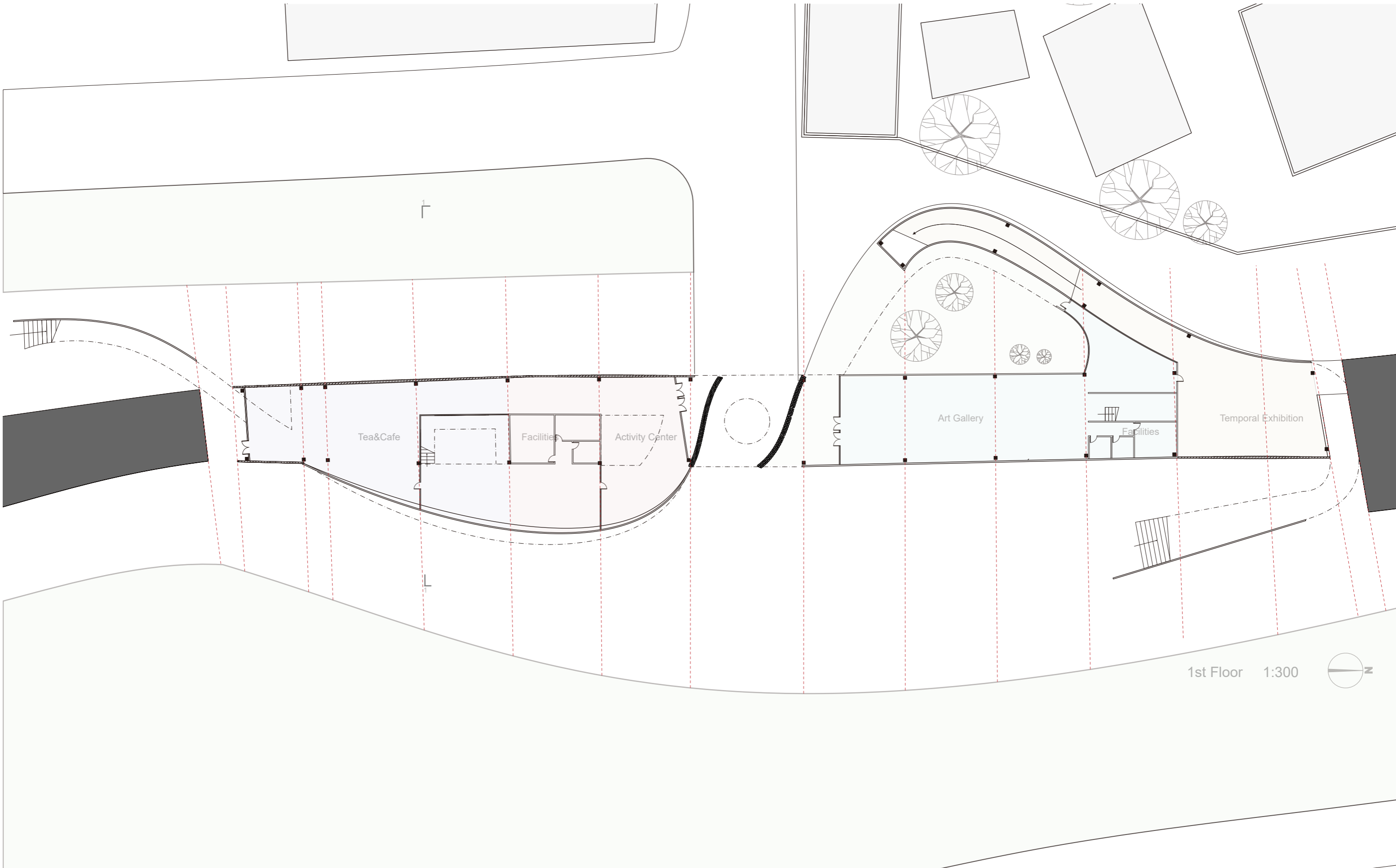
Offset bricks in one and another;  
Standardizing the distance :125mm



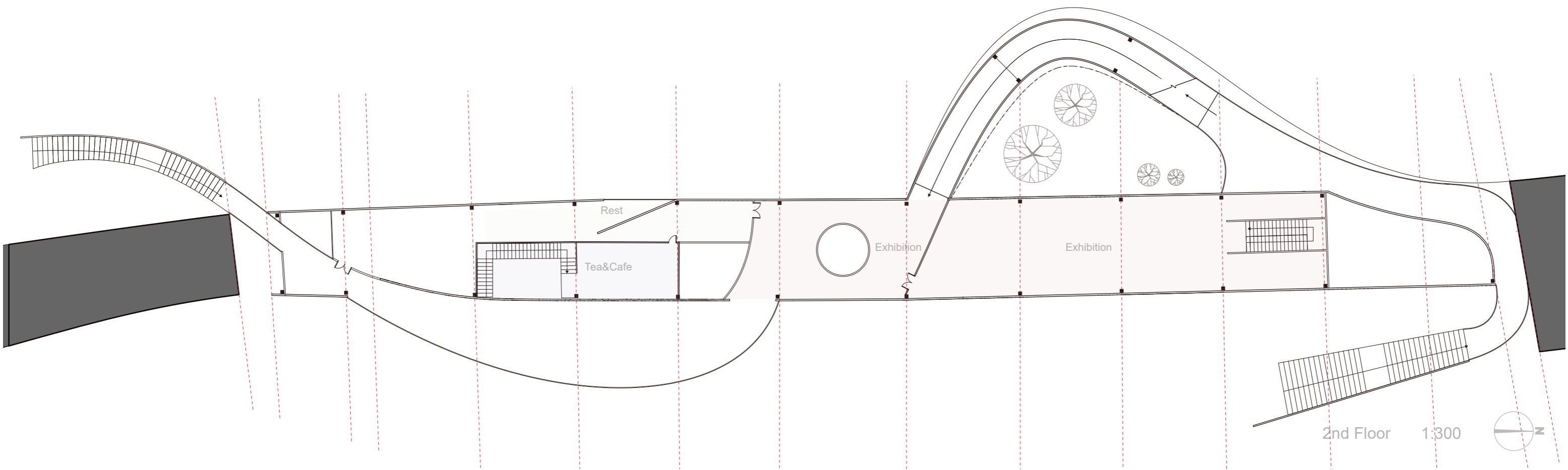
Final result of the wall will perform shading effect as well as an interesting appearance. Plus, this wall could perform in curvature shape.

	Developed Type	Appearance & Standardization	Effect & Feature	Reference Color
A		<p>Gradient: The horizontal gaps between Bricks opening up and closing up gradually in a gradient.</p> <p>Standard Distance: 25mm, 50mm, 75mm, 100mm</p>	<p>Performing translucent effect in a order; Letting light come into interior space; Ventilation; Having view of outside.</p>	
B		<p>Rotation: Bricks rotate along straight axis, the angle of rotation changing from small to wide then going gradually back to straight.</p> <p>Standard Angle: 15°, 30°, 45° determined by checking overlaying and collision in grasshopper</p>	<p>Performing translucent effect from certain degree of angle; Letting light come into interior space; Ventilation; Having view of outside; Interesting appearance to encourage people having interaction with it.</p>	
C		<p>Offset: Bricks offset a distance out in one another</p> <p>Standard Distance: 125mm</p>	<p>light and shade effect on the surface Interesting appearance to encourage people having interaction with it. Could perform in curvature shape(for instance, to embrace a spiritual space).</p>	





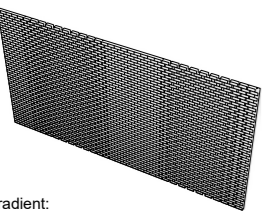

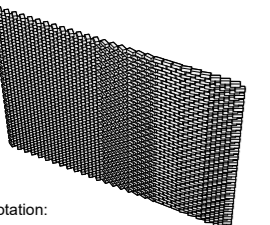

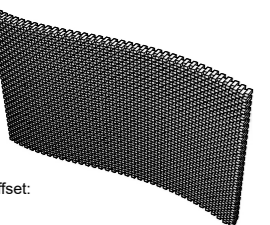

This architecture is a public space welcoming people to stay, encouraging people to have activities around this site. There is a tea/cafe house to offer service for people, and art gallery as a cultural response to the enormous culture in old town, exhibition hall is supposed to exhibit the history of the city and the relic wall.

