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INTERPRETATION CENTRE

TITLE SHEET

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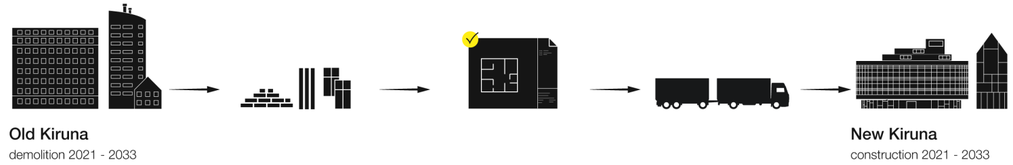
ill. 1. Jonas - Maja - Caroline

ABSTRACT



ill. 2. Relocation of Kiruna

Due to mining activities, and ground deformations, large parts of the Swedish city Kiruna are forced to relocate. European climate and recycling goals call for increased circular thinking and decreased energy usage when constructing new buildings. When relocating Kiruna, a large amount of demolition waste will be created when most of the buildings within the deformation zone are demolished. This generates the opportunity to upcycle construction materials, both regarding decreased energy usage from construction and transportation, according to climate goals, but also in respect to the heritage of Kiruna.

By investigating the architectural potential of a building typology intending to interpret the heritage of Kiruna, upcycled materials from urban mining come to use. By designing an Interpretation Centre located at a former mining site, the interpretation of the heritage and the reason why Kiruna is moving aims to be collected in one place. Through a design methodology where a co-evolution of a formulated problem and ideas for solutions are developed and refined over time, the project results in a design proposal that connects design drivers derived from cultural, built, historical and natural heritage.

READERS GUIDE

The overall structure of this thesis is structured according to the design method applied to the project. The method takes a point of departure in the interaction between the problem space and solution space. The individual chapters are as a result presented with initial analysis, explaining the problem within the specific chapter with corresponding principles on how to deal with these problems. Each chapter is summarized into a collection point and later synthesized in the design development chapter.

Prologue
This chapter folds out the motivation and elaborates on the sustainable approach of this thesis. It also explains the methods used during this project and what purpose they fill.

From heritage to prospects
Gives an understanding of the heritage of Kiruna, by looking into the historical past of the city as well as the region, followed by a description of the new masterplan and what seems to be missing in the prospects for the city.

Interpretation centre
The chapter unfolds what an Interpretation Centre is, how it differs from other cultural buildings, and what the centre will interpret. It is collected with demands on room functions and sizes.

Industrial and natural heritage
This chapter introduces the site and context of Kiruna, by addressing both physical and phenomenological perspectives, resulting in strategies of how to place the building volume on the site and different ways to interact with the industrial and natural heritage on the site.

Climate and adaptation
This section focuses on finding strategies and principles for a subarctic climate adaptation with basis on the local building traditions and climate characteristics of Kiruna.

Cultural heritage
This chapter presents initiatives and strategies regarding the cultural heritage of Kiruna, the present architecture in the demolition zone, building traditions, and the local potential of urban mining to reach a socially and environmentally sustainable project.

Circular approach
This chapter presents an approach to implement circularity into the project by using urban mining as a design strategy. Specific buildings are chosen for the urban mining and suitable materials are evaluated in terms of potential reuse and upcycling.

Design development
The design development chapter unfolds the continued design process focusing on developing the concept based on the principles found in the collection points by integrating simulations and evaluations.

Design proposal
The final design proposal based on the analyses, simulations, and evaluations is presented in this chapter. Through drawings and renders the materiality, relations between rooms and atmosphere are presented.

Epilogue
Here are the reflection and conclusion of this master thesis presented with final thoughts of the design process and the result.

DICTIONARY

Terms and project-specific definitions

Interpretation Centre
A building designed with the gesture to interpret the heritage in-situ of a specific place. This typology invites the visitors to interact first-hand with the heritage by including monuments, historical buildings, unique formations of the nature or heritage sites.

Deformation zone
The deformation zone represents a bi-product of the mining activities. Excessive iron ore extraction causes erosions of the ground that emerges as cracks or sink holes. These occur around the mines whether the mine is still operating or not. The deformation zone is characterized by its dramatic and unpredictable terrain, which is why these zones due to safety are fenced and prohibited to access.

Urban mining
Considers the existing building stock as a material bank for future construction developments. This approach takes advantage of the materials that are gained from demolition of buildings as a resource instead of exploiting the natural resources.

Upcycling
Entails both recycling and reuse strategies of used building materials or components that are processed to obtain a higher utility value than what was originally intended for the material.
In practice: wooden window frame panels are transformed to make an acoustic wall.

Downcycling
To deprive a material from its original function or downgrade the quality in comparison to the original material as a processing strategy.
In practice: concrete is broken up and used as a sub-material for road fill.

Reuse
To reapply a material retracted from a building retaining both form and function as it was originally produced.
In practice: bricks are removed and cleansed from an old building and reused for the construction of a new wall.

Cultural heritage
Cultural heritage possesses both tangible and intangible properties. The tangible elements count historical buildings, buildings with certain architectural values, artefacts in museums, photos, materiality, and written history. The intangible elements refer to personal narrations, traditions, norms, atmospheres, and memories. In this project cultural heritage is an important factor in maintaining and reviving the city identity by addressing both tangible and intangible elements, which at the same time interrelate to the industrial, natural, and built heritage.

Built heritage
Built heritage can be described as buildings, structures, archaeological ruins, towns, monuments at a certain location which are deemed to be worthy of preservation because of certain architectural or historical values. In this project the built heritage refers to the architecture of Kiruna, the relation between buildings and landscape, how works of man have affected the nature and vice versa and the historical ruins of the mining culture. The derivative value of these can appear to be the identity of the city and draws both historical and cultural parallels.

Industrial heritage
Industrial heritage can be described as a witness of a past industrial process that has influenced the local society. The industrial heritage sites can be categorized as man-made where buildings and the original landscape has been subject to the industry and then abandoned after the activity ceased. In this project the industrial heritage is focused upon the building remains, mining infrastructure, traditional mining work process, materials, machinery and lastly the man-made landscape, which also appears in the context of natural heritage values.

Natural heritage
This type of heritage generally refers to landscapes, mountains, gardens, and parks. The attributes of the natural heritage span from untouched wilderness to man-made landscapes that is deemed to possess character. In this project the natural heritage considers a unique scenery, flora and fauna and man-made land deformations, which links this heritage type to the industrial heritage.

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PROLOGUE

This chapter folds out the motivation and elaborates on the sustainable approach of this thesis. It also explains the methods used during this project and what purpose they fill.

Ill. 3. Moving ingengörsvillan

MOTIVATION

Moving a city does not mean taking all the buildings and physically moving them. So, what happens in a city that moves, where a city centre, traditional meeting points, homes, and important buildings such as the church, city hall and the hospital are moved, demolished, and replaced with new ones? And how does one create a new attractive city centre where most buildings are constructed during a short period in time? These questions, among a lot of others, probably arose for the citizens of the mining town Kiruna, when the municipality in 2004 announced that the city had to move due to mining activities. What the moving meant was unclear at that time, but today, 17 years later and a few years into the now called relocation of Kiruna, it is still not completely clear but a bit more visible.

No matter what, Kiruna is now relocating where demolished buildings are being replaced with equivalent buildings in the new urban settlement east of the current city centre. But as the relocation is ongoing and new constructions are popping up while others disappear from the cityscape, people also seem to leave the city (Regionfakta, 2020). When the mine redeems houses threatened by the ground deformation with 25% above the market price (LKAB, n.d.), many choose to take the money and move elsewhere. The reasons why can be many, but the degrowth are threatening Kiruna and lately, investors for constructing new key buildings in the new city centre have been hard to attract (SVT, 2020a). The reason for the lack of interest was in 2020 blamed mainly on the ongoing pandemic which had affected the tourism in the area. However, uncertainty about future iron ore assets is probably what scares most investors (Fastighetsvärlden, 2020). The degrowth in Kiruna has been ongoing since the 1970s (Statistiska Centralbyrån, 2021) and maybe it is necessary to do more than replace buildings to attract people to stay, move back home or move there for the first time.
An opportunity to develop a modern, attractive, and sustainable Kiruna arose when the new masterplan was created for Kiruna's new city centre. The initial ambitions were also to create a place where building materials from the demolished areas could be gathered and reused to create a resource-effective urban development. A plan that seems perfect in a place where it is a set schedule for both demolition and redevelopment. It has however been stated difficult to execute a reuse forum. Evidently when looking at the new buildings, everyone is constructed with a heavy concrete structure and no sign of reused, local materials. As the vision for the Swedish construction industry for 2045 is to have moved towards a circular economy and minimized the amount of waste (Fossilfritt Sverige, 2018), it is time and a perfect opportunity to set an example of up-cycling and recycling.

This project sees a possibility to show that it is possible to design architecture considering the heritage of the area and the subarctic local climate. By designing an Interpretation Centre that makes room for activities independent on the mine it might also be part of a larger strategy to break the degrowth trend. This thesis will therefore study how a building can connect the city to its cultural heritage and function as a meeting place between locals and tourists, generate jobs and give a sense of belonging to a site where the mining history is still present but no longer active.

PROBLEM FORMULATION

How can an Interpretation Centre create a sense of belonging and identity to Kiruna and its heritage through a sustainable architectural approach within the conditions of the location?

SUB-QUESTIONS TO PROBLEM FORMULATION

1. *What defines a sustainable architectural approach within Kiruna's conditions?*
2. *What is an Interpretation centre and how can it create a sense of belonging to a city?*
3. *What is the heritage of Kiruna and how can architecture facilitate the preservation of it?*

SUSTAINABLE APPROACH

Working with sustainable architecture

The three pillars of sustainable architecture are environmental-, economic- and social sustainability. This project will mainly focus on environmental and social sustainability. As stressed in the motivation, Kiruna is moving. With a big transformation in the cityscape and people's lives, environmental and social sustainability is seen as important to highlight.

The motivation for an environmentally sustainable approach is found in the evidence that human activity has affected the global climate system. It is judged extremely likely that greenhouse gas emissions have influenced natural and human systems across the globe and caused rapid temperature increase, acidification of oceans, changes in precipitation, and melting ice (IPCC, 2014). The Paris Agreement from 2015, based upon these findings, acknowledge that the climate changes are a common threat to the humankind and set a course to limit the global warming to 1,5 degrees. It stresses that developed countries should take the lead and responsibility to reduce emissions to make room for developing countries to continue their development (UNFCCC, 2021; United Nations, 2015). Every European country stands jointly behind the Paris Agreement and EU's specific climate and energy goals. Sweden, as part of EU, is therefore included in the goals to reduce the emissions by at least 40% by 2030 and be climate neutral in 2045 (Fossilfritt Sverige, 2018; Naturskyddsföreningen, 2021).

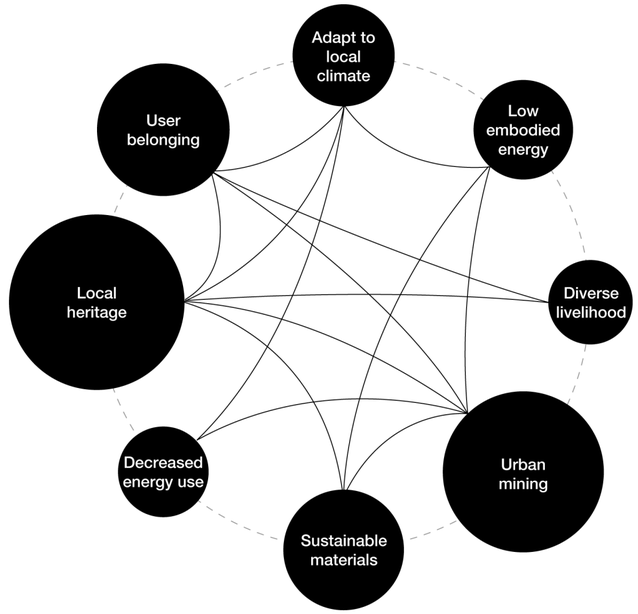
The Swedish building sector stands for one-fifth of the country's total climate impact. Building materials in the construction phase and emissions related to the energy use in buildings have been identified as the largest contributors to the climate impact within the industry. Fossilfritt Sverige's 'Roadmap to a fossil-free competitiveness for the Swedish building sector' urge advisors and architects to early in the design process propose resource-efficient solutions with low climate impact from a life cycle perspective. These measures are stated necessary to reach the European climate and energy goals for 2045 and the European Commission highlight the importance of sustainable construction in order to succeed (European Commission, 2019; Fossilfritt Sverige, 2018).

The goals for 2045 also highlights the life cycle perspective of buildings, which means that the material choice will be of high importance. As Kiruna stands in front of a large change in the cityscape, there is a great possibility to create an example of how old building materials can be up-cycled and reused and thereby lead the way for future projects in the city. Guidance on how to map materials and methods on how to reuse them will be taken from cases and literature. To reduce the embedded energy in the construction, the choices of materials will be weighted through a life cycle assessment approach.

As for social sustainability, focusing on people's health and wellbeing, urban renewal is stated possible to improve social sustainability (Yıldız et al., 2020). Even though extensive research is missing considering social sustainability in established mining communities, such as Kiruna, the existing research points towards social challenges and a lack of diversity of livelihoods. The knowledge of what impact the mining industry has on communities is stated underdeveloped compared to the knowledge of its economic and ecological impact (Segerstedt & Abrahamsson, 2019). As Kiruna now is transforming, there might be a chance to improve the social sustainability by focusing on developing a well-designed and well-constructed built environment.

Social sustainability is however not only under developed in mining communities as the concept has been concluded hard to define as it holds a lot of intangible parameters. Social sustainability cannot be defined in the same way as environmental standards and therefore it lacks a clear definition in European legislation (Mcguinn, 2020; Woodcraft et al., 2012). The indoor climate design parameters are often described as part of the social sustainability within architecture. However, feelings, a sense of belonging and what people find attractive and pleasant to be surrounded by, is not easy to state in numbers. To make sure the project addresses social sustainability from more than indoor parameters, questionnaires and user studies will be undertaken together with case- and literature studies of the subject.

In ill. 4 the project's sustainability initiatives and the priority of them are presented.



ill. 4. Sustainability initiatives and priorities

DESIGN METHODOLOGY

Co-evolution of problem and solution

This chapter presents the methodology of the project as a design process along with tools to analyse, synthesise and evaluate design problems and solutions to reach the final design proposal. The creative design process involves both finding and solving problems, where controlling and varying the process is an important skill for a designer to master (Lawson, 2005). As a focus of this project is to integrate knowledge from architecture and engineering to solve the design problem stated in the problem formulation, the design process will include critical, analytical, theoretical, functional, and technical methods based on relevant knowledge.

Dorst and Cross (2001) describe the creative design process as a co-evolution of a formulated problem and ideas for a solution. The evolution in a design process is defined by Maher et al. (1996) as an interaction between a problem space and a solution space. The two spaces are developed and refined together over time through a constant iteration of analysis, synthesis, and evaluation between the two spaces.

Analysis, synthesis, and evaluation is frequently mentioned in design methodology literature and Lawson (2005) defines the concepts as follows:

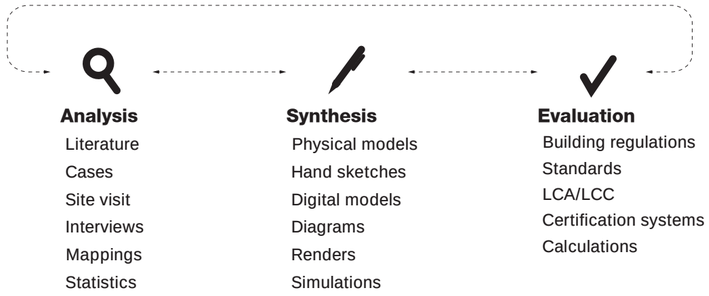
Analysis: Orders and structures the problem by exploring relationships, looking for patterns in available information, and the classification of objectives.

Synthesis: Generates solutions by trying to move forward and create a response to the problem.

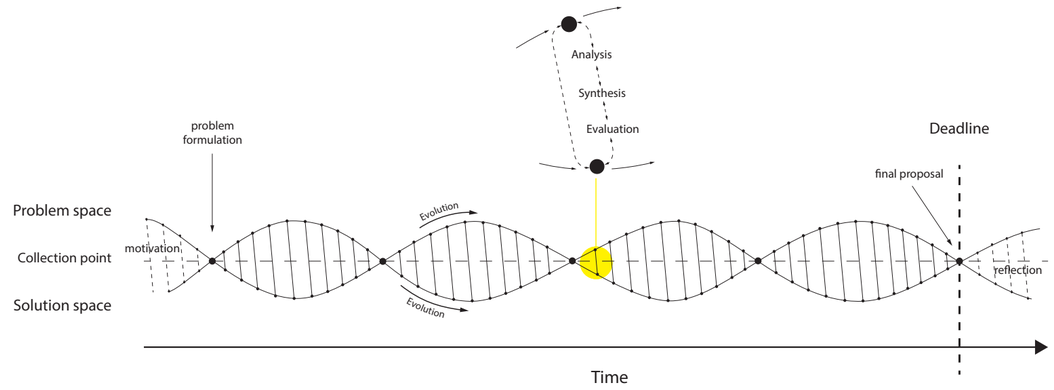
Evaluation: Critically evaluates suggested solutions against objectives identified in the analysis phase.

The design process for this project (ill. 6) is inspired by the 'Problem-Design Exploration Model' defined by Maher et al. (1996) and folds out this thesis' strategy for exploration to reach the final proposal. The strategy aims to bring the analysis, synthesis and evaluation concepts through the whole design process and on the way have 'collection points' where separate problem/solution studies are combined in a collected design proposal. An example of a collection point can be the problem formulation, a function diagram, a decided concept, or final material choices. By having collection points through the project evolution, the aim is to bring together solution ideas to a common idea which then again generates new studies, in a common direction. The combination of sub-problems/solutions is decided through negotiation and priority order, where the priority might differ depending on what area the studies have been conducted. An example of this can be that sustainability is higher prioritised than the atmosphere when deciding for internal cladding, which might give another end result than if the priority was the other way around. The negotiation and priority will be stated in the areas where these collection points occur in the design process.

The horizontal movement in ill. 6 represents the evolution of the problem and the solution through the design process. The diagonal lines are the search process where the analysis, synthesis and evaluation occur and lead to either a solution or to refocus the problem. To ensure that the project focus on sustainable design, functionality, aesthetics, and technical solutions, different types of analysis, synthesis, and evaluation tools will be applied (ill. 5). And as Lawson (2005) states, there is no natural end to a design process so this process will assumingly stop when the time runs out, at the deadline as illustrated in ill. 6. The possible continuing process beyond the deadline can be seen as the reflection of this thesis.



ill. 5. Design methodology tools



ill. 6. Methodology concept

FROM HERITAGE TO PROSPECTS

This chapter gives an understanding of the heritage of Kiruna, by looking into the historical past of the city as well as the region, followed by a description of the new masterplan and what seems to be missing in the prospects for the city.

Ill. 7. Deformation zone

HISTORIC TIME-LINE

The history of a mining town

1963
The City Hall by Arthur von Schmalensee is finished.

1900
Kiruna is founded by LKAB.

1912
Kiruna church by Gustaf Wickman is finished.

1970s
The first demolitions due to mining activity occurs.

2004
Kiruna municipality announces that the city has to move due to mining activities.

2012
The first larger housing projects due to the relocation starts.

The lake Luossajärvi is reduced and dammed up to stop water to leak into the mine.

2013
WHITE & Ghilardi + Hellsten wins the competition of a new masterplan for Kiruna.

The new head level 1365 m under ground in LKAB is put into operation. Which mean the deformation zone will be larger.

2015
The first dwellings are demolished due to deformation risk.

Construction of the new City Hall designed by Henning Larsen starts.

2017
The old train station is demolished.

The first selected houses moves by help of large trailers.

2018
Kiruna's new City Hall 'Kristallen' by Henning Larsen is finished.

2019
The old City Hall is demolished.

The construction of the first blocks in the new city centre starts.

2022
The first blocks in the City Centre will be inaugurated.

2025
Kiruna Church will be moved.

2033
The relocation of Kiruna due to mining activities at level 1365 is finished.

If it is determined financially and technically possible, the mine can go even deeper and the relocation of Kiruna will have to continue.

ill. 8. Kiruna time line

THE HERITAGE OF KIRUNA

A background story

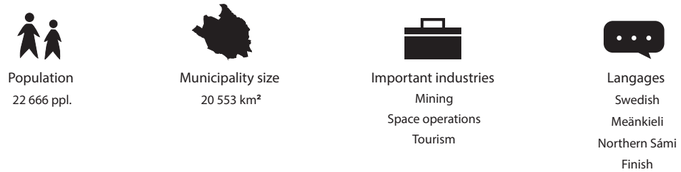
The region Norrbotten is located in the northernmost part of Sweden and borders to both Finland and Norway. The area was for long a very remote part of Sweden, where only nomads, hunters, and fishermen lived of the wilderness' resources across the unclear borders of the three countries. In the 17th century, the first findings of iron were made in what today is called Malmfälten. The findings were, however, made in a time where the knowledge of refinement methods of iron and the transport methods was very limited so it was not until the 19th century and the industrialisation it became possible to establish effective mines in the area. The mines that were established in the area plays an important role in the Swedish economy and generates billions (10,2 billion SEK in 2019) to the government's treasury every year (Länsstyrelssen i Norrbottens Län, 2001; LKAB, 2019).

Norrbotten is, however, not only interesting, and attractive due to its natural resources. Over the last ten years, tourism in the area has doubled its revenue and especially luxury tourism has become more popular in the region (SVT, 2020b). People come to the area for the calmness, learn more about the indigenous Sámi culture, to explore what the wilderness and untameable nature have to offer, and to be mesmerised by the northern lights. Things that stand in contrast to the heavy industries in the region and which gives an extra dimension and of what riches Norrbotten holds and reveal a complexity between the two.

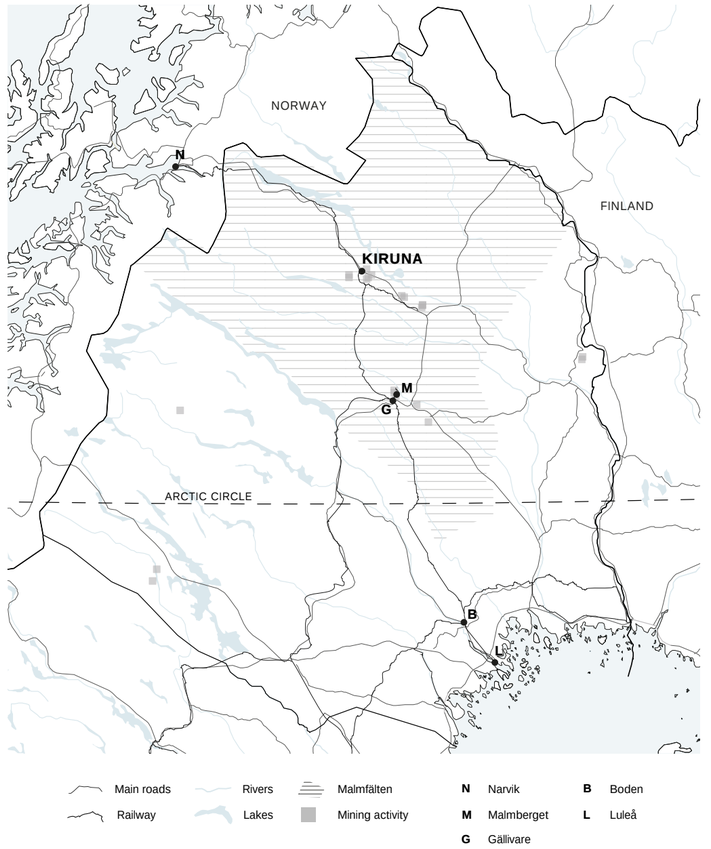
The large influx of workers who sparsely populated Malmfälten, due to mining in the late 19th century, caused informal slum settlements close to the mines. When the mining company LKAB (Luossavaara Kirunavaara Aktiebolag) established Kiruna in 1900 there were no wishes to repeat an uncontrolled settlement previous seen in the area. The iron ore in Kiruna was during this time the world's largest and Sweden's biggest industrial investment ever made. There was therefore no room for failure. LKAB decided to create a 'model-city' to attract the needed workforce to the mine and de remote Swedish outback. By taking help from well-known architects and planners of this time, high-quality architecture and modern infrastructure were prioritised in what became Sweden's first climate-adapted city plan (Sjöholm, 2019; Sotoca, 2020). The development of the city between the two mountains Luossavaara (Salmon mountain) and Kirunavaara (Grouse mountain) was however not an easy task as the location north of the polar circle had a rough and untameable climate. The whole city needed to be built from scratch, as the only people living in the area, before the "colonizing" Swedes arrived, was the indigenous Sámi people, many of them nomads (Brunnström, 2008).

Even though LKAB made a thorough plan of Kiruna, the city is today in need of relocation as it is built too close to the mine. The ground underneath the city is insecure and have started deforming as an open scar in the landscape, creeping closer to the urban settlement. In 2004, Kiruna Municipality announced that the city had to move so LKAB could continue the indispensable mining activity. The first signs of demolition due to the mining activity in Kiruna had, however, already been seen in the 1970s (Sotoca, 2020) and it is a common sight to see large cordoned areas in Kiruna.

Mining towns also lay under another threat as they are heavily dependent on mineral market price and asset of minerals. At the end of the 1970s, LKAB was almost shut down due to the mining crisis, a lot of people lost their jobs, and many left the city (Sjöholm, 2015). However, Kiruna's dependency is slowly moving from being completely mine-dependent and today the economy also relies on space and tourism industries (Carrasco, 2020).



ill. 9. Kiruna fact diagrams



ill. 10. Geographical location of Kiruna

karta över Norrbotten

map over Norrbotten

THE IMAGE OF KIRUNA

What defines Kiruna

ill. 11. Northern lights

ill. 12. Samis and reindeer

ill. 13. Wilderness

ill. 14. Mining

Kiruna, once only populated by the indigenous Sámi people and founded by a mining company is placed in a subarctic climate where the sun never sets in the summer, and never rises in the winter. It attracts people for its untouched surroundings, natural phenomenons and remoteness but also for its job opportunities. People come or stay for the nature or the jobs or both, but might not choose whether they have to move. It is always about extremes.

ill. 15. Research

ill. 16. Icehotel

ill. 17. Current city view

ill. 18. Moving houses

ill. 19. Demolition

ill. 20. Winter fishing

ill. 21. Hunting

ill. 22. Culture

ill. 23. Climate

ill. 24. Space operations

ill. 25. The mine

ill. 26. Midnight sun and festival

ill. 27. Winter activities

THE NEW “PERFECT” MASTERPLAN

But what is missing?

In light of the decision to relocate Kiruna, the municipality invited in 2012, ten architect teams to participate in a competition on the vision, strategy, and design for a future Kiruna. The keywords for the competition were sustainability, attractiveness, and identity. The winners of the competition were White Arkitekter together with Ghilardi + Hellsten Arkitekter with the proposal Kiruna 4-Ever (Sveriges Arkitekter, n.d.).

The winning proposal put the focus on a long-term and flexible extension of Kiruna to the east and it is a plan of slowly phasing out the old city instead of an actual move. That vision, together with a high focus on bringing nature into the city, involve the citizens in the process and develop a place where old building materials could be reused was the major reasons why the proposal won (Kiruna Kommun, 2014). White and Ghilardi + Hellsten has also gone further than the asked for, 20-year development plan, and have extended it to 100 years. The plan aims to develop a city that can stand economically secure even in a future without a mine (White Arktiekter, n.d.).

The relocation of Kiruna that started in 2014 is ongoing and has both demolished and moved old buildings and begun to construct buildings in the new centre. The initial plans of up-cycle and reuse building materials from the demolished Kiruna, that gave White the win, have however been concluded hard to execute and no official plans are currently on the table (Johnsson et al., 2020). Regarding reusing building materials in Kiruna, LKAB’s cultural environment specialist stated that recovery of building materials from demolished buildings so far only has been small-scaled. Time scheduling and increased costs are blamed to be the main reasons. Another reason is the challenge for the building owner to specify certain materials already in the tender (M. Strålberg, personal communication, 2020-11-13). As a result of these claimed obstacles, the citizens of Kiruna could collect old bricks from the demolished city hall as souvenirs (SVT, 2019). Of course, this is better than nothing and a gift to the people attached to the building. But, as the City Hall has been an important building in the city since the 1960s and a place where historical strikes, school proms, and political activities always have been held, it would have been perfect to reuse the building materials to create attractiveness and a sense of belonging in the new city centre instead. A focus on finding a strategy to reuse building materials and do up-cycling in Kiruna is therefore a big part of this thesis. Up-cycling and reuse not only contributes to fewer emissions and embedded energy in a building but also a connection to the past and the heritage.

PROSPECTS

Big investments for a bright future?

LKAB has since 1900 been the big employer in the city and employs about one-third of the people in Kiruna today. In November 2020 LKAB announced that they were planning a new strategy for the company, which meant an investment of 400 billion (SEK) over 20 years, generating thousands of jobs in the area (LKAB, 2020). In 1964, Esrange, the Swedish space station was developed 45 km east of Kiruna and is also one of the big employers in the city (Swedish National Space Agency, 2016). In October 2020, Esrange announced news of a big investment program from the Swedish government to send satellites into space. A program worth 90 million (SEK) over three years, intending to send up the first satellites already in 2022 (NyTeknik, 2020). These investments look promising for Kiruna; however, the city is challenged with degrowth and a big amount of fly-in, fly-out workers, approximately 2000 people work full time in Kiruna, but live elsewhere. There is a risk that Kiruna eventually will turn into a place where more people works than lives (Sotoca, 2020; Tidholm, 2014). Sotoca (2020) and Brunnström (2008) claims that it is important to keep the city diverse and attractive to break the negative trend. One of the ways of getting there, suggested by Brunnström, is to once again create attractive architecture that can put focus on social and environmental sustainability and refine the thinking of the ‘model-city’ as the city now is relocated. It is from these ideas, this architectural project takes a starting point in.

The current level of the mine will cause deformation fully reached by 2033 (ill. 29), if it is seen possible to go deeper with modern technology and it is concluded enough iron in the depth, the deformation might extend further. The old Kiruna might by 2100 be completely relocated (ill. 30) and the architecture will play an important role in Kiruna’s future.

ill. 28. Kiruna 2021

ill. 29. Kiruna 2033

ill. 30. Kiruna 2100

INTERPRETATION CENTRE

What is an interpretation centre? What should be interpreted? And how does it differ from other known cultural building typologies such as museums, visitor centres, exhibition centres and memorial sites?

ill. 31. Familjen Söderberg

INTERPRETING HERITAGE

How heritage can act as a generator for local identity

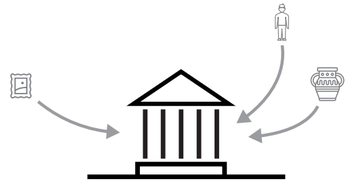
"Heritage interpretation is the art of revealing in-situ the meaning of the natural, cultural or historical legacy to the public visiting these sites in their leisure time" (Morales, 1999).

Heritage interpretation is a relatively new term as it dates back to the end of the 19th century in the United States. At that time, interpretation was utilized as publicity to promote natural parks, however, it was often proven difficult to separate natural heritage from cultural or historic heritage. The landscape of Kiruna as an example has been heavily impacted by the historic heritage the city has as a mining town. The mine has shaped the landscape by creating large deformation zones eventually also being the reason for moving the city centre and thereby heavily impacting the culture of the citizens. The objective of interpretation is as a result of the conservation and communication process of both the cultural and natural heritage to the public to close the distance between heritage and society (Baeyens & Charasse-Valat, 2005).

An Interpretation Centre (ill. 33)aims to make visitors explore and interact with heritage through firsthand experiences. These experiences are placed on-site and can therefore include archaeological and paleontological remains, monuments and historical buildings, unique natural formations and heritage sites. Interpretation centres allow the visitors to understand the meaning of these special places whereas a historical site on its own (ill. 34) doesn't tell the full story but only what have been left behind. It is also what sets the Interpretation Centres apart from traditional museums (ill. 32), as museums put the object at the centre of focus by typically gathering them from their natural site, of course, museums are different, and some are also placed in-situ for a better understanding as defined by the International Council of Museums (ICOM, 2007).

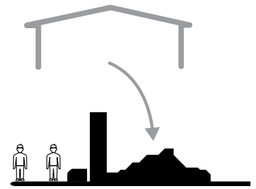
Interpretation Centres occurred as an alternative to the traditional museums but the main objective of an Interpretation Centre is to give the visitors a better understanding of the cultural and natural heritage on the site by being the interpreter of the site. The key benefit when presenting heritage on site is, besides from the visiting tourist, that the local community will benefit deeply from an Interpretation centre. The community have an opportunity to reclaim ownership of their heritage by participating in special events and contributing to temporary exhibitions that adds to a level of authenticity a museum can never reach (Baeyens & Charasse-Valat, 2005).

> *"It is not the objects and places in themselves that are important about cultural heritage but the meanings and uses that people attach to them and the values they represent, the act of interpretation is key.*
>
> - Kathrin Merkle
> Council of Europe, Head of Culture and Cultural Heritage



ill. 32. Museum concept

Focus on the cultural heritage; objects are added to a building volume



ill. 33. Interpretation centre concept

Focus on cultural heritage in-situ; the building is added to interpret the heritage

ill. 34. Historic landmark

Important for the local identity but does not tell the story about why it is there

FOCUS AREA

Cultural building typologies focus area

The graph (ill. 35) shows the focus area of some cultural building typologies that are in relation to the Interpretation centre. Building typologies are often broad definitions applied to a wide variety of buildings and some will therefore vary in focus area depending on the individual building. The general impression is that cultural building typologies have a focus area that is either within cultural heritage or local identity. The Interpretation centre interprets the cultural heritage of the local identity; one cannot function without the other (Baeyens & Charasse-Valat, 2005). It means that the interaction with the cultural heritage happens in an authentic environment and not a curated synthetic environment. Within an authentic environment lies an opportunity to move towards tactile surfaces instead of words describing the feeling of touch, three-dimensional views instead of two-dimensional video, relevant people presenting instead of audio recordings.

The automated systems commonly applied at museums used to describe the tale of the cultural object on display makes the visitor focus on the object. However, as the architectural writer, Juhani Pallasmaa describes in his book The eyes of the skin "The very essence of the lived experience is moulded by unconscious haptic imagery and unfocused peripheral vision. Focused vision confronts us with the world whereas peripheral vision envelops us in the flesh of the world." The difference is that sensory inputs in experiences engages the visitors instead of making them mere spectators. Pallasmaa suggest that all sensory inputs play a part, the touch, the smell, the noise, the view when creating a powerful experience. And that "A powerful architectural experience silences all external noises; it focuses our attention on our very existence, and as with all art, it makes us aware of our fundamental solitude." (Pallasmaa, 2012).

Most traditional museums simply cannot provide the visitors with that extra layer of storytelling that as an example visitor centres can because they are in a natural environment. On the other hand, visitor centres create a narrative of the local identity for the visitors based on their location and relation to the environment they are in. They do not evoke the same kind of emotions that a museum can because it does not have the same historical background.

Cultural buildings placed in surroundings that relate to their storytelling does in general have a possibility to create a holistic narrative where nature, views, local objects, and people can contribute to the atmosphere of the building via sensory inputs.

ill. 35. Cultural building typologies

EXPERIENCING DAYLIGHT

How daylight can stage atmosphere

Daylight in recent times has been analysed and quantified in terms of the illuminance indicators such as daylight factor, lux levels, daylight autonomy, etc. These indicators are based on task performance criteria which make sense for functions like offices or kitchens (Rockcastle & Andersen, 2013). However, as with Interpretation centres and most other cultural building typologies, there is a much lower focus on visual tasks and therefore no demands in terms of a specific luminous goal to uphold for many of the functions needed in these buildings. It is instead the experience of how daylight is perceived that needs to be in focus, as daylight is an essential factor for how to experience the atmosphere of a space. New studies on perceived daylight also indicates that it is not the quantity of luminance but rather the diversity in luminance that leads to occupant satisfactory (Van Den Wymelenberg et al., 2010). And as Pallasmaa states "Deep darkness and shadows are essential, because they dim the sharpness of vision, make depth and distance ambiguous, and invite unconscious pheripheral vision and tactile fantasy" (Pallasmaa, 2012).

How daylight contributes to the atmosphere very much depends on how it enters the room. In general, it can be stated that there are two extreme scenarios: direct sunlight and diffuse sunlight. With the two very much contrasting each other in terms of spatial understanding. The direct sunlight provides the occupants with a dynamic environment where harsh shadows change the spatial perception during the course of the day, thereby also allowing occupants to follow the time of the day. The experience becomes much more involving. Whereas the diffuse sunlight has a more calming effect that settles our mind with a controlled unified light palette.

The table on the right seeks to determine a strategy of how to categorize daylight typologies in terms of spatial contrast and variation. With the aim to choose strategies based on the function of the room. The table includes five categories based on a study that initially includes ten and are sorted a long an axis that indicates the contrast variation level (Rockcastle & Andersen, 2013). Each category includes simple model views along with corresponding references of buildings where light are an essential part in the interior perception.

The first category, Direct & exaggerated let the daylight pass through a structural system or louvres that creates a sharp contrast between the shadow pattern and the light, a feature that changes during the course of the day. The view is dictated through the openings.

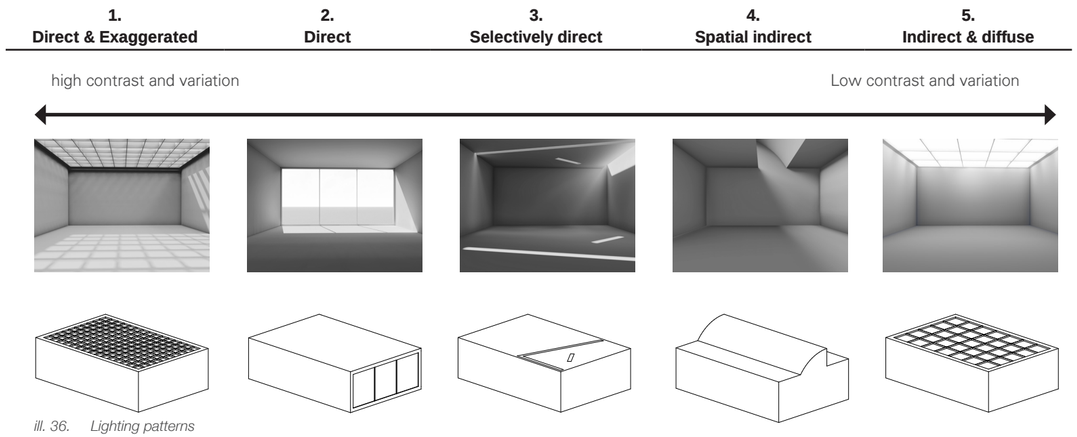
The second category, Direct includes regular side lit windows with little or no obstructions, thereby allowing light to enter while having unfiltered views. The spatial variation during the day is clearly visible but without the shadow pattern.

