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Drama Oriented Narrative Design

Theatre project in Naumburg city

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Content

Abstract

This article is based on our design project of Naumburg theatre design, with descriptions of six chapters of the drama oriented narrative design logic of contemporary theatre project.

Firstly, theatric performance spaces are deeply illustrated through the study of narrative in aspects of drama and theatre. Then, the article moves on to the theatre-related stories in the urban and prison perspective. As a result, we define and classify two storylines of theatre development history and prison history, which are connected in series to form the unique narrative of the site.

Secondly, our strategy initiates from three key strategies: 1. history and memory; 2. multi-task of theatre; 3. education. They are followed by the design process step-by-step. The essay describes methodologies of how we are transforming these narrative elements into architecture language, which is supported by specific space and different spatial narrative circulations, respectively. We define three narratives of spatial experience in theatre ---- narrative of museum, theatre and exterior public space.

In addition, technical services, structure, BIM technology and material study, as appendixes, support the Naumburg theatre project integrally and effectively.

Keywords
Naumburg theatre, Drama oriented, Narrative design, JVAPrison, Spatial experience.

Riassunto

Questo articolo si basa sul nostro progetto di progettazione del teatro di Naumburg, con la descrizione di sei capitoli della logica progettuale narrativa orientata al dramma del progetto teatrale contemporaneo.

In primo luogo, gli spazi teatrali per spettacoli sono profondamente illustrati attraverso lo studio della narrazione in aspetti di teatro e teatro. Quindi, l'articolo passa alle storie legate al teatro nella prospettiva urbana e carceraria. Di conseguenza, definiamo e classifichiamo due trame della storia dello sviluppo del teatro e della storia della prigione, che sono collegate in serie per formare la narrativa unica del sito.

In secondo luogo, la nostra strategia inizia da tre strategie chiave: 1. storia e memoria; 2. multi-task di teatro; 3. educazione. Sono seguiti passo dopo passo dal processo di progettazione. Il saggio descrive le metodologie di come stiamo trasformando questi elementi narrativi in linguaggio architettonico, che è supportato rispettivamente dallo spazio specifico e dalle diverse circolazioni narrative spaziali. Definiamo tre narrazioni dell'esperienza spaziale nel teatro ---- narrativa di museo, teatro e spazio pubblico esterno.

Inoltre, i servizi tecnici, la struttura, la tecnologia BIM e lo studio dei materiali, come appendici, supportano il progetto teatrale di Naumburg in modo integrale ed efficace.

Parole chiave
Naumburg teatro, Drama orientata, Design Narrativo, Prigione, Esperienza territoriale.

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1. Introduction

The thesis is mainly composed of 6 chapters :

1. **The relation between theatre and narrative**, as the core of our concept, inspired us at the beginning of the project study. In this chapter, abundant historical materials, project cases, data, and date are referred to reflect the development of theatre with the change of public performance. The study shows: drama elements can be applied to designing the route of different users in theatre, as an amplifier to stimulate their sensory experience.

2. There is also a clear sign of the relationship between **urban growth and prison extension**. The structure of this chapter is organized according to the chronology, and research objects are classified into two parts: urban elements (such as plaza, street, ruins, shops) and prison elements (court, prison cell, watchtower). It indicates that urban growth and prison development were independent of each other, while the new mission requires a combination of them.

3. Depending on the parallel development of history, we list Three Fundamental Purpose：History and Memory；Multi-task of theatre; Education, by which the design is designed to connect the past and the future. 1 Design strategy

4. In this chapter, aiming at achieving the Fundamental purpose, we are mainly in determining the specific room plan and exploring the **process of architectural design**： 1 Room plan 2 Preservation strategy 3 Composition.

5. This part mainly elaborates on the **narrative** produced by the combination of **architectural space** and **tourist streamline**. Besides that, the aesthetic effect of materials will also be discussed in this chapter

6. Photos of model and perspective rendering will further present our project from a human perspective.

2. The relation between theatre and narrative

The history of theatre has exceeded over 2500 years. Theatrical form has evolved from spontaneous activities to a complex performance which is highly complex script controlled by a series of scenes. Meanwhile, the function of theatre is becoming more and more complex. The mechanical control of stage sound/light effects and other little-known technical equipment behind theatre also need close cooperation among artists and industrial chains and technical team.

By the nineteenth century, the form of theatre was continually changing. There has been a trend to specialize in theatre design for certain plays. For example, Bayreuth Festival Theatre (*Richard-Wagner-Festspielhaus)* which is an opera house built by the 19th-century German composer Richard Wagner and dedicated solely to the performance of his stage works. During the performance, Richard made the auditorium darkened and the orchestra was kept out of sight of the audience. However, the way of watching theatre was mainly indoor or static.

When it comes to 20th centuries, in addition to some dramatic works that continue realism and Naturalism, some dramas have been influenced by modernist and postmodernist movements.

> Throughout the century, the artistic reputation of theatre improved after being derided throughout the 19th century..... In light of this change, theatrical artists have been forced to seek new ways to engage with society. The various answers offered in response to this have prompted the transformations that make up its modern history. （Drain, R. (Ed.). (2002). *Twentieth century theatre: A sourcebook*. Routledge.)

Some experimental theatres rejected those conventions began to appear, like Epic theatre, theatre of Cruelty and the so-called "Theatre of the Absurd."Martin Julius Esslin, *The Theatre of the Absurd,1960.*

According to Barnett's opinion: *'The purpose of epic drama is not to encourage the audience to suspend their doubts but to force them to see their world*.' Epic drama emphasizes the audience's perspective and reaction to the work through various techniques, intentionally making them participate in different ways alone. Those experimental theatres subvert the rules of traditional theatre in subject matter, costume and scene props, and make dramatic stories connect with the present without the limitation of time dimension. Moreover, Artaud thinks that theatre can even have no hint of costume scenes to allow the audience to sit directly in the middle of an empty room surrounded by actors, in order to achieve all sensory stimulation. '*Artaud sought to remove aesthetic distance, bringing the audience into direct contact with the dangers of life. By turning theatre into a place where the spectator is*

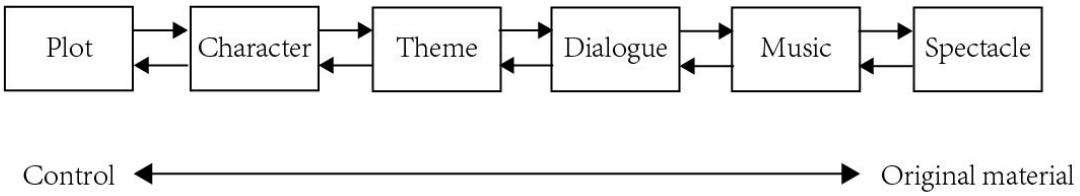
exposed rather than protected, Artaud was committing an act of cruelty upon them.' said by Lee Jamieson.

Given all kinds of pioneering innovations in theatre performance, the innovations in theatre design cannot always satisfy its performance. What we want to explore is not how the larger and more advanced equipment can influence the experience of theatre viewing, but how to go back to the source of theatre architecture and re-establish the connection between modern theatre and its container.

2.1 Drama's narrative

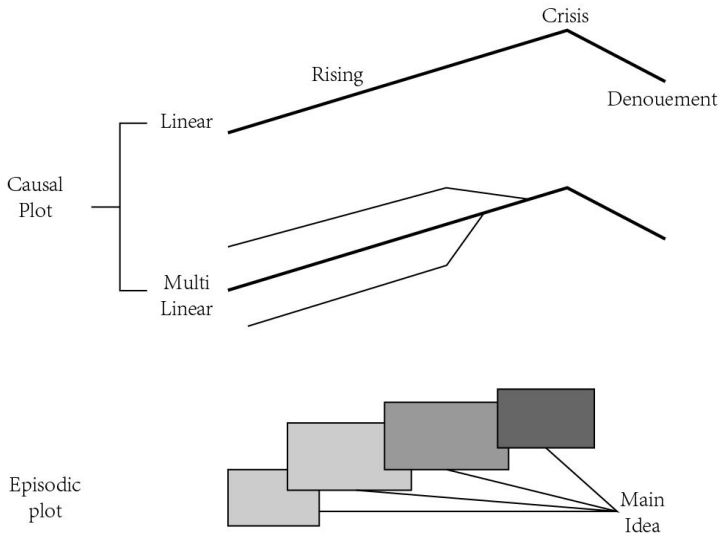
Before we study theatre design, we pay more attention to the drama. In our theatre project, the research of the narrative of drama has played an essential role in our design logic conceptual thinking. Therefore, we did some research to identify and classify elements, requirements and features of drama, and how a drama play on the stage. Based on this information, we try to transform the critical core of drama into performance space.

It is the definition of drama that a composition in verse or prose is presenting a story with pantomime or dialogue. Drama always uses conflict of characters to represent the narrative in front of the audience on the stage (Literary Devices, 2019). Besides, as a story, it needs unique ways and techniques of expression to describe information from actors to guests. Aristotle said six elements of drama mainly influenced performance: 1. plot; 2. character; 3. theme; 4. dialogue; 5. music; 6. spectacle (Cameron & Gillespie 2003).



Picture 1: six elements of drama.

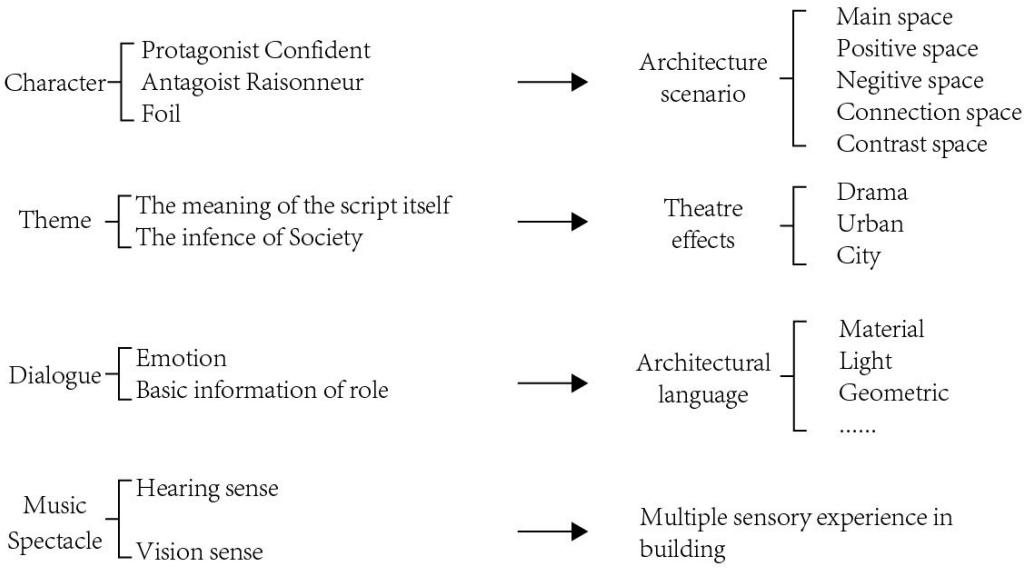
We divide these elements into six levels, and it can find some relationship between them. The next level is the original material of the previous level. The higher level decides what kind of lower-level is needed. On the one hand, polt can be comedy, tragedy, farce, melodrama and music drama. Therefore, different plots have different requirements of character, and they also determine and control the atmosphere, which is positive and negative. On the other hand, music, dialogue and character like structure support the plot to be a story.



Picture 2: two kinds of plots.

Drama itself can tell a story, the building of theatre can also have the characteristic of storytelling. There are two different plots that causal plot and episodic plot. It can be selected by different drama's needs. The circulation of urban and theatre volume composition also can compare the composition of the script. In our opinion, the narrative of space can compare the development of the plot. It also can have spatial rhythm and activity rhythm.

Furthermore, we explored transform these drama elements into space requirements of performance building.



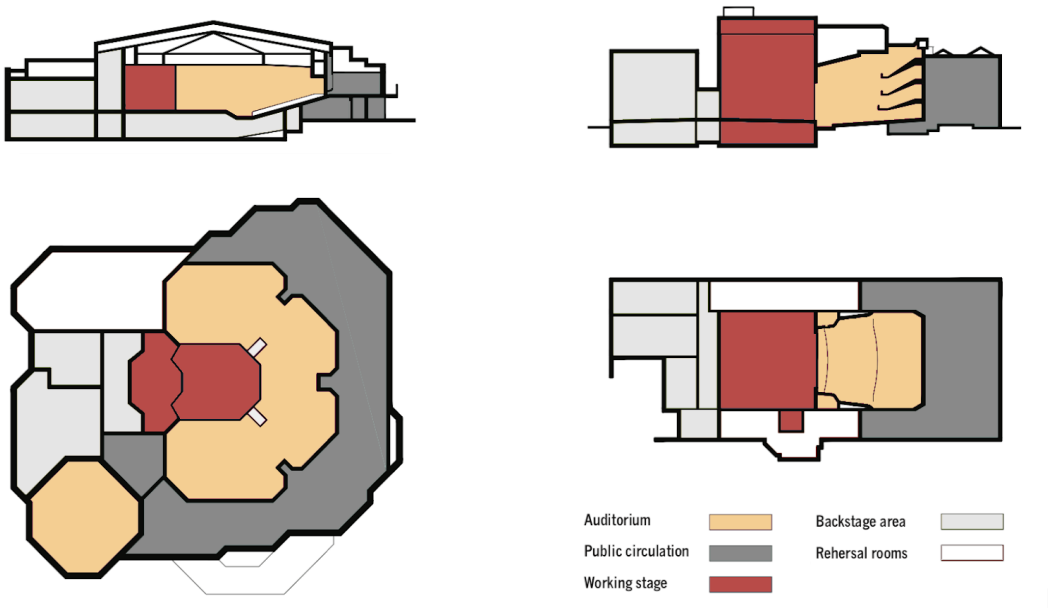
Picture 3: Transform six elements into architecture language.

Each character has unique personality characteristics. Therefore, each space in the theatre can have its unique space atmosphere and experience, such as positive, negative, flowing and staying space. The dialogue in a theatre can be some architecture language to describe the feeling that design wants to provide to guests. The designer can control the light, facade materials and scale of space to change the atmosphere. Therefore, we get some inspiration from these six elements and think space also should have a narrative logic. When people enter the building, they can feel the story beginning and the building as a physical prelude before the real show.

2.2 Theatre's narrative

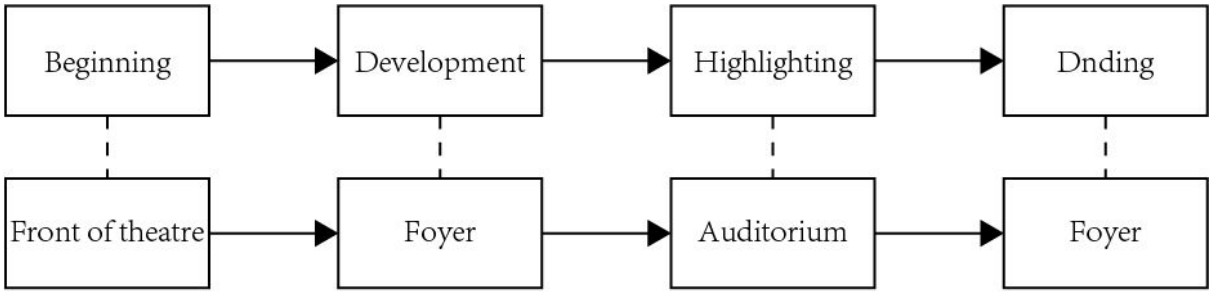
Theatre, as a particular functional building, has a clear purpose and unique operation method. The shape of the theatre can be flexible, and interior function may have some logic. After the study of drama itself, we move to the case study of theatre, such as type of stage, the shape of theatre and distribution of functions.

In this chapter, the narrative of the theatre can be reflected in two aspects of our design. Firstly, the theatre has a strict order of experience, which starts with buying tickets, foyer, watching performances. The continuity of people's experience can be related to the order of plots that happened in performance. Thus, the theatre function arrangement can be designed to follow a narrative logical (beginning, development, highlighting, ending). Secondly, the typologies of stage and auditorium will influence the form of performance and interaction between actors and audiences.



Picture 4: Parabola Arts Centre, UK- Typical plan and section of two theatres (JStrong, 2010).

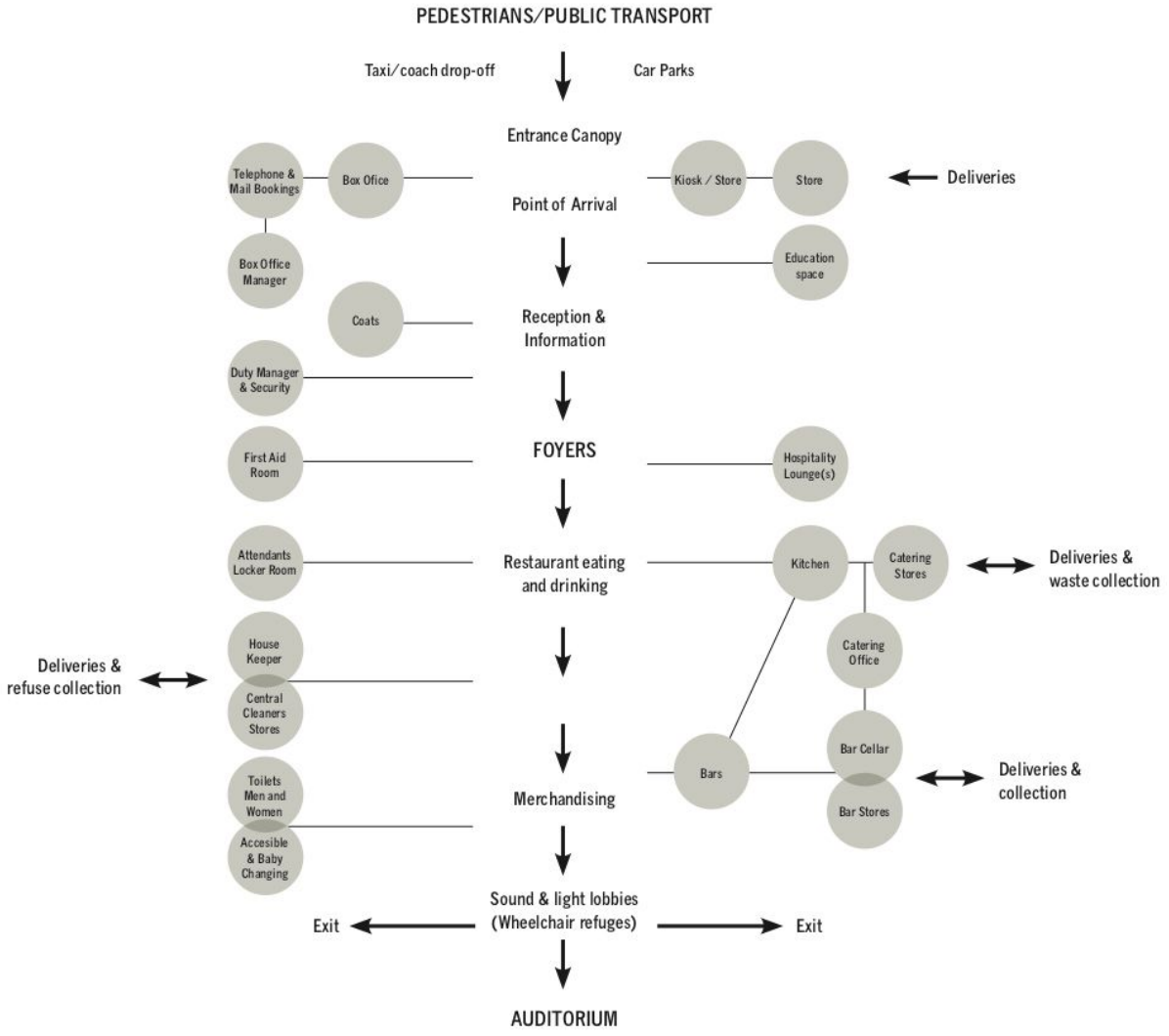
There are two different theatre's plans and sections. It is clear to see that both of them have auditorium, stage, backstage, rehearsal room and public circulation area. Also, theatres have rigorous functional requirements and functional limitations. Depends on different designs, these five basic requirements should combine in different ways. If we divide the plot into four steps that beginning, development, highlighting, ending, the theatre's narrative also can follow these four stories.