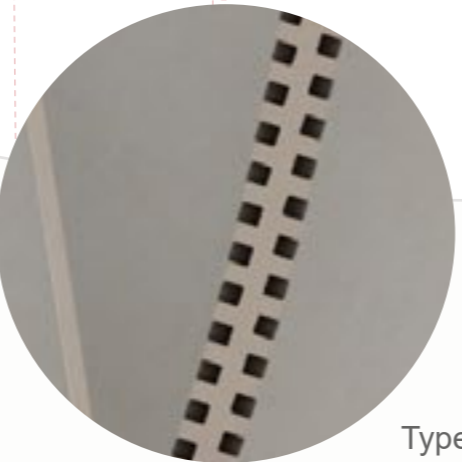
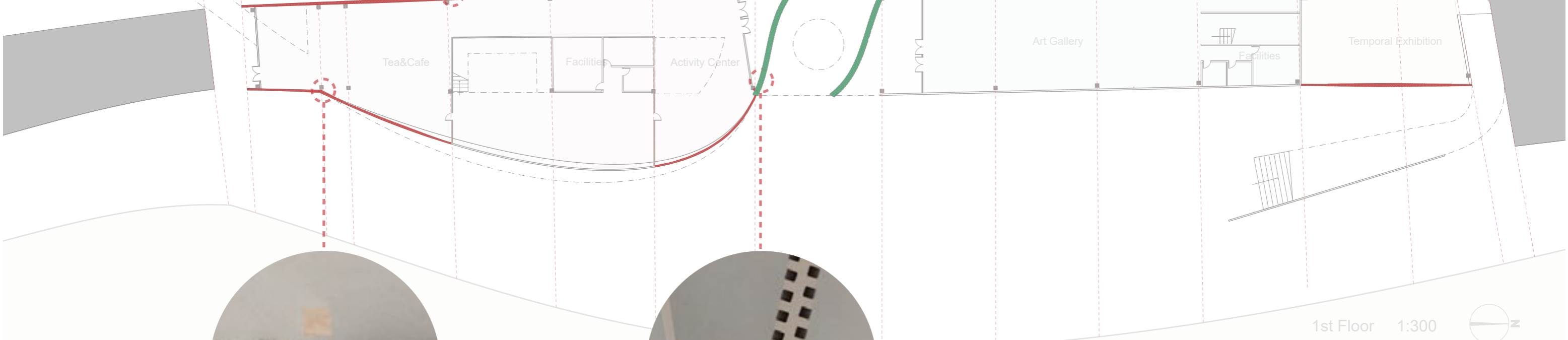
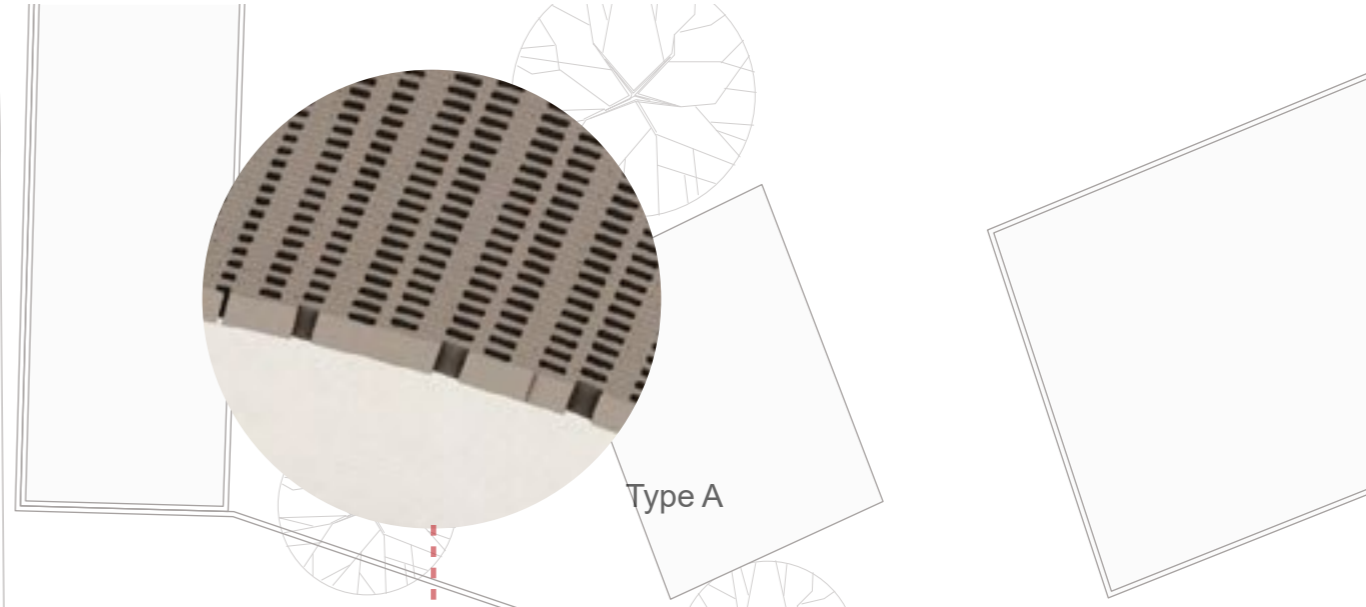
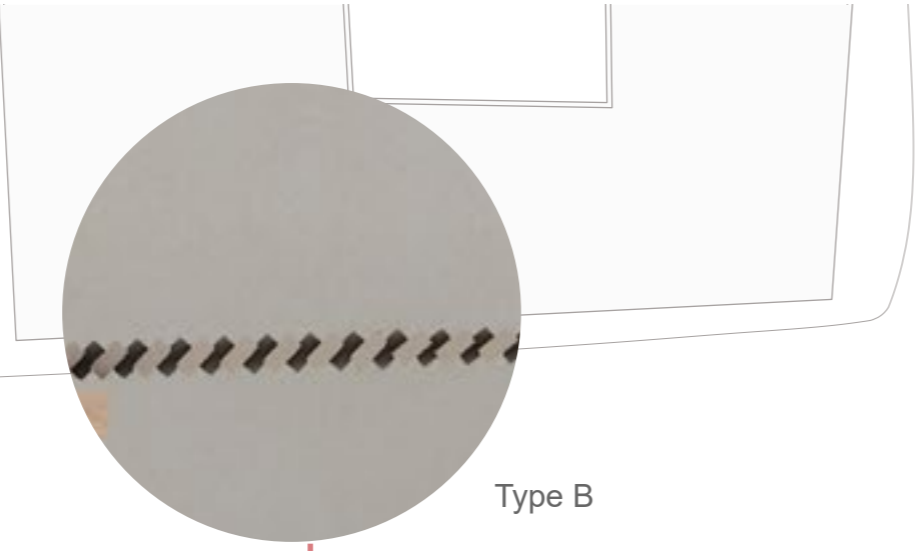


2nd Floor 1:300



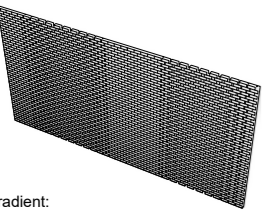

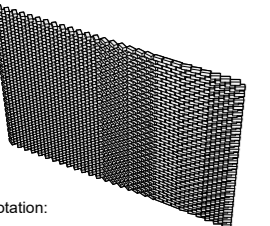

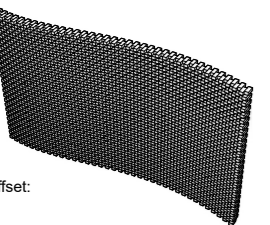

# Bricklaying

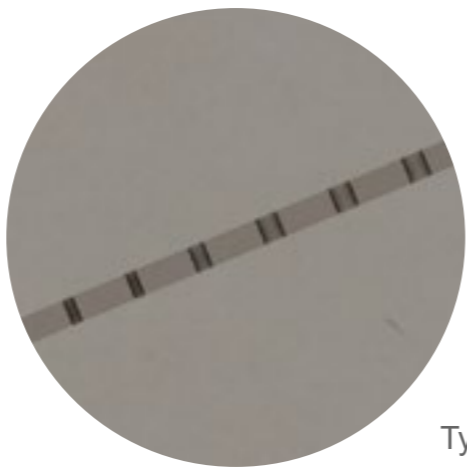
Developed Type		Reference Color
A	 <p>Gradient:</p>	
B	 <p>Rotation:</p>	
C	 <p>Offset:</p>	