The third category, Selectively direct only allows daylight to enter in discrete instances where daylight can have a powerful grazing effect on specific surfaces due to the very limited openings. The change of day is not as significant as the previous two. As is the view very limited.

The fourth category, Spatial indirect directs light to interior surfaces where it then is reflected. The effect is largely dictated by the shape of the roof and ceiling as the light dances down from the top, but without the sharp shadows.

The fifth category, Indirect & diffuse has very limited variation during a day because light are passed through a semi transparent material and thereby enters the room as diffuse light. The room becomes evenly lit with no shadow pattern. No view to the outside

The experience of daylight can help setting the demands for the different rooms and functions within the Interpretation Centre further in the project.



ill. 36. Lighting patterns

ill. 37. Light typologies

MESSAGE TO INTERPRET

The heritage of Kiruna

As stated earlier, Kiruna is a unique city with a unique history ranging from the nomadic Sámi culture to a modern space station all of it situated in, for many, an extreme climate. It is, however, the issue of preserving the local identity as a result of the relocation that truly makes the city to stand out. The relocation of Kiruna will, therefore, be the main focus of the Interpretation Centre.

The interpretation of Kiruna should interpret the heritage in order to secure the identity for future generations. With a focus on what the mining industry leaves behind, both in terms of the leftover physical structures and deformation holes but also the psychological impression of moving a city which will be further explained in the chapter about cultural heritage. An important aspect is the building heritage of the city and how to physically move that into the new city centre. The centre should therefore aim to educate the visitors about the term "up-cycling" and what psychological and environmental qualities lie within taking parts of the old and using it in another setting.

There are no official requirements for room function in an Interpretation centre as each centre very much depend on what there is to interpret. Instead, the room functions will be defined from what the users should experience to understand the message. The users of the centre are the visitors which include tourists, locals, and educational groups as there is a sizable amount of tourists travelling through Kiruna and because the relocation of the city has got international attention (Besoksliv.se, 2020). The educational groups are an important segment of the city as the relocation process is planned to undergo in stages throughout the next 80 years and the option to experience cultural heritage for the youth have been identified as important (Brunnström, 2008). The mixture of visitors will ensure activity in the building throughout different hours of the day and week. The secondary users include the staff needed to run the building and create activities.

Desired experience by user

Tourists

- Sense the scale of the relocation
- Understand the reason of the relocation (industrial heritage)
- Experience the climatic conditions of Kiruna
- Eat and drink
- Gain information

Educational groups

- Hands-on material up-cycling
- Presentation of up-cycling principles
- Material exhibition
- Understand the building heritage of Kiruna
- Meeting point / waiting area
- Eat and drink

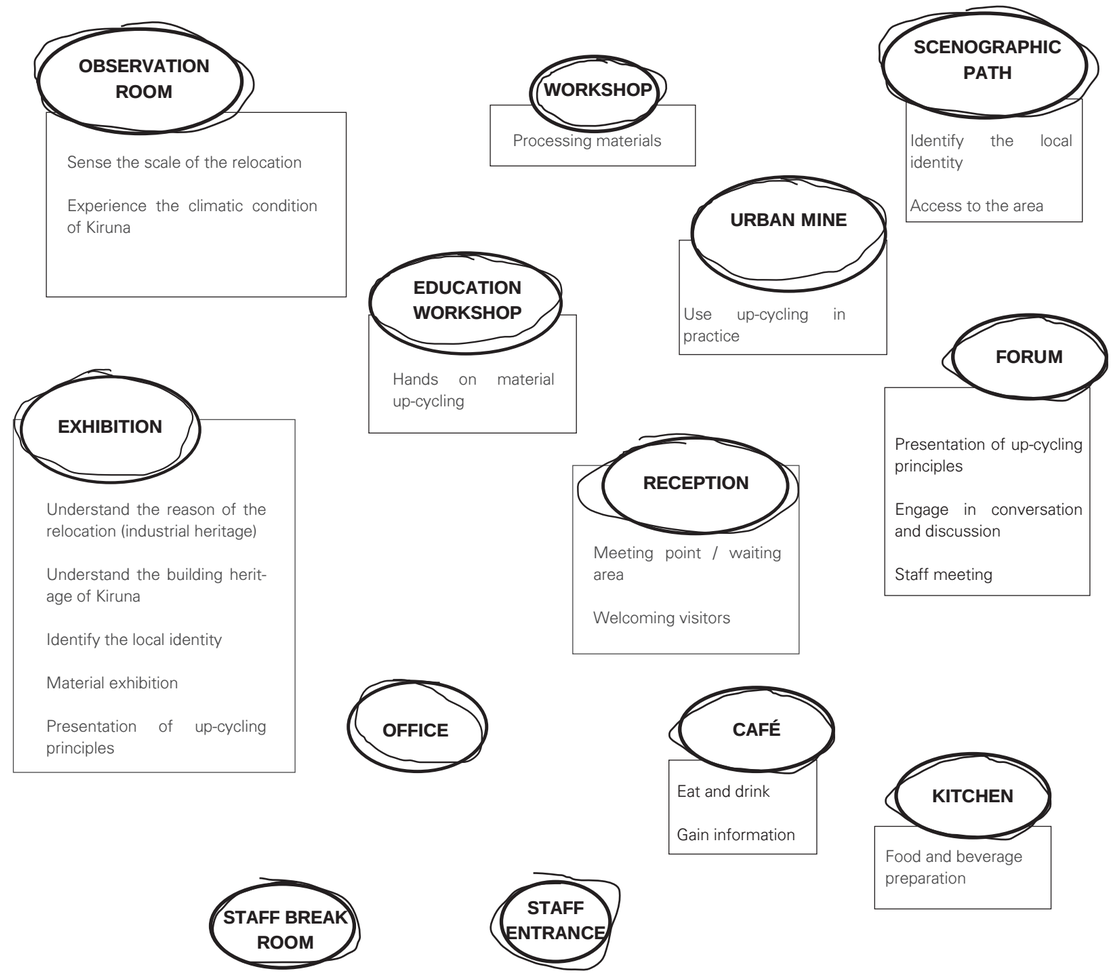
Locals

- Use up-cycling in practice
- Identify the local identity
- Understand the building heritage of Kiruna
- Special events concerning the relocation
- Engage in conversation and discussion
- Access to the area

Staff

- Work and administration
- Welcoming visitors
- Break facilities
- Shower, change clothes, WC
- Food and beverage preparation
- Processing materials

Room function to accommodate the experience



FUNCTION AND ACTIVITY

Mood boards

To understand what functions and activities the Interpretation Centre should contain to fulfil the desired experiences for the different user groups, mood boards regarding the tourists, educational groups and locals presents the project specific experiences. The staff is left out as their experiences are less specific and seen elsewhere.

Understanding the activities for tourists

Understand the reason of the relocation


ill. 38.

Kiruna is full of mining deformation zones, but most are fenced off without any information of why. A close up of the deformation can give the understanding of why Kiruna moves.

Experience the climatic conditions of Kiruna


ill. 39.

Kiruna's location north of the polar circle provides both light phenomenons, many months of snow and extreme temperatures which the centre should adapt to.

Sense the scale of the relocation


ill. 40.

It can be hard to see the scale of the relocation. Information highlighting the amount of houses, people and areas affected by it can help the understanding.

Understanding the activities for educational groups

Hands-on material upcycling


ill. 41.

A workshop provides opportunities to assemble upcycling materials to something new where groups can meet to learn more about materials or building methods.

Presentation of upcycling principles


ill. 42.

As Kiruna is relocated over decades it affects many generations. Younger generations learning about upcycling and circular economy benefits the whole community.

Material exhibition


ill. 43.

Exhibitions of materials can both change the way waste is seen but also put a focus on what is lost when Kiruna is relocated and showcase the heritage of Kiruna.

Understanding the activities for locals

Use upcycling in practice


ill. 44.

A place where locals can exchange and leave materials too good to throw away speaks to a circular approach, provide job opportunities and sustainable thinking.

Identify the local identity


ill. 45.

Upcycled materials from well-known demolished buildings from the old Kiruna on exteriors speaks to the local identity and are visible from the city.

Engage in conversation and discussion


ill. 46.

Making environments where discussion and conversation is welcomed increase the involvement and learning about Kiruna's situation and potential.

USER DEMANDS

Relation between users and the interpretation centre

Tourists
Kiruna is a winter wonderland and as stated earlier tourism is one of the main industries in Kiruna with over half a million booked sleep nights in 2019 a number that, if it weren't for the Covid-19 pandemic would be increasing in 2020 (Besoksliv.se, 2020). The city of Kiruna is relatively small and with only a couple of tourist attractions such as the mining tour and the church, it is however the immense Arctic nature surrounding the city that attracts the major part of the tourists. Using Kiruna and the nearby airport as the gateway to natural activities such as skiing, dog sledding, northern light tours and so on (Tripadvisor, 2021). The Interpretation Centre will add a new symbolic structure for the city's identity as the city that is moving. A cultural tourism attraction focusing on activities that combine cultural, industrial, and natural heritage with education and leisure as this sort of activities are in huge demand by tourists, yet not available in Kiruna (Baeyens & Charasse-Valat, 2005).

Educational groups
The Interpretation Centre provides activities otherwise not possible at the educational institutions by introducing a hands-on workshop area focusing on material up-cycling along with an forum with specialized information regarding the relocation of the city. The educational facilities at the Interpretation Centre will facilitate learning experiences aimed towards class excursions from both middle-school and higher educational facilities. The class quota in Sweden for a middle school is not clearly defined however higher educations have a class quota of 30 students (Kiruna-Kommun, 2018) which can be used to determine the size of the workshop and the forum.

"We seek leisure activities which are a blend of heritage and tourism."

- Baeyens & Charasse-Valat, 2005

"We can help to utilize and find new ways of using Kiruna's resources."

- Kiruna Kommun, 2014

ill. 47. User groups

Locals
The 22.666 locals that currently live in Kiruna is expected to be use the Interpretation Centre's leisure experiences on a regular basis when using the café, urban mine and scenographic path. The locals are an important part in securing the connection between the centre and the local identity, just as an interpretation of the cultural heritage is of importance for the locals' identity (Baeyens & Charasse-Valat, 2005). The centre will facilitate a forum to discuss and exchange materials while the exhibitions and a forum will provide the knowledge of how to up-cycle. The aim is to get locals to start thinking about the positive influence that the circular use of materials will have on their identity and community.

Staff
The permanent staff of the Interpretation Centre includes a manager, a head of interpretation, a guide, a receptionist, a janitor/workshop manager and two cafeteria employees. This group of staff are expected to keep the centre running on a daily basis. Furthermore, there will be visiting specialist consultants within heritage education, conservation and study that require floating workplaces. The staff are based on the Hicira Handbook for Heritage interpretation centres (Baeyens & Charasse-Valat, 2005).

"We think it is important to make culture a business in Kiruna and utilize the unique environment"

- Kiruna Kommun, 2014

"With a place where upcycling of materials are done and taught work opportunities are created."

- Kiruna Kommun, 2014

INTERPRETATION CENTRE COLLECTION POINT

Room functions

The room functions are based on what kind of experiences and needs the visitors are should have for them to understand the heritage of Kiruna. Exterior functions such as parking, arrival situation and outdoor dining are not included in the room functions but will be placed in relation to the building. The scenographic path can be an outside function but will be further investigated further in the project.

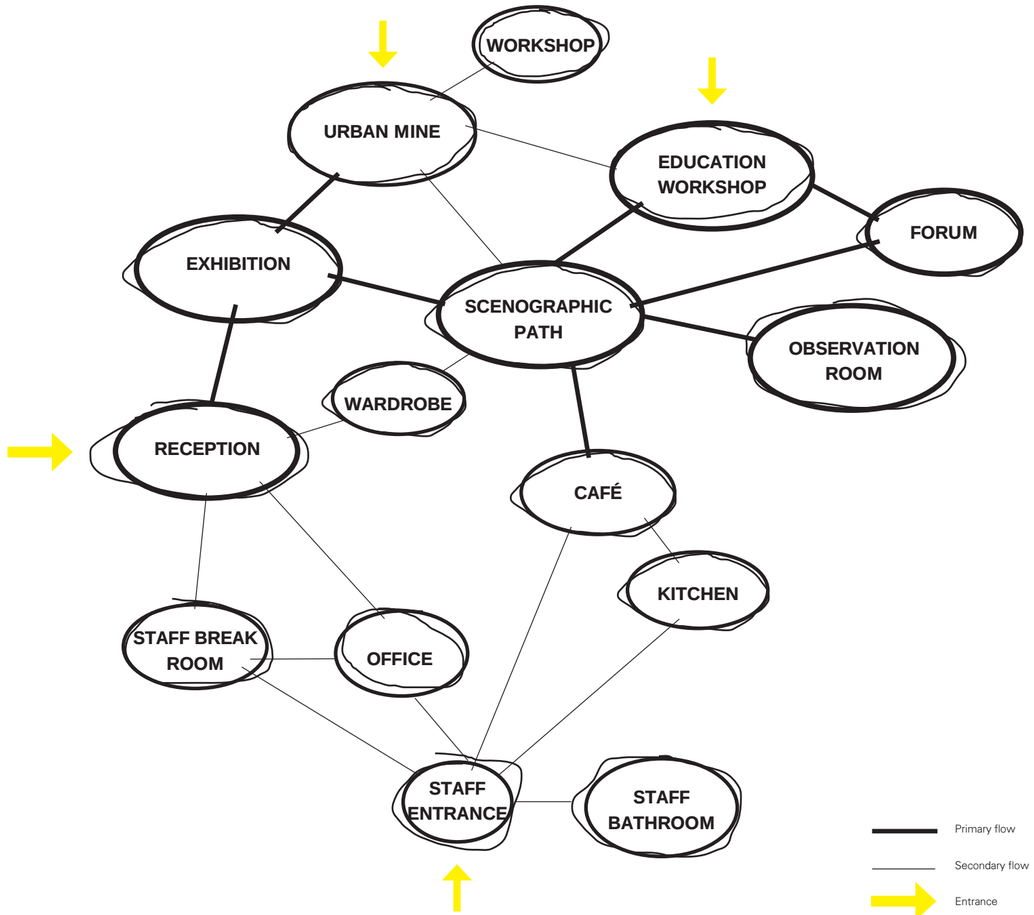
The flow diagram of the centre (ill. 48) illustrates the primary flow for the visitors is indicated with the thick line in between them and the secondary flows are indicated with the thin line. The rooms connected by the primary flow are essential for the Interpretation centre focusing on interpreting the heritage of Kiruna. The Interpretation centre is a public building and rooms connected to the primary flow are open for the public.

The room program and function diagram are the collection point for the interpretation centre chapter and will help the further design of the project.

table 1. Room program

		Net. Size	Number	Focus	Daylight	Active hours
Exhibition	Observation room	100	1	Views	Direct	10-18
	Exhibition	510	1	Intimate · Flexible · Engaging Tranquil	Spatial indirect · Direct	10-18
	Forum	75	1	Striking · Views	Direct	10-18
	Scenographic path	-	-		-	∞
Utility	Urban mine	200	1	Welcoming · Engaging · Flexible	Spatial indirect	10-18
Service	Café	100	1	Tranquil - Views	Direct	10-18
	Kitchen	30	1	Practical - Bright	Direct	10-18
	Reception	50	1	Welcoming · Warm	Direct	10-18
Workshop	Education workshop	100	1	Practical · Bright · inspiring	Direct	10-21
	Workshop	60	1	Practical	Spatial indirect	10-21
Practical	Public outdoor toilets	3	3	Legible	-	∞
	Toilet facilities	3	5	Legible	-	10-18
	Storage	15	2	-	-	-
	Technical room	130	1	-	-	-
	Wardrobe	15	1	Legible	-	10-18
	Circulation space	-	-	Legible	Direct & Spatial indirect	10-18
Staff	Open plan office	45	1	Transparency · Bright	Direct	8-16
	Meeting room	20	1	Welcoming · Bright	Direct	8-18
	Break room	30	1	Homely	Direct	8-18
	Bathroom	10	1	Legible	Direct	-
	Entrance area	10	1	Welcoming	-	-
	Total sqm. 1540					

Flow diagram



ill. 48. Flow diagram

INDUSTRIAL AND NATURAL HERITAGE

This chapter introduces the site and context of Kiruna, by addressing both physical and phenomenological perspectives, resulting in strategies of how to place the building volume on the site and different ways to interact with the industrial and natural heritage.

Ill. 49. Kiruna centrum 2017

LOCATION OF THE SITE

The TGA-area

The project site (marked in yellow in ill. 50) is located in the TGA-area, named after the former mine Tuolluvaara Gruv AB that had mining activities in the area from the early 1900s to 1982 (LKAB, 2020). The area conveys the industrial and cultural heritage of Kiruna and possesses historical value and identity for the inhabitants.

The picked site is in close connection to the new city centre, 3 km east of the current city centre, which is located in the deformation zone as marked in ill. 50.

[1] Nina Eliasson, Kiruna Kommun, 2021 [Writers translation]
[2] Based on the questionnaire in appedix 1

ill. 50. Site location in relation to the city

ENTERING A NEW URBANITY

The context

Zooming in on the site show the relation to the planned urban environment where the new city centre will be. As most of the buildings are not built yet, the roads and placement of buildings are based on the masterplan (appendix 2) developed by White Arkitekter and Ghilardi + Hellsten Arkitekter and the document 'Utvecklingsplanen' (Kiruna Kommun, 2014).

The masterplan for the new city centre shows a dominant green urban strip 'Stadsparken' crossing through the city and connecting the districts Lombolo and Tuolluvaara. This strip moves from the Southwest to the North-eastern corner of the city and out phases towards the TGA-area. In this way, the site has a prominent placement as an extension of the city park in close connection to the city centre and cultural institutions. Furthermore, the site is in the vicinity of 'Stadstorget', which is the new landmark and identity-creating element in the city. The primary cultural institutions are gathering around this square making this area attractive for visitors.

Due to prior mine activity, the terrain on Tuolluvaara mountain has suffered erosion which is now present in defined cracks and holes. These both remain as an industrial remnant of the former mine activity and a danger for adventurous souls. To avoid accidents the site is partly fenced and remains as a deserted and functionless territory.

New Kiruna is designed to be flexible for rapid transition and expansion of the city districts. According to the new masterplan the 2100 expansion scenarios will not interfere with the project site, leaving this area as an open question mark about how it should be handled in respect of the industrial and natural heritage and how to add value for the inhabitants.

1. PROJECT SITE
2. STADSHUSET
3. STADSTORGET
4. SHOPPING STREET
5. CENTRAL STATION
6. GOLF CLUB
7. MINE DEFORMATION
8. TUOLLUVAARA
9. STADSPARKEN
10. E10 ROAD
11. NEW GYMNASIUM

industrial and natural heritage

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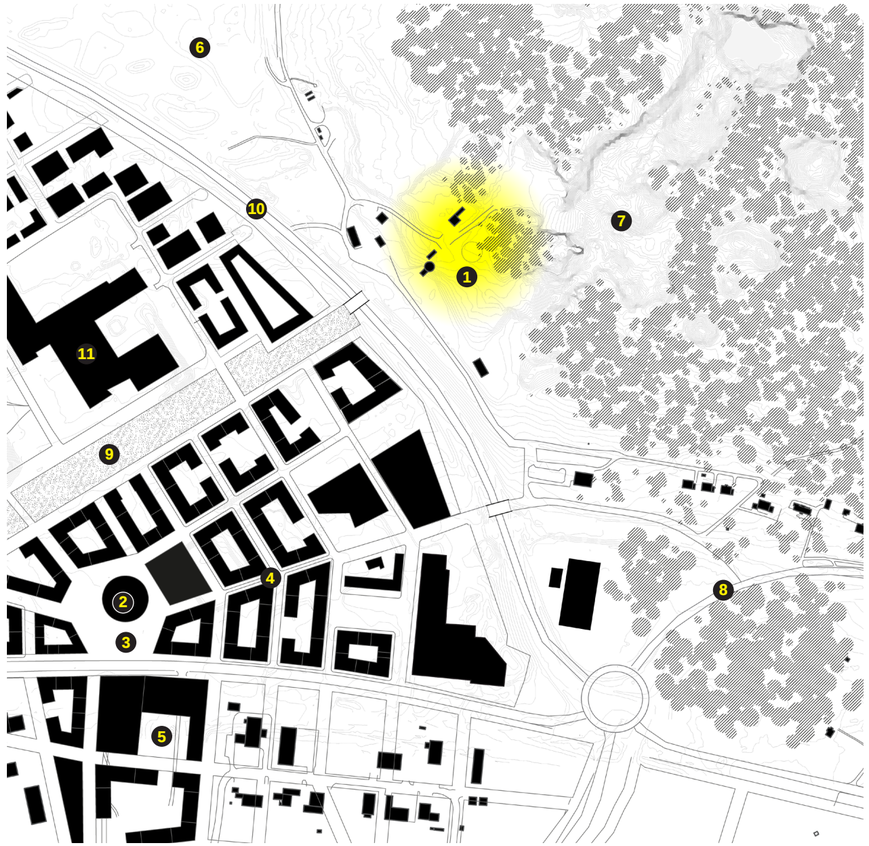

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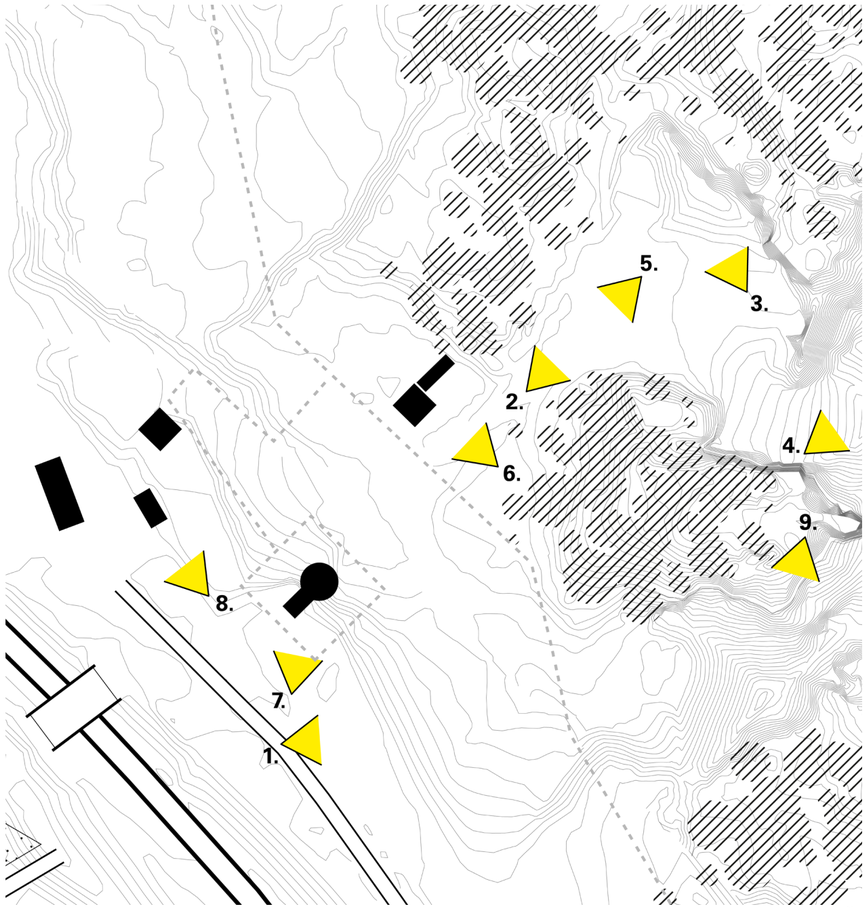
ill. 51. Context plan

VIEWS AND TERRAIN

Site visit



ill. 52. View path on site

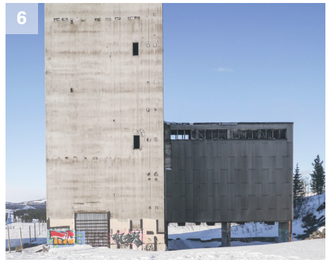
ill. 53. Man-made hill next to towers

ill. 54. Flat pocket behind the towers

ill. 55. Deformation axial to the towers

ill. 56. Deformation zone

ill. 57. Backside of the towers



ill. 58. Elevation of the square tower

ill. 59. Front of the circular tower

ill. 60. Former workshop buildings

ill. 61. View from the peak of the hill

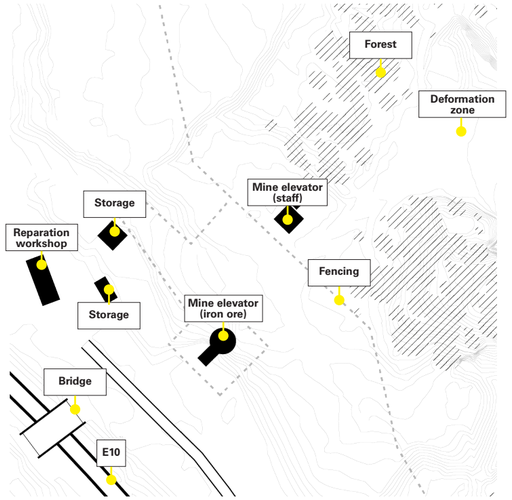
INDUSTRIAL HERITAGE

The former mining site

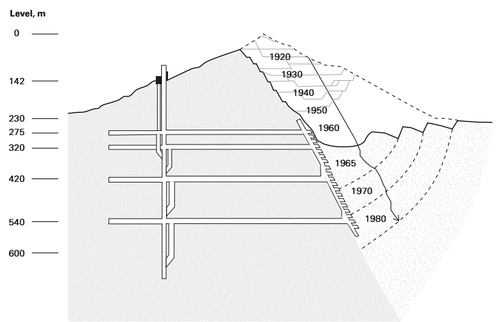
The most prominent figures on the site are the two concrete mine towers that used to be the entries to the mine. The round tower is 76,5 meters tall and originally worked as elevator shaft for iron ore excavations. The square tower has a height of 53 meters and worked as an elevator shaft for staff, heavy machinery and the commercially useless minerals. Both towers have recently been subjects to inspections to analyse their structural state, which was surprisingly good according to the age. Only improvements of the outer surfaces and change of windows within a wide time frame were on topic (KIWA, 2019). Since the mine close down both the towers and the deformation zone have been fenced off due to the risk of falling ice and to prevent visits from daring adventurers. Now they stand as iconic figures of the city awaiting a new purpose of their existence.

The surrounding buildings all have a relation to the former mine operation. The rectangular brick building used to function as reparation workshop connected to the train tracks (Tekniska Museet, 2019). The two other buildings worked as storage spaces for machines and equipment. Today the buildings are abandoned or temporarily occupied by minor businesses.

The forest embosses the East part of the site and partly covers the deformation zone of the ground due to mine operation. The process of erosions is illustrated in the conceptual section of a mine, ill. 63. This shows how the mountain deforms with time as a result of the iron ore excavations taking place over decades. The Tuolluvaara mine was operating from 1950 to 1982 (KIWA, 2019), and within this time the mine channels reached down to approximately 600 meters below level 0 (Brunnström, 2008). Since 1982 the mine has been inactive and therefore no further deformation of the ground has occurred, leaving this historical and unique spot open for new initiatives and ideas.



ill. 62. Site zoom-in

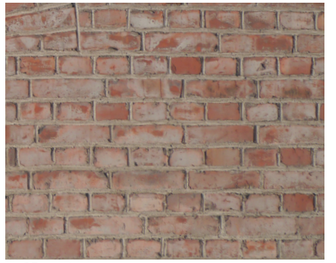


ill. 63. Conceptual section of mine

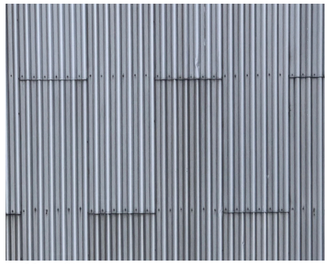
MATERIALS & VEGETATION

The project site

ill. 64. Concrete



ill. 65. Bricks



ill. 66. Steel sheets

ill. 67. Wood

ill. 68. Rocks

ill. 69. Iron

ill. 70. Gravel

ill. 71. Vegetation

ill. 72. Forest

What should the future strategy for the TGA-area be?

ill. 73. The TGA-mine, 1941

Which significance does the towers have in Kiruna?

ill. 74. The two abandoned mine entries

"The towers are an important landmark symbolising that you're soon home when arriving from the south."

"I would want to see the towers used as a view platform, café, restaurant or hotel if it was possible."

"In other cities, old industries are preserved and a new areas of use are found for them. Kiruna should do the same to show its history, and not get rid of everything "old" with the urban transformation."

"Open up and secure all old mining areas around the city so locals can use the beautiful nature. At present, all nice areas are fenced off."

"I would be sad if the old minings towers were demolished"

"The towers should be preserved so the locals can use them in some way "

"I think the mining towers are ugly, but they are a part of Kiruna's history. "

"The TGA-area would be perfect for a museum regarding Kiruna's history."

The quotes are based on the questionnaire from April and May 2021, presented in appendix 1.

HEIGHTS OF THE CITY

Conceptual section

The section shows the relation between the site and the new city centre in Kiruna and the variation in terrain and underground infrastructure (Trafikverket, 2011). The new city centre's buildings stand as dense volumes next to the open and forestry mountainside of Tuolluvaara.

Through the section, it is obvious that the location of the site offers a variety of nature scenes, an intriguing topography, and a strong visual connection to the city centre. Being elevated from the city centre the project site has views to both the old- and new city centre and can even witness the transition and expansion of the future Kiruna.

ill. 75. Conceptual section

industrial and natural heritage

MAPPINGS

Infrastructure, functions & greenery

ill. 76. Hard traffic

ill. 77. Soft traffic

Hard traffic

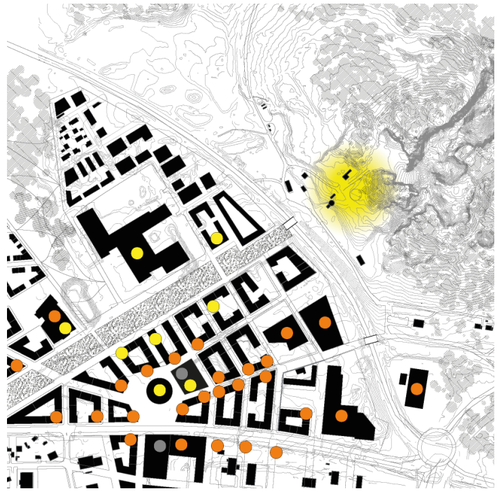
A sustainable goal of the new masterplan (Kiruna Kommun, 2014) is to promote soft traffic and public transportation. The infrastructure is designed as a street network that connects citizens and activities with the keywords: the future mobility and accessibility.

The core point for public transportation called 'resecentrum' is situated at 'Stadstorget' where highest level of activity takes place. The diagram (ill. 76) shows the hard traffic and public transportation points. The project site blends into this traffic system by being located close by Gruvparken bus stop, within 400 m to the central train station and direct connection to the E10 main road. As an addition, a cable car is planned to operate within 500 m from the site.

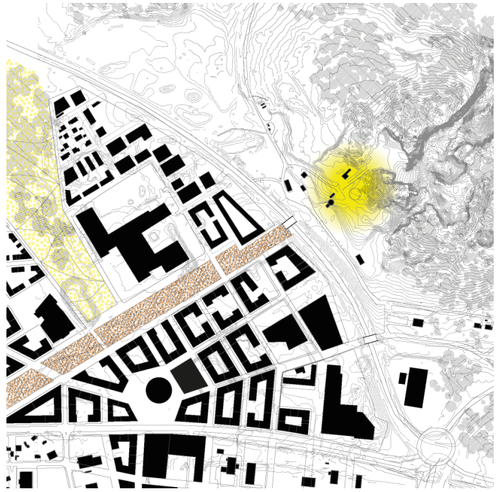
Soft traffic

The soft traffic is promoted by shaping the street network according to the pedestrian prerequisites. The three main elements are pedestrians, cyclists, and kick sleds. The diagram (ill. 77) shows the accessibility for pedestrians, which is intensified around 'Stadstorget'. The site is accessible by foot through a bridge crossing the E10 road. The biking and kick sled system cover the city centre and 'Stadspark' reaching towards the project site and spreads to the other districts.

In addition, snowmobile- and skiing tracks dominate the area around the project site. This gives the site a position that can be reached with a wide range of transportation means – a way for any citizen and tourist to visit the project.



ill. 78. Functions



ill. 79. Types of greenery

Functions

The concept of New Kiruna is to have a city core around 'Stadstorget' with a rich blend of functions. This will create a social, cultural and commercial meeting point in the centre of the city. The diagram (ill. 78) shows how the project site is placed as an extension of various cultural institutions positioned around 'Stadsparken'. Commercial services are concentrated at 'Stadstorget' and the shopping street toward the Tuolluvaara-district. Cultural institutions to be found close to the site are the culture house/city library, town hall and local unions. Tourist information and hotels are placed strategically around 'Stadstorget' at a 400-meter distance to the site. The site is therefore placed in close relation to the diverse and function-rich district that attracts both inhabitants and tourists.

Greenery

New Kiruna is designed with a notion for proximity and accessibility to nature from every district. 'Stadsparken' is a public park cutting through the city centre stretching from Lombolo to Tuolluvaara. It functions as a central link between the inhabitants and nature and is programmed to encompass both cultural elements, social activities and rich vegetation.
Surrounding the build districts are the 'Naturparker'. These are strategically placed to provide a close relation to nature from each district as well as acting as sustainable urban water drainage systems. The natural parks are mainly untouched nature with the original vegetation and scenery. The mountain of Tuolluvaara is covered in wild forest, which is partly inaccessible due to fencing.

SUBARCTIC ATMOSPHERE

Textures, views & light

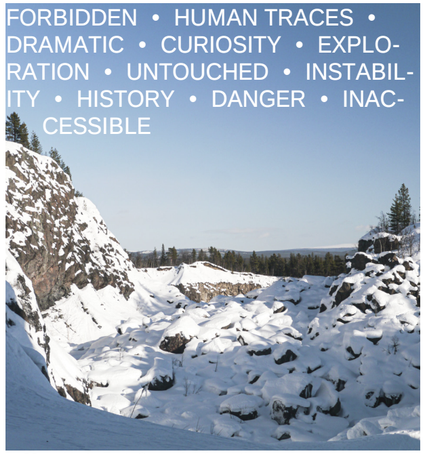
The TGA-area is a historical landmark in Kiruna that keeps the integrity of the whole city's existence – the mine. When approaching the site, the two concrete towers and iron-meshed fencing sets the character of an abandoned industrial territory. The scale of the towers seems overwhelming in comparison to the surrounding forest and a few workshop buildings. Two of the buildings belonging to the former mine operation shows highly detailed brickwork. The two towers are cinstructed in raw concrete and the buildings stands proud as a remain from the past.

Situated in the subarctic climate Kiruna is covered in snow approximately nine months of the year, which means that the landscape appears white and grey most of the time. The inhabitants' way of dealing with this is to colour their houses, and thereby make a colourful collage contrasting the landscape. This collage is visible from the project site and gives a sense of a strong local society and warmth in a cold environment.

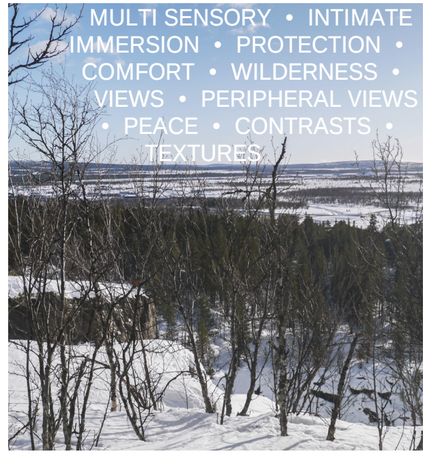
The location of the site offers four views which can be seen in ill. 80 - ill. 83. The words on the pictures describes the different characteristics of the views. The ground deformations characterizes the North East side of the site. In the direction of the Tuolluvaara district, the dense and wild forest dominates the view, whereas the view towards the North West is open and reaching to other mountain tops. Looking towards South West the city, old and new, is visible with the mine and mountains as background. These views are different potentials that awaken different feelings, moods and associations for the visitors and can be framed according to the atmosphere of a certain space.

The snow-clad landscape captures and reflects light in a unique way, where even darkness seems bright. Even though the sun barely rises during the winter months there is no lack of light phenomenons far above the Polar Circle. The dancing Northern Light and pearl coloured Polar Stratospheric Clouds are common visitors on the Kiruna sky and mesmerise its viewers. When the sun arrives bit by bit in January, it colours the sky from bright orange to a soft pink and as a tradition many tries to get as high as possible on a mountain to get the first glimpse of the sun after it has been completely gone for five weeks. In the summer the circumstances are the opposite as the sun never sets. The warm lighted midnight sun lights up the landscape and blurs the boundaries between night and day. The relationship with the sun's position due to these extreme opposites is more present in peoples' everyday lives here, than noticed in other places.

industrial and natural heritage



ill. 80. North East: Ground deformations



ill. 81. South East: Dense forest and open landscape

ill. 82. South West: City - New and old

ill. 83. North West: Mount Luossuvaara

PLACEMENT STRATEGIES

Based on the information regarding the site and its relation to the new city centre, initial placement strategies for the Interpretation centre are developed.

