



DEGREE PROJECT IN ARCHITECTURE,
SECOND CYCLE, 30 CREDITS
STOCKHOLM, SWEDEN 2020

LEFTOVERS

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TRITA TRITA-ABE-MBT-2066

CHAPTER I

- Chapter 1 -

THE LEFTOVERS

Introduction to the project

Master's Diploma, KTH School of Architecture, 2020

Kiruna is facing the great movement of the city center toward 3km away to the east from current location to continue iron excavation work. As the ground gradually sinks to fill the gap made by absense of iron ore, entire city surface is being swallowed into the deep underground of -1,365m. Untill 2035, estimated area reaserched by LKAB, the mining company, will be wiped off from the map and gradually turning into industrial zone which no more people are allowed to access because of the safety issues.

Throuhgout the entire history of Kiruna, iron mining has affected geographical condition of the land in a huge scale. Two iron mountains, Kirunavaara and Luosavaara, were sliced from the top and formed into layered flat artificial landscape. Around half of Luosajärvi, the lake were filled out with dirt to continue the mining. Trace of anthropocenical activities are obvious.

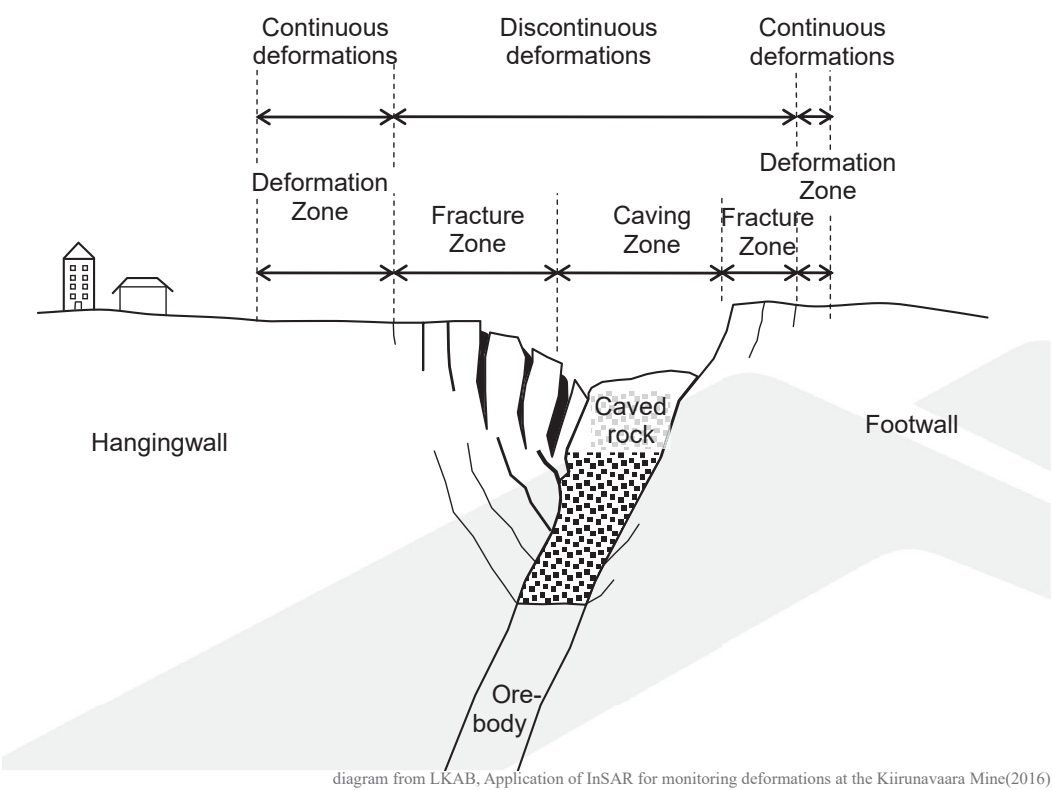
Unlike the city calling the project as 'moving city', what actually happening in Kiruna is that demolishing the old part and building a new area. During this process, specific researches were done on each houses by municipality and only few heritages, estimated as culturally valuable, are picked up and will be preserved as it is. On the other hand, individual houses are facing the demolition, since the city wants to give the space back to the nature. However, these "research" overlooks a phenomenological aspect of individual houses, which cointains the trace of actual daily life of Kiruna people. And when starting to see from this perspective, all these houses, whether it is aesthetically beautiful or not, are worth to be preserved since these spaces allow a common experience for each family to share, which leads community to form an identity.

According to the city's plan, only some fragments from the houses will be reused for the new house construction such as interior moldings with ornament, window frame, door nob...etc. But I believe that the spacial experience is about going through the aggregate of a space.

Therefore, In this project, on the top of situation of Kiruna, the new city development and anthropocenical impact of mining, I would like to criticize the current preservation work by exposing the phenomenological value of individual houses with fictional proposal, that is saving the entire "home" in the underground for the future to share the memory with the next generation, rather than breaking it into pieces.

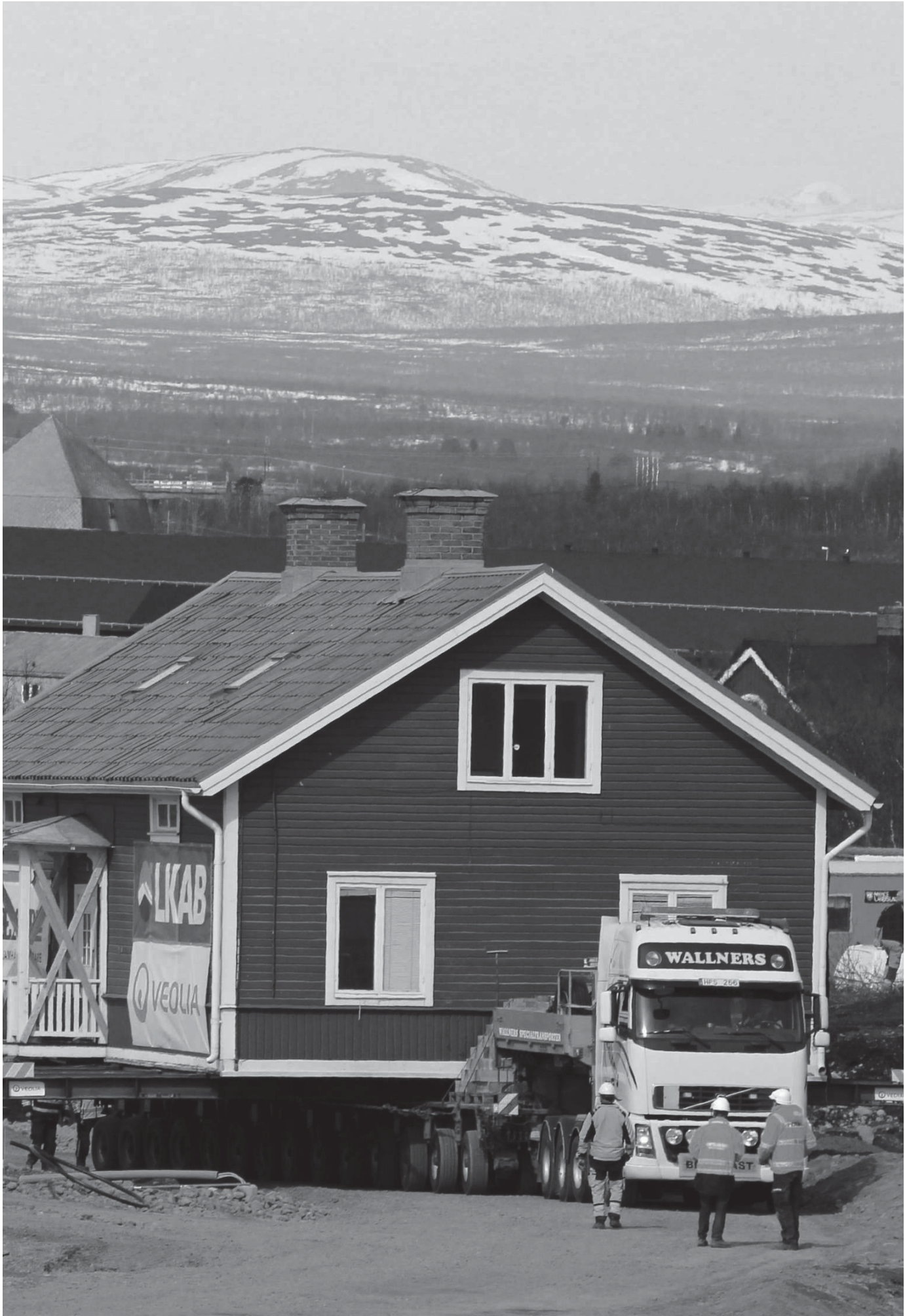
Land deformation

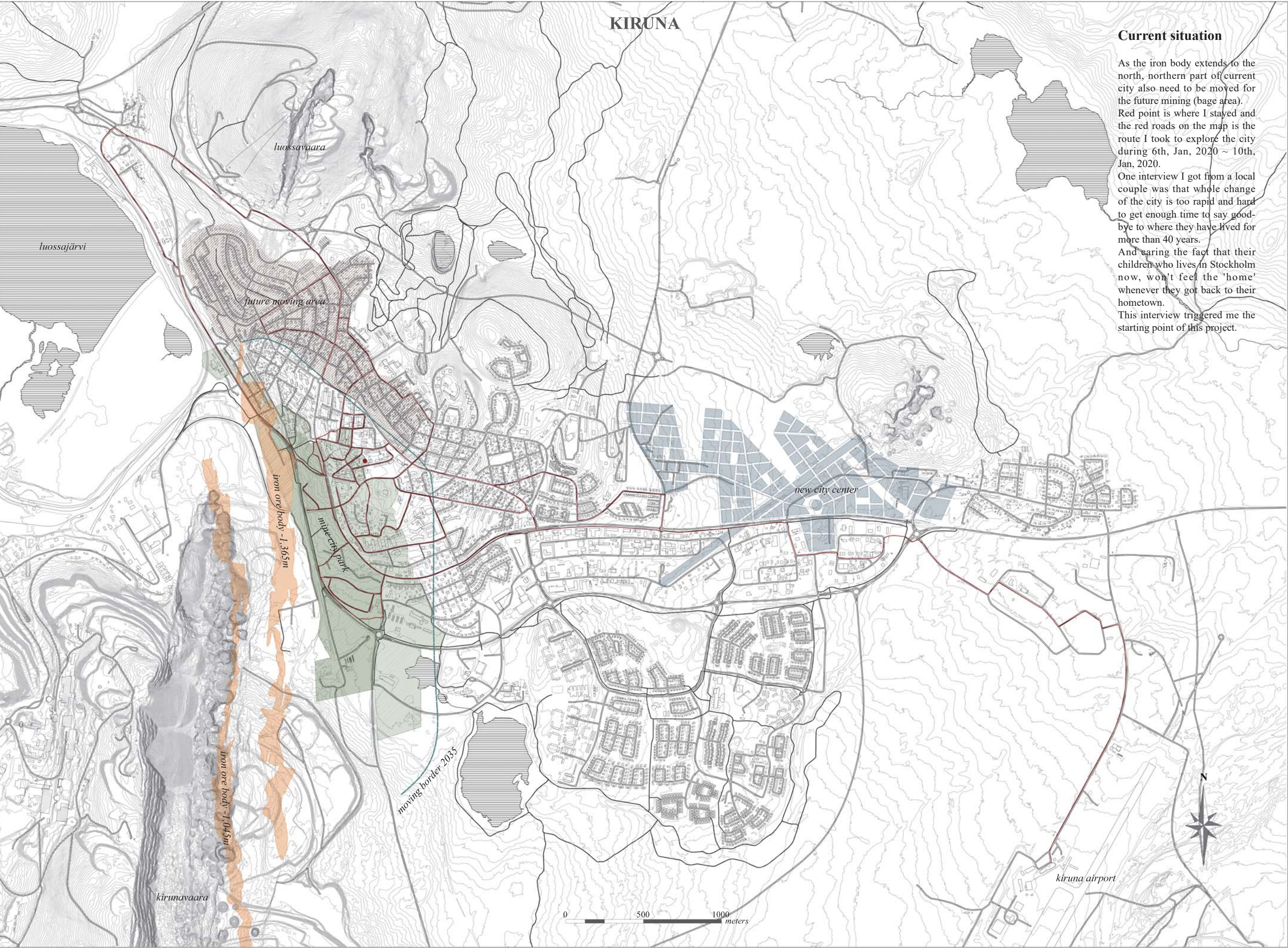
As the excavation goes deeper underground, the surface of ground where the city stands getting carked and sliding down to fill the gap of ore-body. To continue the further mining, Kiruna decided to move the city center to 3km away from where it is now.



Preservation of heritage

Following to the demolition of old kiruna city hall(right), mining company and municipality built up an online site that can look around the whole architecture with 3D-scanned interior. All the drawings and photographs were well documented as well. Some of important cultural heritage of Kiruna (right page), have been relocated to safe place away from the cracking surface by lifting up and moved by special vehicle.





Current situation

As the iron body extends to the north, northern part off current city also need to be moved for the future mining (bage area). Red point is where I stayed and the red roads on the map is the route I took to explore the city during 6th, Jan, 2020 ~ 10th, Jan, 2020.

One interview I got from a local couple was that whole change of the city is too rapid and hard to get enough time to say good-bye to where they have lived for more than 40 years.

And caring the fact that their children who lives in Stockholm now, won't feel the 'home' whenever they got back to their hometown.

This interview triggered me the starting point of this project.



GRUVSTADSPARKEN 2019



2020



2021



2022



2023



2025



2027

Twice bigger area than currently deformed zone in 2020, will be wiped off from the map only within 15years. This diagram shows the fixed plan of deformation until 2027.



List of buildings randomly photographed during the stay. Most of these various types of houses cannot be seen after the demolition. However, from the phenomenological perspective, all these houses are worth to be preserved as it is.



Future possibility

Overview of Normalm area, where could be demolished as well for the future mining work depending on the exploration of underground iron body. The mountain in the photo is *Luossavaara, the Salmon mountain*, where the excavation stopped in 1966.

Kiruna centrum

A view from Kiruna centrum area. many of stores were closed or already moved out during the visit. The area will be demolished until 2035.



leftovers of moving city

Chirstmas decorations for the outdoor. The weather getting clear during the sun set makes nostalgic atomsphere with houses. The houses will be demolished for the moving city.

CHAPTER II

- C h a p t e r 2 -

FUNERAL OF MEMORIES

A fiction of future Kiruna

Master's Diploma, KTH School of Architecture, 2020

House, a container of memory, have standed ever since it had been built on the surface of the ground.

A family have incubated their memories by sharing the time and space.

The parents had seen the next generation grew up and sometimes remind the peaceful moments they had even after their children have left the city to explore their own life.

Once the mining gets deeper and needed to be move to the new place, they decided to remain their 'home' for their children and for themselves.

Their home have gently carried to the mausoleum through underground tunnel to be prepared for the burial.

Once after they reach to the mausoleum, the house is lifted from the tunnel.

The funeral proceeded step by step.

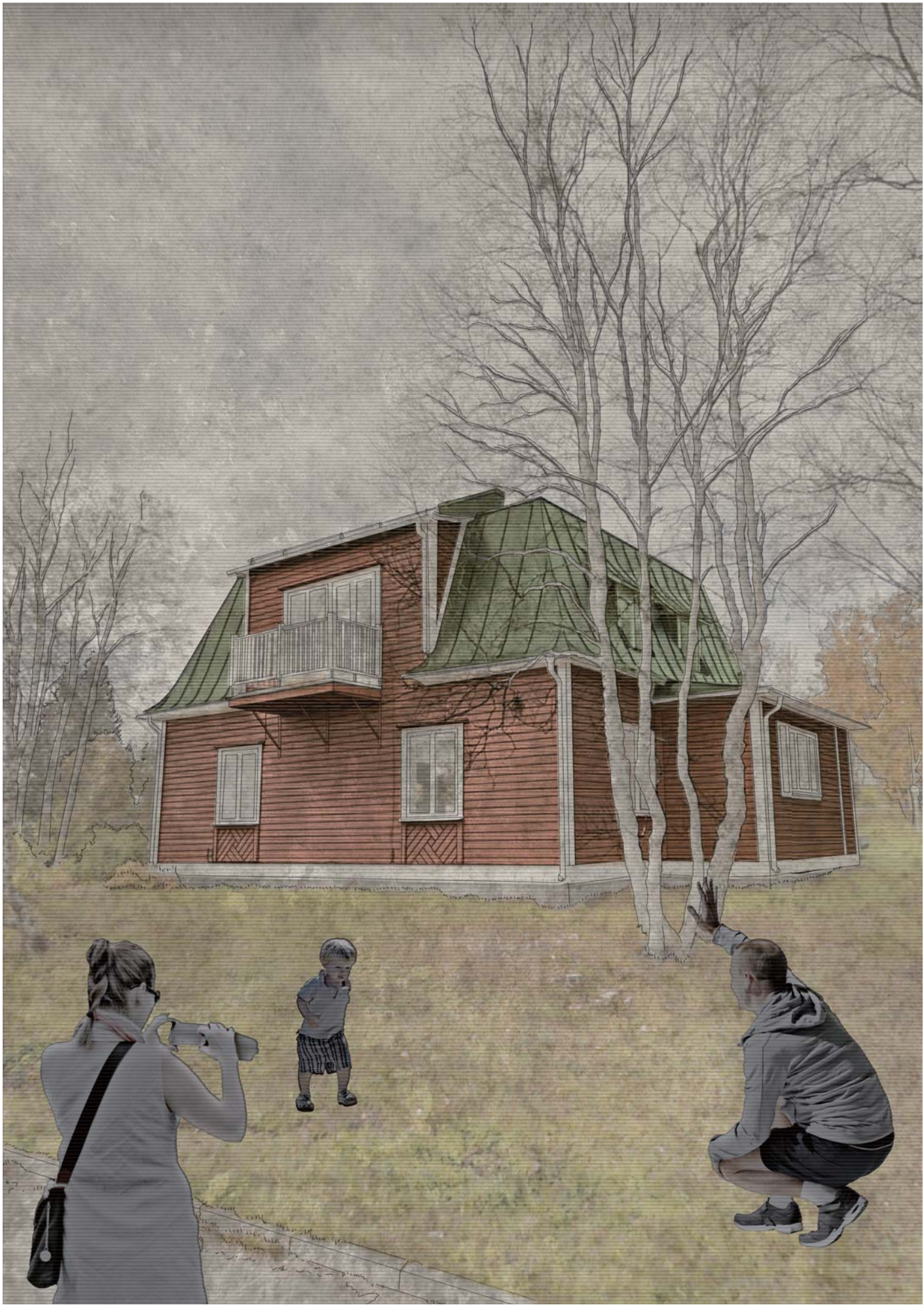
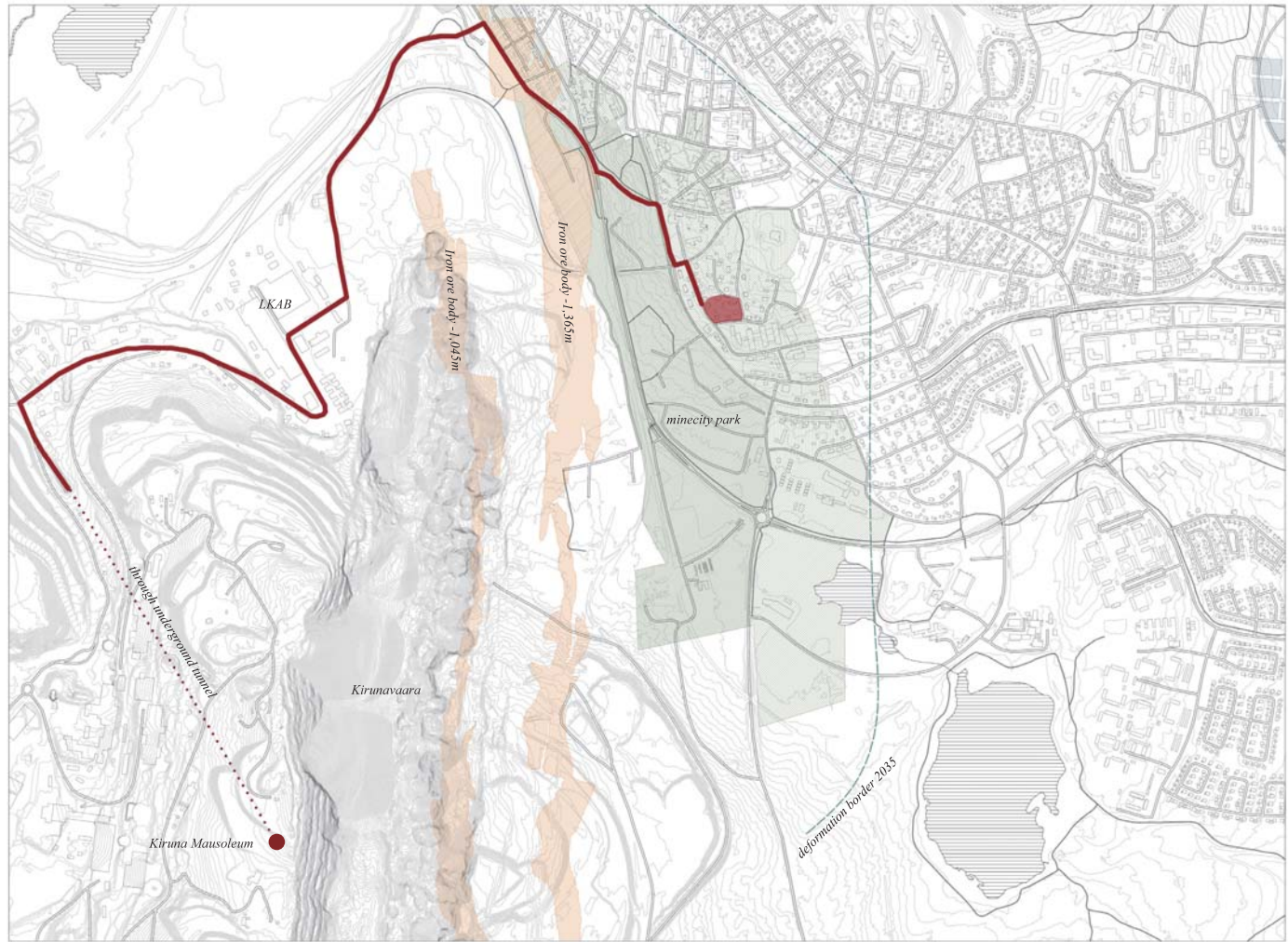
The house was fixed, cleaned and prepared for the burial.