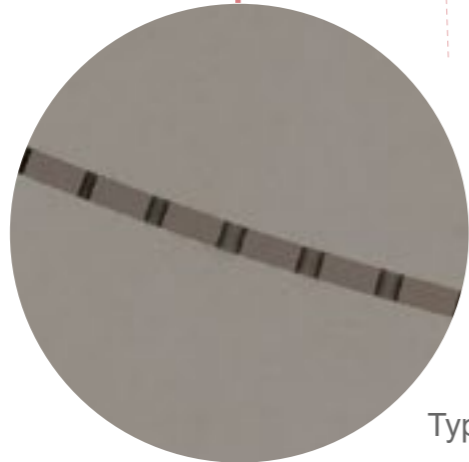
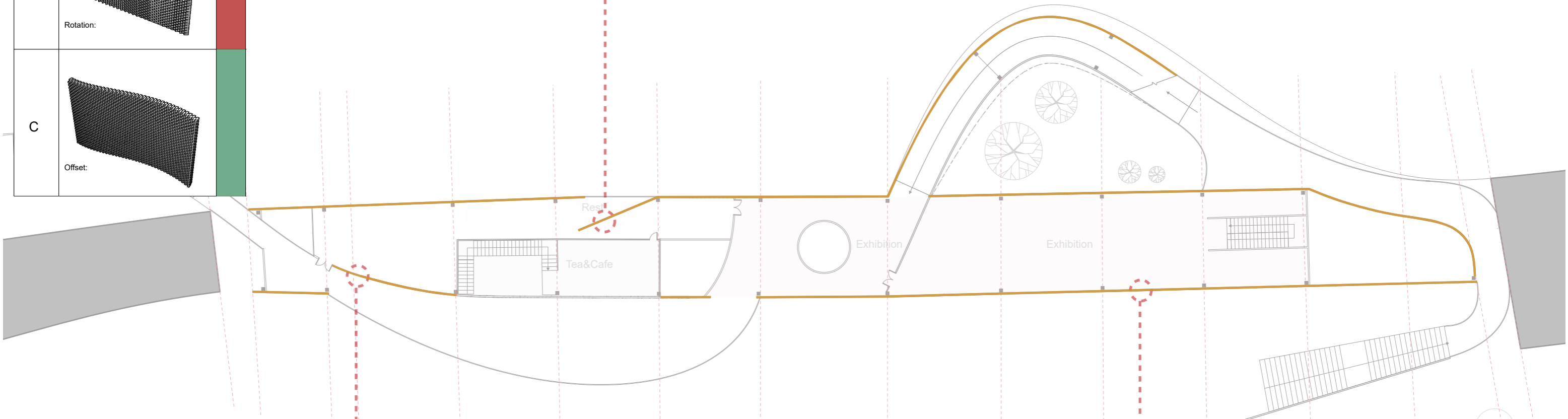


# Bricklaying

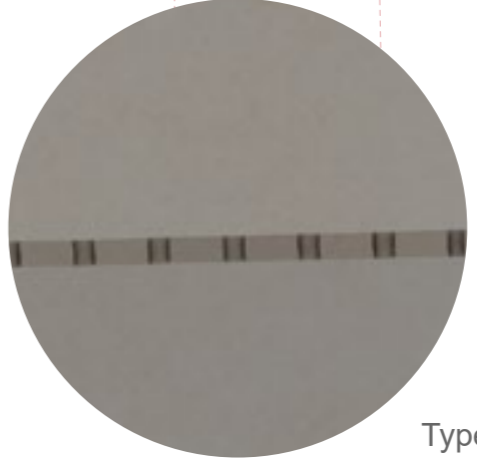
Developed Type		Reference Color
A	 <p>Gradient:</p>	
B	 <p>Rotation:</p>	
C	 <p>Offset:</p>	