Picture 5: Compare show and theatre space.

In the beginning, the narrative already started when people close to the theatre. The plaza in front of the theatre, the space before the box office are beginning space. The most important of this space is the possibility. Here can attract people in and encourage them to find out more information, also can provide space for public activities. Although guests do not see the show, they can feel the enjoyment atmosphere around the theatre.

Foyer is the space that the audience emotion development in the theatre's narrative. According to the definition of the foyer: it is essentially the open and free plan circulation area that links to the auditorium, where the audience assembles before a performance and at the break of the show (JStrong, 2010). It can be seen easily that here is the most comprehensive space in theatre. There are many services functions in the foyer, such as box office, clack room, cafe bar, toilet, and rest area. Occasionally, foyer needs to hold contemporary events. Besides, the communication between guests and managers, audience and audience, between human and building occurrence frequently.

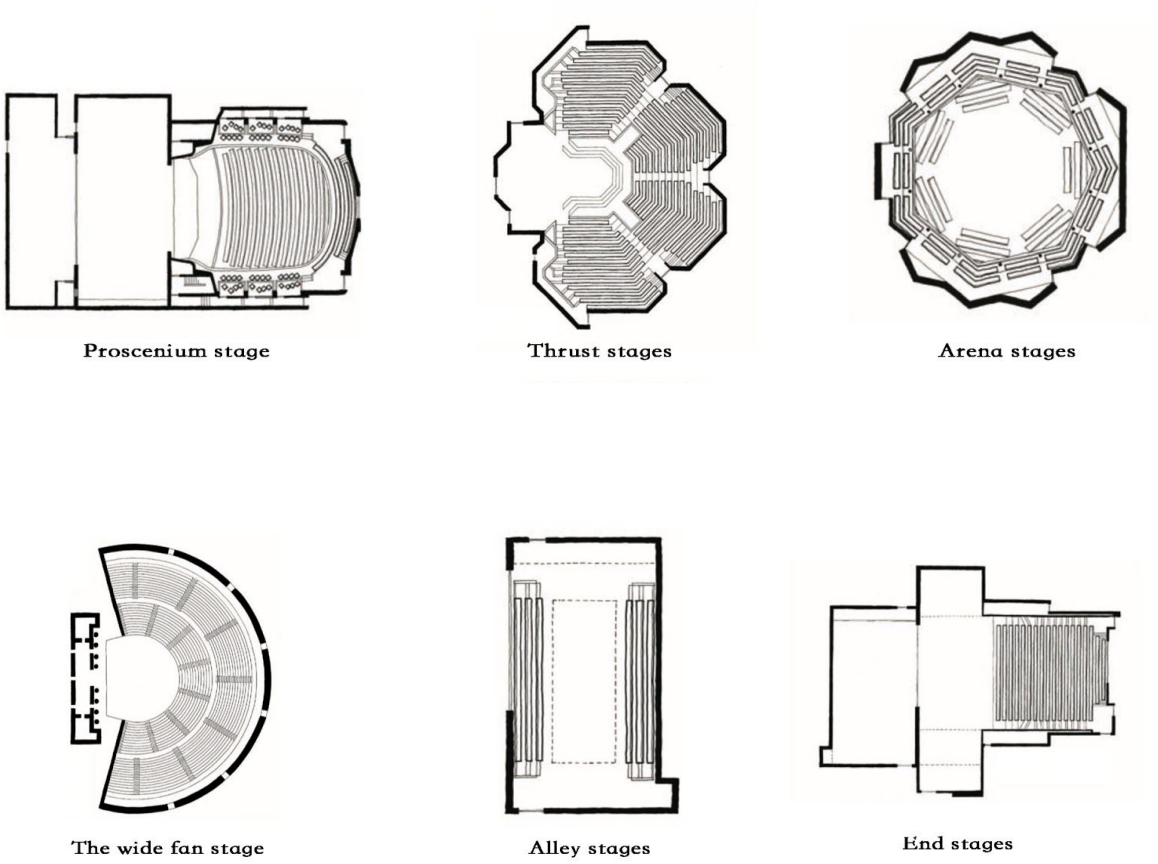


Picture 6: Diagram showing spatial relationships(Judith Strong, 2010).

The auditorium is the main aim that people go to the theatre. Therefore, the auditorium is the highlight in the theatre narrative journey. The drama is from life, but beyond life. In this space, audiences are experiencing another kind of life.

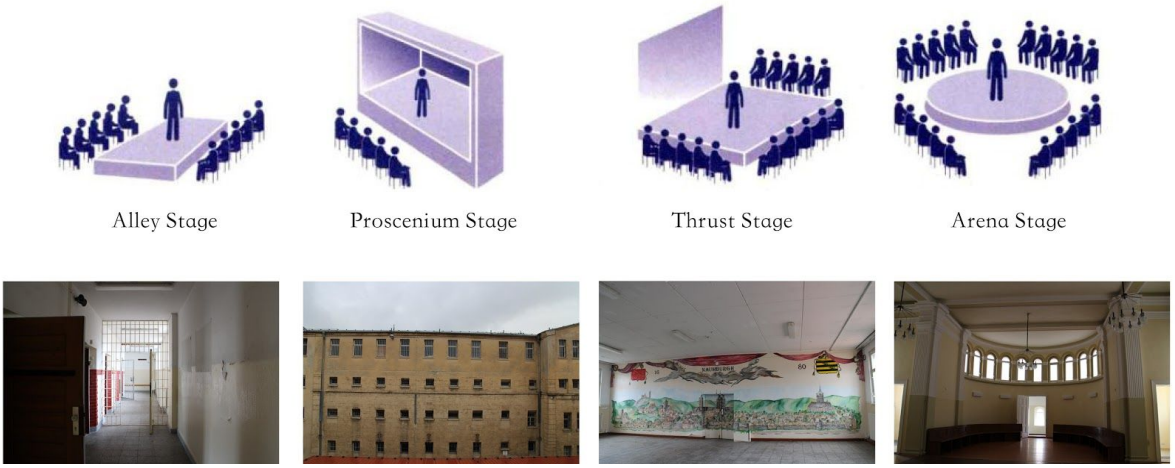
At the end of the show, people go back to the foyer. Theatre provides a large open space for them to socialize and communicate. The foyer, as a transition zone between outside and events on stage, creates the last drama lingering sense after the show.

Not only polt logic affect the narrative of theatre, but also typologies of stages have a significant influence on theatre design. Different stage also has a different way to explain performance. Therefore, we through the study of typology to analysis the relationship between audiences and actors. Then, we will know what kind of stage we need and which relation is we want.



Picture 7: six main types of theatre.

There are six common types of stages. Different types are suitable for different forms of performance, and also reflect the different relationship between audiences and actors. The possibilities of stage also affect the possibilities of theatre design. However, different types of performance spaces exist in daily life. For example, in our project site also can find some space of four types of stages. Therefore, many spaces have the potential to become performance spaces.



Picture 8: Space has the potential for performance in prison.

After we have some basic knowledge of drama's narrative and theatre design, we will focus on our theatre design project. Firstly, we find the story of the site. Then select the valuable narrative of the drama and theatre, and put it into our site. In addition, from these narratives, we get some inspiration to do site analysis. On the one hand, the design should keep the most basic narrative of the theatre and drama. On the other hand, we find some new narrative production and dramatic narrative in site analysis also can reflect drama's narrative.

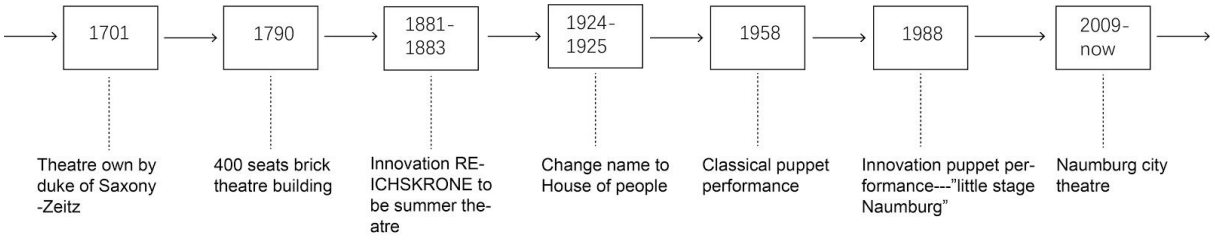
3. City and site

3.1 Theatre related stories at the Urban Scale

After researching and discovering Naumburg, we found that the culture of theatre has a unique role in this city, and some spaces have the potential to become a performance space in the city. Such as daily living space (plaza, garden), historical space(Naumburg Dom, city wall park), and historical space (Marientor Naumburg, Naumburg city theatre). Therefore, we want our design has the influence of backing the theatre culture in the town and bring new vitality daily life for local people.

We study the value of theatre towards the city through the history of the development of local theatre industry. Then, we realized that the continuous development of theatres had a significant impact on the city's culture and the lives of its citizens at every stage.

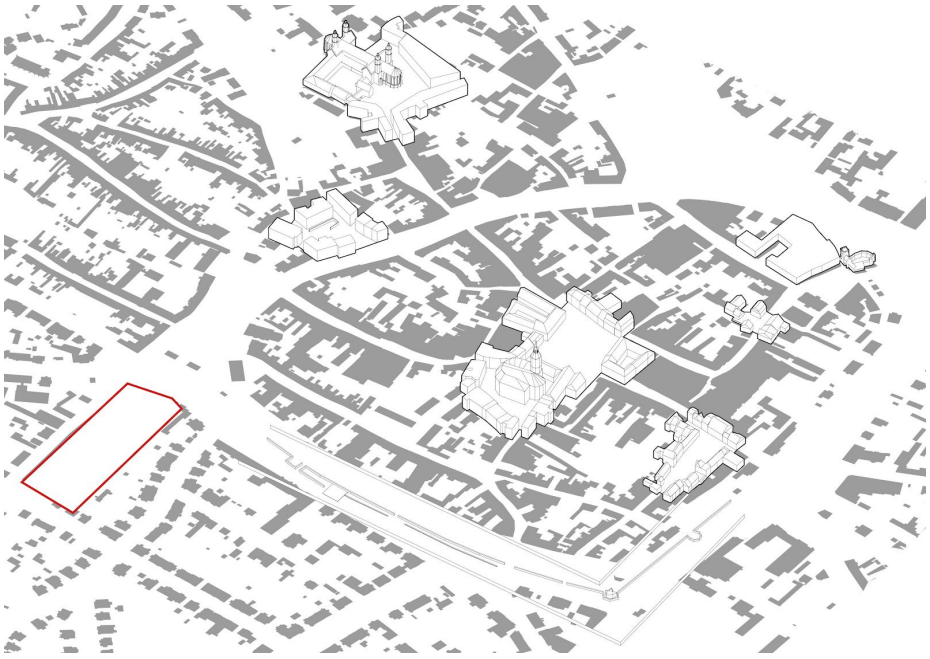
From the year 1701, there were some Greek Tragedies performed in the theatre which own by duke of Saxony -Zeitz. In order to satisfy the amount of audiences, another 400 seats brick theatre building was built in Naumburg in 1790. Then the city renovation the HOTEL REICHSKRONE to be the summer theatre between 1881 to 1883. After 1945's, the hall continues to be played as a city and film theatre and is renamed the House of the People. From 1958, the classical puppet performance was popular in this town, and there was an innovative puppet performance named "little stage Naumburg" in 1988. Two decades later, the THEATRE NAMBURG built in 2009 is called the smallest city theatre in Germany. This theatre has been serving the citizens for long period of time, and citizens are proud of the theatre.



（REICHSKRONE）

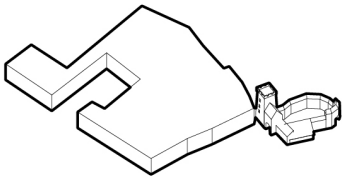
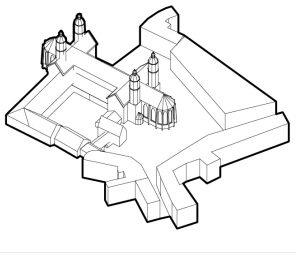
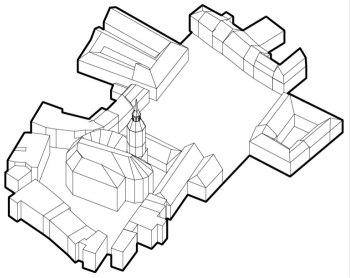
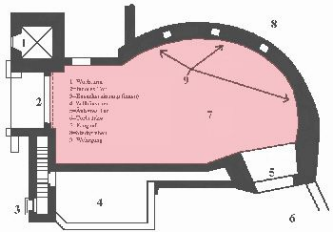
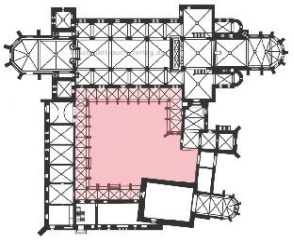
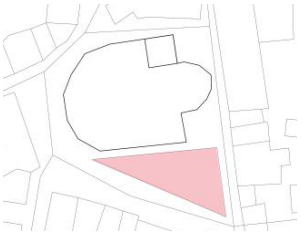
（puppet show in Numburg）

The significant impact of the theatre cultural towards this town inspired us to find the story of drama and theatre elements in the town. Therefore, we first analyze the necessary information about this town, such as function distribution and main traffic road with its direction. Based on that information, we focused on analyzing spaces and activities of people which are related to drama and performance and try to merge them to create a dramatic story that can be constantly happened in this town. Some spaces have the quality to be the use of performance and reflect the different cultures, history and social of Naumburg. We divided those spaces into three categories, which are 'history node', 'heritage node', and 'living space node.



As for the history node, we thought that the history node should have the ability to present the representative culture and history of Naumburg and also have the special quality to become a performance space. Thus, we selected Marientor Naumburg, Naumburg Dom, and St Wenzel church Naumburg.



(Marientor Naumburg) (Naumburg Dom) (St wenzel church naumburg)

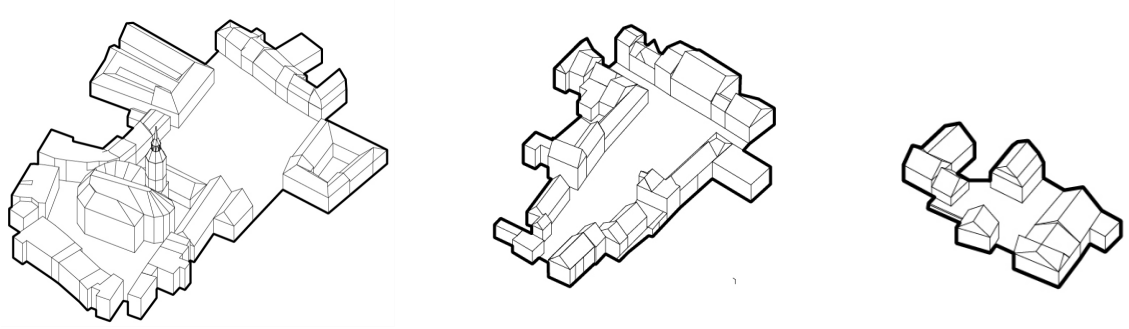
The Marientor Naumburg was an ancient city gate of Naumburg which located in the northeast of the town, and it is the only preserved gate in the town (Marientor n,d). Marientor Naumburg is a typical example of a double gate system; its construction method and structure typology are precious historical data. However, the value of this building not only present in those, but also its function changed in history. The function of this Marientor Naumburg has changed from gate to apartment and then served as a prison (Stadtbefestigung Naumburg: Marientor n,d). Nowadays, this building was used to hold some summer events in the courtyard of the building. Therefore, the function of the gate, the prison history and the high available valuable space of this building determine it is an important part of the theatre-related story of this town and it can be an open-air stage to present the history and culture of itself and the Naumburg.

Another history node is Naumburg Dom. Firstly, It is the German late Romanesque architecture and has been recognized as a UNESCO World Heritage Site in 2018. In the Naumburg Dom, sometimes it will cooperate with some music schools and hold music

concerts. Additionally, the Dom has a big courtyard which is surrounded by the Romanesque corridor. This courtyard and the corridor can be seen as the performance space in which people can immerse themselves with a historical background in the actors' performance.

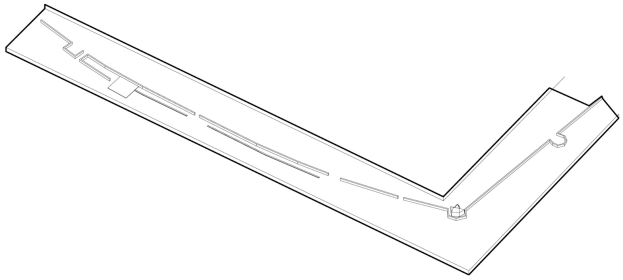
The third history node is St Wenzel church Naumburg which is another church in the town. The reason that we chose this church is because the organ in this church is arguably the best extant example of a "true Bach organ." (PIPE ORGANS, 2009). On the one hand, it represents the music culture of Naumburg. On the other hand, an organ can also serve for performance, in order to enhance the unique atmosphere of this node.

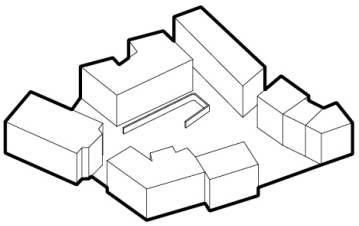
As for the living space node, our opinion is that the drama deduces life and also come from people's daily life. Therefore, we find three spaces where are usual but can present the life of the citizens.



The first place which we selected is the central plaza of this town. This plaza is located in the middle of the commercial street and surrounded by the shop and restaurant. In this plaza, citizens relax and enjoy their life. The second place is also a plaza in the town; however, it has an unusual triangular shape. In this case, it has a different provide a different view for people to see what happened inside. The third one is a small open space in the residential area, facing a small cafe shop. It has an atmosphere of the normal daily life of people. The audiences will feel closer to performance when the show happened in those spaces.