Relation to towers

The building leans toward the exiting tower and thereby creates a suspense between old and new. This strategy releases the potential to interact closely with the remains of the mine and bring this element into play.
Highlighted qualities:

ill. 84. View to the city

ill. 85. Relation to industrial heritage

ill. 86. Variation in terrain

ill. 87. Landmark

ill. 88. Interacting with the industrial towers

Relation to nature and fencing

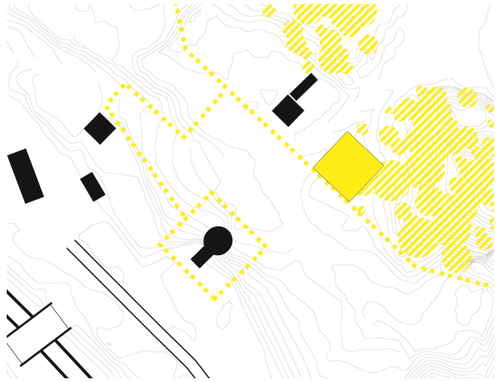
The building places itself in the near proximity to the surrounding forest. This strategy has a close relation to the drastic ground deformations and can be a display of the fenced area while benefiting from the nature views.
Highlighted qualities:

ill. 89. Interaction with nature

ill. 90. Terrain deformations

ill. 91. Offering different views

ill. 92. Shielded by the surroundings



ill. 93. Addressing the surrounding nature

Relation to city network

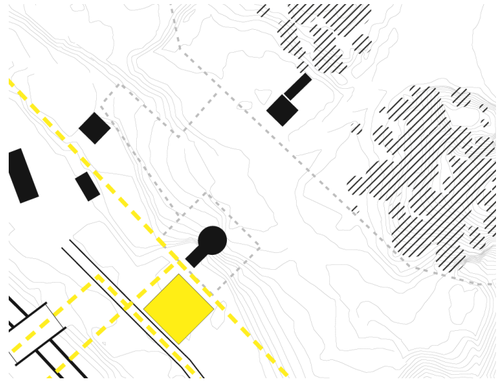
The building weaves itself into the city network of both soft- and hard traffic. This strategy creates an interaction between the building and the liveliness of the city by grabbing into the flows of the locals and tourists.
Highlighted qualities:

ill. 94. A continuation of the city centre

ill. 95. Front figure

ill. 96. Interaction with the liveliness of the city centre

ill. 97. Connecting to city flows



ill. 98. Weaving into the city network

Free-standing

The building takes advantage of the site by focusing on the different views it offers. This strategy places the building as a free-standing volume on the site without involving the existing structures and flows actively.
Highlighted qualities:

ill. 99. Focussed views

ill. 100. Freedom to place building anywhere on site

ill. 101. Interaction with nature

ill. 102. Variation in terrain deformations

ill. 103. Focusing on the views

SKETCHING POTENTIALS

Introducing volumes on the site

Different volume and placement proposals are created as a junction of the general placement strategies presented on the previous page together with the room program and the function diagram of this project. Seen in ill. 104. With the knowledge of the characteristics of the site and the rough volume of the Interpretation Centre, this study provides a sense of scale and relation to contextual spaces of a different character.

The eight proposals in ill. 104 are evaluated with bellow presented design drivers and other pro's and con's identified for the different proposals. Marked are the three placement strategies highest rated in the evaluation which further are studied to identify their respective possibilities more in detail.

The used design drivers below are arranged regarding priority, where relating to the heritage on the site are ranked highest, second-ranked are the involvement with the city and third-ranked are the driver to highlight the industrial heritage.

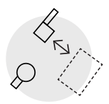
From the volume studies on the site presented in ill. 104, three of the earlier presented placement strategies were chosen to develop further through simple sketching.

DESIGN DRIVERS - SITE

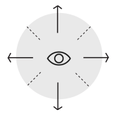
How to engage with the site

1st priority:
Relate to the industrial and natural heritage on site

Utilize the towers as functions



Views and paths towards deformation zone



2nd priority:
Involve the city identity

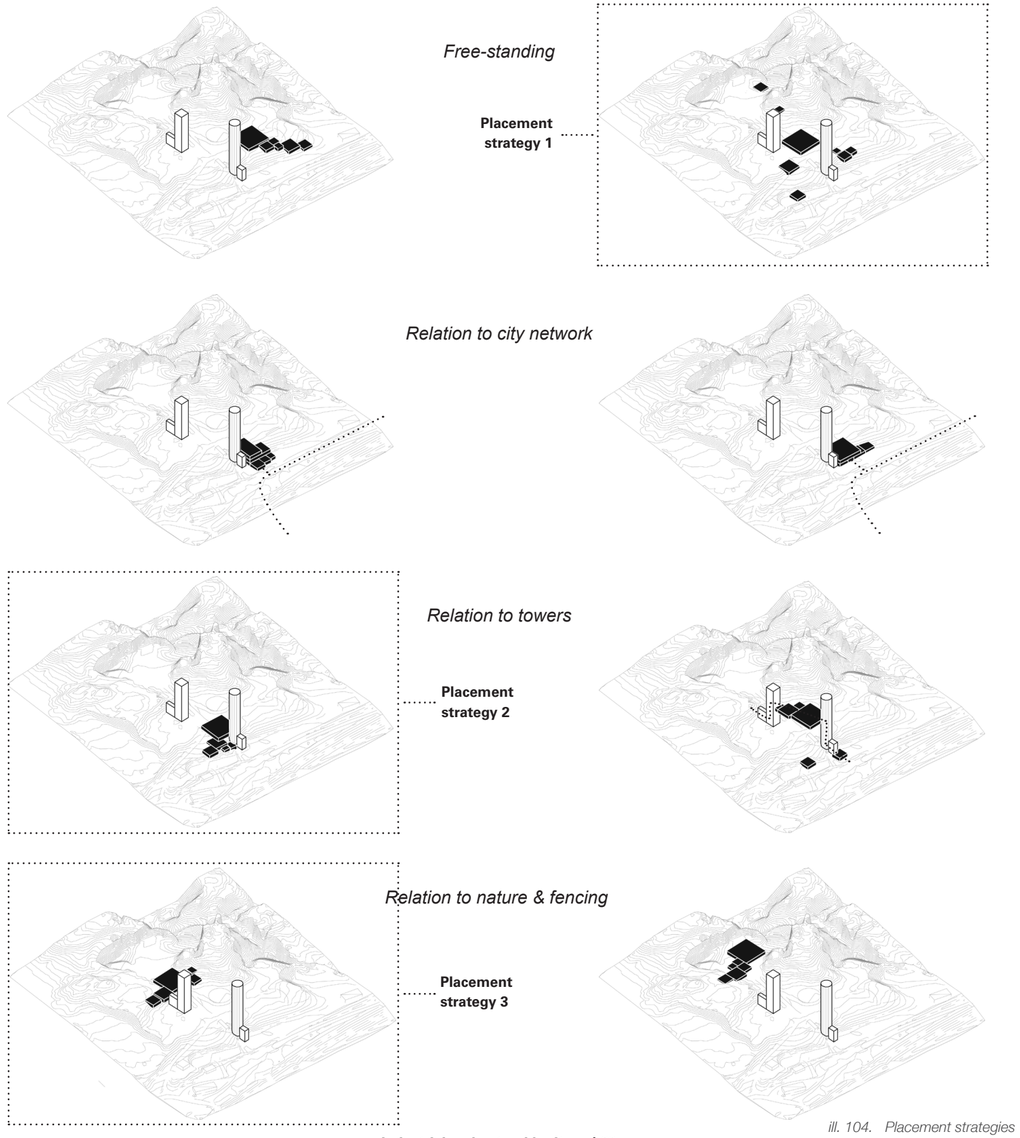
Visible from the city

Views and paths towards the city

3rd priority:
Highlight the industrial heritage

Visual hierarchy between towers and the Interpretation Centre

Differentiation between new and old



ill. 104. Placement strategies on site

PLACEMENT STRATEGY 1

Free standing volumes utilizing the site

Focus on identifying the potentials of several free standing volumes scattered on the site, aiming to utilize the whole site's potential.

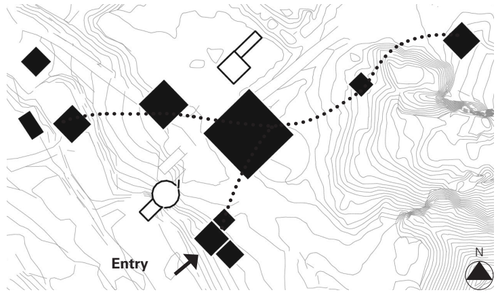
The scattered building volumes create issues with long distances between different functions while on the other hand giving the possibility to create volumes with different characters and views. The scattered volumes relates to the site's heritage and have the possibility to be visible from the city. The readability of the building(s) is identified to be difficult as there are many volumes and the energy and material usage would probably increase compared to a collected volume as there are more external surfaces.

Placement strategy 1 is deselected from further study as the issues with a scattered building seem to big in regard to the benefits it can give. Through sketching an interesting connection between the towers are however identified which have potentials to be used in a concept.

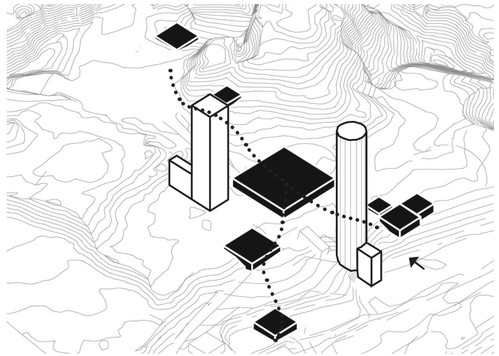
Evaluation of spreading out the building volumes on the site

+ Flexibility
+ Specifies the use and character of a volume
+ Relates to all qualities on at the site
+ Varying views

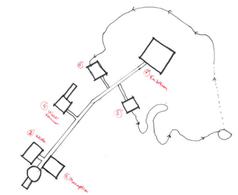
- Challenge in communication (long distances)
- Poor readability with several free-standing volumes
- Demands more energy and materials due to many surfaces
- Challenge with the technical system of the building(s)



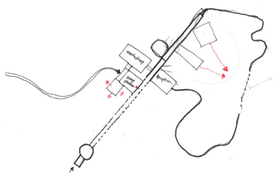
ill. 106. Plan view - Placement strategy 1



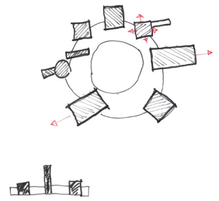
ill. 105. Axonometric view - Placement strategy 1

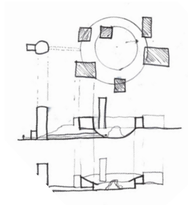


ill. 107. Activates both towers and aims to utilize the whole site.



ill. 108. Works with an axial entrance trough the round tower and utilize views.





ill. 109. A circular building with scattered volumes connected to a communication space

PLACEMENT STRATEGY 2

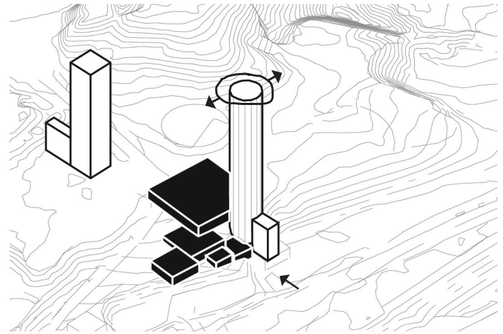
Relation to tower and city

By connecting the building to the tower it can work as a distinct entrance to the Interpretation Centre. The tower can be used to get views over the whole area and the deformation zone, but the location does not connect the centre to the deformation zone or nature physically. The centre itself has less alternating views as it is positioned in a slope. The placement speaks to the city and gives no element of surprise which creates a good readability. By connecting a new building volume to the round tower, the impact of the unique mine tower is seen as big and might influence the experience of the tower negatively.

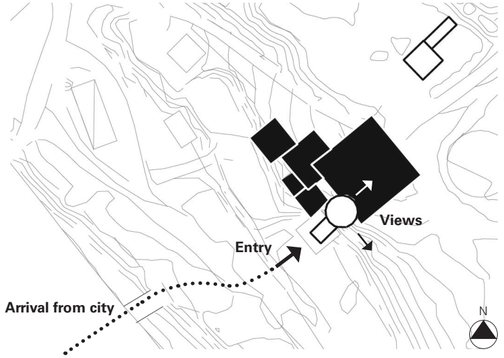
Through sketching the placement of the building volume studies the potential to activate all the buildings on the site. The consequences of that is a scattered experience and therefore the workshop buildings are deselected to be part of the Interpretation Centre. The distinct entrance through the round tower is found interesting to work further with, but the strategy is otherwise deselected from further study. The lack of connection to the deformation zone and few varying views speaks too much against the design drivers.

Evaluation of connecting to the round tower

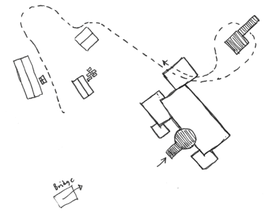
+ Horizontal and vertical contrast in building volumes
+ Associate to the industrial heritage
+ Follows the terrain
+ Activates the tower
+ View to the new city centre
+ Part of the city flow
- No relation to the deformation zone
- No relation to the nature at the site
- Little variation in views
- Large impact on the unique tower



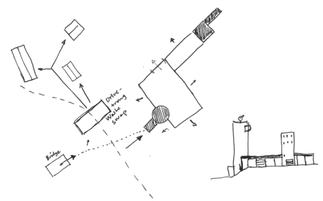
ill. 110. Axonometric view - Placement strategy 2



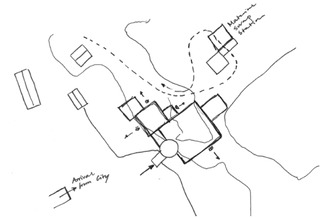
ill. 111. Plan view - Placement strategy 2



ill. 112. Aims to activate all buildings at the site and utilize the sloping terrain.



ill. 113. Alternation with a separate urban mine area and connected towers.



ill. 114. Activates both towers with a separate urban mine and exhibition centre.

PLACEMENT STRATEGY 3

Relation to tower, deformation and terrain

By placing the volume behind the square tower it creates a distinct division between the mine and the city and a hierarchy between the existing mining towers and the new Interpretation Centre. The position also gives potential to control where the access to the deformation zone are and the building can be part of the fencing strategy of the site.

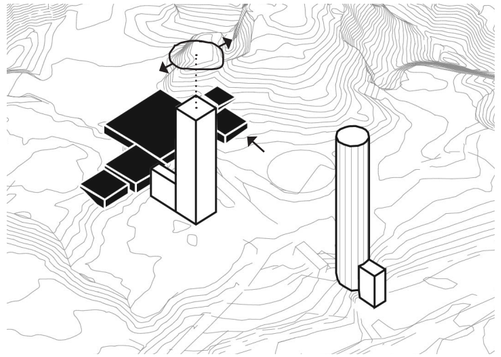
The placement have potential to give varying views both towards the city and the deformation zone and the square tower can be utilized for panorama views over the whole area. The access to the building might however be challenging as it is placed in sloping terrain but the journey to the centre can set the atmosphere for the visitor before entering the building.

Placement strategy 3 is judged to have the potential to fulfil most of the design drivers set for the site and are therefore chosen to develop further in the design process. The continued placement study are presented at page 67.

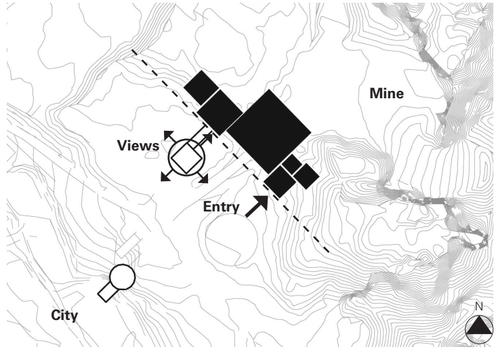
Evaluation of placing the volumes as a boundary between city and mine

+ Clear division of the site
+ Placed between nature and industrial heritage
+ Can activate both towers if entry is through the round tower
+ Clear hierarchy between existing buildings and new
+ Varying views
+ Surprise effect with a withdrawn building volume on site

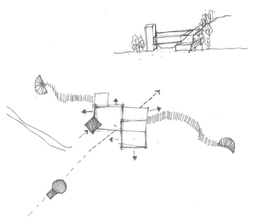
- Accessibility can be an issue due to the terrain
- + Closes the access to the deformation zone



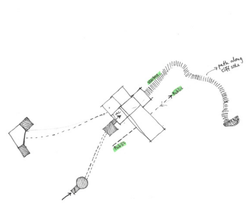
ill. 115. Axonometric view - Placement strategy 3



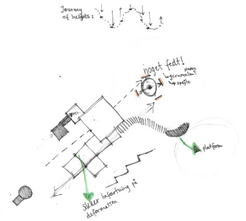
ill. 116. Plan view - Placement strategy 3



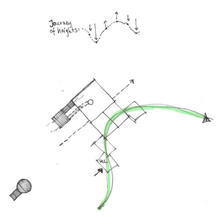
ill. 117. Connect to the square tower and rest on the hillside.



ill. 118. Connects to all buildings on the site and rest on the hillside.



ill. 119. A stepping building connected to the square tower.



ill. 120. A journey of heights leading up on the hillside.

CONTINUED PLACEMENT STUDY

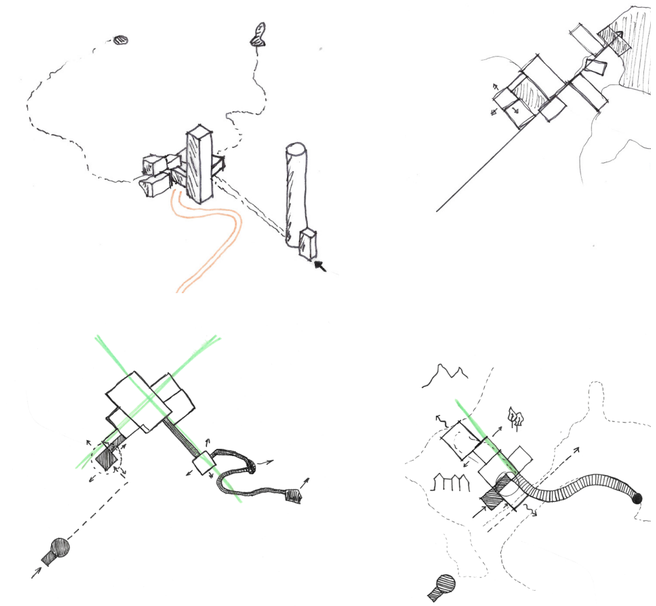
Decided placement for further study

From the three placement strategies, Placement strategy 3 presented on page 66 are chosen to be developed further as the strategy fits best to the design drivers presented on page 62.

Simple sketches and physical volume studies continue to investigate the placement strategy along with an arrival study on page 68 and a scenographic path study seen on page 73.

Through sketching the connection to the square tower are studied further together with the direction of the building as seen in ill. 121. During the sketching, one axis are identified to work as connection between the deformation zone and the tower and another axis as a divider between the city and the mine, making the centre a connection point between the qualities of the site.

The physical model study (ill. 118) show the challenging topography of chosen location and the scale of the tower in comparison to the centres approximate volume.



ill. 121. Placement studies

ill. 122. Physical model study

ARRIVAL STUDY

Journey on the site

This arrival study investigates two possibilities to enter the site from the round mine tower.

The first option (ill. 123) study the arrival through the round tower and up on the site behind with an external path to the Interpretation Centre connected to the square tower.

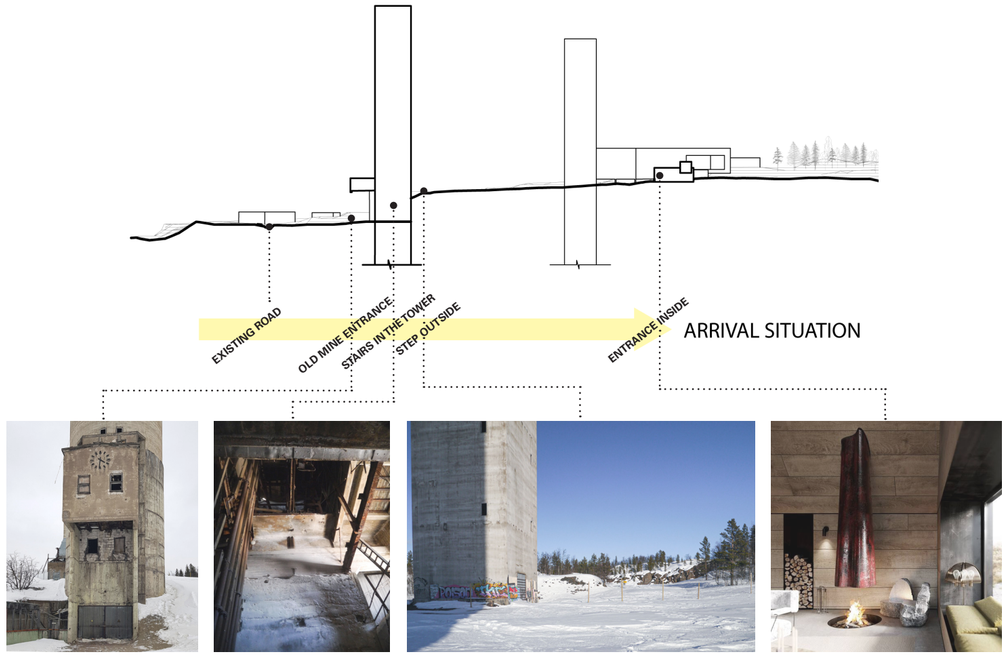
The second option (ill. 125) study an arrival situation from the round tower to the Interpretation Centre through a "mine tunnel" under the ground.

The height difference between the entrance of the round tower and the level of the square tower are 12 m. The height difference has to be taken care off, where a stair and an elevator in the round tower can be a solution for the first arrival option, while a sloping tunnel can be used to enter the centre for the second option.

Regarding the second option, with the tunnel, the arrival experience to the Interpretation Centre might feel imposed on the visitor. As the centre is not a museum focusing on mining the experience might be miss leading and unnecessary for the centre.
An external entrance where the round tower only works as a gate to the site, as option one presents, can help setting the atmosphere of the visit, but leave the arrival more optional for the visitors.

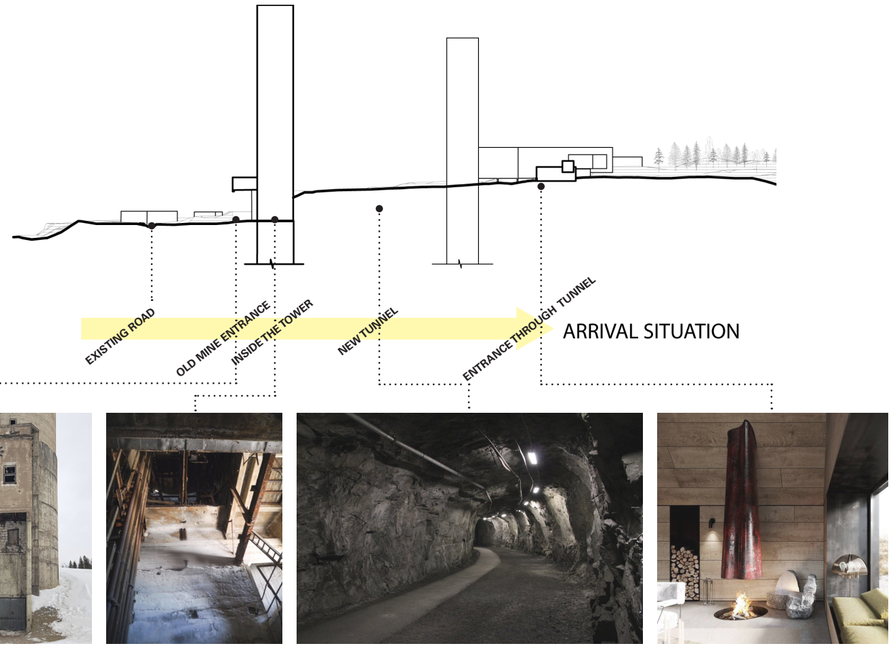
During the arrival study, the parking situation are also considered, where it is concluded that parking on the same level as the round tower is less visible from the city centre than if it is placed on the same level as the square tower. It should still be possible to drive close to the centre for material logistic reasons and for people unable to walk long distances.

The first arrival option is though these considerations chosen as a concept to work further with during the design process.



ill. 123. Arrival option 1

ill. 124. Potential entrance interior



ill. 125. Arrival option 2

ill. 126. Potential entrance interior

RELATION TO TERRAIN

Stereotomics and tectonics

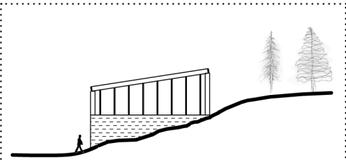
The TGA area has a highly sloping terrain as a result of the previous mining activities. The landscape includes both flat surfaces and rugged cliff sides with loose rock formations. The landscape is also part of the experience of the centre and the building should as a result have a certain dialogue in the meeting with it. Architect Gottfried Semper divides the built form into two distinct and in many ways contrasting categories: the stereotomics, describing the stacking of materials in the same shape indicating that the building belongs to the earth. And the tectonics, which is the joining of material of varying lengths that separates the building from the earth. In the end, the two categories describe the contrast of the frame and the mass and how and where these meet (Baeza, n.d.).

Three suggestions on how the Interpretation Centre can relate to the terrain are listed. With a focus on where to place the stereotomics and tectonics in relation to each other. The roof will be further studied at a later point but also has an impact on the relation.

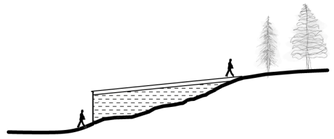
The 1st: inserted in terrain (ill. 127)makes a heavy stereotomic base as an extension of the topography with the light tectonics placed on top. This suggestion makes it possible to have a facade and thereby entrances and windows on both sides, and a natural relationship between the bottom and the top.

The 2nd: dug into the terrain (ill. 128)with a heavy stereotomic building volume without the light tectonic integrates and from the one side almost hides the building in the terrain. Making it possible to potentially utilize the roof as part of the path.

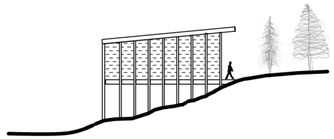
The 3rd: Lifted on top of the terrain (ill. 129)stands as a contrast to the first iteration, with a heavy top and light bottom. The light bottom could either raise the entire building volume on poles for the maximum effect, but could also merely be an indication of the materials.



ill. 127. Inserted in terrain (chosen): Heavy bottom light top

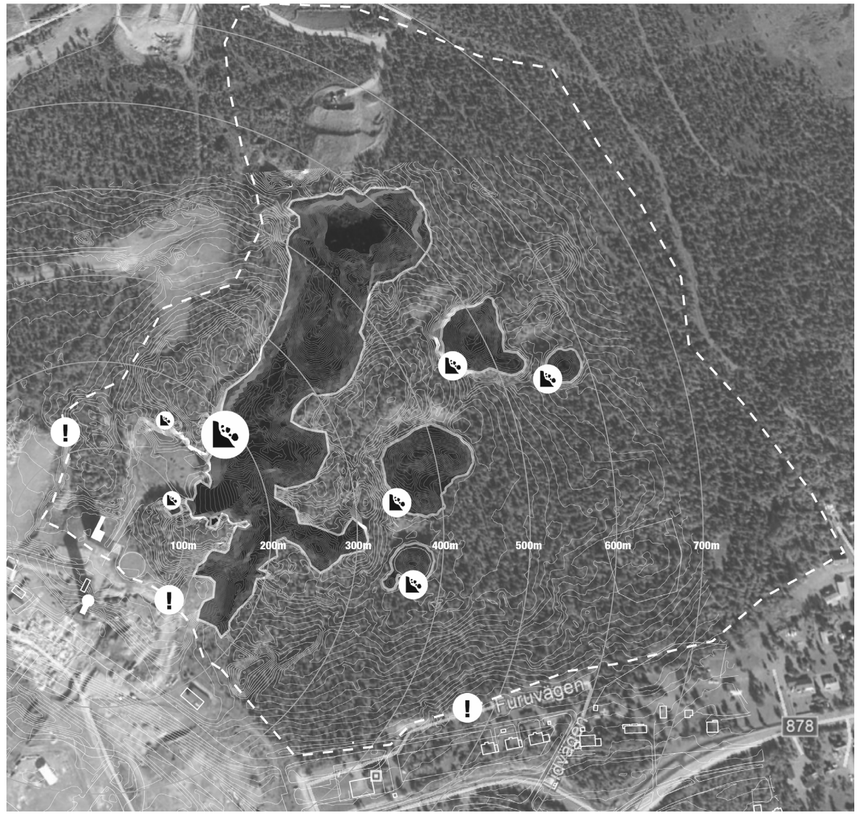


ill. 128. Dug into the terrain: Heavy bottom light top



ill. 129. Lifted on top of the terrain: Heavy top light bottom

ill. 130. The square tower



ill. 131. Fenced in mining area

SCENOGRAPHIC PATH STUDY

Experience the whole site

To extend the experience of the Interpretation Centre to the site, a scenographic path can work as an elongation of the centre and attract locals to the area. This study is an early investigation on how a scenographic path can reach out to places of interest at the site, be part of shaping the building and the experience of the Interpretation Centre, and connect the centre to the local network.

With a scenographic path, the currently fenced in mining area as seen in ill. 131, can get better controlled. The path and the fence has a possibility to be integrated to create a nicer looking fence than what stands there today. By opening up the area in a controlled way, locals and tourists get access to an unique area that has been untouched since the 80's. By connecting the path to the local network, it can also provide more movement and life in the area around the centre.

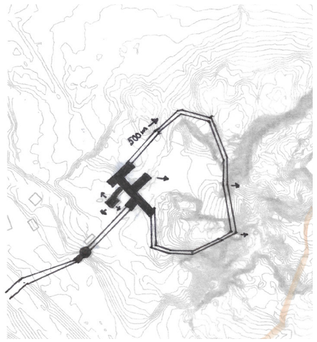
The challenges with the path is to keep the visitors safe from the deformation holes, increased material usage, and due to snow, the path might be inaccessible during the winter months. The benefits with the path is however seen as greater than the disadvantages and fulfil the design drivers for the site.

To further study how the path can help shaping the centre, the Hammershus visitor centre on Bornholm is taken as a case study and presented more in detail on page 74.

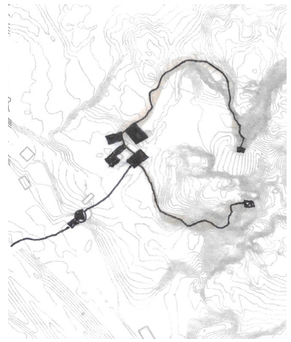
Evaluation of connecting a scenographic path to the centre

+ Controlled access to the mining site and deformation
+ Possibility to create a nicer looking fence
+ Variation of views as complement to the building
+ Access to something unique
+ Opening up a normally locked area
+ May attract visitors daily to the site

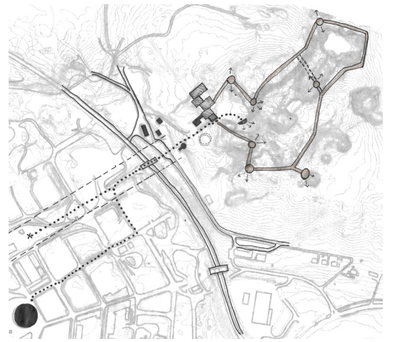
- Challenge with climate/snow (seasonal opening)
- Material usage
- Challenge with preferred length
- Scale in relation to the centre



ill. 132. Short path in a loop as part of the building.



ill. 133. Two separate paths connected to the building.



ill. 134. Long path (2 km) focusing on different qualities at the site, part of city flow.

HAMMERSHUS BESØGSCENTER

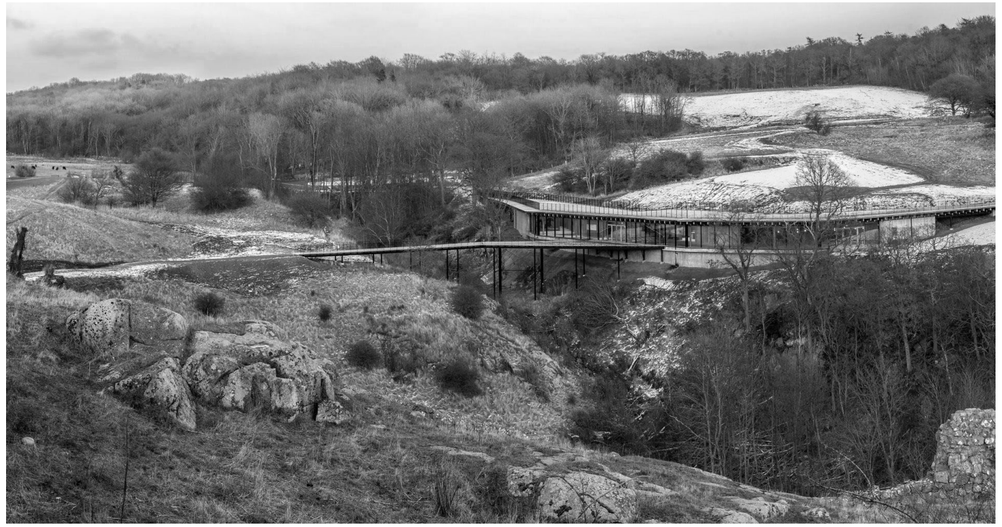
How to integrate path and building

Building owner: **Naturstyrelsen**
Architects: **Arkitema Architects & Prof. Christoffer Harlang**
Engineers: **Wissenberg**
Year: **2013 – 2018**
Size: **1.400 m²**

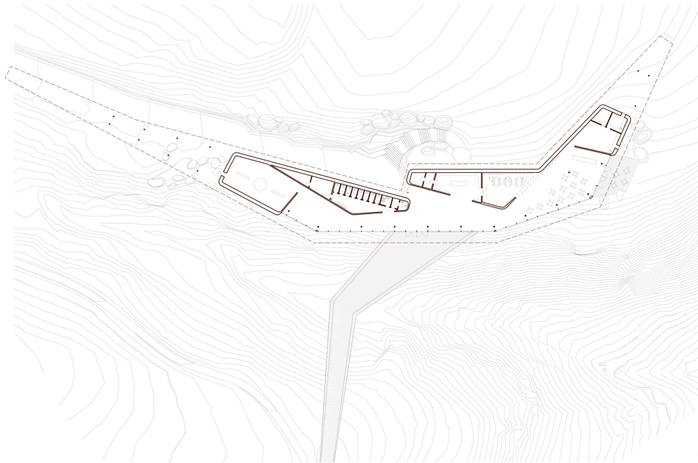
Hammershus visitor centre (ill. 135) on Bornholm stages the well-preserved fort ruin Hammershus. The centre was designed to handle the many visitors at the site and to give the fort the dignified prelude it deserves. The visitors centre is designed as a natural part of a cliff-side where the path leading to the ruin ends up on the centre's roof. As a visitor the experience of a merged landscape, ruin, and architecture are clear and inside the centre, a permanent exhibition gives more information regarding the fort ruin while having a panoramic view over it (Arkitema Architects, n.d.).

Hammershus visitor centre is taken as a case study for this project due to the way the centre is connected and shaped by the path system at the site, and how it welcomes several user groups to the site. The many possibilities to move on top, through and parallel to the Hammershus centre give the visitor the choice to either pass or enter the building in several ways. The centre informs about the ruin, but it is optional for the visitor to stop by or move on to see the site, speaking to both the first-time visitor and the local just wanting to get a scenic walk with the dog. This optional way of using the paths and the building at Hammershus stands as an inspiration for the scenographic path connected to the Interpretation Centre in Kiruna and by aiming to incorporate the two, the aim is to attract both tourists and locals to the site.

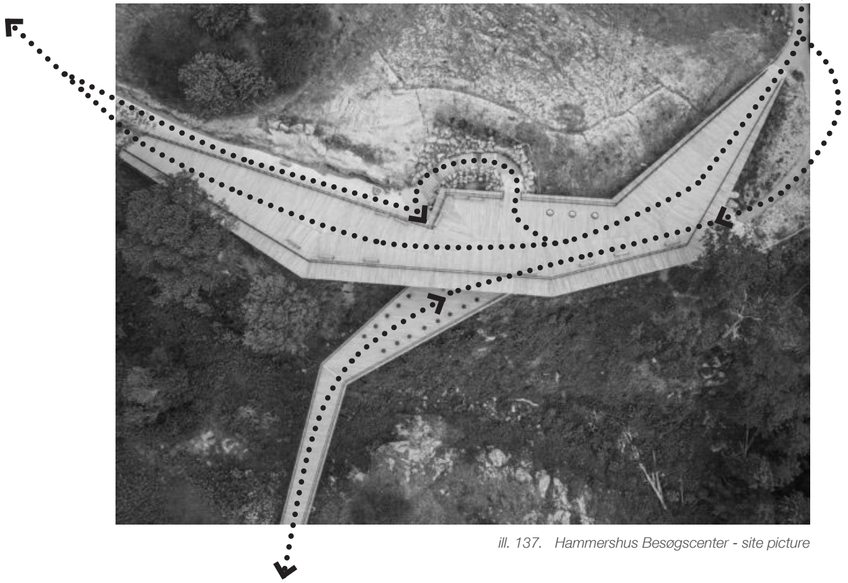
The way the centre at Hammershus also stages the visit and views to the fort ruin is inspirational for this project, however not the main focus of this case study.



ill. 135. Hammershus Besøgscenter



ill. 136. Hammershus Besøgscenter - plan drawing



ill. 137. Hammershus Besøgscenter - site picture

SITE COLLECTION POINT

Site concept

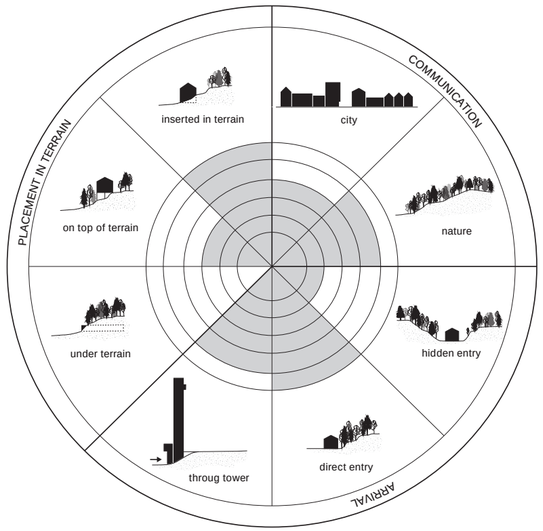
Through the previous presented studies of the site, priorities on how the Interpretation centre should relate to the site are presented in ill. 138. The site concept priority wheel presents how the centre should be placed when considering communication between city and nature, arrival and placement in the terrain.