Type A



Type A



Type A



West Elevation 1:300



Pattern of Brick Walls



Gradient Brick Wall  
Type A

Gradient Brick Wall  
Type A

Gradient Brick Wall  
Type A

Offset Brick Wall  
Type C

Gradient Brick Wall  
Type A

Rotated Brick Wall  
Type B

Pattern

Original Wall

West Elevation 1:300

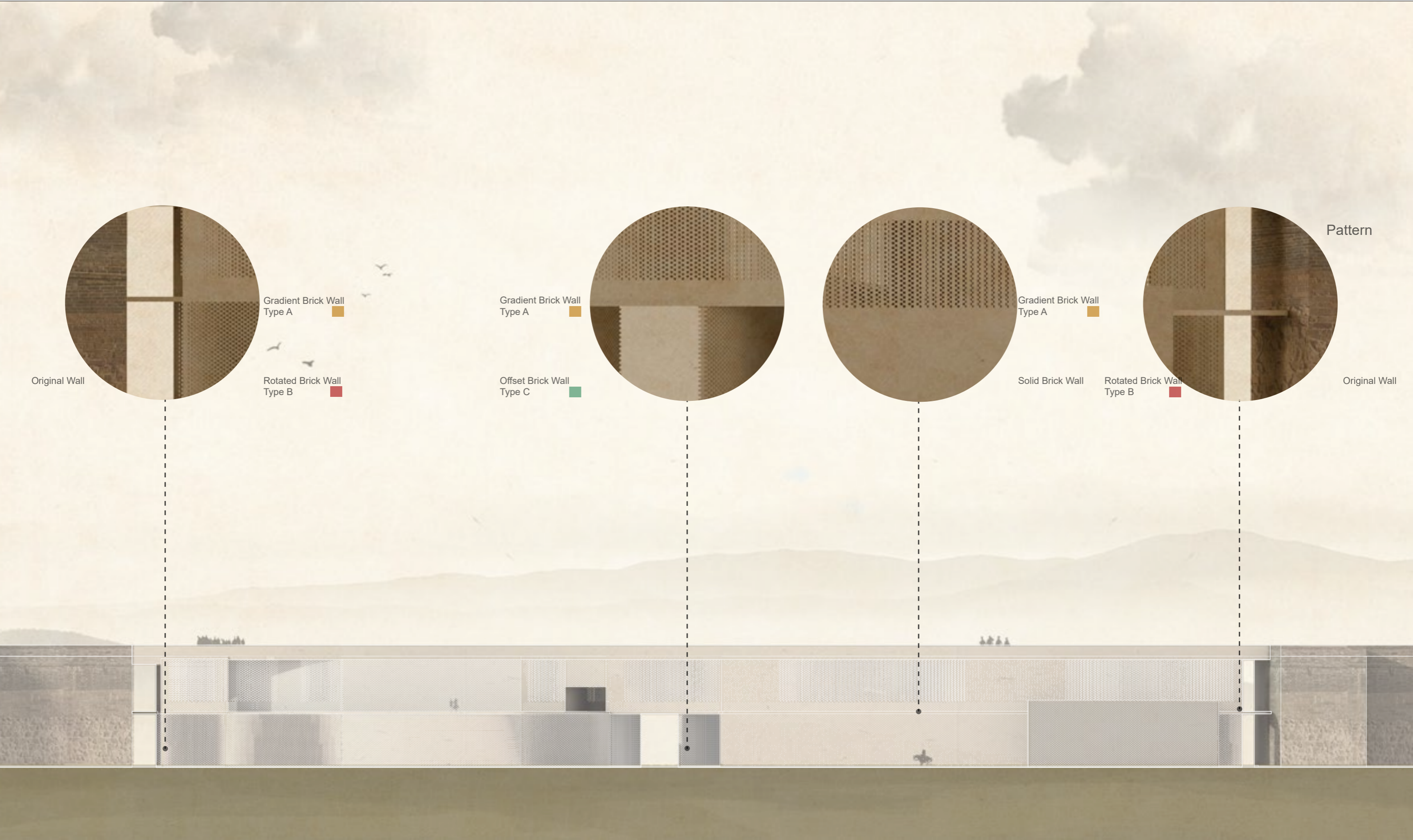




East Elevation 1:300



Pattern of Brick Walls



Original Wall

Gradient Brick Wall  
Type A

Rotated Brick Wall  
Type B

Gradient Brick Wall  
Type A

Offset Brick Wall  
Type C

Gradient Brick Wall  
Type A

Solid Brick Wall

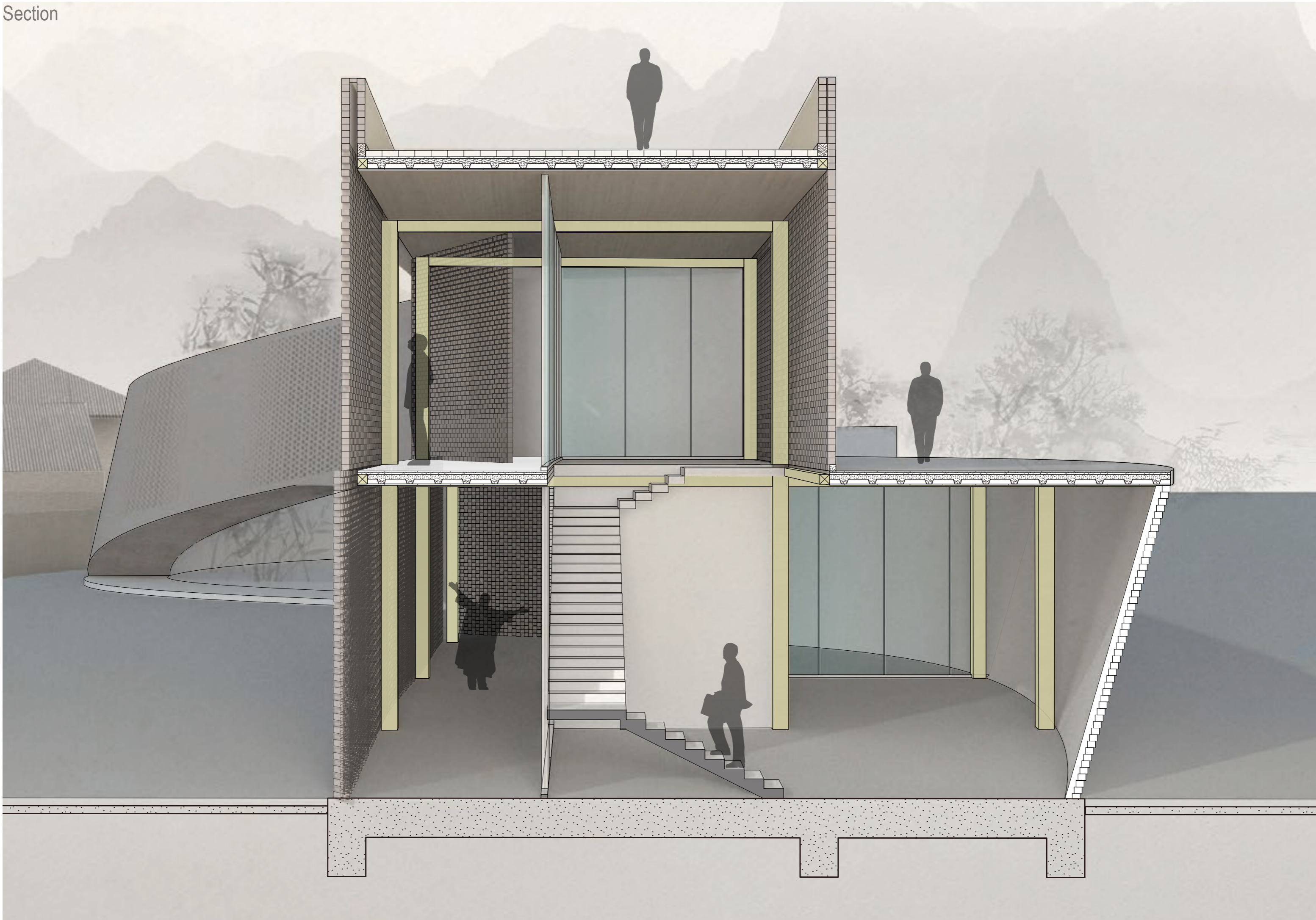
Rotated Brick Wall  
Type B

Pattern

Original Wall

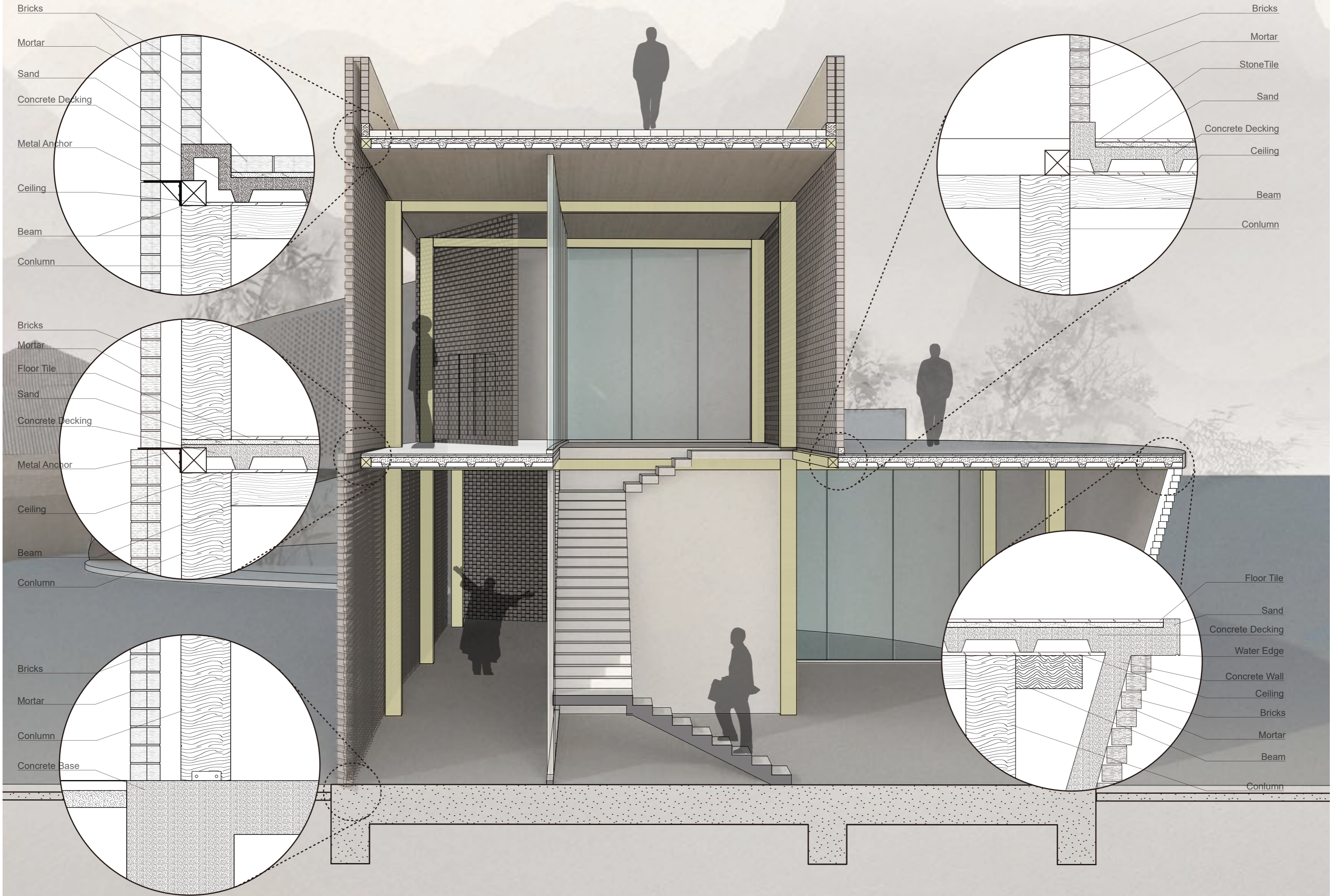
East Elevation 1:300







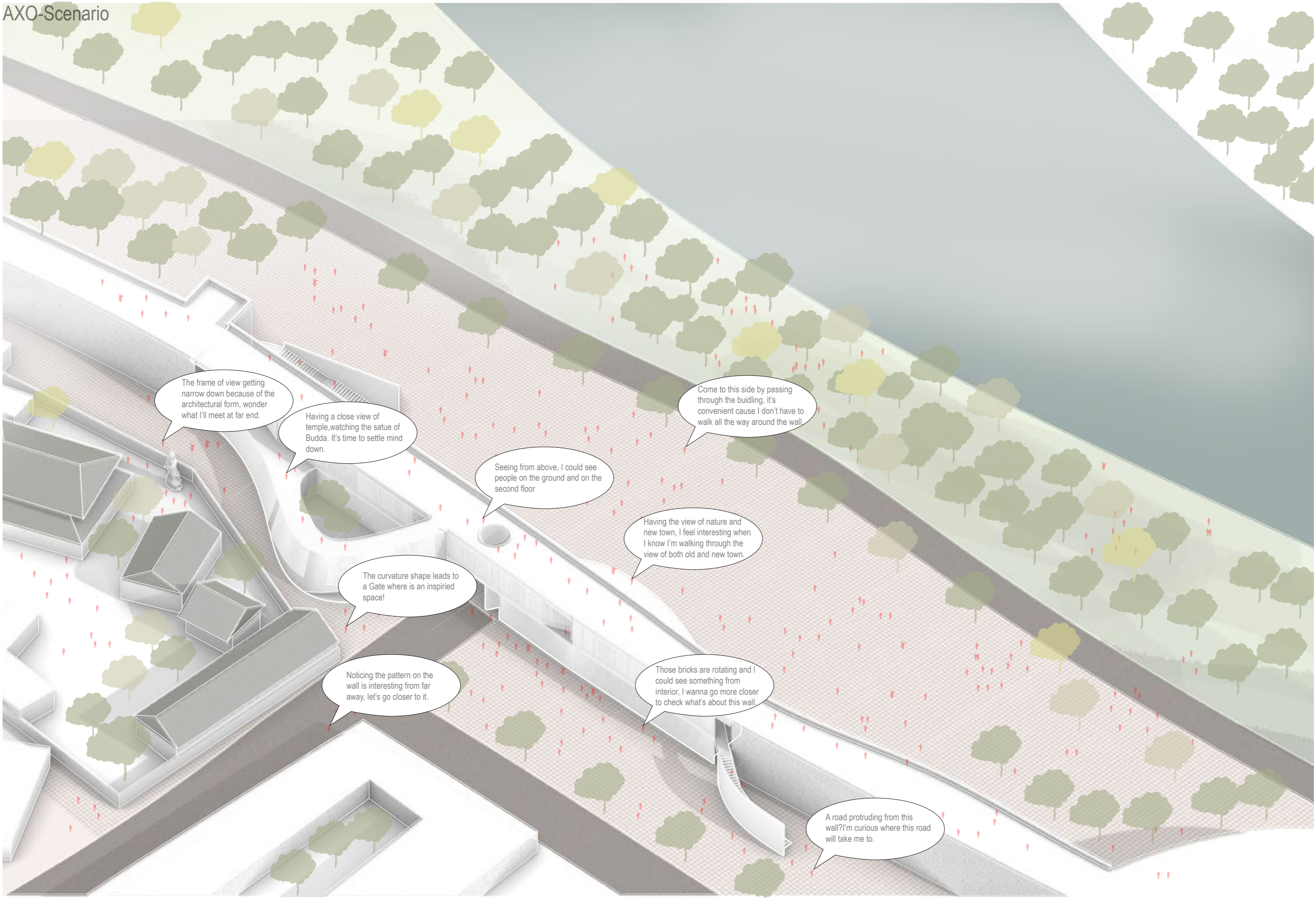
Section-Detail











The frame of view getting narrow down because of the architectural form, wonder what I'll meet at far end.