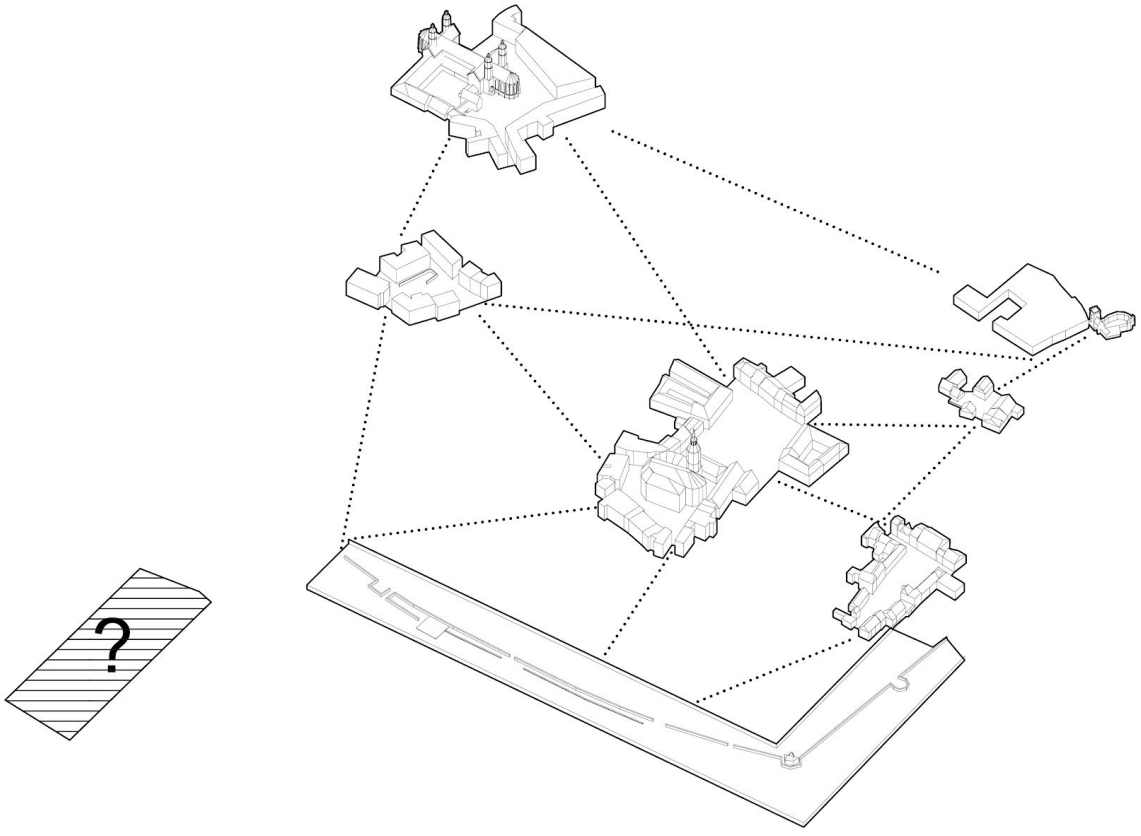
Some memory of the town can be found in the heritage sites in the town. In this way, we think that the heritage of the citadel wall and the reserved city ruin can be the heritage node.





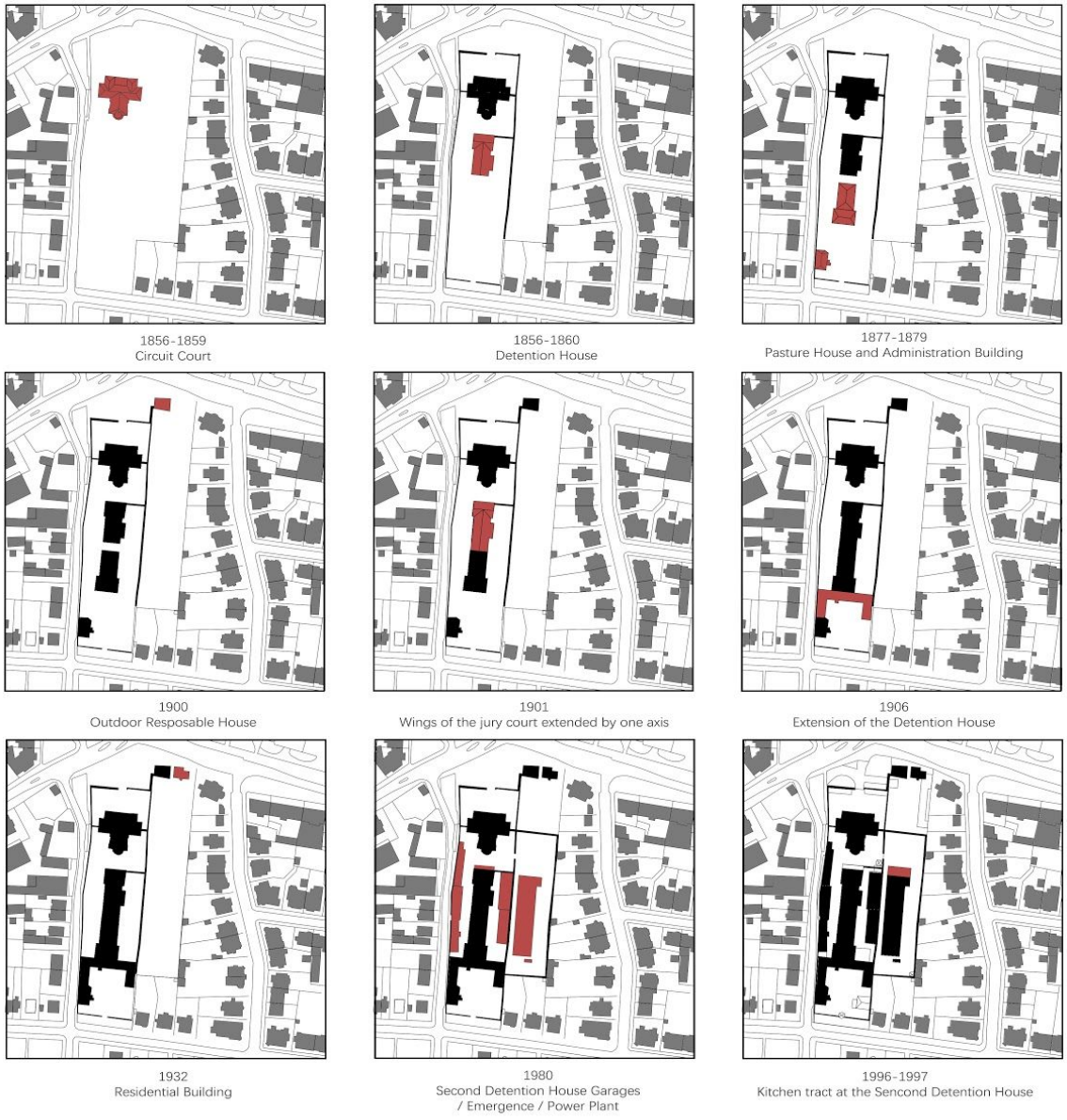
There are two layers of the ruins of the heritage wall located at the ancient city boundary. Those heritage walls reserved the memory Naumburg. People can feel the past of the city here. Another heritage site that we selected was a ruin located in a residential area. This site keeps the memory of some buildings abandoned in the urban development process.

Based on the analysis of the town and exploring the drama nodes in the town. We got the accessibility of the drama node and found that those nodes can be continuously visited and told a story about Naumburg. Therefore, we attempt to build a network of the drama nodes and think about the role of our site in this story. According to the existing buildings in the site were served as prison before and it is the witness of the change of this town. We think that the design in this site needs to reflect the history and using a dramatic way to tell.



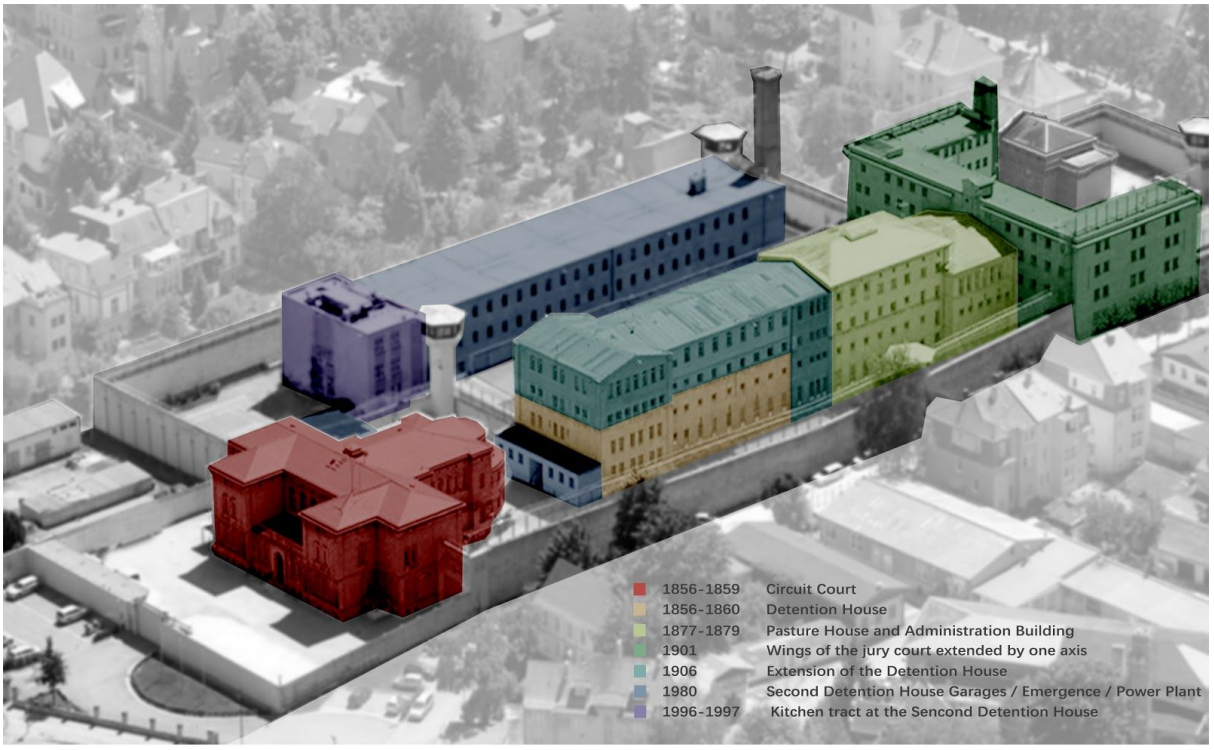
3.2 Drama related stories at prison scale

When we researching the site, we first realized the history of this prison, in order to find out some relation with the city's development, and then we try to evaluate the dramatic value of the element in the site. In this case, we can redefine and develop those elements in our design and keeping the significant memory of this prison.



The construction of this prison since 1856. The circuit court and the first part of the detention house was constructed from 1856 to 1860. Meanwhile, more than 350 prisoners were imprisoned here. In the next four years, Administration building, pasture house and responsible house completed the construction. The detention house was extended to house

I and house U between 1901 to 1906. However, this prison was destroyed by bombing in World war two. After the bombing, the second detention house was complete the construction in 1980 and add the kitchen tract between 1996 to 1997. Finally, Naumburg prison closed at 2012 and all the prisoners were changed to imprison in another prison.



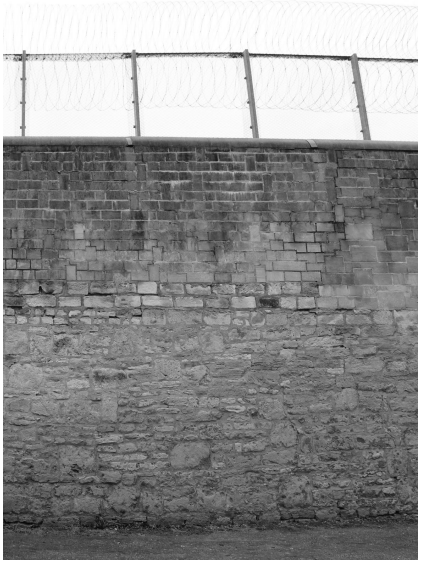
The result of researching the history of this prison shows that history of the prison is very valuable to be presented in our design by redeveloped some elements in the prison which have the characteristic of drama, such as watching towers, historical walls, facades, material and window. In this way, we can keep the memory of the site and give visitors the contract feeling of existing and new.

There is 4 watching tower in the site, those towers were the typical landmark of this prison area. Inside of the watching tower, it is a narrow mental spiral staircase that can provide a special limited spatial experience.

（watching Tower）

(staircase inside of watching tower)

The existing prison walls were also the representative element of the prison site. Those walls have isolated the site with the city. Therefore, we want to reserve some walls or some parts of the wall to keep the perception of this space was isolated before. Except for those representative element, there are some staircase inside of the prison building have high value to be redefined. In addition, we find the little window on the door and some paper-cuts on the wall, those elements are traces of the life of prisoners in prison.



（existing prison wall）

(staircase inside of court)

(paper-cut one the wall)

(window on the prison door)

4. Strategies and Concept

4.1 The coincidence of two timelines create a syncretic story

We compare the history of prison with the development of Naumburg City Theatre and use pictures to describe the point of intersection in these two narrative timeline. This part will specifically expand the description of intersecting time nodes, combined with the particularity of the site. Our design will like a new story that continues the narrative of prison and combines the development of city theatre.

Depending on the parallel development of history, we will explore the historical importance of the existing volume as well as the future activities of the theatre to discover a new and old dialogue. On the one hand, existing historical volume is a memory of prison development. On the other hand, in our opinion, future activities should pay more attention to drama education and multitasking of theatre.

4.2 Design concept

- History and Memory

The most identifiable characteristic of the site is that those buildings were prison before. The complex has witnessed many renovations and extensions over the past 100 years. Design continuity of narrative, also empower existing building with exhibition function.

Prisoner Museum: The theme of the exhibition should be memorial to prisoners who died in prison. Prisoners are a group of people who are often ignored in the war. They are many but weak, and curled up in the shadow of war, twisted by their warden. They are not as useful as animals when they live; they are not recorded when they die. By reorganizing the relationship between some existing buildings and recycling demolished building materials, we can reawaken the memory of the site. Meanwhile, by arranging and displaying the prison life of prisoners, we can mention the dark history and reflect on the cruelty of war.

The Exhibition topic is based on some historical event from previous newspapers, biographies and Survivor interview such as Eleven Channel Islanders ; *Jersey Evening Post* published by Frank Falla ; USAAF bombed Naumburg city on 9-11 April 1945; Memoir, *The Silent War*, by Frank Falla

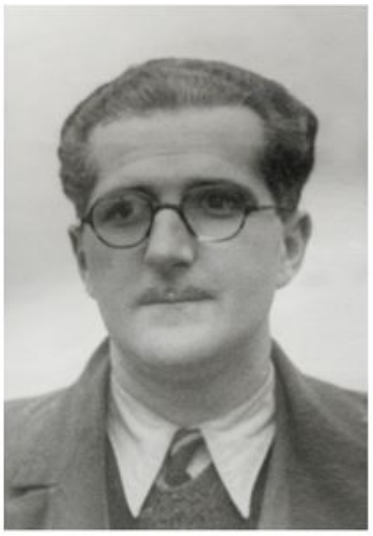
- Multi-task of Theatre

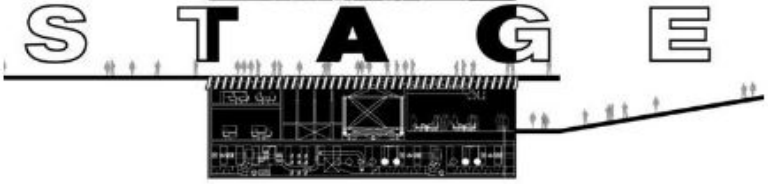
Because Naumburg is a small German city where our potential visitors, potential audiences and users are limited. Therefore, it is necessary to design different size of auditorium for different needs, and interior public space could be flexible for various activities.

- Education

Due to the fact that the percentage of the popularity of theater is decreasing among young generations, our primary task is exploring its educational ability by revealing unseen part to the public; proposing experimental stage design for contemporary art.

General citizens are encouraged to visit the fly tower, backstage and set workshop and to experience the complexed process of making a set, like the activity that happened in BASE Milano and Taipei Performing Arts Center (TPAC);





P1 Frank Falla photo from Falla's Occupation ID card. Copyright Guernsey Archives

P2 Ombing damage from the USAAF attack on 9-11 April 1945, by Ernst Hammer

p3 Oma, Dee and Charles Wyly Theatre, Dallas, 2009

P4 BASE Milano

P5 Oma, TPAC, taipei, 2011

5. Design process

5.1 Room plan

This part we will based on these requirements to find different architecture elements, and transform drama into architecture language.

Naumburg Theatre - Room plan
400 seats
Rooms and spaces with *** partly relocatable elsewhere (existing buildings, new buildings) but always with direct connection to the stage

	Main stage		Width: mt.18 (incl wing) Depth: mt.18 (excluding forestage) Max proscenium width: mt. 10 Max proscenium height: mt. 7 Under stage area, height mt 4 approx
	Fly Tower		Fly tower mt 14 width x mt. 14 depth approx. with fly galleries grid height: mt. 20 approx Height (excluding under stage area) mt. 23 approx
	Under stage area		Height mt. 8 approx
	Orchestra pit	60 m² approx	Mobile, adjustable floor
	Backstage	100 m²	
	Stage manager	8 m²	Close to the mainstage
	Props	8 m²	Close to the mainstage
***	Reherseal stage	150 m²	
	Dressing rooms for performers (m)	55 m²	4 rooms including toilet with shower.
	Dressing rooms for performers (f)	55 m²	4 rooms including toilet with shower
	Group Dressing room (f)	35 m²	1 room including toilets with showers
	Group Dressing room (m)	35 m²	1 room including toilets with showers
	Band room	40 m²	2 rooms m² 20 + m² 20
	Green room	30 m²	(1 or 2 rooms m2 15 +15 with kitchenette)
	Toilets (f)	20 m2	
	Toilets (m)	20 m2	
	Lounge/ wardrobe	25 m²	(for guests & school-classes)

Workshops / service rooms

Rooms and spaces marked with *** partly relocatable elsewhere (existing buildings, new buildings)
but always with direct connection to the stage

	Control room: sound / lighting / projection	24 m²	Separate room and partially inside the auditorium
	Recording studio	32 m²	Speech and music recording, soundproofing, acoustic design
	Director's room / recording studio	12 m²	Soundproofing, acoustic design, window towards recording studio
	Lights /electric control Dimmer room and stage equipment	24 m²	
	Server / computer system	12 m²	
	Lounge, kitchenette (for stage workers)	15 m²	
	Toilets, showers: employees	20 m²	10 (m) +10 (f) incl hand.

