

# **BRIDGING**

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## ABSTRACT

It all started with one of my deep memories -- when I was a child, and first saw QINGMING FESTIVAL, a masterpiece created by great painter, Zhang Zeduan, I was attracted by the riverside city scene of Song dynasty, and was surprised by the amiable atmosphere among citizens' social life and the comfortable sense of urban scale. This memory has deeply affected me.

In contrast, our Chinese newborn modern cities become dreadfully alike, with their monotonous expansion, and meanwhile, they gradually lost their intimate sense of scale and regional sense of identity that they once had.

Bridge, as one of Chinese infrastructural development, not only indicates the Chinese urban development in history, but its role and responsibilities go beyond its proper functions. No matter who we are, ancient Chinese or modern Chinese, their love for the bridge have beyond the practicability of the bridge itself. The bridge has a deep cultural heritage in a sense.

Since such issues have arisen in our contemporary cities, why not date back to the origins of Chinese cities development -- to reinterpret the function of bridges so that reshape the scale of entire city by using modern architectural language?

## ACKNOWLEDGEMENT

I deeply thank my thesis chairman, Prof. Heiner, for being my thesis guide and supporting me throughout, for your countless encouragements and for always pushing me to strive for the best. I would also like to thank my two other committee members, Prof. Jim and Prof. Katie, for their valuable suggestions and guidance.

I would like to thank my parents for their endless love and care, and all that they have given to me and made me what I am today.

I would like to thank my friends, and everyone else who helped me throughout the thesis. I feel blessed to have all of you around.

Thanks all of you. I wouldn't make it without all of your support.

— *Ye Kong*

*Dec 2018*



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## **DEEP IN MY MEMORY**

Urban Scale and infrastructure in China

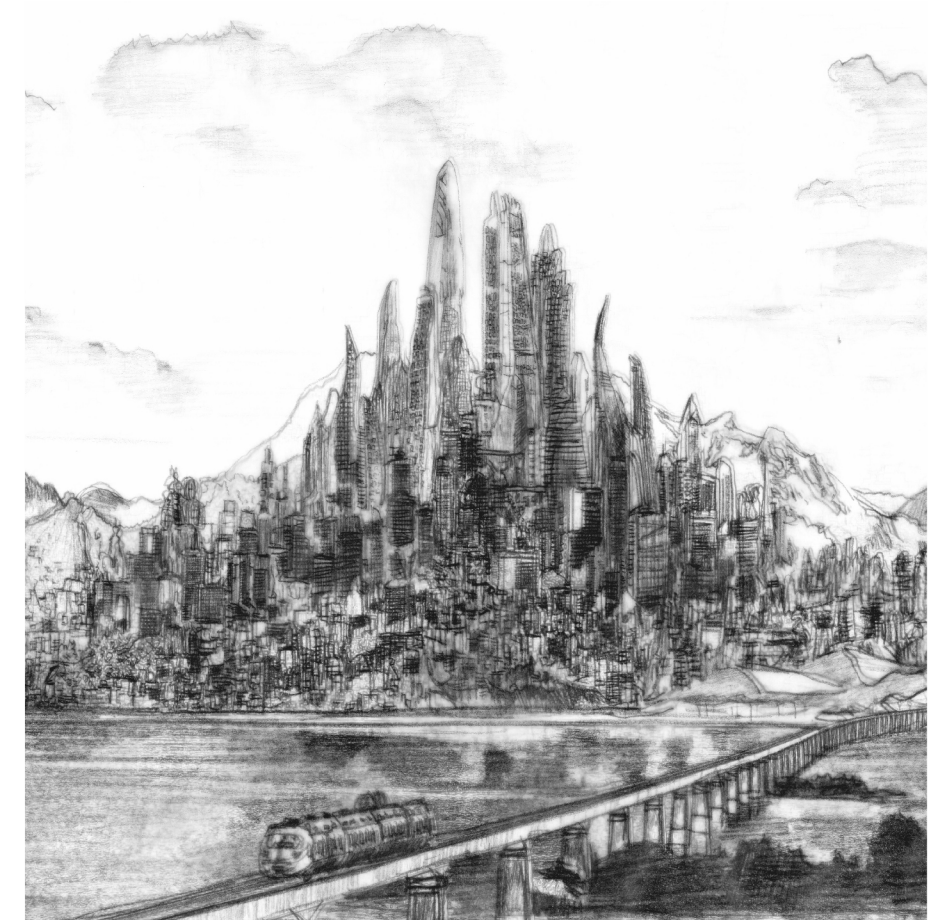


*Intimate and harmony sense of scale*

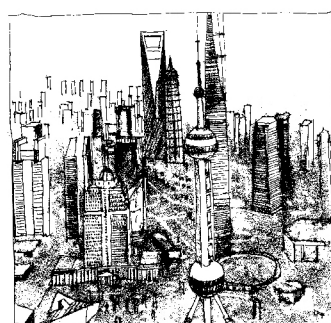
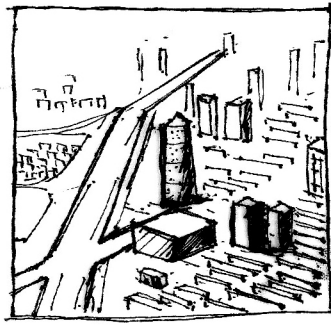
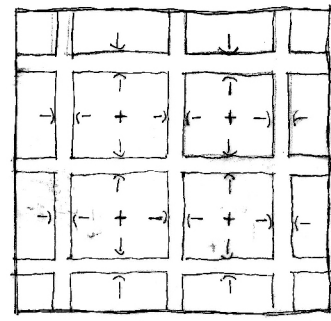
#### **Lost of intimate sense of scale and identity**

The city has always been constantly evolving, at flux and ever-changing. It is not a static object in space, but a living organism in time. Historically humans built cities along the rivers for convenience of transportation and availability of resources. As time goes by, they find other ways to build across the rivers and mainland to meet their requirements. The city is in the process of reorganizing itself, redistributing density of buildings, population and activities. City prosperity, sense of scale and identity come from the daily growth and development.

Many metropolitan areas in China also experience this radical change. Many newborn cities rise over at yesterday's farmland in a very short time period. The architecture and urban planning make most cities dreadfully same, by pursuing broad roads and huge buildings. Numerous newborn cities lose the sense of scale and characteristic that grown places often offer. The current rapid growth of cities brings often a sense of discomfort instead of harmony.



*Uncomfortable sense of scale in newborn city*



*Super wide roads and giant-scale buildings*

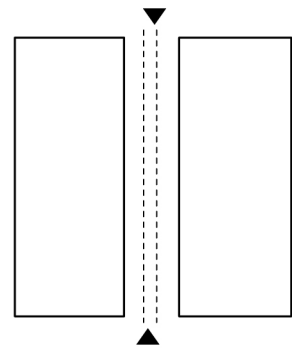
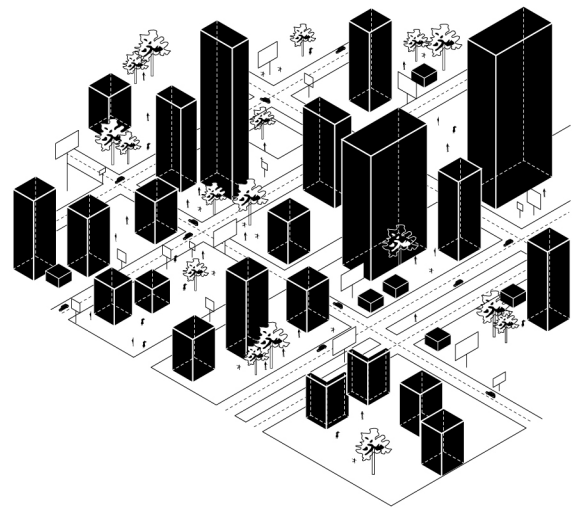
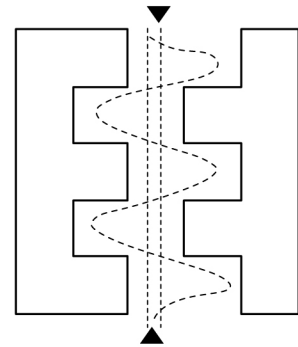
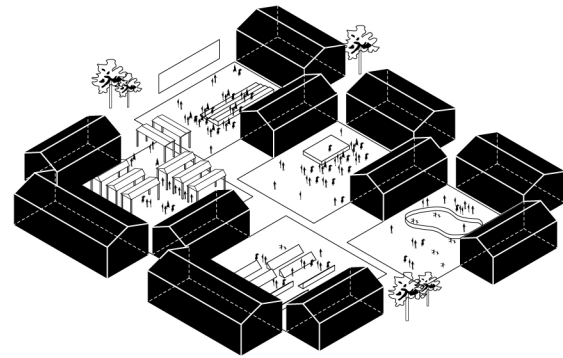


*No space to stop over or interact with others*

### **Uncomfortable sense of scale**

The monotonous expansion of modern Chinese cities with their super high-rise buildings and broad roads everywhere compress people's living spaces and social spaces. Citizens don't know where to go when they stand in the middle of broad crossroads.

When I walked in the street of Shanghai the first time, I was terrified by the super-wide roads and extremely huge buildings. The giant-scale buildings often make people feel small and depressed. Shanghai is, in this sense, a metropolis without identity.



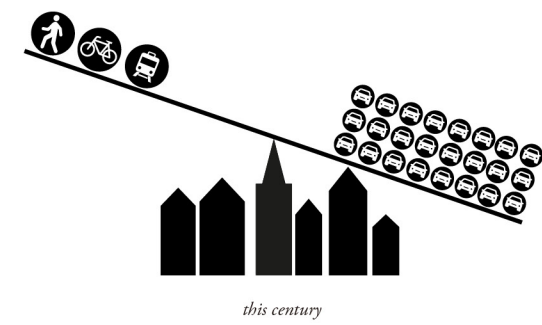
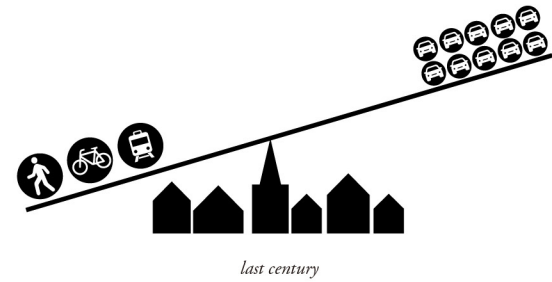
*The bridge -- one of the key infrastructural development*

**Lack of pedestrian pathways and social interaction spaces**

Social interaction spaces which a city once had are neglected in favor of broad roads and highways. Architecture is no longer integrated into the urban context,

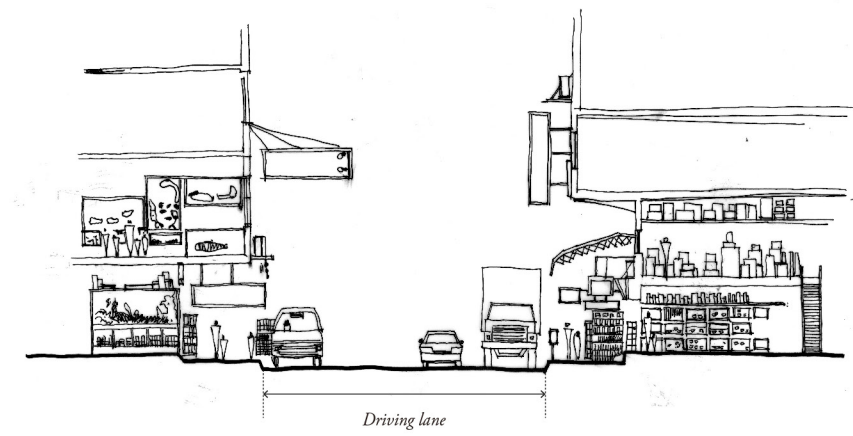
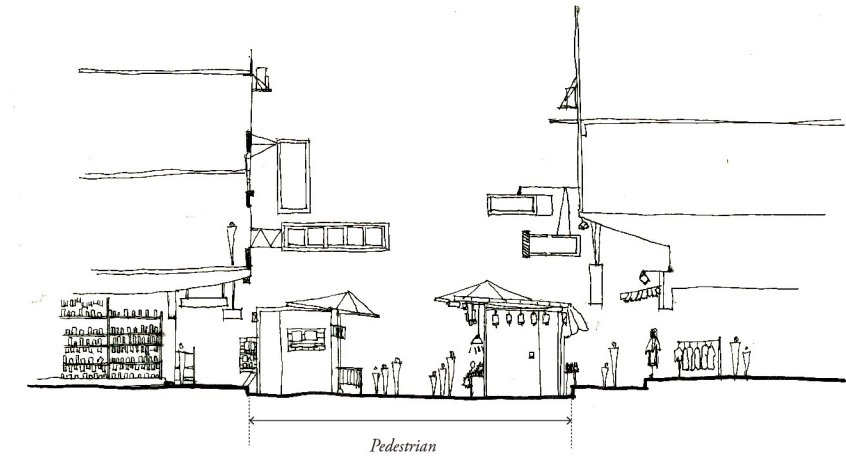
instead solitary buildings are like independent containers, no longer a part of the city. Spaces for recreation for the pedestrian are the traffic island.

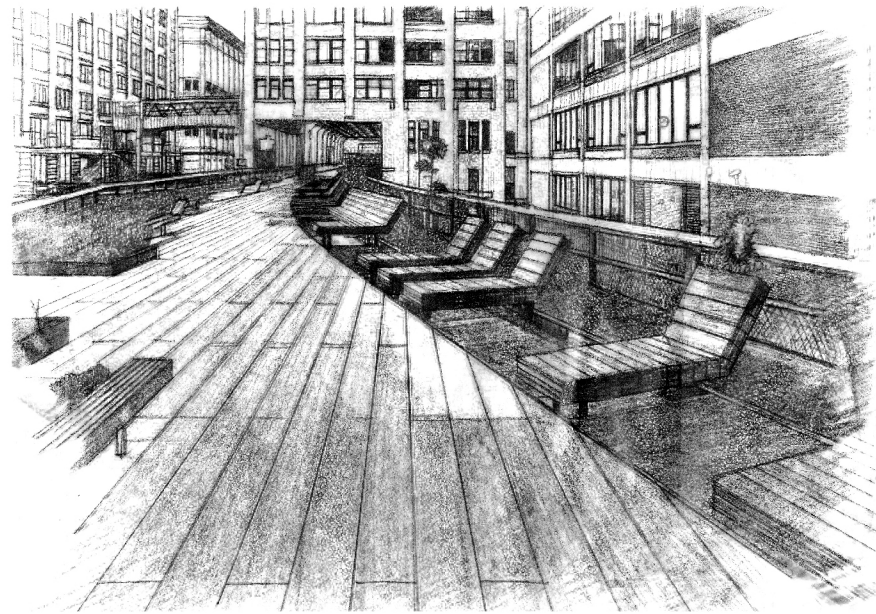




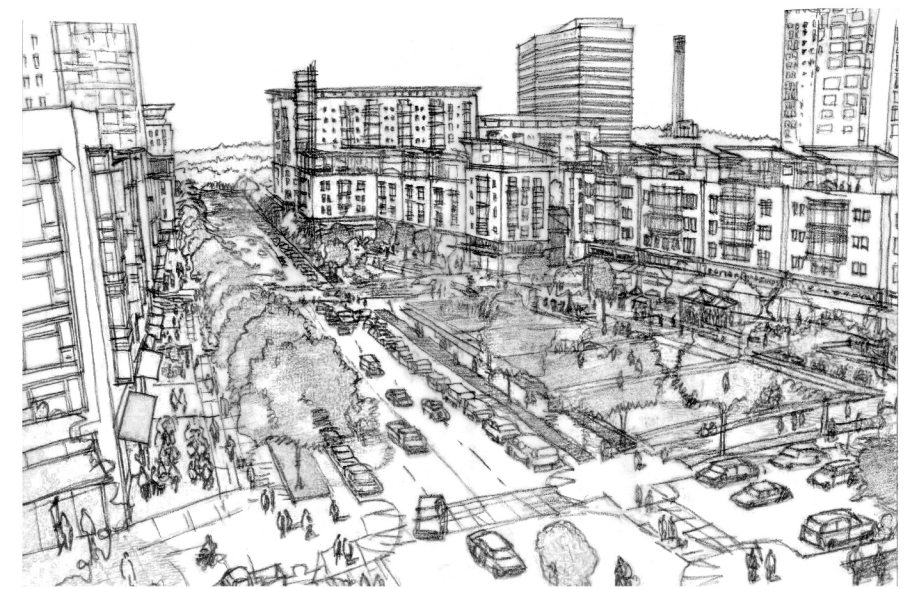
The lack of pedestrian pathways is mostly due to the automobile centric development.

Social interaction spaces, pedestrian way and amiable atmosphere of a positive urban context disappear.





*Pedestrian friendly and interaction inviting*

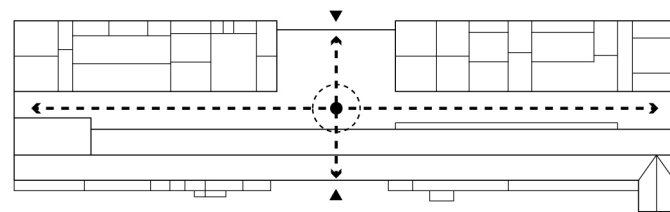
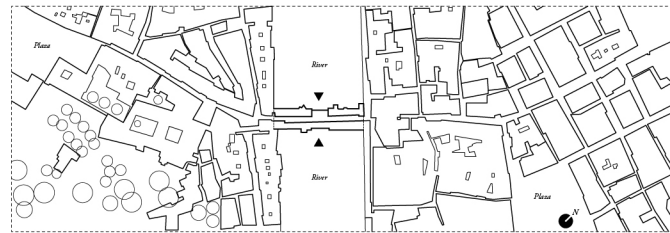
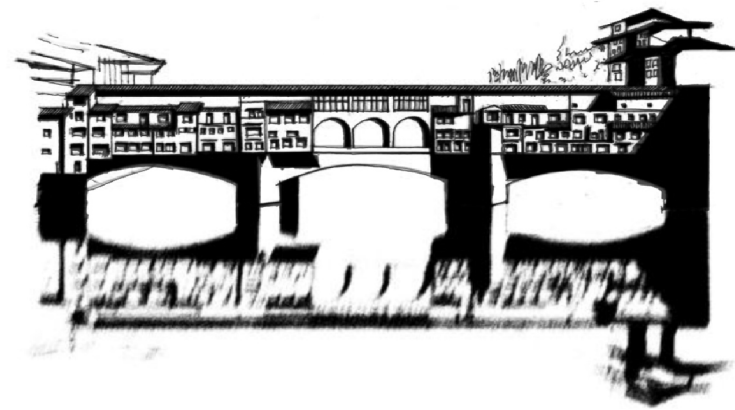


*Pedestrian friendly and interaction inviting*

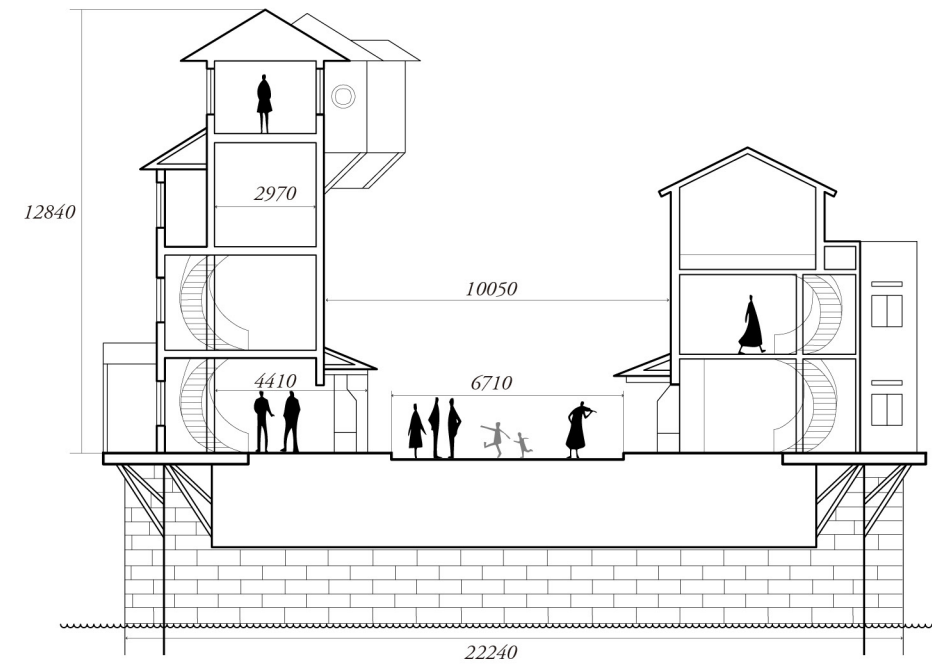


*The bridge is a traffic structure, but its role and responsibilities can reach beyond its initial utility*

We need to re-examine the infrastructural development of our modern cities. One of key infrastructural development is the bridge. The bridge plays a very important role in the history of Chinese urban development. It not only serves a city as a connector of two banks, but also indicates the development of rivers' sources and end.



*Analysis for organization and movement*

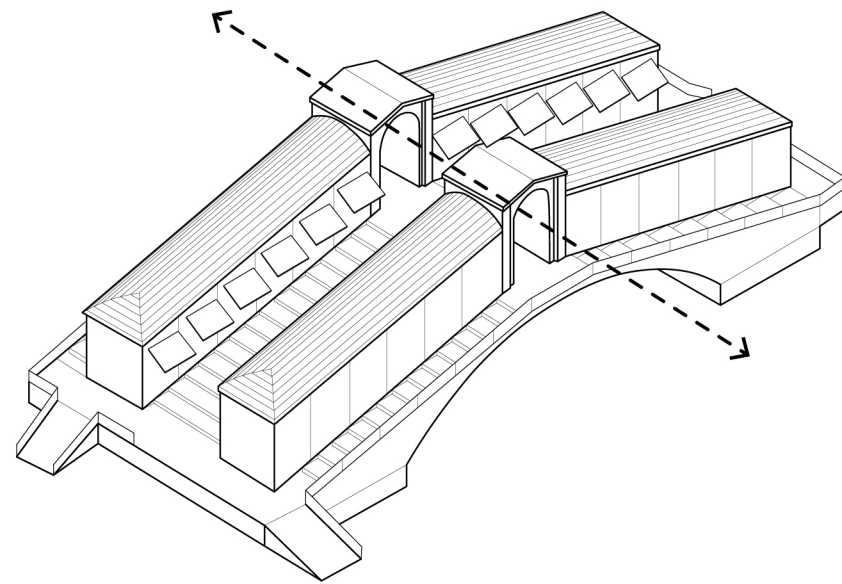


*Section analysis*

**Case study 1: Ponte Vecchio, Florence**

The Ponte Vecchio in Florence is organised in four groups, with a passage in the center and the road. This organization creates a linear movement pattern along the bridge.

The center space acts as plaza on the bridge where people can take a break to look from the bridge towards the river. Also, this configuration improves the interaction of space. It not only creates amiable atmosphere, but also contributes to a healthy urban scale.