A parent, even though there is no partner anymore, photographed as much as possible and stored it to the library in the mausoleum, as trying to remind all the time they had spent at home.

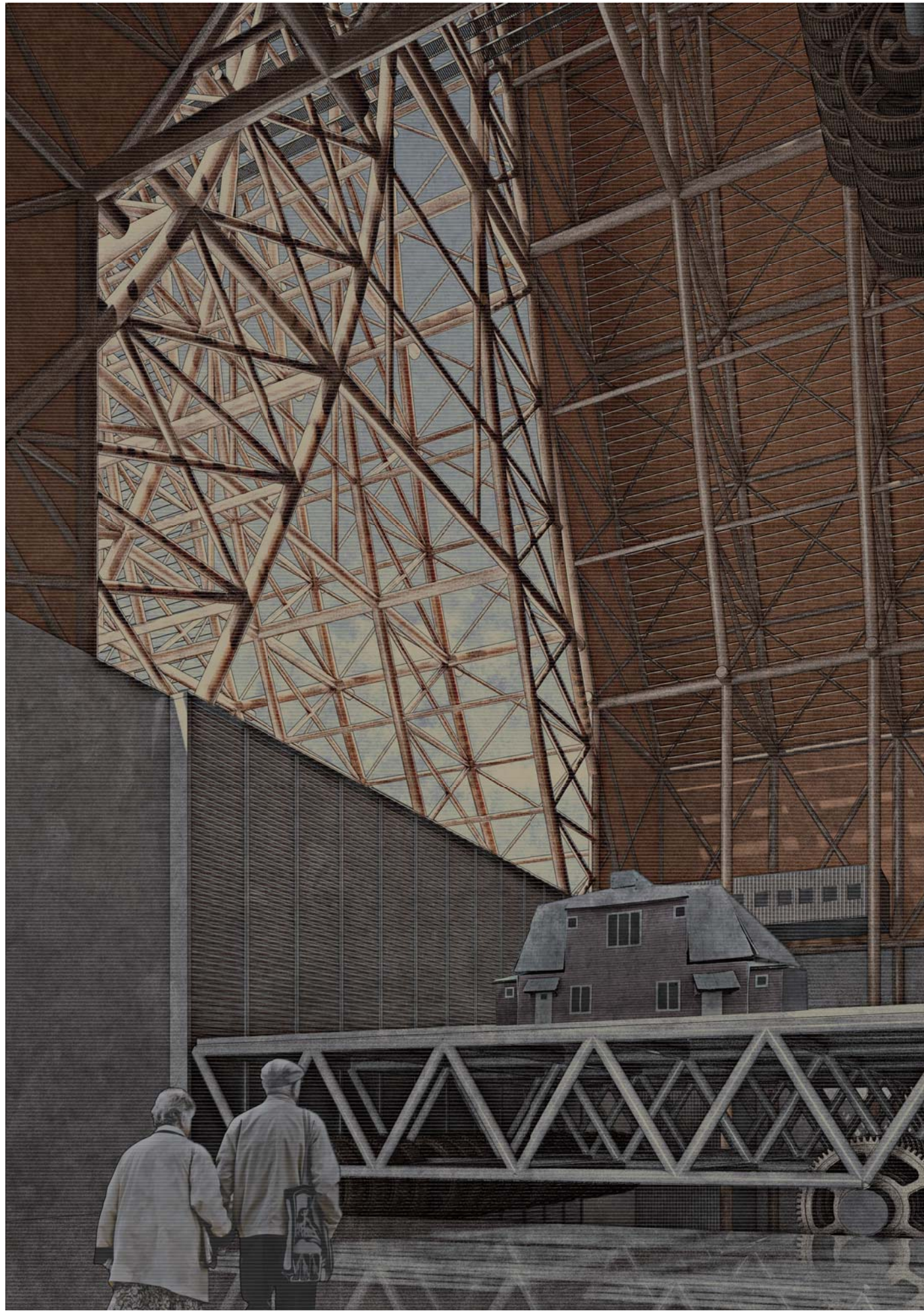
When the house is dried and ready to be buried, a parent stands for the last meeting under the sky.

Time has passed and children came to visit their home town with new family, with their new children.

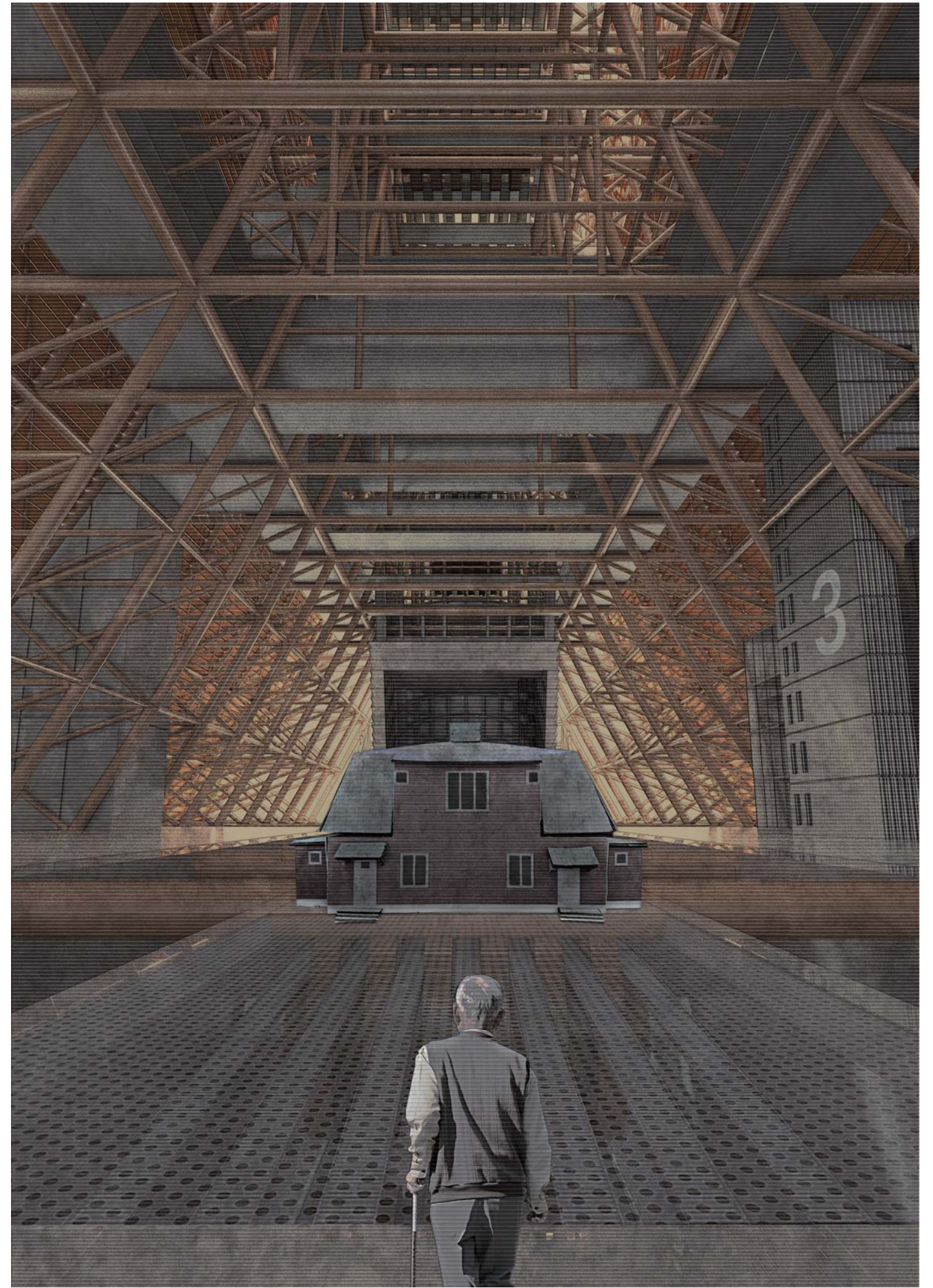
A parent took a grand children to the Chamber underground to share the family's story, which deeply imprinted to the house.



Before the Moving city



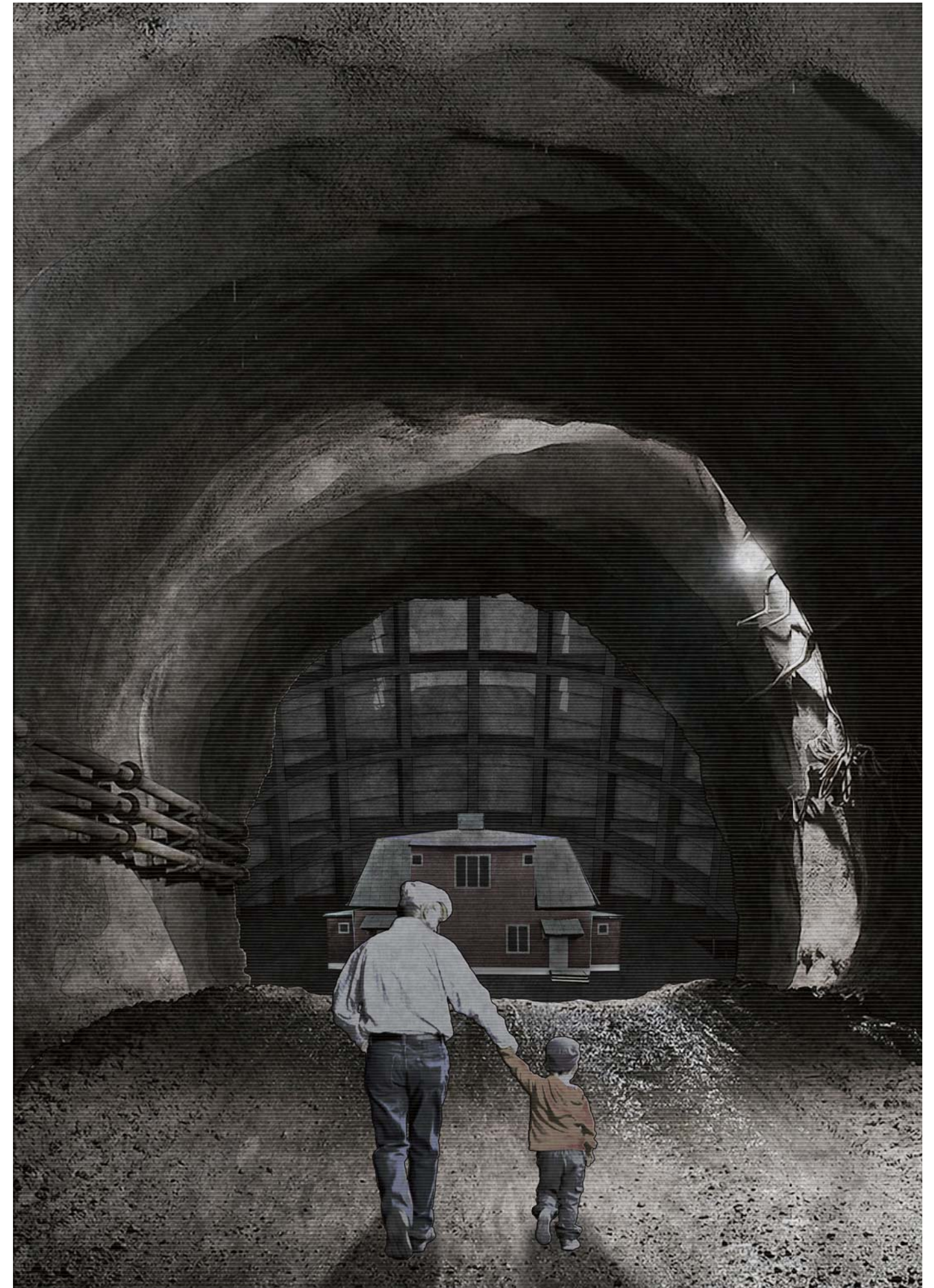
To the Mausoleum



Funeral of House



The Burial



Sharing the Memory

KIRUNA MAUSOLEUM

how to preserve the memory of Kiruna

Master's Diploma, KTH School of Architecture, 2020

If the individual houses contains memory of family and the city, this is the very object to be preserved.

As the city have been growing on the top of production gathered from underground resource, it is not an option to stop the mining business, which leads the void where once iron existed gets deeper and larger. I imagined a giant structure holding abandoned houses will be stuck to the ground and gradually sink depending on the progress of iron excavation. Once after this chamber shaft buried for certain level, people will be able to access to each chamber through excavation tunnel, which is also abandoned from the past mining activity. On the top of mountain, a structure will stand not only to support this whole system, but also to note the activity of excavation of iron, expanding city and burial of houses are connected. Therefore, the property of the underground business will be returned to where it once belonged, as the trace of people is wiped off from the surface by moving city.

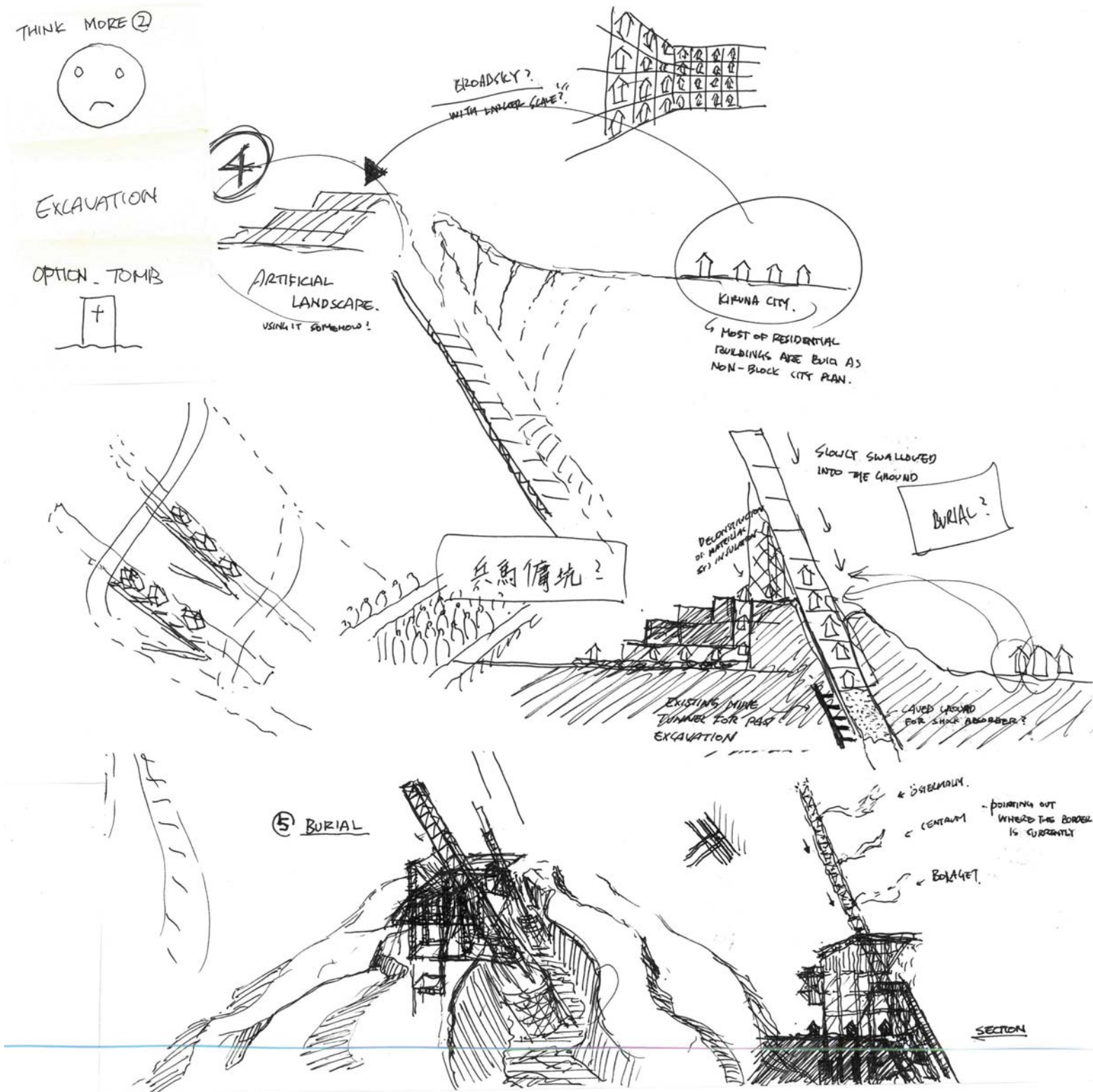
A mausoleum is an external free-standing building constructed as a monument enclosing the interment space or burial chamber of a deceased person or people. (...) A mausoleum may be considered a type of tomb, or the tomb may be considered to be within the mausoleum.

- wikipedia

If an architecture or a structure stands for supporting the burial of individual houses, this project also could be called as a mausoleum for an architecture, according to the definition.

Idea of burying the architecture came across while searching for a proper space to store the abandoned houses instead of demolishing, since the city wanted to delete the human trace from the surface. At the very first stage of the project, I was thinking of transforming the giant flat artificial landscape, formed with underground soil by the excavation. Analyzing through the section of Kiruna mine, I soon realized that there is much greater space exists under the ground, the trace of excavated iron.

- Kiruna Mausoleum consists of chamber shaft and several supporting structures to maintain the facility.
1. Chamber shaft is the actual structure holding the houses and gradually sinks into underground.
 2. Gear system helps to adjust slipping speed of the Chamber shaft and also put the force in the case of the shaft getting stuck.
 3. Structure that holding Chamber shaft and Gear system.
 4. Platforms supporting additional construction of Chamber shaft and maintenance of Gears and houses.
 5. Vertical core to send construction material and vehicle to Platforms.
 6. Underground tunnel to transport houses to the top of mountain.
 7. Public space for visitors and Office space running the entire facility of mausoleum.



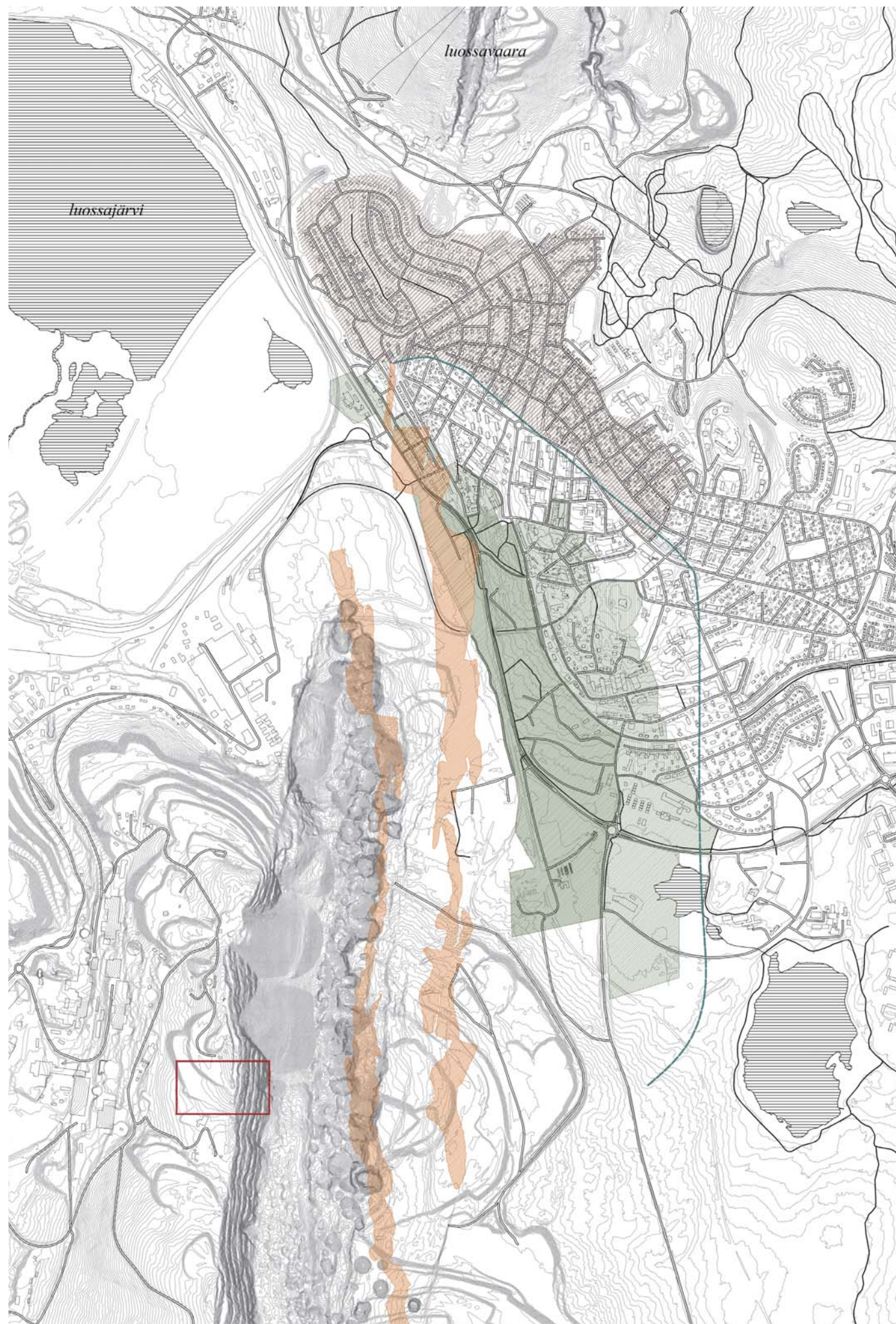
Initial concept sketch

There were several sketches before this, but were mainly using different idea and location. As can be seen from number 4, the initial idea of using mining mountain was to transforming the flat artificial landscape, formed with caved soil from underground, into a kind of huge library where the houses can be stored in 1:1 scale.

Once after drawing the section of the site, I soon recognized the great hole filled with caved rock and the abandoned infrastructure from the mining of the past days. so that I switched idea to burying a huge tomb of abandoned houses by sticking it into underground, which is number 5.

This burial corresponds to the excavation work by gradually sinking down to the great hole, since the hole is getting deeper and deeper.