***	Wood workshop	70 m²	Height: 5-6 m
***	Metal workshop	40 m²	Height: 5-6 m
***	Storage: wood and metal materials	40 m²	Also divided into two separate units, stored materials , length: 6,5 m
***	Workshop: sets and props	120 m²	Height: 5-6 m, work with spray guns, suction, separating basin for gypsum
***	Tailor shop	55 m²	Including fitting / big cutting table
***	Washroom	15 m²	Industrial wash basin, dying fabrics
***	Storage: costume collection	150 m²	Two stories, walkable
***	Storage: decorations sets	200 m²	Height: 6 m,
***	Storage: platforms	60 m²	Height: 3,5 m
***	Storage: furniture	100 m²	Height: 3,5 m, incl.- 2 storage levels
***	Storage: lighting equipment	60 m²	Height: 3 m
***	Storage: sound equipment	35 m²	Height: 3 m
***	Storage: materials	35 m²	Height: 3 m
***	Storage: small props	35 m²	Height: 3 m
***	Puppet collection	60 m²	Height: 3 m, on two levels / probable relocation to Fröbelstrasse / otherwise min. 80 m2
***	Storage / cleaning material	25 m²	
***	Toilets, showers: employees (f)	20 m²	Adjoinment to workshops, possible separate area for costume shop
***	Toilets, showers: employees (m)	20 m²	Adjoinment to workshops, possible separate area for costume shop

Technical facilities

variable position, to be decided (based on the different technology)

	Heating - Cooling		
	Transformer station Safety lighting, backup battery		
	Ventilation station		
	Sprinkler control station		
	TOT	m² 300 – 400 approx	

Secondary theater facilities

Rooms and spaces marked with *** partly relocatable elsewhere (existing buildings, new buildings) but always with direct connection to the stage

***	Locker room (m)	10 m²	Lockers
***	Locker room (f)	10 m²	Lockers
***	Technician's offices	30 m²	Including lounge area
***	Director's office	20 m²	Including interview area
***	Procurement manager's office	12 m²	Near director's office
***	Accounter's office	12 m²	
***	Theatre educator's office	12 m²	
***	Dramatic advisor's office	12 m²	Near director's office
***	Office (general use)	15 m²	Assistents and guests
***	Employees' Lounge	25 m²	Lunch room with kitchenette
***	Copy room	12 m²	
***	Toilets 1 + 1 (incl Hand.)	15 + 15 m²	

Main theatre

Rooms and spaces marked with *** partly relocatable elsewhere (existing buildings, new buildings)
but always with direct connection to the auditorium

	Auditorium (approx 1,2 – 1,5 m² for seat)	400 seats	Flexibility in seating, Peripheral galleries for technicians and actors, mobile platforms, ceiling grid over fore stage for spots, sound system, etc.
	Chair storage	80 m²	
	Toilets (m)	60 m²	Da verificare in base alle normative tedesche (prof Pinardi)
	Toilets (f)	60 m²	Da verificare in base alle normative tedesche
	Toilets, handicapped	16 m²	Da verificare in base alle normative tedesche
	Toilets, children	20 m²	Da verificare in base alle normative tedesche
	First aid	12 m²	
	Fire safety office	12 m²	
***	Visitor cloakroom	60 m²	
***	Box office + shop	60 m²	Including visitor service, open area
***	Foyer / cafe / bar	250 m² approx.	Open area, multiple use for external events and meetings
***	Storage for cafe	24 m²	Refrigeration, refuse
***	Toilets (m)	15 m²	For cafe visitors, and employees
***	Toilets (f)	15 m²	For cafe visitors, and employees
***	Toilets, hand.	10 m²	For cafe visitors, and employees
***	Storage for tables, chairs, podiums (foyer)	40 m²	(Moveable exhibition walls, tables, bar tables, chairs, printed material) close to foyer

Accommodations

for visiting actors, directors, etc. (existing buildings, new buildings)

***	rooms, open kitchen / dining area, etc.		to be defined according to the project

Exhibition + Museum

Variable size and quantities, mainly distributed in exsting Building.

	Exhibition room (for temporary works)	300 ㎡	flexibility in division and distribution
	Exhibition room (for Permanent works)	600 ㎡	flexibility in division and distribution
	Toilets 3 + 3	20 ㎡ + 20 ㎡	
	Storage room	600 ㎡	
	Study room	100 ㎡	
	Community library	200 ㎡	
	Administrative office	30 ㎡	
	Security office	15 ㎡	
	Conference room	200 ㎡	share space, muti-functional
	Closet room + Locker room	30 ㎡	
	Ticket office	30 ㎡	

Music school

Variable size and quantities, mainly distributed in exsting Building.

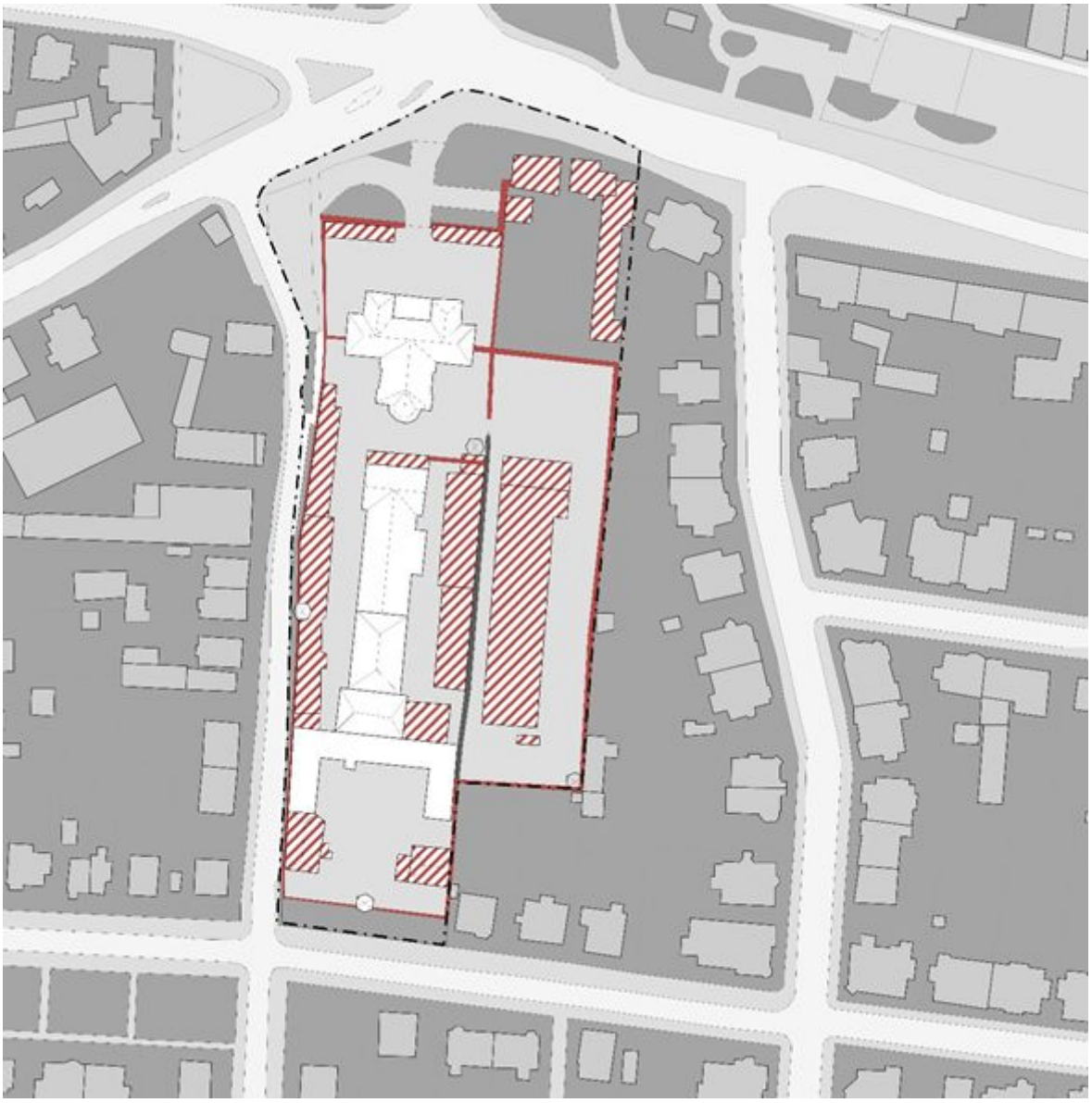
	Lecture room	45 ㎡ x 5	
	Practicing room	15 ㎡ x 15	
	Toilets 5 + 5	30 ㎡ + 30 ㎡	
	Storage room	200 ㎡	
	Study room	100 ㎡	
	School library	200 ㎡	
	Administrative office	30 ㎡	
	Security office	15 ㎡	
	Conference room / Concert hall	150 ㎡	share space, muti-functional
	Closet room + Locker room	30 ㎡	
	Public space	30 ㎡	

5.2 Preservation strategy

Depending on the existing building analysis, we defined the value and significance of existing buildings and walls. Some parts were retained in order to keep their historical value and memory of the site.

The criteria of preserving existing building is determined by several aspects: monumental significance, adaptability of new functions, position and building conditions.

Most of the buildings are demolished; only the buildings that are marked in white will be preserved and reused.

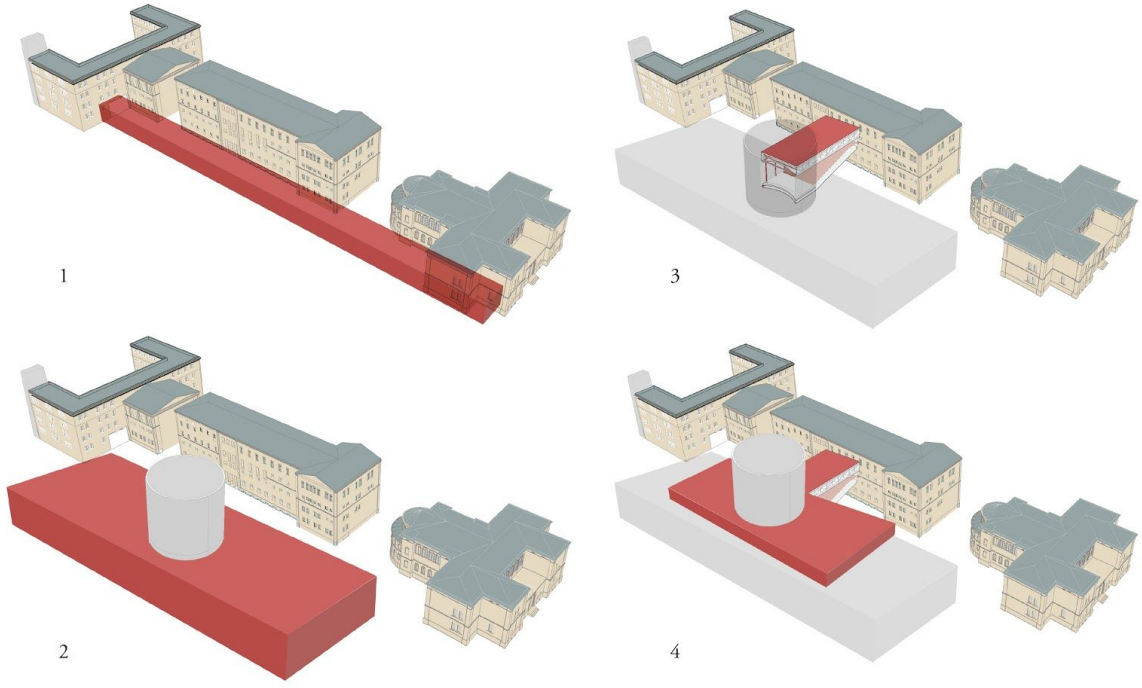


5.3 Site design

This part will use function mapping to show the composition of the theatre. In addition, we will tell the story that how we transform the 2d plan to 3d architecture volume.

5.4 Building composition

This part will use function mapping to show the composition of the theatre. In addition, we will tell the story that how we transform the 2d plan to 3d architecture volume.



1. Define the in between space
- route between history and modern
- limitation and boundary of design

2. Define shape of theater
- Circular flytower : rotatable machine inside

3. Create a new connection
- Second small auditorium between existing building and theater
- Share one flytower

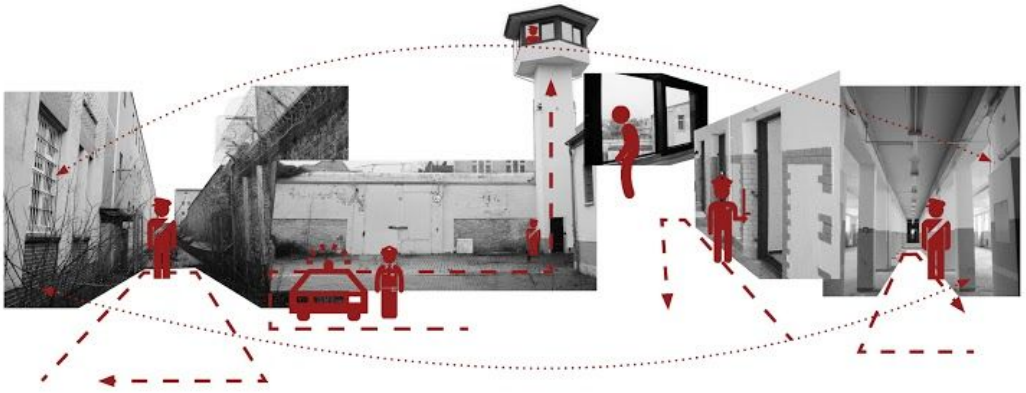
4. Flytower system
- Two auditorium and backstage, workshop controled by one flytower
- Ground level creates lighting atmosphere to respect environment

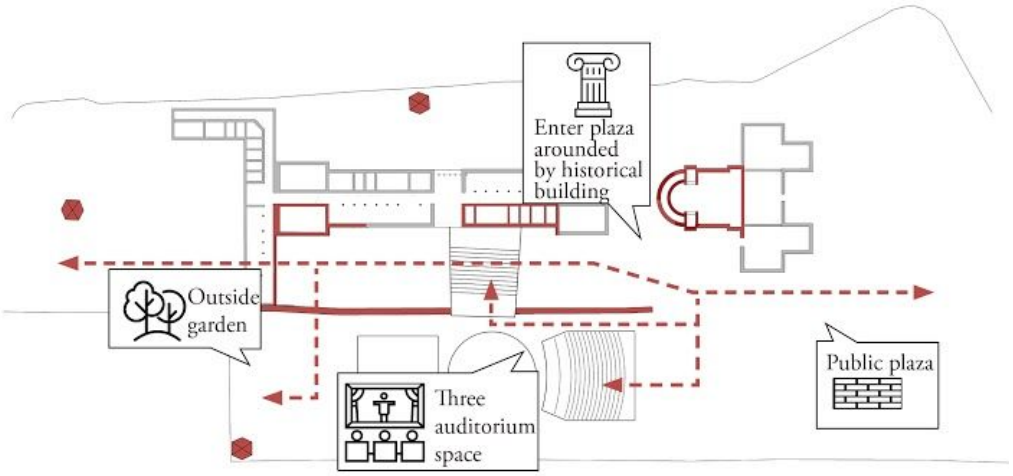
6. Space narrative expression in our theatre design

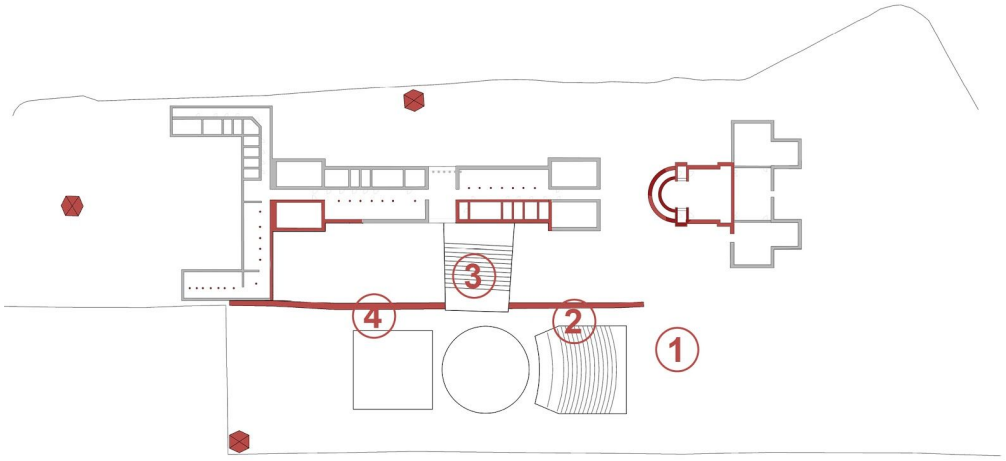
We selected some specific space to describe the space experience, atmosphere and the definition of we want to entrust, such as open foyer, the long corridor between foyer and second auditorium, the bridge between new and old building and the backstage long stairs.

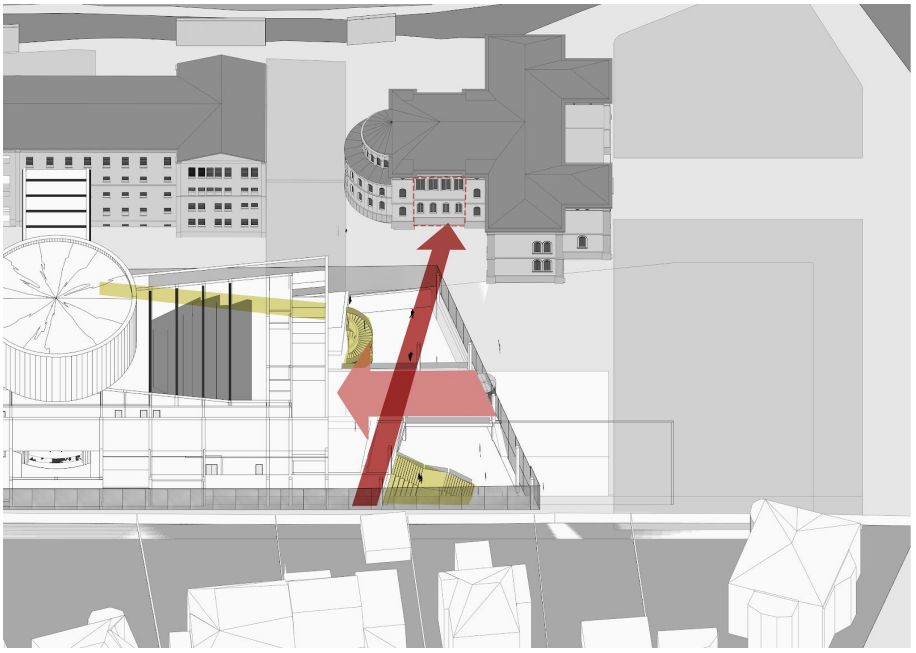
On a different narrative route, people will use different spaces and have different circulations. We defined three different kinds of narratives in our design. In the following part, we will specifically describe how the narrative happens and reflect in the building.