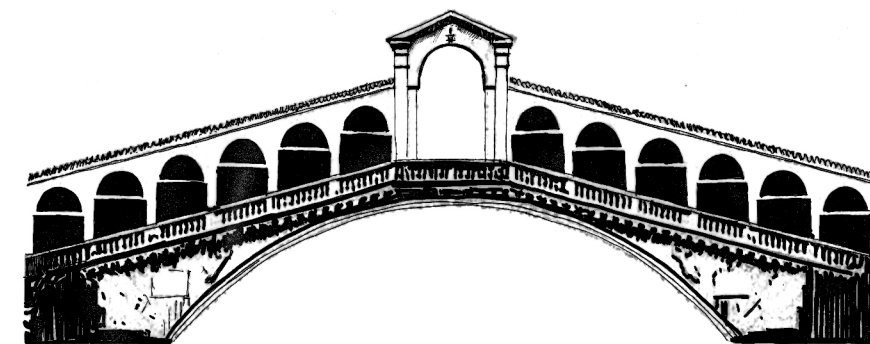
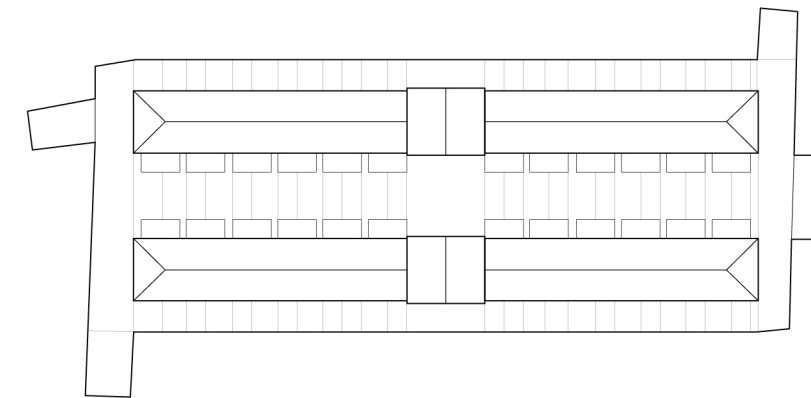


*Analysis for organization and movement*

**Case study 2: Ponte Rialto, Venice**

The bridge is organized by two parallel masses, split up by the inclined ramp in the center and also two parallel smaller ramps facing the canal on the edges. This organization also makes for a linear movement along the bridge, and the opening in the center cross connects the ramps

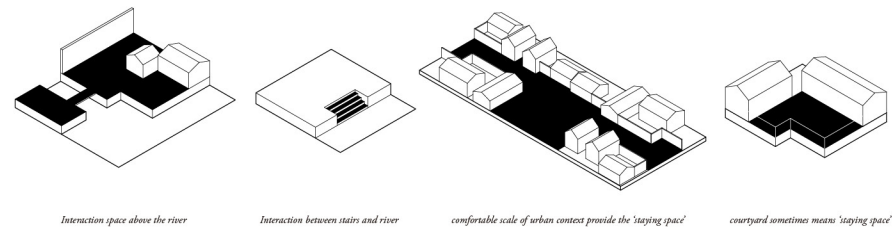
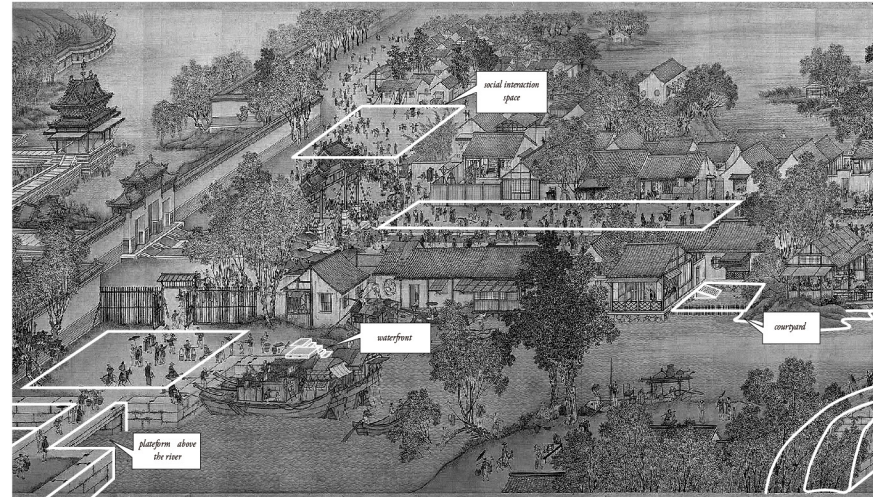
The proportions of the bridge, in terms of its height and depth, are modest, because they tend to merge into the urban context, which means, it does not emphasize visual difference with the surroundings. However, the buildings on the bridge and main body of the bridge are separated so that it creates an identity to itself.



*Analysis for facade and plan*

## **PRINCIPLES**

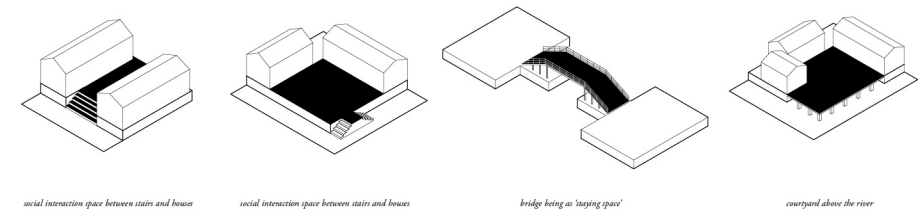
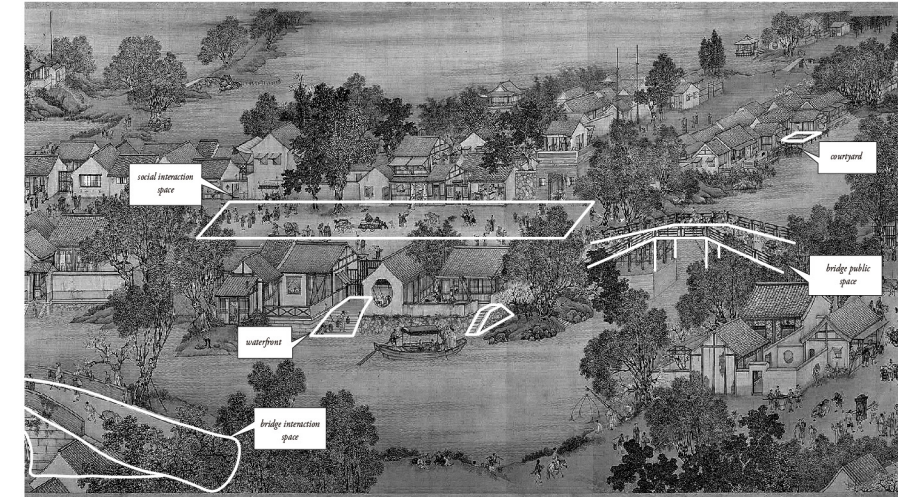
Traditions in Chinese urban planning



**The traditional Chinese city**

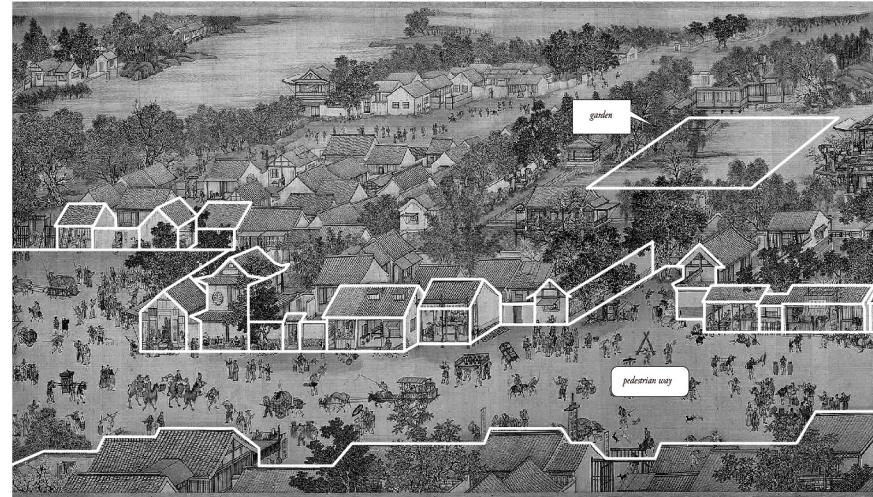
Chinese modern cities gradually lost their intimate sense of scale and its regional sense of

identity. As a future architect, I want to find a way to respond the monotonous expansion of modern cities and strengthen the ties between architecture and city in order to reshape the



urban sense of scale. Riverside scene from traditional Chinese cities provides a inspiration. This masterpiece was created by ancient Chinese painter called Zhang Zeduan. It depicts

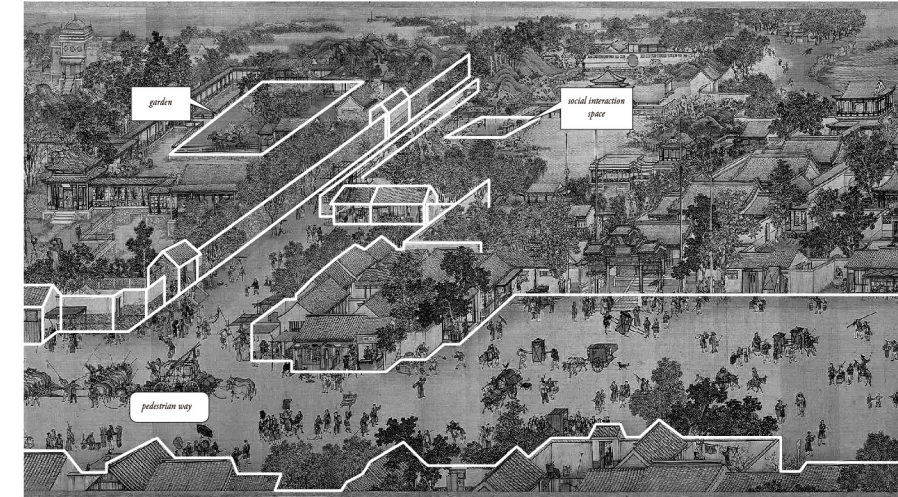
the prosperity of Song Dynasty. Behind his proficient skills, what attracts me is the amiable atmosphere among people's urban social life and the texture freely extends along riverside.



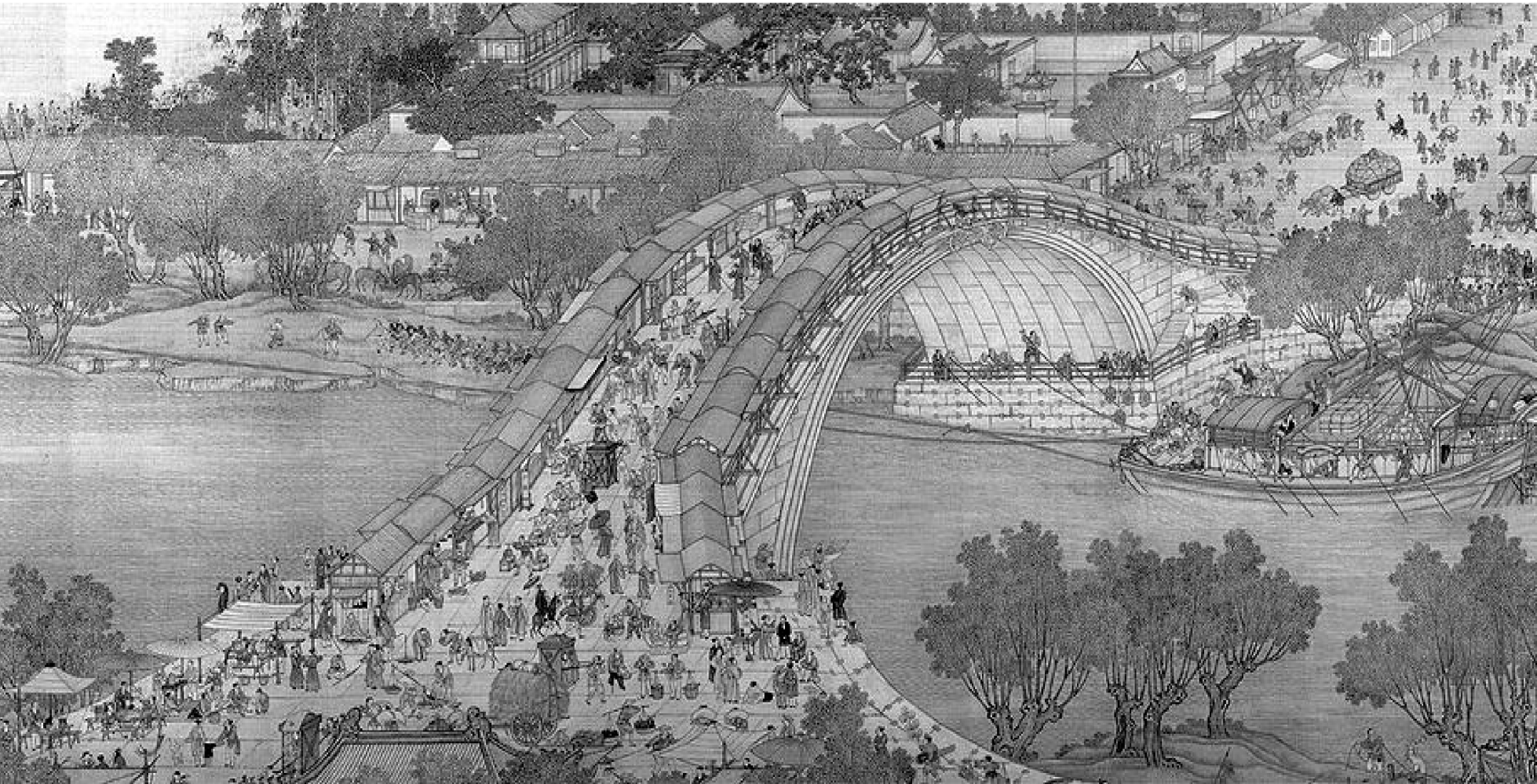
Compared to Chinese modern cities, there are no buildings with uncomfortable sense of scale and super wide roads which are just used for the movement of automobile vehicle, but instead of modest proportional shops, bazaars and residentials. These buildings freely extend along the riverside and harmoniously scaled roads go through them. The pedestrian ways also provide a lot of social interaction spaces for citizens.

In such a city scene, harmony atmosphere and intimate sense of proportion are dominant. Architecture is no longer a separated but a part of the whole urban context, creating a vibrant social corridor between the river barrier.

Based on the consideration above, I am attempting to make the architecture become a part of the whole urban context.



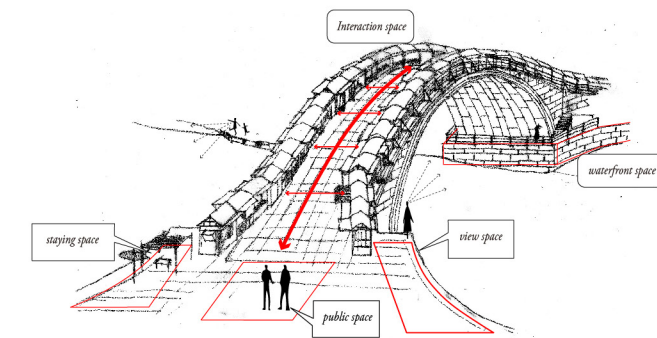


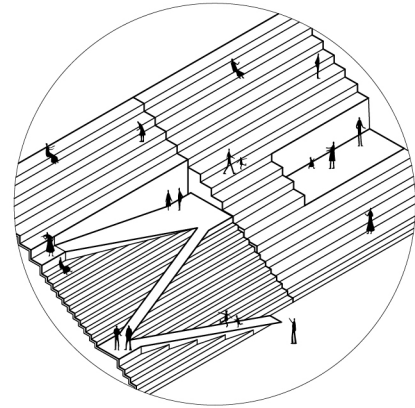
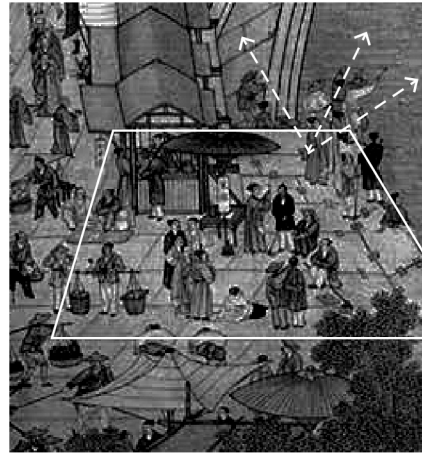


*The bridge not only melts into the whole urban context but also brings harmony and intimate sense of scale for the whole city.*

**Inspired from the bridge in QINGMING FESTIVAL**

The harmony, social life and intimate sense of urban scale which are depicted in this masterpiece are noteworthy. However, what interests me most is the bridge in QINGMING FESTIVAL. The bridge, one of key infrastructural development in our cities, allowing for a crossing, but its wider role as an urban artifact and generator of social interaction is equally important. Thus, the dividing line between bridge and architecture is blurred. The bridge not only support traffic movement but more importantly, it can operate as a social corridor for people to interact with each other.



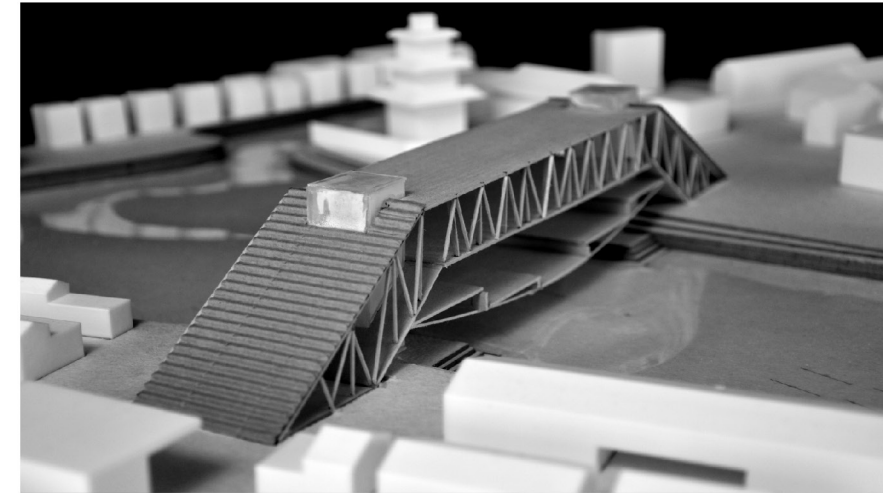


*Diagram for 'stop over' space*

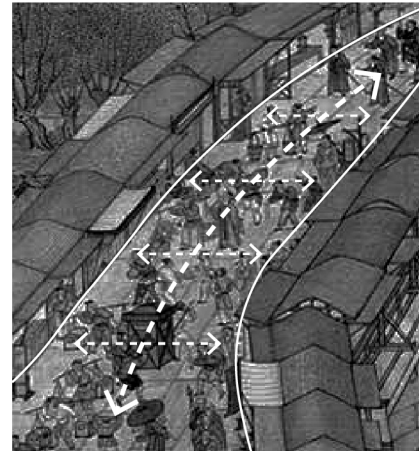
### **'Stop over' space**

In QINGMING FESTIVAL, we can find that the landing part not only offers a place for citizens to go up to the bridge's top, but also provides wide spaces for people to stop over, and to congregate. It is easier for people to enter into buildings on the bridge like shops and markets, while people can enjoy a beautiful view of the river. This kind of 'stop over' space actually improves the interaction between people and the bridge, which corresponds with issues of urban sense of scale. As mentioned before, the paucity of 'stop over' space

and unconsidered walkways often lead to an uncomfortable sense of scale. Therefore, I am trying to extract and transform the design elements of the landing area to improve the interaction. These openings on the landing stairs provide entrances for citizens to get into the different areas of my bridge, and also support a wide space to interact with each other and enjoy the beautiful view of the river. 'S' shape ramps not only connect all of openings, but also divide the whole landing stairs into different parts as additional places for social interaction.



*Model for 'stop over' space*

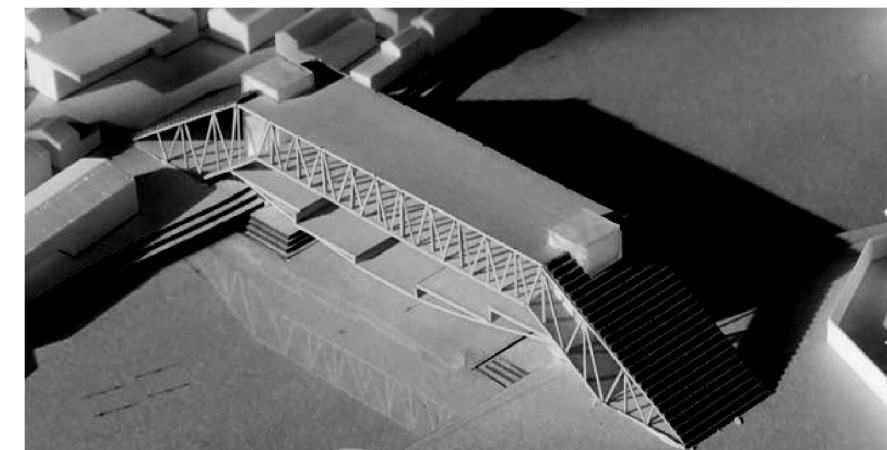
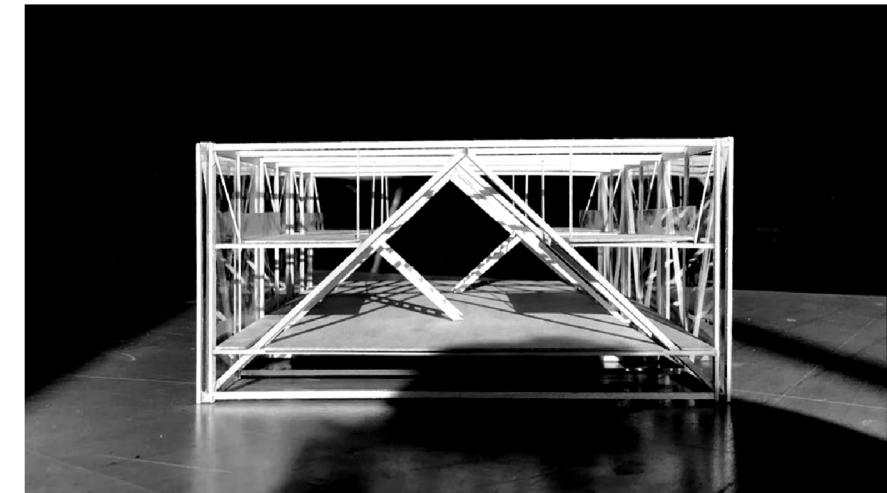


*Diagram for interaction space*

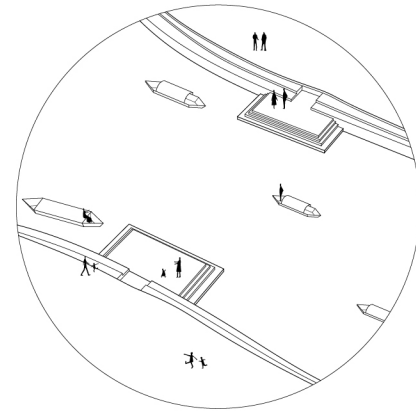
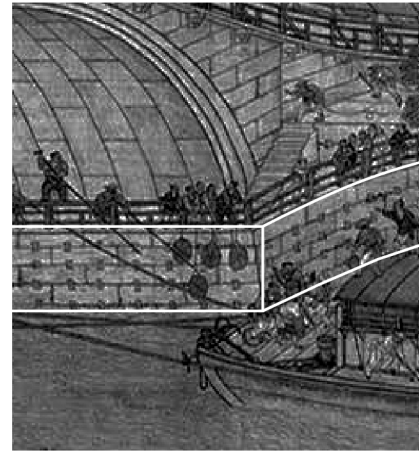
**Interaction space**

The bridge in QINGMING FESTIVAL is split up to two groups of buildings so that the traffic road is in the center. This organization creates a linear movement along the bridge. The two groups of buildings are shops, markets and traditional bars, which open to the center area of the bridge. Citizens heading into the center will be attracted by these commercial activities and meanwhile, they also carry out several simple trades between each other on the bridge.