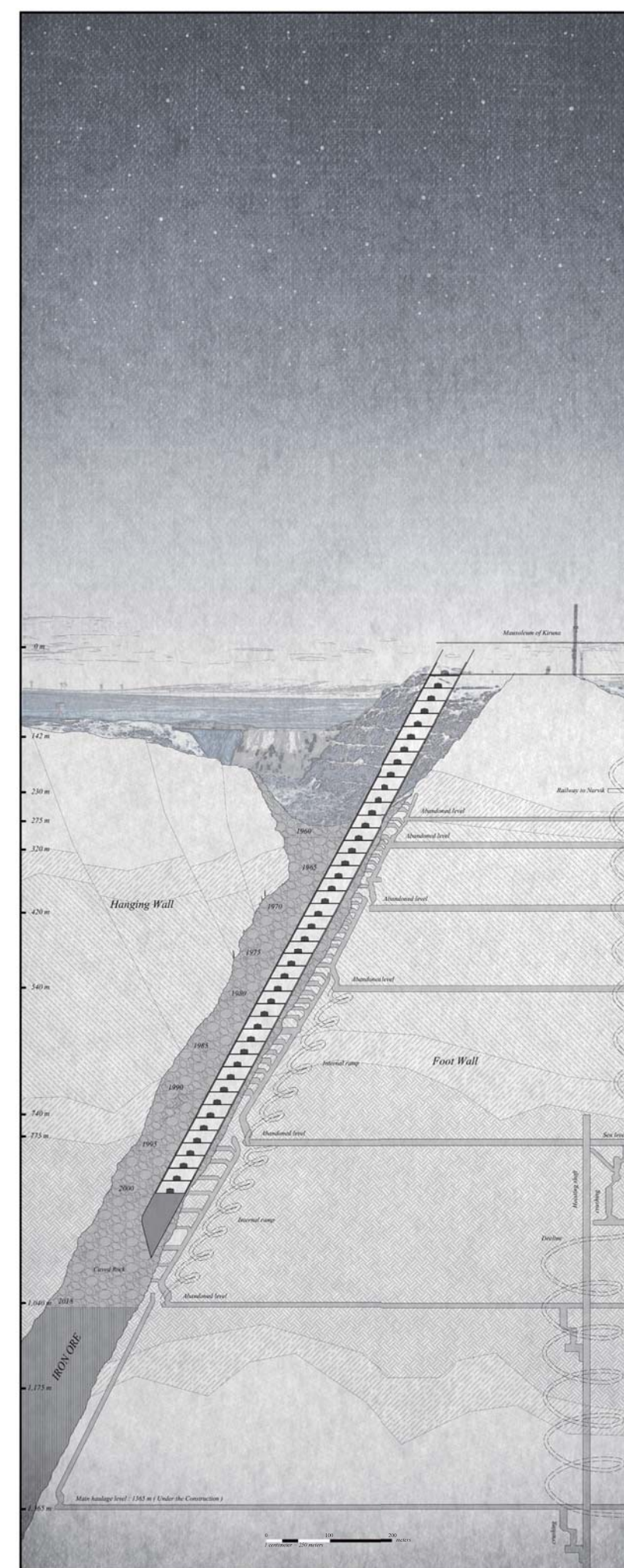
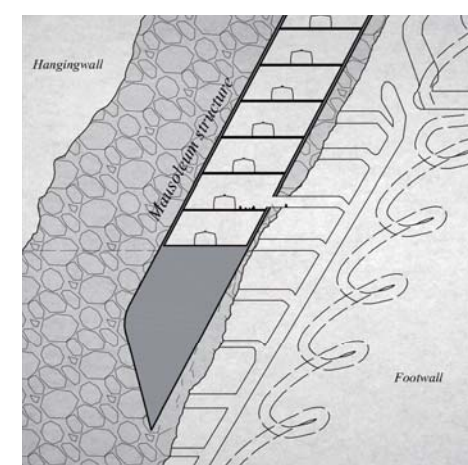
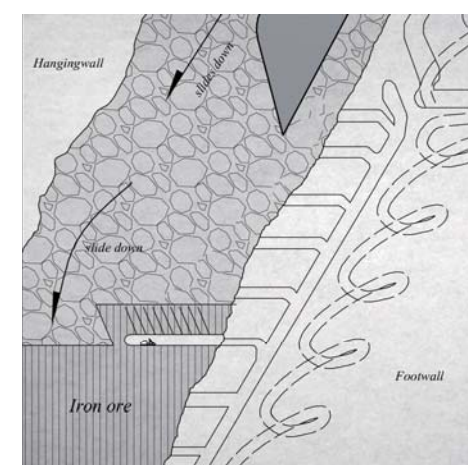
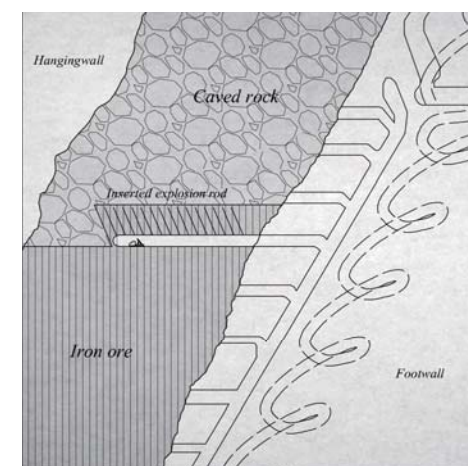


Kiruna Mausoleum (ground section)

Since the project is based on the great hole of excavated iron, grasping the situation of underground was must. Bottom level of -1,365m is where LKAB, the mining company, currently working on to construct the infrastructures needed to start the mining, estimated to be completed around the 2035, when the end of current moving city project.

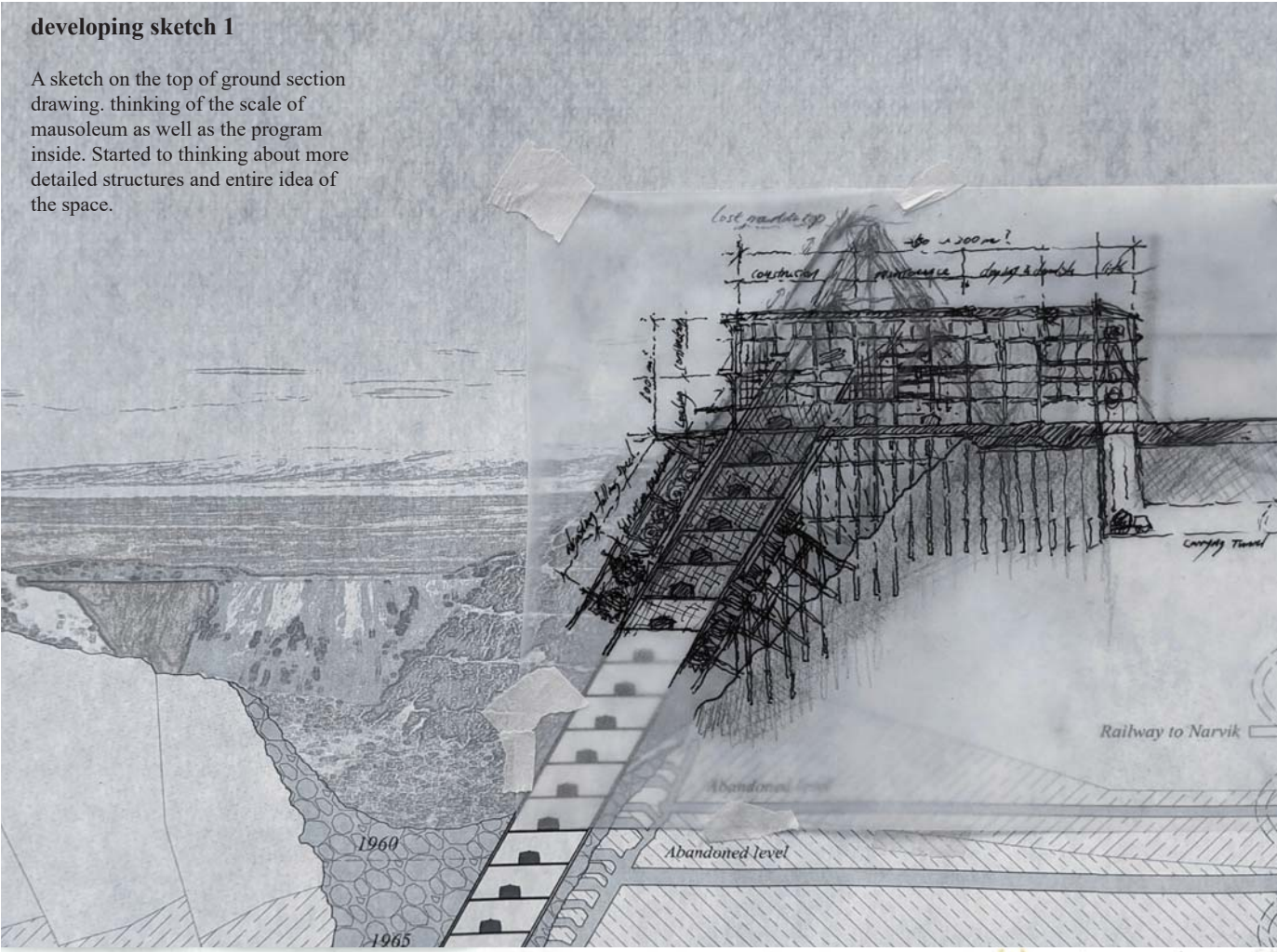
Sinking diagram (below)

When the company explodes the iron body and gather the picese, the caved rock above falls down. At the same time, the structure also will slip down to underground. Abandoned excavation tunnels will be open again to access to get to the inside.



developing sketch 1

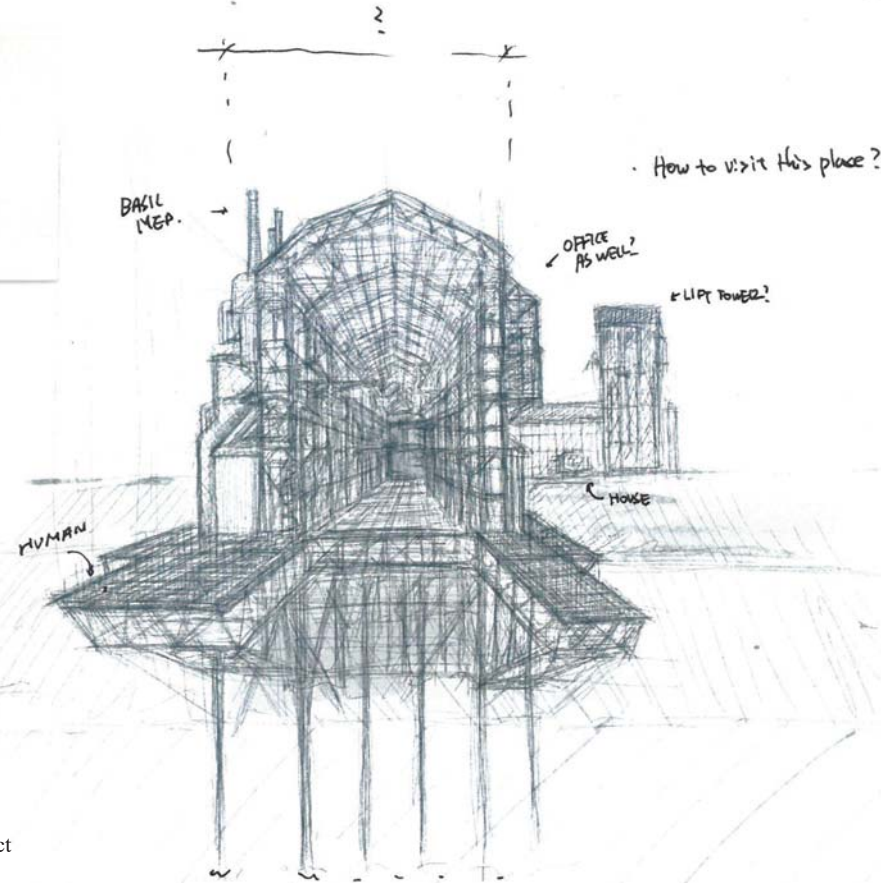
A sketch on the top of ground section drawing. thinking of the scale of mausoleum as well as the program inside. Started to thinking about more detailed structures and entire idea of the space.



INITIAL SKETCH

What kind of machinery I need?
Structure?

MAINTENANCE INFRA?
ON DAY WALK...ETC

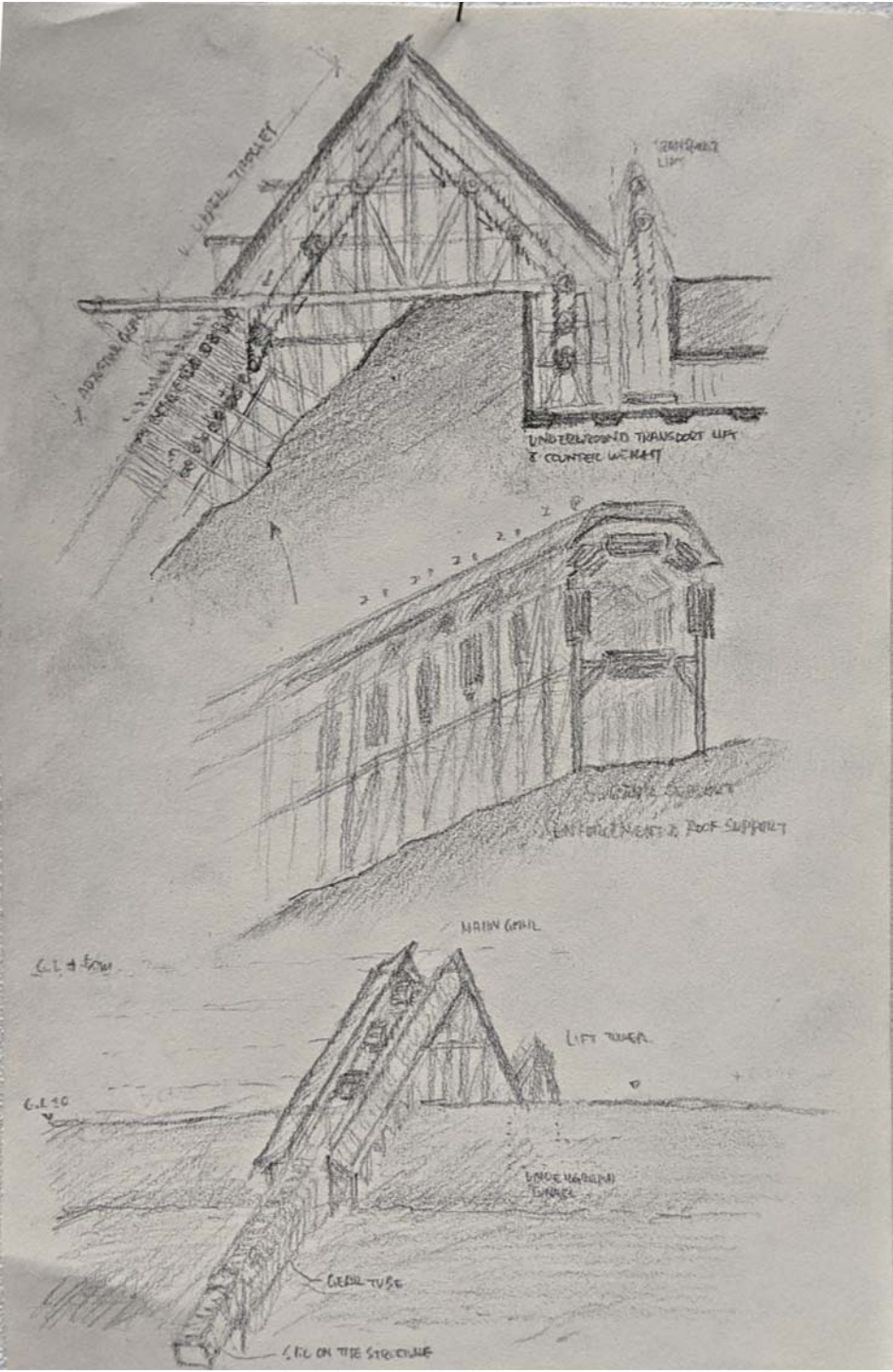


developing sketch 2

A sketch of upper part of the project from the perspective view. More detailed structures and programs are added. A design language such as industrial elements started emerging.

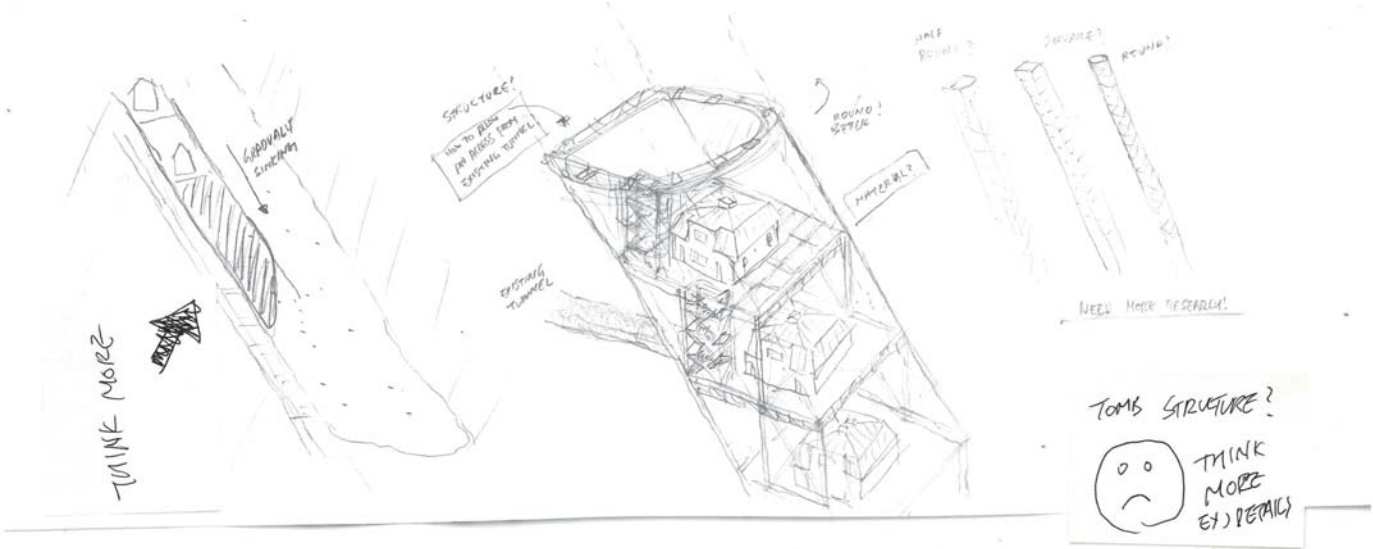
developing sketch 3

Overall structure of the mausoleum gets more detailed. Imagining the support structures that works with gear and belt to hold and adjust the slipping speed of Chamber shaft. Furthermore, I was thinking about an structure to be stabilized by adding a tension mechanism, resulted having a pointy shape on the top. This was well matched with an idea of using underground tunnel to transport the houses on the top of mountain since underground structure works as a counter weight for the tension.



Chamber shaft (below)

Developing sketch for the Chamber shaft, gradually sinking structure, with some ideas about entire shape, mainly for enduring the high pressure from the hanging wall.