A site concept (ill. 139) is derived from the previous presented studies and information of this chapter together with the priority wheel, which culminates into the collection point of this chapter. The continuing design process will take part from here.

The concept activates both towers, the round tower as the entrance to the site and the square as the connection to the heritage of the site.

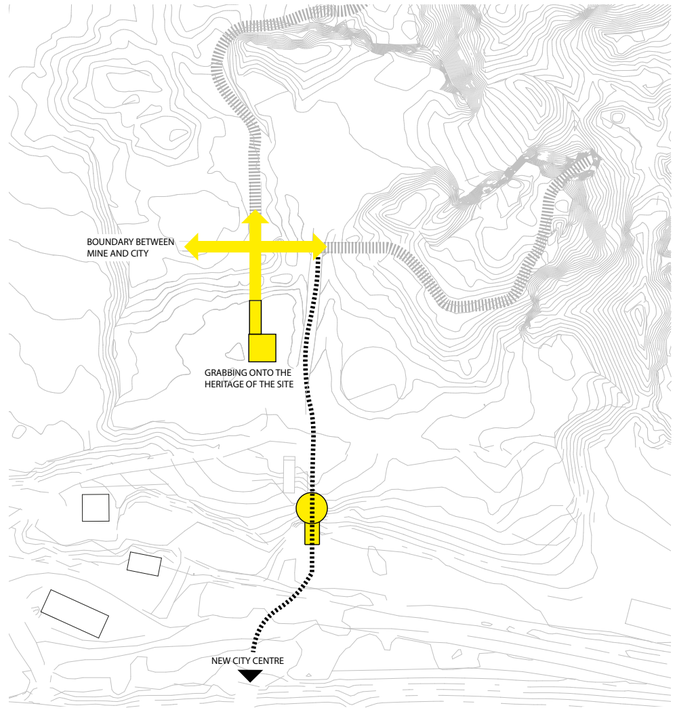
Connected to the square tower are two axis in plan, the vertical connects the building to the tower and the deformation zone and focus on the heritage of the site. The horizontal axis in plan is the boundary between the mine and the city. The scenographic path are connected to the axis in plan and activates a larger area of the site.

The tower has the possibility to connect the centre downwards towards the under ground mine, upwards towards multiple views and backwards towards the visible deformation zones.



ill. 138. Site concept priority wheel

placeringskoncept



ill. 139. Site plan concept

site concept

CLIMATE AND ADAPTATION

This section focuses on finding strategies and principles that can adapt the building to the subarctic climate with basis on the local building traditions and climate characteristics of Kiruna.

ill. 140. Reindeers

SUBARCTIC CLIMATE ADAPTATION

A dialogue between climate and building

The primary function of a building is to shelter and protect its interior against the outside climate while also being protected on the outside for long time deterioration. The basic human need for protection is what first defined architecture. Through centuries of climatic adaptation, architecture has moved from providing mere protection to provide comfort in even the most extreme climates. With the implementation of modern technologies such as mechanical ventilation, artificial lighting and central heating buildings can now ensure a general sense of comfort. These technologies are in many cases also necessary to comply with today's indoor climate requirements. However, these technologies are working against the climate at the cost of energy. They, therefore, need to be supplement by climate adaptive solutions that are working with the climate to become more environmental sustainable (Dahl & Møller, 2012).

The climatic elements of light, cold, warmth, wind and precipitation also stimulate the sensory output of the body. Thereby emphasizing the relation between man, space, climate screen and natural powers.

The most distinctive climate adaptations are found in traditional architecture. A long experience-based development process has found ways of working with the natural resources and special climatic and cultural traits of a specific site. Usually, the harshest climate of the year is the primary setting that traditional architecture is adapted to. This can be the extreme warmth of a desert, or in the case of Kiruna, the extreme cold during the winter season (Dahl & Møller, 2012). However, the Interpretation Centre is about stimulating the connection to Kiruna, including for many visitors, the very different climate that can be experienced in the subarctic both during the winter and the summer months. Therefore, climate adaptation aims to emphasize the special traits of the subarctic climate with special emphasis on extreme seasonal characteristics. The following pages will look into the climate characteristics regarding participation, temperature, wind and sun of both summer and winter along with traditional and modern solutions typically applied in the region to deal with the climate.

"

Live with nature but improve it - not cover and exclude it

- Ralph Erskine
The Arctic Architect

ill. 141. Frozen landscape

LOCAL BUILDING TRADITIONS

Traditional architecture

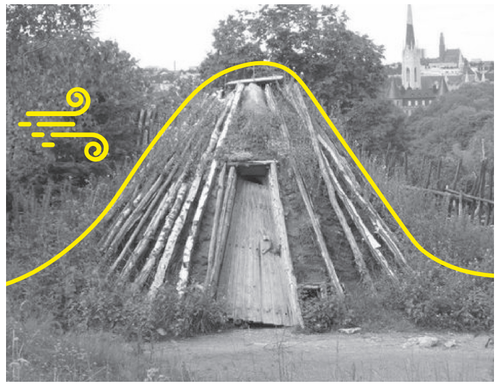
Lavvú - Keeping warm

The traditional Sami Lavvú is a highly adapted subarctic structure made for a nomadic lifestyle. The 'Lavvu' is usually placed in forests where trees cover the structure. The structure is organized around a central fireplace as there is no solar heat gain from the outside during the winter months, heat needs to come from the inside. Thereby the fireplace with its ring of hearthstone is an essential tool for keeping warm. The small cracks in the door allow for some ventilation making the lower part of the 'Lavvu' cold and drafty and the upper parts filled with smoke. The burning of wood is a continues effort requiring constant attention making the fireplace the main activity and thereby also hindering other activities (Cook, 1996; Emmons, 2004).

Peat Goathi - Landscape as protection

Another traditional Sami structure is the 'Peat Goathi' which is composed of layers of logs, peat and bark and can be seen as a small hill in harmony with the surrounding landscape. The soft round geometry of the 'Goathi' decreases wind-turbulence by simply carrying the wind beyond, making the inside protected by the landscape itself. The domelike shape also has the advantage that it creates a minimal surface to floor area, making the interior easier to heat. That, combined with the thermal properties of the turf and snow-covered roof makes the 'Goathi' a very well protected structure against the harsh climate of the subarctic (Cook, 1996; Emmons, 2004).

ill. 142. Lavvú



ill. 143. Peat Goathi

Modern architecture

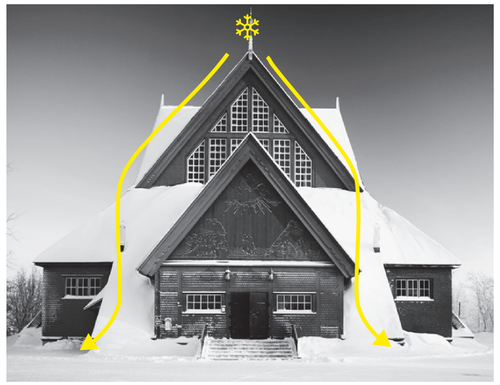
'Kristallen' (Kiruna Town Hall) - Optimizing daylight

The new Town Hall of Kiruna designed by Henning Larsen Architects in 2018 stands as a symbol of the new city of Kiruna. The building is comprised of the two main geometries each serving their objective with the inner building drawing inspiration from the angular geometry of the iron ore and thereby having a local historical objective. The unique outside shape optimizes daylight intake by 17% due to the round surface (González, 2018).

Kiruna Kyrka - snow management

The iconic church in Kiruna by Gustaf Wickman, inaugurated in 1912, stands as a landmark of the city. The church was inspired by the traditional Sami building heritage by extending the roof to the ground thereby also dealing with a key issue in the subarctic climate; snow. Considering the volume of the church, the massive amounts of snowfall during a year needs to be carefully handled. Whereas the 'Goathi' uses the snow as an extra layer of insulation the church disperses the majority of the snow to the ground to keep the structural forces of the massive roof to a minimum while also getting rid of the potential danger of falling snow (Bedoire, 1973).

ill. 144. Kristallen

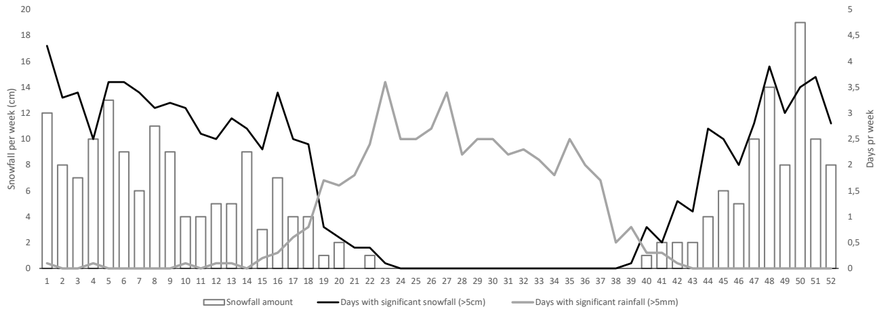


ill. 145. Kiruna Kyrka

CLIMATE CHARACTERISTICS

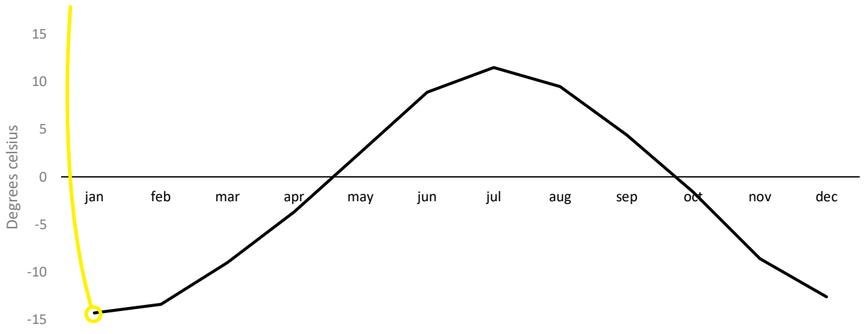
Winter and summer conditions

8,5 MONTHS OF SNOW



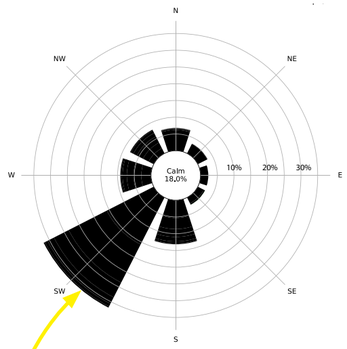
ill. 146. Average participation (2007-2018)

MINUS 15 DEGREES IN AVERAGE FOR A MONTH

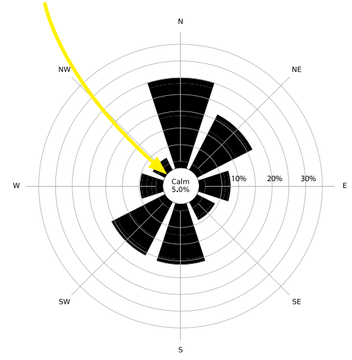


ill. 147. Annual average temperature

WIND 95% OF THE TIME

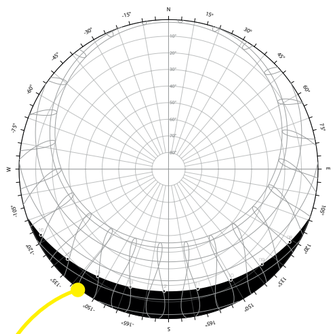


ill. 148. General wind direction - Winter



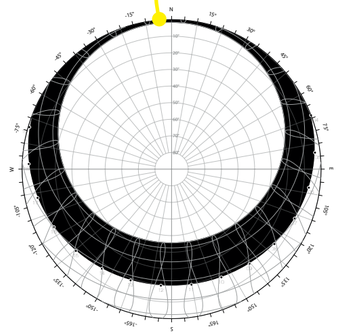
ill. 150. General wind direction - Summer

HIGH CHILL FACTOR



ill. 149. Sun angle - Winter

MIDNIGHT SUN



ill. 151. Sun angle - Summer

POLAR NIGHT

INITIAL ROOF SHAPE STUDY

Adapting to snow participation

As mentioned in the subarctic climate adaptation section earlier there has been a traditionally larger focus on adaptation to the harshest climates of the year, which is the winter in Kiruna. The major challenge with the winter in Kiruna, besides the coldness, is the excessive amounts of snow participation that hits the city. An initial study of how the principle "when dealing with snow" affects the shape of the roof can be seen on ill. 155. The study does not only explore snow slides from the roof but also investigates on a principle level how to ensure that the thermal properties of the snow are utilized. The study takes a point of departure in Ralph Erskine's drawing of the four fundamental ways of how the shape of the roof can dictate snow (ill. 152 to ill. 155).

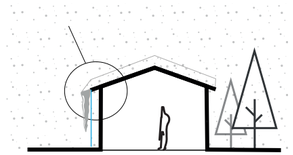
Steep pitch (ill. 152): The steep pitch that ensures the majority of the snowfalls of
+ Lower structural loads
- Less insulating mass

Low pitch, cold attic (ill. 153): Snow stays on the roof as a result of a low pitch, but will not melt
- High structural loads
- No insulating mass

Low pitch, warm attic (ill. 154): Snow stays on the roof but melting snow could potentially cause issues with icicles and standstill water
- Potential issues with melting snow
+ Insulating mass
- Structural loads

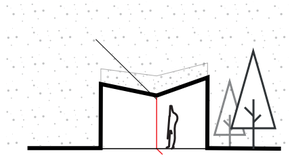
Internal downpipes (ill. 155): Snow is caught in the middle of the roof, while melting snow is directed through internal drainage
- Internal drainage
+ Increased insulating mass
- Increased structural loads

ill. 152. Steep pitch

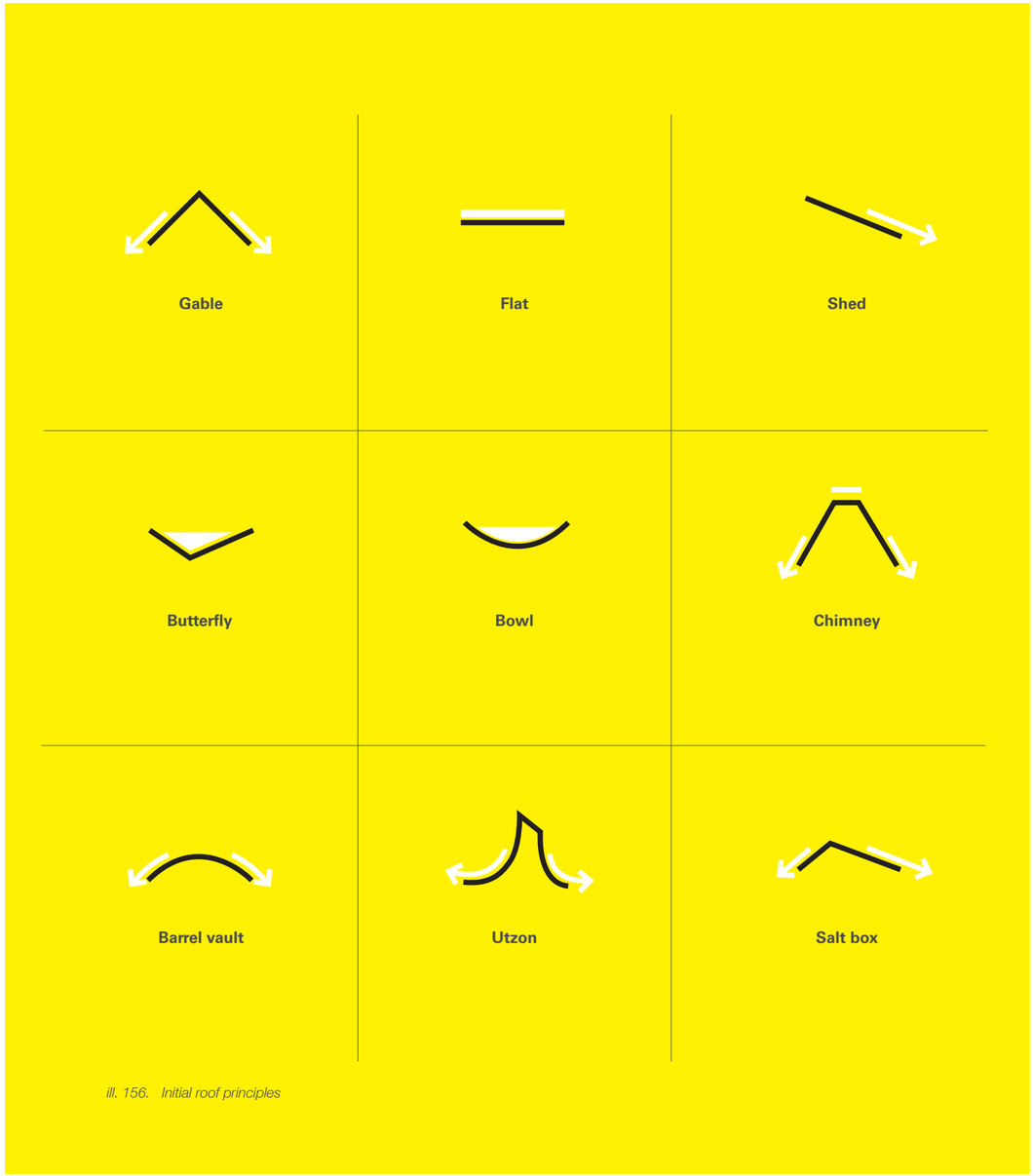


ill. 154. Low pitch, warm attic

ill. 153. Low pitch, cold attic



ill. 155. Internal down pipes



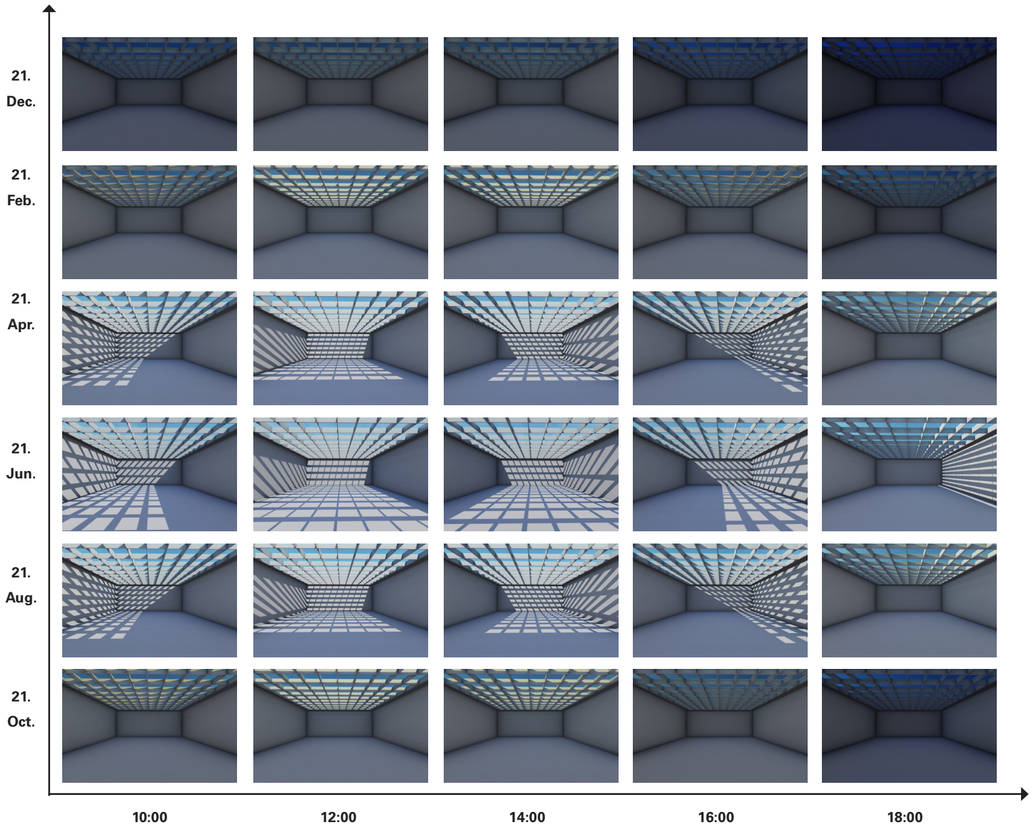
ill. 156. Initial roof principles

PERCEIVED DAYLIGHT IN KIRUNA

How daylight is perceived in temporary variability

The daylight in the subarctic region of Sweden have been studied to document how daylight are perceived during the opening hours of the centre in the course of a year. The study is based on the daylight typologies, exaggerated direct and direct, as these two typologies have the biggest temporary variability of sun and shadow.

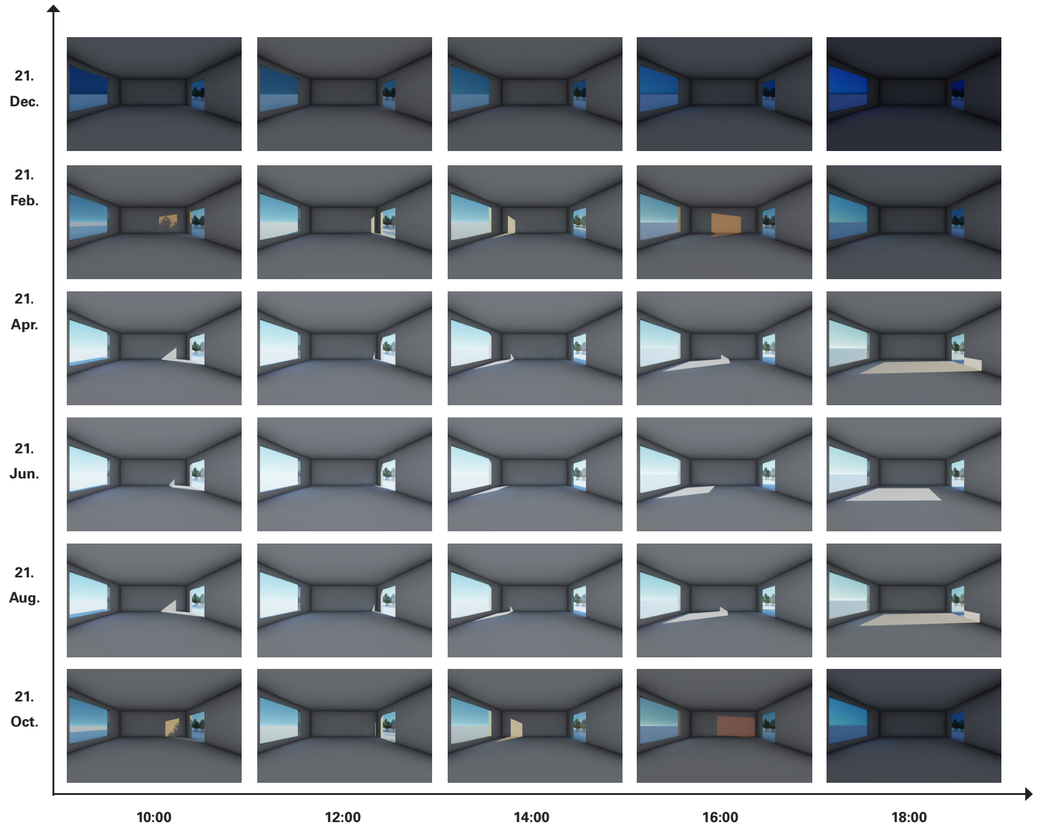
Exaggerated direct
The light and shadow play when light enters in a direct way through a certain pattern in the ceiling makes the space alive and draws attention, while at the same time providing plenty of light as the sun enters from the top. The light is experienced with little colour variation due to the angle.



ill. 157. Exaggerated & direct light

Direct
When sun enters directly through the facade it makes it possible to experience both sunset and sunrise during the opening hours, depending on the season. The light intensity and colour varies during the day while the outside nature shapes the shadows making it easy to follow time and seasonal variability.

Reflection
The study indicates that daylight in the subarctic varies greatly with, as expected, certain months experiencing no daylight at all. The centre could benefit from an artificial light pattern to be seen from the outside but also provide sufficient light within the centre during the winter moths.



ill. 158. Direct light

THE CLIMATE IN KIRUNA IS...

COLD

The average temperature is below the freezing point at seven months of the year and temperatures can drop to -43,3 degrees Celsius.

SNOWY

Snow from September to mid-May with occasional snowfalls all year round.

DARK OR BRIGHT

Rising on May 27th and not touching the horizon until July 17th the sun does not settle for 1,7 months and does not rise between 25th of NOvember and 17th of January.

WINDY

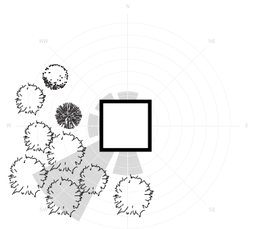
The primary wind direction is south-west which accounts for more than 35% of the total wind in the winter months. During summer, the main winds comes from the north.

CLIMATE AND ADAPTATION COLLECTION POINT

Climate and adaptation principles

Windy

The cold winds in the winter are screened by landscape or natural elements such as trees or building orientation from the prevailing direction. Thereby protecting the exterior cladding and keeping the chill factor at a minimum on potential outdoor areas. The summer winds are utilized as natural ventilation.



ill. 159. Principle when dealing with winter wind

Cold

The building is part of the landscape thereby utilizing the insulating capabilities of the earth while also allowing for a layer of snow during the cold winter months.

ill. 161. Principle when dealing with coldness

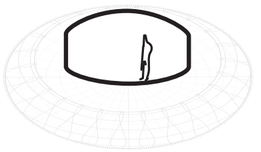
Snow-clad

A large amount of snow will be managed by the direction of the roof pitch, ensuring that snow will not fall in front of the entrance and important windows.

ill. 160. Principle when dealing with snow

Bright

The building geometry should embrace the sun-path by inviting the sun from all angles. Making the building in constant connection with the time of the day.



ill. 162. Principle when dealing with midnight sun

CULTURAL HERITAGE

This chapter presents initiatives and strategies regarding the cultural heritage of Kiruna, the present architecture in the demolition zone, building traditions, and local potential of urban mining, to reach a socially and environmentally sustainable project.

Ill. 163. Gamla stadshuset

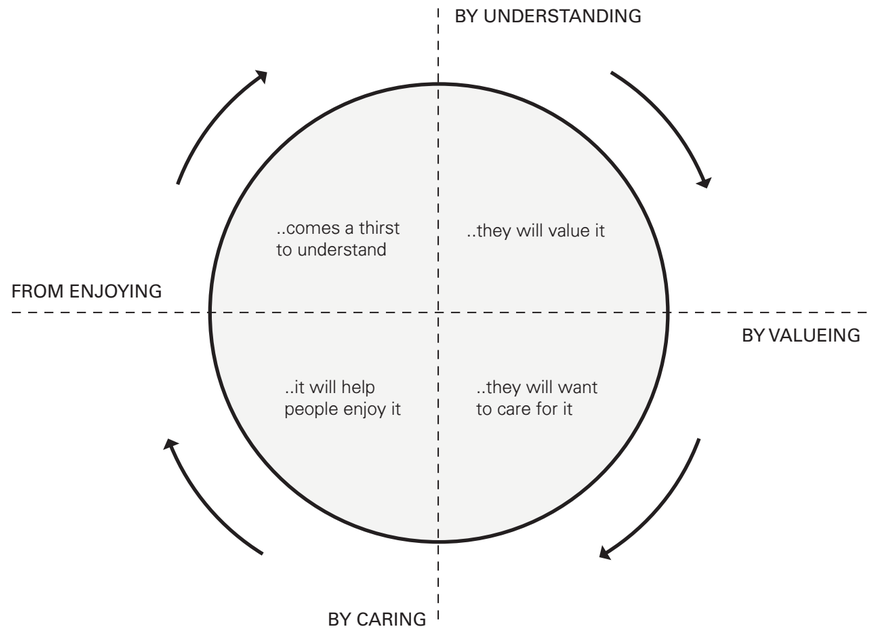
THE EXPERIENCE OF CULTURAL HERITAGE

How do people experience it?

The word "heritage" is a property that is passed down from previous generations; things that are inherited. "Cultural heritage" however does not merely include property but also immaterial elements such as traditions, values, personal narratives, stories and memories that represent the local community, in general, it is what connects the past with the future. It can be all kinds of evidence of human existence including artefacts, historical monuments, buildings, traditional craftmanship, rituals and knowledge but also documents and photographs. Everybody contributes to the cultural heritage, which is why it is important to safeguard it for future generations since it belongs to all members of a community (Franchi, n.d.).

It can however be difficult to identify precisely what is cultural heritage and what it means for the individual since it very much depends on people's individual interpretation of both the tangible and intangible. As defined by the Council of Europe (2005); "Cultural heritage is a group of resources inherited from the past which people identify, independently of ownership, as a reflection and expression of their constantly evolving values, beliefs, knowledge and traditions. It includes all aspects of the environment resulting from the interaction between people and places through time". A historic building or neighbourhood can evoke strong mental images and feelings for locals experiencing the site and thereby reflect both cultural- and personal identity. While the same neighbourhood or building can have a completely different influence on someone seeing it for the first time. It is important to understand the conditions of which the buildings are in to fully understand the influence of that building in a community (Do an, 2020). The organization Culture in Development states that in order to make the past a part of our future, people must understand the cultural heritage, and by understanding it they will value it, by valuing it people will care for it, and that will lead to people enjoying it which leads to a thirst to understand it even more and so on, see ill. 164 (Culture in Development, n.d.). Another aspect of experiencing cultural heritage is the interplay between emotions and atmosphere. Juhani Pallasmaa argues that architecture articulates our experience of the world through sensory inputs, and in order to be fully integrated in an experience, architecture needs to address all the senses simultaneously - not just the sense of vision. There are several contributors to the atmosphere of a place including scale, textures, smells, noises and temperature. These inputs not only provide information but can be said to ignite the whole process of imagining the place and its heritage. Pallasmaa describes several examples of the interplay between emotions and atmosphere and as an example "There is a strong identity between naked skin and the sensation of home. The experience of home is essentially an experience of intimate warmth. The space of warmth around a fireplace is the space of ultimate intimacy and comfort." (Pallasmaa, 2012).

When making preservation decisions of built heritage there is a lot of heritage values that can be used as reference points. Mason (2002) divides it into two major categories – sociocultural and economic and state that they are two alternative ways of understanding and labelling the same wide range of heritage values. Sociocultural values he describes as the cultural core of preservation. They are values attached to a building because it holds meaning for people due to either its age, beauty, artistry or association with a significant person or event. Historical values as part of the sociocultural value are the root of heritage, but there are also the cultural/symbolic values and social values of buildings. That does not necessarily have to do with historic connections but more in a sense of connection and use of a building or a place, which can be just as important when speaking about heritage (Mason, 2002). Hence the following pages will investigate how heritage in Kiruna can be preserved, with suggestions on what further actions can be implemented in the Interpretation Centre.



ill. 164. How the experience is created

ARCHITECTURE OF KIRUNA

From 1900 to 2020

ill. 165. The new City Hall 2018

ill. 166. 'Bläckhorn' from early 1900s

ill. 167. Östermalmsskolan 1920s

ill. 168. Traditional barn from early 1900s

As a rather young city, Kiruna's architecture spans from the early 1900s to today. Here, selected architecture from different time periods presents Kiruna through the largest urban developments; Early 1900s when the city started to grow, 1960s when a large change in the cityscape occurred thanks to a thriving economy and the latest architecture - sprung from the new urban development due to the mining activity deforming the ground.

ill. 169. SJ housing 1910-1915

ill. 170. Högalidskolan built 1966

ill. 171. Kupolen from 1960s

ill. 172. Kv. Ortdrivaren 1959-65

ill. 173. The new 'Culture House' 2020

ill. 174. 'Jerusalem' built 1927

ill. 175. Kiruna Krematorium 1933

ill. 176. Single family housing 1910s

ill. 177. Ralph Erskines Kv. Ortdrivaren

ill. 178. Multi family housing 1960s

ill. 179. Hjalmar Lundbohmsskolan 1970

ill. 180. Multi family housing 2019

ill. 181. Single family housing 1920s

CULTURAL HERITAGE AND IMPORTANCE IN KIRUNA

What, where and why?

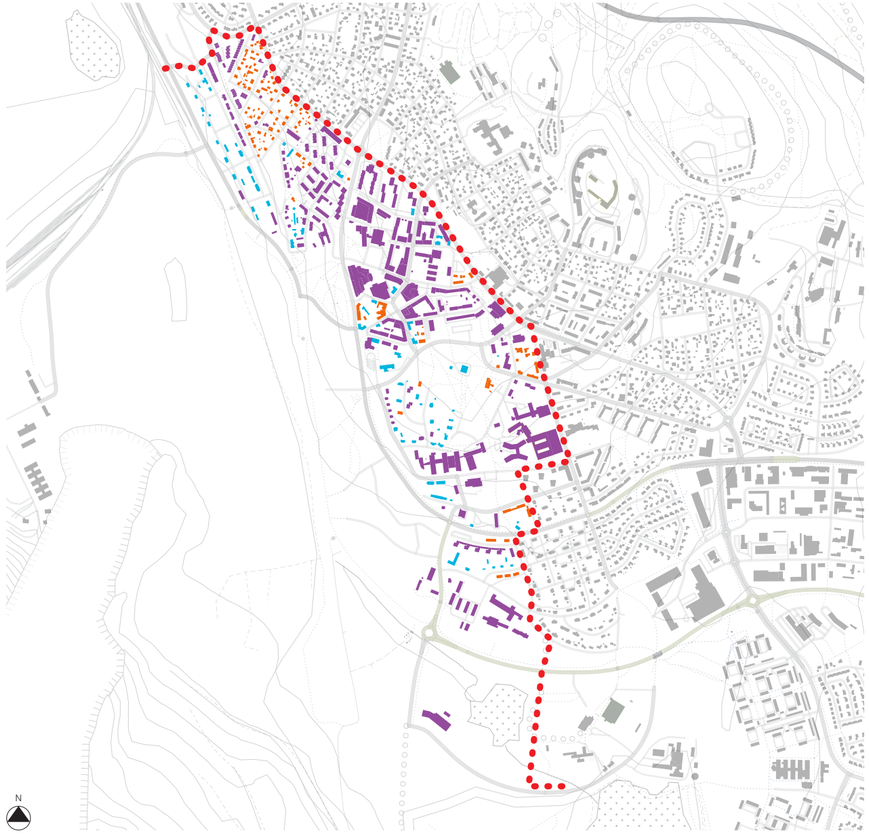
KAB and Kiruna municipality has agreed to relocate 31 historical buildings within the deformation zone (Kiruna Kommun, 2020). How the selection of the buildings was conducted has not been accounted for in the development plan, but it means that the rest of the buildings affected by the mine's expansion will be demolished (Sjöholm, 2016, p. 52). The town of Kiruna is an established heritage site of national interest that aims to protect historically valuable buildings. The preservation plan from 1984 identifies several areas and buildings that should be protected, many of them are today concluded to be within the mine's future demolition zone and only a few are part of the relocation plan. A lot of those buildings are also protected by the Heritage Conservation Act, where the old City Hall, demolished in 2019, was one of them. The City Hall was even concluded by the County Administrative Board of Norrbotten in 2010 to be possible and worth relocating as the heritage values were more significant than the estimated cost of the dismantling and rebuild. The municipality and LKAB however opposed the county's decision (Sjöholm, 2016) and what is left of the building today are the old bell tower, the entrance's doorknobs and some interior details.

The citizens of Kiruna seem to trust that LKAB has their best interests and do what is beneficial for the community when it comes to the built heritage (Sjöholm, 2016, p. 91). The mining company, however, stated that demolition of the City Hall was much cheaper than relocating the building so the demolition decision was probably mainly based on economic reasons.

It is also stated both regarding social sustainability by McGuinn (2020, p. 86) and what should be determined as the cultural heritage of Kiruna by Schwanborg and Isola (2008) that local communities and citizens' opinions are important to consider to get successful and sustainable results. There have been attempts to involve the citizens through surveys and dialogues over the years regarding the relocation of Kiruna. In 2006 the municipality sent out a survey to understand what is seen as beautiful buildings in Kiruna (Kiruna Kommun, 2006), with the main focus on historical and aesthetic values of a few chosen buildings in the city. This survey is referred to in the official cultural environment analysis made for the municipality which regards the affected buildings in the deformation zone (Kiruna Kommun, 2014b). But little focus is set on single-family houses and multifamily housing, which also are affected by the mining activities. As 48% of the buildings affected by the mining deformation are dwellings and private homes (Kiruna Kommun, 2014a, p. 32) there might be other buildings that have high cultural, symbolic or social values for people, that probably could be worth preserving in one way or another. There is however not an option to relocate your private home, other than probably at your own expense, as LKAB only gives private owners the possibility to take the money for their house or get a new house (LKAB, 2020).