6.1 Narrative of theatre



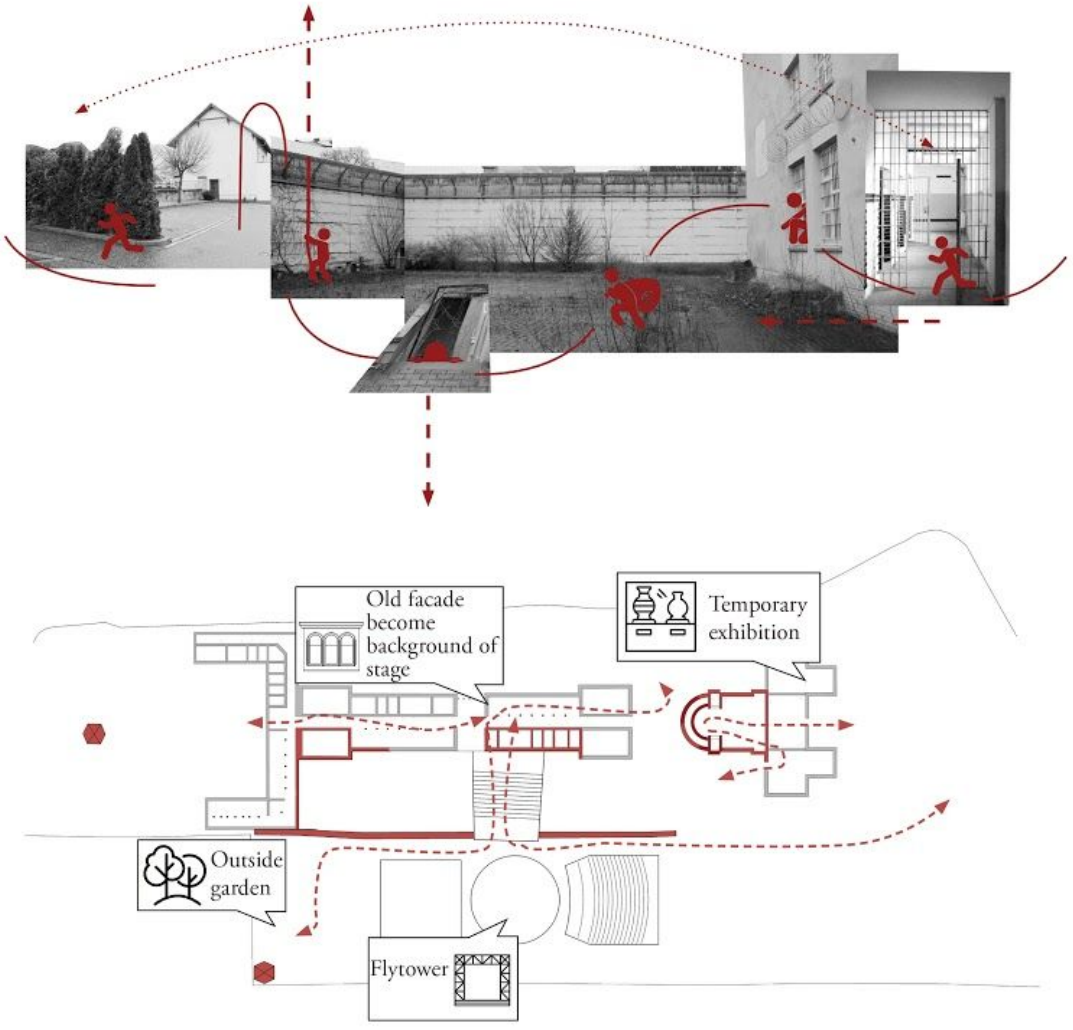






Scenario 1 Intersection
keywords: introduction, transition, choices
Scenario 2 Escalation
keywords: inter-space,
Scenario 3 Climax
keywords: connection, domination, penetration
Scenario 4 Behind the scenes
keywords: decoding, participation, interaction

6.2 Narrative of museum



6.3 Narrative of exterior public space

There are many problems that build a new building beside historical buildings. How to deal with the relationship between the old and the new is also a challenge for us. The design concept that creates harmony or contrast between the old and the new will have different effects for the site.

In our design, we want new and old can be clearly distinguished and new building also has a harmonious connection with surrounding. Therefore, the theatre uses white concrete and likes a background of ancient buildings. The sense of history and time of existing buildings like a 3D drawing on the white background. In addition, the old and new will have a strong communication on the site.

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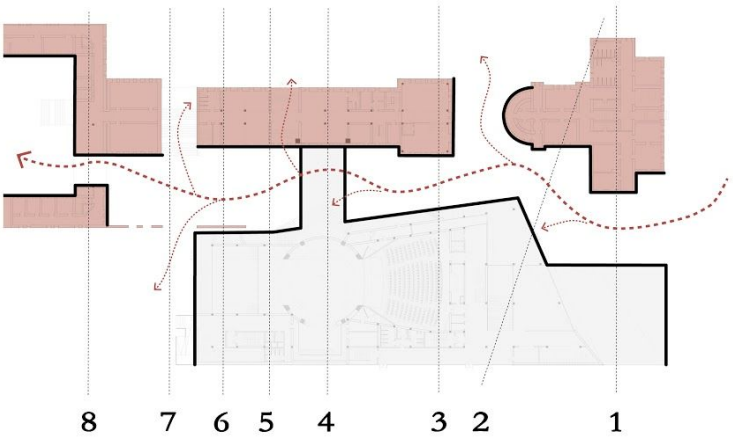
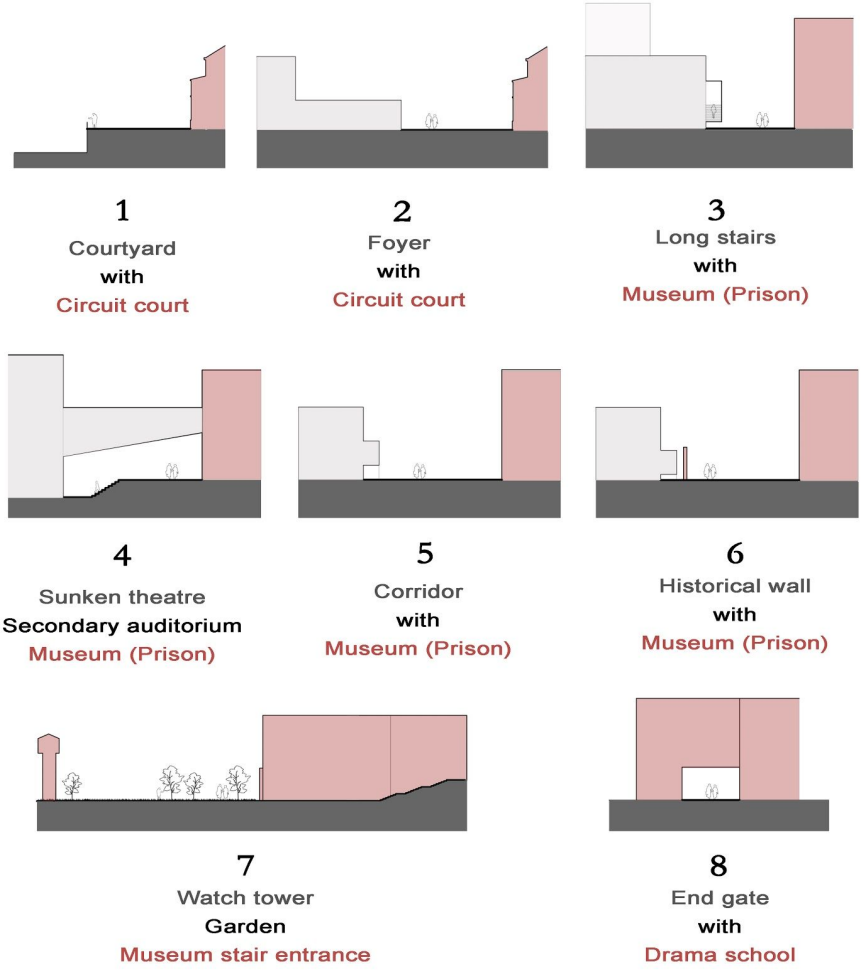
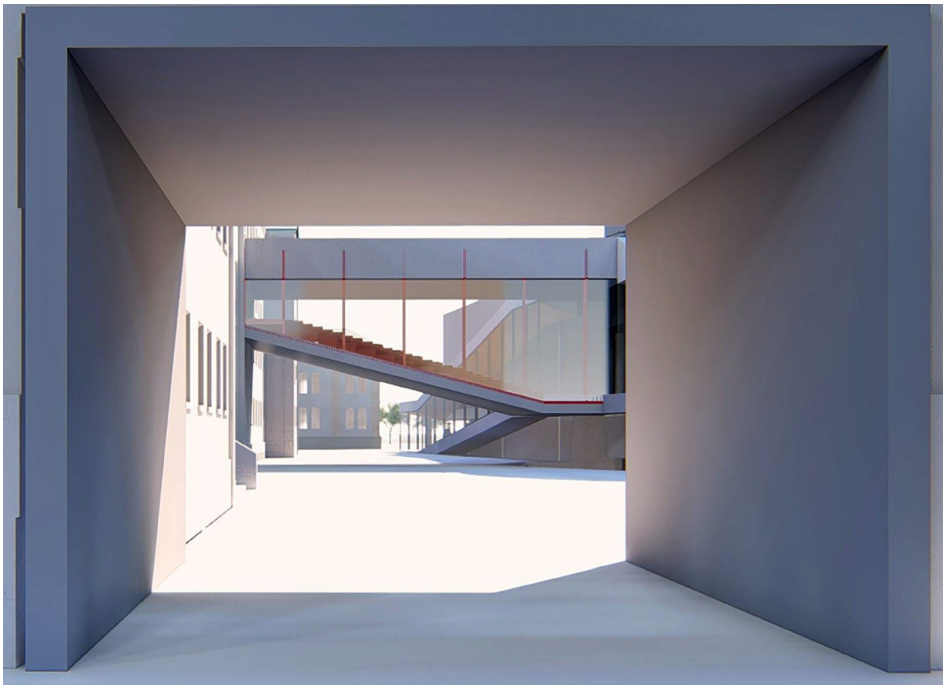


We select eight interesting points to cut sections and use these sections to show the rhythm of this in-between space. The start point is courthouse as view 1. The last view is people go through the theatre school as view 8. The distance between new and old and height of two buildings change with people's move step by step.



Secondly, it is a new urban corridor. Originally the site is an independent space, now we broken the boundary and mead the route through the building. Therefore, here has a corridor through the site, break the limitation, and continue the development of the city.



View from the drama school entrance

Third, around this corridor axis, there are many different spaces and many different functions happening, such as sunken theatre and museum entrance, even people can under the small auditorium. It also is a reflection of our ‘patrol route’ that we defined in the narrative of theatre.

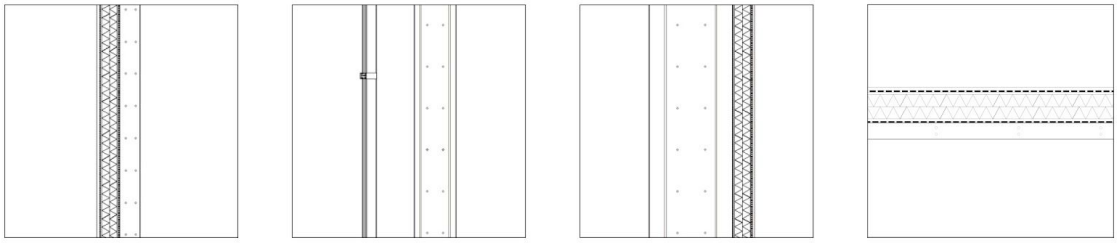
Depend on these three meanings, we find two narratives stories of exterior public space. On the one hand, this corridor not only can be used by theatre and museum but also as an urban pass for local people in Naumburg city. It represents the communication between history and contemporary and shows time layers of the site. Furthermore, it also symbolizes the significance of the site itself between past and contemporary in city development.

7. Conclusion

8. Appendix

8.1 Building services design

8.1.1 U-value calculation



Wall 1 Wall 2 Wall 3 Roof

U Value= 1/ (R + Ri + Ro+....+ Rn)

R = Material tickness (m)/Thermal Conductivity (m*k/w)

U value							
material			thickness (m)	thermal conductivity k (w/m.k)	R value=d/k	R total (m2.k/w)	U value (w/m2.k)
eastern facade	wall 1	plaster	0.02	0.4	0.05	4.9405	0.202408042
		vapor control layer	0.024	0.33	0.072727273		
		waterproof	0.016	0.25	0.064		
		glass wool insulation	0.15	0.033	4.545454545		
		reinforced concrete	0.15	1.2	0.125		
		internal pavement wood	0.01	0.12	0.083333333		
	wall 2	reinforced concrete	0.15	1.2	0.125	0.3950	2.53164557
		double glass	0.01	0.04	0.27		
north facade	wall 1	plaster	0.02	0.4	0.05	4.9405	0.202408042
		vapor control layer	0.024	0.33	0.072727273		
		waterproof	0.016	0.25	0.064		
		glass wool insulation	0.15	0.033	4.545454545		
		reinforced concrete	0.15	1.2	0.125		
		internal pavement wood	0.01	0.12	0.083333333		
western facade	wall 3	plaster	0.02	0.4	0.05	5.3155	0.18812852
		vapor control layer	0.024	0.33	0.072727273		
		waterproof	0.016	0.25	0.064		
		glass wool insulation	0.15	0.033	4.545454545		
		reinforced concrete	0.6	1.2	0.5		
		internal pavement wood	0.01	0.12	0.083333333		
south facade	wall 1	plaster	0.02	0.4	0.05	4.9405	0.202408042
		vapor control layer	0.024	0.33	0.072727273		
		waterproof	0.016	0.25	0.064		
		glass wool insulation	0.15	0.033	4.545454545		
		reinforced concrete	0.15	1.2	0.125		
		internal pavement wood	0.01	0.12	0.083333333		
Typical Roof	Roof	plaster	0.02	0.4	0.05	5.0856	0.19663457
		vapor control layer	0.024	0.33	0.072727273		
		waterproof	0.016	0.25	0.064		
		glass wool insulation	0.15	0.033	4.545454545		
		vapor control layer	0.024	0.33	0.072727273		
		waterproof	0.016	0.25	0.064		
		reinforced concrete	0.2	1.2	0.166666667		
		plaster	0.02	0.4	0.05		

U-value

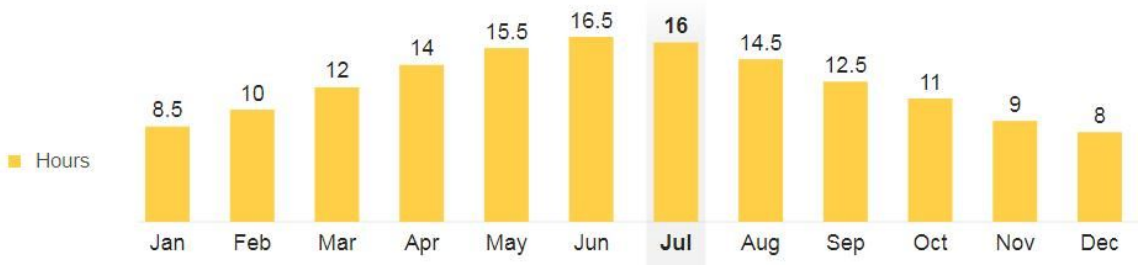
wall 1 = 0.202 w/m2.k

wall 2 = 2.53 w/m2.k

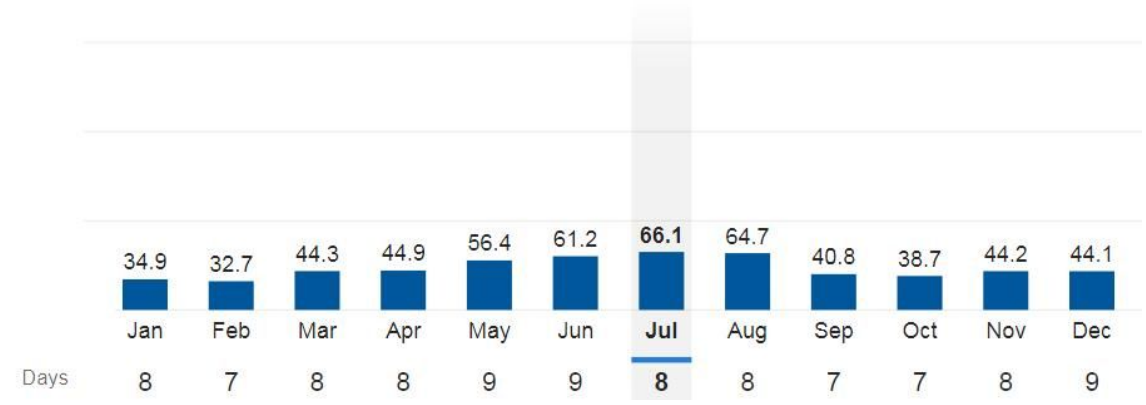
wall 3 = 0.188 w/m2.k

roof = 0.196 w/m2.k

double glazing = 3.7 w/m2.k

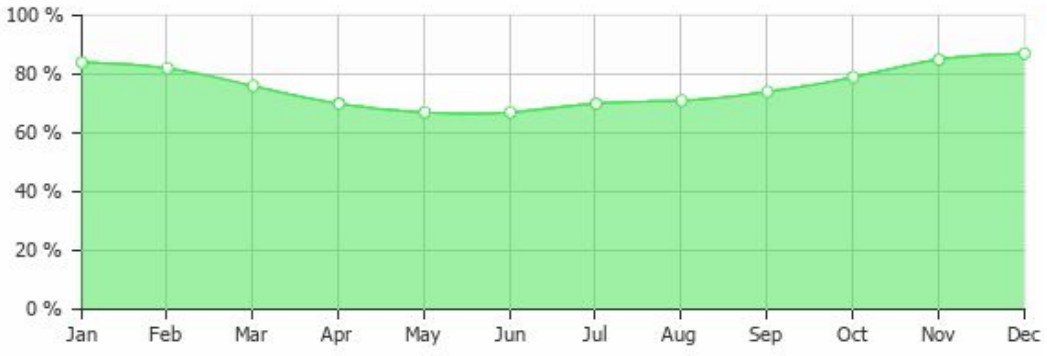


Daylight



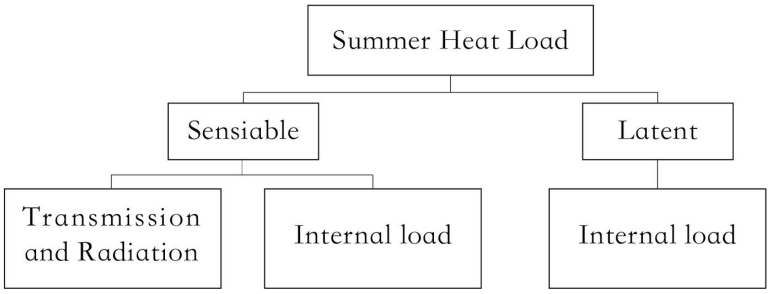
Rainfall (mm)

Average temperatures (°C)