program development

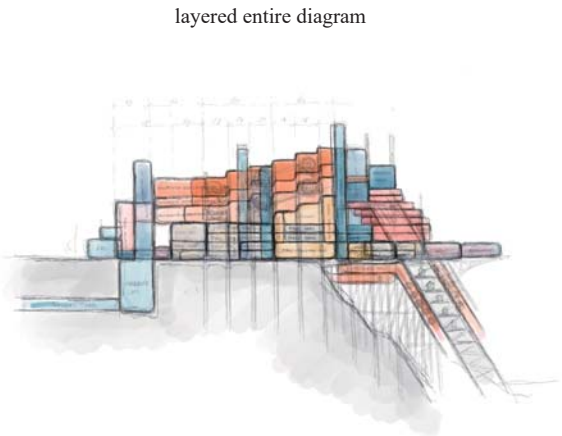
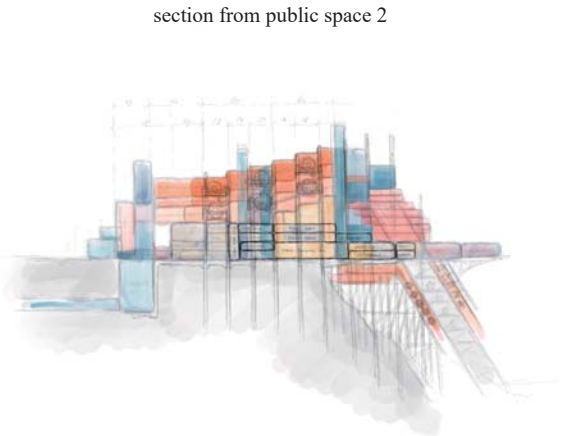
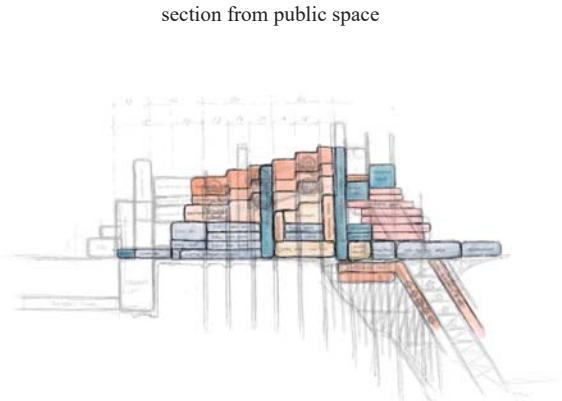
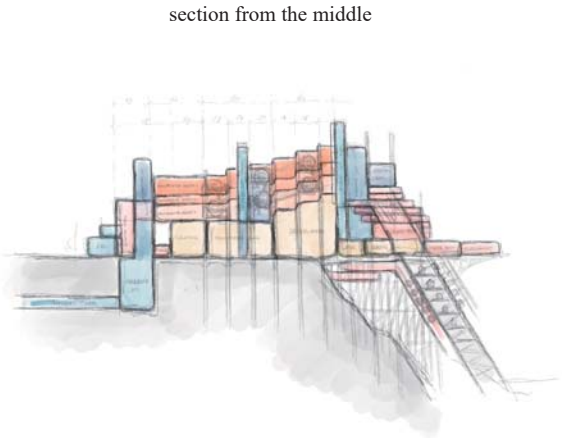
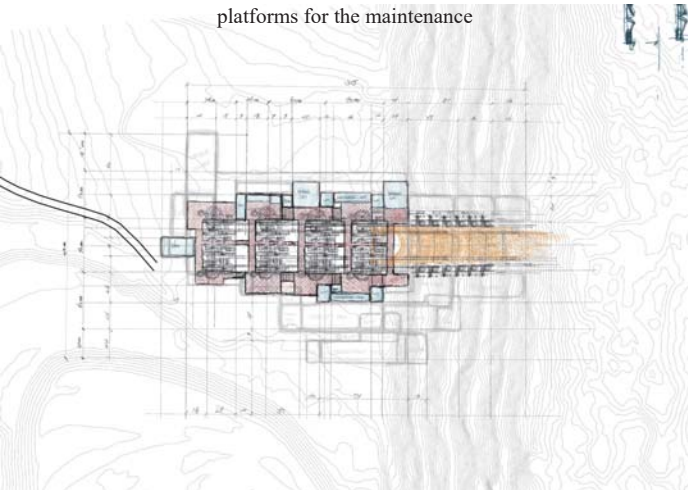
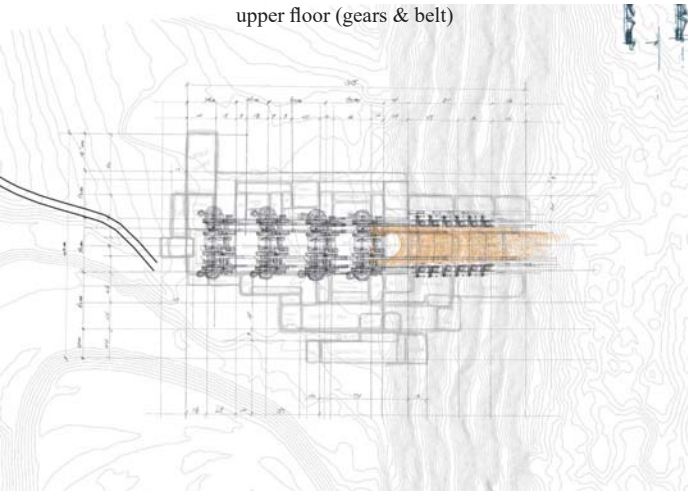
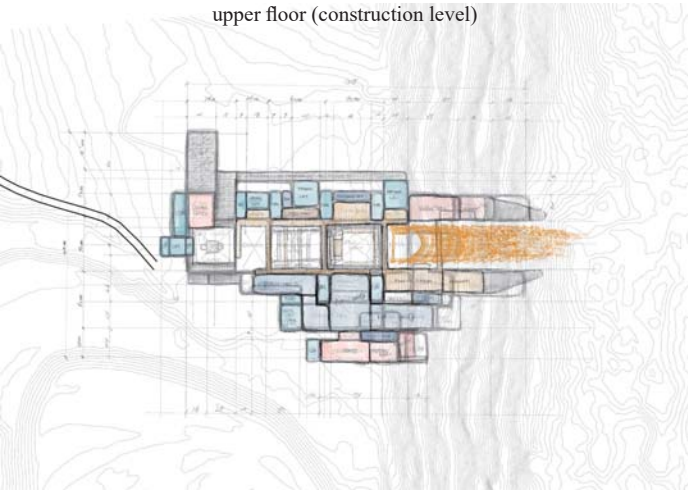
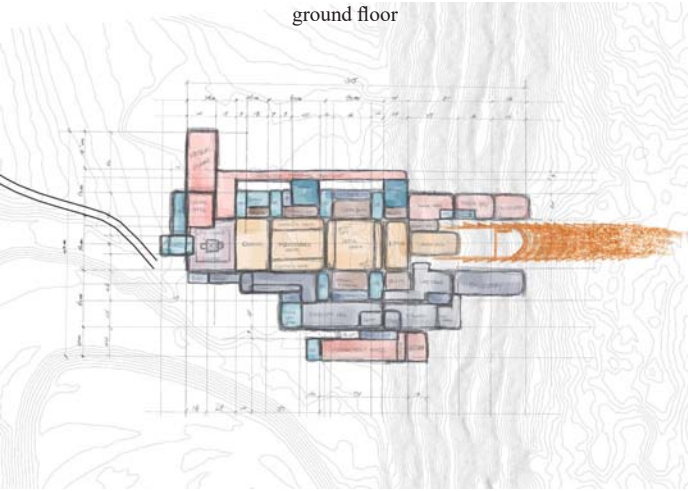
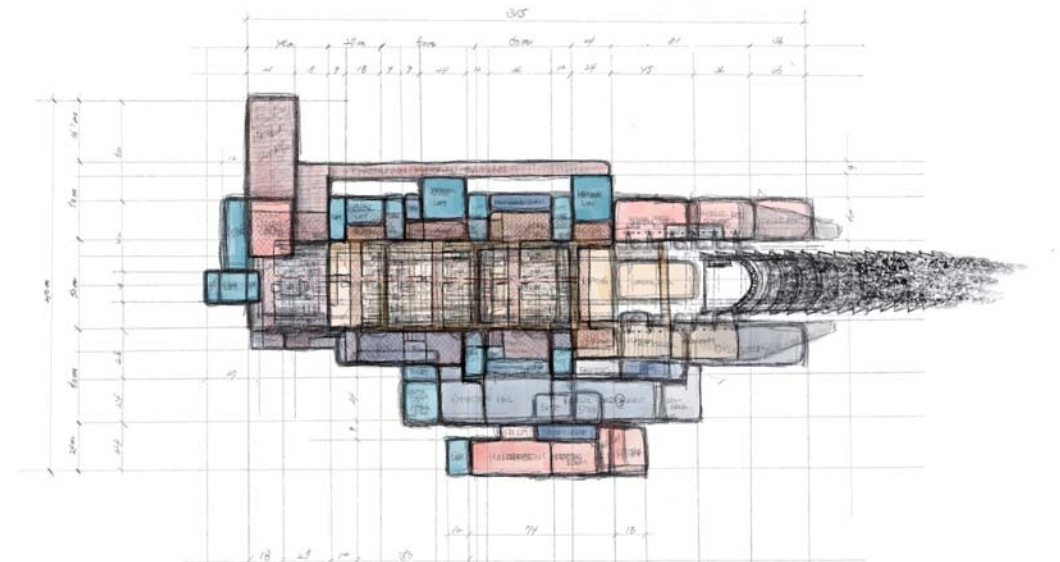
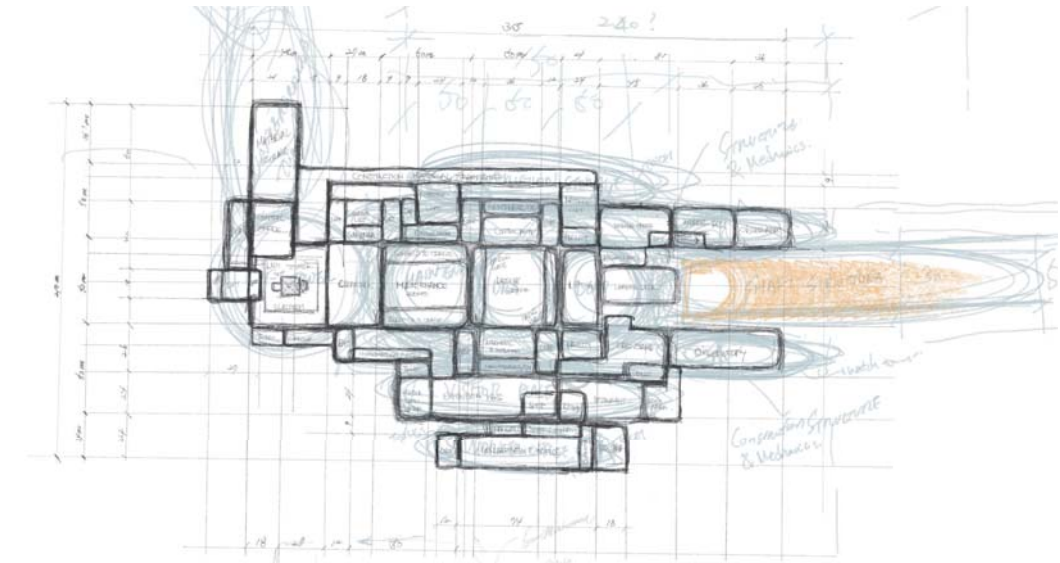
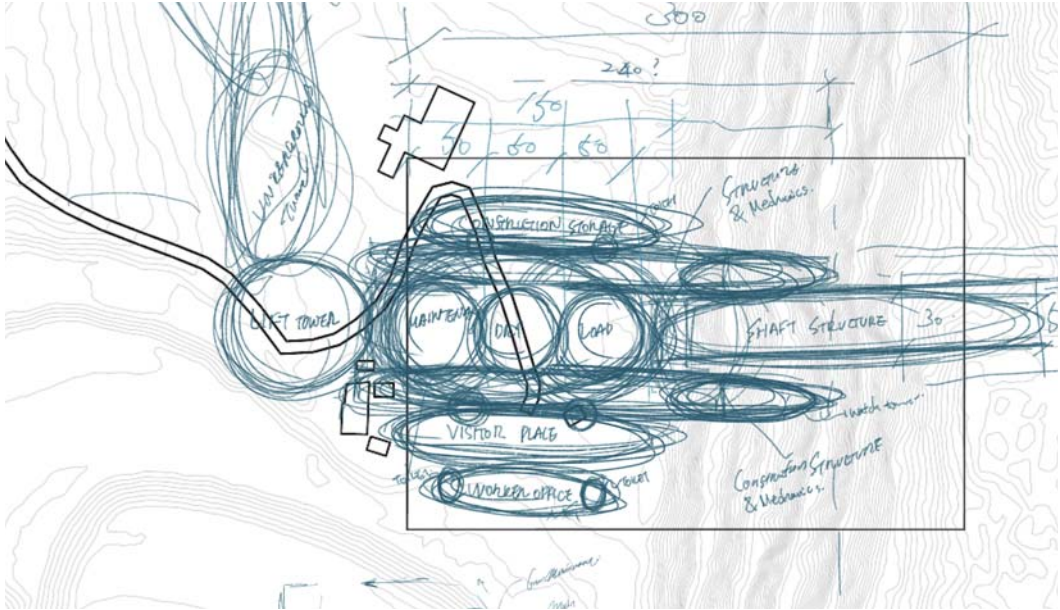
Program diagram were developed cumulatively on the top of each layers. Plan diagram shows program for the house before get into the chamber shaft locates in the middle of structure. Visitor space and worker space are added from south and north side of mausoleum.

On the left side of drawing, lift tower and underground tunnel can be seen as well.

Mausoleum was developed on right next to the existing radio center, but moved to bit aside later.

As the program started to be detailed, I also thought about the scale at the same time.

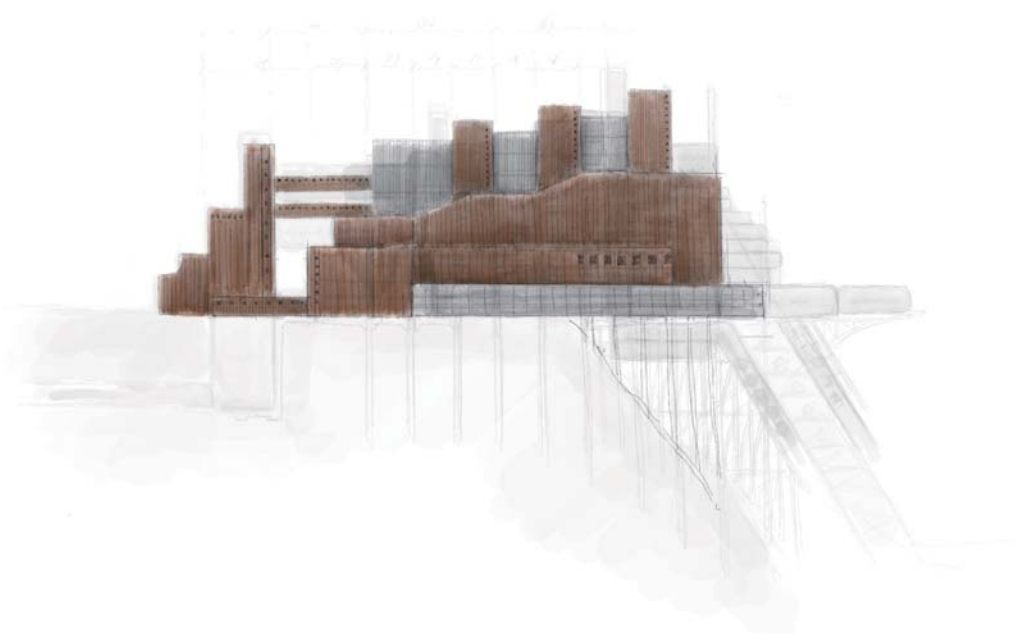
The series of sequence on the next page shows how it has been developed from both side of plan and section.



elevation sketch (right)

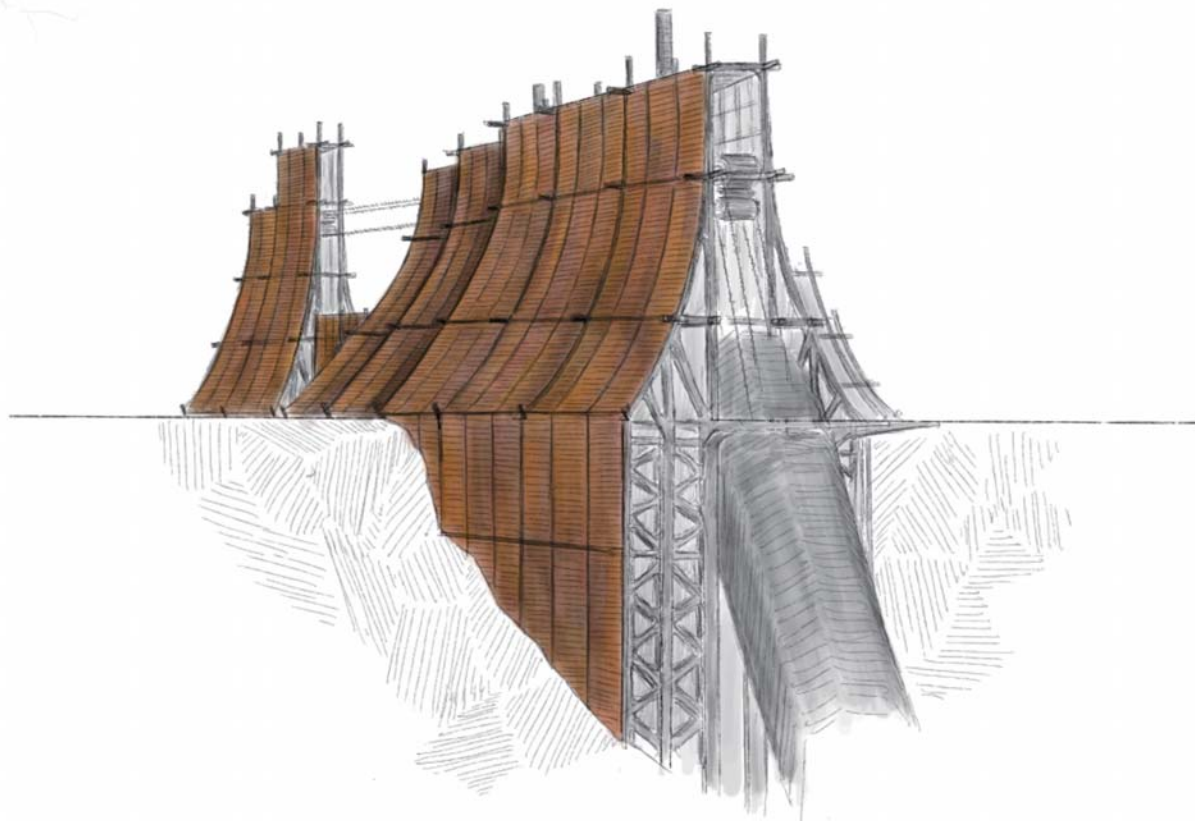
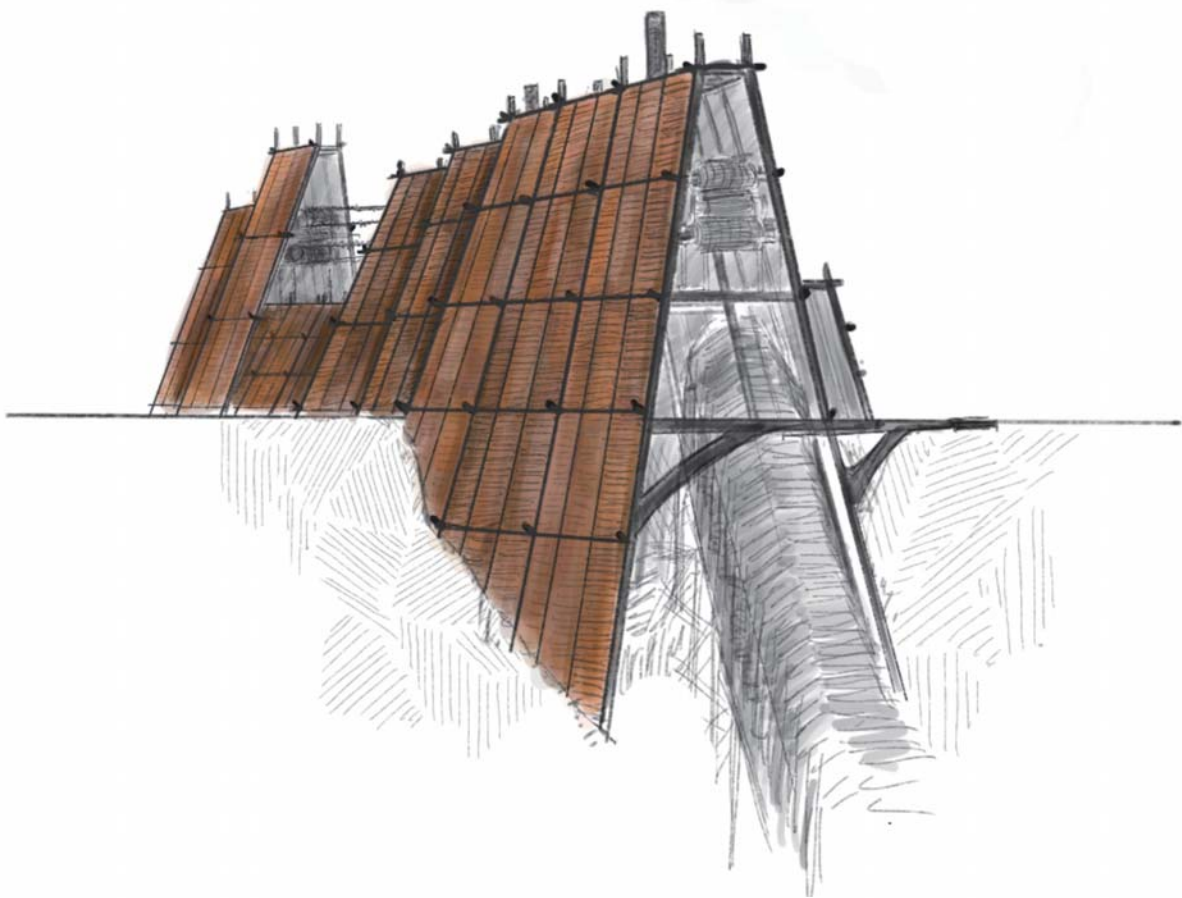
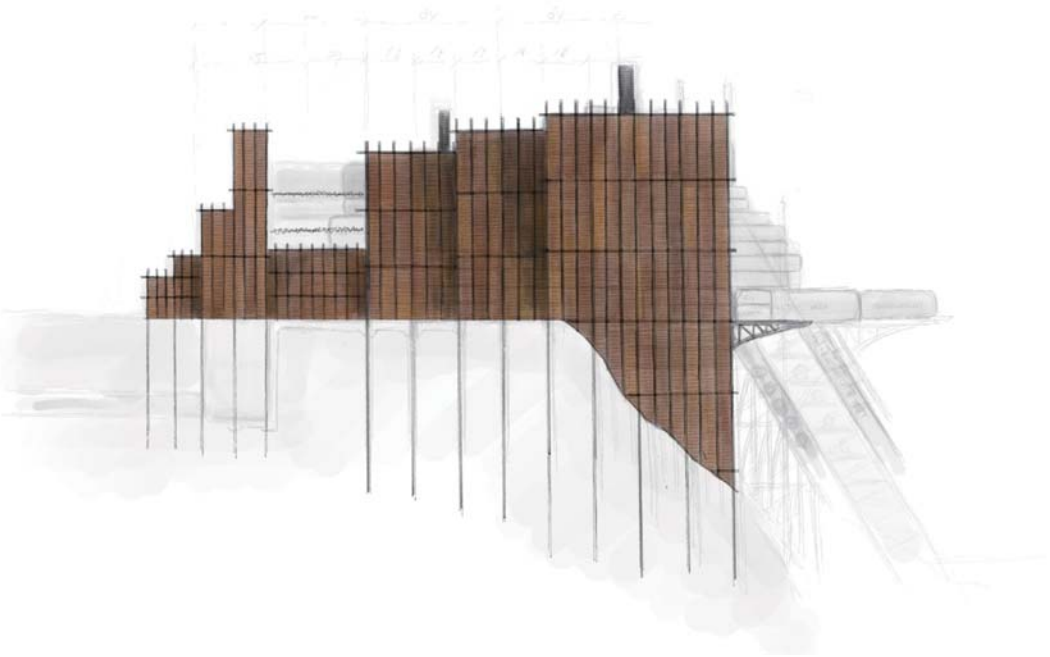
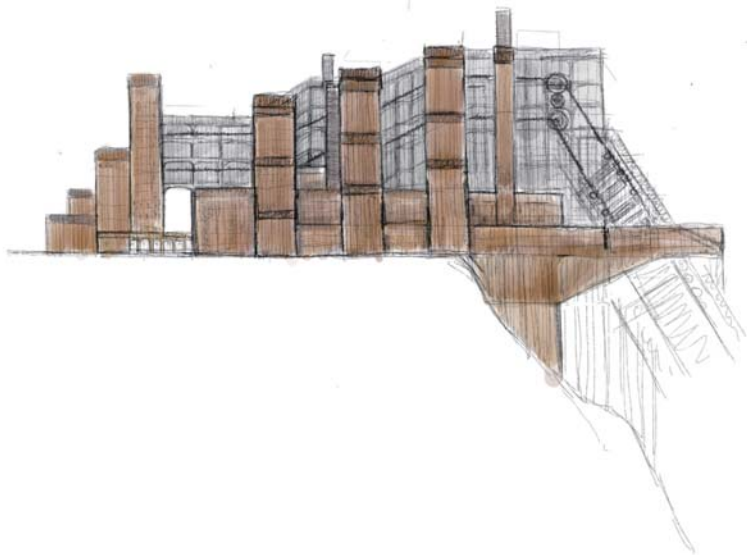
I started sketch on the top of fixed program diagram. One idea for the design was to express the inner program with the overall form of architecture.