The decision to save only a few of all affected buildings in Kiruna has been made and mainly with a focus on the historical value of the buildings (Sjöholm, 2016). This does not necessarily mean that the cultural heritage of the demolished buildings vanishes completely. One initiative to keep a connection to the past is to build monuments of the old buildings as formations in the ground where they once stood. Another initiative is to document buildings before demolition, this has so far mainly been done on public buildings, but private initiatives have also covered documentation of buildings seen by the authorities as less significant. A third way of preserving some of the history from the old buildings has been to save and reuse building details in the new city centre (Sjöholm, 2016). Here, it is necessary to again mention the old City Hall as it is the only known building where details have been reused. The fourth initiative, which so far has not been realised, is to save, reuse and upcycle old building materials from the demolished buildings. This is also recommended to do in the official cultural environment analysis made for the municipality, where it is stated that materials and details from demolished buildings should be reused in the new city centre (Kiruna Kommun, 2014b).
As up-cycling of materials can give new life to something seen as waste, decrease CO_2 emissions and at the same time give a connection to the past, there are strong reasons together with already stated heritage preservation strategies to do so. The private and self-driven initiatives to document their "non-historically significant" homes, also show that there is a movement and wish among the citizens to preserve the heritage. If it is not possible to "save" more buildings from the demolition zone, the user and social sustainability

byggnadsår

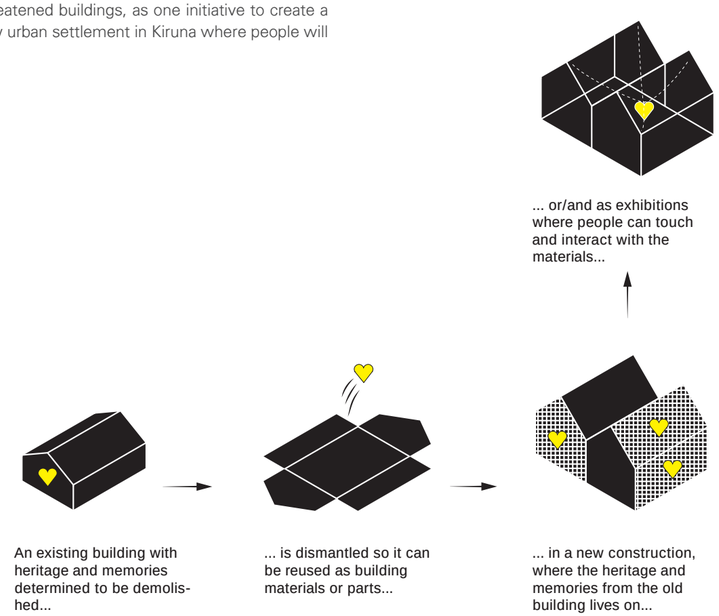


ill. 182. *Building year of each building in the demolition zone and upcycling potential*

building year

focus must accommodate the symbolic and cultural values within heritage in another way.

When the new city centre is taken into use, without any connection to the heritage of the city, what will stop people offered money for their homes from moving to another place where they identify themselves just as much - or just as little? To try to stop the de-growth trend in Kiruna, it might be necessary to economically invest in several initiatives focusing on that. As there are plenty of job opportunities in the city, the potential for a larger population exists. This thesis will therefore put a big focus on up-cycling strategies for the demolition threatened buildings, as one initiative to create a connection to the new urban settlement in Kiruna where people will feel that they belong.



ill. 183. How to reinterpret cultural heritage

LOCAL POTENTIALS

Urban mining

Most of the buildings placed in the mine's 1365 deformation zone are constructed between 1900-1976 (Kiruna Kommun, 2014b). By making a study of typical construction methods and material choic-es in Sweden during this period, an understanding of the building typologies and potential reuse materials can be identified. The understanding of the construction can also help setting an up-cycling strategy for the affected building typologies. Focus of up-cycling and reuse will mainly be on exterior materials and details, windows, and load bearing structures. Interior materials are harder to identify as renovations might have changed the materials over the years, therefore they are extracted from this study. Exterior materials and windows might also have been shifted since the construction year of a building. This will be determined while doing a closer study of chosen buildings in the next chapter.

table 2. Typical constructions and materials 1900-1970

	1900-1920	1930-1940	1950-1970
Load bearing structure	Solid log walls Solid plank walls Wooden trusses	Solid plank walls Wooden trusses	Wooden frame system Wooden trusses
Facade	Timber cladding Clay bricks Plaster finish	Timber cladding Clay brick Plaster finish	Timber cladding Clay brick Plaster finish Asbestos cement sheets Limestone bricks Light concrete sheets
Roof	Clay tiles Copper sheets	Clay tiles Copper sheets Steel sheets	Concrete and clay tiles Steel sheets Roof felt
Foundation	Natural stone	Concrete	Concrete
Windows	Customized wood frames 2-layered glass	Customized wood frames 2-layered glass	Standardised wood frames from 1960s 2-layered glass 3-layered from 1970
Other details	External wood orna-ments Detailed wood railings	Railings of metal	Railings of metal or wood Details in teak or oak wood

LOCAL CONSTRUCTION PRINCIPLES

1900-1970

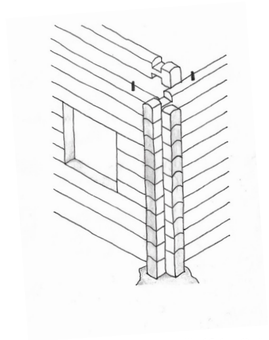
1900-1920 Solid log walls

The load bearing system in this construction principle consist of massive log wood assembled horizontally using vertical dowels and joint using carving techniques in the corners (ill. 184). The structure typically stands on a granite rock foundation, which occasionally facilitates a basement.

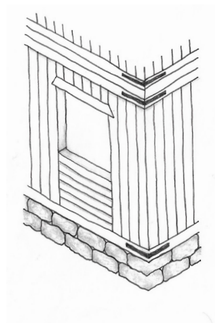
Normally the structure is cladded with wooden panels or paste to increase fire safety and wind proofing (Björk et al., 2015). Towards the 1910's the log wall structure was optimized gradually into the solid plank wall structure that was slenderer and time efficient in the building phase. However, this new optimization causes a decreased heat capacity. To enforce the structure iron fittings were applied in joints, which sometimes appeared on the exterior façade (ill. 184).

1930-1940 Solid plank walls

To address the issues of the low heat capacity, which was a challenge in the 1920s, the solid plank structure was improved with two layers of planks, exterior wall and interior wall, with an insulating air gap in between (Björk et al., 2015). To increase the wind proofing and fire safety the façades were clad with asphalt-impregnated cardboard and plastered or clad with wood panels. The construction continued to be crafted by hand on the construction site and was dominated by manual and heavy work. In the 1940s, the buildings still consisted of massive plank walls, but the use of wood frames began to increase by the end of the decade. This meant that the construction went from manual craftwork to prefabricated wooden frames containing door and window elements.



ill. 184. Solid log wall



ill. 185. Solid plank wall

1950- Wood frame walls

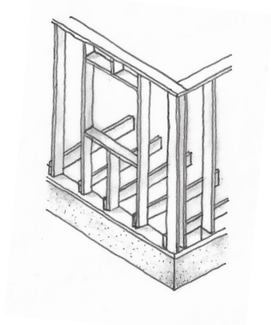
As a result of material shortage during World War II, the state took the initiative to develop constructions that focussed on minimizing material usage. This resulted in the wood frame system, which gradually overruled the plank walls and worked as the typical residential housing construction method. However, the challenges of this construction were heat loss and fire safety, but this was solved with the introduction of plasterboards in the 1950s, which replaced the wood fibre boards (Björk et al., 2015).

During the 1960's the façades of this construction type were typically cladded with bricks, wood panels or eternit. Through the 1970's the frames were developed into elements that could be delivered prefabricated to the building site. Furthermore, basements were phased out as leca blocks were introduced on the market.

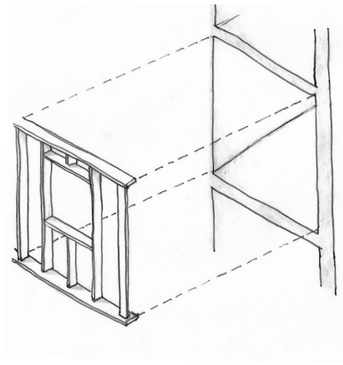
1960- The curtain wall

This construction technique is the most common for multi-story apartment buildings in Sweden (Svenskt Trä, 2019). It consists of wooden frames and is typically inserted into a concrete or steel construction, meaning that the curtain wall does not transfer any vertical loads, only wind forces and dead load.

Looking at the demolition plan (ill. 182) the area consists of numerous multi-story buildings blocks constructed upon this curtain wall system. A principle of this curtain wall system shows how each wall piece can be dismounted with ease upon demolition giving it potential for being reused. As this construction method is easily disassembled from the structure it can potentially release material for re- or up-cycling making it a harvesting of the materials is efficient due to the easy disassembling from the structure.



ill. 186. Wood frame walls



ill. 187. Curtain wall

GENERIC WALL CONSTRUCTION

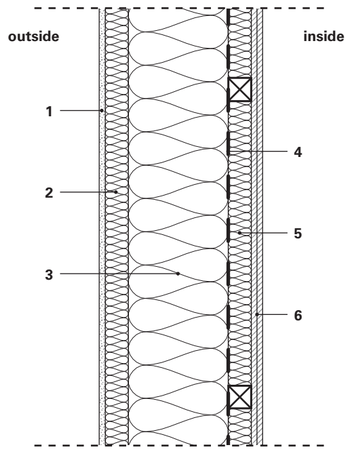
Exterior wall solution

By taking a starting point in local building traditions, a generic exterior wall solution (ill. 188) for the Interpretation Centre is developed to ensure a sufficient U-value regarding building demands.

The generic exterior wall, where upcycled materials are applied to the exterior and interior surfaces, simplifies the usage of upcycled materials as their individual performance can be less considered when focusing on the thermal performance of the wall.

The location of Kiruna, far north in Sweden, speaks for using local materials, as the transport of other materials with origin further away has significant difference in CO2 emissions. Therefore, are local wood products used for the generic wall build up, both in respect to the local building traditions and the CO_2 emissions.

As the U-value for one building component are not enough to judge if the complete building will reach the energy demands in the Swedish building regulation, the generic wall presented here might be adjusted when the Interpretation Centre is more developed.



ill. 188. Generic exterior wall

Generic exterior wall 319 mm
U-value: 0,12 W/m²K

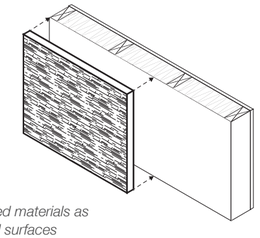
1. Wood Fibre wind-board // 12 mm
2. Wood Fibre insulation // 45 mm
3. Wood Fibre insulation & Wood frame cc 600 // 195 mm
4. Waterproof membrane
5. Wood Fibre insulation & counter joist cc 600 // 45 mm
6. Wood board // 2 x 11 mm

CULTURAL HERITAGE COLLECTION POINT

Strategy for cultural heritage involvement

Apply upcycled materials as external surfaces

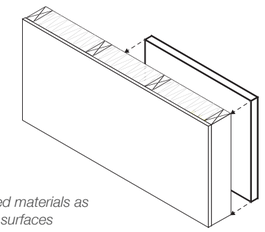
The external surfaces of the Interpretation Centre will be visible from the city and part of many peoples daily **view** from their homes and work places. By reusing materials from the old Kiruna they can be a symbol for the cultural heritage of Kiruna, both new and old.



ill. 189. Upcycled materials as external surfaces

Apply upcycled materials as internal surfaces

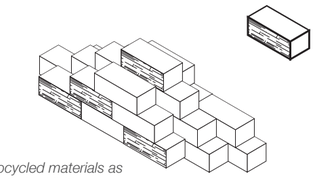
When visiting the Interpretation Centre, the upcycled materials can be a big part of the experience inside the Interpretation centre as internal surfaces. The material will be easy to access, get close to and **touch**. They will play an important role for the atmosphere, tactility and architecture of the centre.



ill. 190. Upcycled materials as internal surfaces

Showcase materials as exhibitions

Connection to the cultural heritage can also be given at the Interpretation Centre through exhibitions of materials or building parts. These can either be showcased in its original form but also processed into e.g. an art piece or as an exhibition where visitors can **interact** with the materials.



ill. 191. Upcycled materials as part of exhibition

CIRCULAR APPROACH

This chapter presents an approach to implement circularity into the project by using urban mining as a design strategy. Specific buildings are chosen for the urban mining and suitable materials are evaluated in terms of potential reuse and upcycling.

Ill. 192. Stadshus demolition

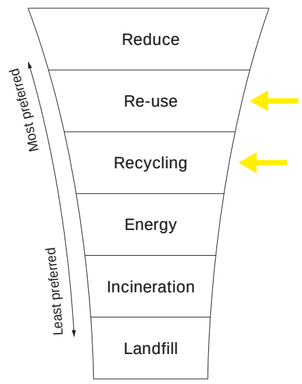
DESIGN FOR CIRCULARITY

Implementing upcycled material in the design process

The building sector stands for the largest amount of annual waste in Sweden, if excluding the mining sector. Out of 13 million tons of waste from construction and demolition in 2018, only 1,8% were recycled while 83% was used as landfill and the rest was mainly incinerated as energy recovery. As landfill is the least wanted output in the waste hierarchy (ill. 193) ongoing initiatives from industry organisations aims to prevent generation of construction and demolition waste and improve recycling and reuse of materials (Naturvårdsverket, 2020). From EU, the goal for 2020 was that 70% of the total construction and demolition materials should be recycled and reused (Regerinskansliet, 2020). This thesis will have a large focus on a circular approach in the design phase as Kiruna has a huge potential to decrease the waste amount and embedded energy in new constructed buildings by reusing materials from demolished buildings. As 80% of a construction's environmental impact are determined in the design phase (The European Commission, 2020) it is important to include upcycling as early as possible.

A circular economy, according to Ellen MacArthur Foundation (2017), is based on three principles: Design out waste and pollution, keep products and materials in use, and regenerate natural systems. The circular approach is designed to benefit businesses, society, and the environment where the built environment play an important role to drive a global transition towards circularity. Upcycling of building materials are a big part of a circular economy and it can both have a positive impact on human and natural systems and are essential for reaching climate-neutrality. The demands for new materials later possible to upcycle is that they should be renewable and non-toxic so they in the end can be returned to the biosphere (Ellen MacArthur Foundation, 2017; The European Commission, 2020). In Sweden, a system to log where and what materials are in the buildings, has been developing since 2014. A new demand from 2020 also put a focus on documenting materials possible to later reuse and how they should be taken care of when they are dismantled and reused (Naturvårdsverket, 2020). The challenge with upcycling old building materials is, however, that it can be hard to identify the properties and the presence of toxic substances of the materials as the demands for them might have looked different when they were added to the building. The focus on upcycling for this thesis will therefore be limited to materials easy to identify, as wood, glass, bricks, concrete, and metals, which will be based on assumptions that the materials chosen are safe to upcycle.

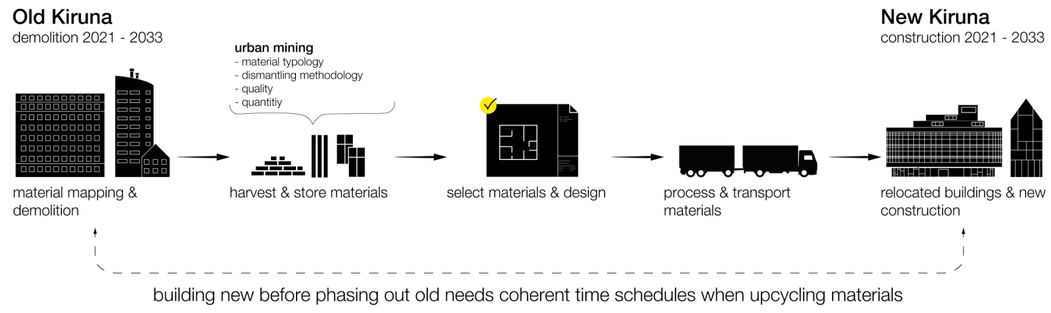
A big challenge with upcycling connected to Kiruna's unique situation is that demolition time plans, and design phases and time plans for new constructions need to interlock with each other (M. Strålberg, personal communication, 2020-11-13). However, it is the building owner's responsibility to take care of the construction and demolition waste (Boverket, 2021) and therefore also responsible for making materials accessible and possible to upcycle. The extraordinary situation in Kiruna, where LKAB buys all property not already owned by themselves before demolition, make them responsible for



ill. 193. waste hierarchy & project aim

all expected demolition waste in Kiruna. This is approximately 480 000 m² of constructed area (Kiruna Kommun, 2014). To reach the national and European goals for upcycling of materials, it seems that LKAB should set a larger focus on how they should map, harvest, process, and store materials to later reuse them in new constructions. As LKAB also are owned 100% by the Swedish government it is a great opportunity to set an example on how this should be done on a national level.

In theory, a circular economy and upcycling of materials might seem rather simple. In practice, there are still challenges with lack of knowledge, but also with legislation and regulations which must be changed to simplify for and enable circularity. The construction sector needs education and tools to be able to build and demolish in the proper ways but it is stated that the sector has a huge potential to move towards circular flows, be more energy-efficient and increase the upcycling and reuse of materials (Fossilfritt Sverige, 2018). This thesis is therefore aiming to work as a pilot project that set principles on how materials from soon demolished buildings in Kiruna can be mapped, harvested, repurposed, and then reused in the Interpretation Centre at the TGA-area. The possibility of decreasing the global impact is weighted high together with the symbolism of doing upcycling concerning cultural heritage in a city where major areas will be demolished and gone in just a few years.



ill. 194. Inverted design process when upcycling materials from Old Kiruna

TECTONIC SOLUTIONS FROM CIRCULAR THINKING

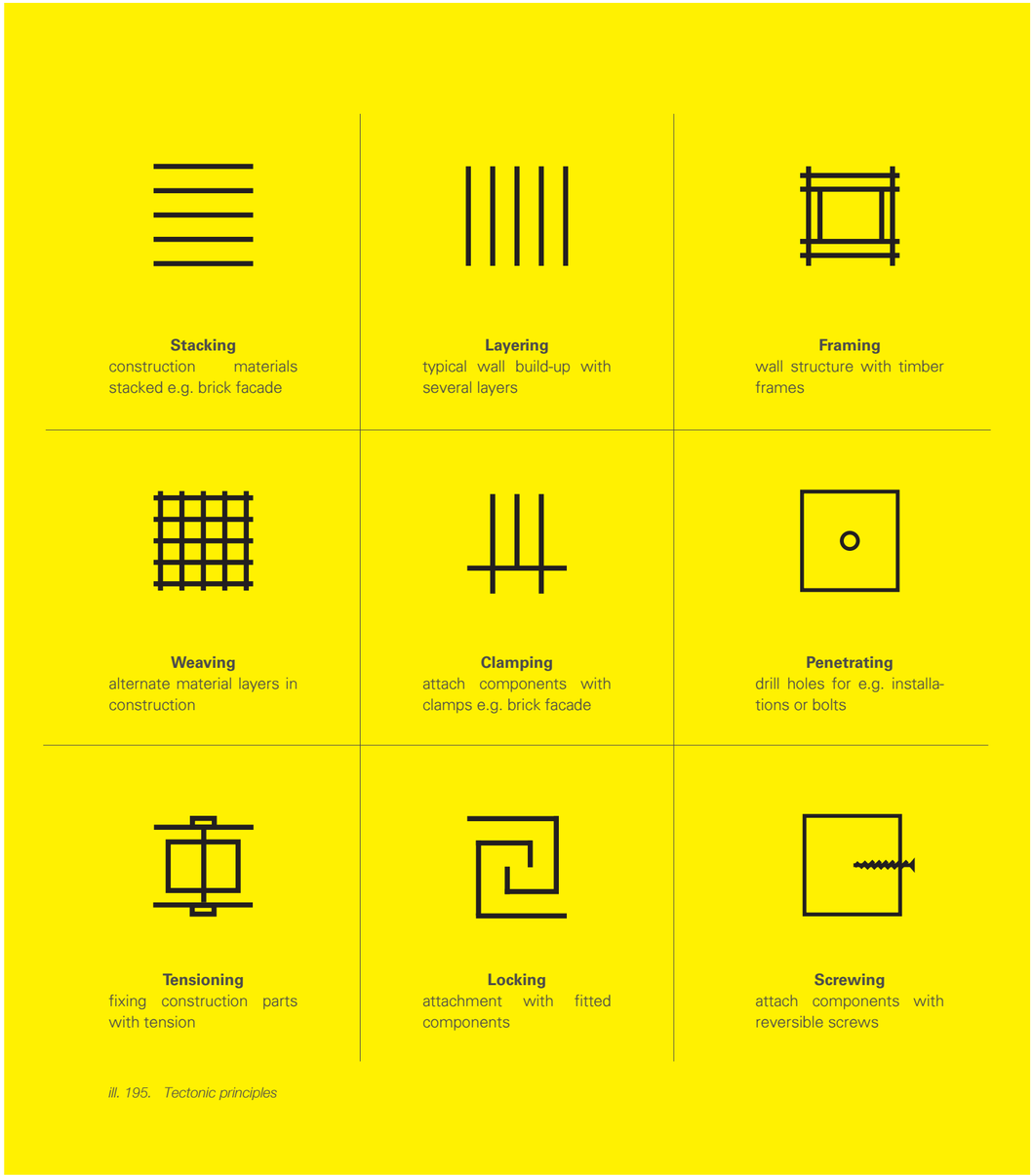
Boundaries and possibilities for materials

Circular principles at component and material levels must be considered early in the design process to avoid the creation of waste. This put demands on reversible architectural solutions where components and materials can be upcycled with principles allowing the highest possible total value of the parts when a building is dismantled (Beim et al., 2019). In old constructions reversible principles might be less used, where e.g. nails, hard to remove from a construction without causing damage, traditionally have been used in Swedish wooden frames and constructions. Tectonic solutions regarding material choices, building principles, and architectural solutions for both new constructions and old are therefore necessary to consider when designing with a circular approach and upcycling of materials. Tectonic solutions derived from circular thinking for this project regards both the mapping and harvesting of old materials as well as new construction principles.

When considering upcycling materials from the old buildings in Kiruna, the tectonics are relevant when mapping and harvesting the materials. The traditional tectonics set the boundaries if materials can be upcycled or downcycled and reused or repurposed in the design of the Interpretation Centre. The tectonics also addresses the cultural and aesthetic dimension of the detailing of the buildings (Beim et al., 2019) which can be of inspiration for the architectural expression of the new construction.
When designing the Interpretation Centre with a circular approach, the tectonics according to Beim et al. (2019) set the following design principles for new constructions:

- Minimize the amount of material and the number of different materials in a construction
- Construct details and use building methods possible to disassemble (ill. 195)
- Use natural, durable, and non-toxic materials with low embedded energy

The principles will be followed by considering a life cycle assessment of each material from specific buildings chosen for urban mining.



ill. 195. Tectonic principles

URBAN MINING

Determine the material inventory for circular use

As the whole city centre of Kiruna is about to be demolished, an abundance of material is potentially available for circular use. In order to choose the materials that give the highest symbolic value for the broadest section of the population in Kiruna, three-building typologies have been chosen as material mines: a classical Swedish single-family house, a multi-family apartment complex and public buildings. Specific buildings are then chosen from each of the typologies representing different time-frames. The buildings are not chosen for their architectural quality but because they symbolise the general architectural heritage of the old city centre in Kiruna. As said stated earlier, cultural heritage can be everything relating man to the past and includes all layers of a society.

The urban mining of materials will be focused on the exterior cladding and the structural system to find materials that will be considered for circular use in the interpretation centre. The structural system have been analysed in the cultural heritage chapter and therefore can be estimated with a realistic possibility. The exterior also holds a symbolic value for a larger amount of Kiruna's residents as the outside expression contributes to the built heritage of a neighbourhood and thereby not limited to a specific family. The exterior materials and structural system are also the typical building components with the longest lifespan and therefore more suited for circular use (Li et. al., 2019).

The materials are then quantified and measured manually (appendix 4). And studied in terms of quality and potential dangerous chemicals. The quality assessment have been done by visual inspection, while the chemical content are classified with the none, low, high or very high categories based on the materialeatlas (Oberender & Butera, 2016). The first three categories can be considered for further circular use while the category "very high" is being discarded due to the amount of chemicals. The chemical levels have been studied to consider the impact on the indoor climate along with the health of the workers that are handling the materials during processing.

ill. 196. Single-family housing

ill. 197. Multi-family housing

ill. 198. Key-buildings

ill. 199. Chosen single family house

ill. 200. Chosen Multi-family house

ill. 201. Chosen public building 1

ill. 202. Chosen public building 2

table 3. Material inventory

SINGLE-FAMILY	Material	Quantity	Quality	Chemicals
Load bearing structure	Solid plank wall	499 m²	?	None
Facade	Painted timber cladding	499 m²	Good	High
Roof	Steel sheets	547 m²	Good	Low
Foundation	Natural stone	256 m²	?	None
Windows glass	2 layer glass	40 pcs.	Good	None
Window frame	Painted wooden frame	40 pcs.	Good	High
Other details	Porch, drainpipes, wooden trusses, white doors	-	-	-

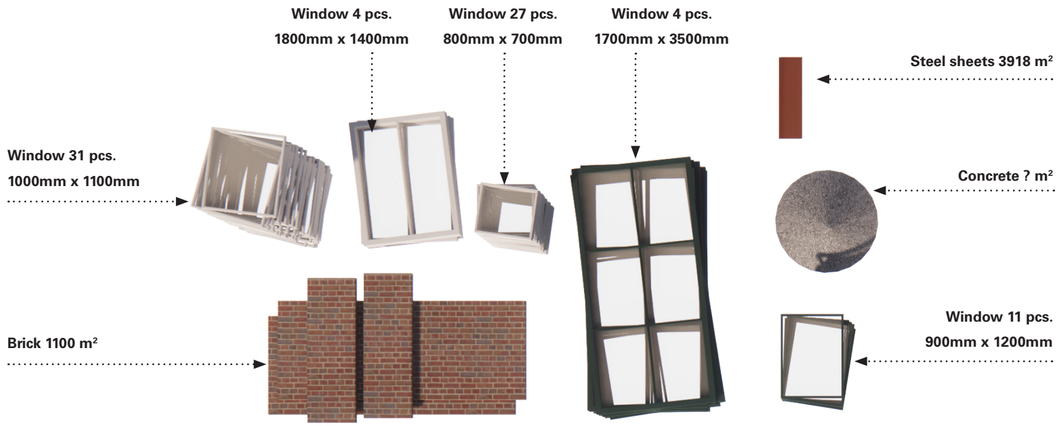
MULTI-FAMILY	Material	Quantity	Quality	Chemicals
Load bearing structure	Solid plank wall	489 m²	?	None
Facade	Painted timber cladding	489 m²	Good	High
Roof	Clay roof tiles	386 m²	Good	Low
Foundation	Natural stone	163 m²	?	None
Windows glass	2 layer glass	55 pcs.	Good	High
Window frame	Wooden frame	55 pcs.	Bad	High
Other details	Balconies, drainpipes, doors, wooden trusses	-	-	-

FIRE STATION	Material	Quantity	Quality	Chemicals
Load bearing structure	-	-	-	-
Facade	Clay brick, cement mortar	1100 m²	Good	Low
Roof	Steel sheets	3918 m²	Good	Low
Foundation	Concrete	?	?	Low
Windows glass	2 layer glass	96 pcs.	Good	None
Window frame	Aluminium wooden frame	96 pcs.	Good	High
Other details	19 gates, doors, lamps, drainpipes	-	-	-

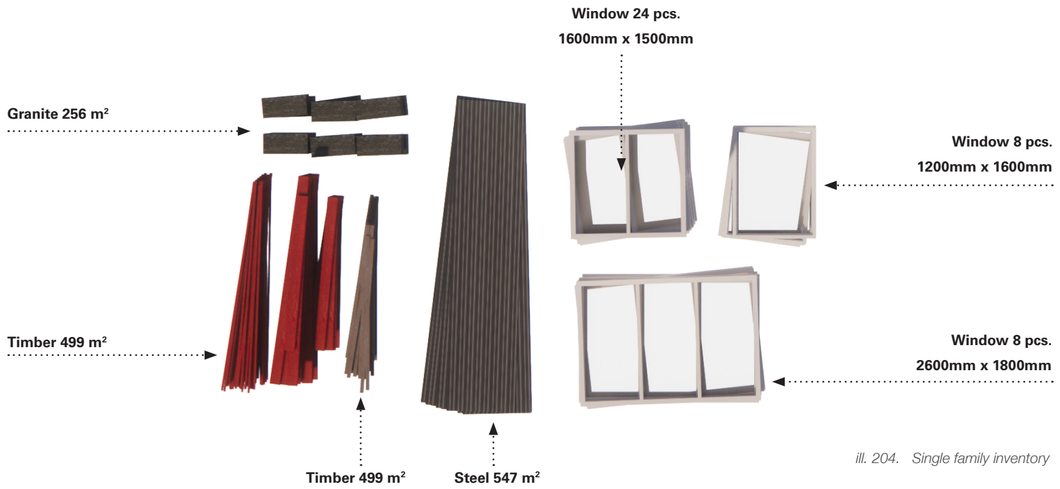
GYMNASIUM	Material	Quantity	Quality	Chemicals
Load bearing structure	-	-	-	
Facade	Clay brick, cement mortar	2627 m²	Good	Low
Roof	Roof felt	5737 m²	?	Very high
Foundation	Concrete	?	?	Low
Windows glass	2 layer glass	465 pcs.	Good	High
Window frame	Painted wooden frame	465 pcs.	Bad	High
Other details	Doors, downpipes, wooden details, copper sheets	-	-	-

MATERIAL INVENTORY

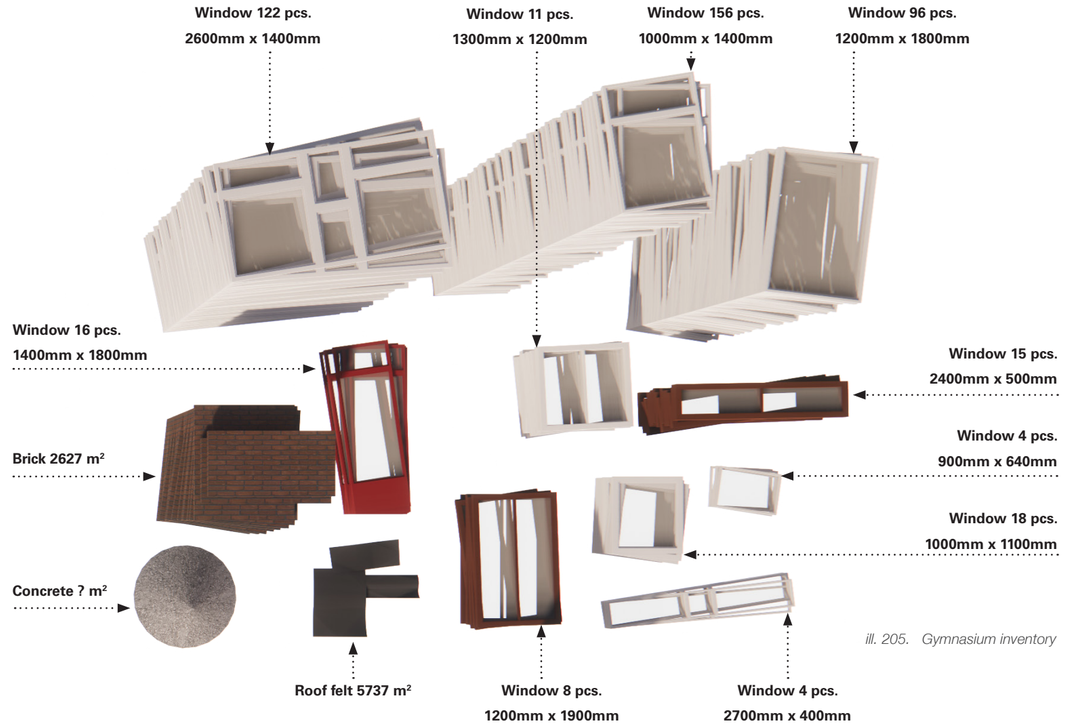
Overview of the mapped materials for the four buildings



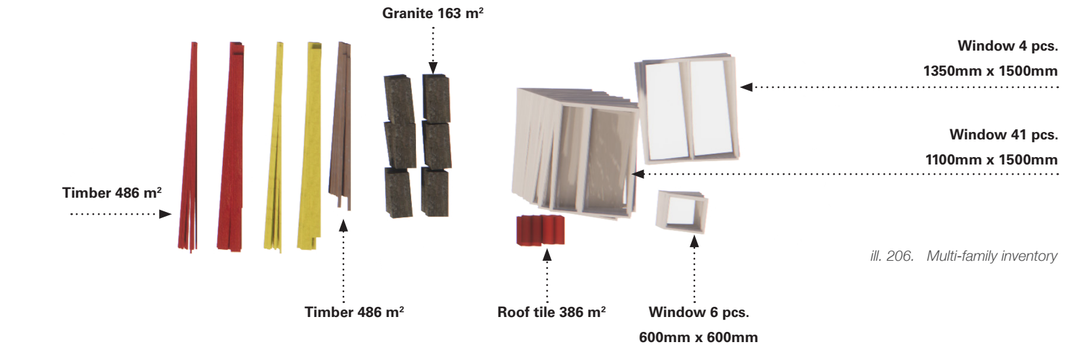
ill. 203. Fire station inventory



ill. 204. Single family inventory



ill. 205. Gymnasium inventory



ill. 206. Multi-family inventory

WINDOWS

Cost 140 kg CO_2 per pcs. when turned into waste after demolition

ill. 207. Windows

What a window can be beside waste

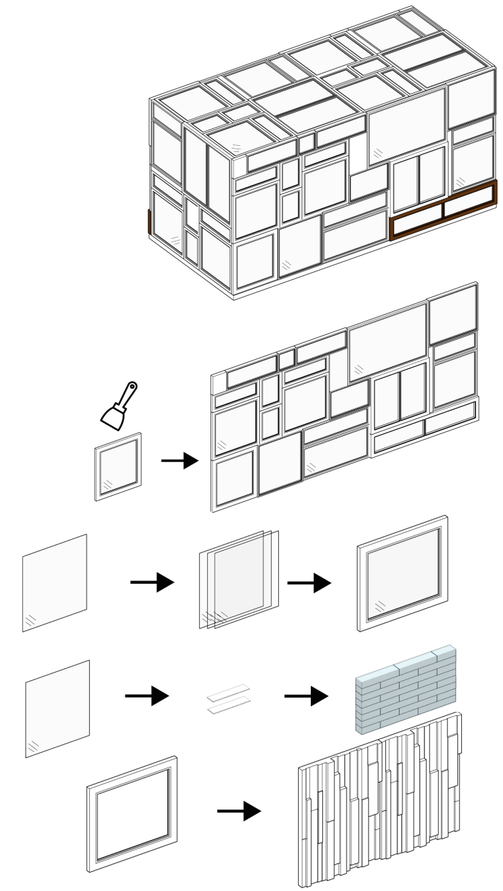
CONSERVATORY
Windows are screwed together as they are. Only possible if there are no energy requirements

CURTAIN WALL
Paint needs to be removed to avoid toxins inside. Windows are then screwed together to make an interior curtain wall.

UPCYCLED WINDOW
Check U-value on glass and insert needed amount into new frame.

GLASS BRICKS
Glass are cut into pieces and assembled with low viscosity silicone.

UPCYCLED WOOD PANEL
Panes are cut to pieces and assembled into an interior wooden panel.



ill. 208. Up- or downcycling principles for windows

CONCRETE

Cost 299 kg CO_2 per m^3 when turned into landfill after demolition

ill. 209. Concrete

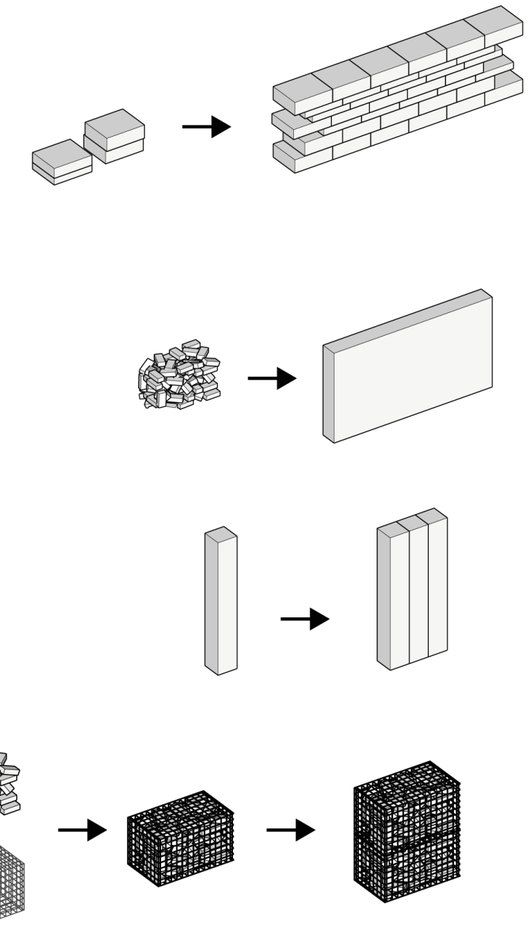
What concrete can be beside landfill

UPCYCLED CONCRETE BLOCKS
Concrete foundation and facade elements are cut into blocks for new facade material. Height and length could vary.

RECYCLED CONCRETE
The concrete are used as aggregate in new concrete.

REUSED CONCRETE ELEMENTS
Beams and columns are used as new walls in their original size, requires the dimensions to fit.

CONCRETE GABION
Concrete are cut into pieces and filled in gabion modules and then stacked. The modules are locked together with a steel wire into a facade.



ill. 210. Up- or downcycling principles for concrete

BRICKS

Cost 542 kg CO_2 per m^3 when turned into landfill after demolition

ill. 211. Bricks

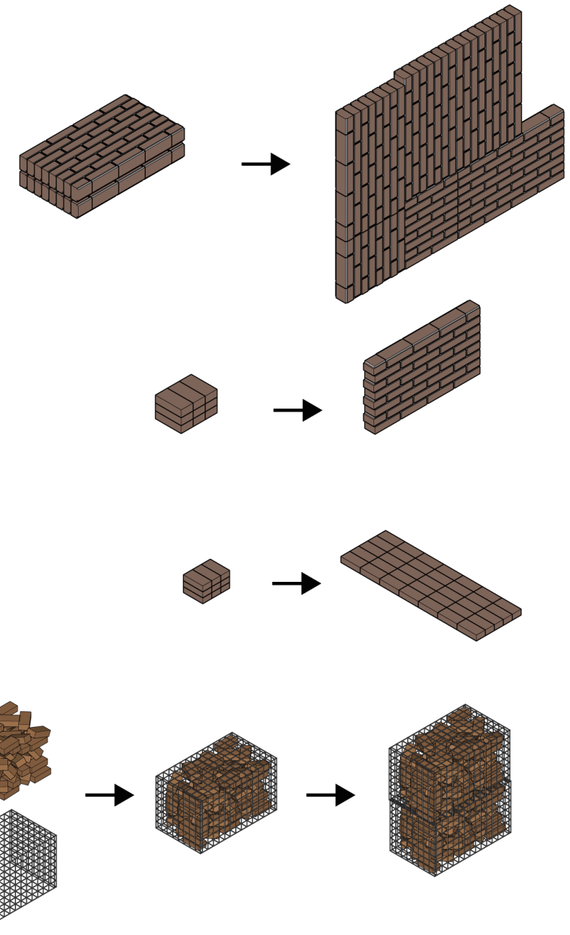
What bricks can be beside landfill

BRICK MODULES
Brick modules are cut in modules and assembled in larger patterns as facade material.