Relative humidity

8.1.2 Summer heat load



			U value	surface (m2)	T outside	T inside	ΔT	heat flow
Wall Transmission	eastern facade	wall 1	0.202	430.2	30	25	5	434.502
		wall 2	2.53	261				3301.65
	north facade	wall 1	0.202	471				475.71
	western facade	wall 3	0.1881	570.8				536.8374
	south facade	wall 1	0.202	240				242.4
	roof	roof	0.196	2681				2627.38
	total							7618.4794

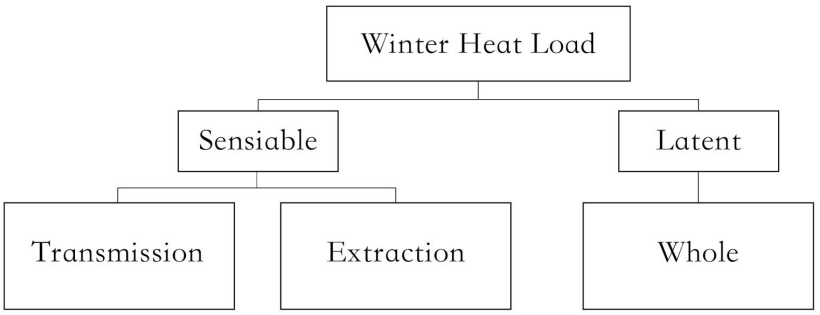
Window radiation	window heat load	surface (m2)	shading coefficient	solar cooling load factor	heat load
	window	3086.8	0.8	16	39511.04

		number	Qint.s.pp (w)	sensiable internal load	Qint.v.pp (w)	latent internal load
latent internal load	people	1206	65	78490	45	54270
	equipment	2 auditorium	300	600	–	650
		8 office	20	160		
		11 storage	20	220		
		10 toilte	30	300		
		1 workshop	30	30		
		1 shop	30	30		
		2 foryer	60	120		
		1 backstge	100	100		
		1 rehearsal room	30	30		
		1 orchestre	30	30		
		others	100	100		
	total (W)			80210		54920

Qs = 7618.48 + 39511.04 = 47129.52 W
QI = 5492 W
Qtot = Qs + QI = 102049.52 W

Summer heat load = 102049.52 W

9.1.3 Winter heat load



			U value	surface (m2)	T outside	T inside	ΔT	heat flow
Wall Transmission	eastern facade	wall 1	0.202	430.2	0	25	25	2172.51
		wall 2	2.53	261				16508.25
	north facade	wall 1	0.202	471				2378.55
	western facade	wall 3	0.1881	570.8				2684.187
	south facade	wall 1	0.202	240				1212
	roof	roof	0.196	2681				13136.9
	total							38092.397

Window transmittance	window heat load	surface (m2)	U value	heat flow
	window	3086.8	3.7	11421.16

additional heating power	heat space surface m2	specific heating up	total
	2258	84 w/m2	189672

Thermal dispersion	heat flow
transmission towards the ground	139745
transmission towards heated spaces	15241.5
transmission towards external	38092.397
Window transmittance	11421.16
additional heating power	189672
winter total heat load (W)	394172.057

Qs = 38092.397 + 11421.16 + 139745 + 15241.5 = 204500 W
Ql = 189672 W
Qtot = Qs + Ql = 394172 W

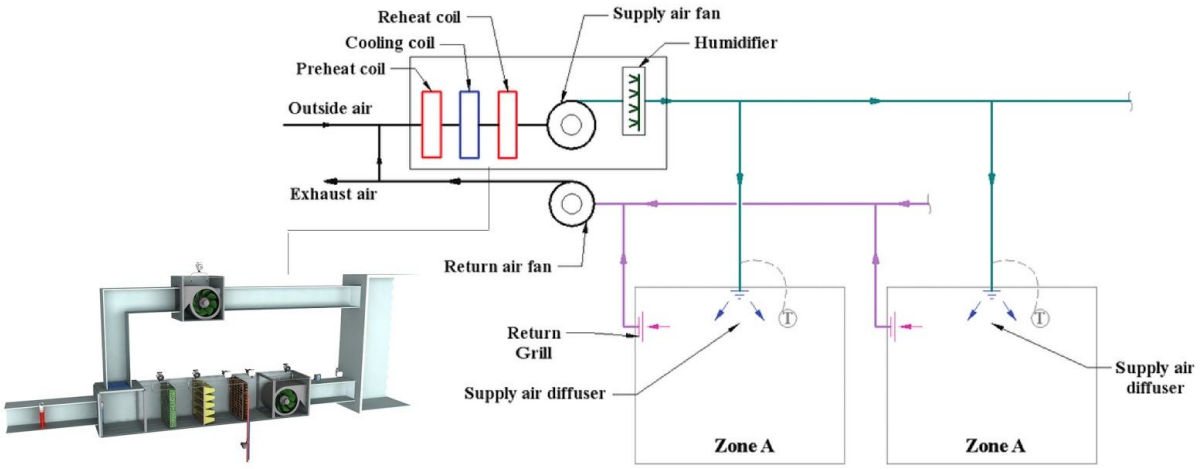
Winter heat load = 394172 W

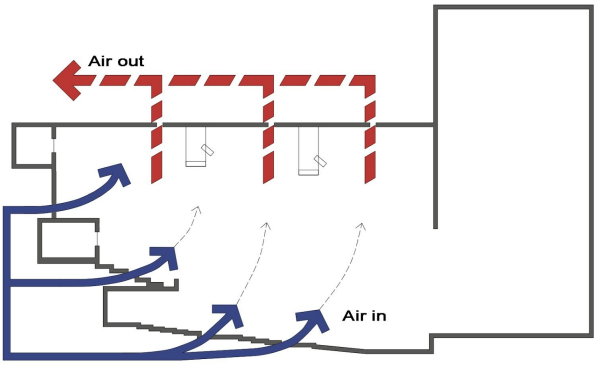
9.1.4 Air ducts and HAVC system

HVAC System - All Air System

Advantages of all air system in theatre design

1. Maintenance is performed in unoccupied areas, for example on the roof.
2. No drain piping or power wiring or compressors.
3. Systems can include options such as air-side economizer, heat recovery, winter humidification, and large outside air volumes where required.
4. Good for temperature and humidity control.
5. Simple seasonal changeover.





ventilation system in auditorium.

Unit conversion :

1W = 3.412 Btu/h

Bruh = CFM x 1.08 x (EAT - LAT)

1 CFM = 1.7 m3/h

Summer
Btu = 102049.5194 x 3.412 = 348192.894
CFM = 348192.894 / 1.08 x (86 - 77) = 35822
35822 x 1.7 = 60897 m3/h

Winter
Btu = 394172.057 x 3.412 = 1344915.058
CFM = 1344915.058 / 1.08 x (77 - 32) = 27673
27673 x 1.7 = 47044 m3/h

If the maximum required ventilation is 6100 m3/h :

Ventilation pipe flow	main supply (m/s)	main return (m/s)	secondary pipe (m/s)	branch pipe (m/s)	tertiary pipe (m/s)
rate	4	6.5-10	5-6.5	3-4.5	3-3.5
select flow rate	4	8	6	4	4
	14400m/h	28800m/h	21600m/h	14400m/h	14400m/h

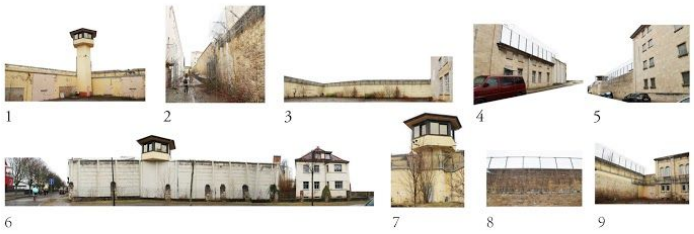
heat flow m3/h	61000 m3/h				
pipe area (m2)	main supply : 4.2	main return :2.11	secondary pipec : 2.8	branch pipe : 4.2	tertiary pipe : 4.2
pipe select d(mm)	1000	1000	600	450	300
number	6	3	10	26	60

8.2 Innovative material for architecture

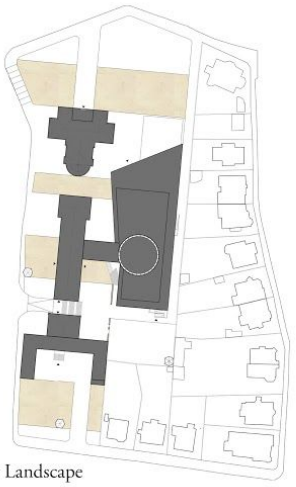
Main Materials

Materials		Thickness	Thermal Conductivity	U value	Reason	Texture
Facade	white concrete	0.15 m	1.5 m.k/w	0.1 w/m2.k	Pure facade has a contrast with existing buidling.	
	double glass	0.01 m	0.04 m.k/w	0.27 w/m2.k	Provide more natural light for public space.	
	polycarbonate	0.1 m	0.2 m.k/w	0.5 w/m2.k	1.It cover the fly tower to reduce strong volume's atmosphere. 2. Hightlight theatre at night.	
Interior	timber	0.02 m	0.13 m.k/w	0.15 w/m2.k	Create harmonious and soft interior atmosphere.	
	marble	0.02 m	2.07 m.k/w	0.009 w/m2.k	Pavement of floor.	
landscape	brick (reuse)	0.05 m	0.8 m.k/w	0.0625 w/m2.k	Reuse brick from demolition pision to keep memories.	
	gray concrete	0.1 m	1.4 m.k/w	0.071 w/m2.k	For road and plaza.	

Recycling Brick From Demolition Prison



Demolition Part

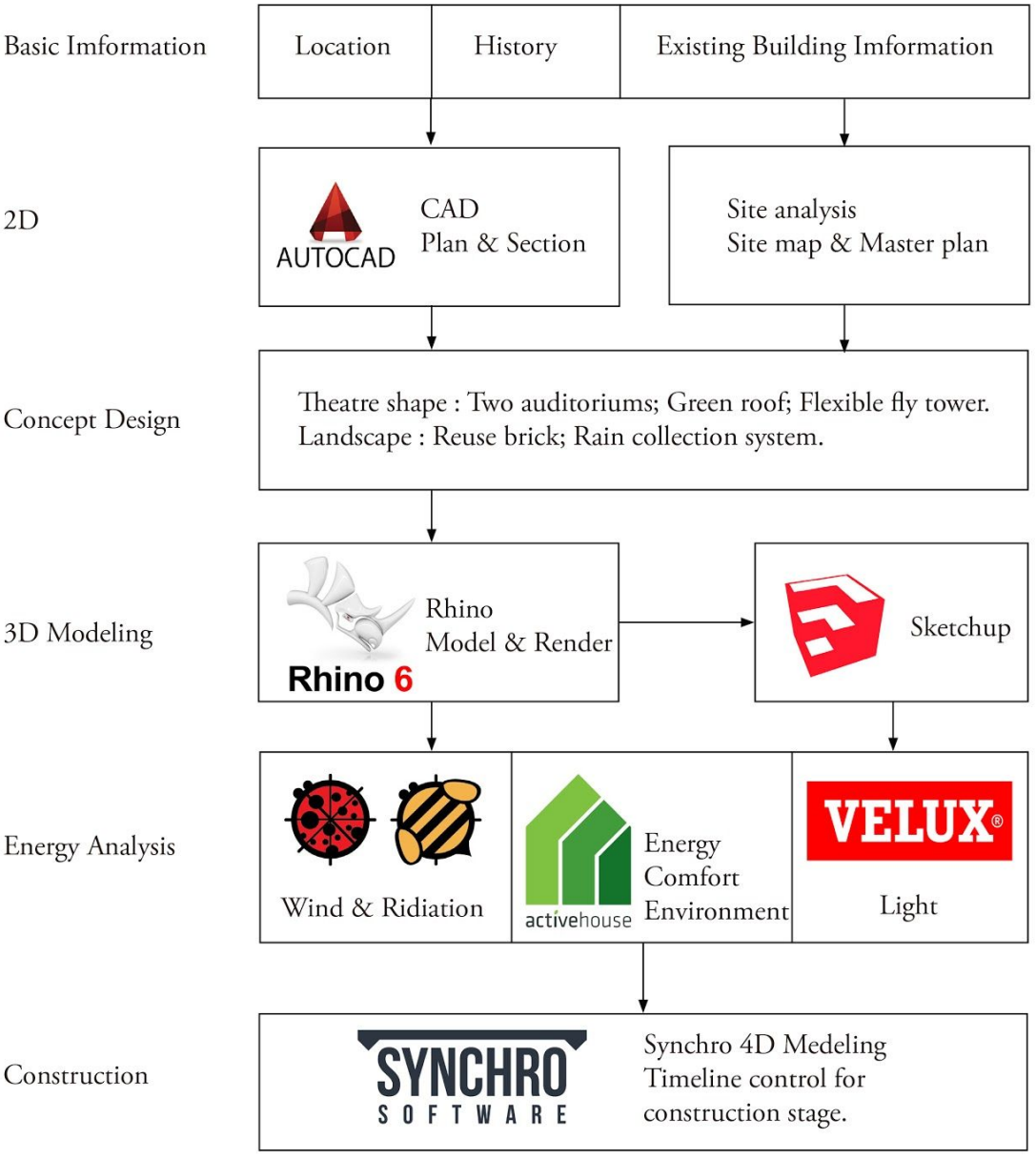


New Landscape

8.3 Technology and design in BIM environment

Workflows

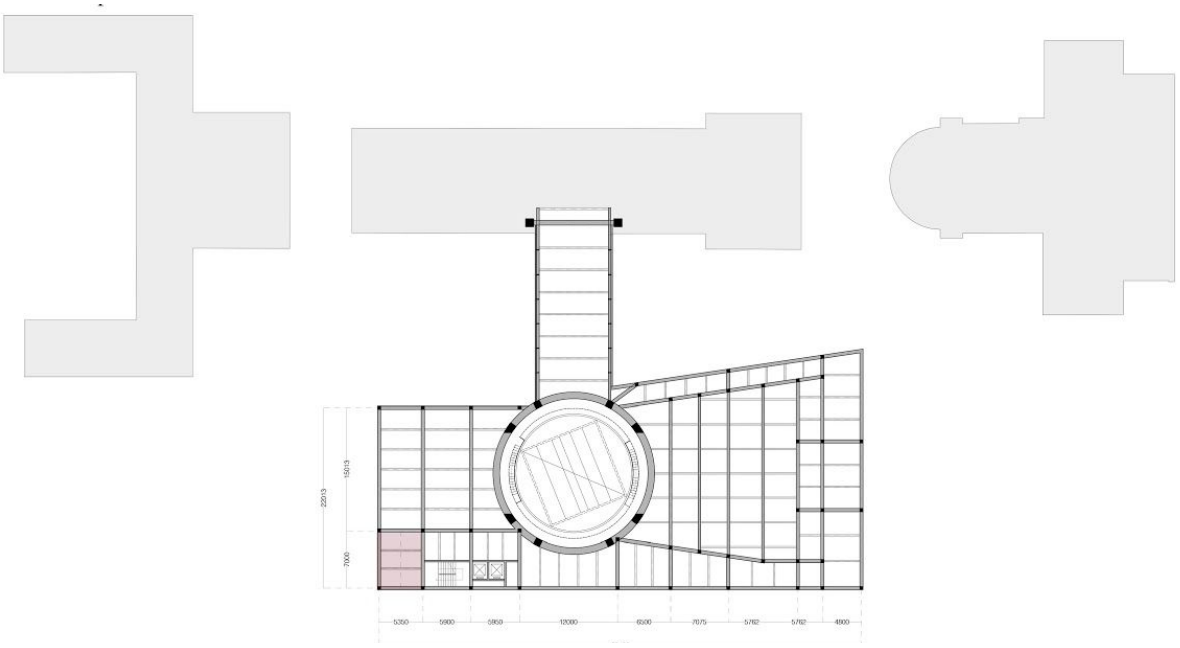
BIM analysis aim : Energy analysis and sustainability design for theatre.



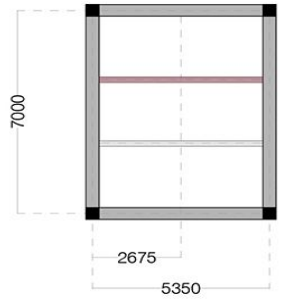
8.4 Structure

8.4.1 Beam and column calculation

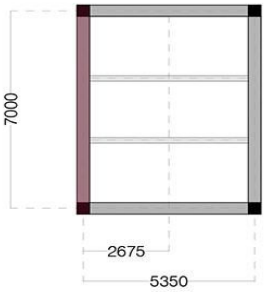
Stuctural plan of Third floor



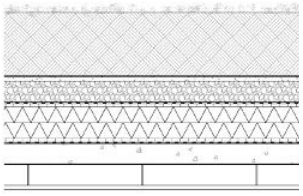
Secondary beam



Primary beam



Typical section and material form

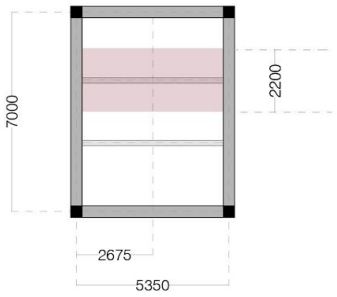


mm
150mm
nm

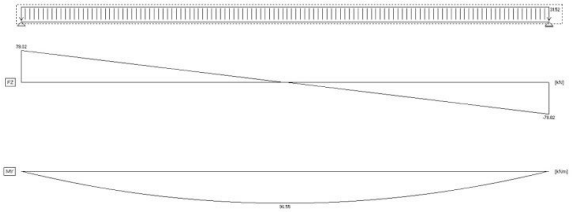
n

Roof Load(green roof)	Bulk density(kg/m³)	Thi
Dead load from slab(structural)	2300	
Dead load from slab(no structural)		
green roof		
Waterproof-high density polyethylene	950	
Vapor barrier membrane polyethylene sheet	500	
polyurethane foam	20	
Vapor barrier membrane polyethylene sheet	500	
Waterproof-high density polyethylene	950	
Plaster finishing	55	
Snow load		
Roof service load		

Secondary beam calculation



Secondary beam information	number	unit
Roof		
L1: interval of beam	2.2	m
L2:Length of beam	5.35 4.95	m
H1：height of beam	0.3	m
B1：width of beam	0.15	m
A1: area of beam	0.045	m²



Green Roof Q1=(G1+G2+G3)1.3+Qs+Qr	formula	number	unit
G1: Self load of beam	H1*B1*23KN/m³	1.035	KN/m
G2: Dead load from slab(structural)	L1*2.3KN/m²	5.06	KN/m
G3: Dead load from slab(non-structural)	L1*6.713KN/m²	14.769	KN/m
Qs: Snow load	L1*1.5KN/m²	3.3	KN/m
Qrs: Roof service load	L1*0.5KN/m²	1.1	KN/m
Q1: factored total load on secondary	Q1=(G1+G2+G3)1.3+Qs+Q	31.523	KN/m

Check the main reinforcement

Grade C45/50, concrete less than C50, The maximum x/d=0.45

Check the Moment				
Med max	Max applied moment	Med max=Q1*L²/8	112.782	KNm
Mrd max	Max moment without compression ste	Mrd max=0.168*bd²fck	90.758	KNm
				Mrd max<Med max