The first sketch (top) was to follow the modern industrial style building which stands near the project site. But it leaded to the second sketch (middle) since it lacked a big gesture with it. Point of second sketch was showing the inner program by using glass so that gear system could be seen from the outside. However, there were too much languages colliding each other and I ended up as the third sketch (bottom). the mass of building gets bigger with fractal mechanism depending on the program inside.



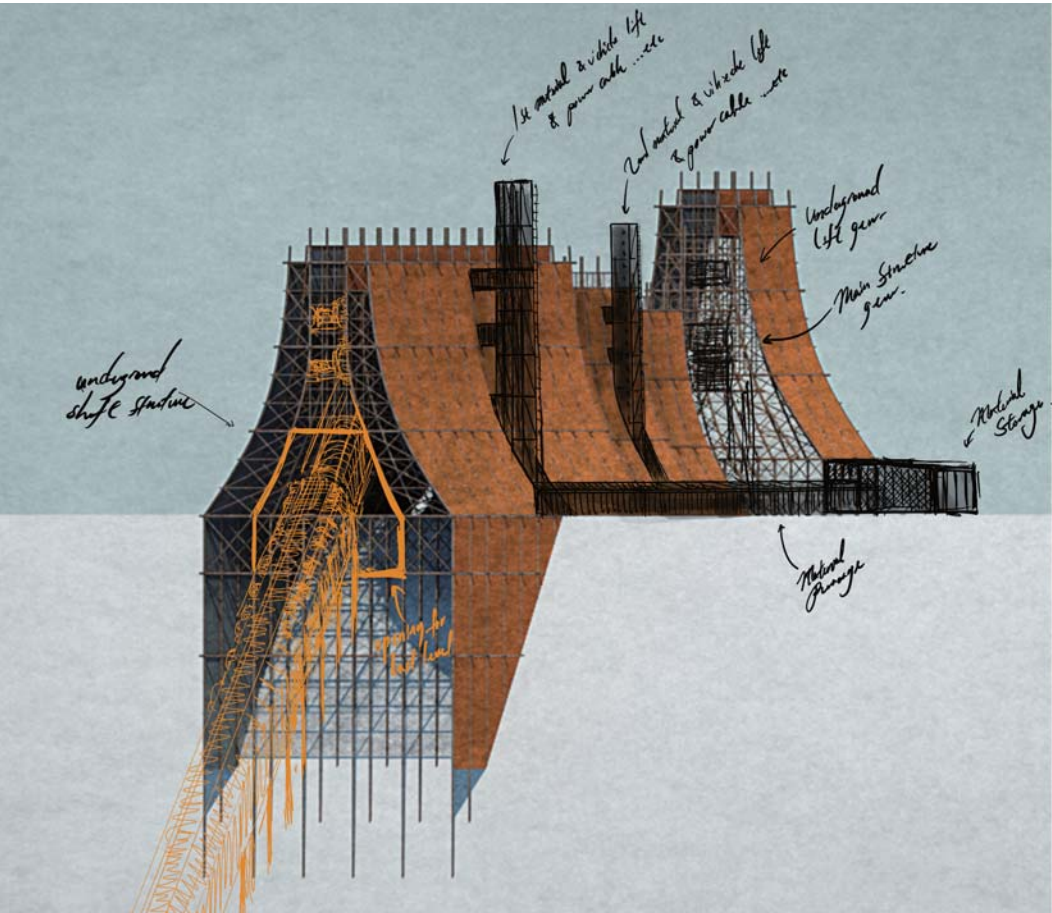
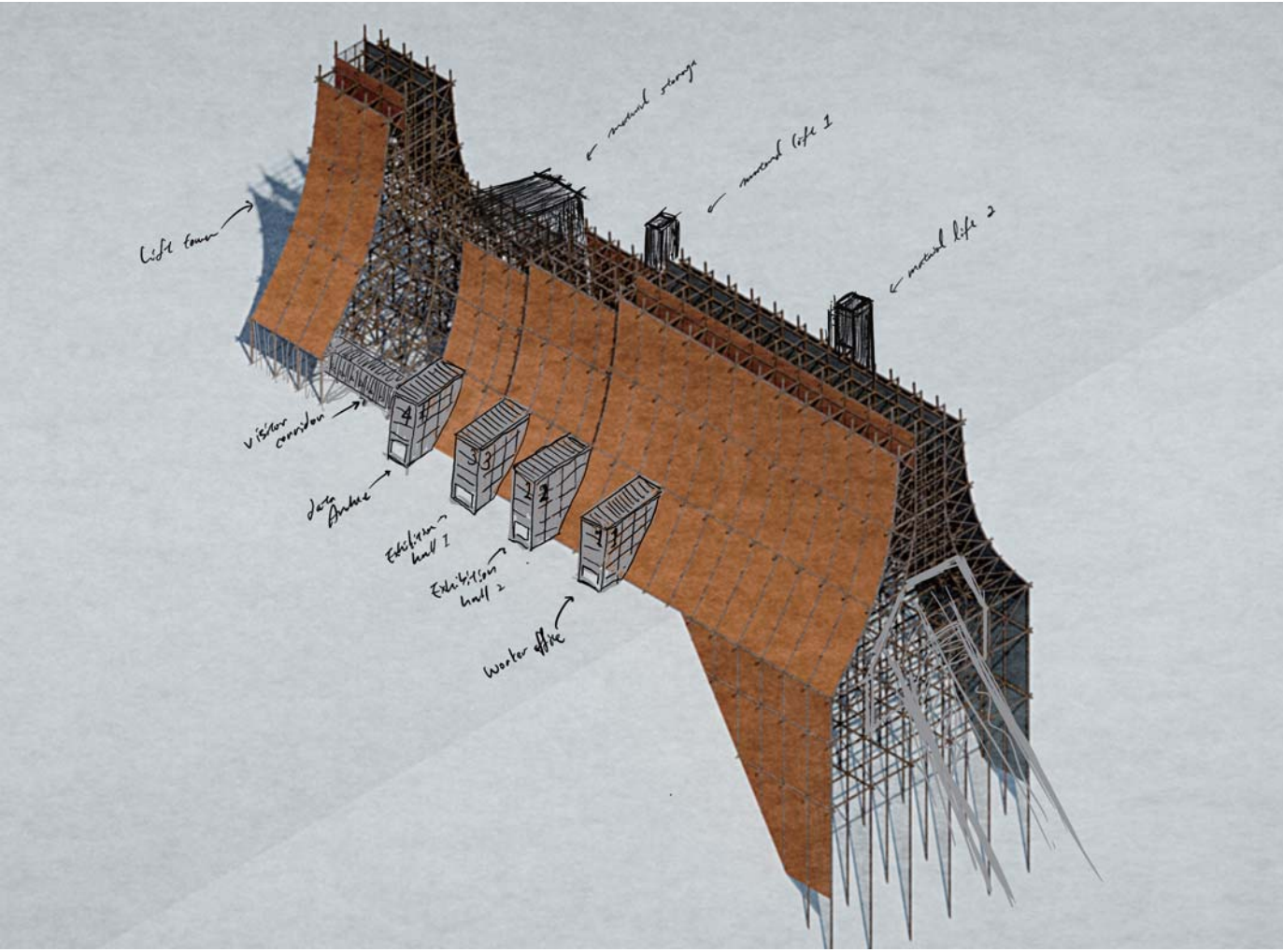
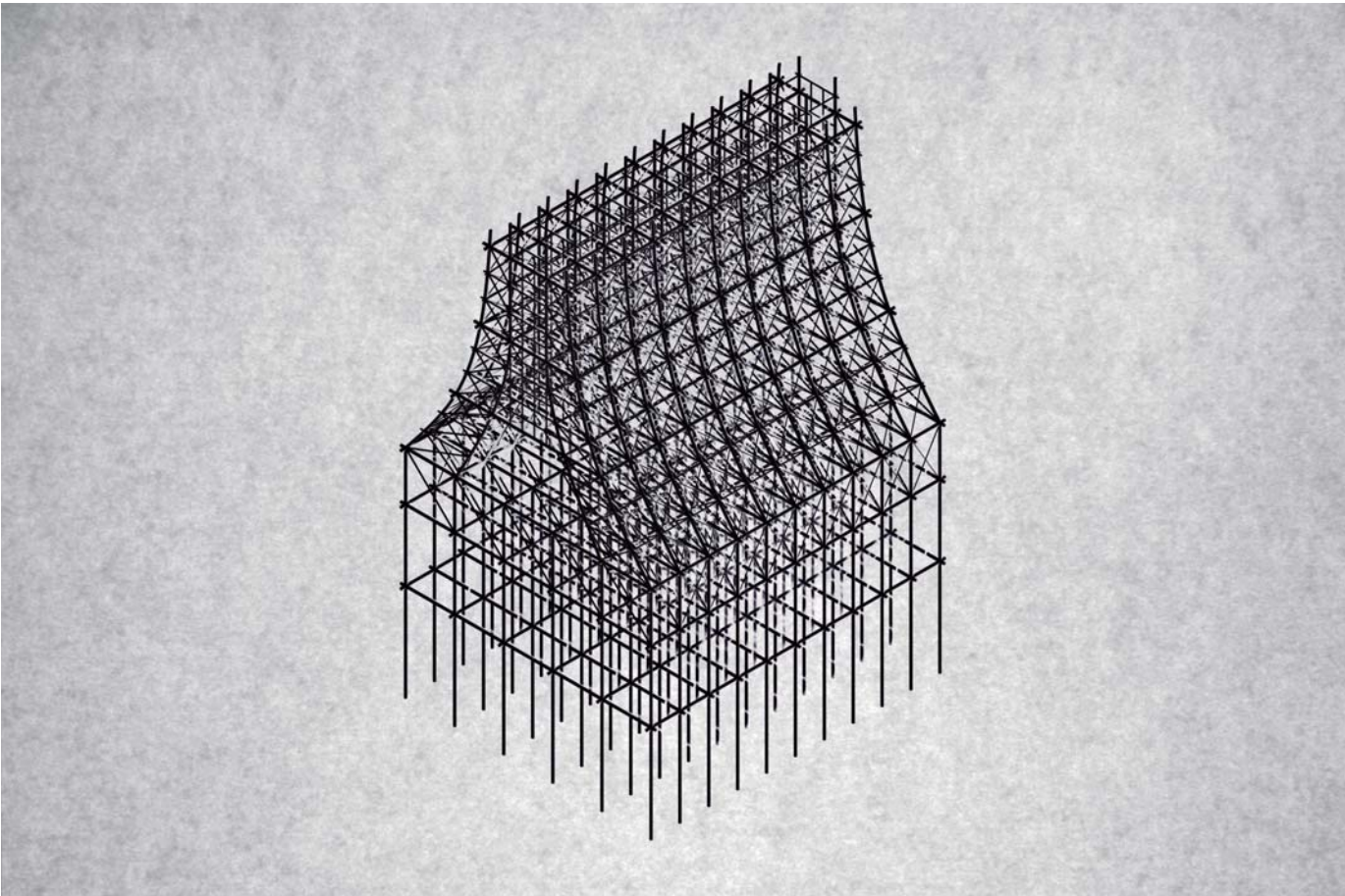
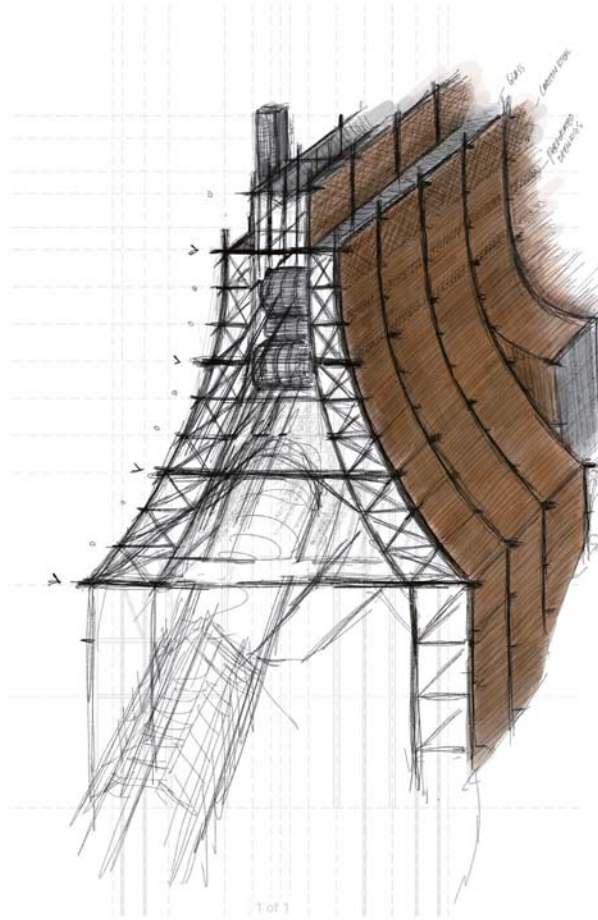
perspective (right page)

After vague design fixed from the elevation sketch, I started to think it from different perspective. Ideas were narrowed down into two options and ended up with the second drawing (bottom).



design methodology

One methodology Gustaf Wickman, an architect, used to design the Kiruna church, an icon of Kiruna was "patchworking". Exterior of the church is neo-Gothic style while interior follows national romance and Art Nouveau. And he collected the patterns for decoration from all over the world which even including the sami ornaments. One reason for this was that he wanted the church to be public space rather than the religious space. This resulted the church remains extremely unique building without any christian symbol. I tried to follow this methodology for this project as well since I wanted the mausoleum to be familiar to Kiruna people. Therefore, I avoided to have any distinctive style. I referenced the entire shape from Meenakshi temple in India, and structure from Eiffel tower, since I needed bigger space for the bottom of mausoleum to serve the Chamber shaft and the houses.



sketch on rendering

After adjusting the mass of whole structure, additional space were needed to fulfill the programs which developed before. Therefore add-on spaces for the mausoleum were inserted from the both side of south and north.

southern part of mausoleum (above) shows that four masses, containing each own program with it, have inserted through the exterior border.

For the northern part (left), I followed the same design language used the other side. Vertical core for carrying construction material and vehicle were stuck. Additional material storage and logistic tunnels are also extended from the vertical core to the mass of mausoleum.



KIRUNA MAUSOLEUM

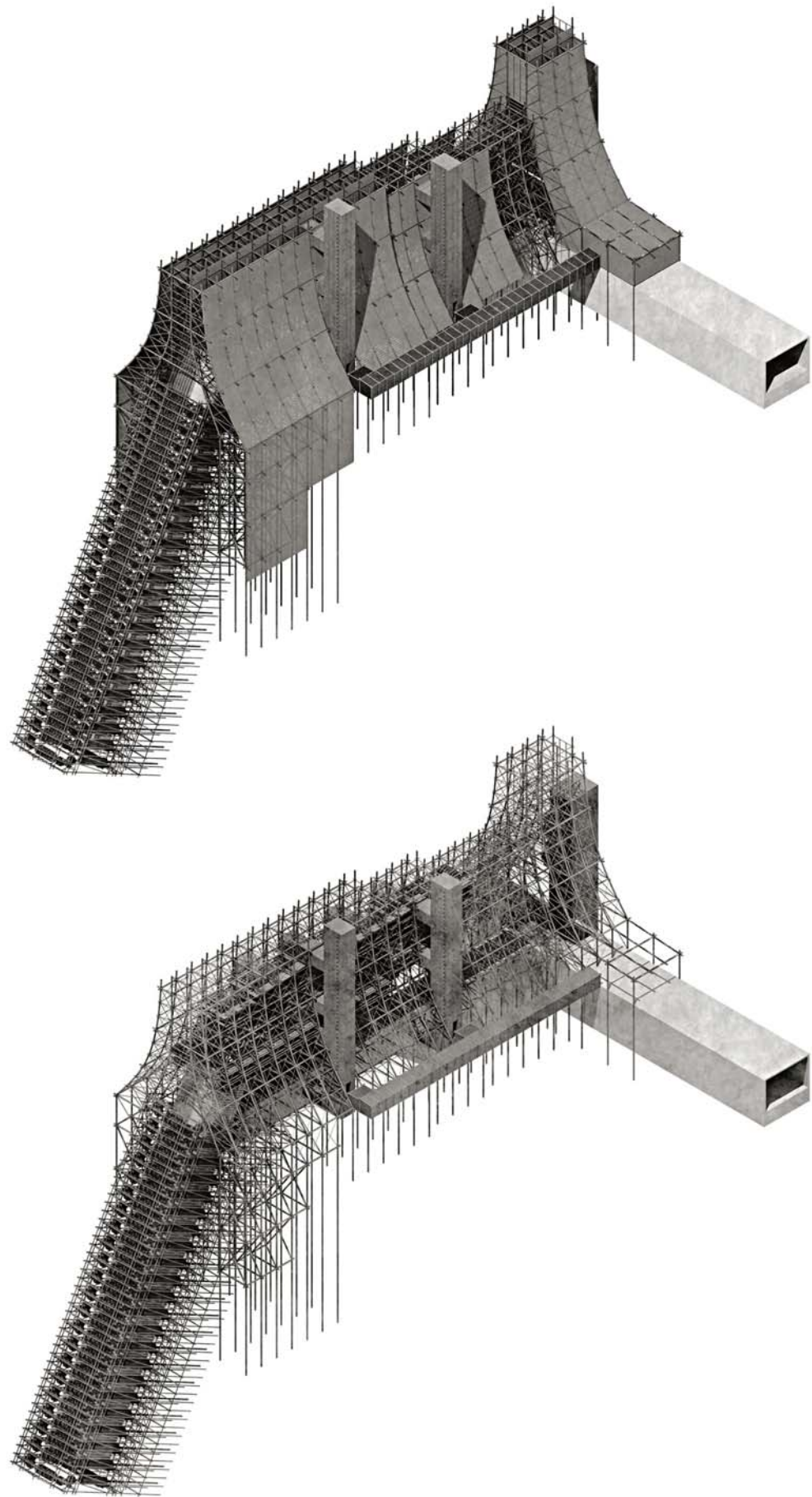
Kiruna mausoleum indicates the development of Kiruna by taking the void space, formed by continuous work of iron mining. Abandoned houses, the container of personal history of Kiruna people, will sink into deep underground and be able to accessed with abandoned infrastructures such as mining tunnel. As development of Kiruna, iron mining and the sinking mausoleum are connected each other, more houses will be carried to the top of mountain and be buried to deep abyss. Memories raised up by the excavation of iron ore will be returned to where it once has belonged.

isometric diagram

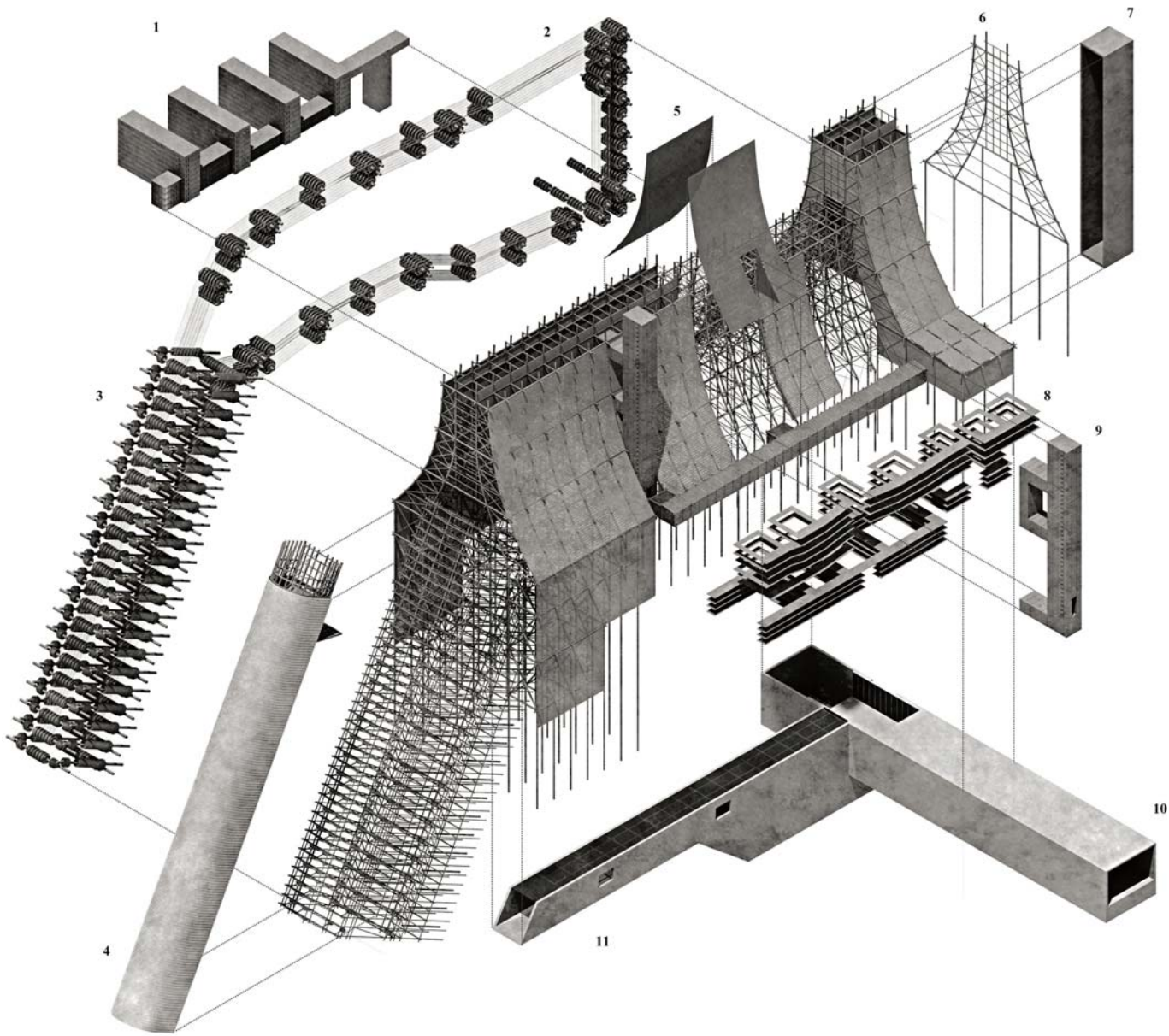
Mausoleum is composed of several different parts, but theses can be understood as main Chamber shaft and the support structures.

Diagram shows how these support structures are stacked on the top of each other inside of giant scaffoldings that is covered by exterior material.

As the scale of structure is huge and part of it stands on the slope of kiruna iron mountain, the pile foundation was considered to make building stabilize.