Having a close view of temple, watching the statue of Buddha. It's time to settle mind down.

Seeing from above, I could see people on the ground and on the second floor

Come to this side by passing through the building, it's convenient cause I don't have to walk all the way around the wall

Having the view of nature and new town, I feel interesting when I know I'm walking through the view of both old and new town.

The curvature shape leads to a Gate where is an inspired space!

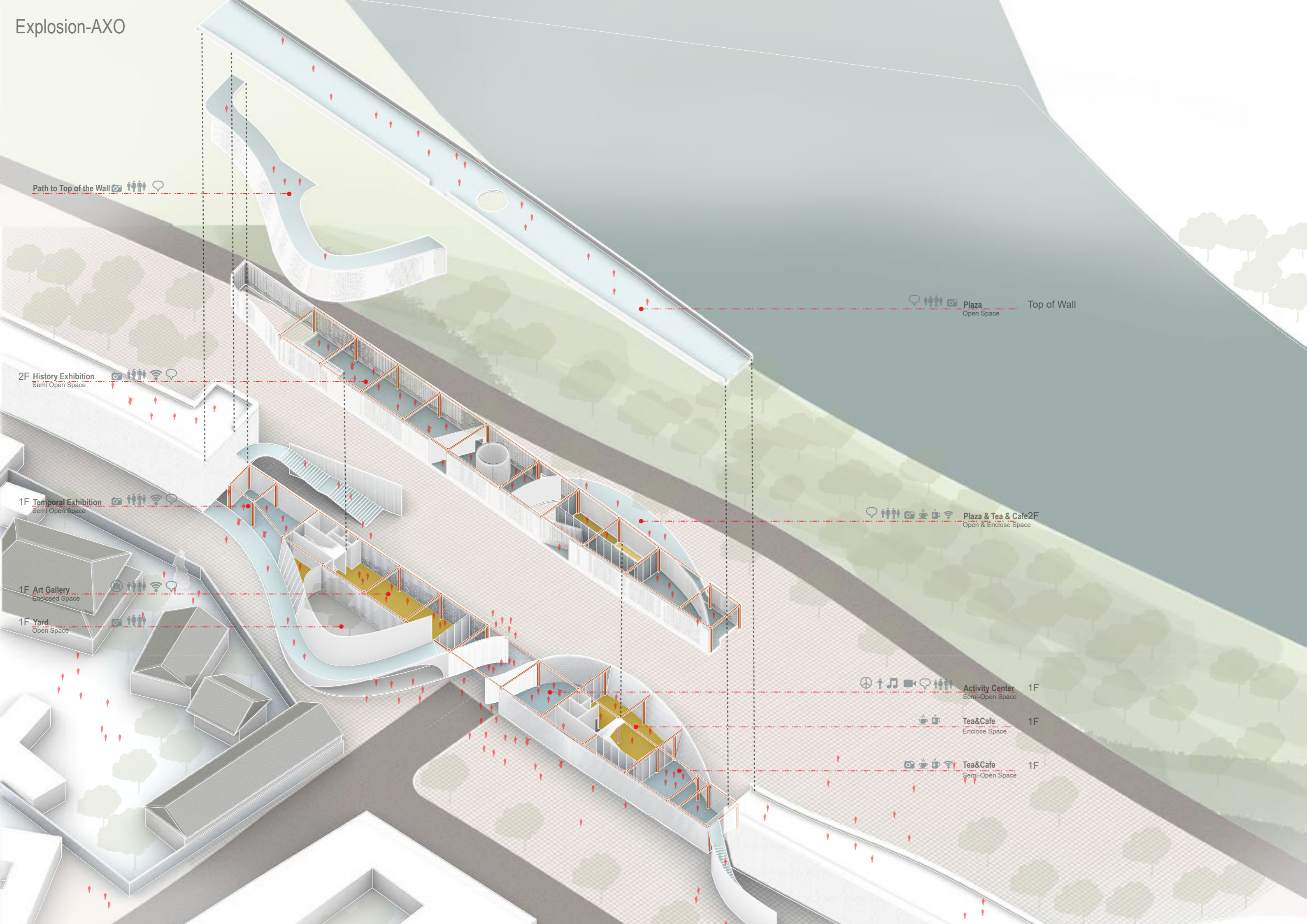
Noticing the pattern on the wall is interesting from far away, let's go closer to it.

Those bricks are rotating and I could see something from interior, I wanna go more closer to check what's about this wall.

A road protruding from this wall? I'm curious where this road will take me to.