RECYCLED BRICK FACADE
Bricks are cleaned for excess mortar and layed as a new facade. Only possible with lime mortar.

RECYCLED BRICK PAVEMENT
Bricks are cleaned and laid as pavement. Only where there are no structural requirements.

BRICK GABION
Broken bricks are used as fill in gabion blocks and then stacked as modules. The modules are locked together with a steel wire into a facade.



ill. 212. Up- or downcycling principles for bricks

STEEL SHEETS

Cost 35680 kg CO_2 per m^3 when remelted into new metal after demolition

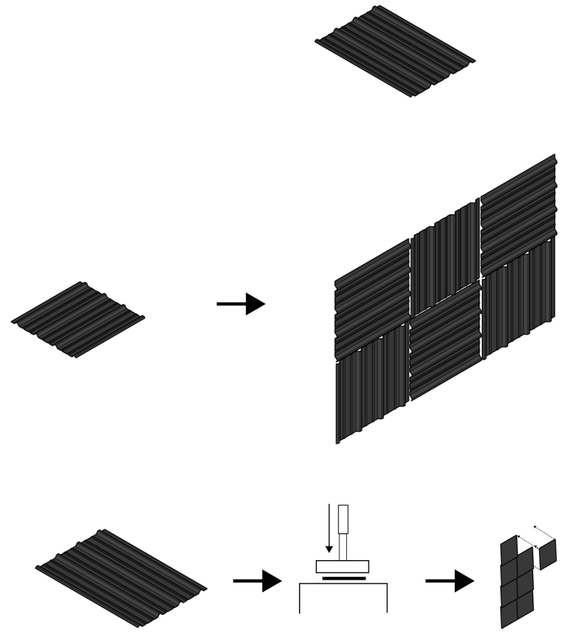
ill. 213. Steel sheets

What steel can be beside remelted

RECYCLED STEEL SHEET
Steel plates are dissembled and then refitted in the original shape as either roof or facade cladding.

STEEL MODULE
The steel plates are cut in modules and assembled in a system with bolts. Could be used as ceiling.

STEEL SHINGLES
The bended steel sheets are pressed flat and the cut to shingles and then screwed into a new facade.



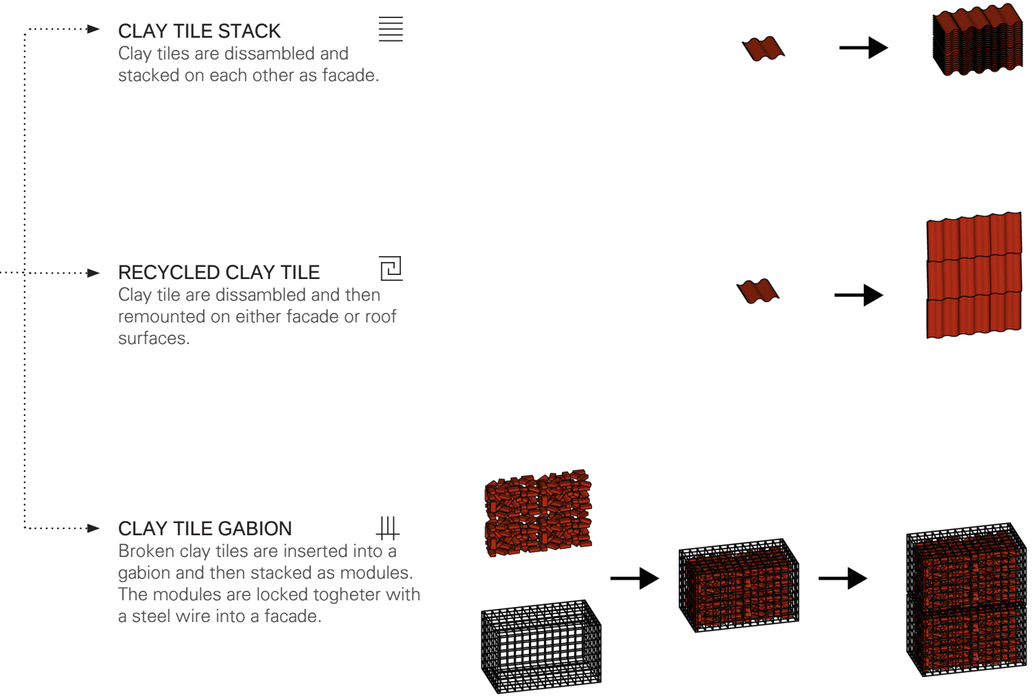
ill. 214. Up- or downcycling principles for steel sheets

CLAY TILE

Cost 1079 kg CO_2 per m^3 when turned into landfill after demolition

ill. 215. Clay tile

What clay tiles can be beside landfill



ill. 216. Up- or downcycling principles for clay tile

TIMBER

Cost 93 kg CO_2 per m^3 when incinerated after demolition

ill. 217. Timber

What timber can be beside incinerated

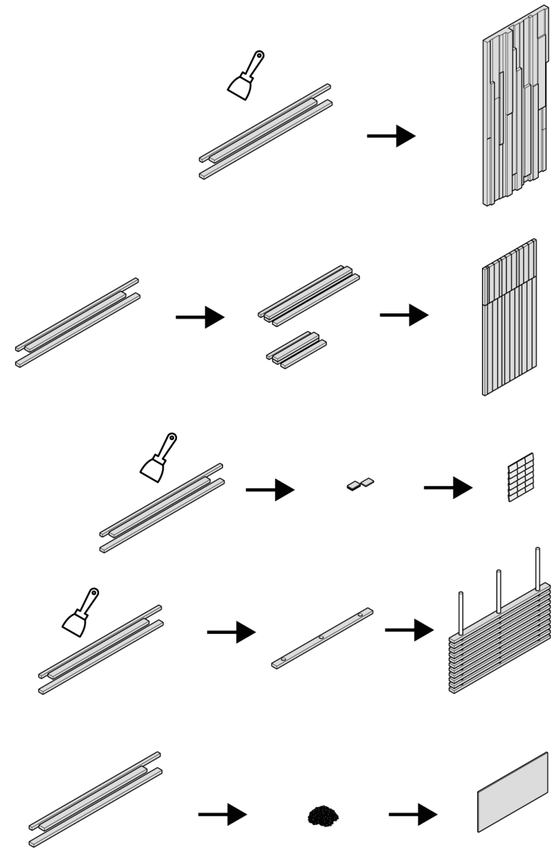
LAMELLA WALL
Salvaged timber are cleaned for paint and assembled with screws into an interior lamella wall in their original shape

RECYCLED TIMBER
The timber are cut into certain lengths and assembled with screws into a new facade cladding

TIMBER SHINGLES
Timber are cleaned for paint and cut into shingles and screwed into a backplate

TIMBER STACK
Wide boards of timber are cleaned for paint, holed and stacked on rods for interior walls

RECYCLED CHIPBOARD
The timber are being chipped and used in chipboard



ill. 218. Up- or downcycling principles for timber

CIRCULAR APPROACH COLLECTION POINT

Evaluation of the material products

Carbon dioxide cost calculation

The materials from the four buildings have been quantified and qualified with the intend to be used for a circular approach instead of their intended end destination as either landfill or fuel for incineration. The CO_2 cost listed from each of the materials are based on data listed in the specific materials' EPDs. And include the product- and end of life stages;

A1 (Extracting and processing raw material)
A2 (Transportation of raw material)
A3 (Manufacturing of the product)
C3 (Waste processing)

The products listed from each of the materials are all based on either upcycling or recycling and will as a result avoid both the product- and end of life stages listed above for the material itself. Only the process of dismantling, reshaping, transporting and the required tectonic method needed for the materials to be assembled should be included in the CO_2 cost. The reuse and upcycling will further have a positive benefit as stated in the EPDs. Due to too many uncertain parameters and assumptions when manufacturing new products out of upcycled materials, the products will be evaluated through soft pointers instead of hard numbers in this project. Specifically the phases bellow are hard to determine actual CO_2 emissions, energy usage and pollution levels from when dealing with upcycling:

A1 (Extracting and processing raw material for assembly)
A2 (Transportation of raw material for assembly)
A3 (Manufacturing of the product for assembly)
C1 (Deconstruction)
C2 (Transport)
D (Reuse, recovery and recycling potential)

Evaluation

The soft pointers can give an indication of the energy intensity needed along with the recognition and atmospheric qualities they posses.

Process energy

An estimation of how much energy is needed to transform the material into the new product. The evaluation have been simplified to include low, medium and high and are based on the tools needed to transform the material.

Process labour

The labour process is based on estimations on how many man-hours that are needed. A larger change of the material and use of small irregular pieces are deemed high on this scale. The evaluation includes low, medium and high.

Recognition

The new material products should reflect the cultural heritage of the old Kiruna and should be clearly recognizable in terms of colour, shape or texture. The recognition can be low, medium or high.

Atmosphere

What atmospheric traits does the new material product have; tactile, transparent, smooth, mat or glossy.

table 4. Material evaluation

Material	Process energy	Process labour	Application	Atmosphere	Recognition
Windows					
Conservatory	Low	Low	Window in non heated space	Transparent	High
Upcycled window	Low	High	Exterior window	Transparent	Medium
Interior walls					
Upcycled wood panel	Low	High	All surfaces	Tactile	Medium
Lamella wall	Low	High	All surfaces	Tactile	Medium
Curtain wall	Low	Low	Interior divider	Transparent	Medium
Timber stack	Low	Medium	Facade / interior wall	Semitransparent	Medium
Glass bricks	Medium	High	Interior divider	Semitransparent	Low
Reused concrete elements	Medium	Low	Interior wall	Smooth, mat	High
Facade					
Upcycled concrete blocks	Medium	Medium	Heavy facade	Tactile	Medium
Timber shingles	High	Medium	Facade, interior wall / roof	Tactile	Low
Concrete gabion	Medium	Low	Heavy facade	Tactile	Medium
Brick modules	High	Medium	Heavy facade	Tactile	High
Recycled brick facade	Low	High	Heavy facade / interior wall	Tactile	High
Brick gabion	Medium	Low	Heavy facade	Tactile	Medium
Recycled timber	Low	Medium	All surfaces	Tactile	High
Clay tile gabion	Medium	Low	Facade	Tactile	Medium
Roofing					
Recycled steel sheet	High	Medium	Roof	Smooth	High
Steel module	Medium	Low	Ceilings / walls	Smooth	High
Steel shingles	High	Medium	Light facade / roof	Smooth	Medium
Clay tile stack	Low	Low	Facade / interior walls	Tactile	High
Recycled clay tile	Low	Low	Roof / Facade	Smooth	High
Structure					
Recycled concrete	High	Medium	Structural / walls / floors	Tactile	Low
Recycled chipboard	High	Low	Interior surfaces	Tactile	Low
Recycled brick pavement	Low	High	Pavement	Tactile	High

DESIGN DEVELOPMENT

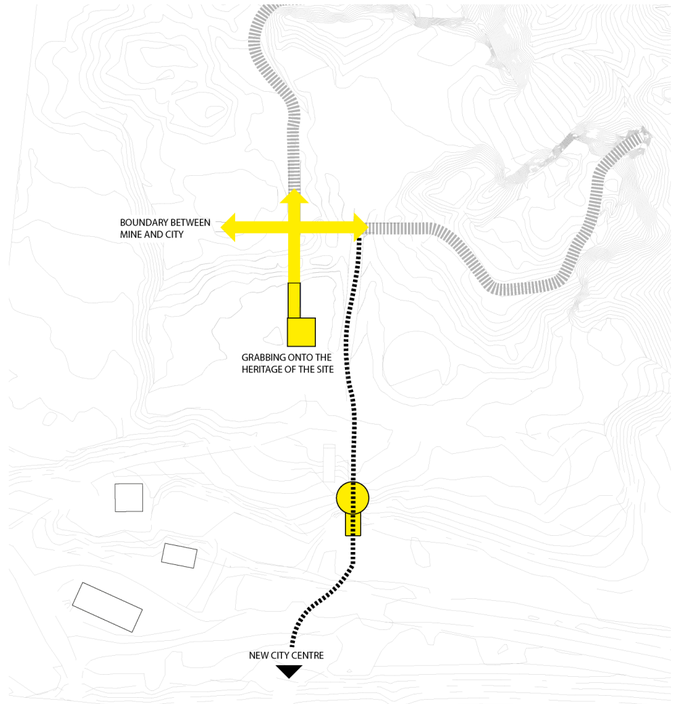
This chapter unfolds the continued design process focusing on developing the concept based on the principles found in the respective collection points by integrating simulations and evaluations.

ill. 219. Own Illustration

VISION

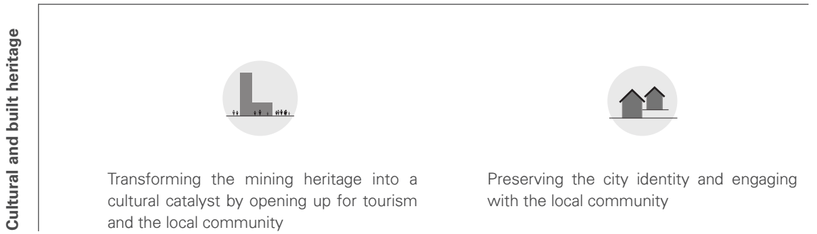
This project aims to reform the on-going and prospective relocation of Kiruna by conveying a narration of the past as well as informing and inspiring the future. By placing the interpretation centre in an abandoned mine landscape, the narration is articulated through an in-situ experience of the industrial and natural heritage. Through a circular approach, the architecture should engage the cultural and built heritage to inspire and intrigue the senses of the visitors while preserving the local identity.

CONCEPT



ill. 220. Design concept

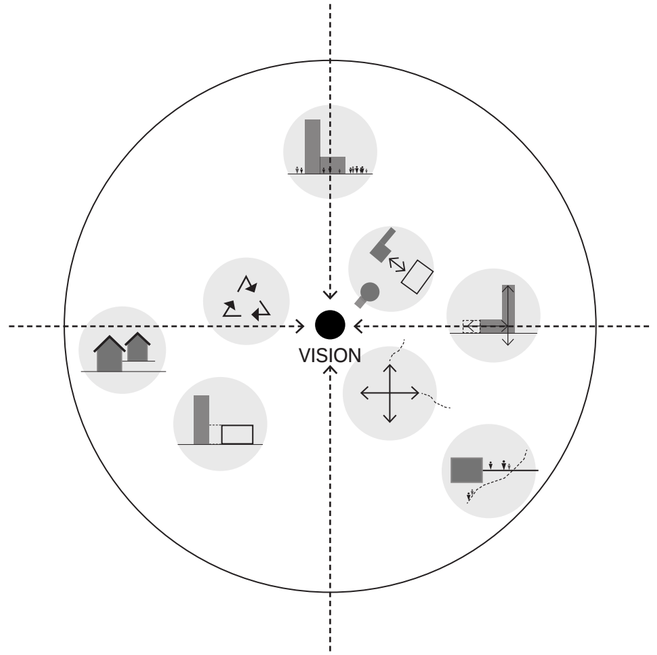
DESIGN DRIVERS



HIERARCHY

Cultural heritage

Personal narrations
Memories
Traditions
Norms
Atmospheres
Photos
Written history
Vernacular architecture
Present architecture



Industrial heritage

Mining buildings
Mining remains
Mining infrastructure
Mining work process
Minerals
Materials
Mining machinery
Mining surroundings

Built heritage

Building traditions
Vernacular architecture
Architectural works
Local use of materials
Sites
City identity

Natural heritage

Natural geological sites
Flora and fauna
Land deformations
Scenery

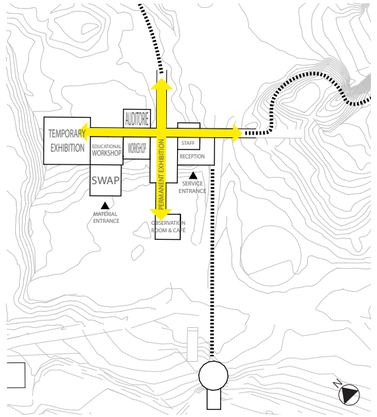
PLAN ITERATIONS

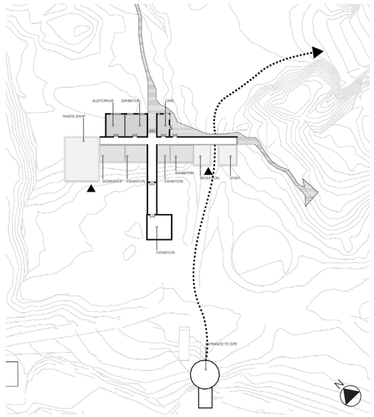
Connecting the towers and deformation zone thorough axis paths

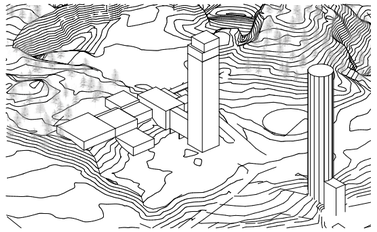
The initial plan study (ill. 221 - ill. 224) integrates the room program to the design concept. The room functions are placed in relation to the axis to connect the mining tower to the functions in the Interpretation Centre.

The plan iterations identified unclear user flows and access points, mostly due to the sloping terrain. One challenge was to provide entrance access to the tower and the scenographic path. This lead to a access study for the building volume seen on the next page.

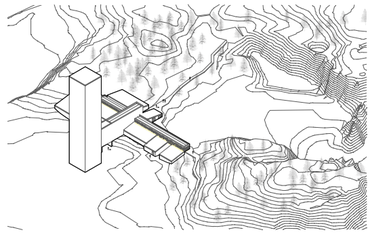
Design driver focus



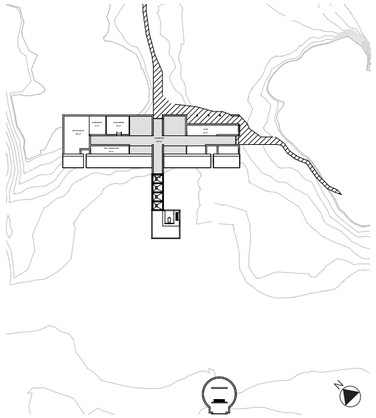


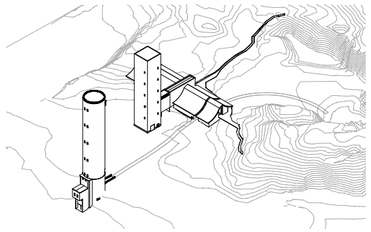


ill. 221. *Sizes of rooms in relation to the tower and terrain*

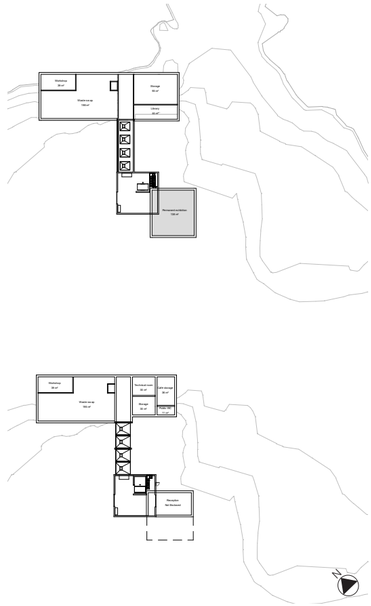


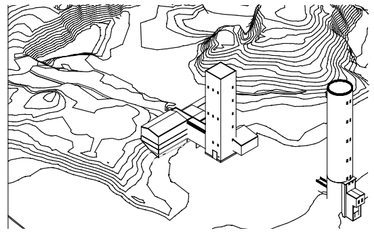
ill. 222. *Refining rooms and path in connection to the axis*





ill. 223. *Centring the exhibition space by integrating the axis space*





ill. 224. *Using the tower as part of other functions in the centre*

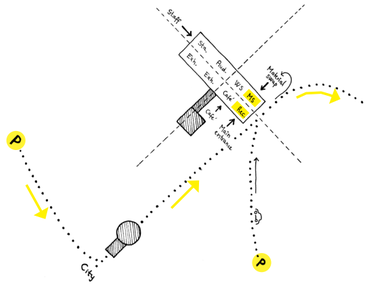
Access to the building

The placement of functions and accessibility studied in ill. 227 - ill. 226 show different iterations on the plan concept. Each investigation addresses the relation to parking, car access points and user flows.

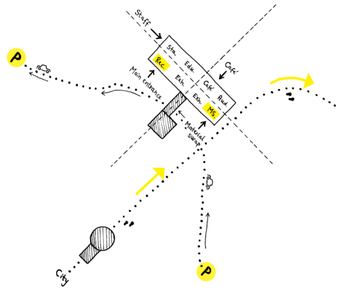
Concept 1
The main entrance is placed as in concept 2 accompanied by a parking lot on the right side of the towers. The urban mine is situated on the right backside of the centre meaning that the walking path will be combined with a car road to access it. There will be no car road connected to the exhibition area.

Concept 2
The main entrance is placed in the left corner of the building in close relation to the parking lot. The urban mine is situated in the right side of the building and creating a passage where cars can tip of materials without having to turn when leaving. This passage crosses the walking path and runs beneath the silos.

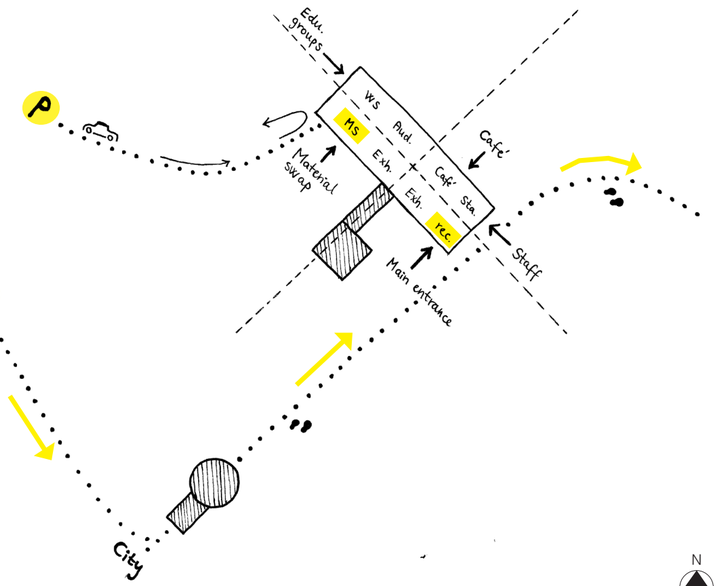
Concept 3
The main entrance is placed in connection with the public path on the axis of the round tower. Parking lots are situated on the left side of the towers with a pathway leading to the round tower. A road from the parking lot allows access by car to the urban mine, which doesn't disturb the walking paths to the centre.



ill. 225. Concept 1



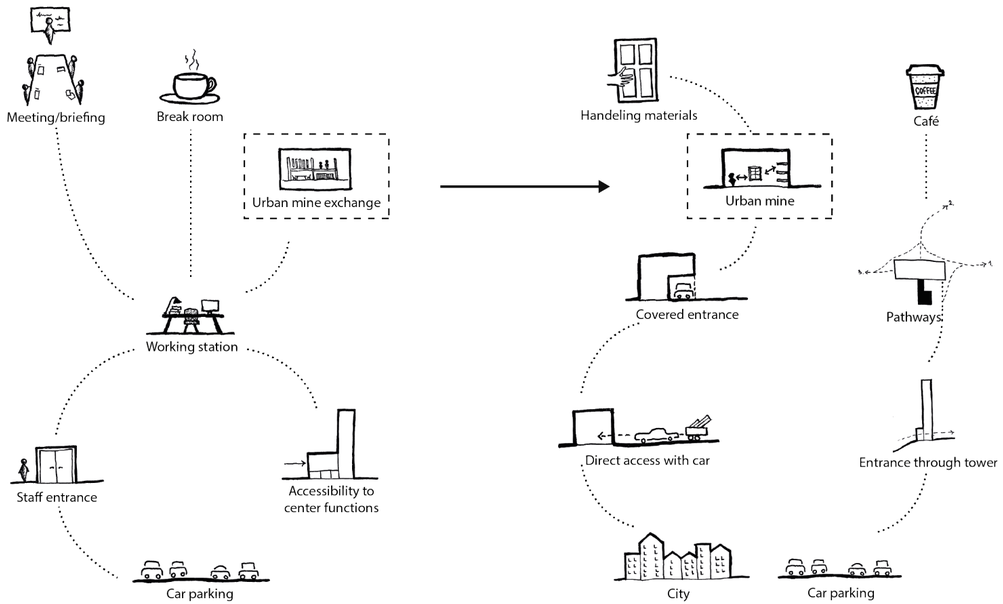
ill. 226. Concept 2

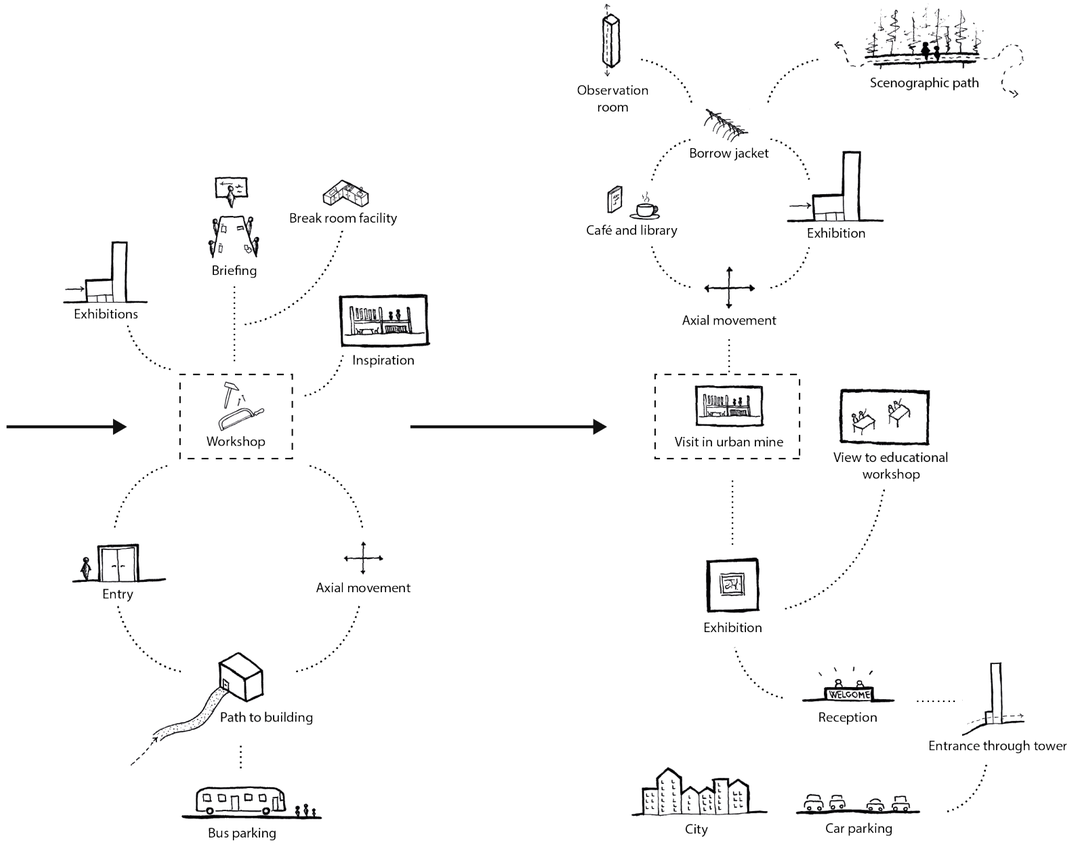


ill. 227. Concept 3

Merging flow and users within the Interpretation Centre

The illustration show how the user and material flow are planned to be integrated within the Interpretation Centre. It is highlighted that the material flow is central in the user flow as they are integrated in all of them. The ill. 228 highlights the material flow's importance in the interpretation centre and the relation between the users and materials.





ill. 228. User and material flows

THE MINING TOWERS

Tower ideation

Leaning towards the background knowledge about the content and function of the square tower (appendix 5) the ideation process of utilizing it for a future purpose is initialized with a sketching phase.

The ill. 232 explores different visual expressions and levels of interventions that provides different experiences for the visitor. As a common feature all the concepts involves a type of observation space or deck to provide views and different ways to perceive the tower and surroundings.

As the tower stand as an icon for Kiruna and with the placement in the new city centre the new visual expression from the city is important for the overall presentation of the Interpretation Centre.

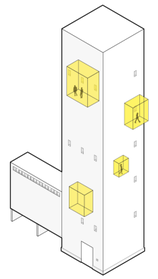
Due to the subarctic climate the experience for the visitor is highly reliant on the way heated/unheated and covered/uncovered spaces are distributed. The explorations unfold different variations of this, raising the question of how the tower should be utilized inside and which functions it should entail.

Design driver focus

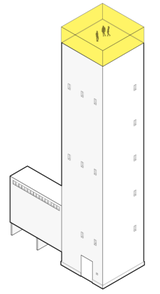
ill. 229. The square tower and silos

ill. 231. Beneath the silos

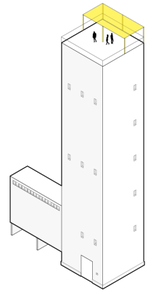
ill. 230. Verticality emphasized in texture and height



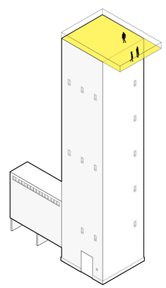
The add-ons



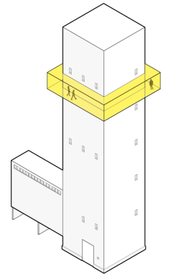
The hat



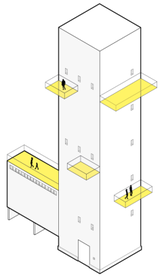
The platform



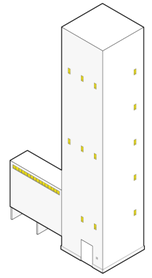
The cap



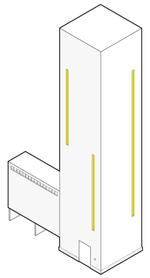
The parasite



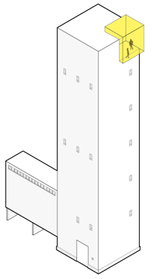
The decks



The original



The cut-outs



The box-in-box

ill. 232. Tower explorations

The experience of the tower

As established in the site concept the towers play an active role in achieving the experience of the industrial heritage on the site. This matrix strives to unfold and explore the possibilities of how to utilize the square tower by combining the four variables (ill. 233) resulting in different outputs. This is followed by an evaluation based on pre-set goals, which are derived from the earlier stages of the design process.

The goals revolve around the extent of interference to achieve a certain atmosphere and addresses both aesthetic and technical measures. The two combinations with the highest final score are carried out for further examinations.

Variables

STAIRCASE

ELEVATOR

COMFORT

FUNCTION

ill. 233. Variables for combinations

Evaluation parameters

Create an authentic and inclusive experience of the industrial heritage

Minimizing structural interventions

Keeping the historical architectural appearance

Minimize energy usage considering operation and renovation

ill. 234. Goals for evaluation

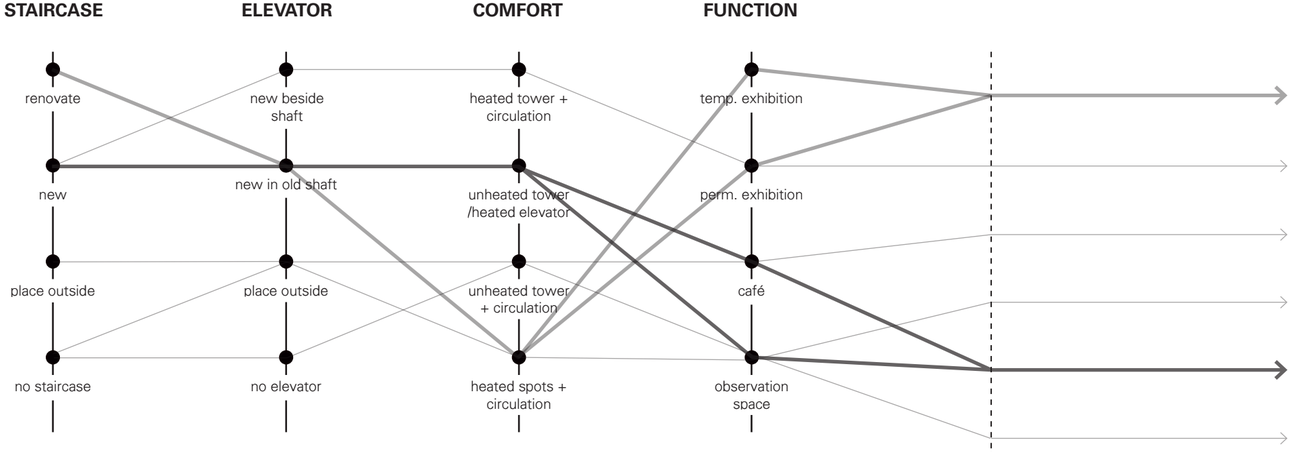
Degree of accomplishing the goals

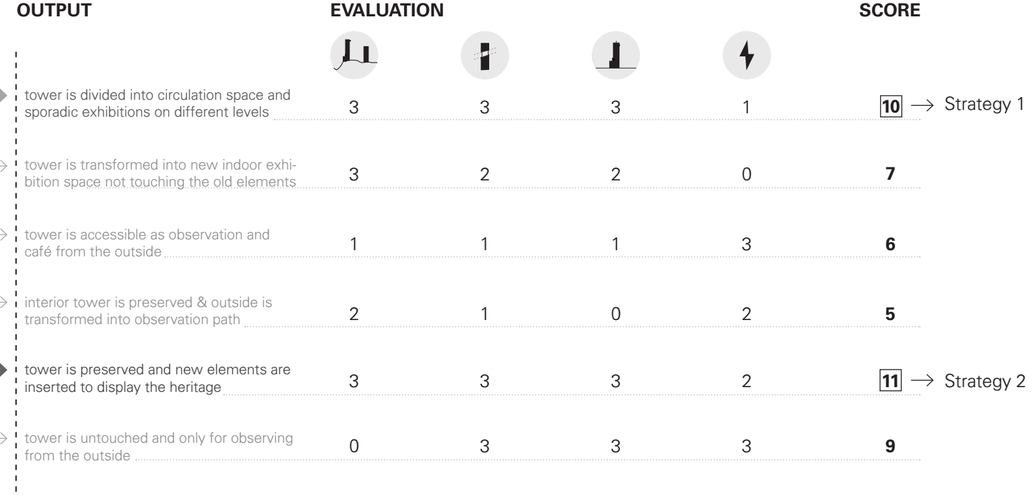
3 High

2 Middle

1 Low

0 Minimal



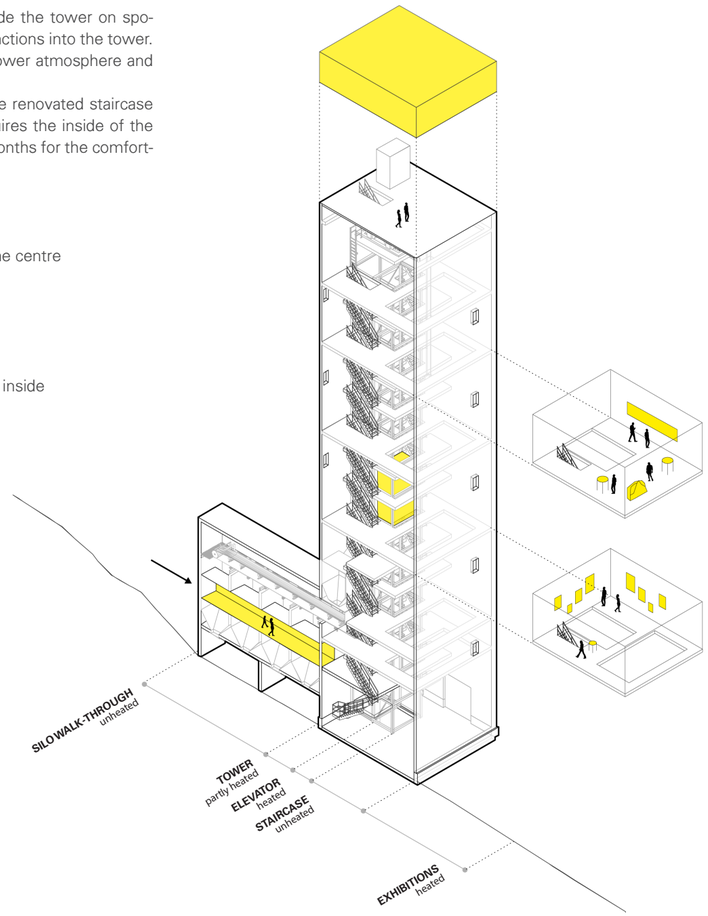


Evaluation of strategy 1

This strategy invites the exhibition space inside the tower on sporadic levels and thereby extends the centre functions into the tower. The focus will be split into experiencing the tower atmosphere and exhibitions.
The visitor can access the exhibitions from the renovated staircase or elevator in the old shaft. This strategy requires the inside of the tower to be partly heated during the coldest months for the comfortability of the visitors and staff.