Mausoelum Components

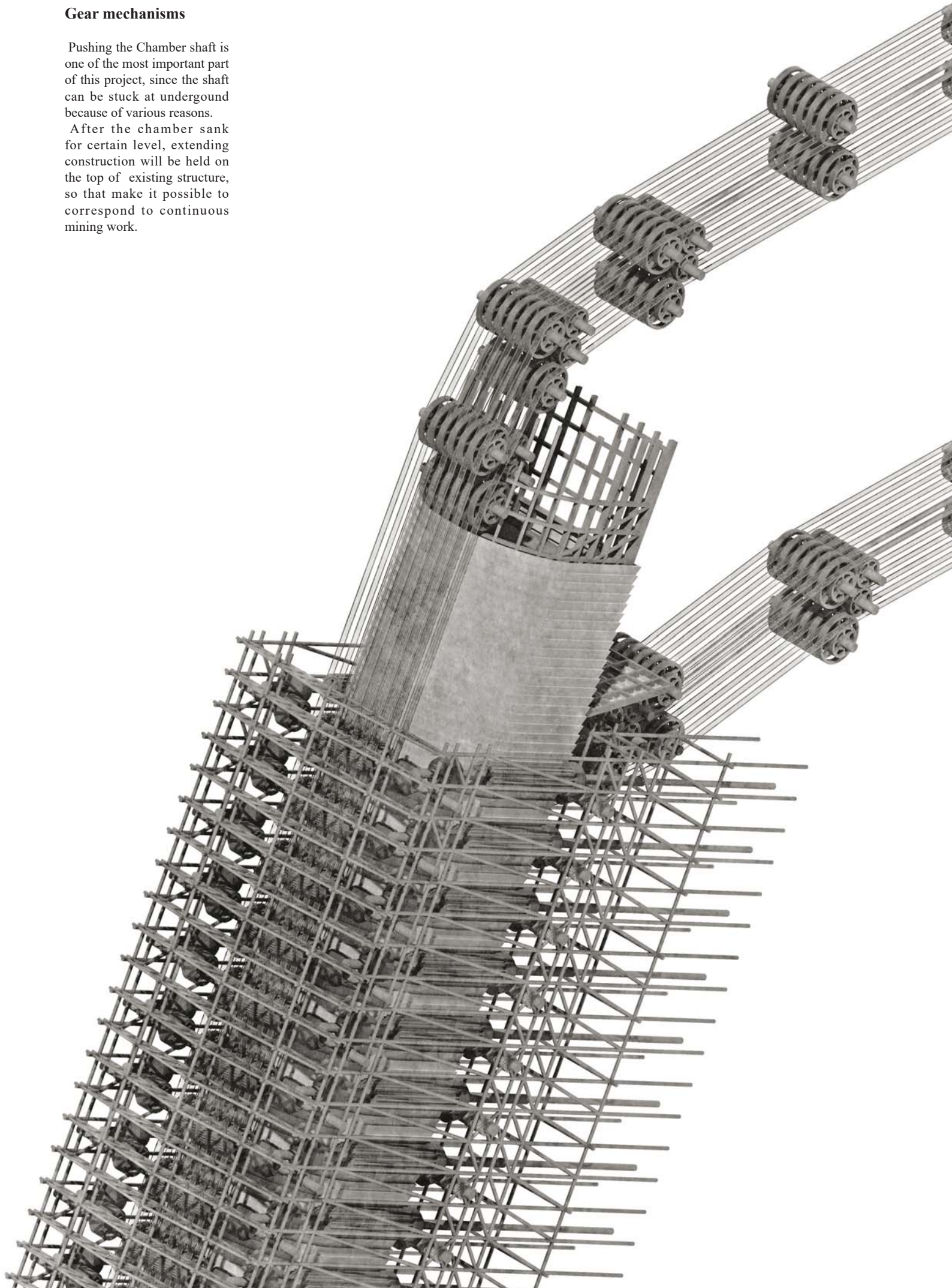


Exploded diagram below shows overall view of each component that consisting Kiruna mausoleum. The main Chamber shaft(4), which slides down to underground with houses in it, is the main structure of the space. Pushing gears(3) adjusts the slipping speed of Chamber shaft by rotating and pushing the zig-zagged surface of Chamber shaft. Holding gears(2) extending from underground space to pushing gear, makes whole structure stable with tension mechanism. Scaffolding structure(6) covered with exterior panel(5) helps to hold whole gears and shaft. Vertical core(9) are inserted from the north side of mausoleum so that make it possible to carry construction materials and vehicles to the each platforms(8) for building activities and maintenance. The houses will be transported to mausoleum through the underground tunnel(10). The tunnel is connected to the other underground space that holding the bottom gears(11).

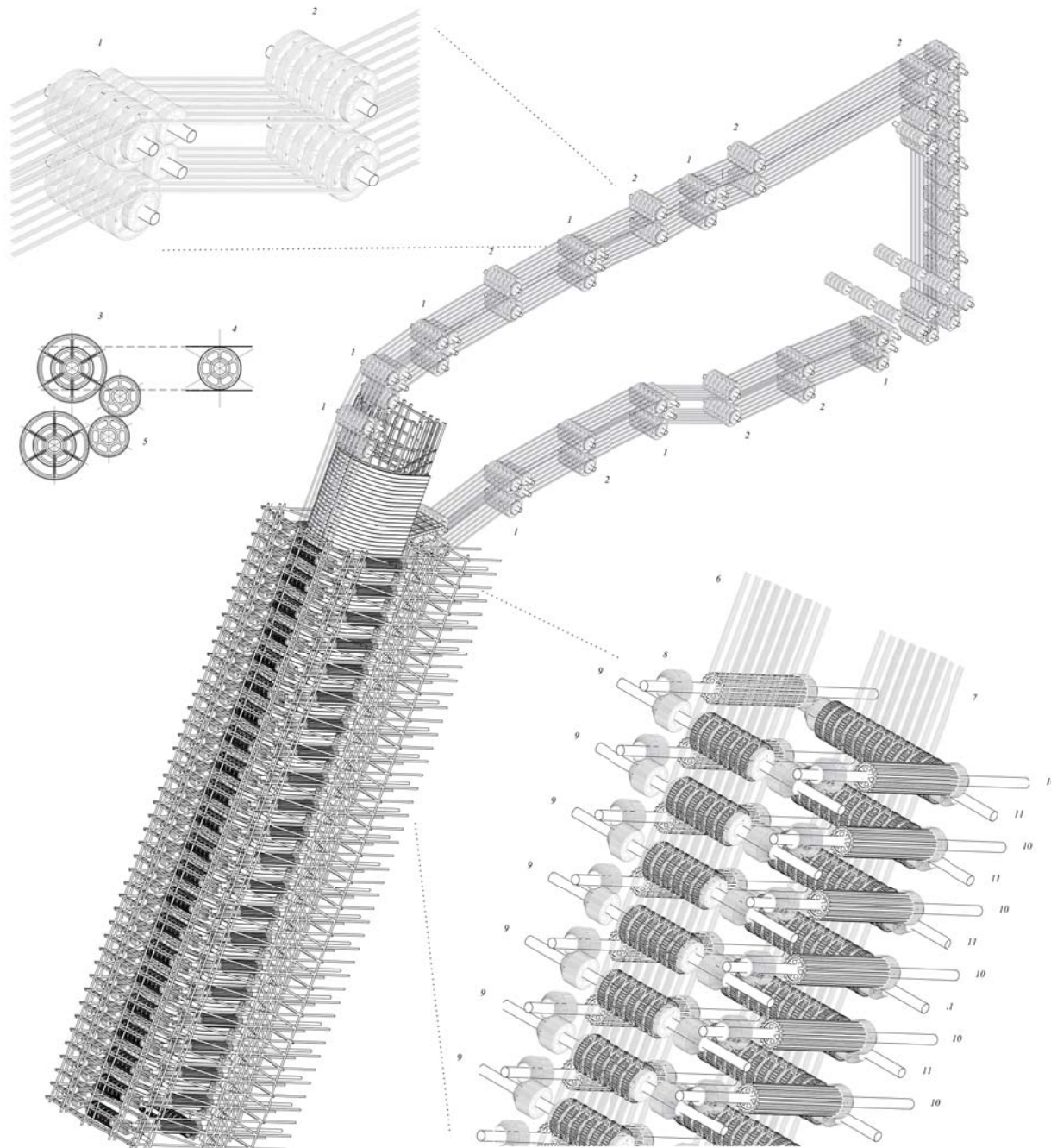
- | | |
|--------------------------|-------------------------------------|
| 1. public space | 7. holding gear space |
| 2. holding gear | 8. platform for construction worker |
| 3. pushing gear | 9. vertical core for worker |
| 4. chamber shaft | 10. underground tunnel |
| 5. exterior panel | 11. bottom gear space |
| 6. scaffolding structure | |

Gear mechanisms

Pushing the Chamber shaft is one of the most important part of this project, since the shaft can be stuck at underground because of various reasons. After the chamber sank for certain level, extending construction will be held on the top of existing structure, so that make it possible to correspond to continuous mining work.



Pushing the Chamber



Pushing the Chamber shaft works with gear & belt. Each power gears(1) makes entire belt circulate by rotating, and tension gears(2) helps belt not to lose its tension. Power gears consists of large gear(3) and belt gear(4), which actually circulates the belts.Synchronizing gears(5) makes power gears rotate without any lags that causes several issues. From the zoomed drawing(right down), mechanism of pushing the Chamber shaft can be seen. As the belt from top(6) and bottom(7) powers the horizontal gears(9, 11), transfer gear(8) transfers the momentum to the vertical gears(10). Large gears from bottom gears(11) and vertical gears(10) pushes the zig-zagged surface of Chamber shaft to make it inserted down to the underground.

1. main gear set

2. tension gear set

3. large gear

4. belt gear

5. synchronize gear

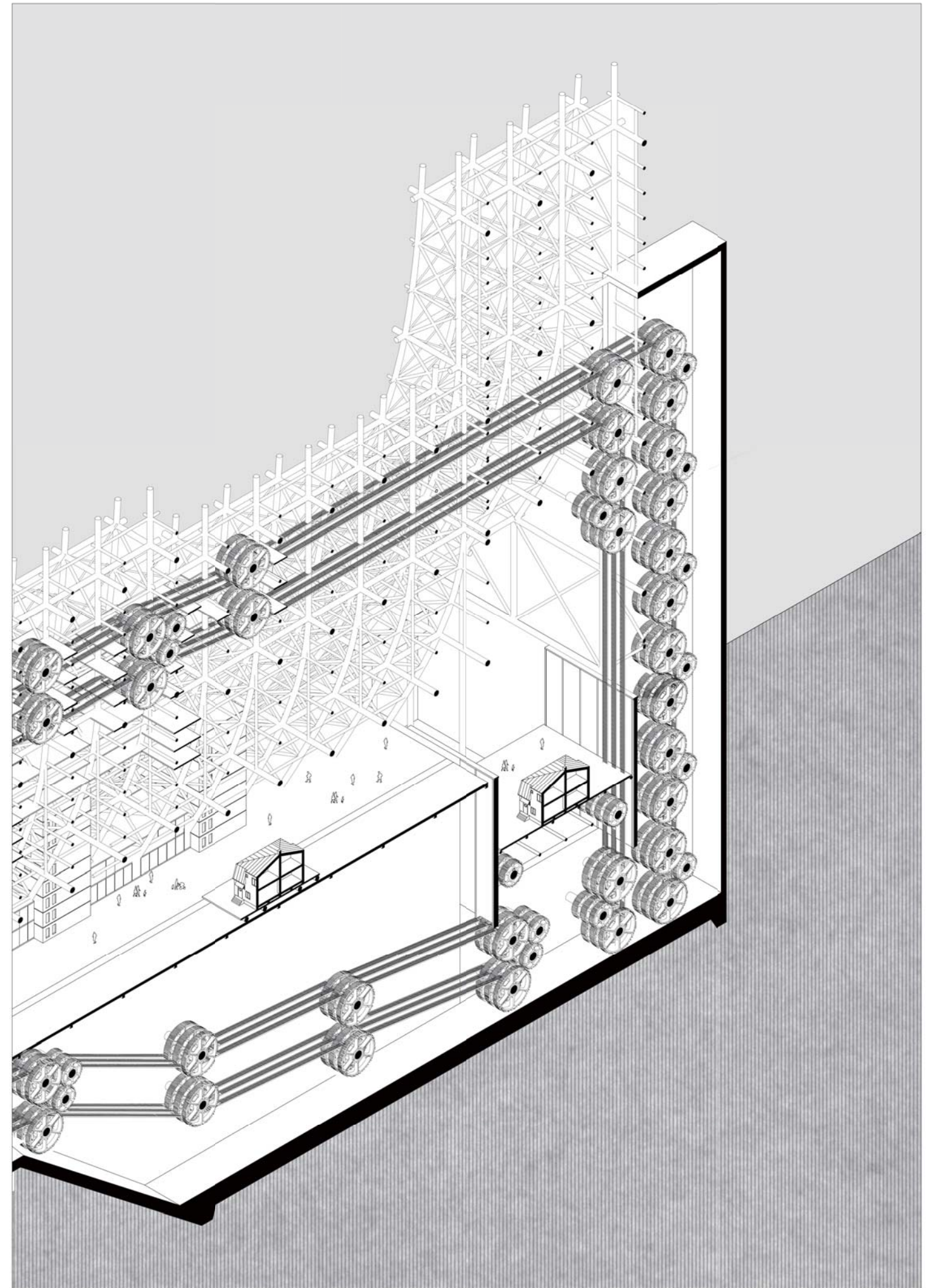
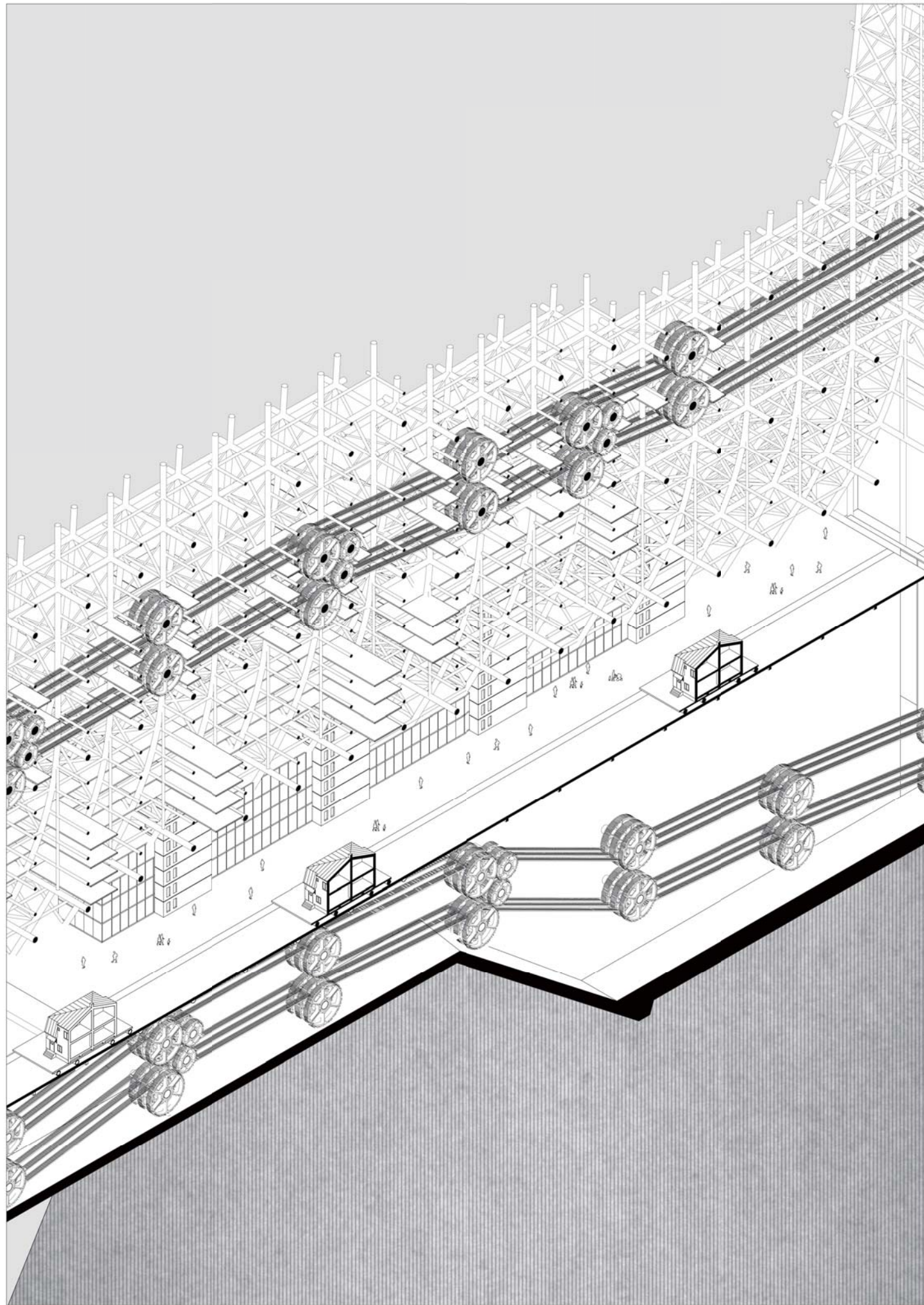
6. upper belt
7. bottom belt

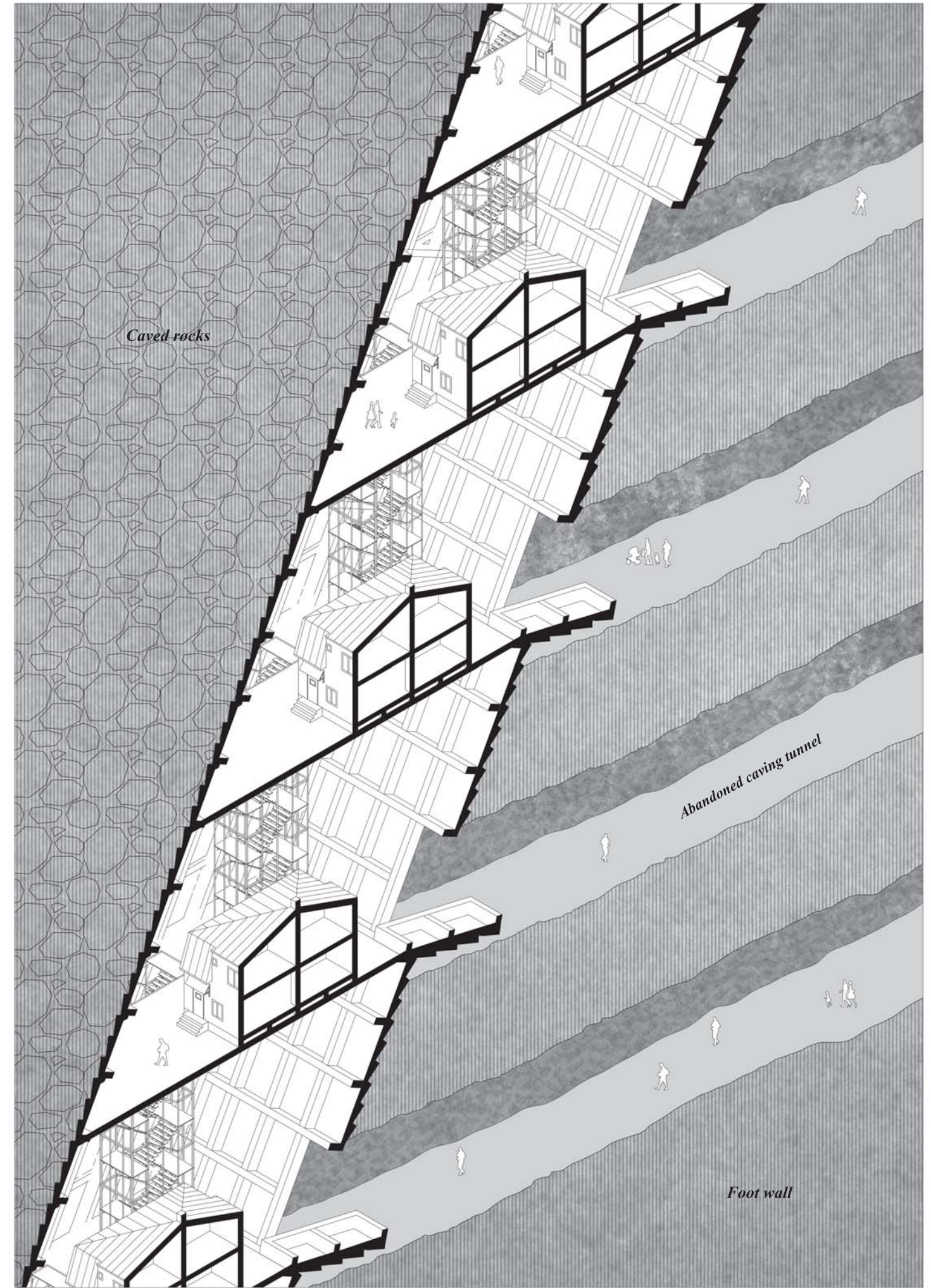
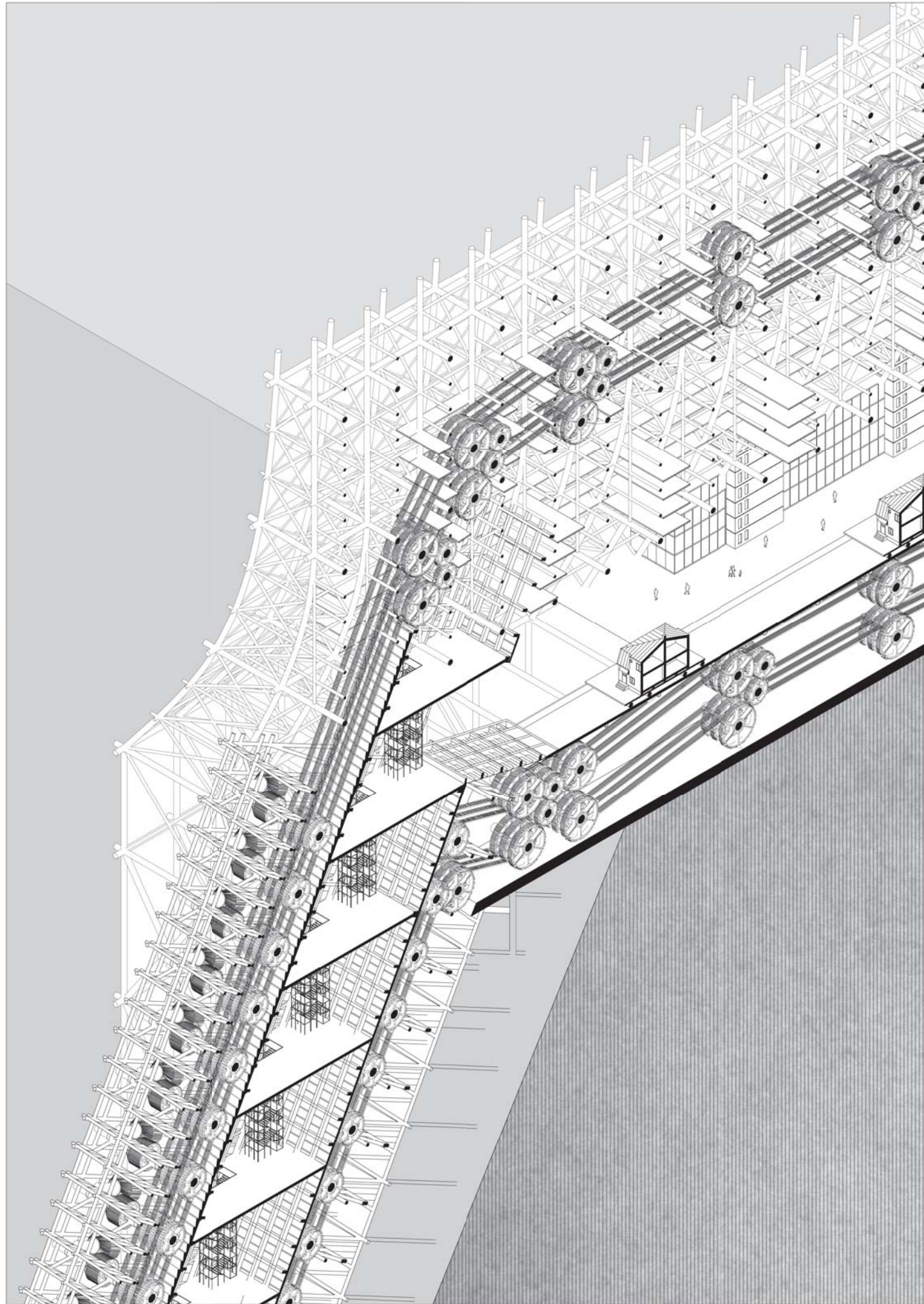
8. transfer gear

9. upper horizontal gear set

10. vertical gear set

11. bottom horizontal gear set





APPENDIX

Practical drawing set

Master's Diploma, KTH School of Architecture, 2020

Typical architectural drawings such as plan, elevation and section were attached to help understanding the overall view of the project and mausoleum. Below are some points that can be read from each drawing.