# Explosion-AXO



Path to Top of the Wall

Plaza  
Open Space

2F History Exhibition  
Semi Open Space

Plaza & Tea & Cafe 2F  
Open & Enclose Space

1F Temporal Exhibition  
Semi Open Space

1F Art Gallery  
Enclosed Space

1F Yard  
Open Space

Activity Center  
Semi-Open Space

Tea & Cafe  
Enclose Space

Tea & Cafe  
Semi-Open Space

Top of Wall

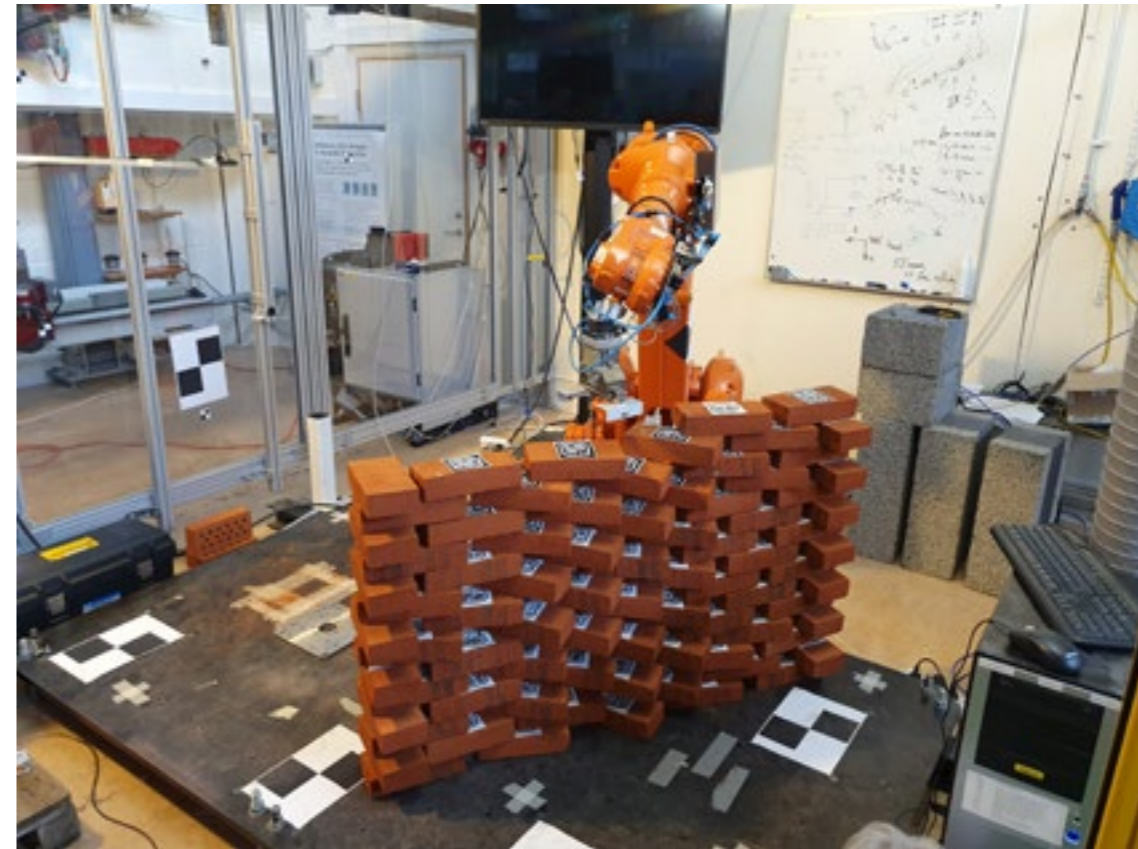
1F

1F

1F



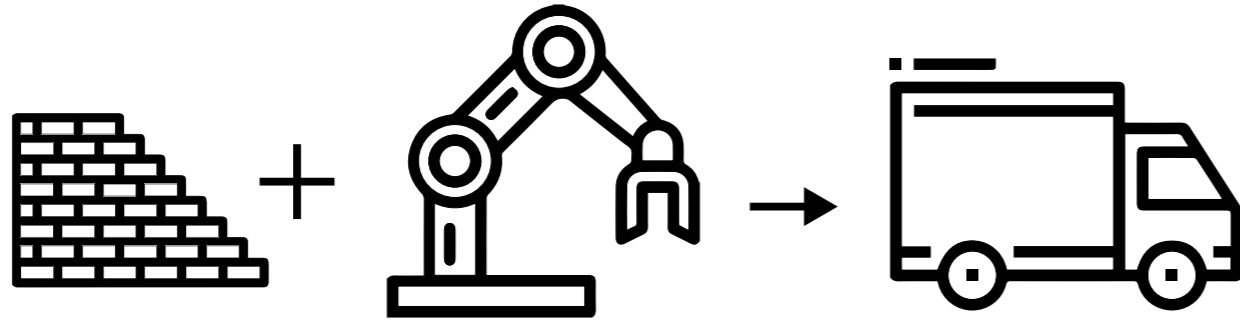
Fortunately, I have the chance to participate the workshop of bricklaying by robotic arms in Lund University. Although I didn't contribute much to the team, I still learned something about robotic fabrication. Therefore, I think I could also use this approach in my project as a conceptual strategy.



Fabrication

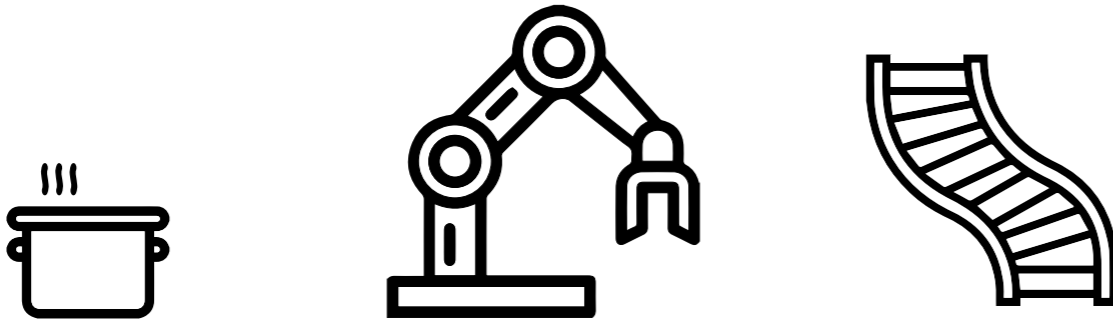
Step:

1



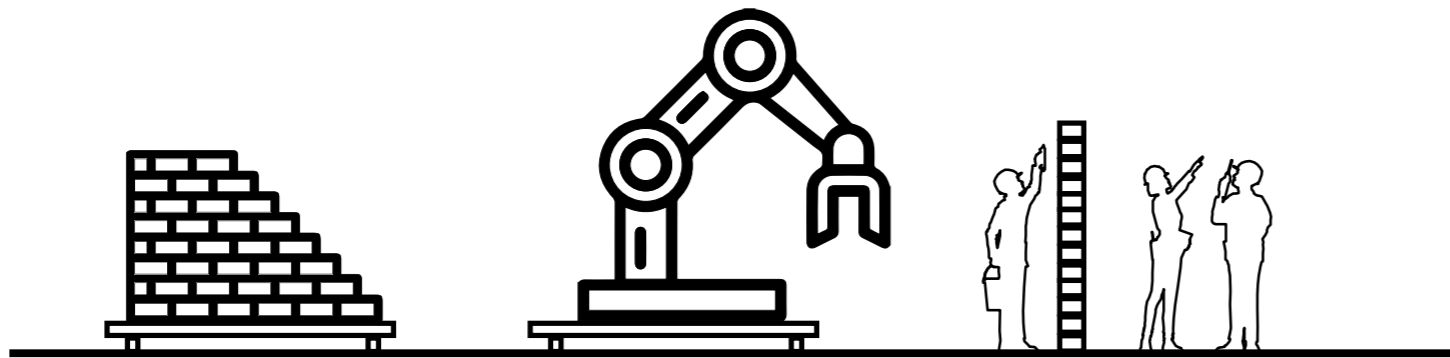
Transporting building materials, bricks and robotic arm on site

2



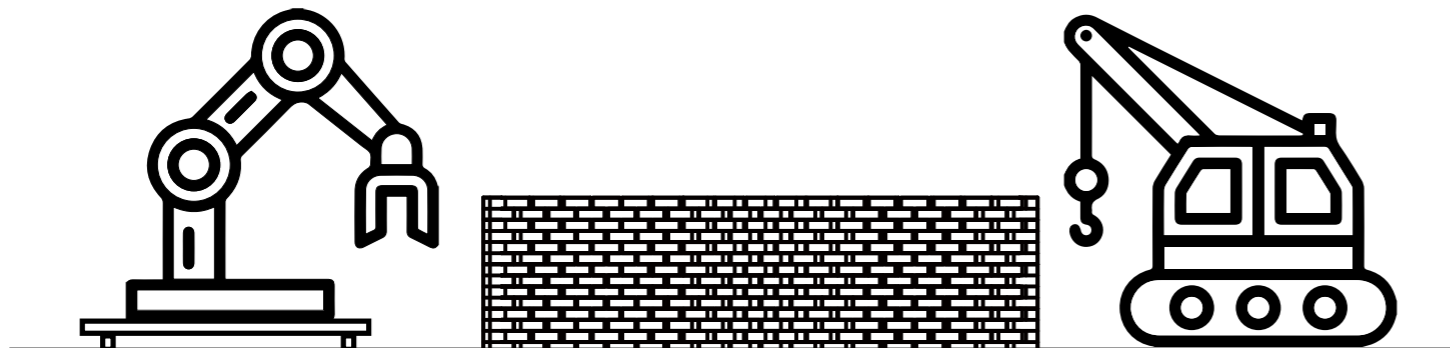
Setting up mortar boiler, robotic arm and rails on site. Calibrating for robotic arm, testing construction, preparing for fabrication

3



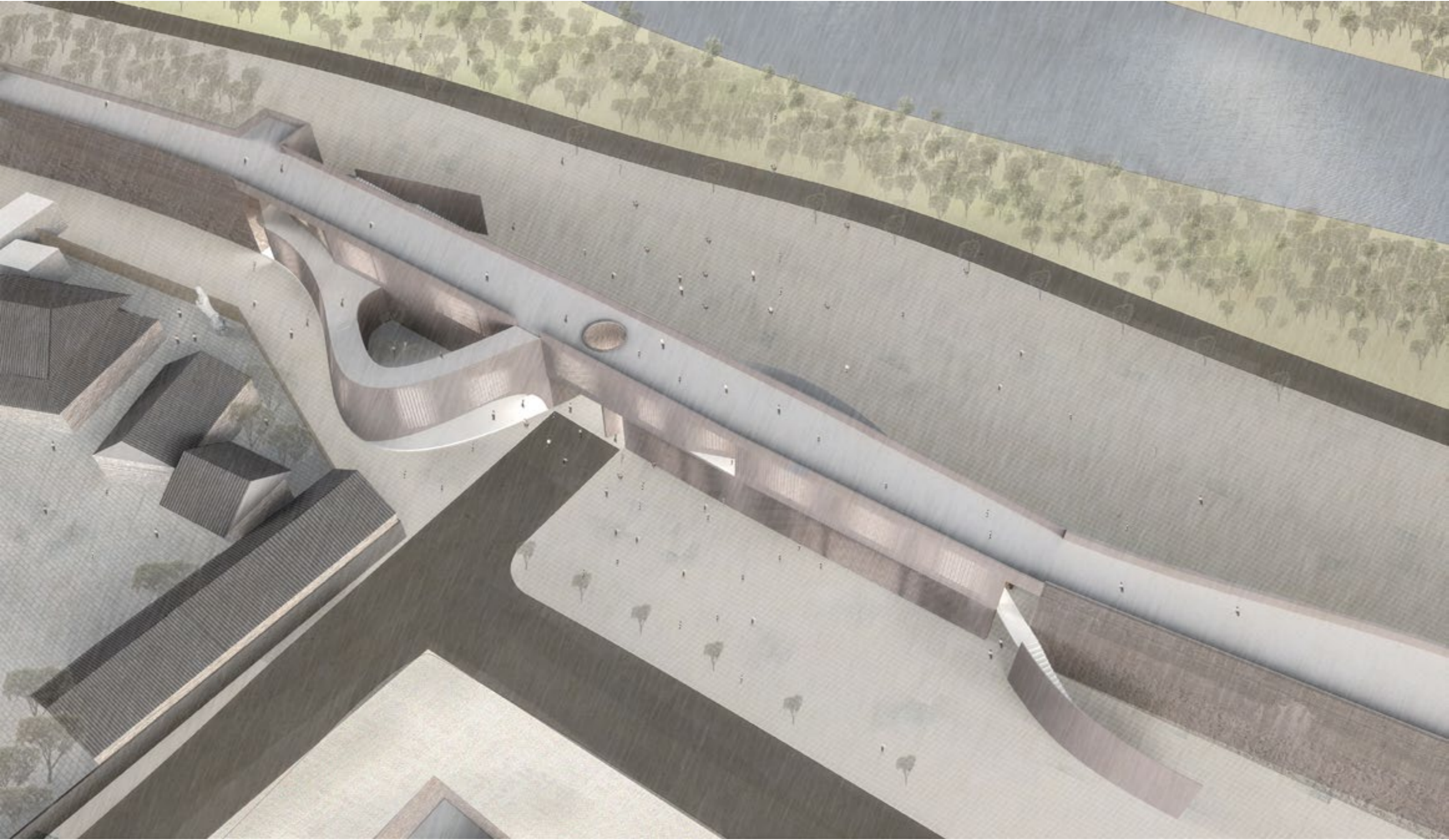
Strating construction by following computational program, local worker as supervisor to help do finishing and calibrating