Therefore, the compression steel is required

Compressed steel yield		
fyk		500
Xlim		0.45
d'/d	d'/d=(1-fyk/805)Xlim/d	d'/d=0.17
		d'>0.17d=41.65mm
		d'=45mm

Table A: Sectional areas of groups of bars (mm²)

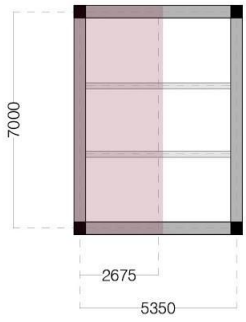
Bar size (mm)	Number of bars									
	1	2	3	4	5	6	7	8	9	10
6	28.3	56.6	84.8	113	141	170	198	226	255	283
8	50.3	101	151	201	251	302	352	402	452	503
10	78.6	157	236	314	393	471	550	628	707	786
12	113	226	339	452	566	679	792	905	1018	1131
16	201	402	603	804	1005	1207	1408	1609	1810	2011
20	314	628	943	1257	1571	1885	2199	2514	2828	3142
25	491	982	1473	1964	2455	2946	3437	3928	4418	4909
32	804	1609	2413	3217	4022	4826	5630	6435	7239	8044
40	1257	2514	3770	5027	6284	7541	8798	10054	11311	12568

compression bar	3D6	84.800	mm²
fs'	fs'=700(1-(d'/d)(d/Xlim))	414.286	Mpa
As'	As'/bdfck=(Mrd add/bd²fck)/(1-d'/d)	73.560	mm²
tension bar	5D16	1005.000	mm²
As add	As add=As'fs'/(fyk/1.15)	80.802	mm²
As lim	0.233*bdfck/fyk	885	mm²
As total		965.8022857	mm²

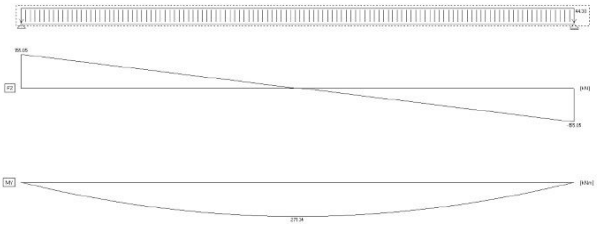
Check the shear

Check the shear			
l	L2/2	2.675	m
d	B1/2	0.075	
Vmax		78.02	KN
Ved	Ved=(L-d)/L*Vmax	75.833	KN
Vn=Vc+Vs			
	Vc=2*fck^-2bwd	49.3	Vc<Ved
Vs	Vs=Vrd1-Vc	26.533	KN
Av	6mm*2	12	mm²
fy		6000	psi
S	Av*fy*d/Vs	19.17	cm

Primary beam calculation



Primary beam informatic	number	unit
Roof		
L1: interval of beam	5.35	m
L2:Length of beam	7.00	m
H1：height of beam	0.50	m
B1：width of beam	0.40	m
A1: area of beam	0.20	m²



Green Roof Q1=(G1+G2+G3+G4)1.3+Qs+Qr	formula	number	unit
G1: Self load of beam	H1*B1*23KN/m³	4.60	KN/m
G2：load ofsecondary beam		1.04	KN/m
G3: Dead load from slab(str	L1/2*2.3KN/m²	6.15	KN/m
G4: Dead load from slab(no	L1/2*6.713KN/m²	17.96	KN/m
Qs: Snow load	L1/2*1.5KN/m²	4.01	KN/m
Qrs: Roof service load	L1/2*0.5KN/m²	1.34	KN/m
Q1: factored total load on se	Q1=(G1+G2+G3+G4)1.3+Qs+Qr	44.03	KN/m

Check the main reinforcement

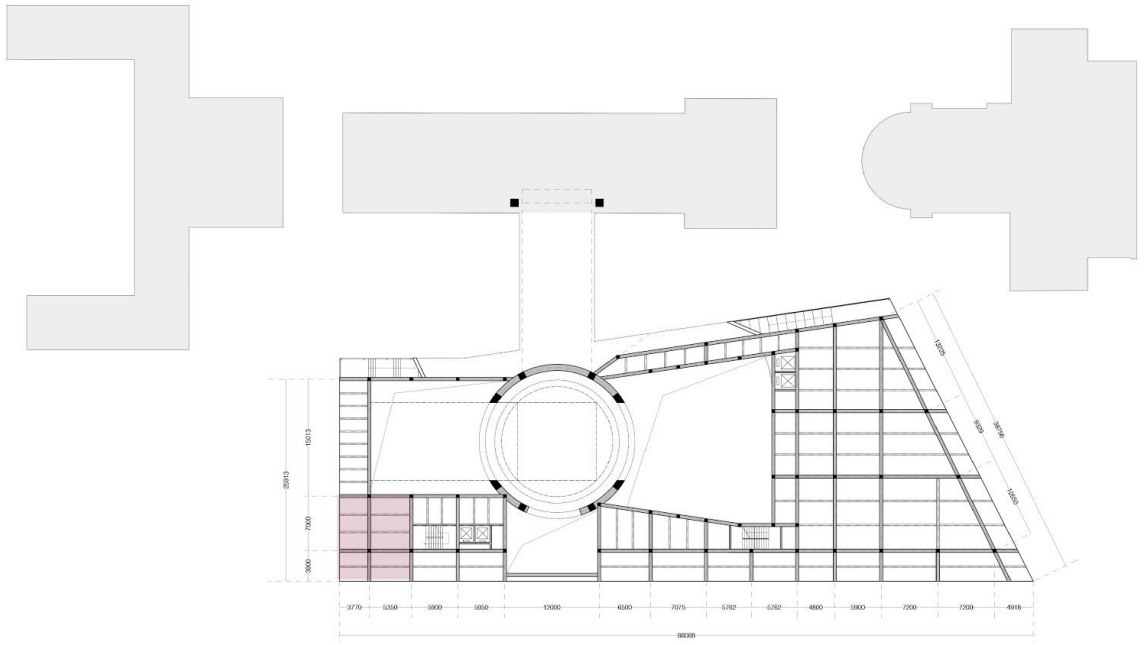
Grade C45/50, concrete less than C50, The maximum x/d=0.45

Check the Moment				
Med max	Max applied moment	Med max=Q1*L²/8	269.65	KNm
Mrd max	Max moment without compression steel	Mrd max=0.168*bd²fck	572.22	KNm
				Mrd max>Med max

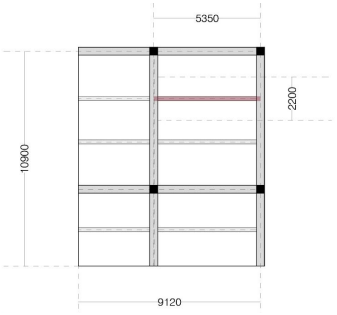
Check the shear

Check the shear			
l	L2/2	3.50	m
d	B1/2	0.20	
Vmax		155.05	KN
Ved	Ved=(L-d)/L*Vmax	146.19	KN
Vn=Vc+Vs			
	Vc=2*fck^-2bwd	233.45	
			Vc>Ved

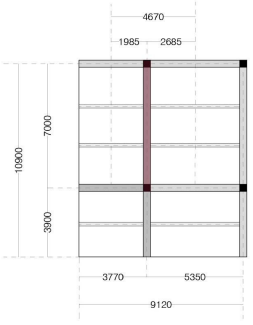
Stuctural plan of Ground floor



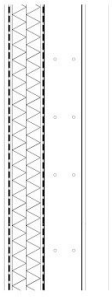
Secondary beam

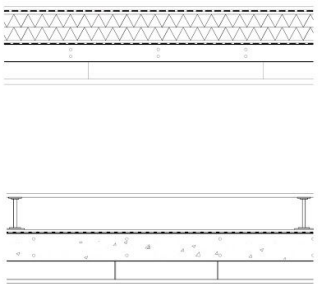


Primary beam



Typical section and material form



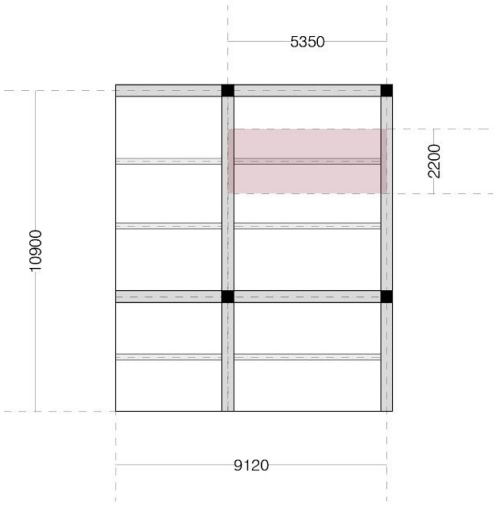


Wall load	Bulk density(kg/m³)	Thickness(mm)	Weight per unit area(KN/m²)
Dead load from wall(structural)	2300.00	200.00	**4.60**
Dead load from slab(no structural)			**0.29**
Plaster finishing	55.00	20.00	0.01
Waterproof-high density polyethylene	950.00	8.00	0.08
Vapor barrier membrane polyethylene shee	500.00	15.00	0.08
Glass wool insulation	32.00	150.00	0.05
Vapor barrier membrane polyethylene shee	500.00	15.00	0.08
Waterproof-high density polyethylene	950.00	8.00	0.08
Plaster finishing	55.00	20.00	0.01

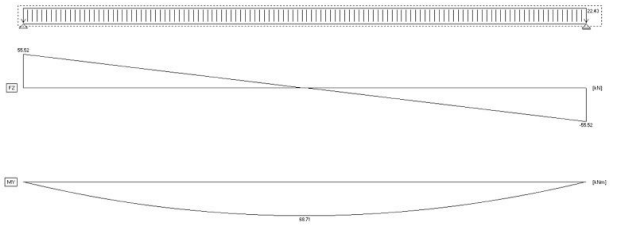
Roof Load(green roof)	Bulk density(kg/m³)	Thickness(mm)	Weight per unit area(KN/m²)
Dead load from slab(structural)	2300	100	**2.3**
Dead load from slab(no structural)			**0.354**
Plaster finishing	55	20	0.011
Waterproof-high density polyethylene	950	8	0.076
Vapor barrier membrane polyethylene shee	500	15	0.075
polyurethane foam	20	150	0.03
Vapor barrier membrane polyethylene shee	500	15	0.075
Waterproof-high density polyethylene	950	8	0.076
Plaster finishing	55	20	0.011
Snow load			**1.5**
Roof service load			**0.5**

Floor load	Bulk density(kg/m³)	Thickness(mm)	Weight per unit area(KN/m²)
Dead load from slab(structural)	2300	100	**2.3**
Dead load from slab(no structural)			**0.458**
Plaster finishing	55	20	0.011
Mental spacer	7750	96	0.3
Waterproof-high density polyethylene	950	8	0.076
Vapor barrier membrane polyethylene sheet	500	12	0.06
Plaster finishing	55	20	0.011
Live load			**4**

Secondary beam calculation



Secondary beam information	number	unit
Floor		
L3: interval of beam	2.2	m
L4:Length of beam	5.35	m
H2：height of beam	0.3	m
B2：width of beam	0.15	m
A1: area of beam	0.05	m²



Floor Q1=(G4+G5+G6)1.3+1.5Q	formula	number	unit
G4: Self load of beam	H2*B2*23KN/m³	1.035	KN/m
G5: Dead load from slab(structural)	L3*2.3KN/m²	5.06	KN/m
G6: Dead load from slab(non-structural)	L3*0.458KN/m²	1.008	KN/m
Q: live load	L3*4KN/m²	8.8	KN/m
Q2: factored total load on secondary	Q2=(G4+G5+G6)1.3+1.5Q	22.433	KN/m

Roof Q3=(G7+G8+G9)1.3+Qs+Qr	formula	number	unit
G7: Self load of beam	H2*B2*23KN/m³	1.035	KN/m
G8: Dead load from slab(structural)	L3*2.3KN/m²	5.06	KN/m
G9: Dead load from slab(non-structura	L3*6.713KN/m²	0.779	KN/m
Qs: Snow load	L3*1.5KN/m²	3.3	KN/m
Qrs: Roof service load	L3*0.5KN/m²	1.1	KN/m
Q3: factored total load on secondary	Q1=(G7+G8+G9)1.3+Qs+Q	13.336	KN/m

Check the main reinforcement

Grade C45/50, concrete less than C50, The maximum x/d=0.45

TABLE Values of limiting design parameters for concrete Grades less than or equal to C50.

α_{cc}	x_{max}/d	$A_{s,max}f_{yk}/bdf_{ck}$	$M_{Sd,max}/bd^2f_{ck}$
0.85	$(\delta-0.44)/1.25$	$0.417\delta-0.184$	$0.535\delta-0.21-0.133\delta^2$
	for $\delta=1$		
	0.45	0.233	0.168
	Plastic		
	0.25	0.13	0.117
1.00	$(\delta-0.44)/1.25$	$0.491\delta-0.216$	$0.63\delta-0.246-0.157\delta^2$
	for $\delta=1$		
	0.45	0.275	0.227
	Plastic		
	0.25	0.153	0.138

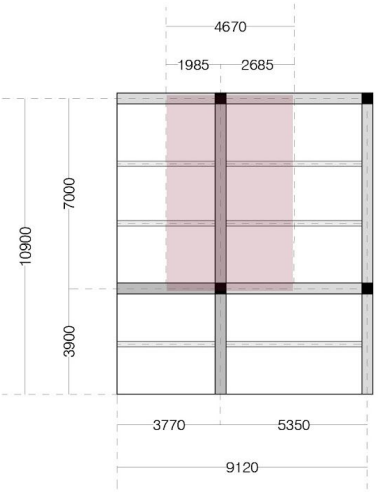
Check the Moment				
Med max	Max applied moment	Med max=Q2*L4²/8	80.26	KNm
Mrd max	Max moment without compression steel	Mrd max=0.168*bd²fck	90.76	KNm
				Mrd max>Med max

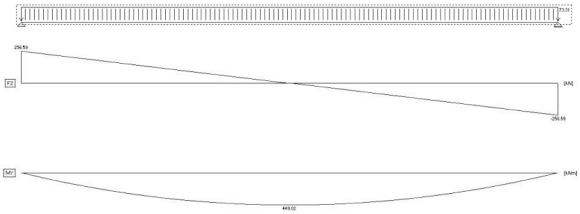
Check the shear

Check the shear			
L1: interval of beam	L4/2	2.675	m
d1	B2/2	0.08	
Vmax1		55.52	KN
Ved1	Ved=(L-d)/L*Vmax	53.84	KN
Vn=Vc+Vs			
	Vc=2*fck^-2bwd	49.30	Vc<Ved
Vs	Vs=Vrd1-Vc	4.54	KN
Av	6mm*2	12.00	mm²
fy		6000.00	psi
S	Av*fy*d/Vs	26.66	cm

Primary beam calculation

Primary beam information	number	unit
Floor		
L3: interval of beam	5.35	m
L4:Length of beam	7.00	m
L5:length of cantilever beam	3.90	m
H2：height of beam	0.50	m
B2：width of beam	0.40	m
A1: area of beam	0.20	m^2





Floor Q1=(G4+G5+G6+G7+G8)1.3+1.5Q	formula	number	unit
G4: Self load of beam	H2*B2*23KN/m³	4.60	KN/m
G5：load ofsecondary beam		1.04	KN/m
G6:Load from wall	Qw*L4/2	17.10	KN/m
G6: Dead load from slab(structural)	L3/2*2.3KN/m²	6.15	KN/m
G7: Dead load from slab(non-structural)	L3/2*0.458KN/m²	1.23	KN/m
Q: live load	L3/2*4KN/m²	10.70	KN/m
Q2: factored total load on secondary	Q2=(G4+G5+G6+G7)1.3+1.5Q	55.19	KN/m

Roof Q3=(G7+G8+G9+G10)1.3+Qs+Qr	formula	number	unit
G7: Self load of beam	H2*B2*23KN/m³	4.60	KN/m
G8: load of secondary beam		1.04	KN/m
G9: Dead load from slab(structural)	1.98*2.3KN/m²	4.55	KN/m
G10: Dead load from slab(non-structura	1.98*0.354KN/m²	0.70	KN/m
Qs: Snow load	1.98*1.5KN/m²	2.97	KN/m
Qrs: Roof service load	1.98*0.5KN/m²	0.99	KN/m
Q3: factored total load on secondary	Q1=(G7+G8+G9+G10)1.3+Qs+Qr	18.12	KN/m

Check the main reinforcement

Grade C45/50, concrete less than C50, The maximum x/d=0.45

TABLE Values of limiting design parameters for concrete Grades less than or equal to C50.