Thus, people will stay on the bridge for a longer time so that improve their interaction with each other. However, these commercial buildings are actually independent of the bridge, which merely offers a place for interaction rather than operating as a multi-functional architecture. My bridge is an architecture with different commercial functions in different layers. Vertical stairs go through every layers to foster people's interaction.



*Model for interaction space*

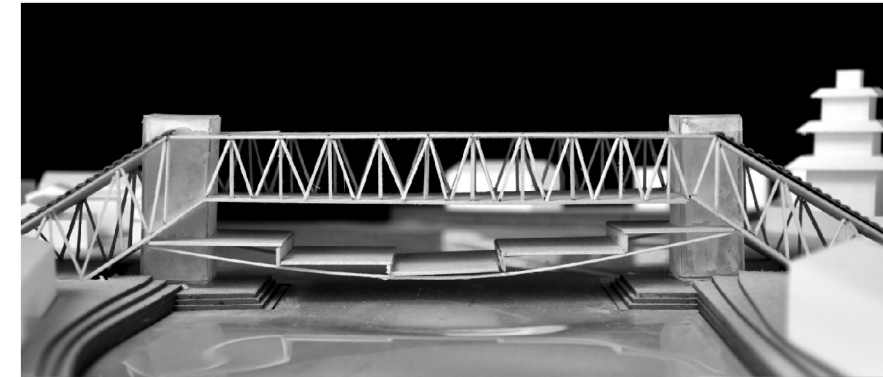


*Diagram for riverwalk space*

### Riverwalk space

The riverwalk space is also a kind of interaction space between the bottom part of the bridge and the river. It provides a congregation place for citizens' social activities. The bridge in QINGMING FESTIVAL has a certain height difference from river surface. Traditional Chinese people use the giant pier structure to deliberately create a special interaction space to enjoy the harmony atmosphere of river activities. By extracting and translating this kind of approach, I hope that my riverwalk space could offer and

better present the river. An oblique space is formed between the bridge landing when it makes contact with ground. The huge steel structure nodes are a tangible attraction to touch the bridge and form a dynamic space. When people stand on the intersection of horizontal space and vertical space, they will feel that the riverwalk space is going to extend to the center of river. This approach not only can provide a better platform for citizens to see water activities, but also can increase the interaction between citizens and the river.



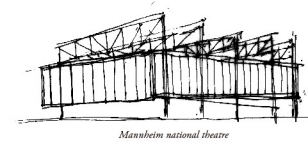
*Model for riverwalk space*

### Traditional Chinese opera stage

The traditional Chinese opera is a very important ritual activity. Especially during some special festivals, bridges will become a crucial place for citizens to celebrate. Although Chinese modern opera gradually evolved into a commercial art performance, it is still an indispensable part of people's spiritual life. A theater in the bridge is formed with tensile members which connect with steel truss. The theater volume is suspended.



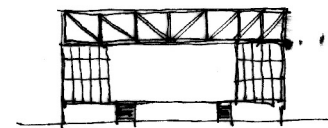
*Model for Chinese opera stage*



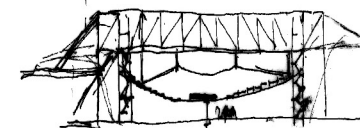
*Mannheim national theatre*



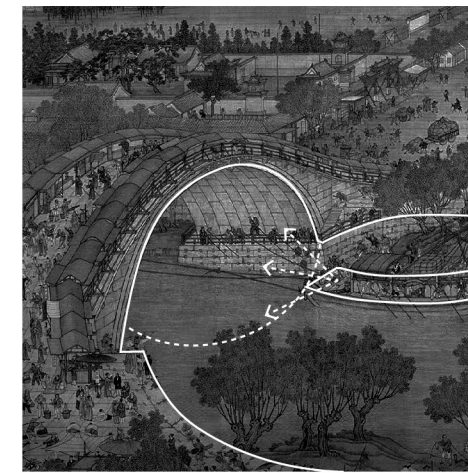
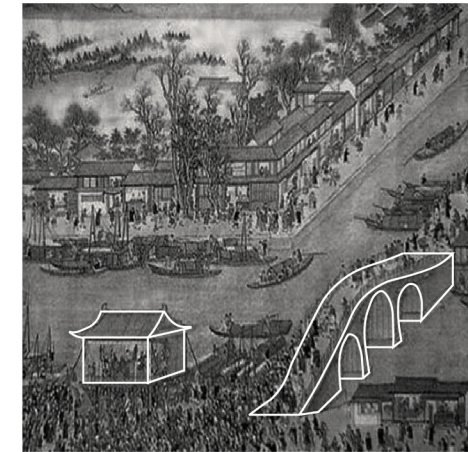
*The theater is suspended by steel columns.*



*The hall is suspended between two towers, its floor sloping gently toward the center of the space.*



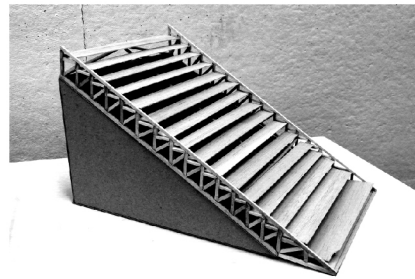
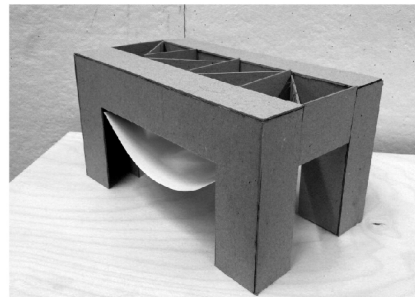
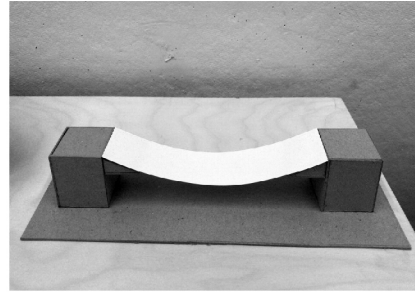
*Why not suspend the floor of my theatre?*



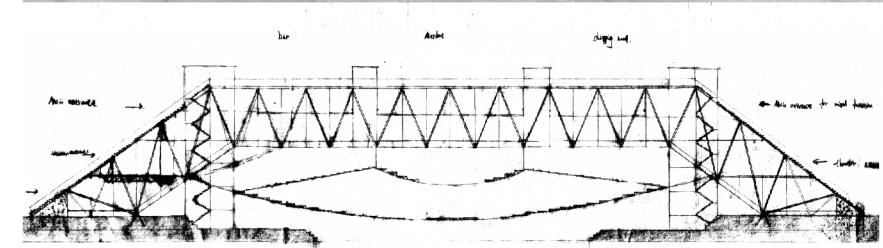
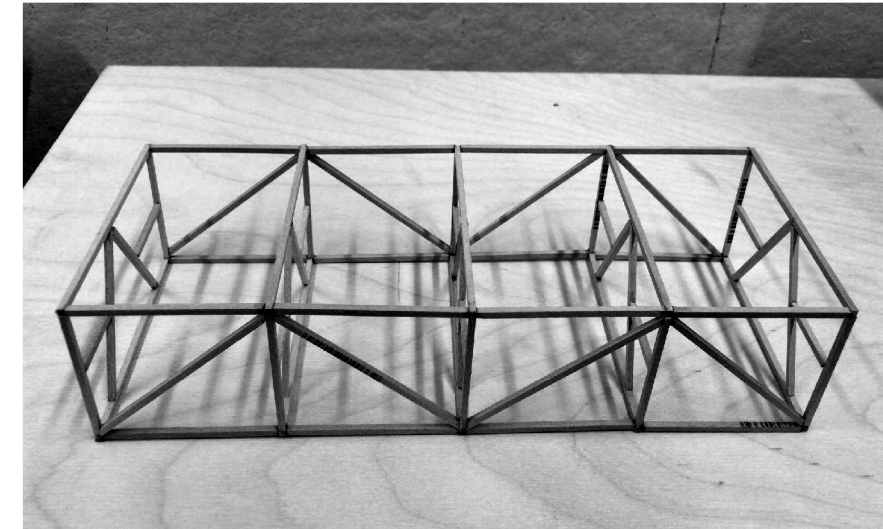
*Analysis for traditional Chinese opera stage*

## **STRUCTURE AND SPACE**

Inquires of structure and spatial test



*Conceptual models for studying the structure of the bridge from concrete to steel*



*Study of steel truss*

**Test and study for bridge structure**

The proposed bridge includes three main parts-landing area, center part across the river and suspended opera stage. Several models test for

structure and steel truss to build the main body of the bridge. Tensile members suspend the theater to make it float lightly across the river visually.

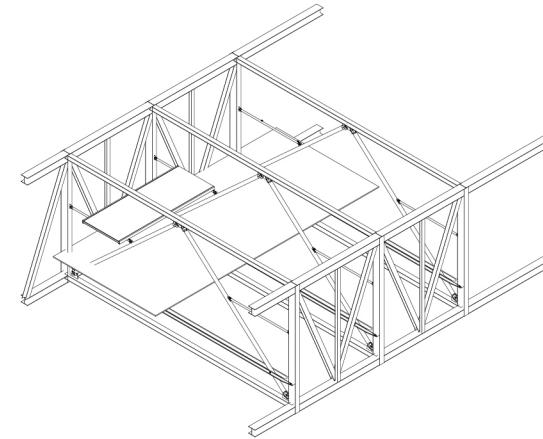


**Bridge structure**

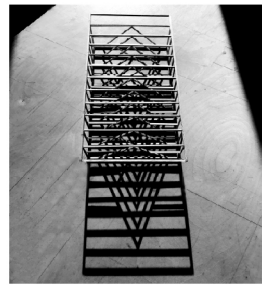
The steel truss is conceived as an elegant bridge shape across the river. In order to keep the entire structure of the bridge stable, two diagonal steel beams are added in each steel truss frame, so that I can create a kind of centric framed spaces.

The truss is a structure that consists of two-force members only, where the members are organized so that the assemblage as a whole behaves as a single object. Trusses typically are comprised of five or more triangular units constructed with straight members whose ends are connected at joints referred to as nodes. A truss can create a very interesting moment with light and shadow.

*Structural study | Steel truss and tensile members  
Steel truss framed the main body of bridge*



*A special moment from 'V' shape truss*



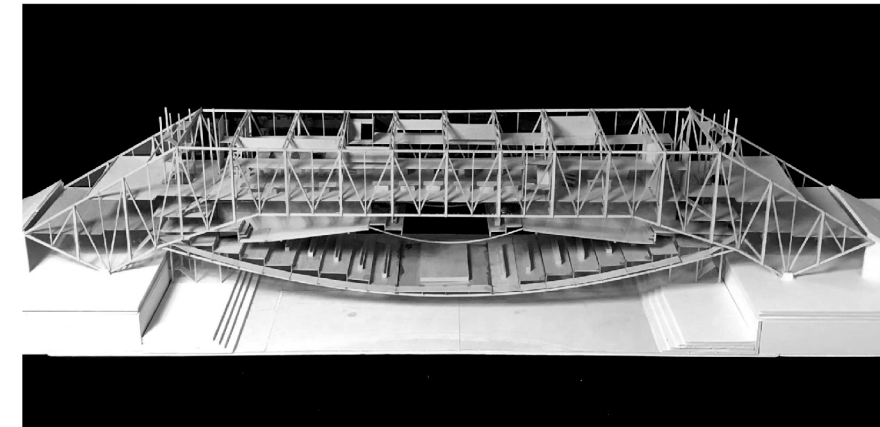
*Model for steel truss*



*Model for steel truss*



*Model for steel truss*

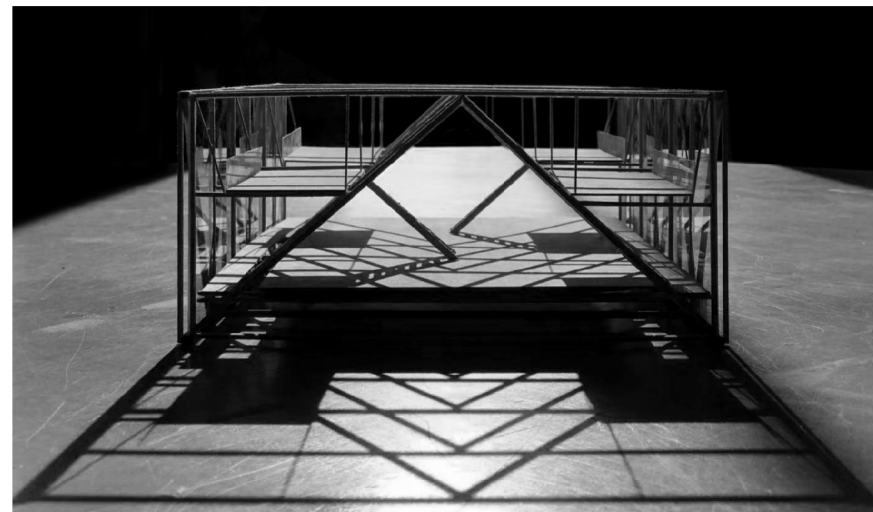
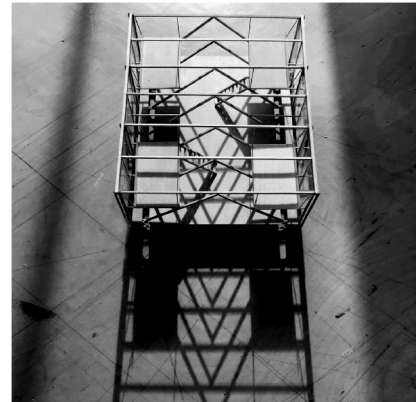


*Model for steel truss structure of the bridge*

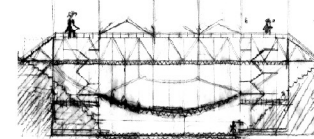
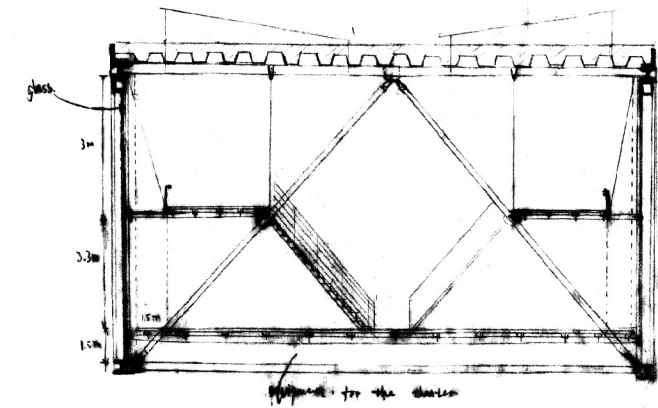
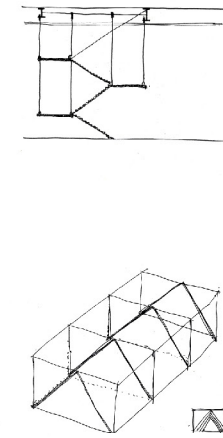


**Spatial study**

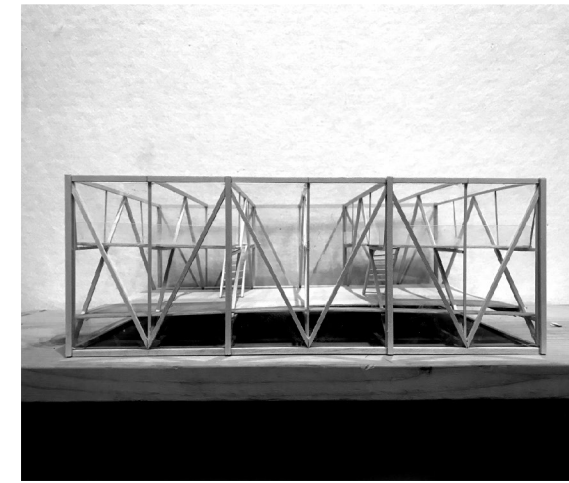
The space which is consist of the steel truss, which offers different functions with the aim to foster the interaction between each. This mezzanine space is an intermediate floor in a building which is partly open to the double-height ceilinged floor below. Mezzanines offer a good view onto the lower space. Segmentation with geometrical proportion is attempting to provide a harmony of scale and of spatial experience.



*Model for spatial study*



*Sketch study for space*

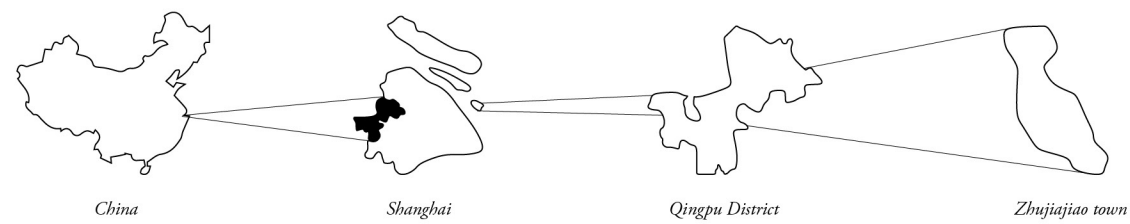


*'V' shape steel truss from outside*



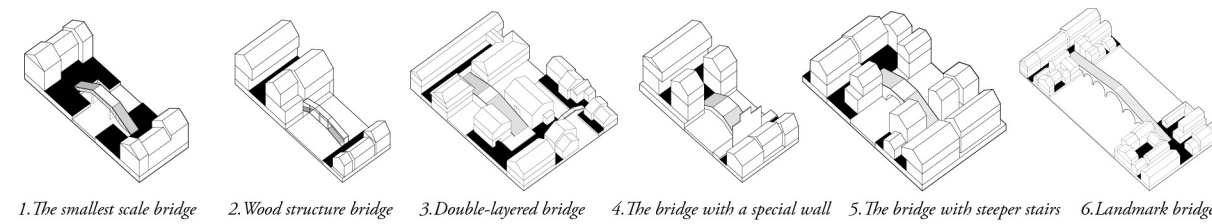
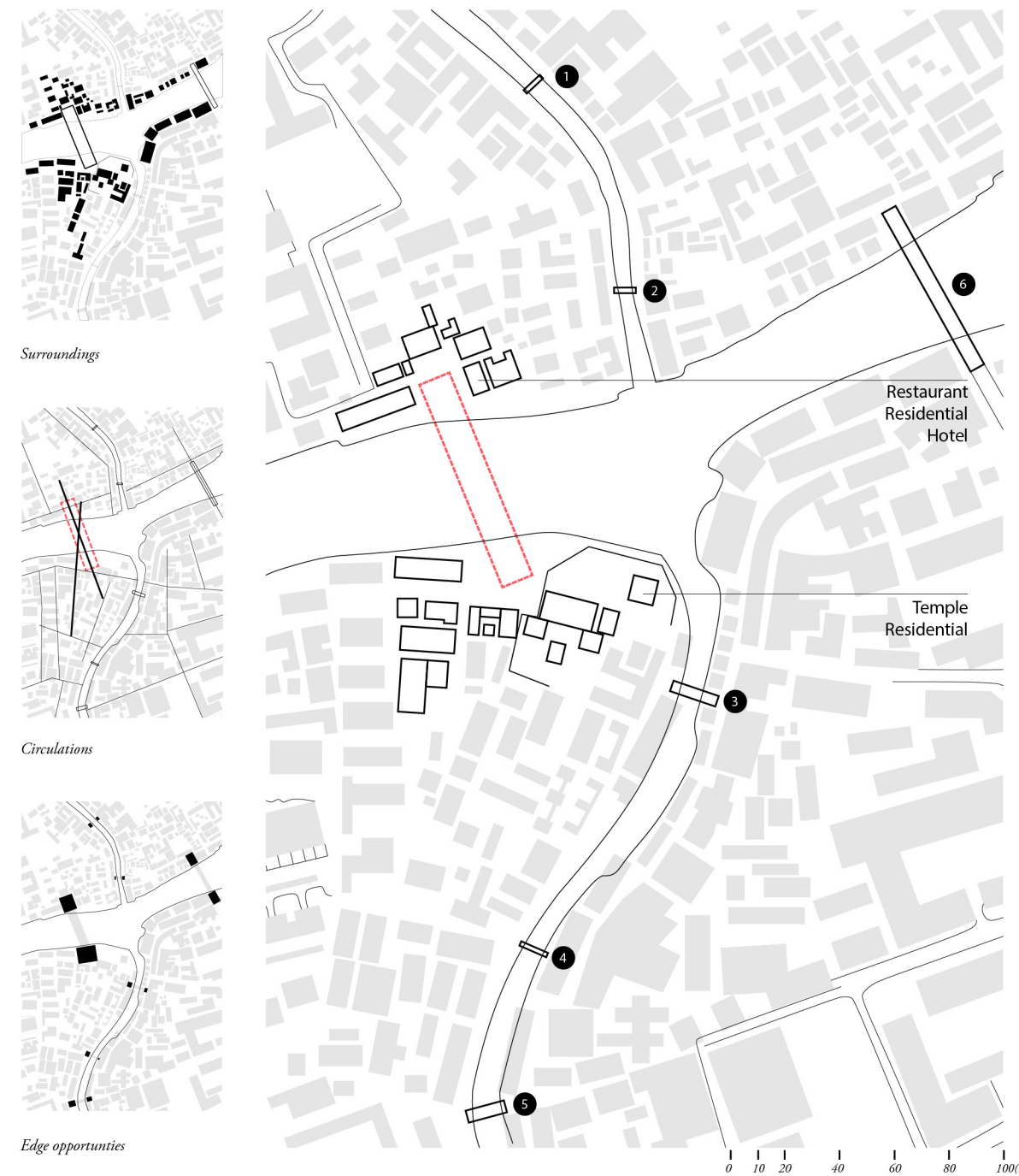
## BRIDGING