Site plan

the location is next to where kiruna radio station currently stands, since there is already some infrastructures to run the facility exist. Also the footwall foundation is except from sink hall affect where is proper place to build a giant structure.

Plan

- underground : Underground tunnel for transporting the houses can be checked. Bottom gear structures and vertical cores connected to the ground floor allows maintenance work.

- ground floor : On each side of funeral road in the middle, working space and visitor space is located on the northern and southern part of the mausoleum. Public space consists of four major programs - running office, library of house, open exhibition hall and restaurant. Each volume of programs are connected with hallway with glass, which make people able to follow the proceed of funeral.

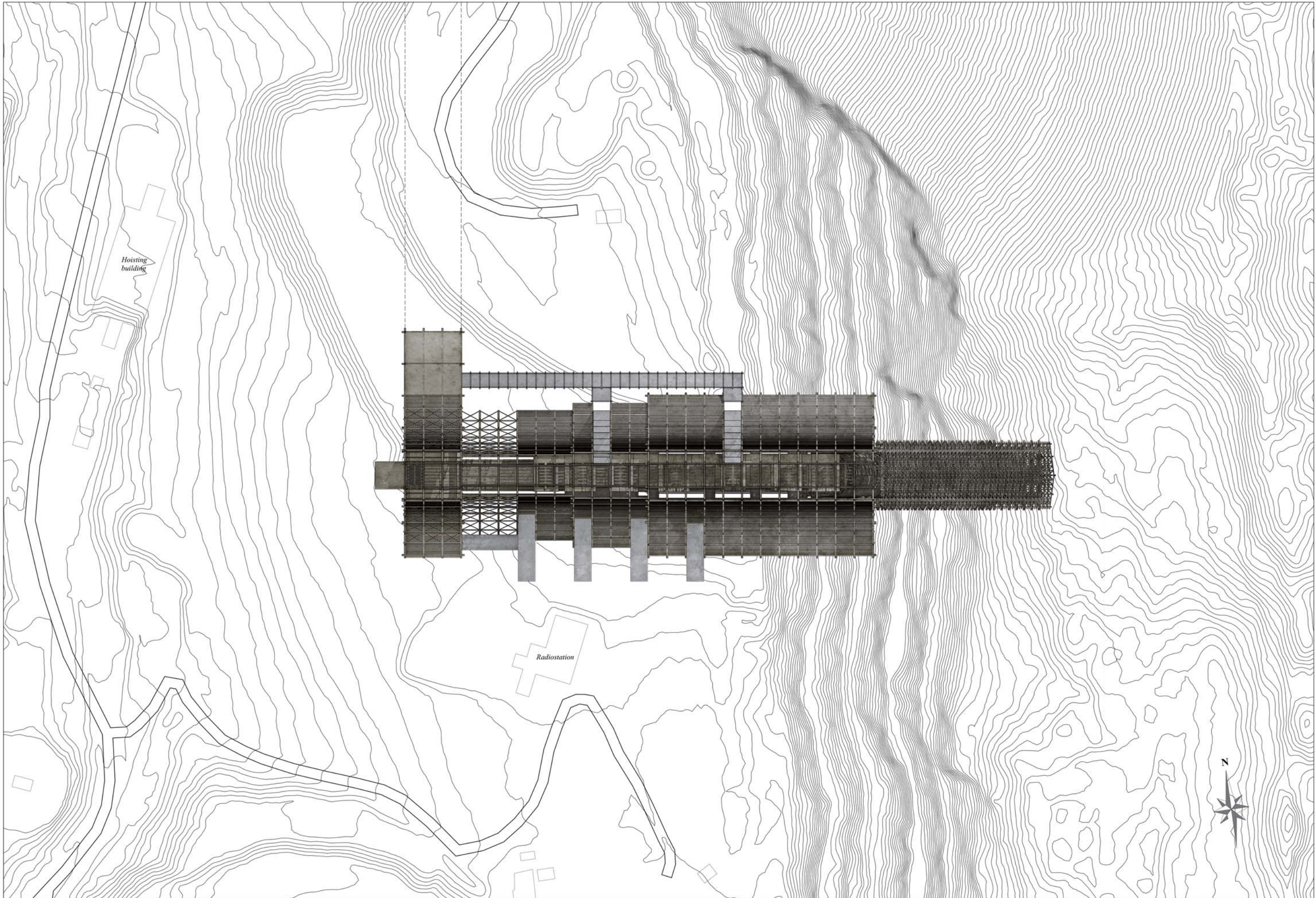
- construction floor : Platform stretching from the vertical core allows workers to construct extension of the Chamber shaft by adding a new chamber on the top of exisiting structure.

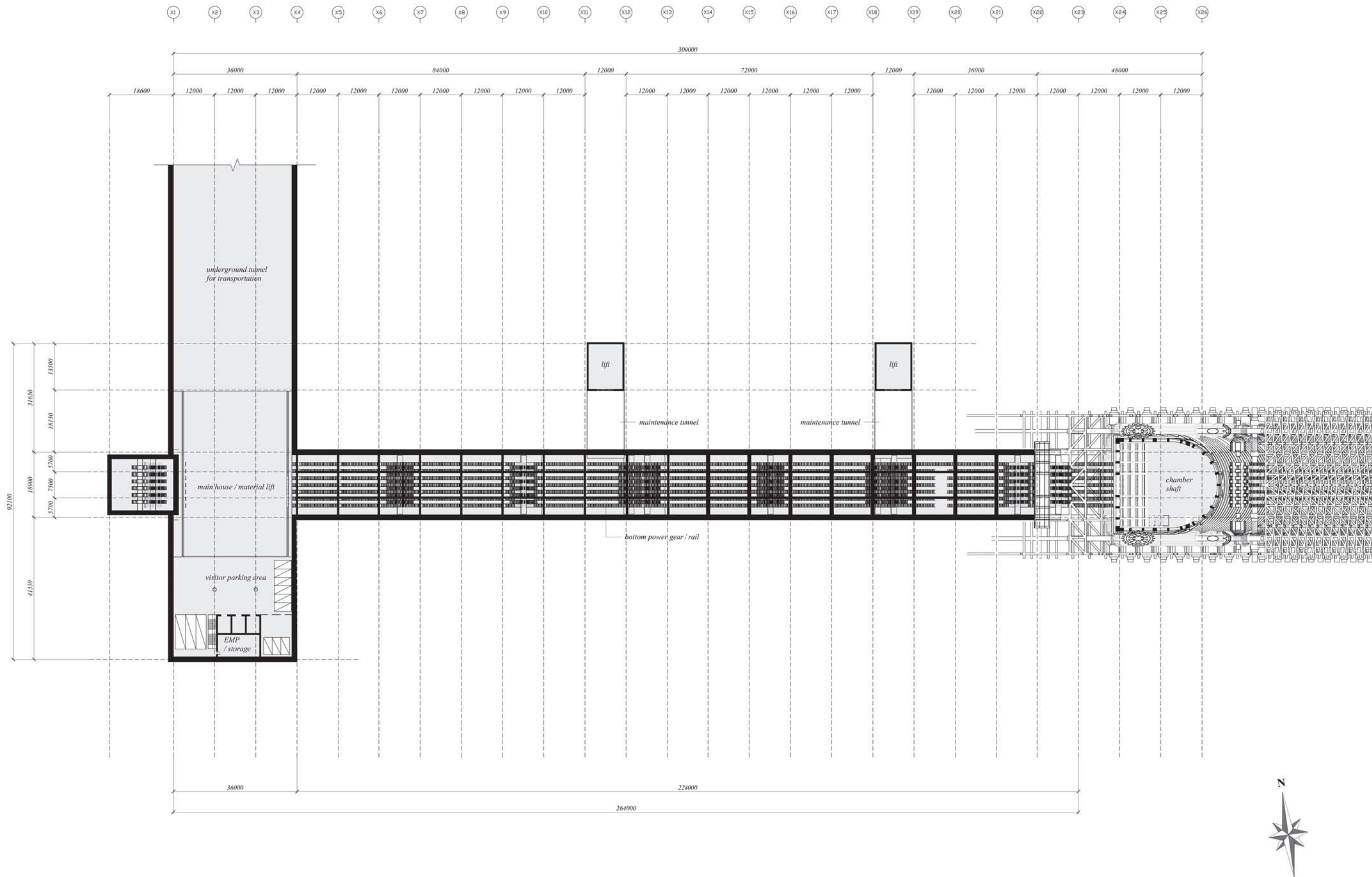
- upper gear platform : Same as construction floor, platform supports the maintenance activity of the gears.

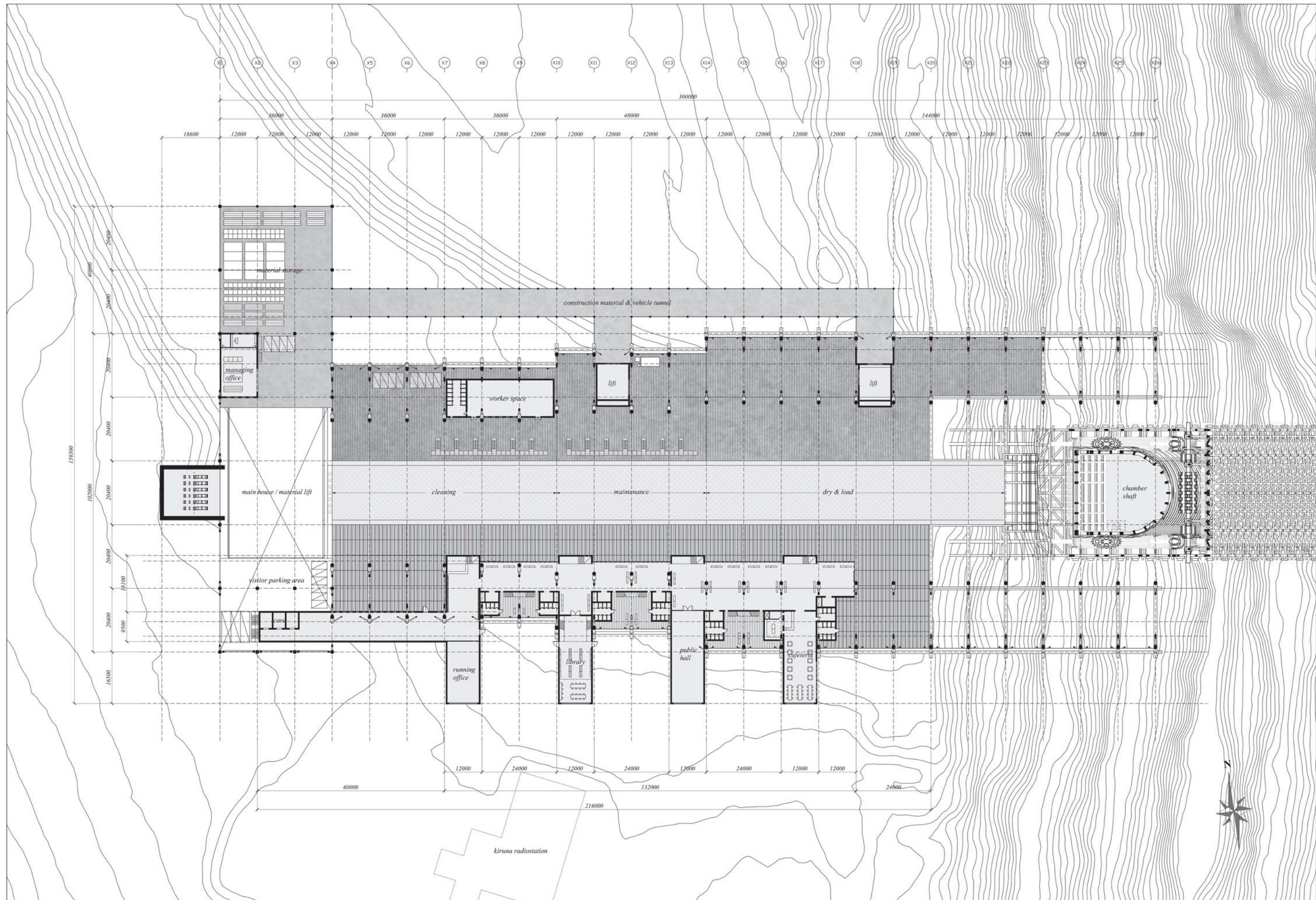
- roof plan : glass is attached on the top of mausoleum to maximize incoming daylight since Kiruna has limited amount of the light during the long dark winter.

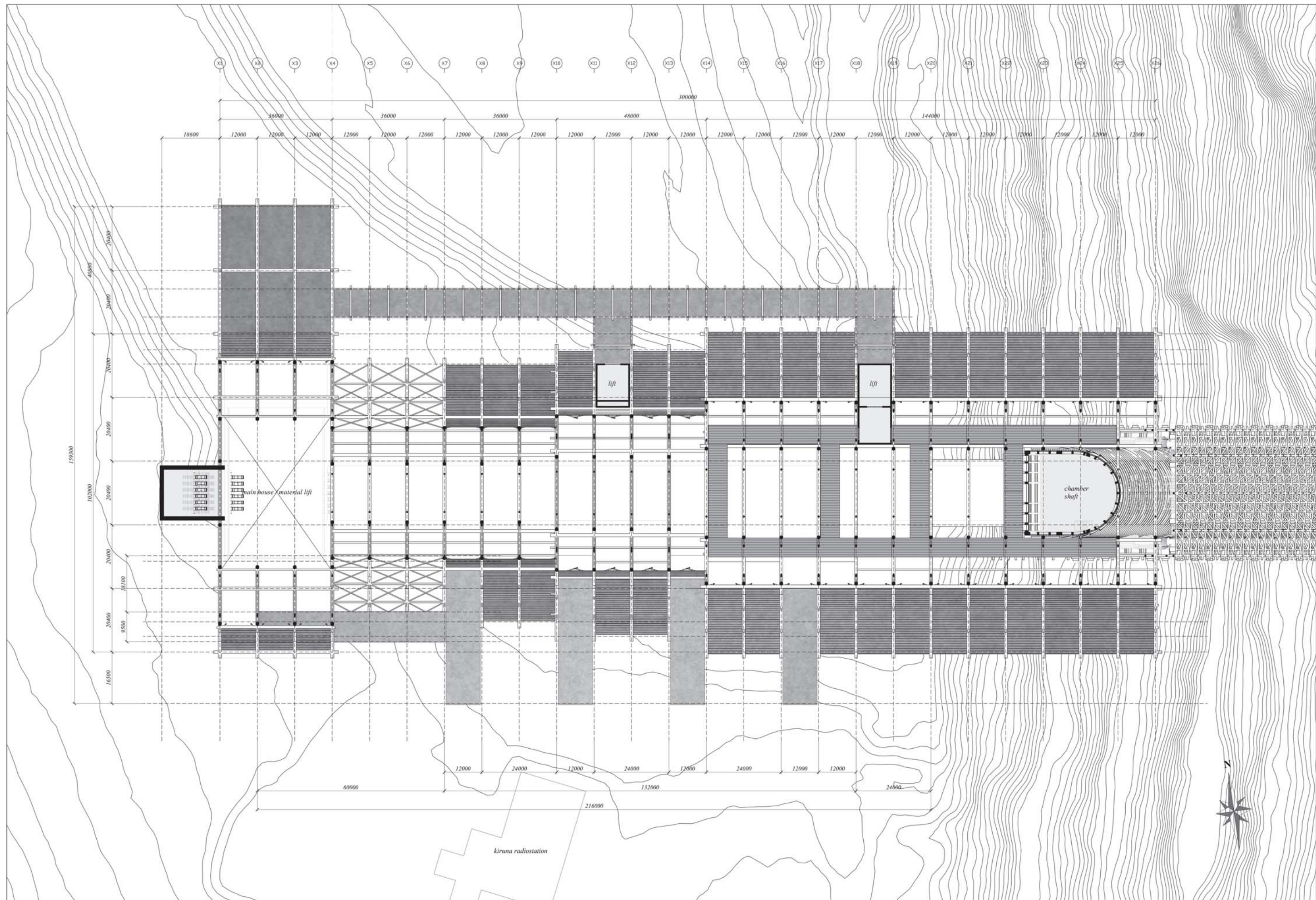
Elevation

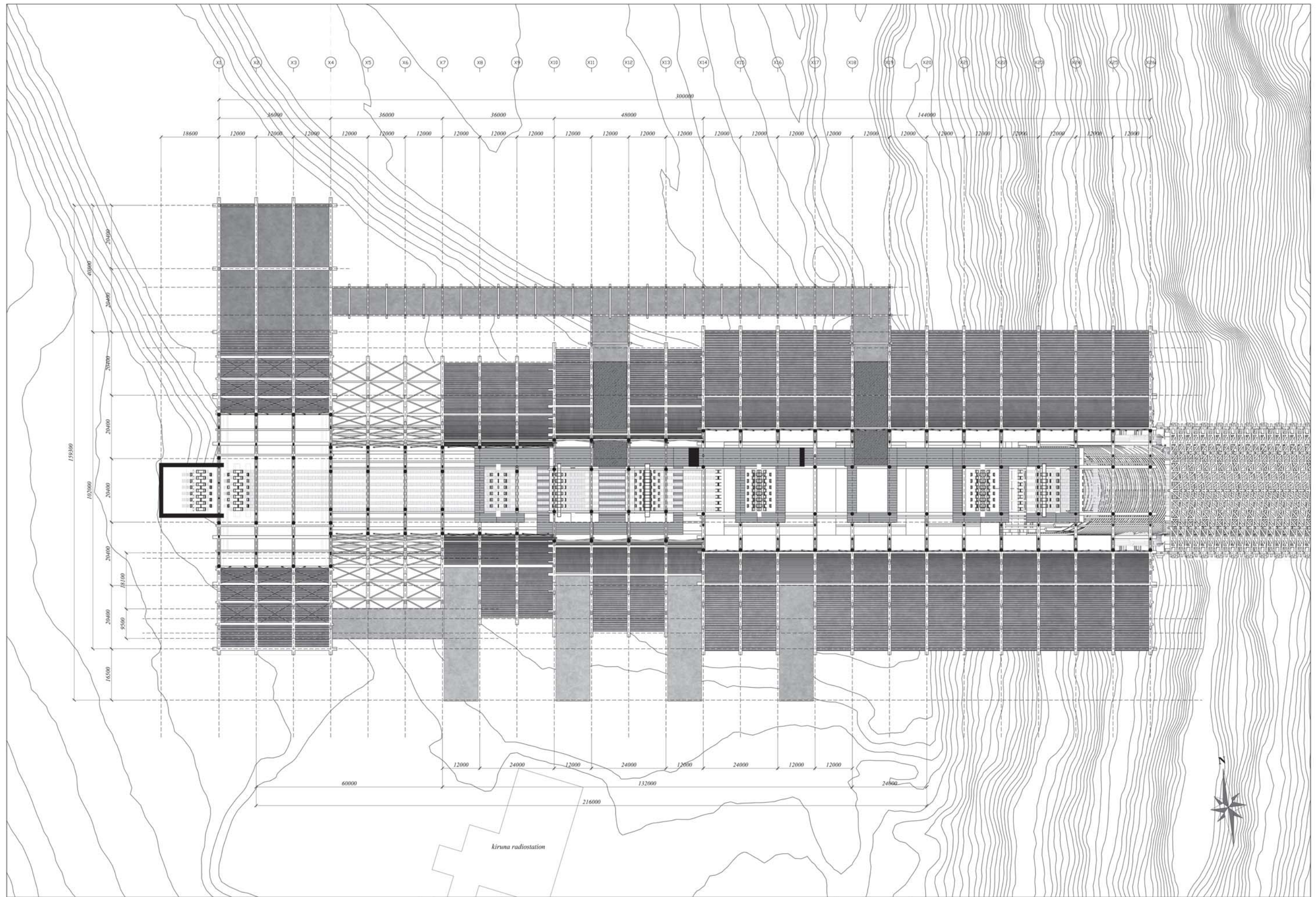
Overall design of mausoleum is not only to follow the industrial language in the factory building next to the location, but also to somehow remind the shape the top of mountain that flattened after mining started.