+ Tower is an extension of the exhibitions in the centre
+ Activity on different levels

- Energy usage for operation
- Energy usage for renovation
- Risk of lack of authentic atmosphere
- Change of exterior expression due to heating inside



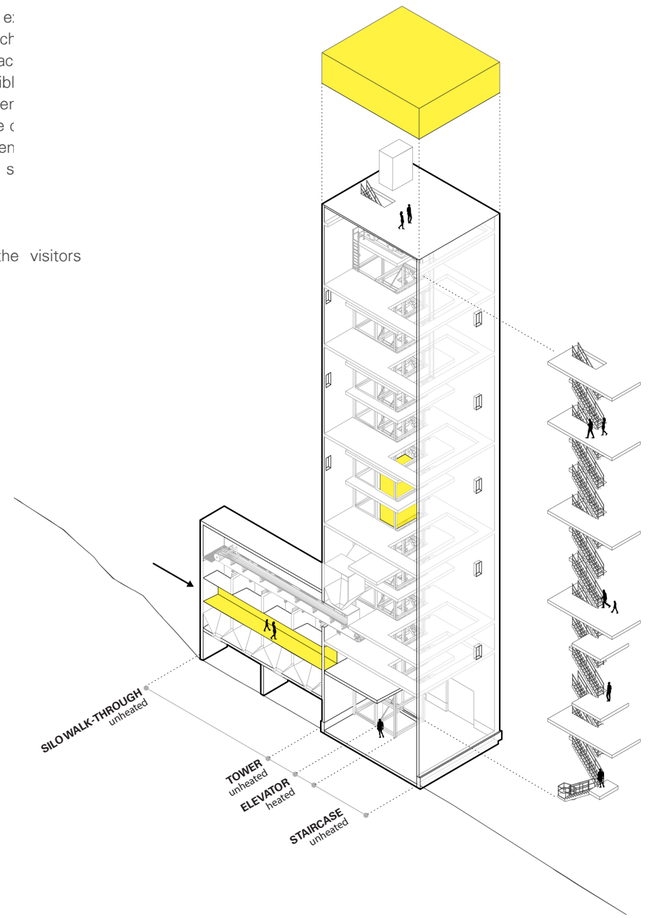
ill. 235. Strategy 1

Evaluation of strategy 2 (chosen)

This strategy focusses on giving the visitor an authentic e
of the tower, which is preserved in its original state as much
ble. The visitor can access the tower and observation spac
a new staircase from which the original staircase is visibl
elevator is inserted in the old shaft to provide the experier
original vertical transportation system in the mine. These
elements are the only activities on the tower, which inten
experience of the mining heritage. From evaluation this s
chosen to develop further in the project.

+ Tower distinguish itself from the centre giving the visitors an authentic experience
+ The outside expression of the tower remains
+ Low energy usage on operation and renovation
+ Original tower elements are preserved

- Unheated circulation space require outerwear
- Necessary safety precautions

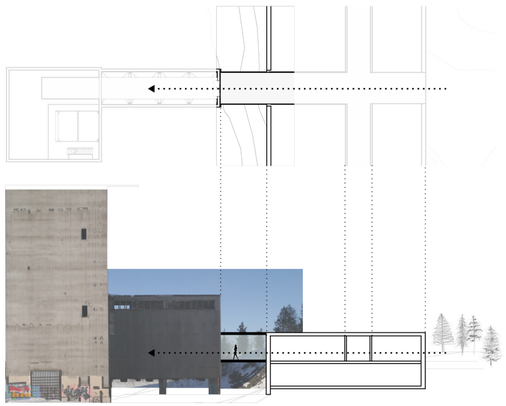


ill. 236. Strategy 2

Building placement in relation to terrain and existing structures

Glass walkway (chosen)
+ Builds up tension during transition
+ Easier navigation because of increased view
+ Clear division of new and old

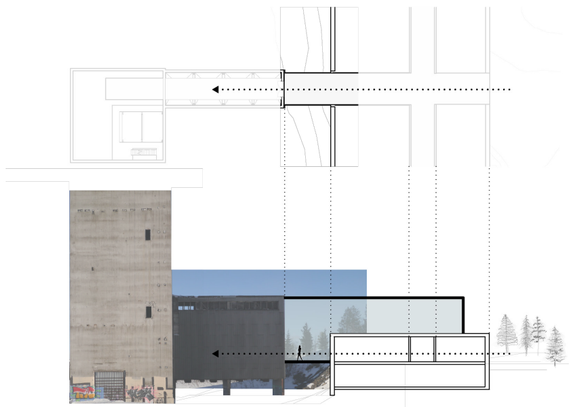
- Physical division between new and old
- Added energy usage for operation



ill. 237. Connection to tower 1

Glass walkway as extension
+ Builds up tension during transition
+ Easier navigation because of increased view
+ Clear division of new and old
+ Extending the volume

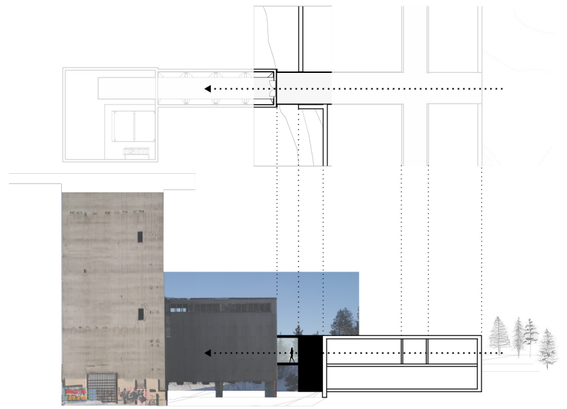
- Large volume and material usage
- Division from new and old
- Excessive added energy usage for operation



ill. 238. Connection to tower 2

Cut-in
+ Pushes the top rooms out
+ Easy navigation because of increased view

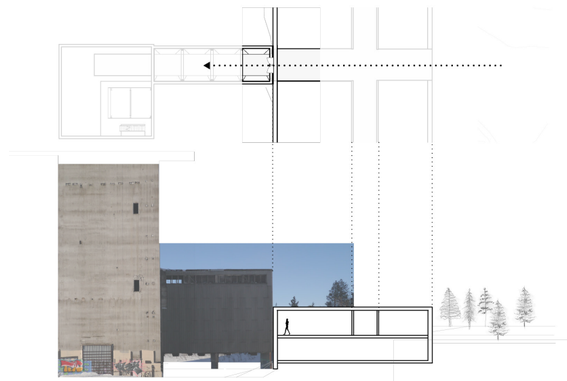
- Less clear transition
- Adds the only cut in the facade



ill. 239. Connection to tower 3

Directly placed next to
+- No walkway between masses
+ Easier navigation because of increased view
+ Clear division of new and old

- Less division between new and old
- No build up to the tower



ill. 240. Connection to tower 4

THE URBAN MINE

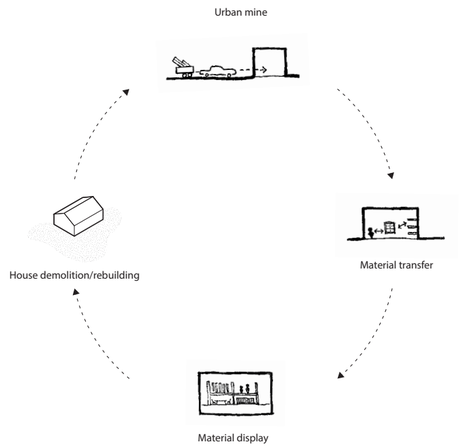
Merging heritage and upcycling to the experience

The large number of buildings that will be demolished in Kiruna are sources for materials possible to reuse and upcycle. Apart from using the materials for the Interpretation Centres architectural expression, the centre also aims to use the materials as part of the exhibitions and experience within the centre. A urban mine station where demolition materials can be left or retrieved by locals speaks for the circular approach of this project.

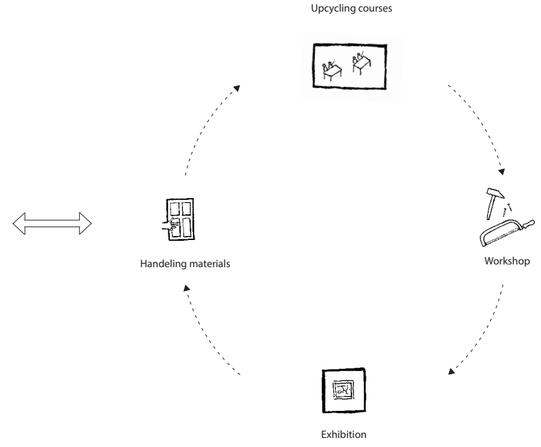
The urban mine can be seen as the gate where material enter the centre and where it then either can be bought by locals to be used in private projects or continue further on in the centre. By getting processed by educational groups or the staff and then exhibited, the visitors/tourist of the centre can view the end result. The material can also stand unprocessed as an exhibition to tell the story of a demolished building. By enabling the material to move on, develop and be exhibited in the Interpretation Centre, it gets activated and an important part of the experience. The centre can thereby stand as a role model on how materials from demolished buildings can be reused and upcycled, but also as a place where the materials can tell their own story.

Design driver focus

The function of the urban mine is therefore important for the Interpretation Centre, which put a high demand on how it is integrated into the centre. In ill. 243, principles of how materials can be displayed and stored are presented and described. The integrated and layered principles are chosen as the preferred and best suitable principles on how to store and display the demolition materials in the Interpretation Centre as they can activate the centre both vertically and horizontally.

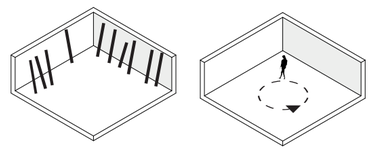


ill. 241. Circular approach

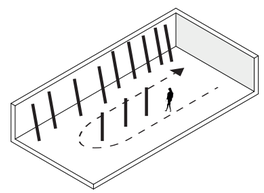


ill. 242. Educational approach

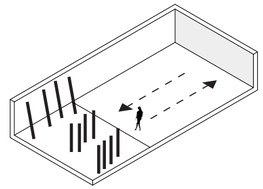
Divided
Urban mine located nearby the exhibition, but in a separate building.



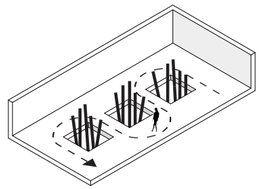
Integrated (chosen)
Urban mine as part of the exhibition and circulation.



Continued
Urban mine located in the end of exhibition and circulation area.



Layered (chosen)
Urban mine located under exhibition but with clear visual connection to spaces above.



ill. 243. Material storage and display principles

Combining storage and structure

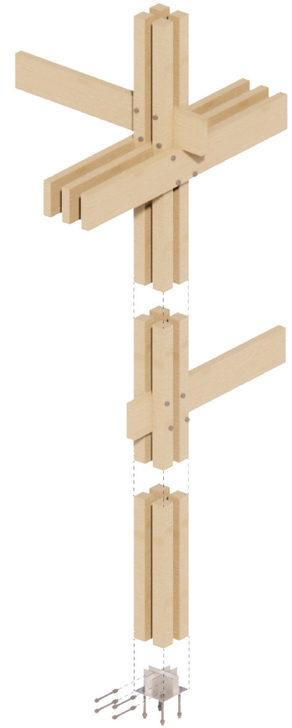
Typical storage in a warehouse often contains rows of shelves in a standardised system easy to read. But the principles to integrate and layer the urban mine into the Interpretation Centre puts other demands on the storage system. The idea to merge a standard storage system with the load-bearing structure allows making architecture out of a system that normally just is seen as practical.

The load-bearing structure is a column and beam structure in a 3 x 3 x 3 m system as seen in ill. 246. A zoom-in on the detail, as presented in ill. 247, shows the overall principle of how the beams and columns are assembled. Inspiration to the chosen system comes from the project Mediatek at Arkitetkskolen Aarhus, by Praksis Arkitekter (ill. 245). The system is flexible and gives the possibility to add storage and other functions to it.

ill. 244. Standard storage system

ill. 245. Load-bearing structure, Mediatek, Arkitektskolen Aarhus by Praksis Arkitekter

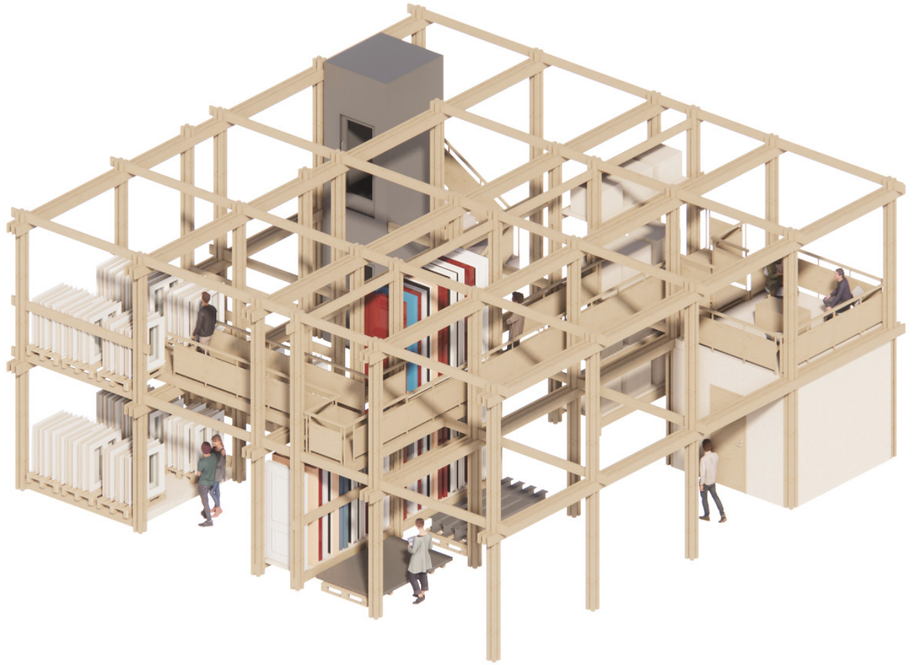
ill. 246. Load-bearing structure



ill. 247. Structure detail

Urban mine principle

In ill. 248 the concept of a combined solution of storage and structure are presented. The materials arriving at the urban mine are stored in the grid system and can be stored on several levels. Other functions added to the grid are both functions for the urban mine but also for the rest of the interpretation centre.
Presented in ill. 249 are the different alternatives of functions that can be placed in the grid system



ill. 248. Combined storage and load-bearing structure

Empty
An open section used where double height is wanted.

Room
The grid is closed into a room to divide functions.

Storage
Integrated storage in the structure grid for materials.

Path
A path between stored materials to reach higher up in the shelves.

Platform
An open platform used for seating or exhibition.

Transfer
Stairs and elevators connecting several levels in the grid.

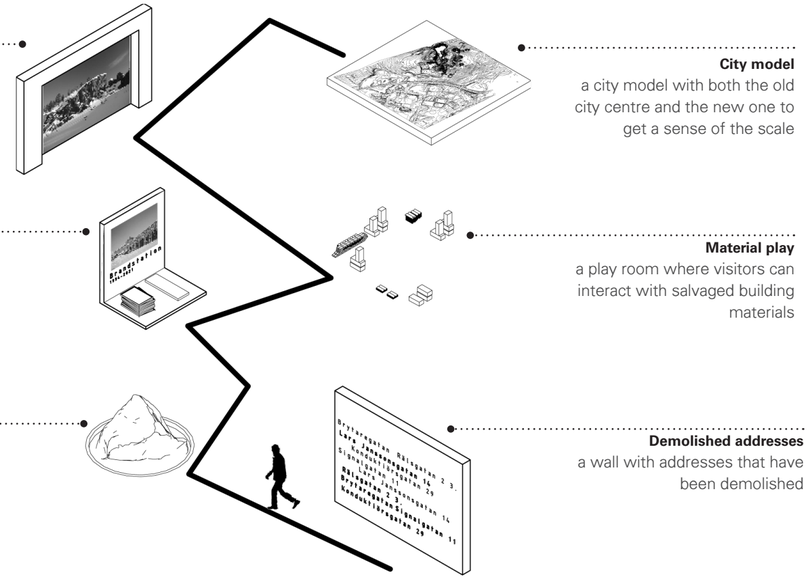
ill. 249. Functions added to the structural grid

EXHIBITING CULTURAL HERITAGE

Exhibition proposals

The use of upcycled materials from Kiruna in the centre provides the visitors with a clear reference to the demolished buildings, and the locals can make their own assumptions on where they believe the materials derive from. To further add to the narrative all exhibitions will somehow relate to a phase of the moving process; from the reason why, the city must be relocated, keeping the identity of the city of Kiruna. To ensure the experience will have an impacting effect, the exhibitions are focused on the mental process of understanding, valuing, carrying and enjoying. By focusing on providing the visitors with a sensory input in combination with hands on interaction. The proposed exhibitions are showcased in ill. 250.

Design driver focus



ill. 250. Exhibitions within the interpretation centre

THE VERTICAL CONCEPT

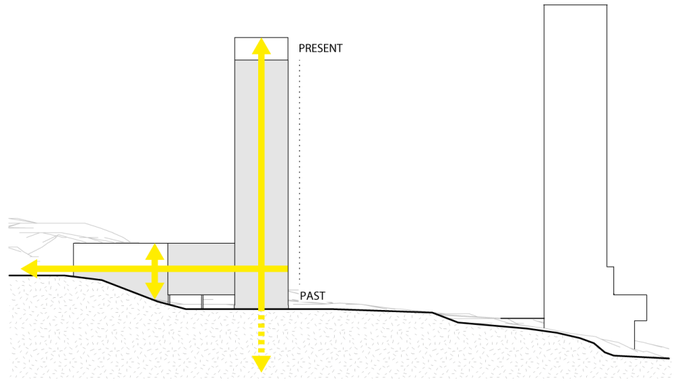
Continuing the concept development

The vision to create an Interpretation Centre that inspire the future and inform about the past will be articulated through a clear separation of the stereotomic and the tectonics of the centre. The separation will allow visitors to embark on a journey that starts with a focus on the heritage of Kiruna (the past) and ends with inspiration on how to preserve the heritage throughout the relocation process (the future). The vertical concept (ill. 251) takes inspiration from the organization, Culture in Development statement, that in order to make the past a part of our future one must understand, value, care and enjoy it.

Design driver focus

How to emphasize the vertical concept

- Clear separation in materials
- Differences in facade depth
- Views from the top
- Openings and solids
- Artificially lit top
- Differences in structural system
- Dark bottom and light top



ill. 251. Vertical concept

THE HERITAGE NARRATIVE

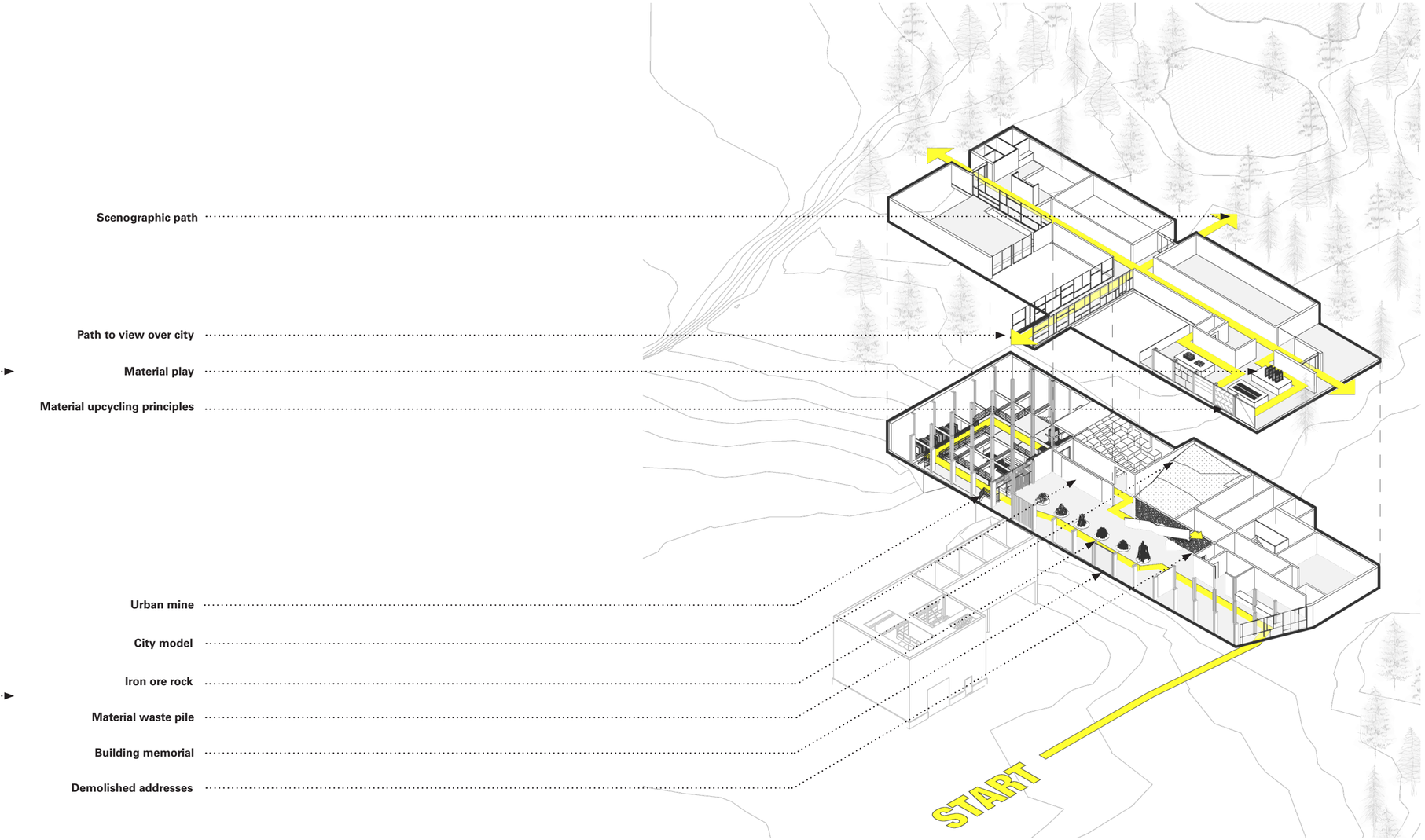
Exhibition flow

Second floor - Future

The second floor aims to inform and inspire the visitors about the future by exhibiting:

First floor - Past

The first floor aims to convey a narration of the past by exhibiting:

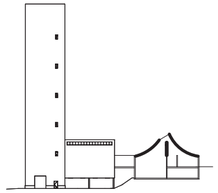


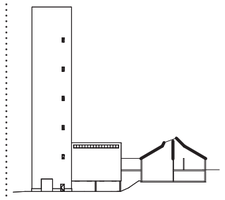
ill. 252. Visitor flow in the centre focusing on the heritage exhibitions

ROOF STUDY

Roof shape principles section

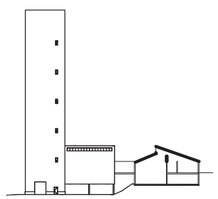
Utzon
Curved roof and skylight

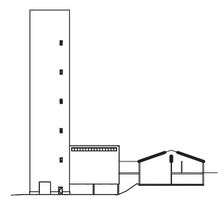




Angular chimney
Saddle roof with an angular chimney skylight

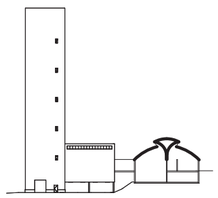
Offset
Straight roof faces with vertical skylight

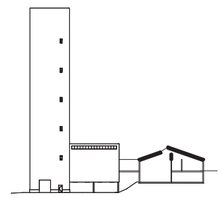




Saddle roof
Basic saddle roof with equestrian light

PH-Lamp
Curved faces with light intake





Offset saddle
Saddle roof with skylight

ill. 253. Initial roof study

Angular chimney developed

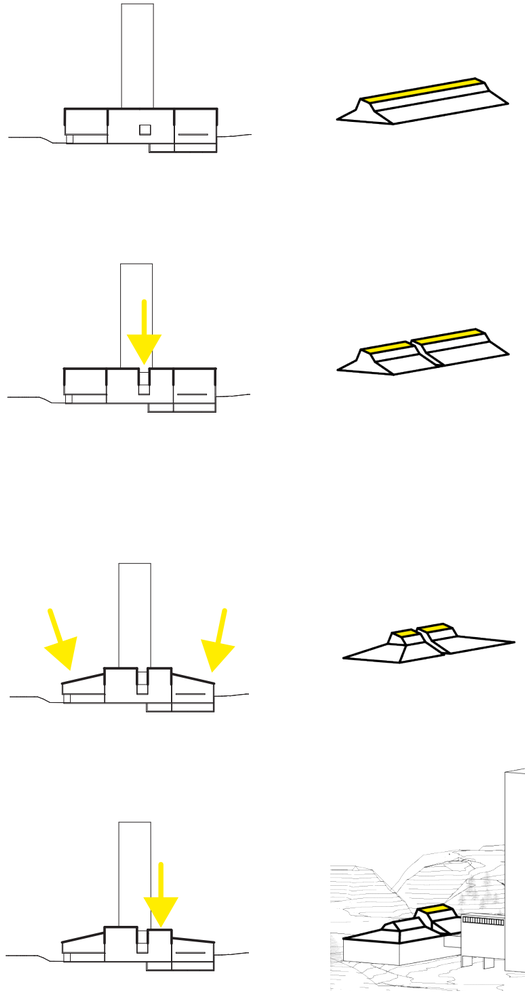
1.
Straight roof with skylight from end to end.

2.
Opening up the roof in the tower connection to allow views to the tower from the circulation space and amplify climatic experience inside.

3.

Decreasing the roof angle to utilize the snow as an insulator.

4.
Diversifying the roofscape with differentiating heights and orientations on the chimneys.



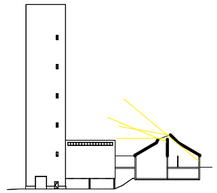
ill. 254. Developed roof study

20º Chimney angle

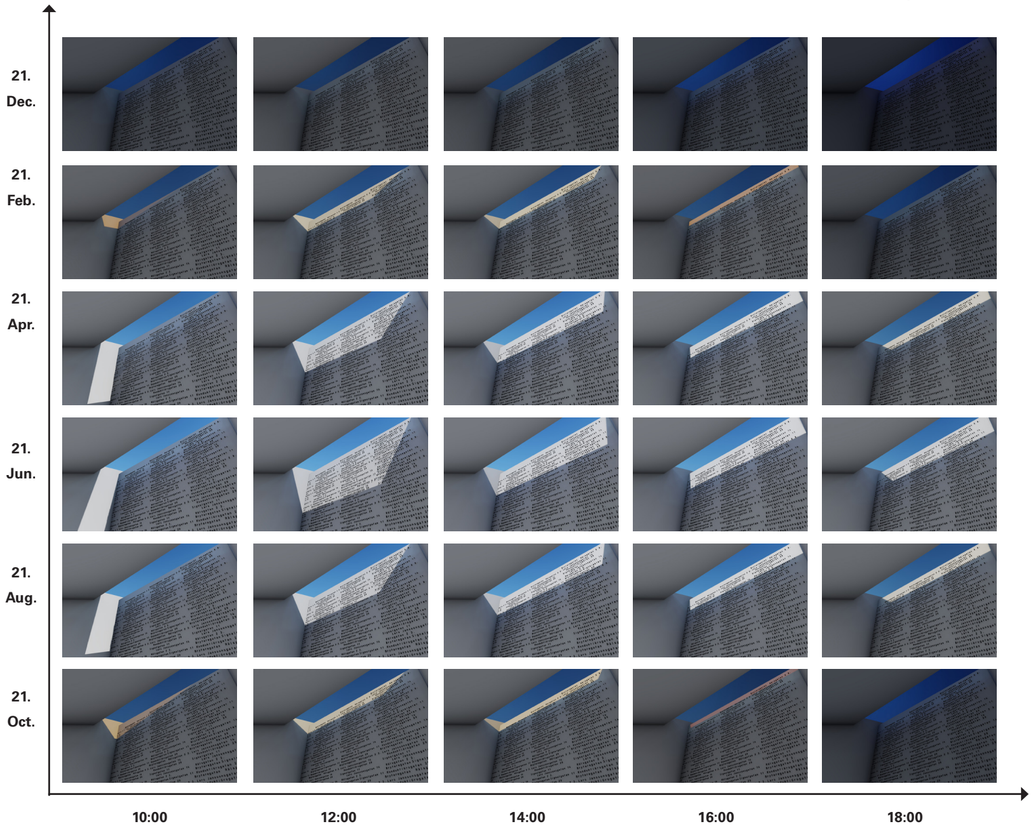
Study on how a 20 degree angular skylight is perceived in the exhibition.

Winter sun angle (SW) 0-10 º

Summer sun angle (SW) 20-40 º



ill. 255. 20 degree angle on light chimney



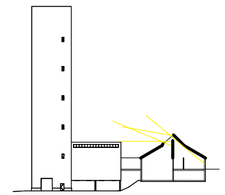
ill. 256. 20 degree angle light schedule

40º Chimney angle (chosen)

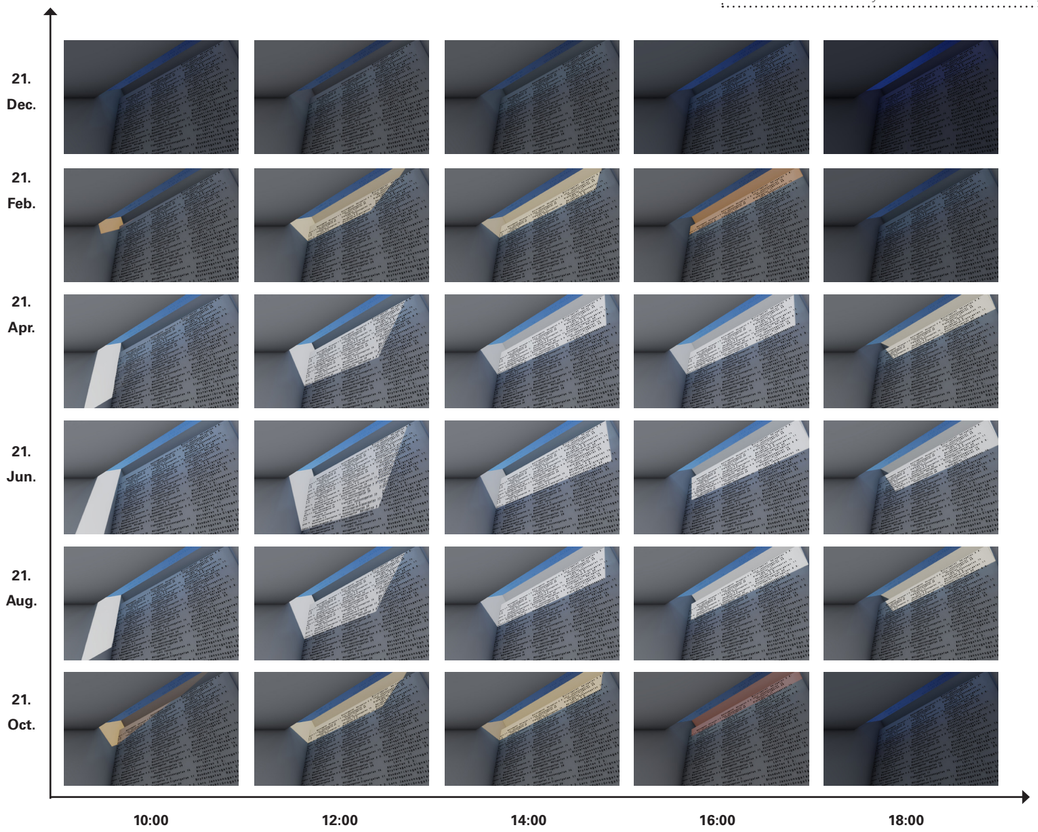
Study on how a 40 degree angular skylight is perceived in the exhibition.

Winter sun angle (SW) 0-10 º

Summer sun angle (SW) 20-40 º



ill. 257. 40 degree angle on light chimney



ill. 258. 40 degree angle light schedule

BUILDING PERFORMANCE

Technical considerations

The Swedish building code (BBR) states that buildings must be designed so the energy use is limited by low heat losses, low cooling demand, efficient heating and cooling use and efficient electricity use (Boverket, 2018). Low heat losses and efficient heating use are ensured by designing a building envelope with sufficient thermal performance. Cooling is assumed unnecessary in Kiruna due to the climate and will, therefore, be disregarded. To ensure that the Interpretation Centre has a sustainable approach regarding the heating supply, it will be connected to the local district heating system. The system uses waste heating from the active mine and aims to be climate neutral by 2025 (Energi & Miljö, 2020). Efficient use of electricity can partly be reached by providing sufficient daylight in rooms where there are demands for specific light conditions e.g., workplaces, which minimize the use of artificial lighting. However, as Kiruna has several weeks between November and January with almost complete darkness, this cannot be completely avoided.

The building envelope affects both the heat losses, the need for heating and the amount of daylight in the Interpretation Centre. To ensure that the design of the building envelope lives up to the building code and the desired experience within the centre, simple calculations and simulations regarding U-values and daylight (appendix 6) are made. The chosen U-values for the building envelope components are presented in table 5 and are based on minimum demands in BBR and thermal performance of component solutions previous used during this education. The desired placement of glazing in the façade are presented in ill. 259, which shows areas where glazing is wanted regarding either view, perceived daylight and/or daylight comfort.

In BBR, there is a demand for an average U-value of 0,6 W/m²K for the building envelope of the Interpretation Centre. When adding glazing to the envelope, the average U-value is calculated to ensure it does not exceed the demands. The iterations of envelope and glazing are seen in table 6 and show that the envelope design is within the demands.

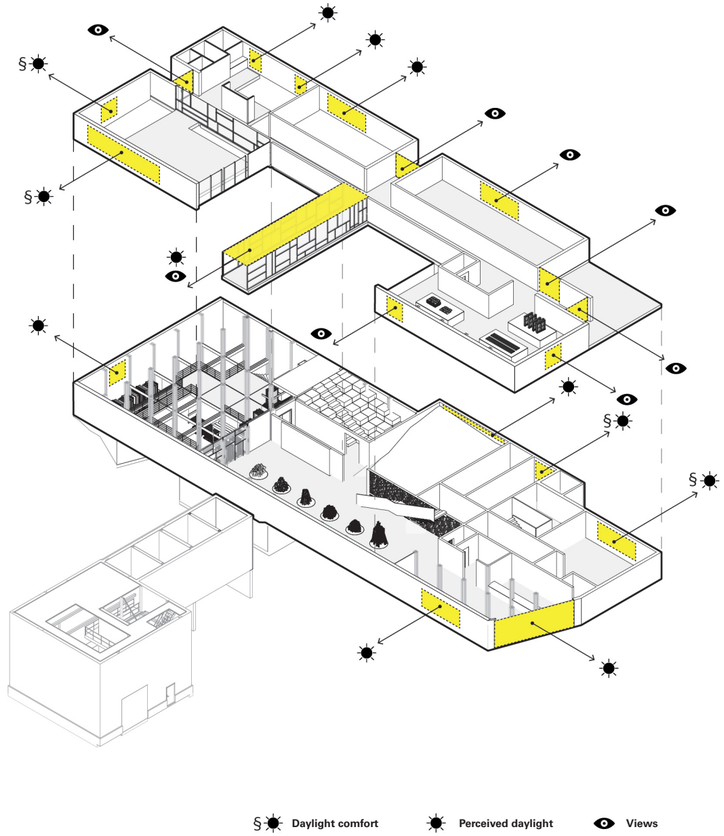
table 5. U-values

Building components	U-value [W/m²K]
Wall	0,12
Roof	0,10
Floor	0,08
Glazing	1,2
Doors	1,0

table 6. Envelope performance

	Starting-point	Adjusted	Final	Average U-value demand in BBR 2011:6
Iteration	Areas and U-values before adding openings as presented in ill. 259 - 8% windows in facade and 9% glazed roof.	Areas and U-values with added windows for daylight and views according to ill. 259 - 20% windows in facade and 14% glazed roof	Areas and U-values for the Interpretation Centre with final correction of window placement to fulfil wanted lighting conditions - 21% windows in facade and 14% glazed roof	
Average U [W/m²K]	0,17	0,22	0,22	0,60
Attain the wanted light conditions	no	no	yes	

Main focus of windows



ill. 259. Main focus of each window

THE CRITICAL ROOMS

Determining the window size based on indoor comfort

The educational workshop is chosen to be the critical room in terms of atmospheric, visual, and thermal comfort. The room is assumed to accommodate up to 30 people doing seating work and is facing south-west and north-west. The educational workshop, kitchen and office all have special visual comfort requirements as they are placed where task-oriented work is in focus (Dansk Standard, 2015). These rooms need large window areas, but while the kitchen and office areas do not have a high people load and are oriented towards the northeast, they are assumed to not have issues with atmospheric and thermal comfort due to overheating.

The educational workshop has been analysed in the hygrothermal building simulator BSIM with the weather file closest to the climatic conditions in Kiruna (Tromsø). BSIM has been used to estimate how much glazing that is possible to place in the façades while ensuring the comfort criteria. The room has been modelled with open faces on the floor between the urban mine and the educational workshop, and a fixed temperature in the adjacent rooms.

The evaluation of the thermal comfort has been based on requirements from the Danish Building Regulations as these regulations are based on general comfort for the human body and does not depend on geographical location.

1. Iteration 13,5 m² glass area
The first iteration takes a point of departure in the 10 per cent window to floor area required by Danish standards, split equally on the two façades.

table 7. Thermal comfort iteration 1

	Results	Requirement
Hours > 26	2 h	**100 h**
Hours > 27	0 h	**25 h**
Hours < 21	779 h	**-**
CO2 mean	498 ppm	**660 pm**

2. Iteration 27 m² glass area
The second iteration doubles the window to floor area split equally on the two façades.

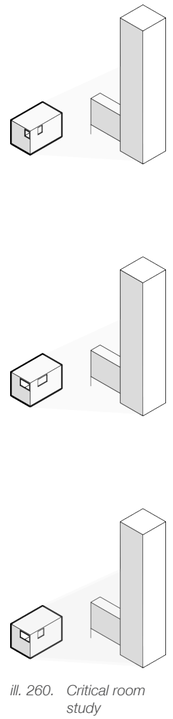
table 8. Thermal comfort iteration 2

	Results	Requirement
Hours > 26	142 h	**100 h**
Hours > 27	69 h	**25 h**
Hours < 21	738 h	**-**
CO2 mean	498,2 ppm	**660 pm**

3. Iteration (chosen) 22,5 m² glass area
The third iteration is placed in between the two first iterations, with 13,5 m² on the northwest and 9 m² on the southeast.

table 9. Thermal comfort iteration 3

	Results	Requirement
Hours > 26	74 h	**100 h**
Hours > 27	25 h	**25 h**
Hours < 21	781 h	**-**
CO2 mean	497 ppm	**660 pm**



ill. 260. Critical room study

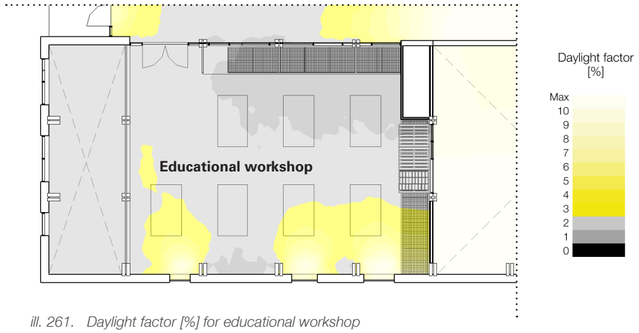
Daylight analysis of critical room

In the Swedish building code (BBR) it is stated that rooms where people stay more than temporarily must be designed and oriented so that good access to direct daylight is possible unless this is unreasonable regarding the intended use of the room (Boverket, 2018).