The story of a special architecture and sense of scale and identity



**Site analysis I**

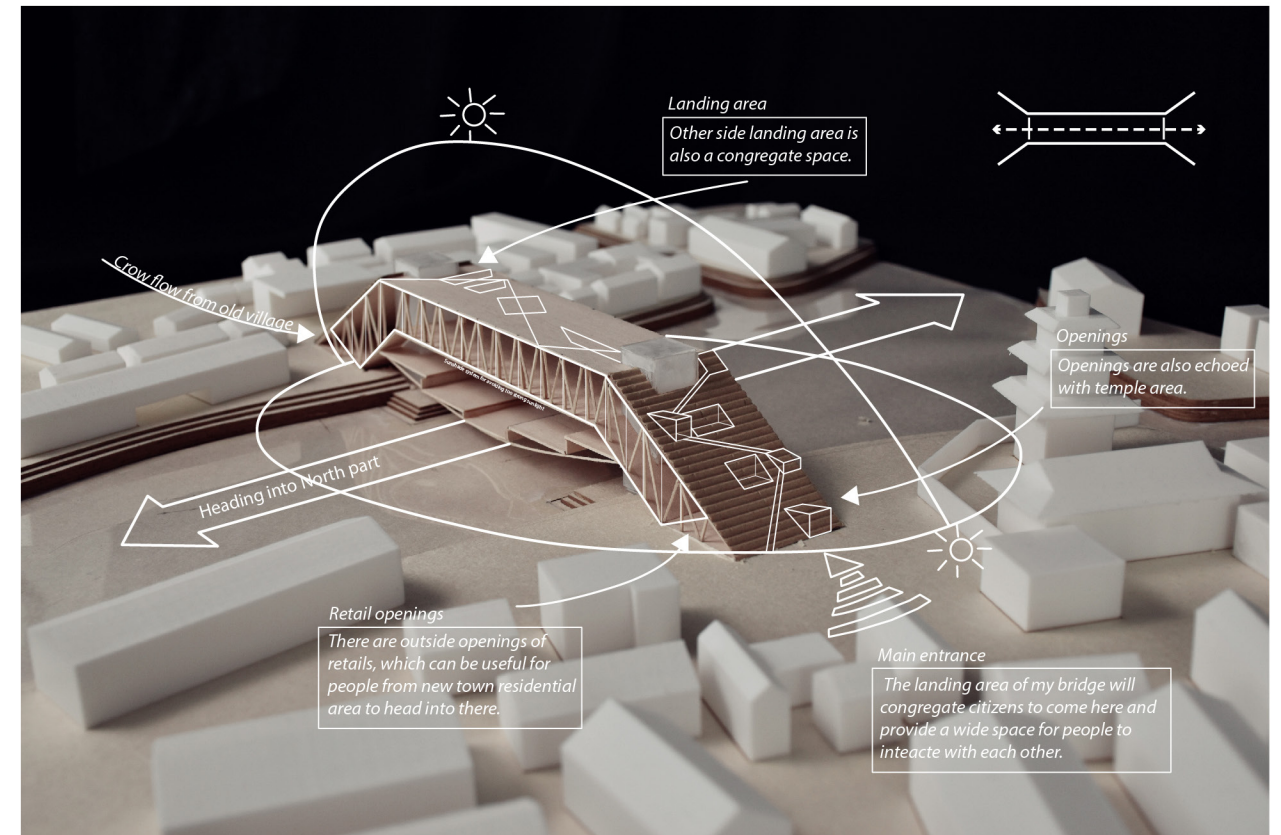
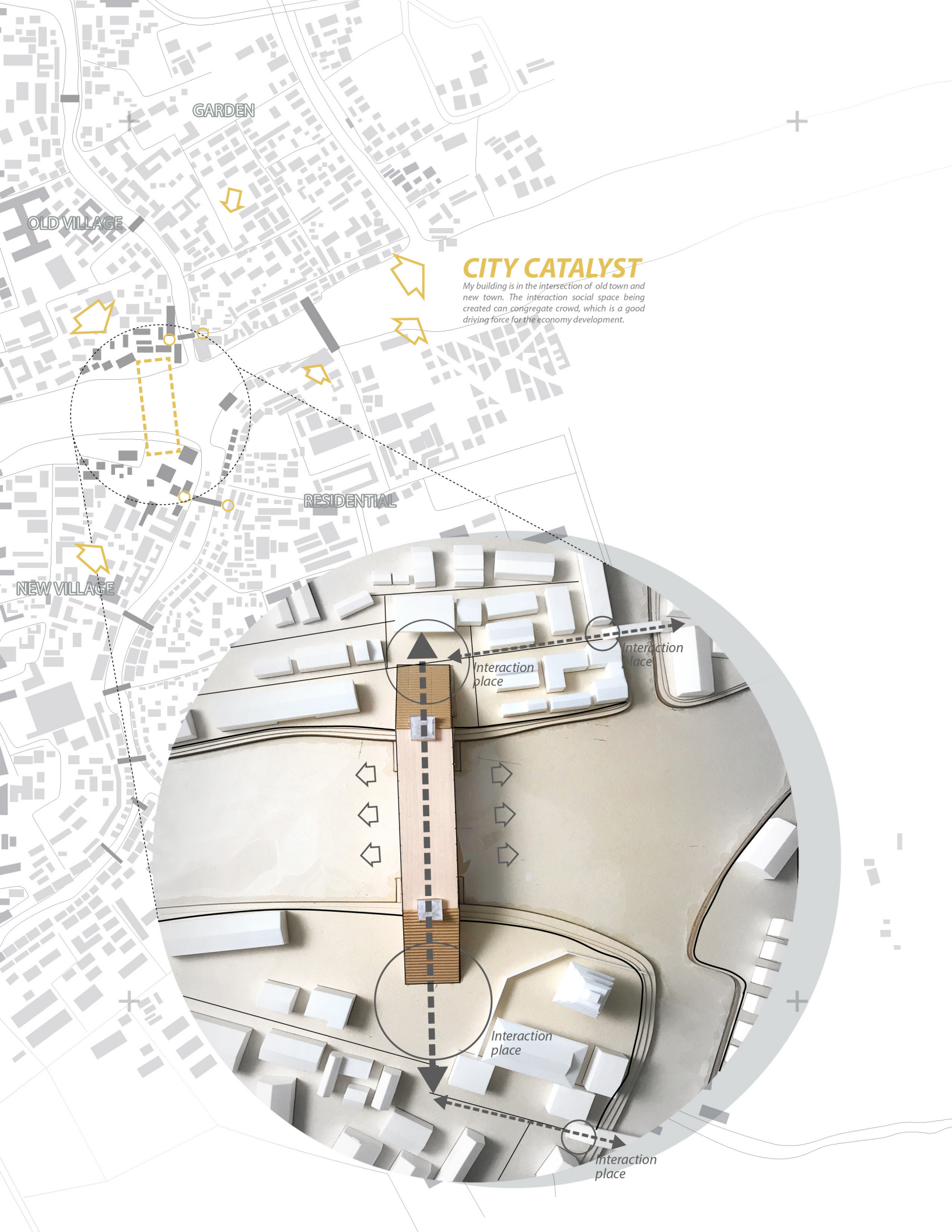
The site lies between the old town of Zhujiacao and new residential developments, between existing crossings of the Fangsheng Bridge (a landmark since 1571) and the Caoping Rd. Bridge (a low-key modern road bridge). Given that the bridge should establish a relation with the historical and calm surrounding, and its functions area inside also are supposed to be the supplements for the both sides of the river.



**Site analysis II**

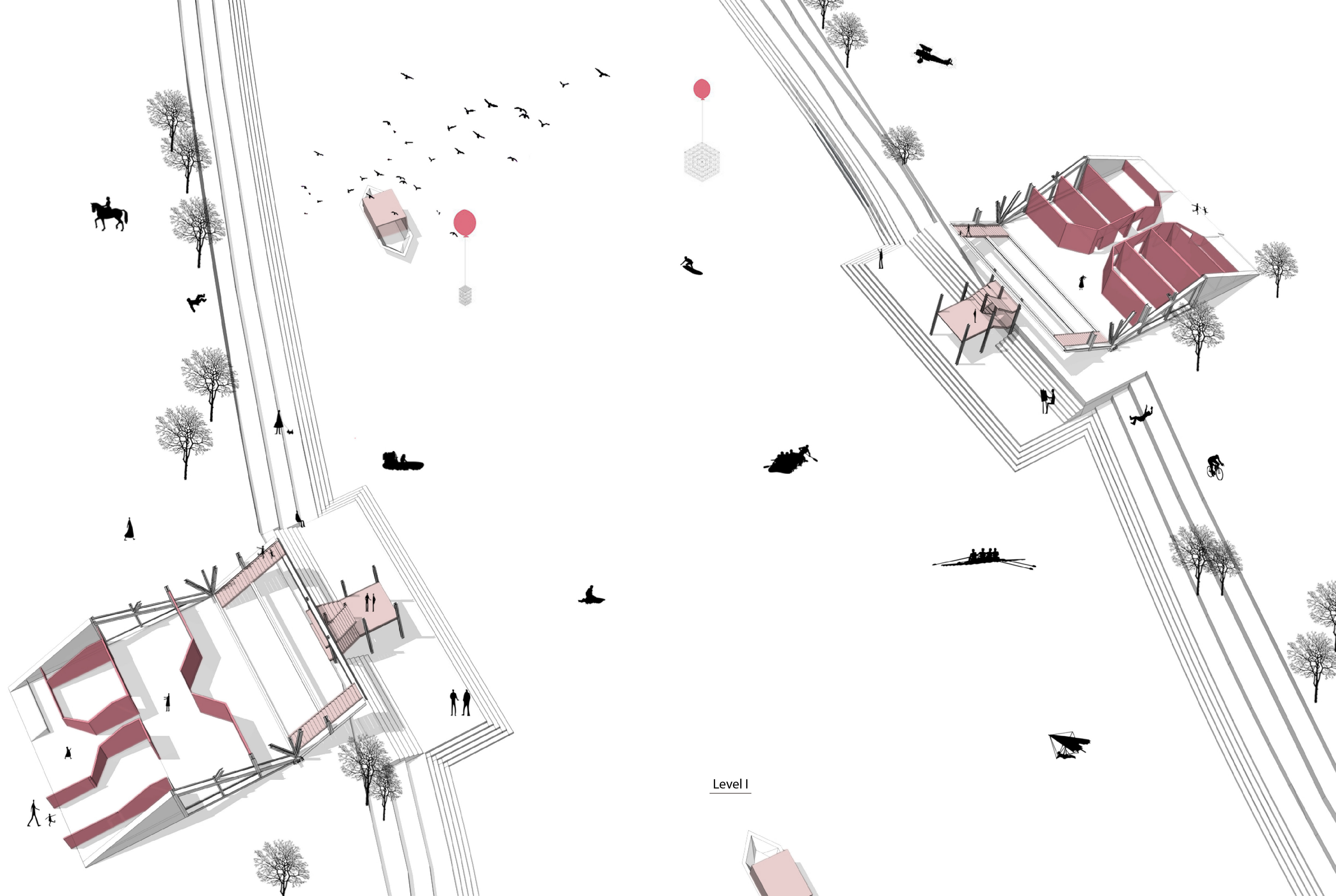
Four typical towns surrounding the site with more than 100 years history indicate that the significance of bridge on organizing the whole environment. Types of bridge are categorized into six conditions that corresponds to their scale, ways of construction and materiality, relation to the surrounding contexts.

1. The smallest scale bridge 2. Wood structure bridge 3. Double-layered bridge 4. The bridge with a special wall 5. The bridge with steeper stairs 6. Landmark bridge

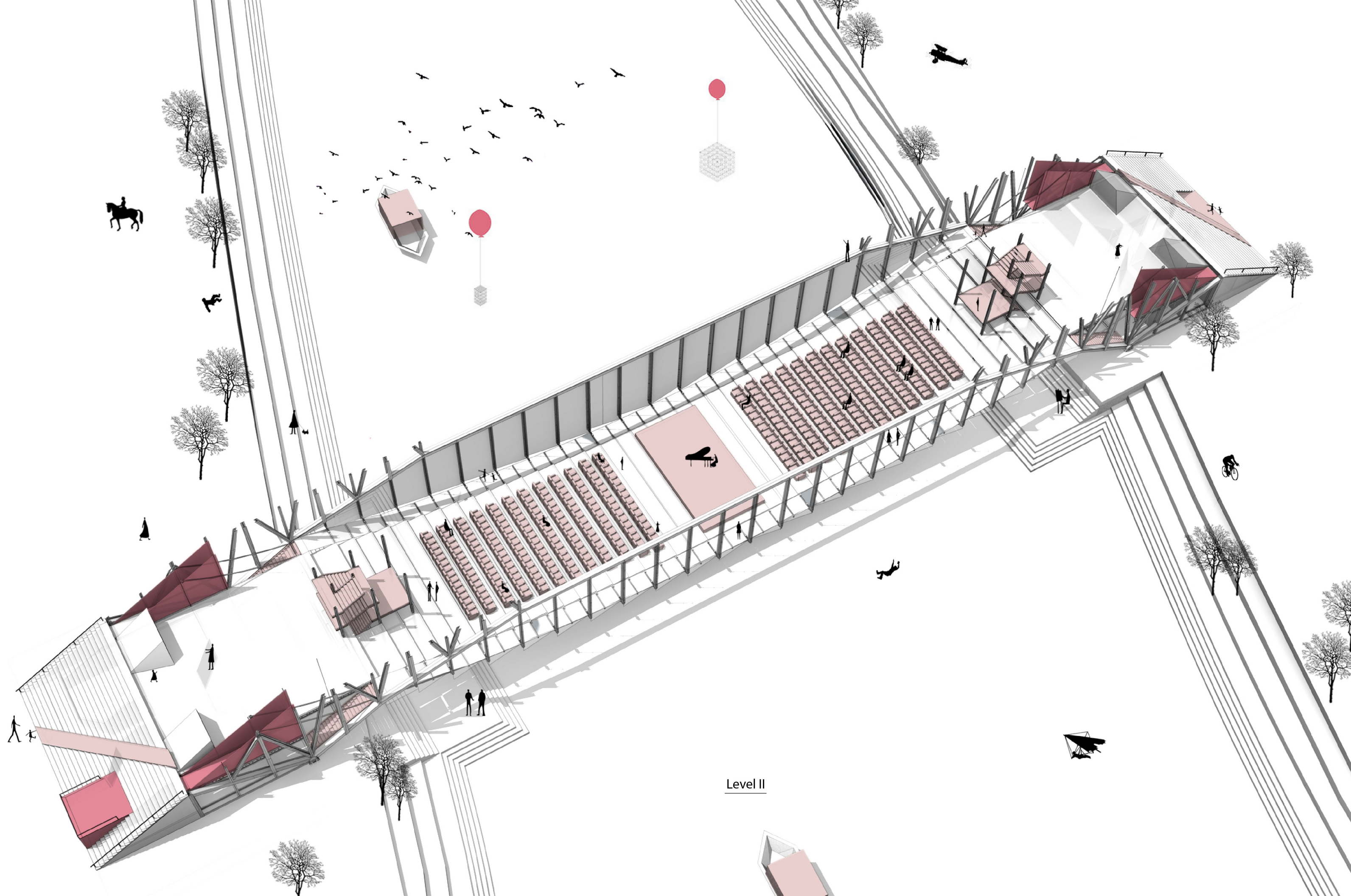


**Site analysis III**

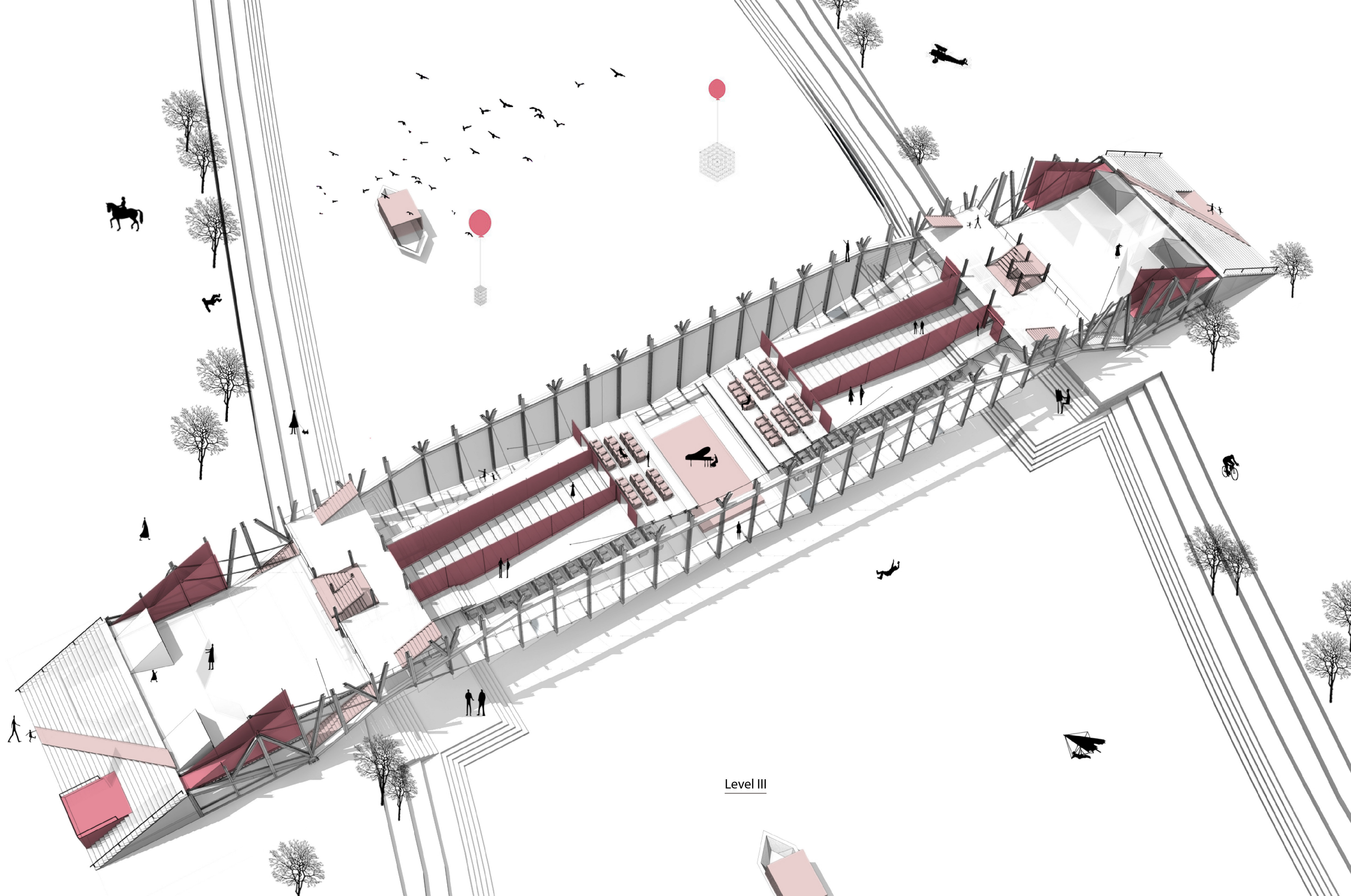
*My bridge is not only used as connection of both side of river, but more important is that it will be a landmark, which can attract more people to come to these interactions space which it creates. Besides, by analyzing the local weather conditions, sun shade system is designed for avoiding too strong north sunlight to get into the function area.*