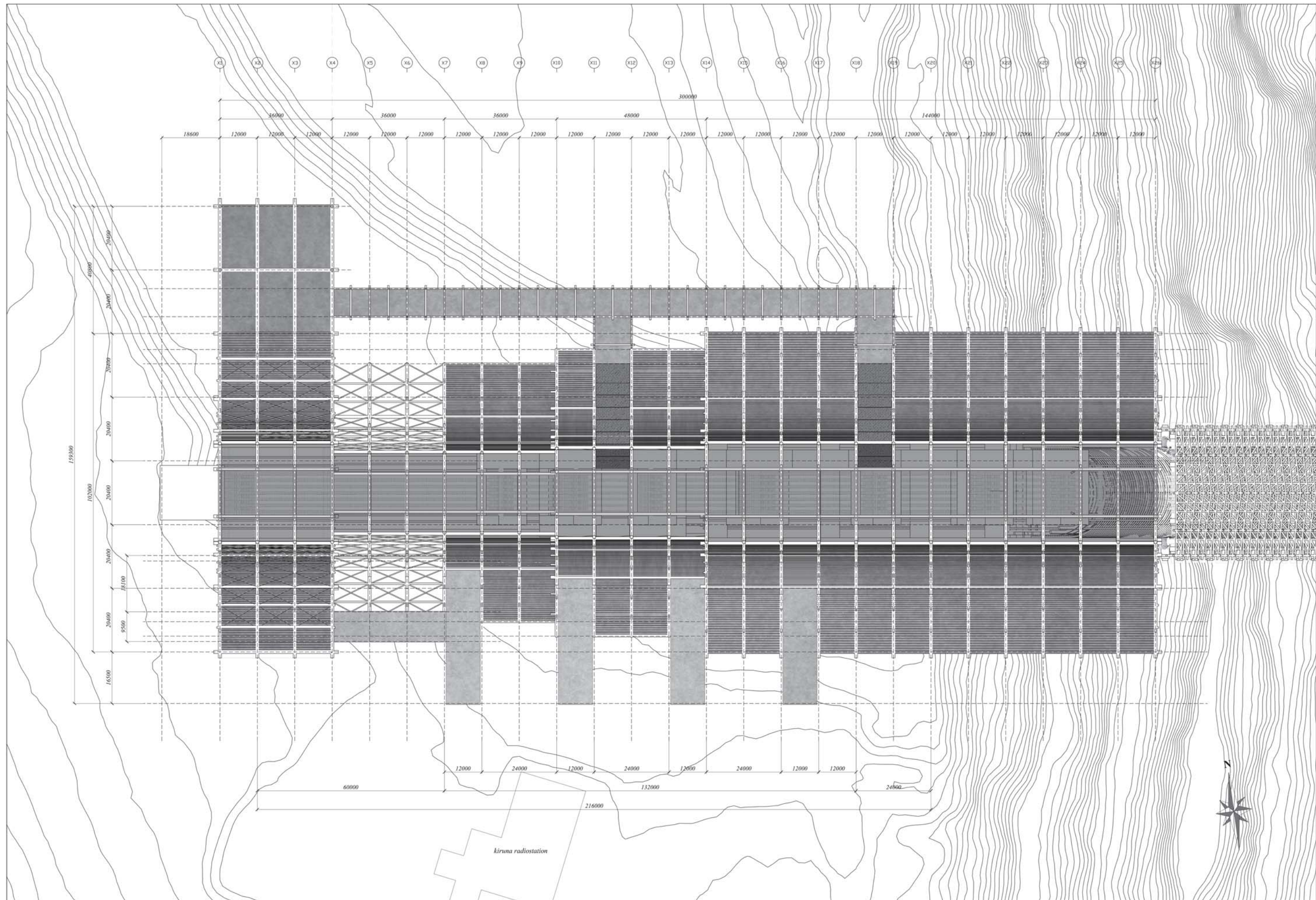


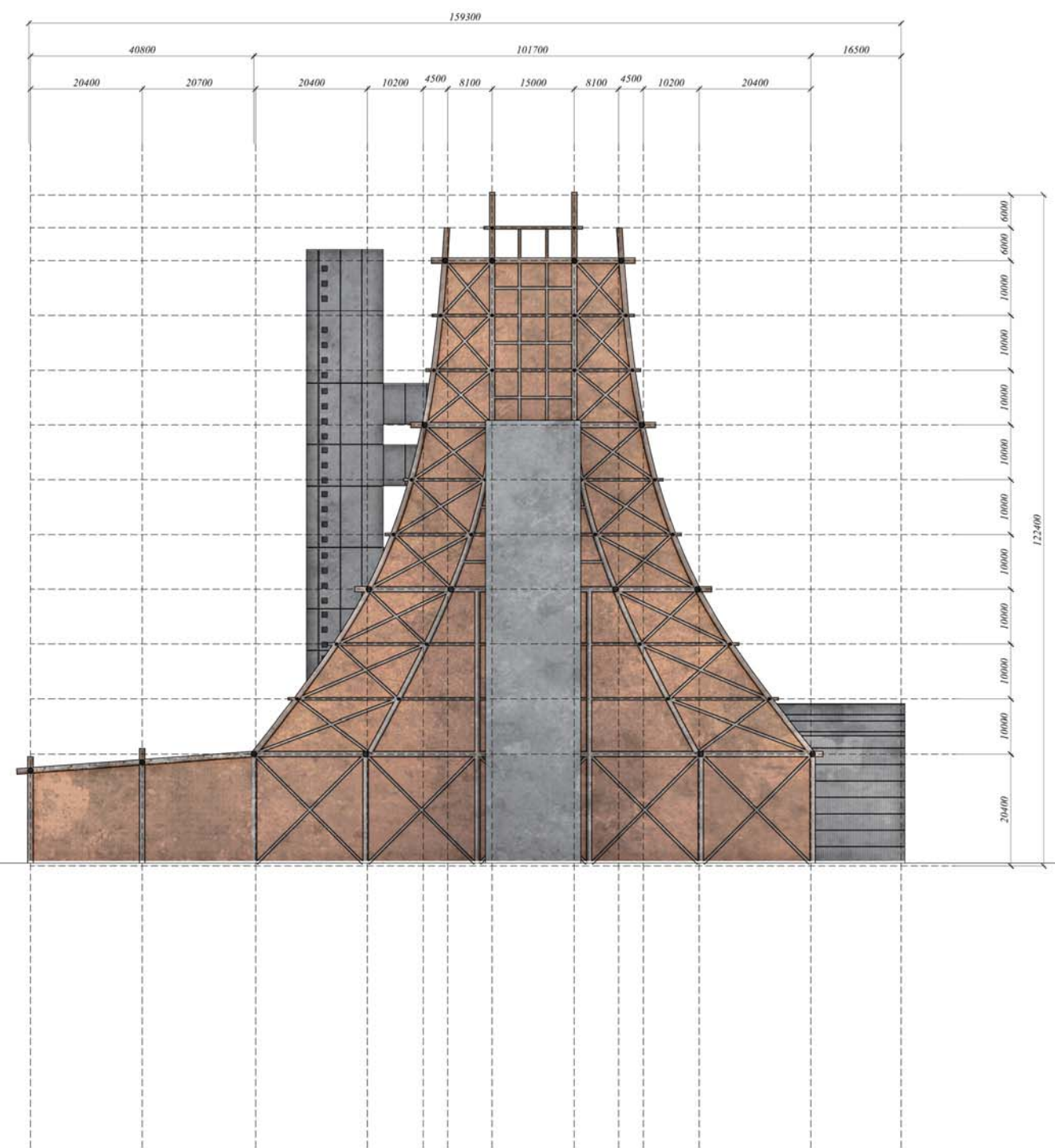
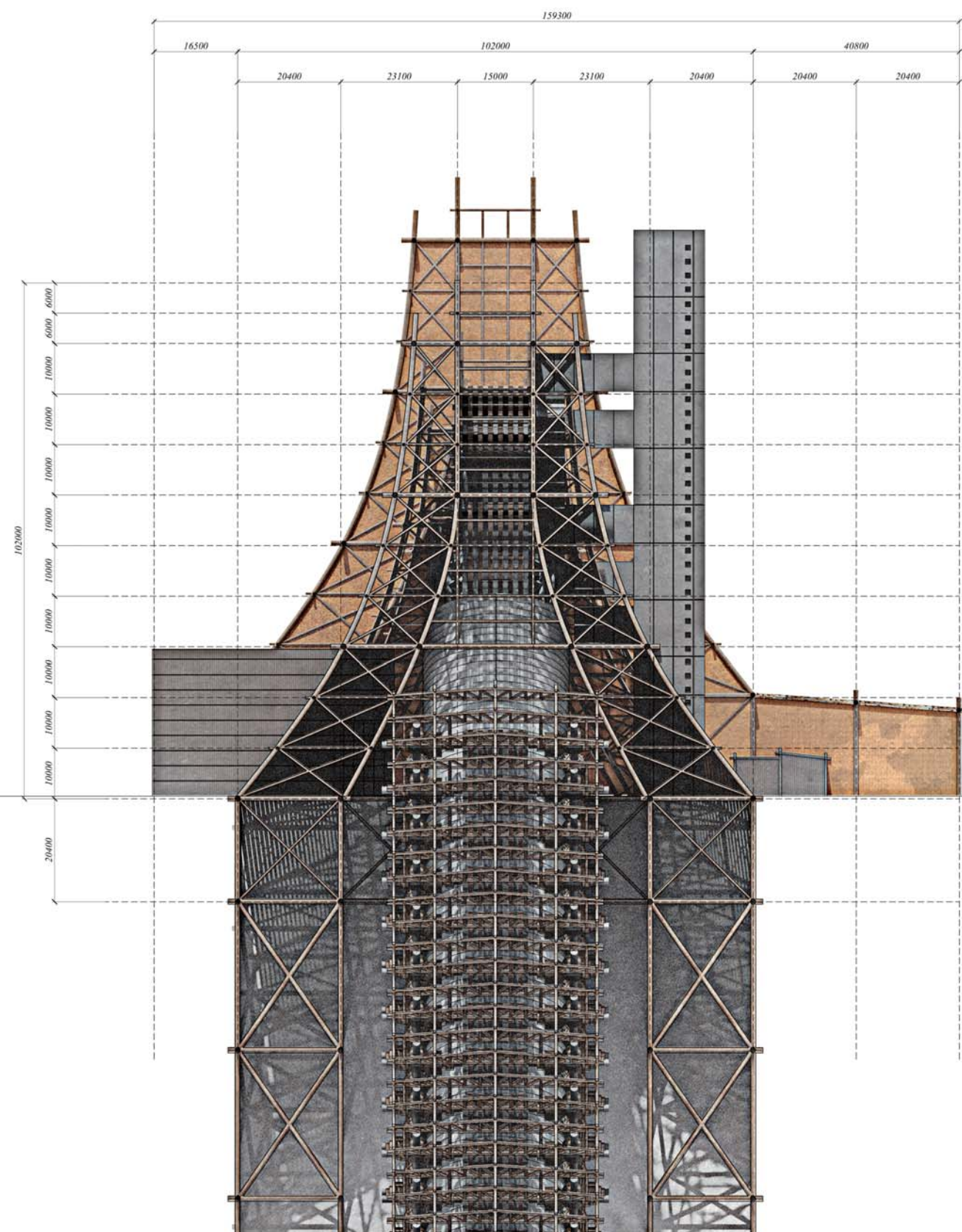


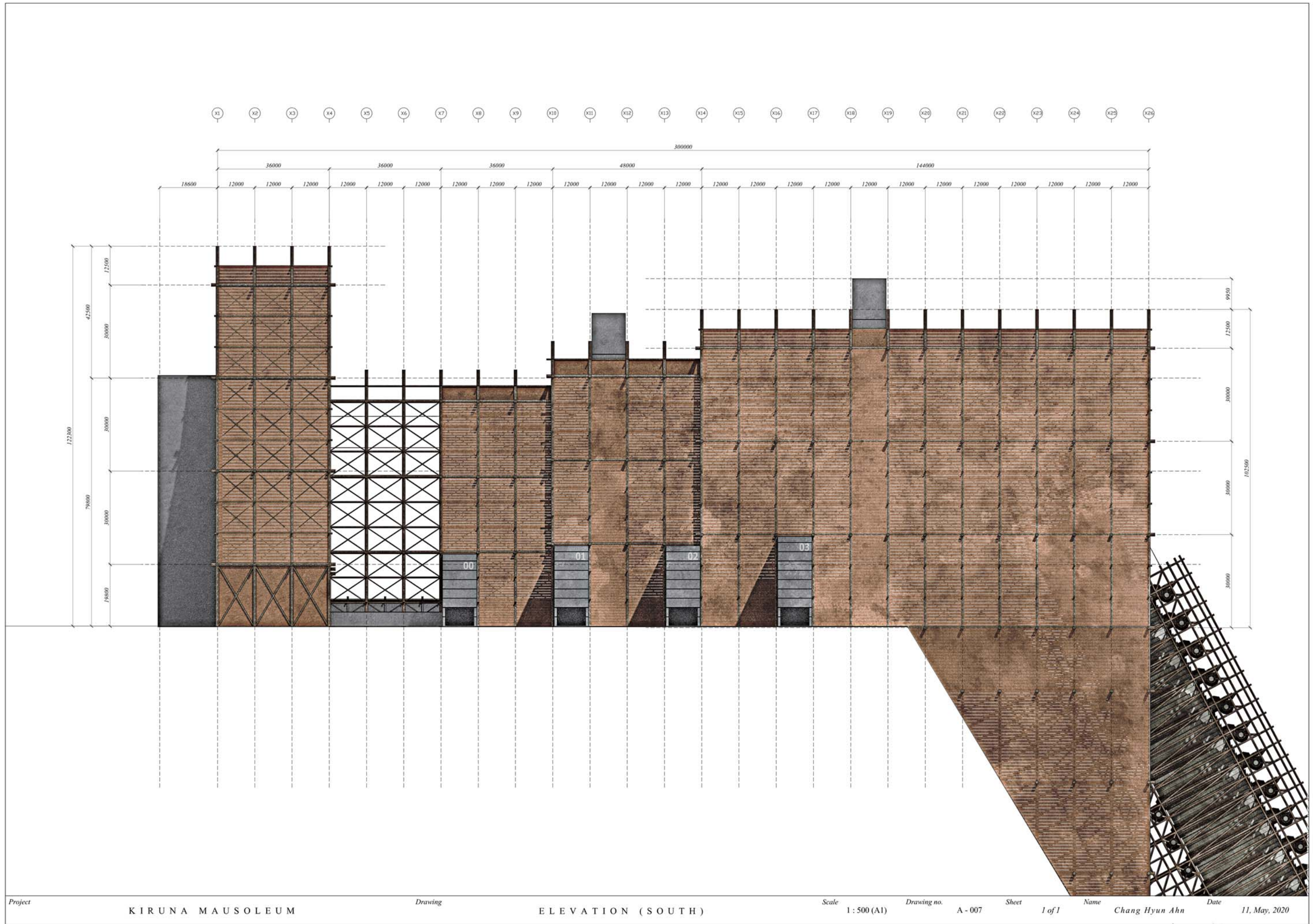












Project

KIRUNA MAUSOLEUM

Drawing

ELEVATION (SOUTH)

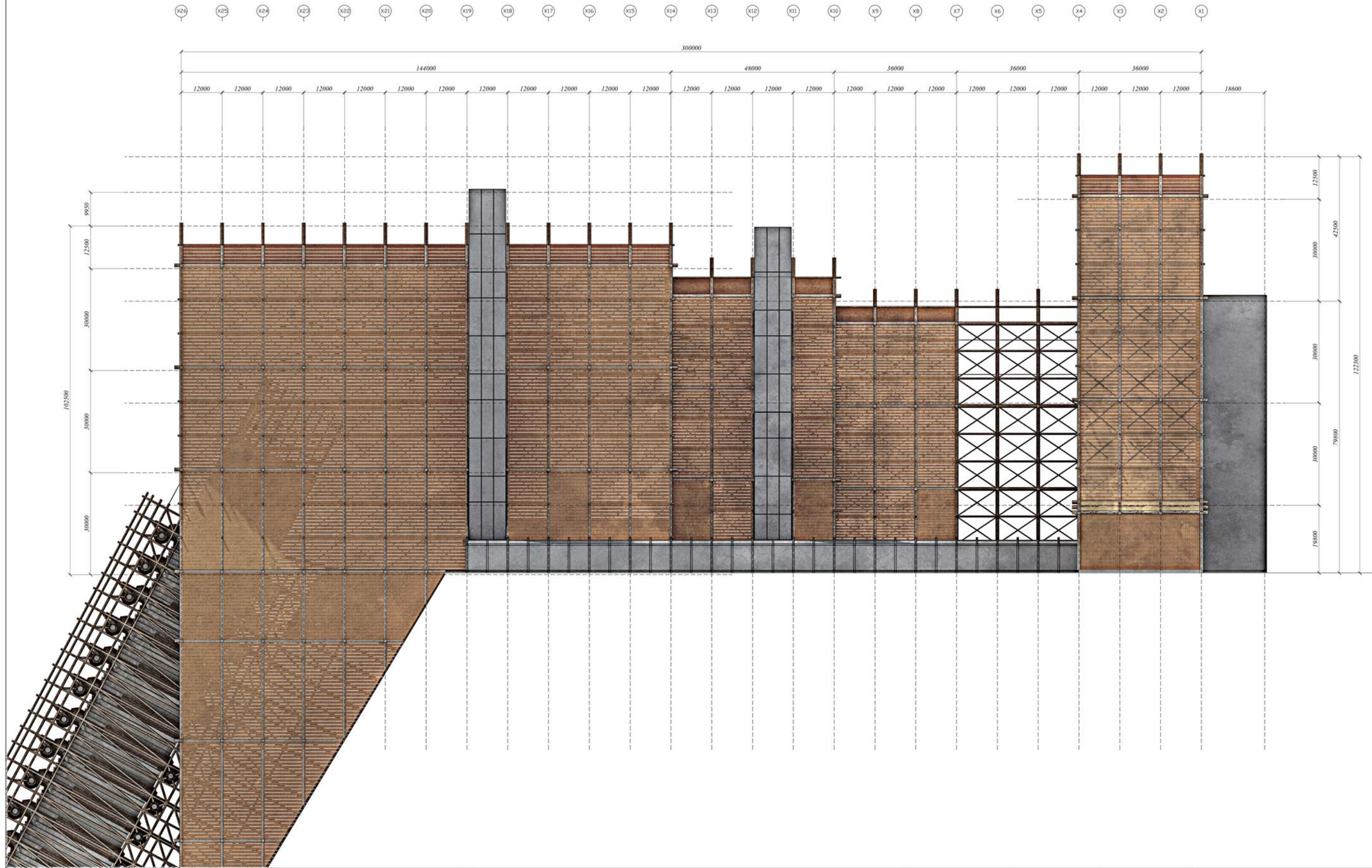
Scale 1 : 500 (A1)

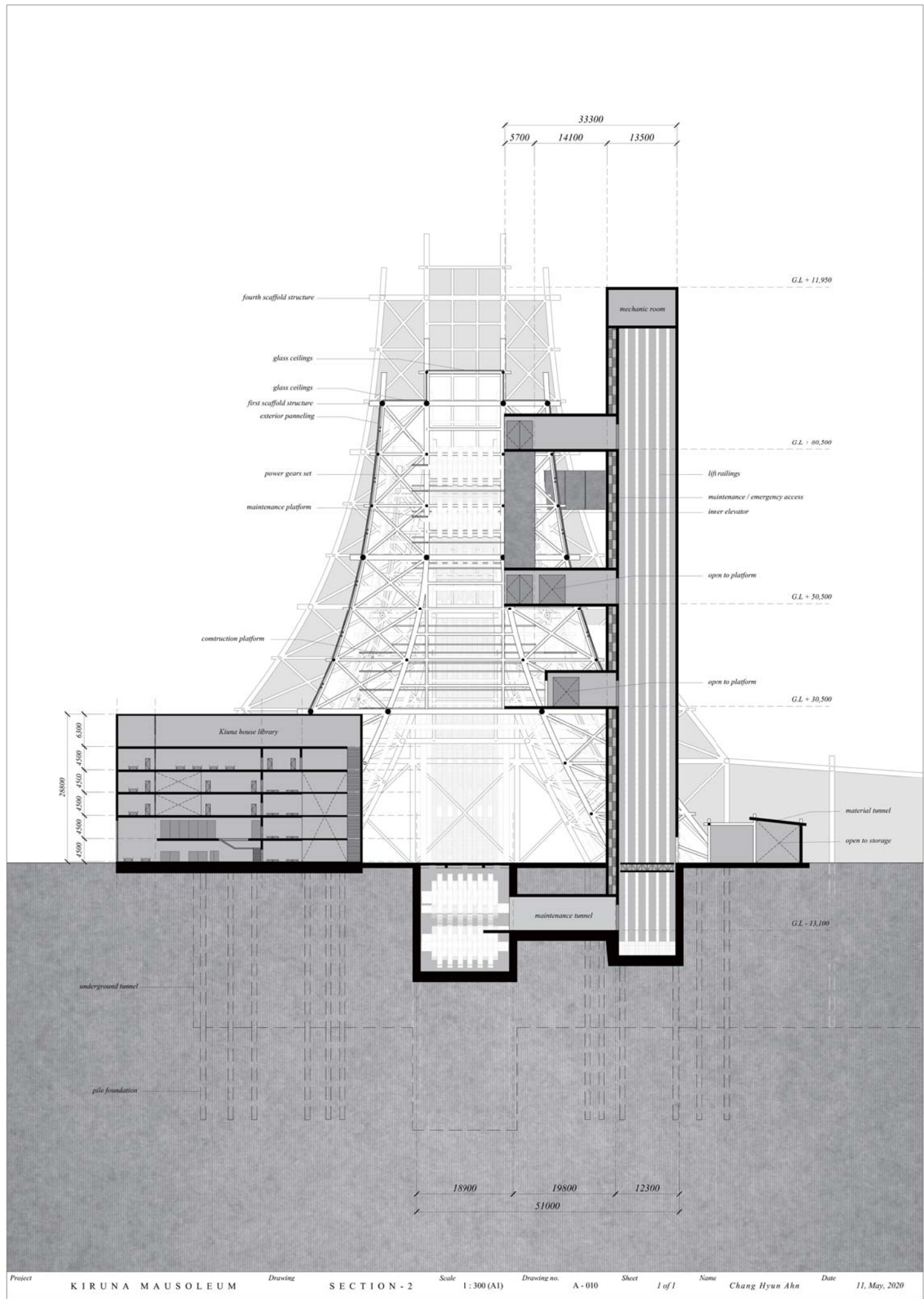
Drawing no. A - 007

Sheet 1 of 1

Name Chang Hyun Ahn

Date 11, May, 2020





END