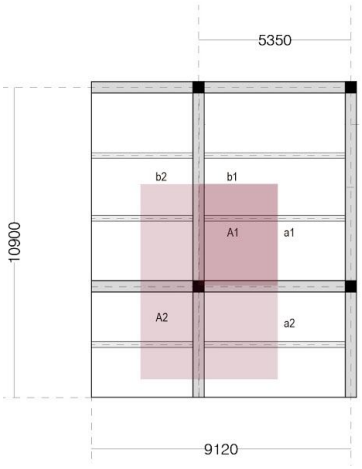
α_{cc}	x_{max}/d	$A_{s,max}f_{yk}/bdf_{ck}$	$M_{Sd,max}/bd^2f_{ck}$
0.85	$(\delta-0.44)/1.25$ for $\delta=1$	$0.417\delta-0.184$	$0.535\delta-0.21-0.133\delta^2$
	0.45	0.233	0.168
	Plastic		
	0.25	0.13	0.117
1.00	$(\delta-0.44)/1.25$ for $\delta=1$	$0.491\delta-0.216$	$0.63\delta-0.246-0.157\delta^2$
	0.45	0.275	0.227
	Plastic		
	0.25	0.153	0.138

Check the Moment				
Med max	Max applied moment	Med max=(Q2+Q3)*L4²/8	449.02	KNm
Mrd max	Max moment without compression ste	Mrd max=0.168*bd²fck	572.22	KNm
				Mrd max>Med max

Check the shear

Check the shear			
L1: interval of beam	L4/2	3.50	m
d1	B2/2	0.20	
Vmax1		256.59	KN
Ved1	Ved=(L-d)/L*Vmax	241.93	KN
Vn=Vc+Vs			
	Vc=2*fck^-2bwd	233.45	
			Vc<Ved
Vs	Vs=Vrd1-Vc	8.48	KN
Av	6mm*2	12.00	mm²
fy		6000.00	psi
S	Av*fy*d/Vs	20.55	cm

Column caclulation



a1	3.50
a2	2.05
b1	2.70
b2	1.96
A1	9.45
A2	16.41

Green Roof Q1=(W1+W2+W3+W4)1.3+Ws+Wrs	formula	number	unit
W1:primary beam	H1*B1*b2*23KN/m³+H1*B1*a1*23KN/m	25.12	KN
W2 secondary beam		2.79	KN
W3: Dead load from slab(structural)	A1*2.3KN/m²	21.74	KN
W4: Dead load from slab(non-structural	A1*6.713KN/m²	63.46	KN
Ws: Snow load	A1*1.5KN/m²	14.18	KN
Wrs: Roof service load	A1*0.5KN/m²	4.73	KN
Q1: factored total load on column	Q1=(W1+W2+W3+W4)1.3+Ws+Wrs	165.93	KN

Floor（1,2） Q2=(W4+W5+W6+W7)1.3+1.5WI	formula	number	unit
W4: primary of beam	H2*B2*23KN/m³*b2+H1*B1*a1*23KN/m	25.12	KN
W5：Secondary beam		2.79	KN
W6: Dead load from slab(structural)	A1*2.3KN/m²	21.74	KN
W7: Dead load from slab(non-structural	A1*0.458KN/m²	4.33	KN
WI: live load	A1*4KN/m²	37.80	KN
Q2: factored total load on column	Q2=(W4+W5+W6+W7)1.3+1.5WI	126.87	KN

Roof Q3=(G7+G8+G9+G10)1.3+Qs+Qr	formula	number	unit
W7: primary beam	H2*B2*a2*23KN/m³+H2*B2*b2*23KN/m	18.45	KN
W8: load of secondary beam		6.85	KN
W9: Dead load from slab(structural)	A2*2.3KN/m²	37.75	KN
W10: Dead load from slab(non-structura	A2*0.354KN/m²	5.81	KN
Ws: Snow load	A2*1.5KN/m²	24.62	KN
Wrs: Roof service load	A2*0.5KN/m²	8.21	KN
Q3: factored total load on column	Q1=(W7+W8+W9+W10)1.3+Ws+Wrs	122.34	KN

Total	Q1+2Q2+Q3	542.01	KN

SW=d*v=d*A*h	density(KN/m³)	A(m²)	h(m)	SW(KN)
	23.00	0.16	11.00	40.48

Ned=Q+SW	Q(KN)	SW(KN)	Ned(KN)
	542.00	40.48	582.48

Nrd

Nrd=A*fcd*0.8	A	fcd=fcu(C45/50)/rm	Nrd(KN)
	0.16	30.00	3840.00
			Ned<Nrd

Check the blucking of column

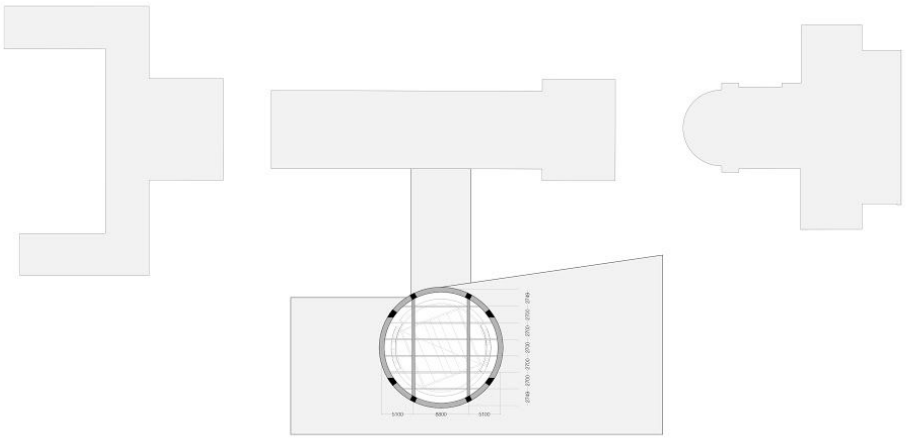
λ=L0/i	i=(j/A)	L0=L0.8	λ
	c/12^-2=0.11	3.60	32.73

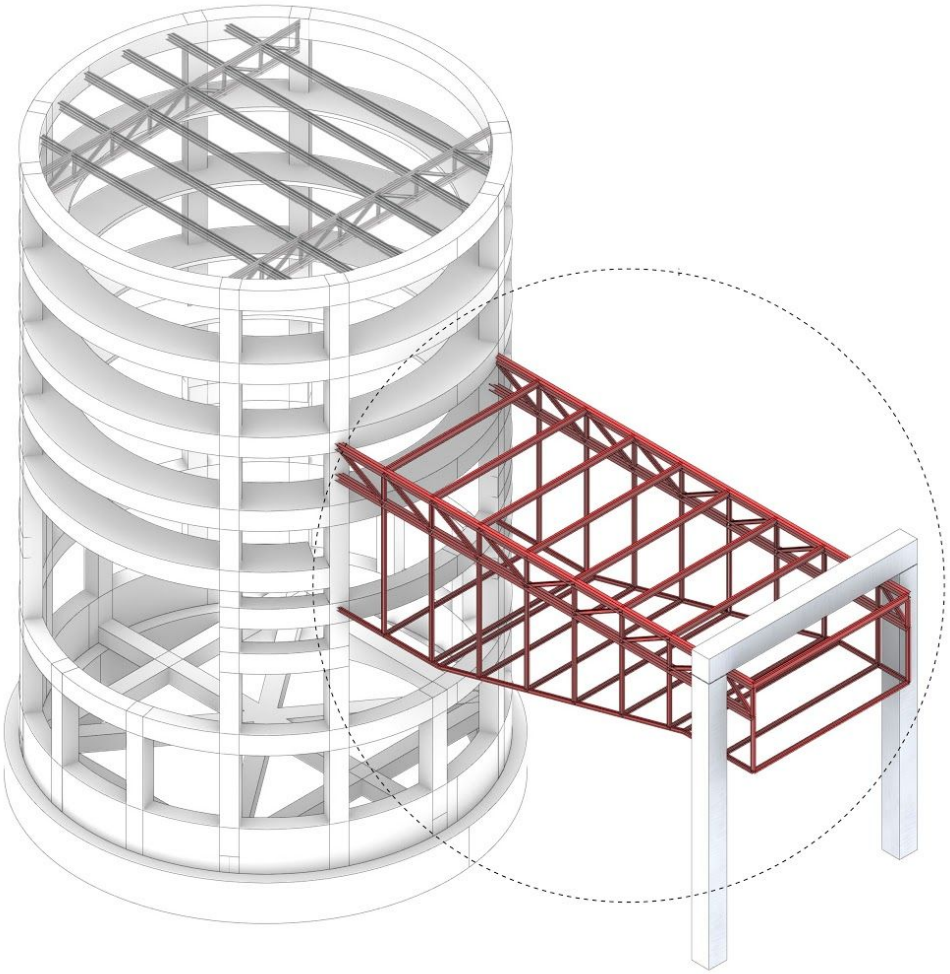
Conclusion

Primary beam	0.4*0.5	C45/50
Secondary beam	0.15*0.3	C45/50
Column	0.4*0.4	C45/50

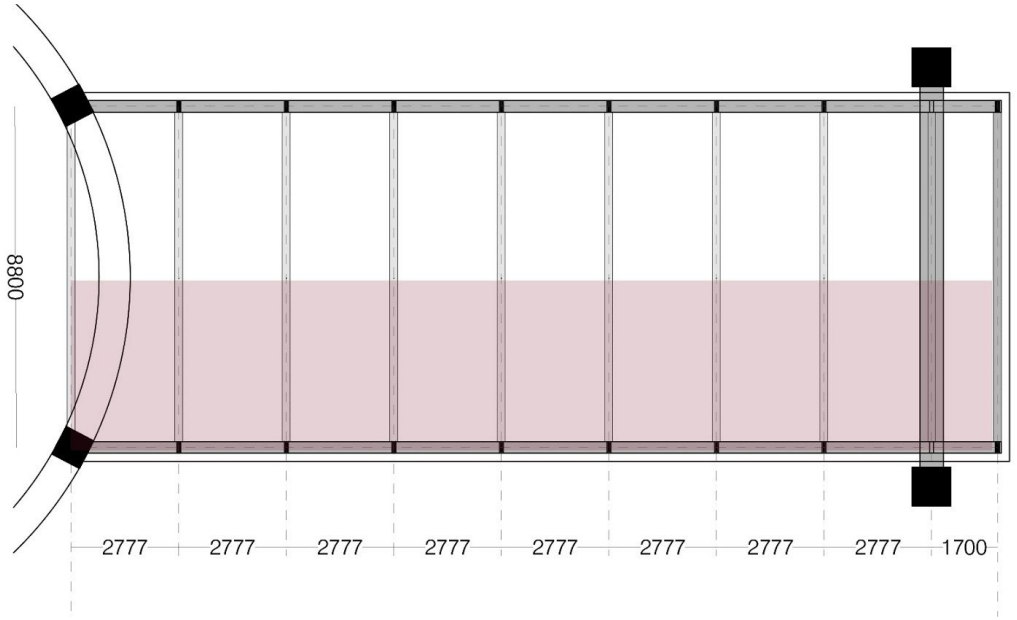
8.4.2 Secondary structure analysis

Strutural plan of the dly tower

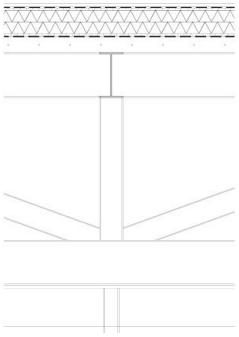


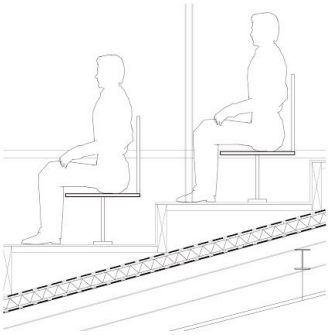


Structural plan of secondary auditorium



Typical section and material form





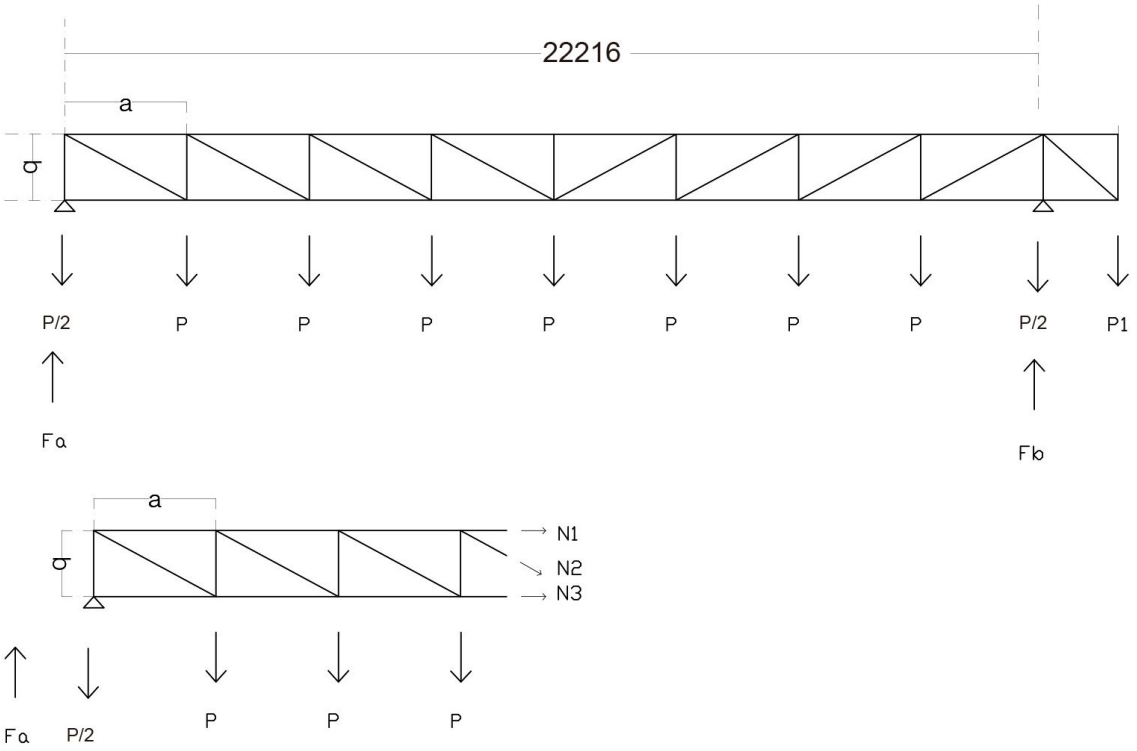
Roof Load	Bulk density(kg/m³)	Thickness(mm)	Weight per unit area(KN/m²)
Dead load from slab(structural)	2300	100	**2.3**
Dead load from slab(no structural)			0.481
Timber finishing	600	20	0.12
Waterproof-high density polyethylene	950	8	0.076
Vapor barrier membrane polyethylene shee	500	15	0.075
Glass wool insulation	32	150	0.048
Vapor barrier membrane polyethylene shee	500	15	0.075
Waterproof-high density polyethylene	950	8	0.076
Plaster finishing	55	20	0.011
Snow load			**1.5**
Roof service load			**0.5**

Floor load	Bulk density(kg/m³)	Thickness(mm)	Weight per unit area(KN/m²)
Dead load from slab(structural)	2300	100	**2.3**
Dead load from slab(no structural)			**0.4112**
Timber finishing	600	12	0.072
Timber stub	600		0.037
Waterproof-high density polyethylene	950	8	0.076
Vapor barrier membrane polyethylene shee	500	12	0.06
Glass wool insulation	32	60	0.0192
Vapor barrier membrane polyethylene shee	500	12	0.06
Waterproof-high density polyethylene	950	8	0.076
Plaster finishing	55	20	0.011
Live load			**4**

Load calculation

Secondary beam:
$q1=1.3dl+1.5+0.5=5.6KN/m^2$, $Q=Q1+Qw=18.5KN/m$
$M=Ql^2/8=179KNm$
Beam IPE360 S275, $WpIx=1090cm^3=109000mm^3$
$M/fyd=M/(fyk/1.05)=46901.90mm^3<WpIx$
Primary Truss:
$q=1.3dl+1.5dl+1.5+0.5=15.53KN/m$
$Q=68.32KN/m$, $Qsecondary=23*72.73*10^{-4}=0.16$
$Qt=Q+Qsecondary+Qw=80.98KN/m$

Calulation of the truss



Truss calculation

M=QtL²/8=4889.58KNm
As for steel S275,fy=275N/mm²
M=f*A*h
When using HEA300A, 1.5m height of truss can be used

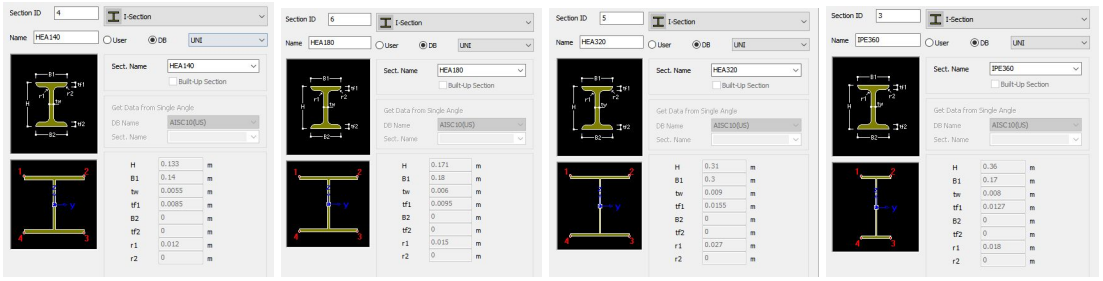
Calculation the Force in the Truss

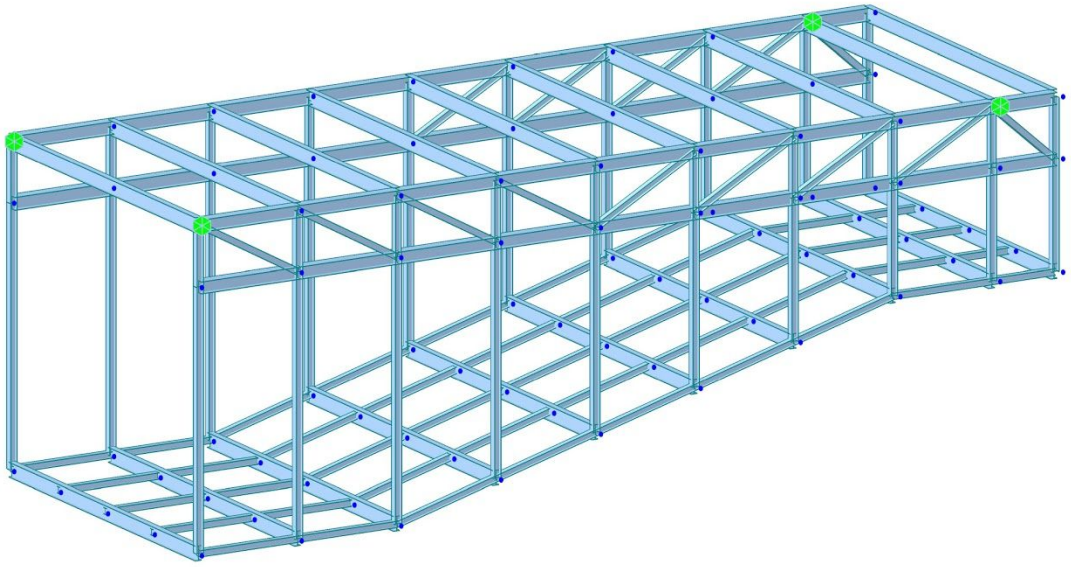
As ΣF=0 and ΣM=0
P=184KN
Fa=Fb=4p,
ΣFy=0, so N2=0.5p/sinα
ΣM=0,so N1=-7.5Pa/b
ΣFy=0,so N3=-0.5pcosα/sinα+7.5pa/b
N2=43.81KN, N1=2548.4KN, N3=2382.8KN

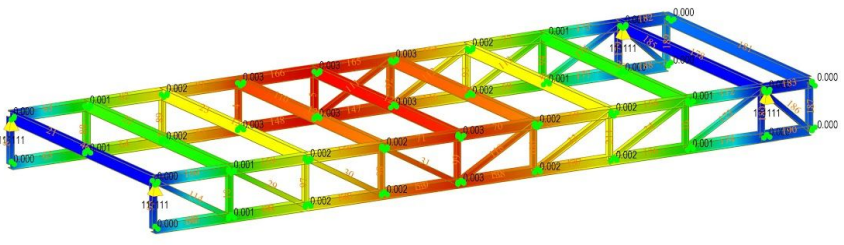
Check the buckling

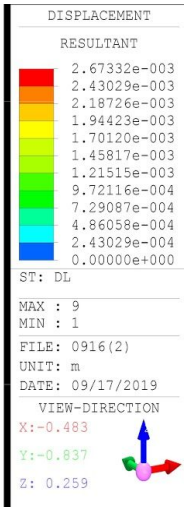
Ncr=π2 EI/(Ka)2=20710822.68N, λ=(Afy/Ncr)-1=0.39,
Φ=0.5[1+α(λ-0.2)+λ2]=0.61, X=1/(Φ+(Φ2-λ2)-1)=0.93
NbED=2728KN
Ned/NbED=0.87<1, It is OK

Structure analysis in Midas









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