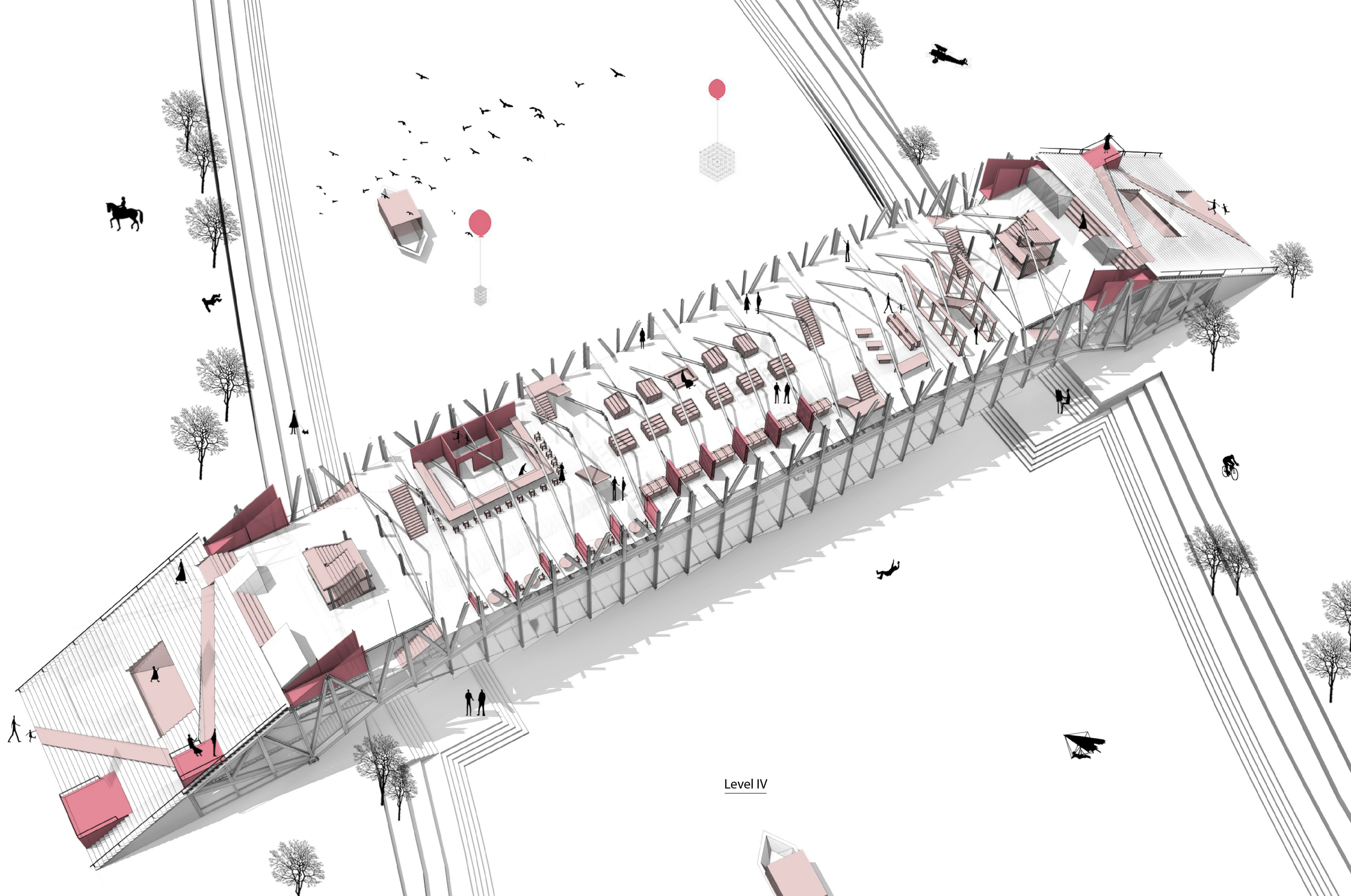
Level I



Level II

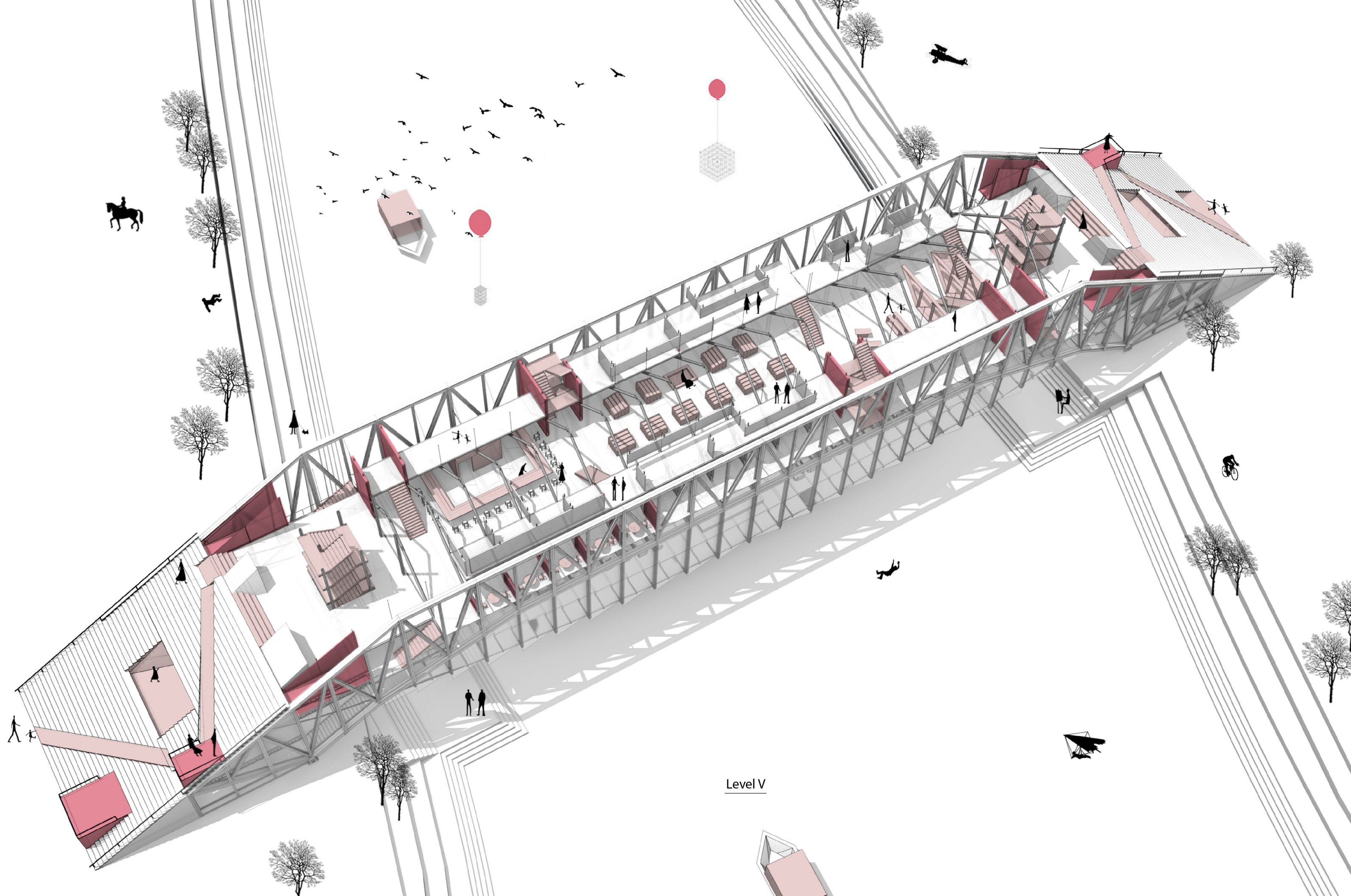


Level III

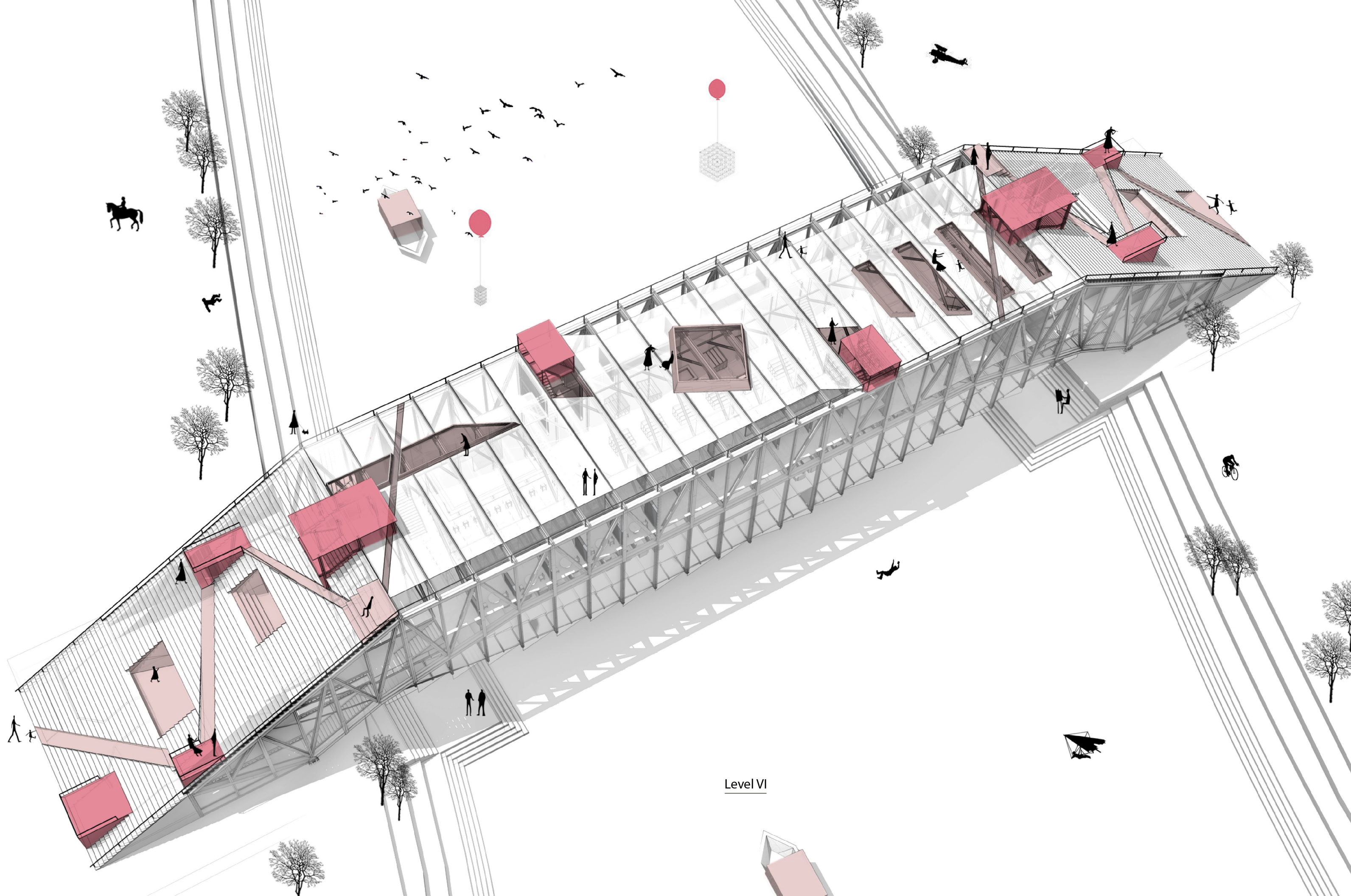


Level IV





Level V



Level VI



RETAIL

GALLERY

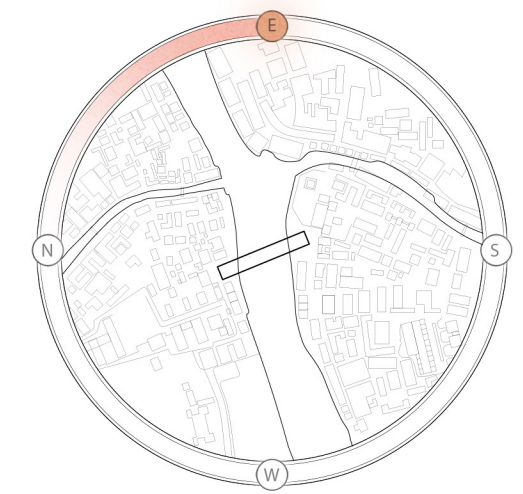
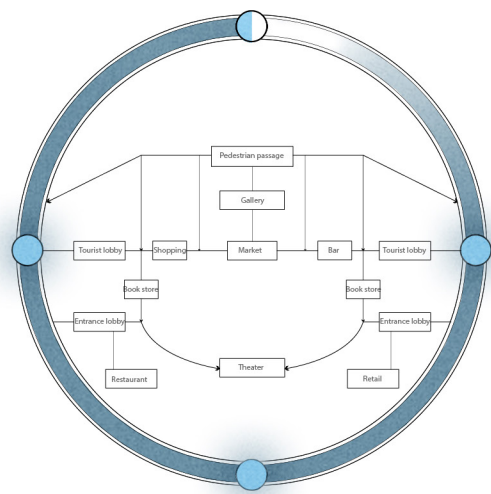
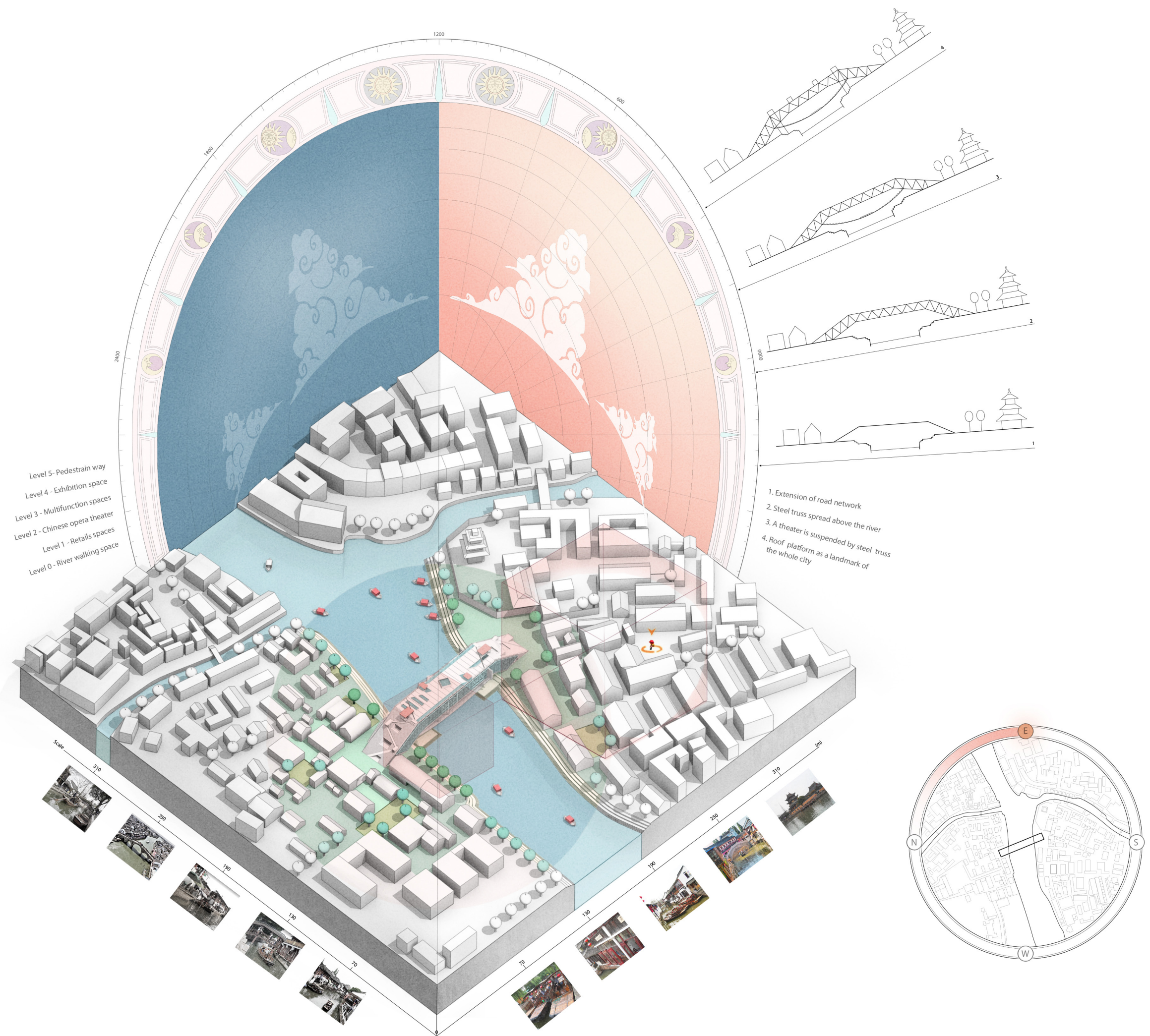
THEATER

CHINESE  
MODERN GARDEN

RESTAURANT

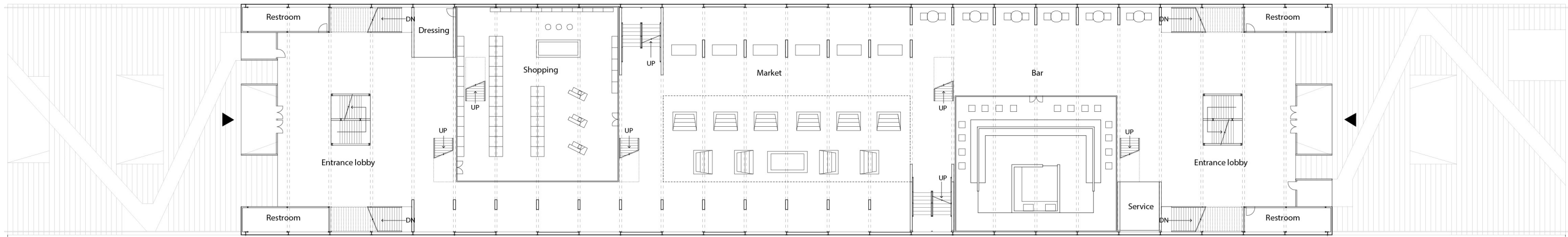
### 3D VIEW FOR SITE CONDITIONS

This view in general, is more about displaying that the relationship between my building and surroundings. The bridge, which is built by steel truss, spread from the north filed to the south filed. It not only well-follow the whole urban context, but support more interactive spaces for citizens as well. Just like the riverside scene at *Qingming Festival*, the bridge architecture provides the amiable atmosphere for people's social life.