4

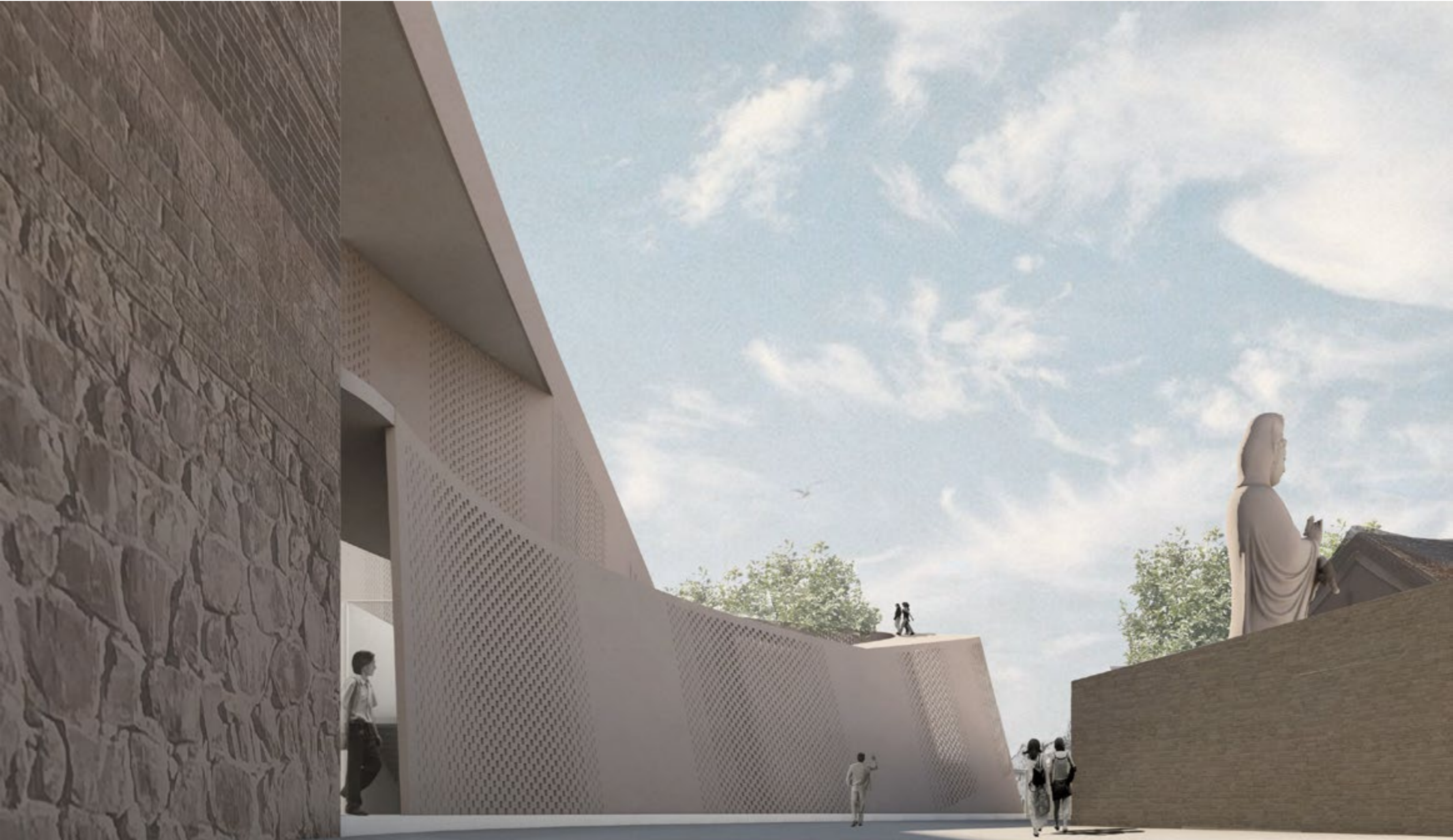


Crane truck to help assmble brick walls on second floor while robotic arm finished construction.