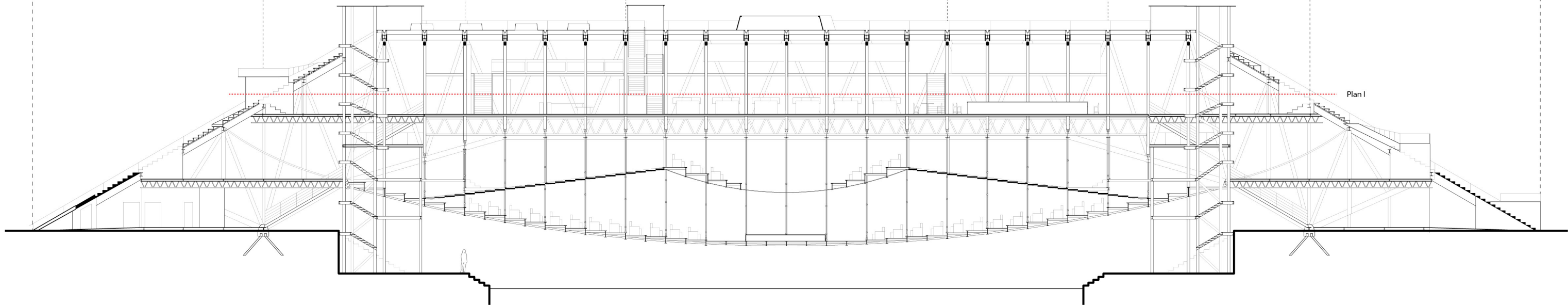






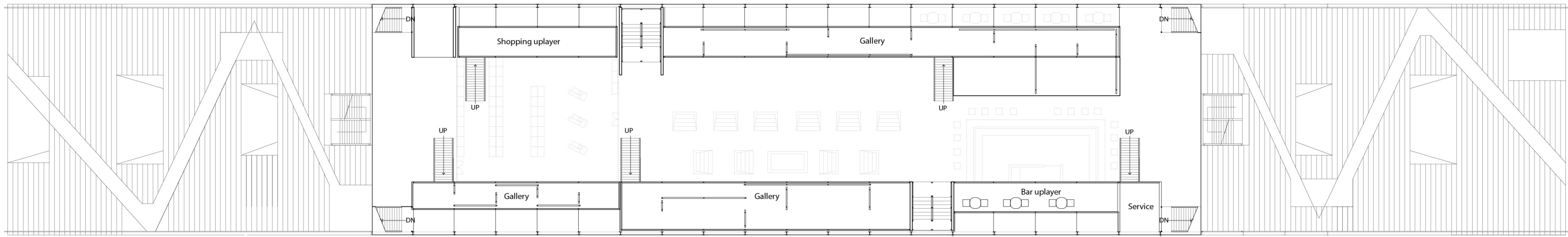


Plan I 1:300

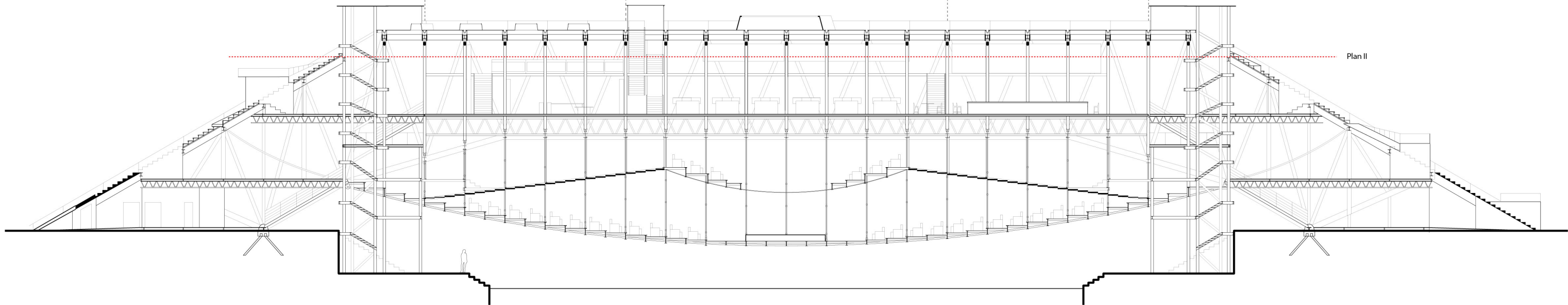


Section 1:300





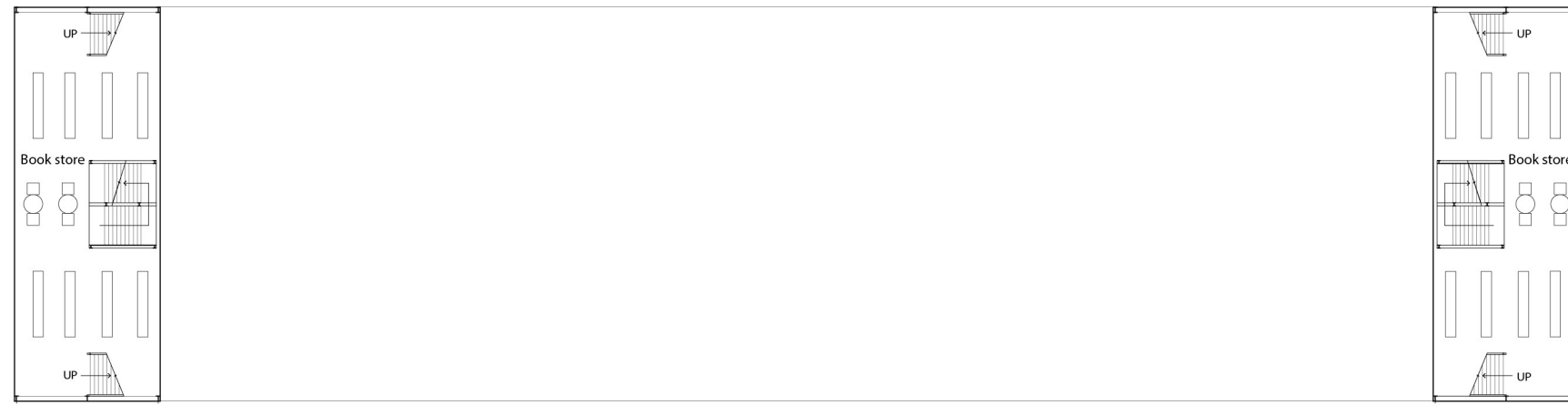
Plan II 1:300



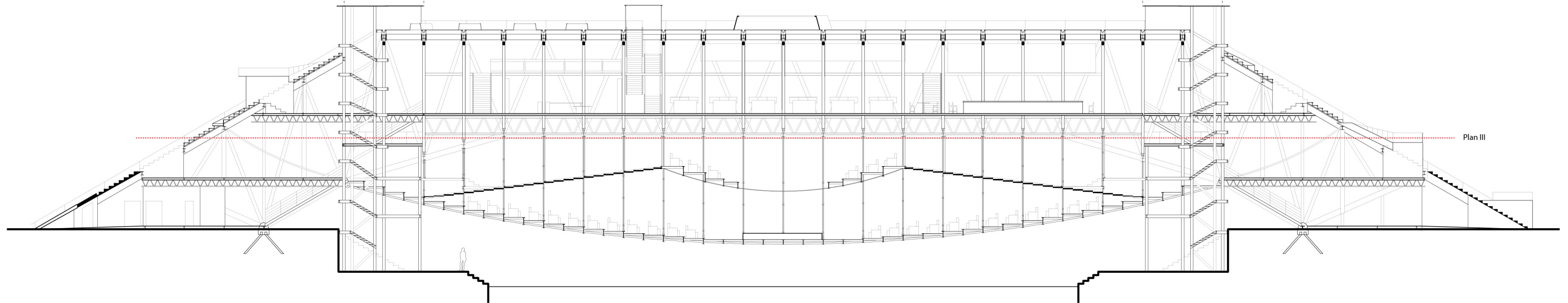
Section 1:300





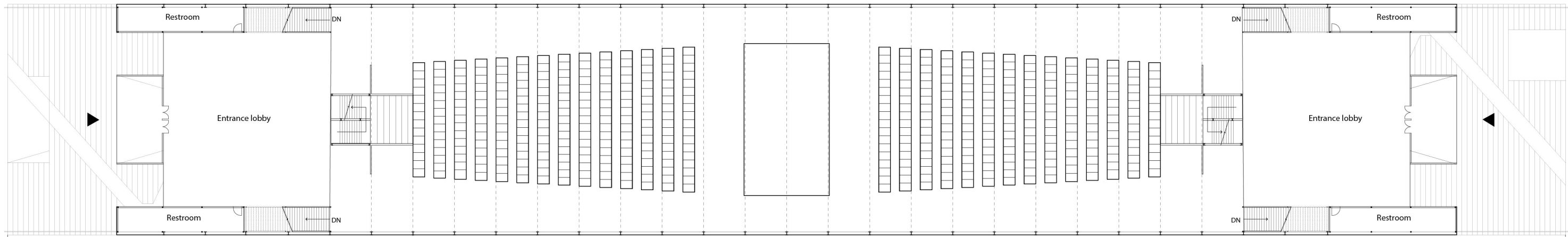


Plan III 1:300

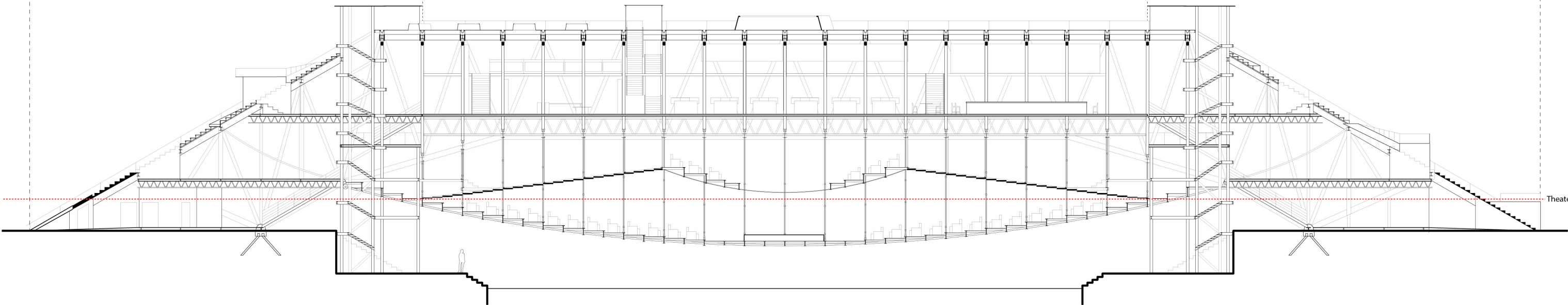


Section 1:300



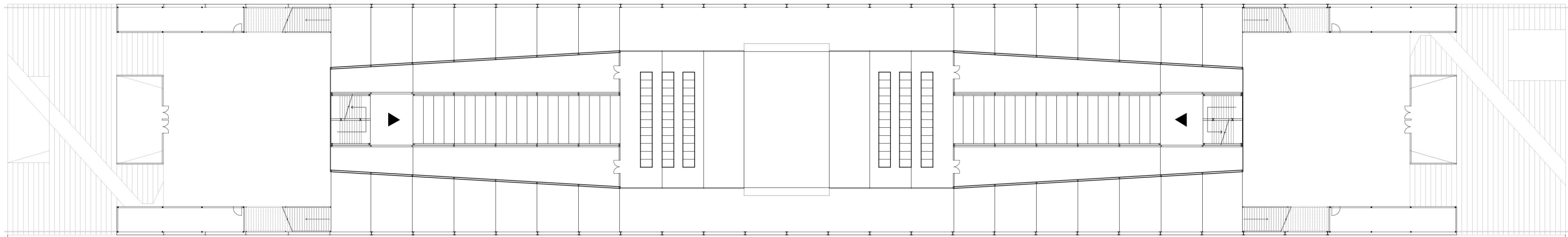


Theater I 1:300

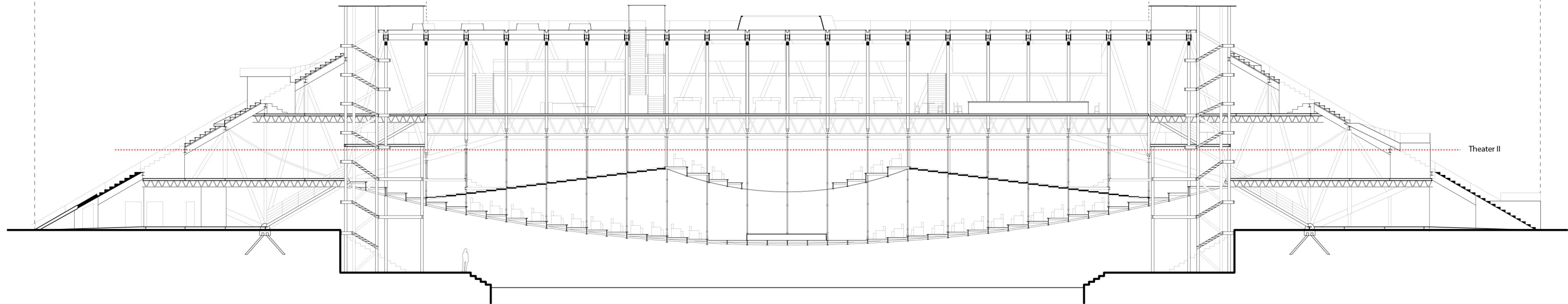


Section 1:300



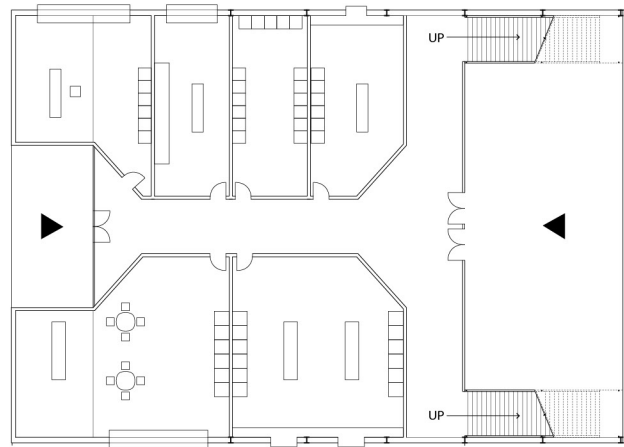


Theater II 1:300

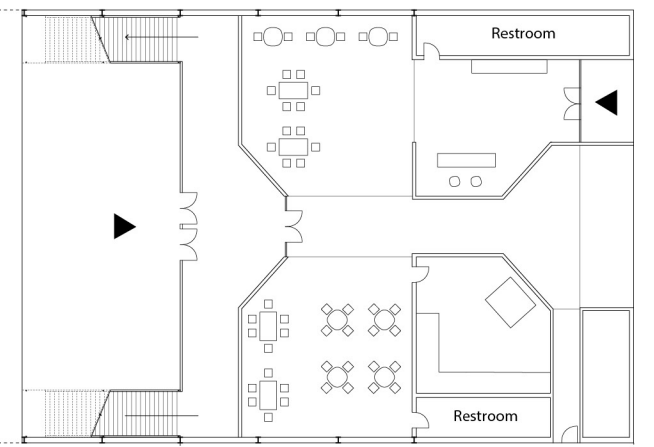


Section 1:300

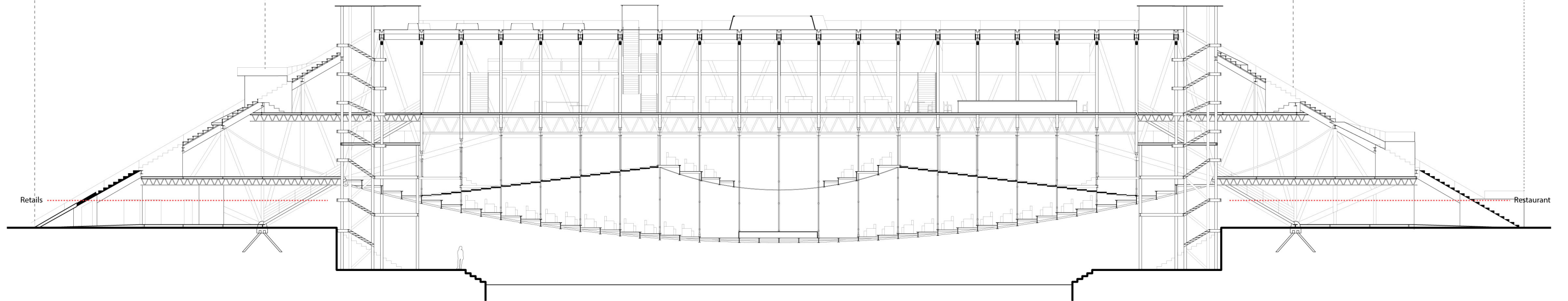




Retails 1:300

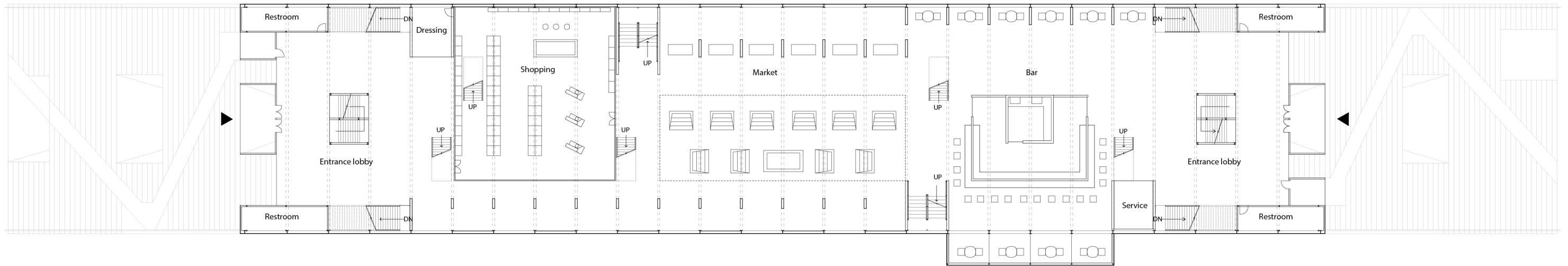


Restaurant 1:300

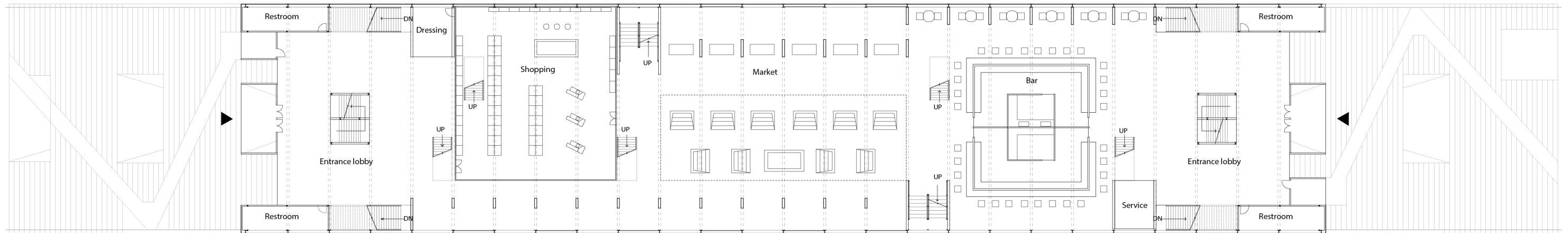


Section 1:300



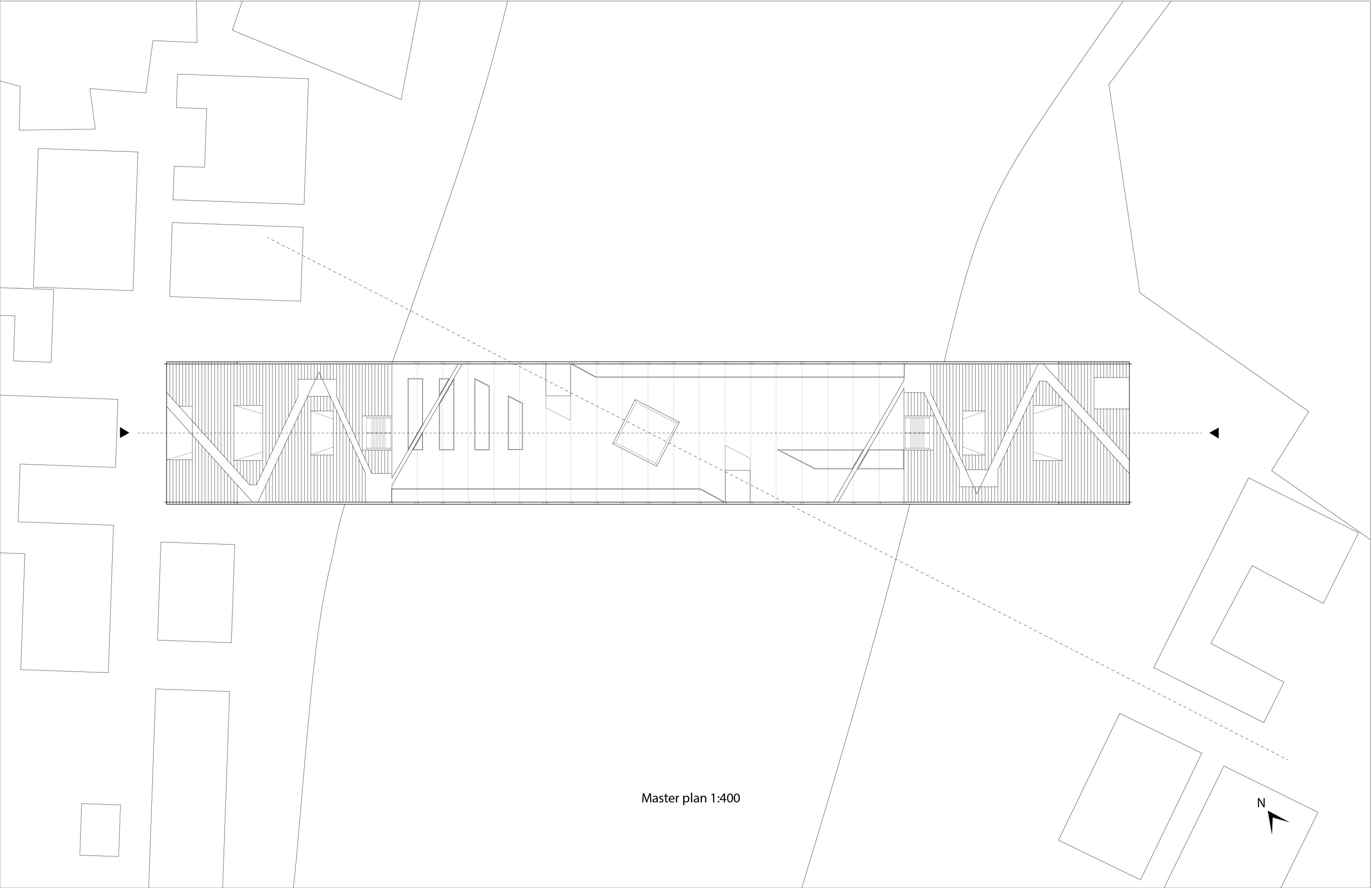


Derived floor I 1:300



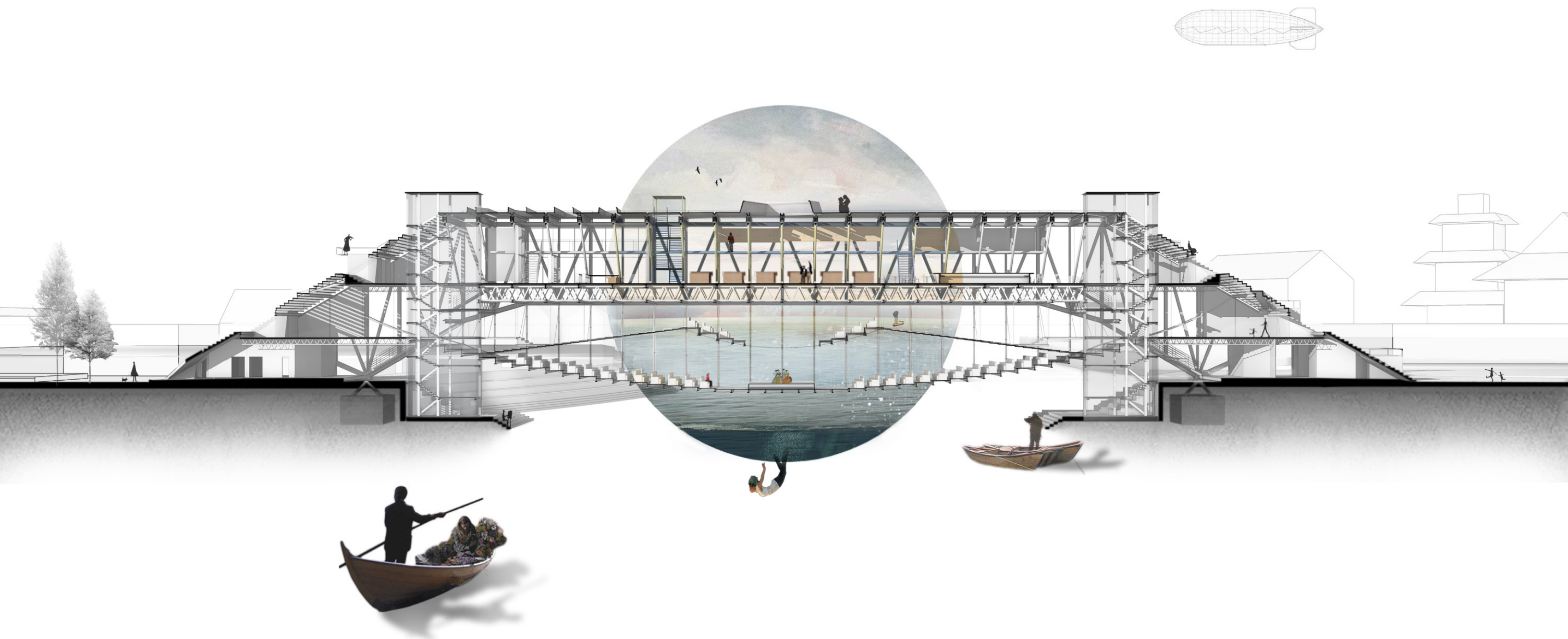
Derived floor II 1:300





Master plan 1:400

N



SECTION PERSPECTIVE



*Model view for Bar area*



*Render for Bar area*



*Model view for Bar area*



*Model bird view for Bar area*

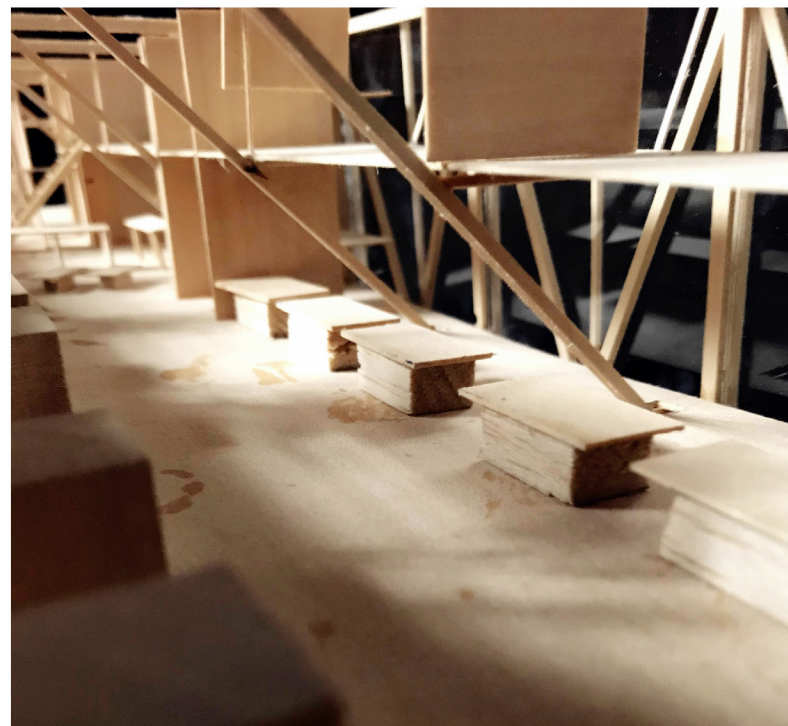




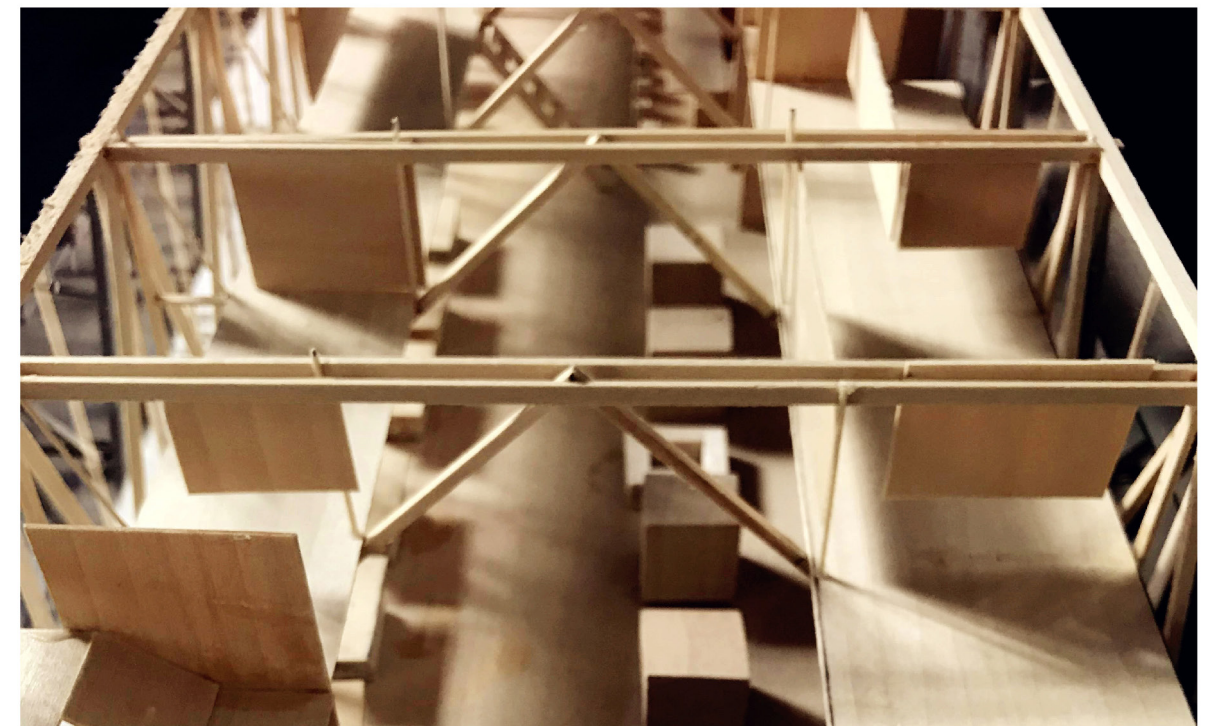
*Model view for Market area*



*Render for Market area*



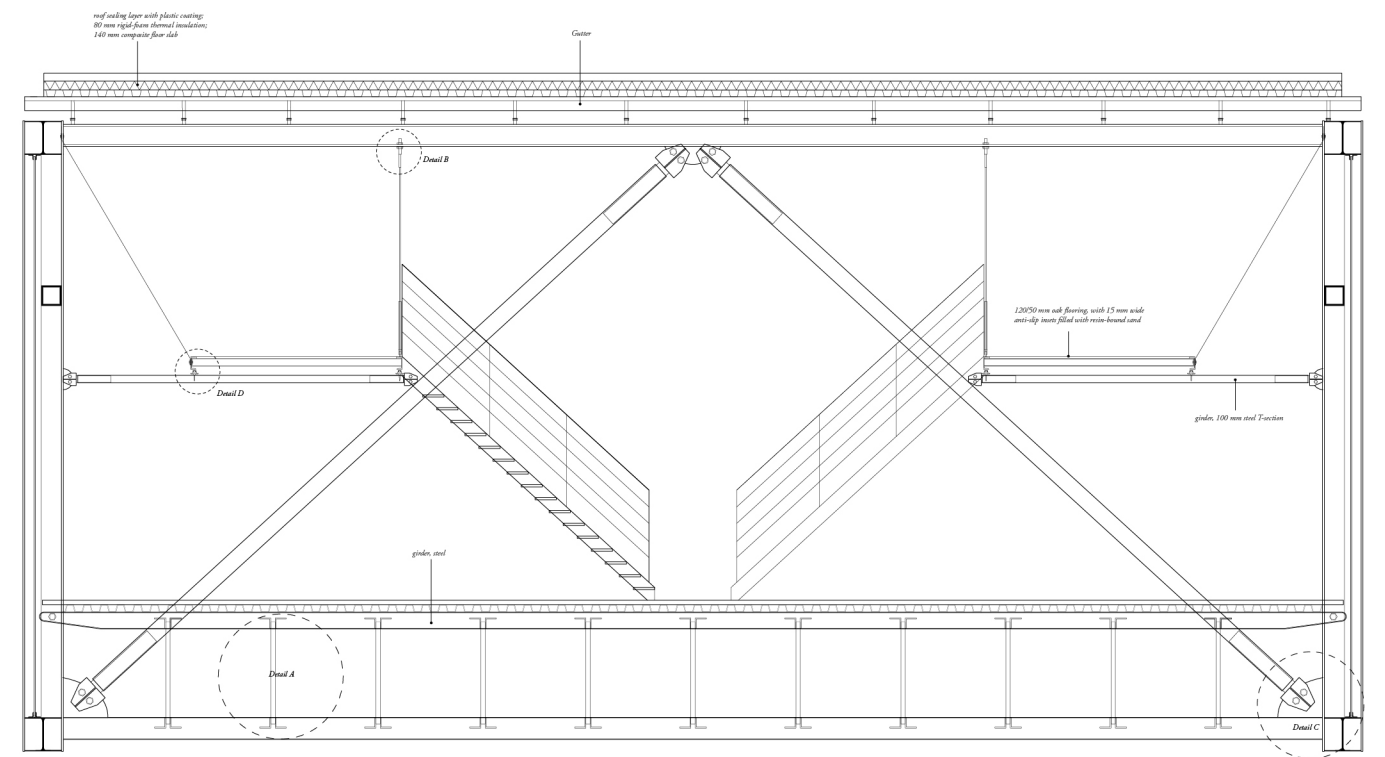
*Model view for Market area*



*Model bird view for Market area*



Rendering for shopping area



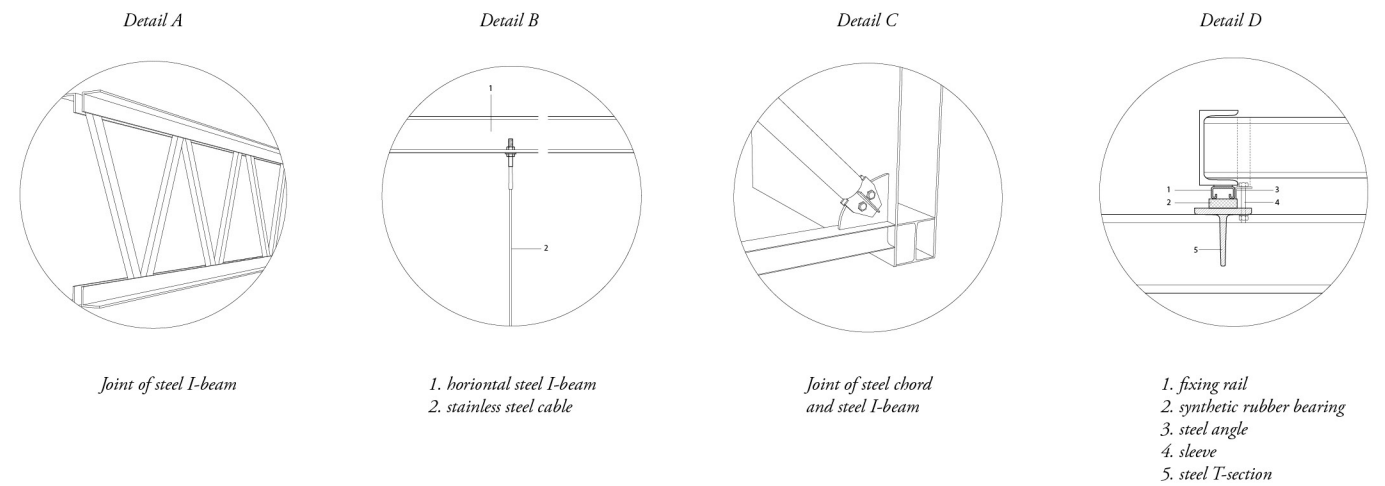
Cross-section for the bridge upper floor<sup>©</sup>

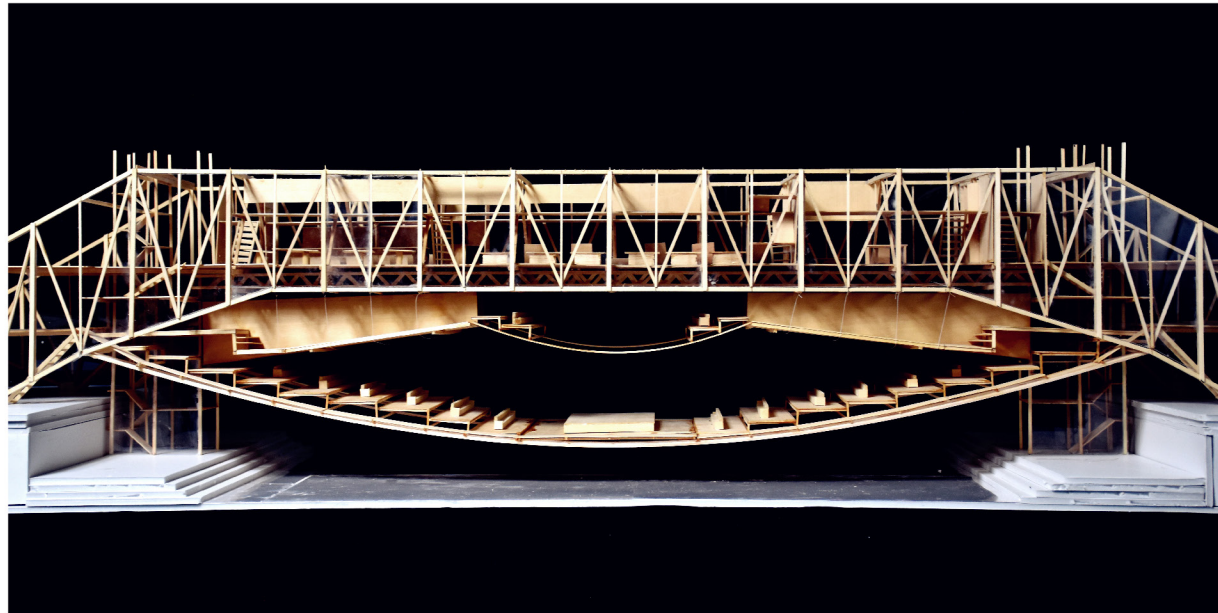


Model view for shopping area

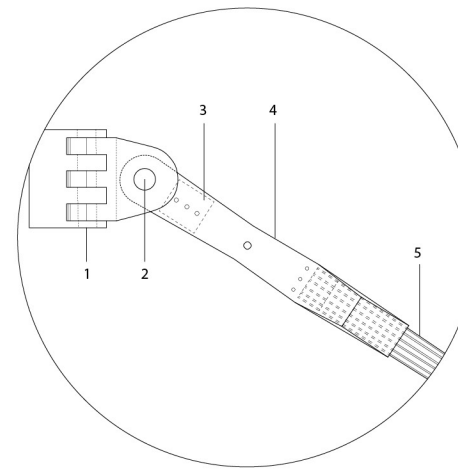


Model view for shopping area

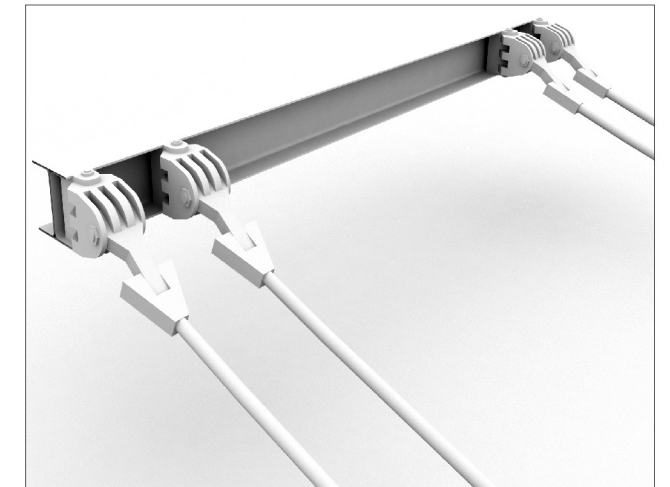




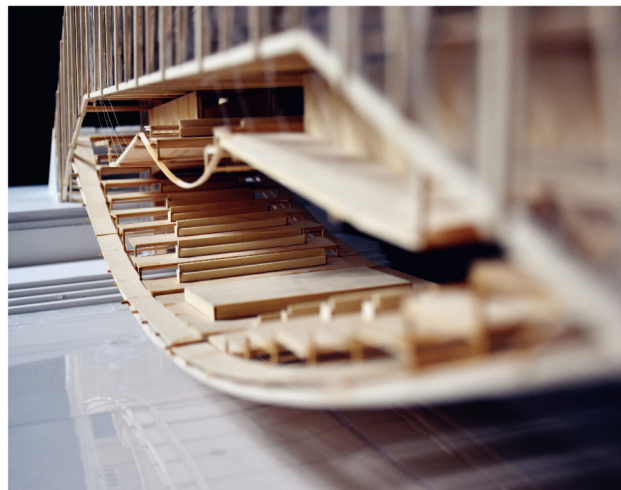
Model for traditional Chinese opera stage



1. lower primary steel pin
2. upper primary steel pin
3. plate metal clevis attachment
4. metal plate to receive strand anchors
5. 151 × 15.2 mm strand cable, bundled,  $\varnothing$  226mm



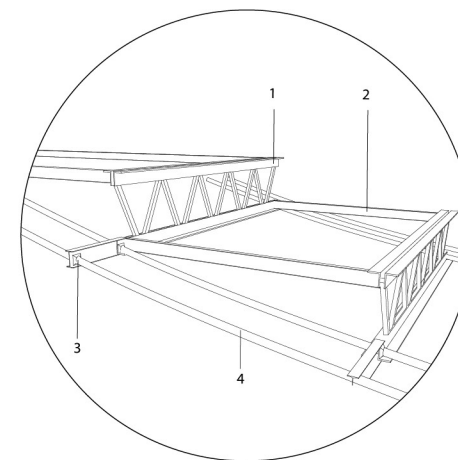
Render for connection between I-beam and cable



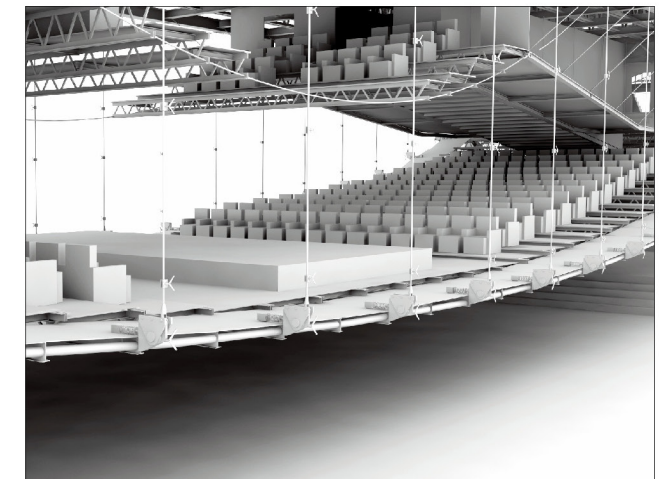
Perspective view for first floor of opera stage



Perspective view for second floor of opera stage



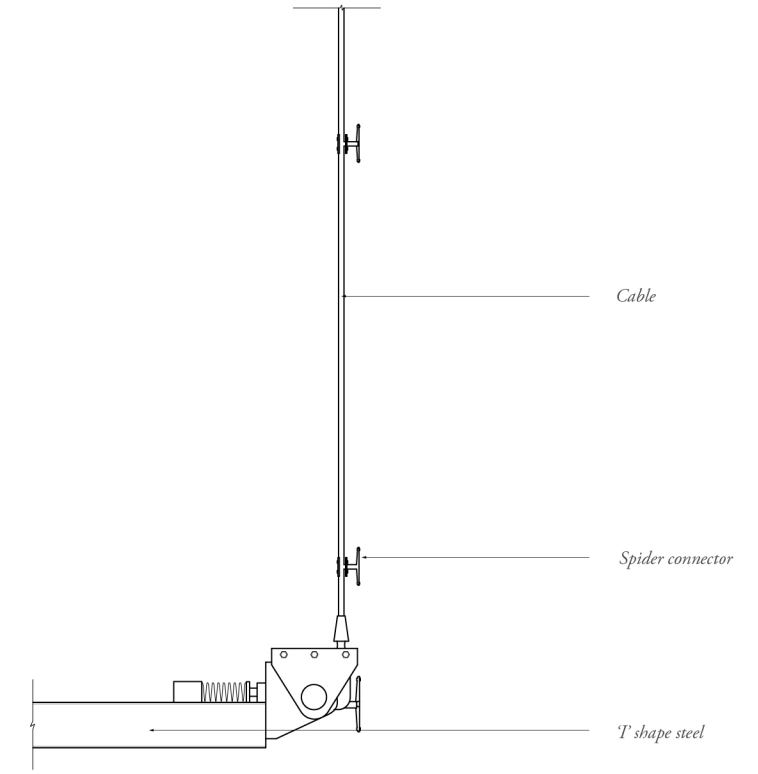
1. steel truss
2. steel I-beam
3. intermediate supports
4. 151 × 15.2 mm strand cable, bundled,  $\varnothing$  226mm



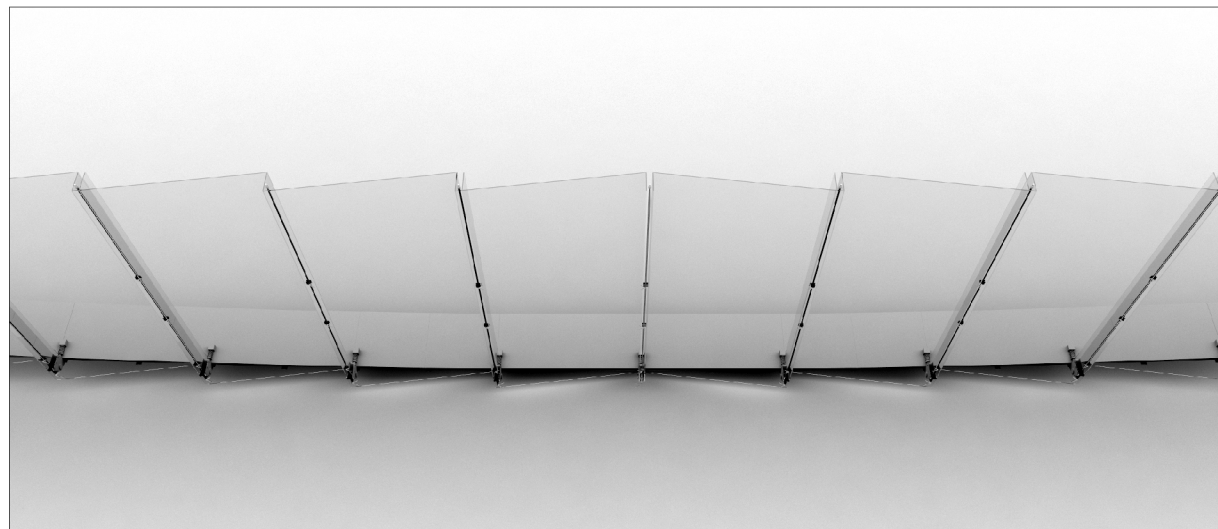
Render for connection between cable and steel truss



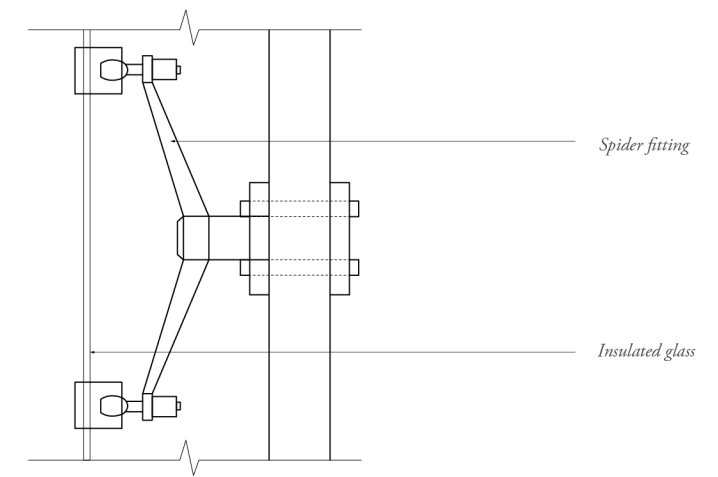
*Perspective view for windows of Chinese opera stage*



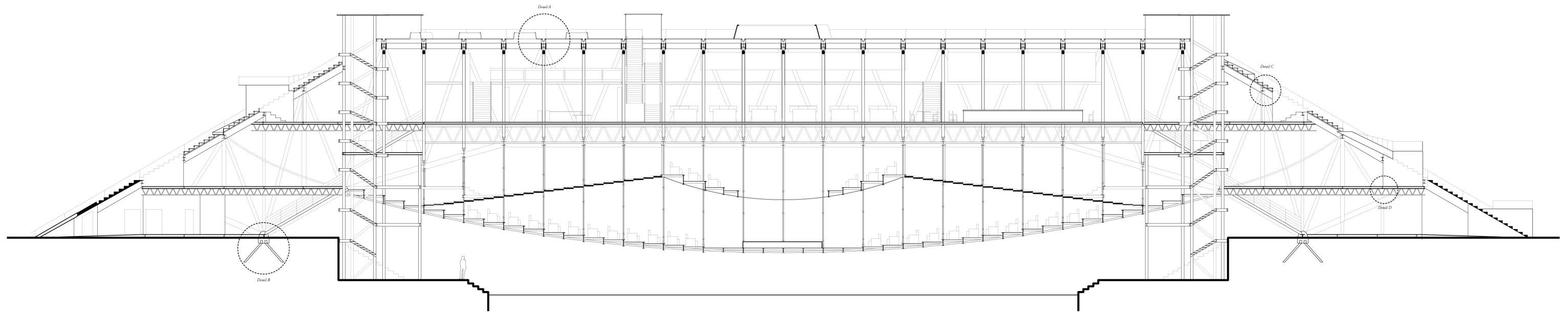
*Connection between cables and suspending floor*