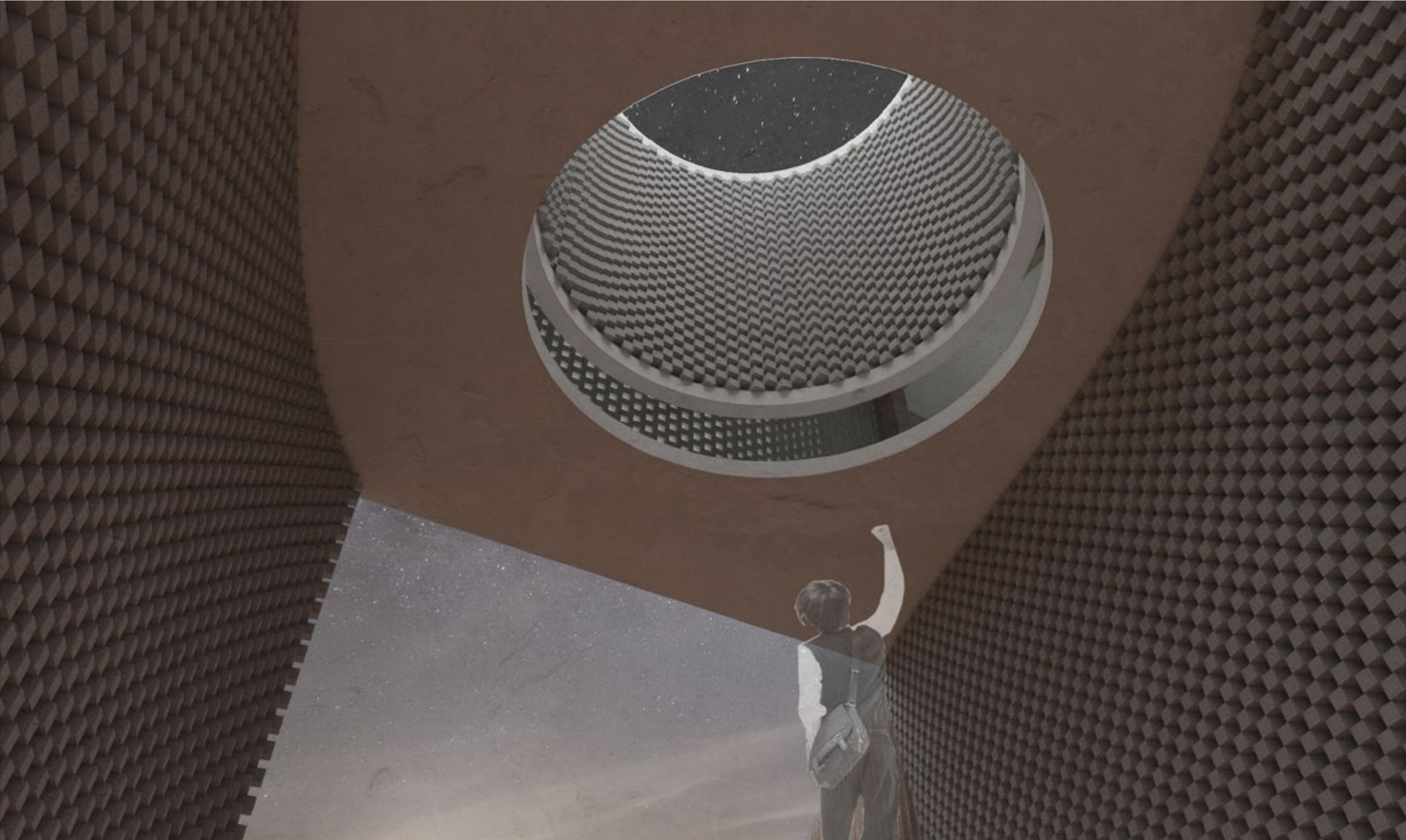












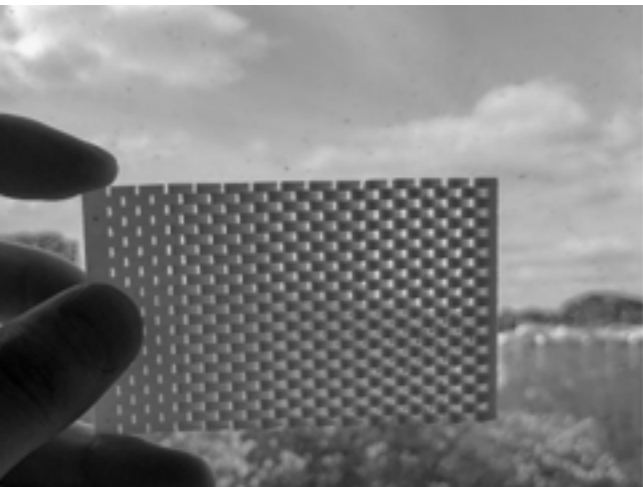
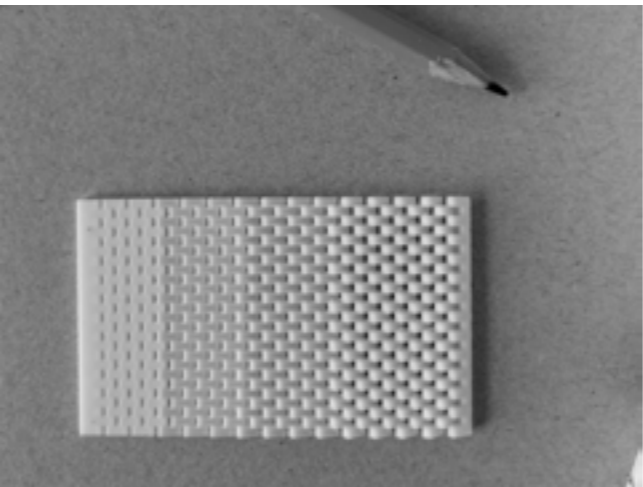
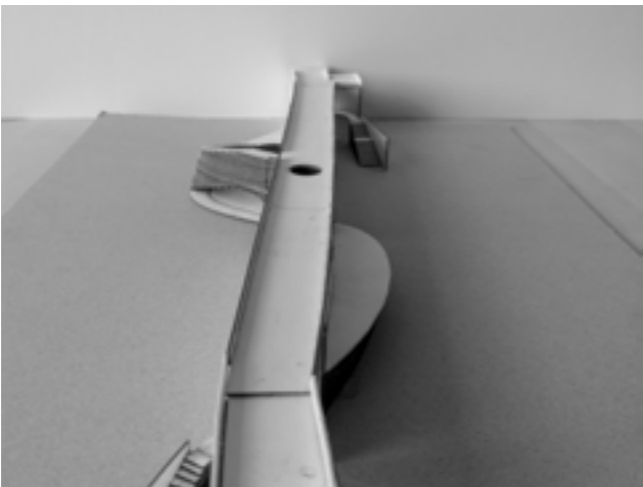
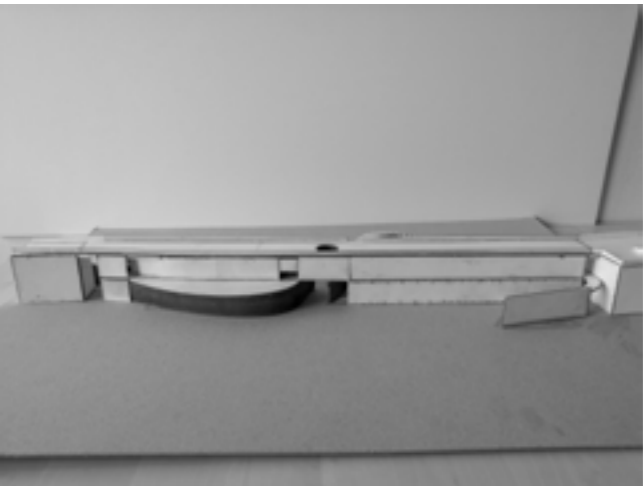
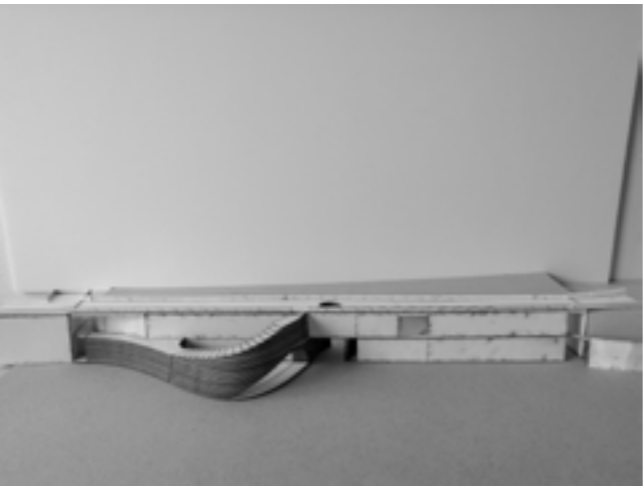
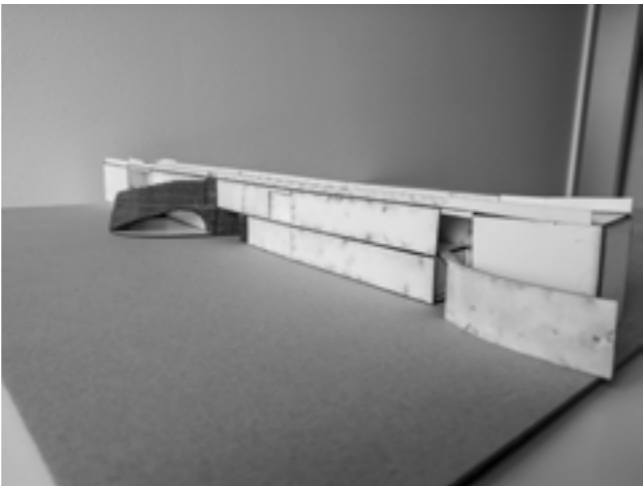
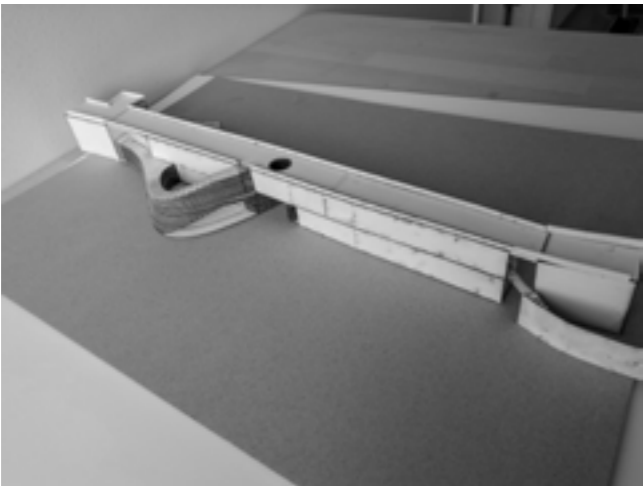






Physical Model

Form model & Rotation wall 3D printing test





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**Master Thesis Course AAHM10, Spring 2019  
Thesis of Social Architecture -  
Circular Community for Homeless**

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### **Opposition**

For Au Siu Pang's project, it has a good structure of telling a story in architectural sense. His intention is to take care of homeless people in Hongkong while also offer them a good condition to manage a better life. So, he proposed a district with residence for homeless people, exhibition area for products which produced by homeless people, and workshops. We could see many fetching scenarios about citizen life in Hongkong as well a possible lifestyle for homeless people from his project.

Basically, he selected a site where has contrast between old and new districts, or in some degree, poor and rich blocks. The site provides the potential to encourage people to merge underneath the impact of programming of masterplan design. He's been inspired by the life style on street in Hongkong then he tries to develop a new typology (in my opinion) which would create a nice and friendly environment for people living there. From my perspective, this approach is suitable for this site, but the problem is maybe the project can't embrace enough homeless people in order to solve a social issue. Since I've been told this area has over 300 homeless people yet this project as 95 single rooms, therefore, I think the usage of space is a bit luxurious. Even if a family could live within a single room that will undermine the living condition to some extent, then it will lose the point of really changing their life. So, I'm thinking what if expanding the residence part or combine the commercial part with it in order to give more capacity? Can this typology of taking care of homeless people be used at other sites regardless of contrast in context?

Secondly, his project mentions that establishing those houses by using recycled material, in spite of the question that how could this construction last, I concern about the reasonable way to build it, does it need professional people to teach homeless people since those recycled materials are not permanent. Then this concern leads another concern, who or which organization will help manage this place, how to manage it, such as how long can a person live there, how to define a person if he does not need this room after work-training.

Although I have those concerns about this project, I think that's a good start to care homeless people as well social issues.