*Top view for windows of Chinese opera stage*

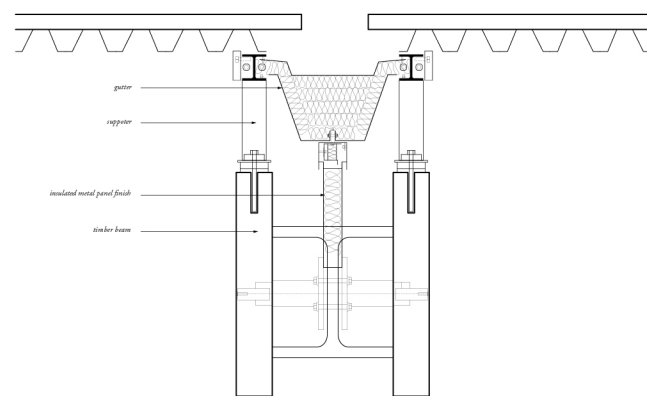


*Connection of glass and spider fitting*



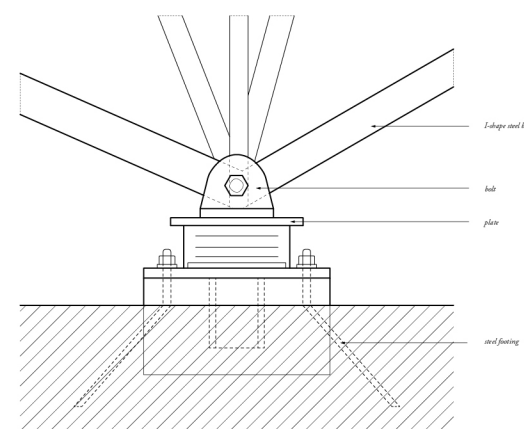
Section 1:300

Detail A



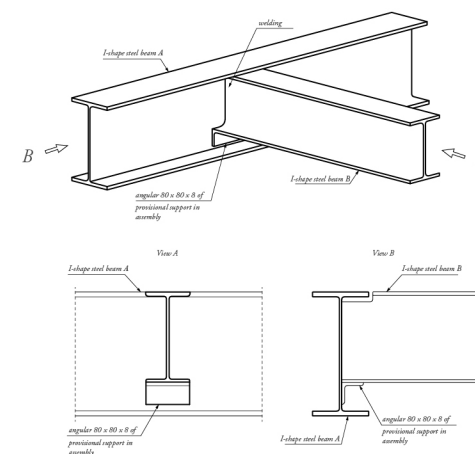
Rain-guider

Detail B



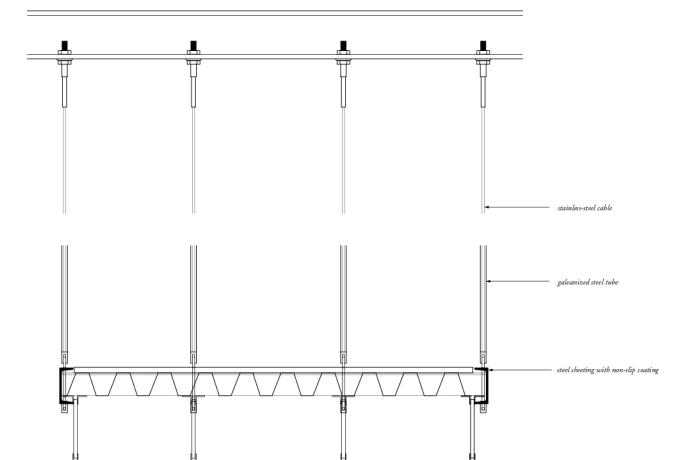
Steel footing meets with ground

Detail C

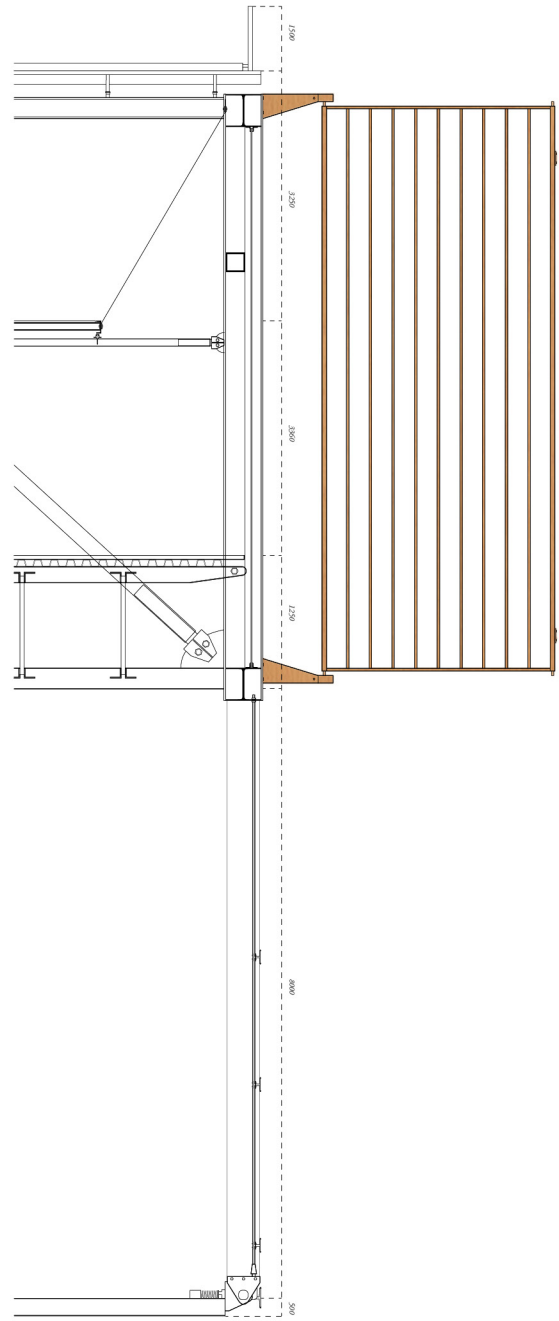


Welding details for exterior steel stairs

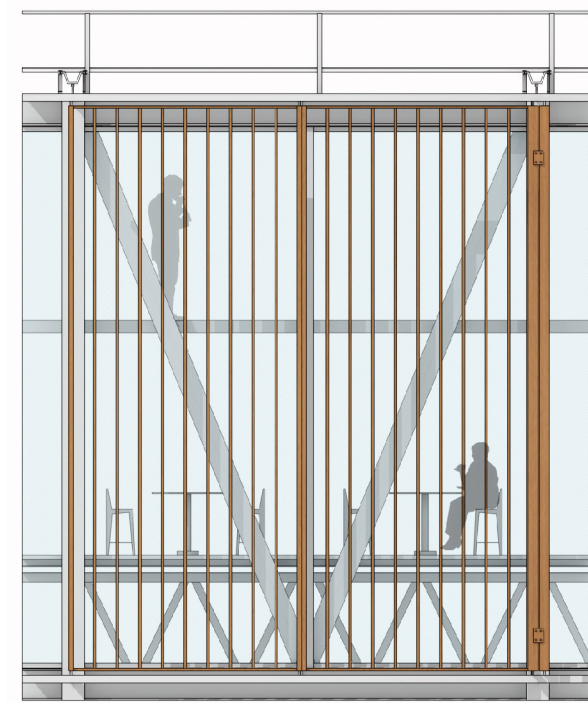
Detail D



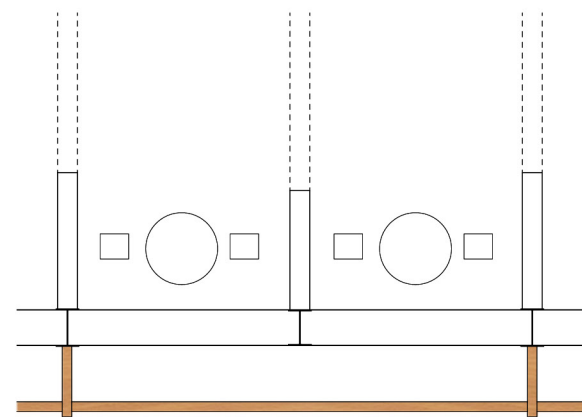
Suspending floors



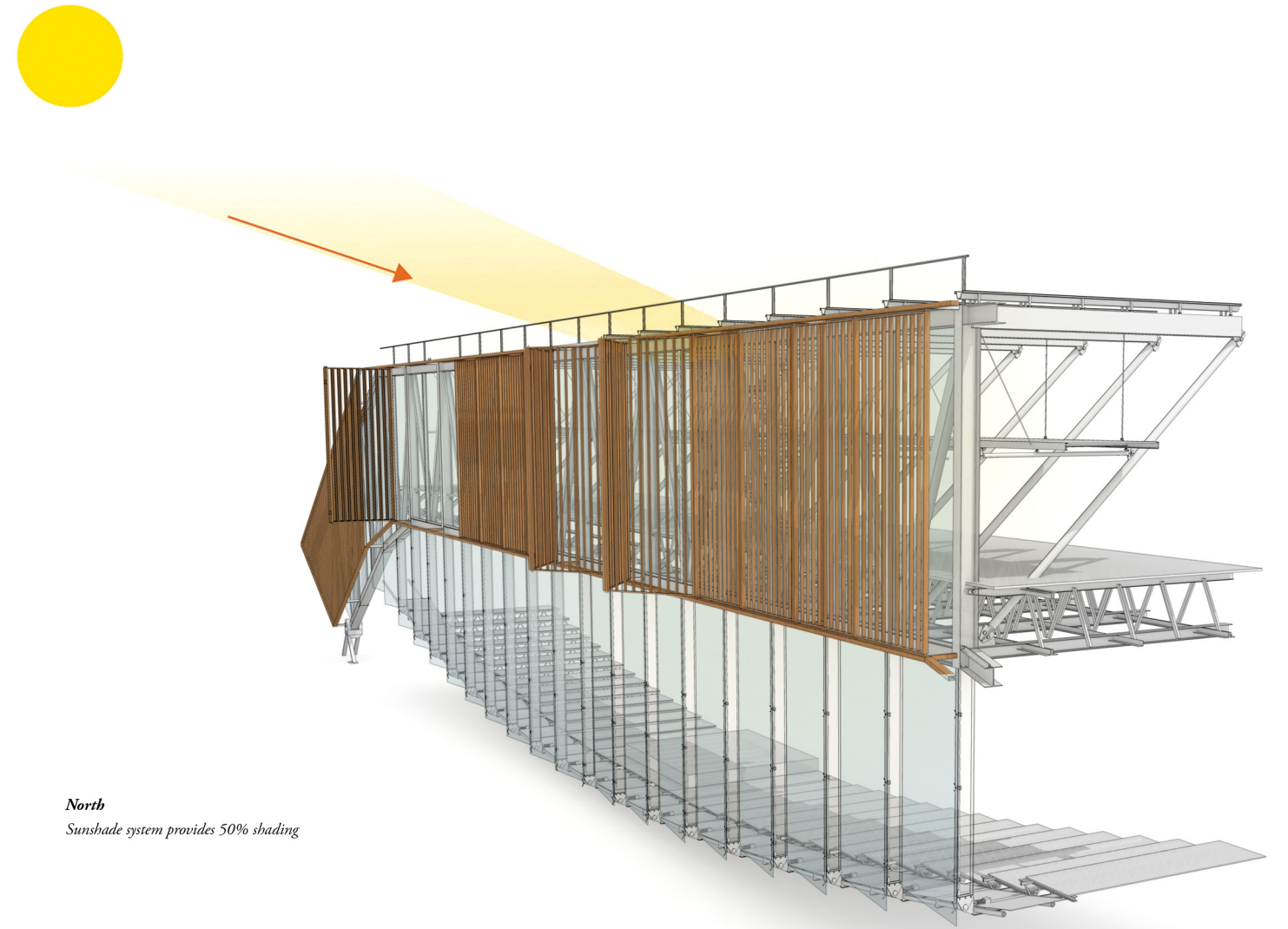
Wall section details



Facade elevation

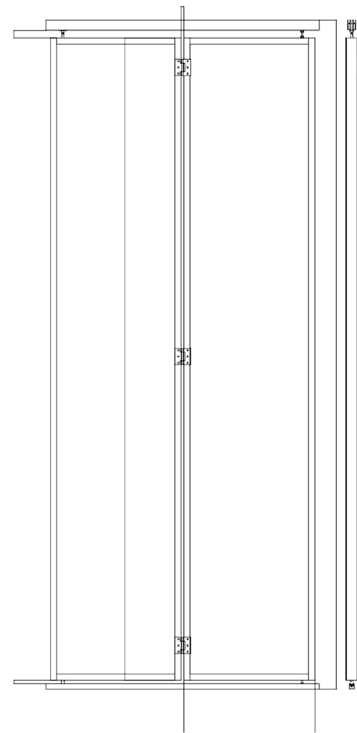
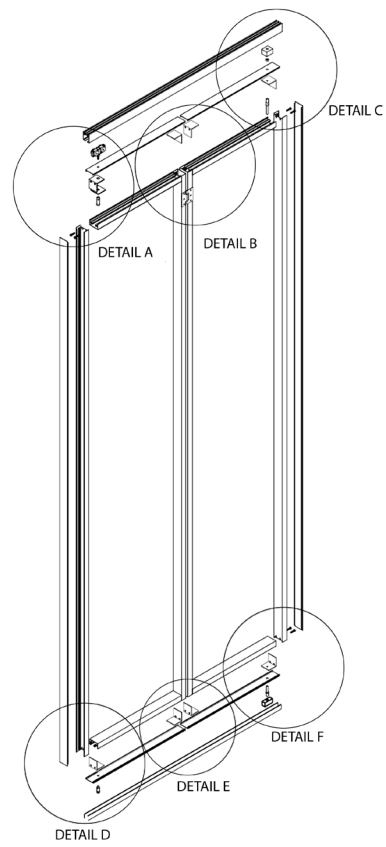


Detail plan

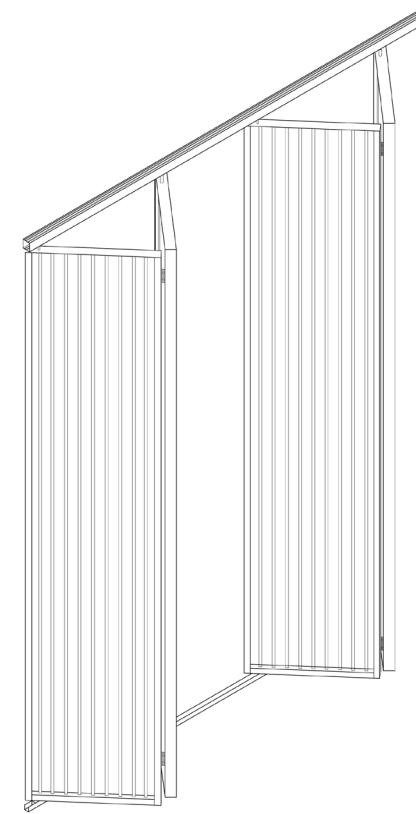


North  
Sunshade system provides 50% shading

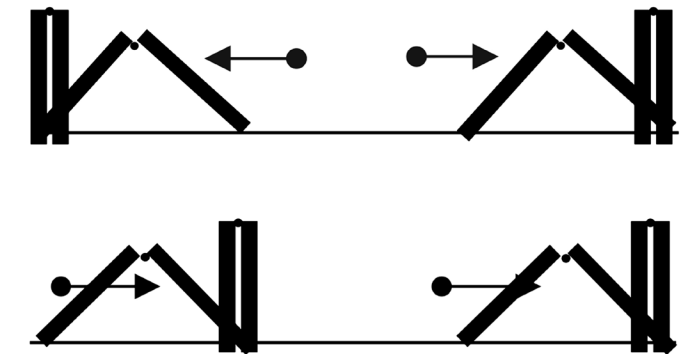
Rendering for sunshade system



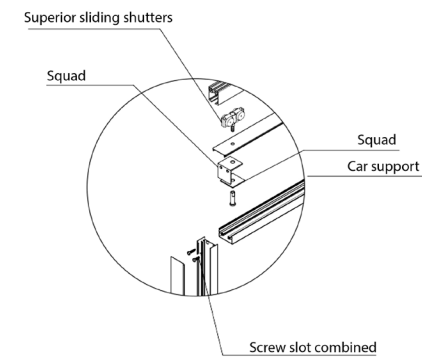
FOLDING SHUUTERS WITH 2 SHEETS TOWARDS ONE END



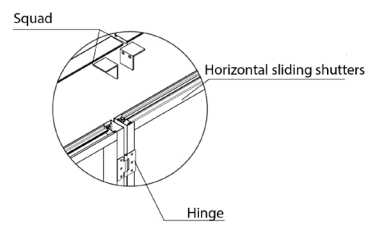
INSTALLATION ALTERNATIVES  
2 SHEETS



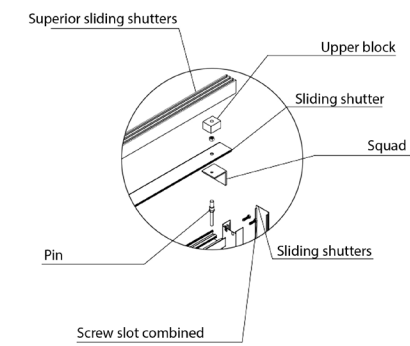
DETAIL A



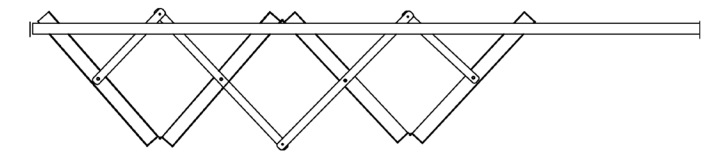
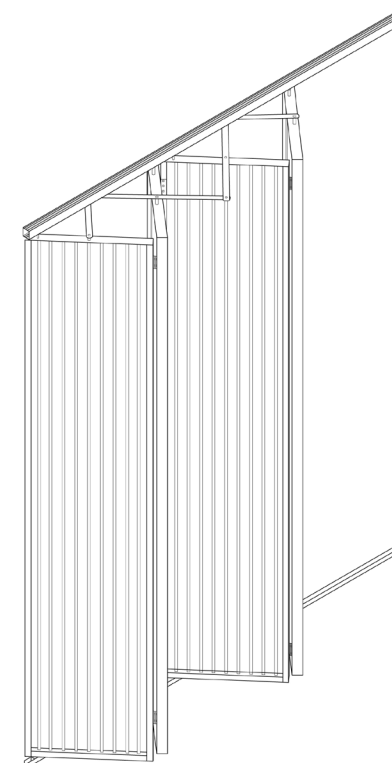
DETAIL B



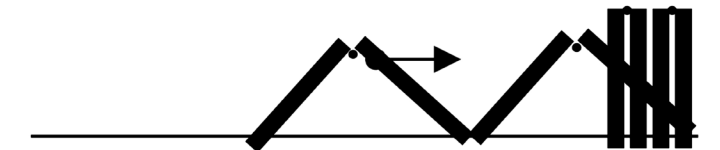
DETAIL C



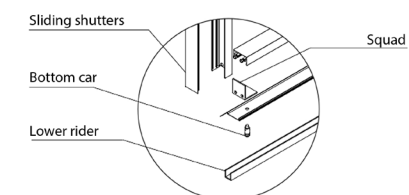
FOLDING SHUUTERS WITH 4 SHEETS TOWARDS ONE END



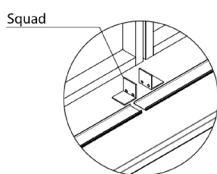
INSTALLATION ALTERNATIVES  
4 SHEETS



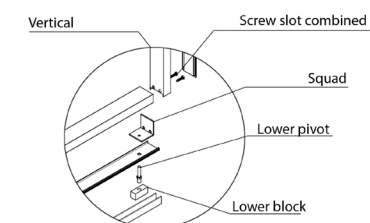
DETAIL D

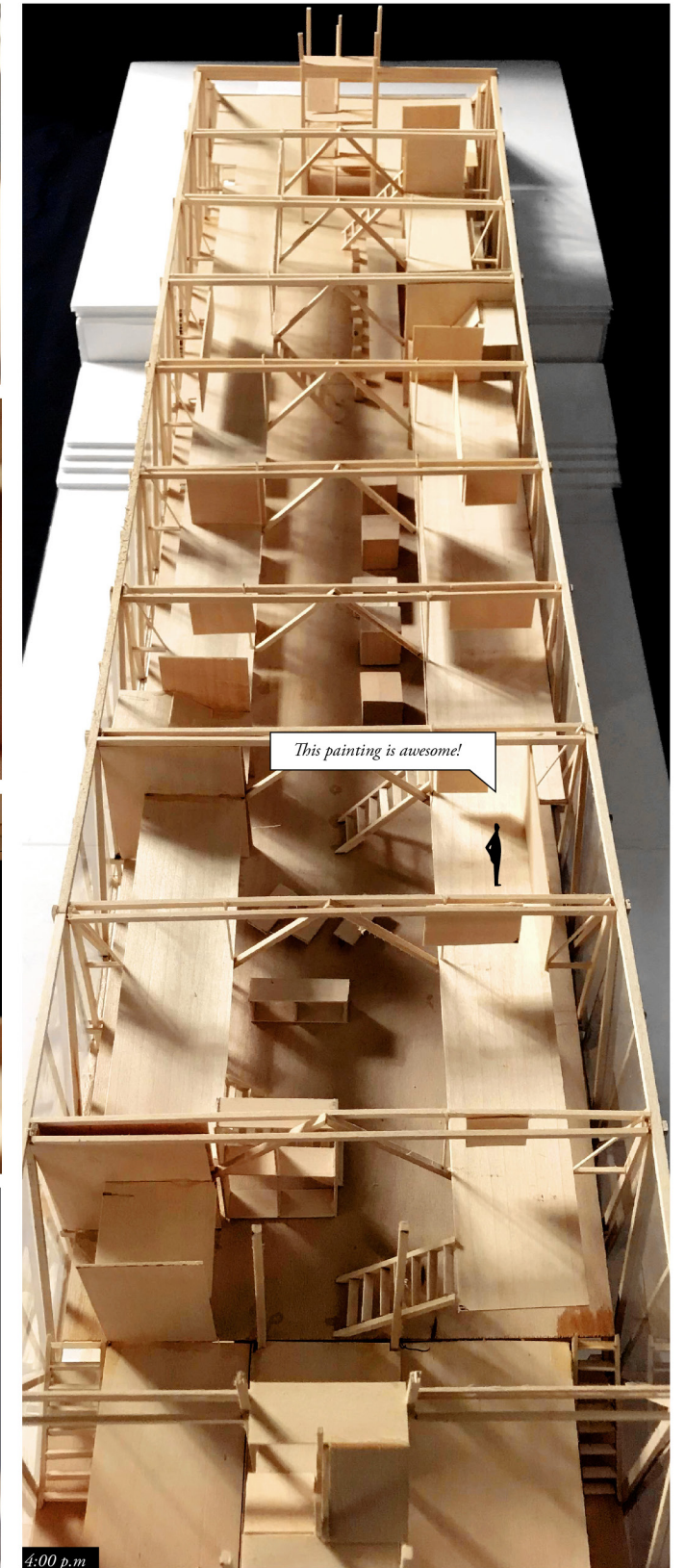
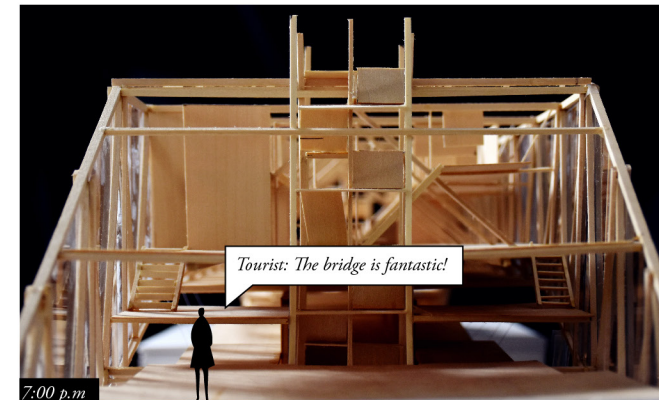
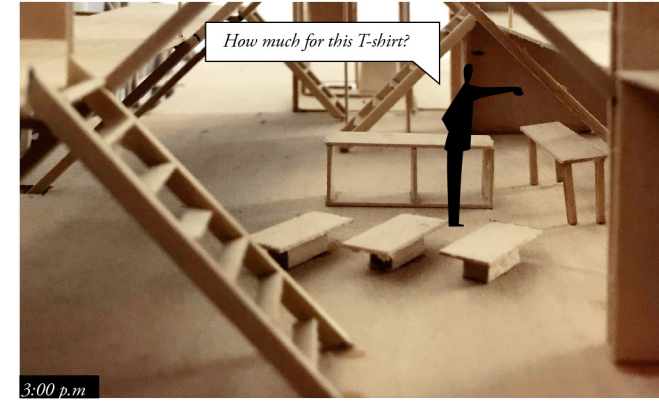
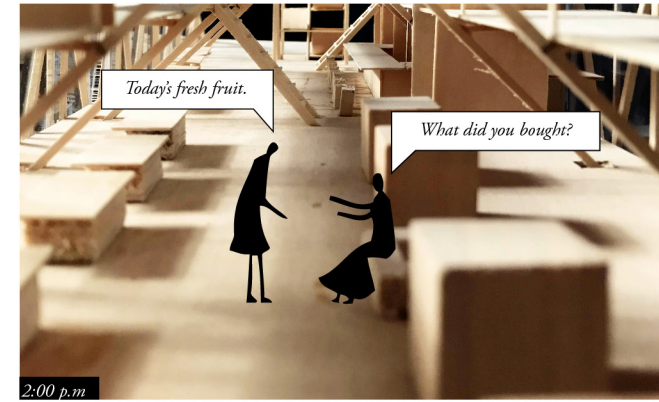
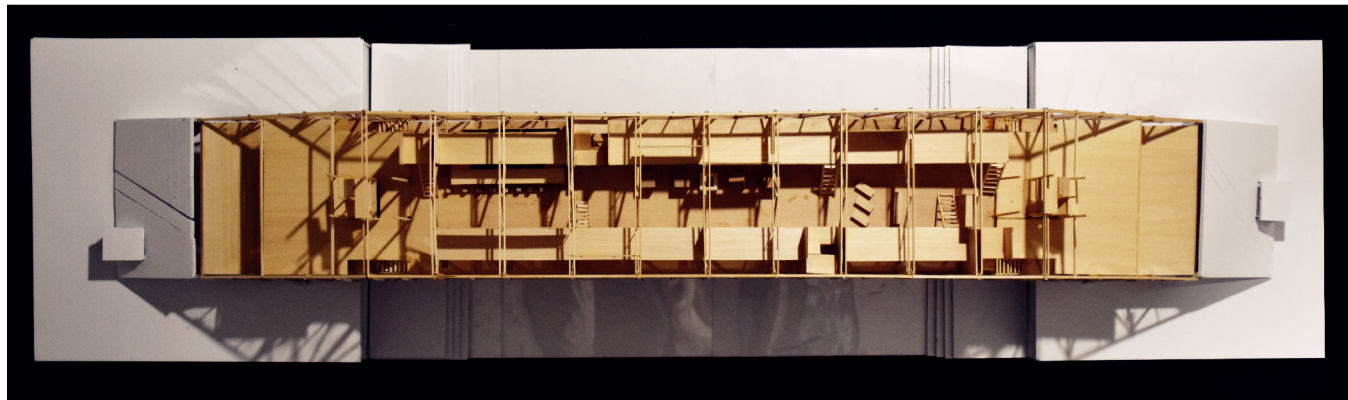
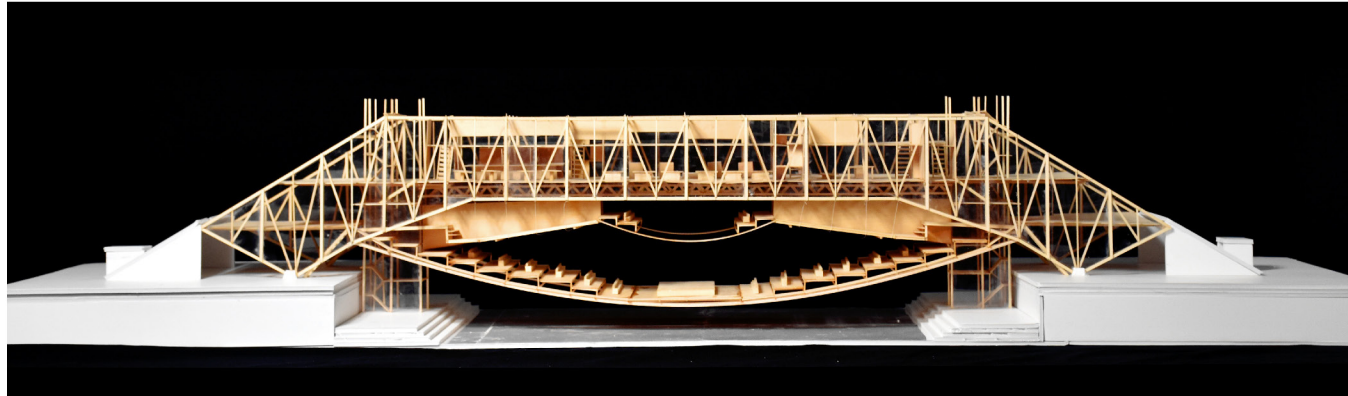
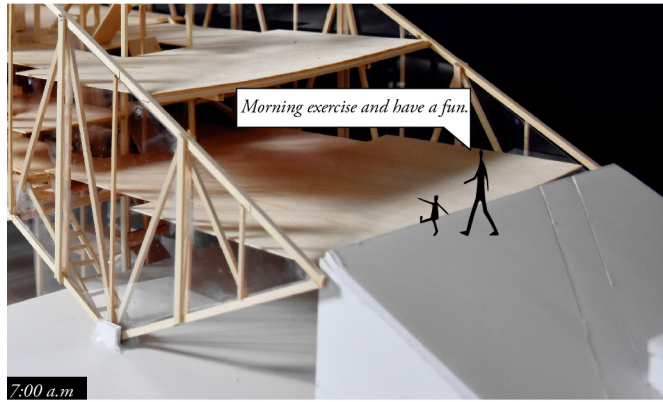


DETAIL E



DETAIL F





Physical model-making gives me a chance to think twice about the design, following the true process of construction and structure. First, I started from the main structure of the bridge, which is a steel truss. Then I clearly built several different spaces by following the structure. I was inspired from the construction process, which how can I make structure to lead to the spaces and how can I make structure details connect with each other ideally.

Physical model show of one day in the bridge



## CONCLUSION

The bridge, and its role in Chinese urban development, has shows numerous opportunities as an urban architectural object. Chineses' love for bridges go beyond the practicability of the bridge itself. The love for bridges is evident in many paintings, most of all the QINGMING FESTIVAL.

I was deeply impressed by the sense of harmony and the intimate sense of urban scale in this painting, and also was surprised by the bridge's diversity and versatility.

Through the design language of modern architecture, I hope to continue the tradition of urban bridges as a place-making artifact.