Daylight is dynamic, it varies depending on the time of day, season, and weather conditions. The experience of a daylit room, therefore, always comes to vary over time. That is also seen as one of the foremost qualities of daylight that makes the environment alive and the people in a room with varying daylight more alert (Alenius, 2017).

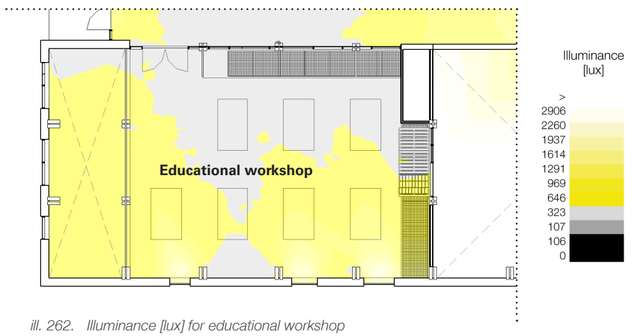
When analysing the daylight conditions in the educational workshop for the chosen iteration, both the daylight factor and illuminance for the room are investigated to see if the daylight condition is critical or acceptable.

Daylight factor (%)
Daylight factor analyses are based on a standard sky not dependent on location in the world. The analyse should only be seen as a safety measure to ensure a room does not get too dark (Alenius, 2017). The recommendation for a classroom is set to 2% on a work surface by the Swedish National Agency of Education. The standard recommended DF set by BBR is 1% (Boverket, n.d.). The DF in the educational workshop is judged acceptable as it is in ill. 261 as an increased window area affects the overheating hours negatively.



ill. 261. Daylight factor [%] for educational workshop

Illuminance (lux)
Illuminance measures the light radiation that falls on a surface and is recommended for an office or a work desk to be between 300-500 lux. The presented analysis in ill. 262 is simplified as it only shows one time frame of the light radiation which has a large variation in reality. It can on the other hand show how far the radiations can reach in the educational workshop where the inner desks get less light radiation. The access to daylight and views in the room where a lot of movement will occur is however judged sufficient.



ill. 262. Illuminance [lux] for educational workshop

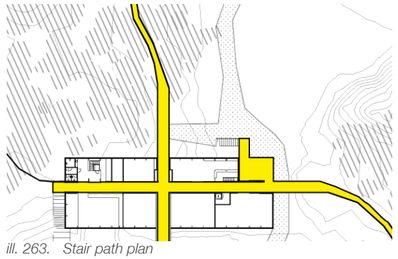
SCENOGRAPHIC PATH

How to connect with the building

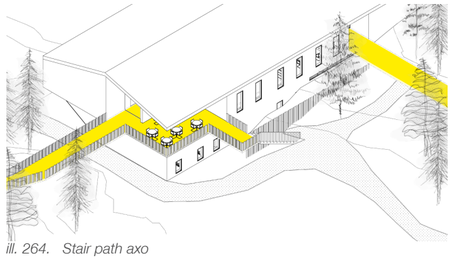
In ill. 263 - ill. 268 three iterations on how the path connects with the building are presented. Specific emphasis has been given to the connection of the path to the terrace as it is wanted as a junction to the whole path.

Issues with limited views and daylight for rooms on the level bellow the path indicates that the solution which extends the facade under the path is the most ideal solution (ill. 265 - ill. 266).

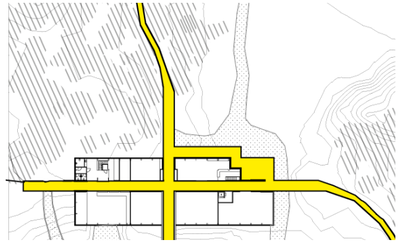
Design driver focus



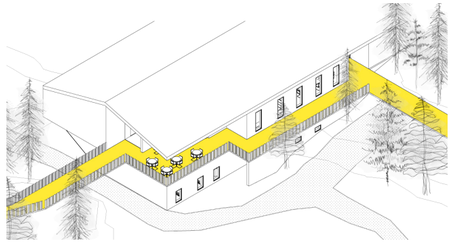
ill. 263. Stair path plan



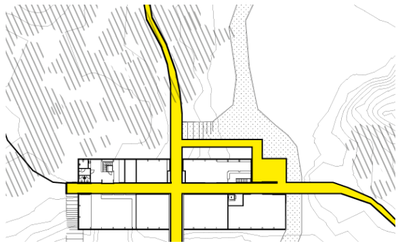
ill. 264. Stair path axo



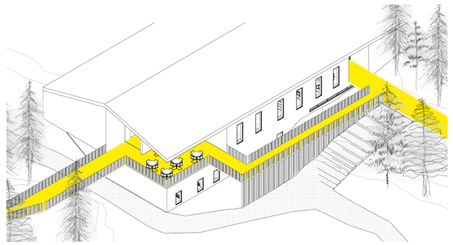
ill. 265. Extended facade plan



ill. 266. Extended facade axo



ill. 267. Bridge path plan



ill. 268. Bridge path axo

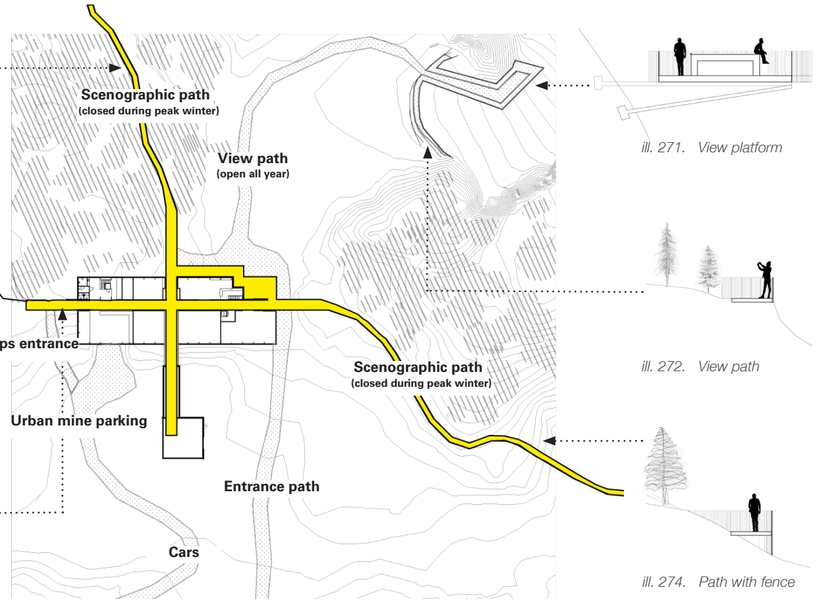
From fence to?

The Interpretation Centre will act as an entrance to the mining area, with dictating paths that, in places needed, also acts as fences.

The experience along the scenographic path starts at the centre and goes all the way around the deformation zone through a forest, high cliff sides and hills. The path options for how to showcase the natural heritage can be seen in the illustrations below.

The length and direction of the scenographic path requires it to be closed during extreme winter conditions, while the view path is considered to be kept open all year around.

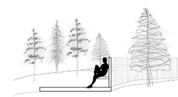
ill. 270. Path inside fence



ill. 271. View platform

ill. 269. Fence

ill. 272. View path

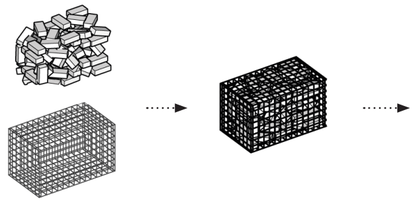


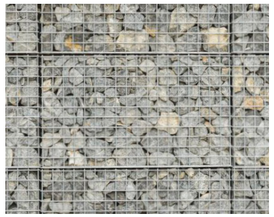
ill. 273. Sitting area fence

ill. 274. Path with fence

Materiality on the fence and railings

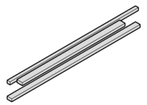
Gabion wall
+ Can retain landscape
+ Blocks animal
+ Low labour during upcycling process





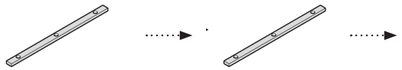
ill. 275. Gabion wall

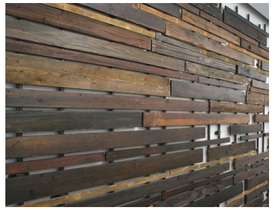
Lamella wall (chosen)
+ Natural material
+ Low energy during upcycling process



ill. 276. Lamella wall

Timber stack
+ Natural material
+ Low energy during upcycling process





ill. 277. Timber stack

Curtain wall (without glass)
- Minimal strength
+ Views for low people and kids
- To open to be a fence (or two layers)
+ Low energy and labour during upcycling process

ill. 278. Curtain wall

Materiality on the path

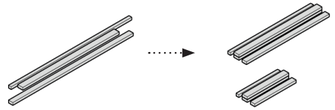
Perforated Steel (chosen for platforms)
+ Snow falls through
- New material
+ Low energy during upcycling process

ill. 279. Perforated steel

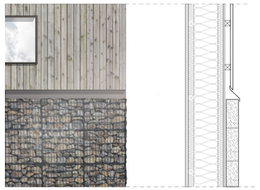
Crushed bricks
+ Difficult to clear for snow
+ Low energy during upcycling process

ill. 280. Brick cladding

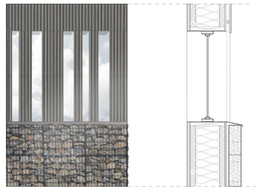
Recycled timber (chosen)
+ Natural material
- Slippery
+ Low energy during upcycling process



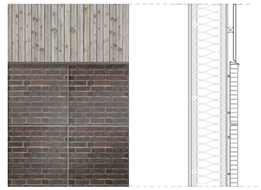
ill. 281. Recycled timber



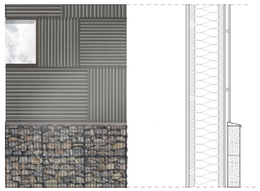
ill. 282. Gabion wall / wood



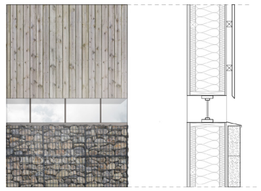
ill. 283. Gabion wall / steel panels with openings



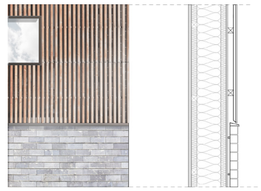
ill. 284. Brick modules / wood



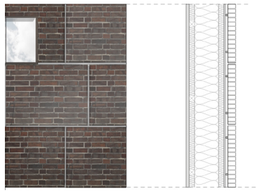
ill. 285. Gabion wall / steel panel pattern



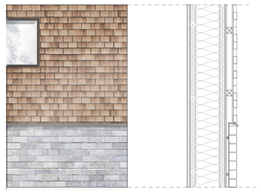
ill. 286. Gabion wall / opening / wood



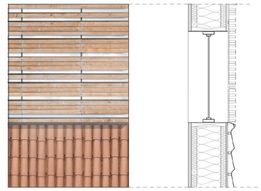
ill. 287. Concrete bricks / lamellas



ill. 288. Brick modules



ill. 289. Concrete bricks / wood shingles



ill. 290. Ceramic tiles / stacked wood

MATERIALITY AND CIRCULARITY

Exterior materials exploration

Design driver focus

The rich diversity of materials from the urban mining has the function to revive, innovate and praise the identity and cultural heritage of Kiruna as well as representing a circular approach to the use of recycled materials in the building industry.

Presented in ill. 282 - ill. 290 are explorations of different upcycling materials applied onto the exterior facade focusing on a light top and heavy bottom. In regard to window placement, the iterations also explore different levels of transparency and horizontal and vertical openings.

In a life cycle assessment perspective it is desired to recycle and upcycle the heaviest CO_2 imprinted materials, which according to previous studies is steel, bricks, clay tiles, and concrete. When using these materials the A1-A3 and C3 phase of the respective materials are eliminated and the energy consumption will be reduced to the C1, C2 and D phases. Below, different ways of upcycling these materials are specified as a background for the facade design (ill. 291 - ill. 296).

ill. 291. Concrete gabion

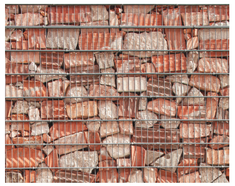
Concrete gabion

Avoided CO_2 wasted: **299 kg/m3**
Process energy: **medium**
Process labour: **low**
Recognition: **medium**
Tectonic principle:

ill. 294. Recycled steel sheet

Recycled steel sheet

Avoided CO_2 wasted: **35680 kg/m3**
Process energy: **high**
Process labour: **medium**
Recognition: **high**
Tectonic principle:



ill. 292. Clay tile gabion

Clay tile gabion

Avoided CO_2 wasted: **1079 kg/m3**
Process energy: **medium**
Process labour: **low**
Recognition: **medium**
Tectonic principle:

ill. 295. Steel module

Steel module

Avoided CO_2 wasted: **35680 kg/m3**
Process energy: **medium**
Process labour: **low**
Recognition: **high**
Tectonic principle:

ill. 293. Brick gabion

Brick gabion

Avoided CO_2 wasted: **542 kg/m3**
Process energy: **medium**
Process labour: **low**
Recognition: **medium**
Tectonic principle:

ill. 296. Steel shingles

Steel shingles

Avoided CO_2 wasted: **35680 kg/m3**
Process energy: **high**
Process labour: **medium**
Recognition: **medium**
Tectonic principle:

DESIGN PROPOSAL

The final design proposal based on the previous analyses, simulations, and evaluations are presented in this chapter. Through drawings and renders the materiality, relations between rooms and atmosphere are presented.

ill. 297. Kiruna Interpretation Centre

design proposal

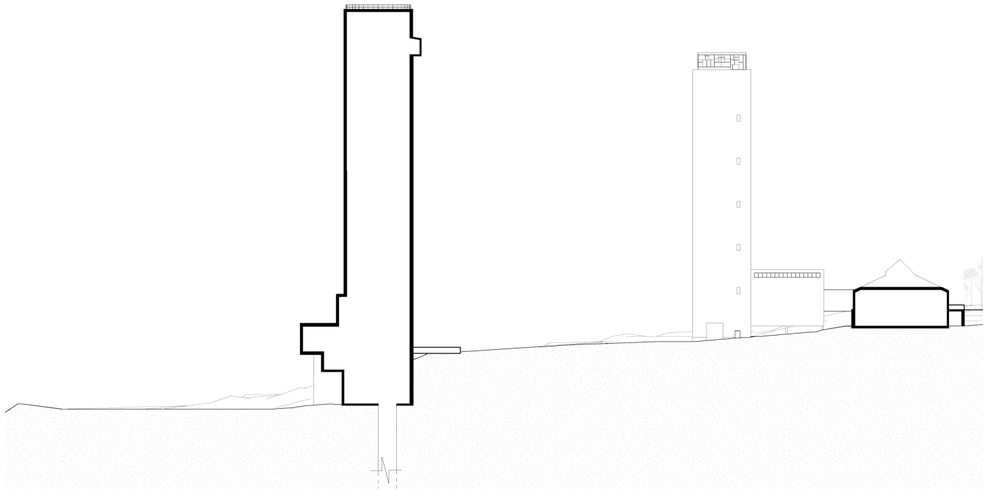
MASTERPLAN

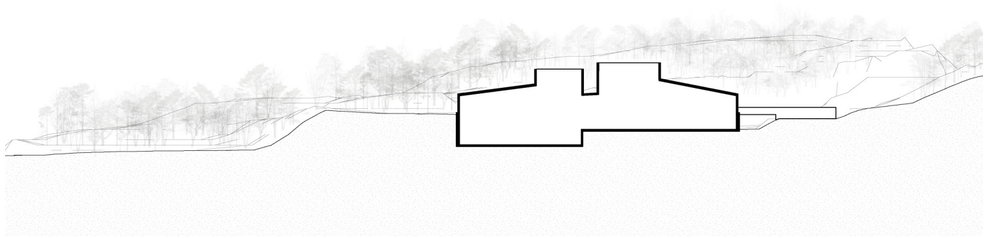
1:2000

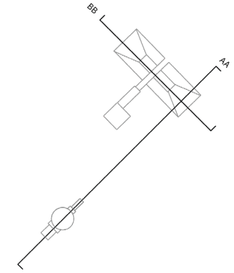
1:2000

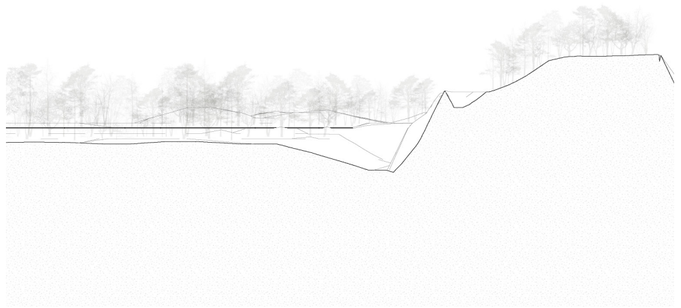
ill. 298. Masterplan Scale 1:2000

MASTER SECTIONS

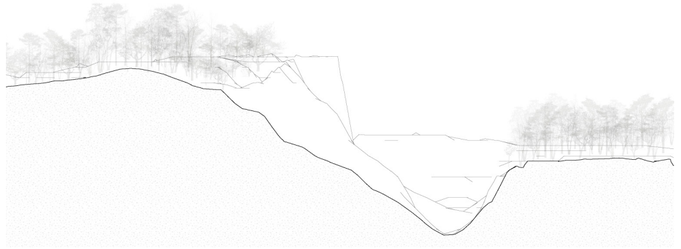






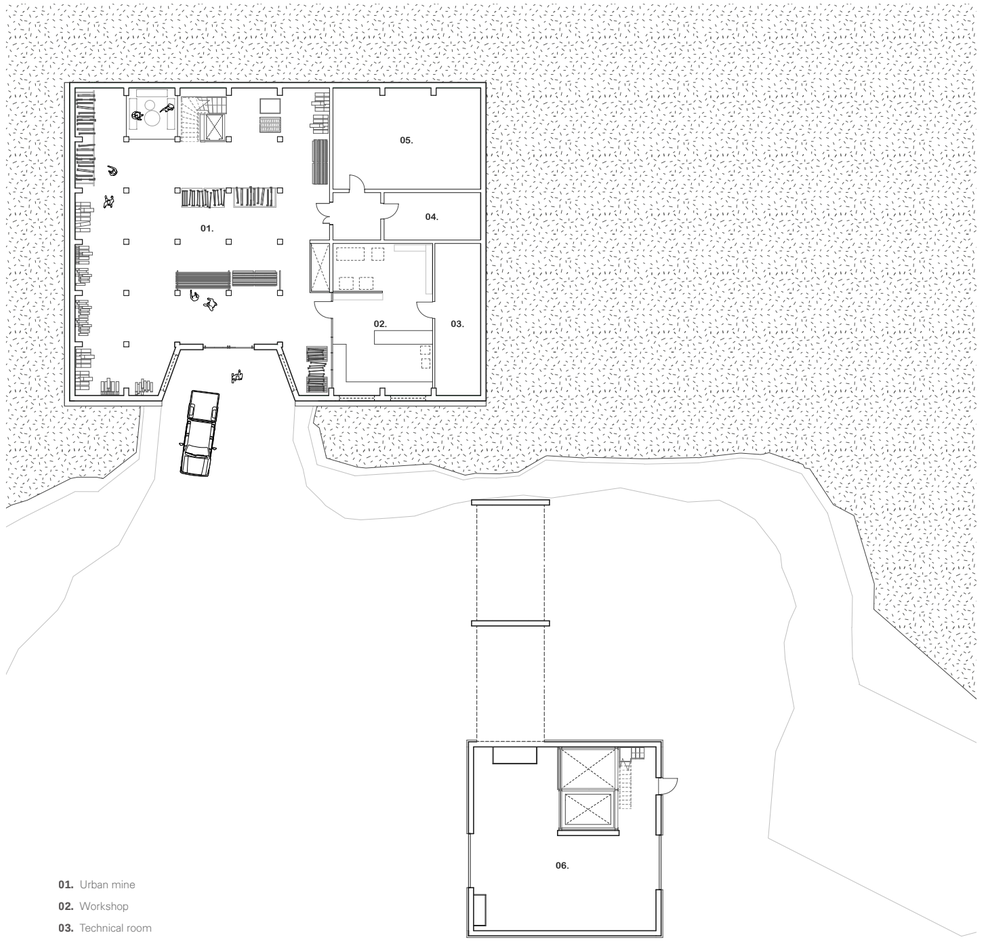


ill. 299. Master section AA Scale 1:1000



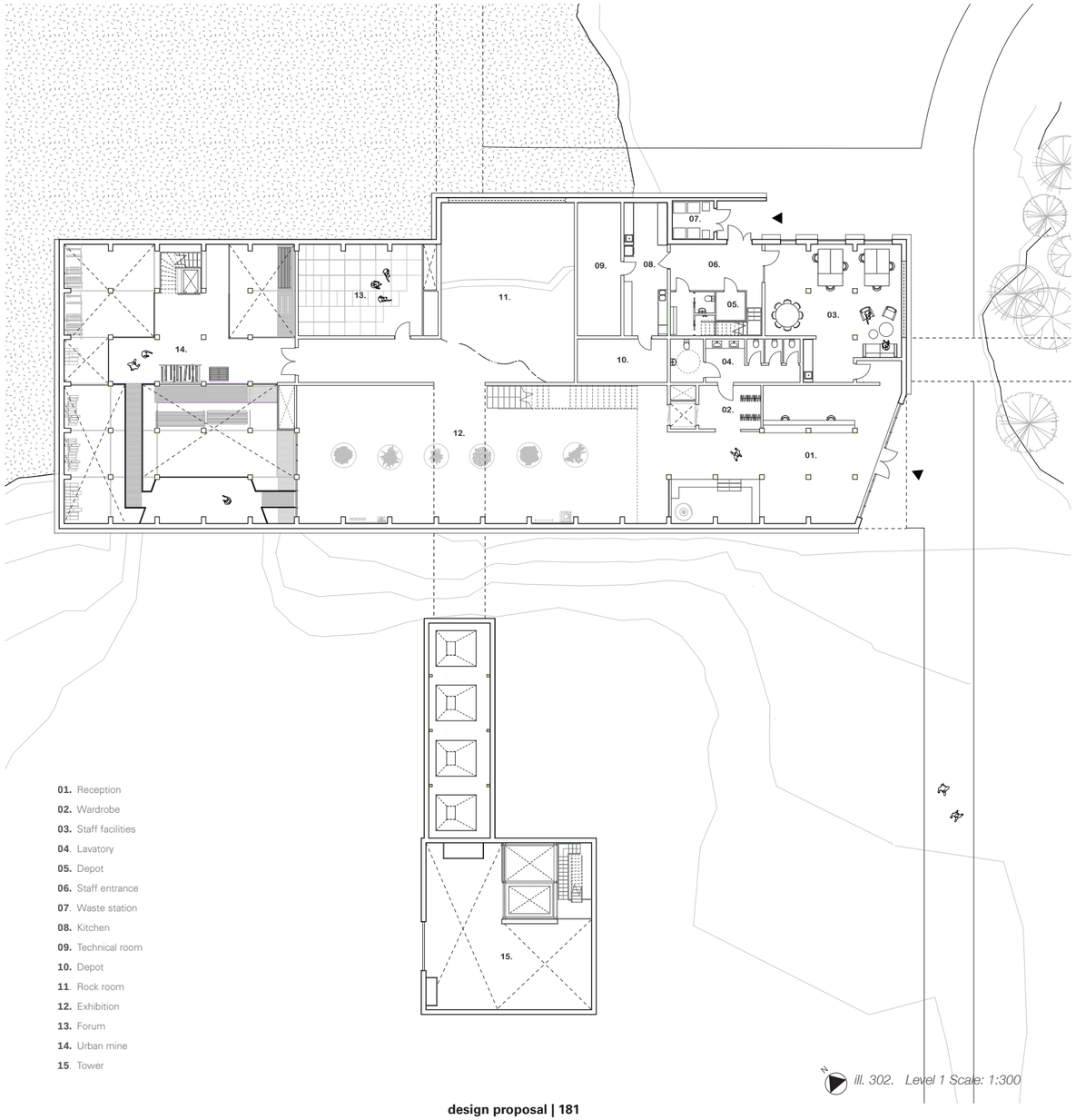
ill. 300. Master section BB Scale 1:1000

FLOOR PLANS



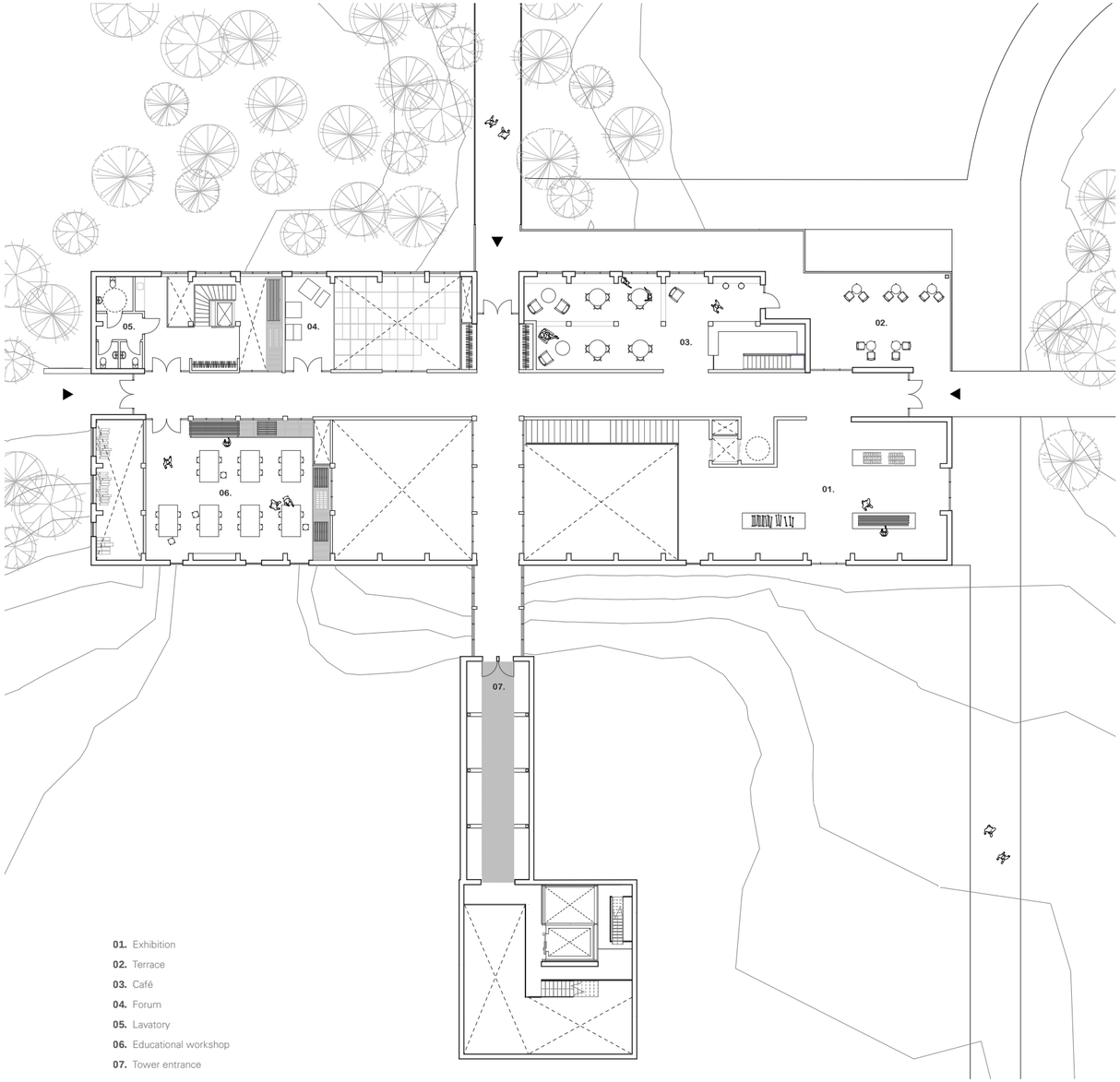
01. Urban mine
02. Workshop
03. Technical room
04. Cleaning depot
05. Storage
06. Tower

ill. 301. Ground level Scale: 1:300



01. Reception
02. Wardrobe
03. Staff facilities
04. Lavatory
05. Depot
06. Staff entrance
07. Waste station
08. Kitchen
09. Technical room
10. Depot
11. Rock room
12. Exhibition
13. Forum
14. Urban mine
15. Tower

ill. 302. Level 1 Scale: 1:300



01. Exhibition
02. Terrace
03. Café
04. Forum
05. Lavatory
06. Educational workshop
07. Tower entrance

ill. 303. Level 2 Scale: 1:300

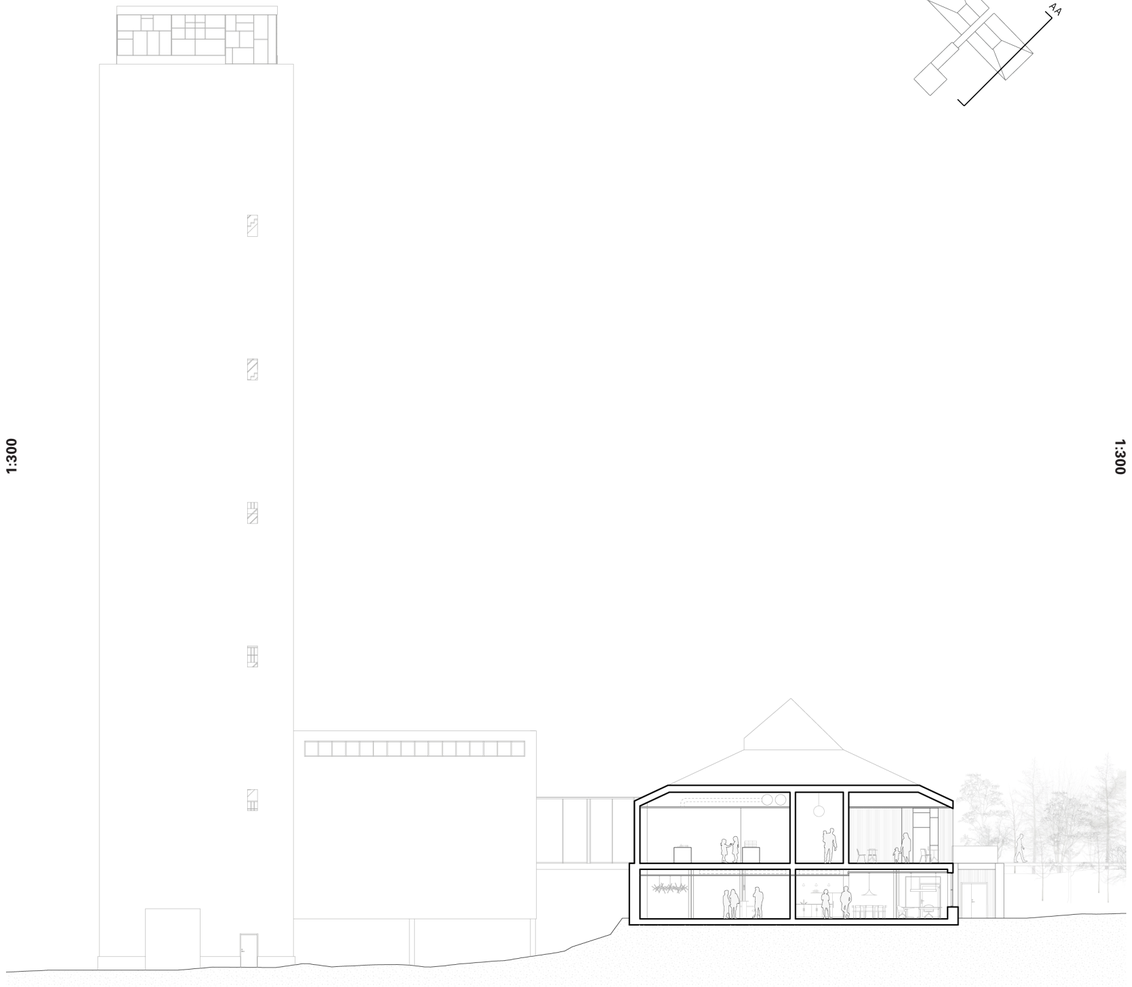
ill. 304. Arrival to the site

Discrete path marked with lighting

vy från runda tornet

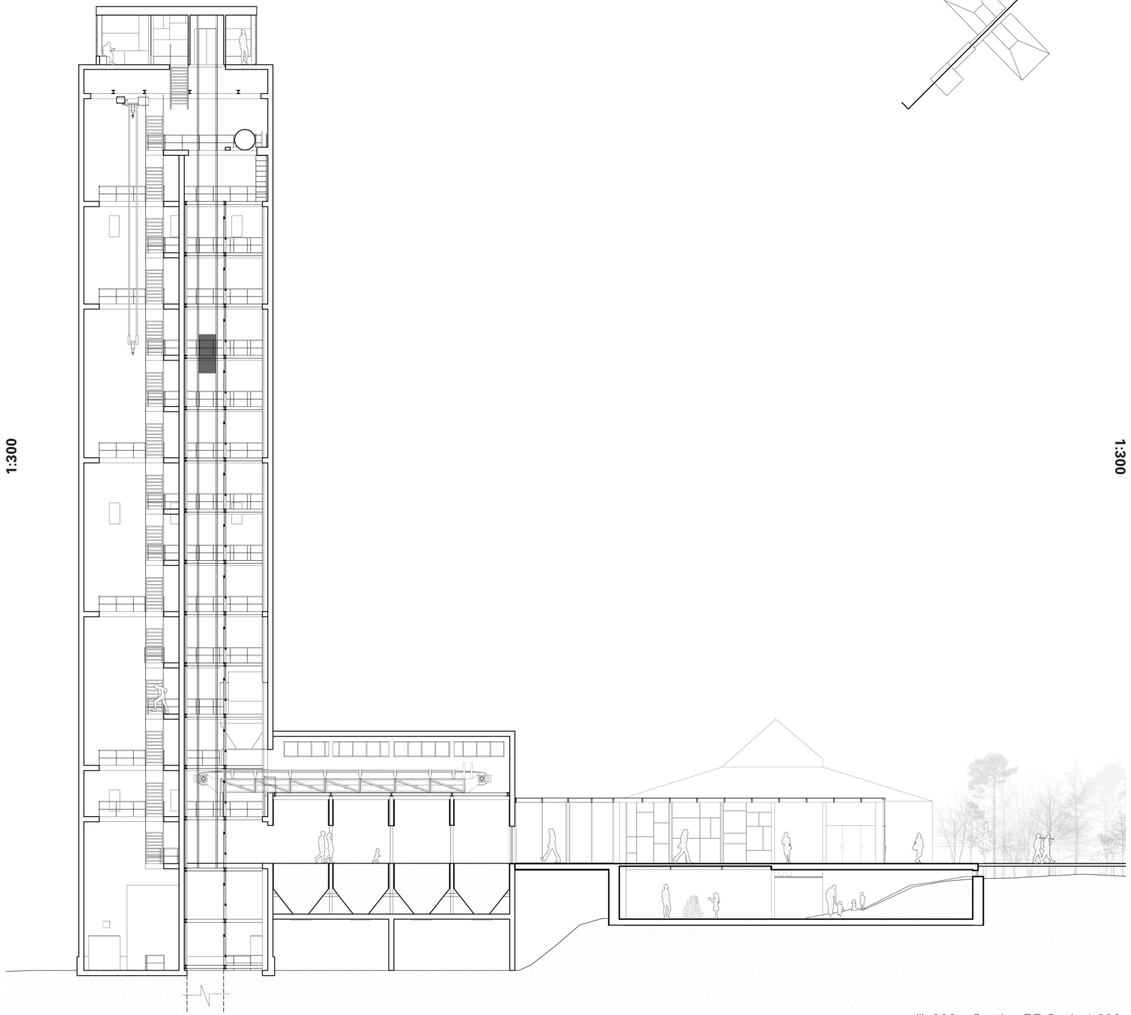
view from the round tower

SECTIONS



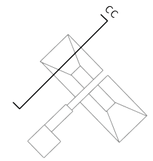
1:300

ill. 305. Section AA Scale 1:300

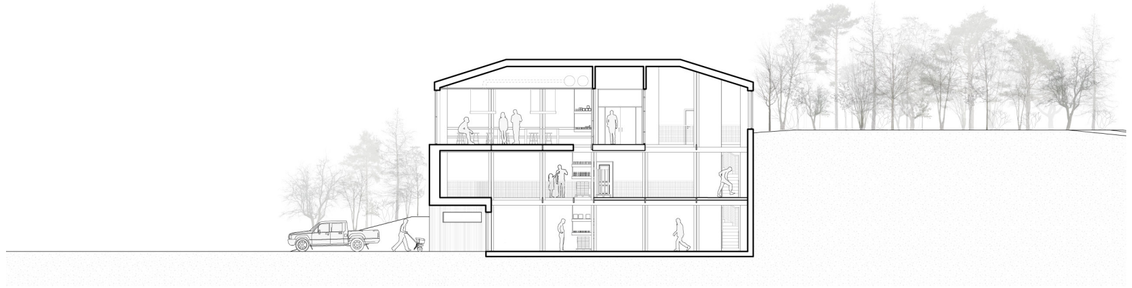


1:300

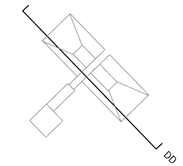
ill. 306. Section BB Scale 1:300



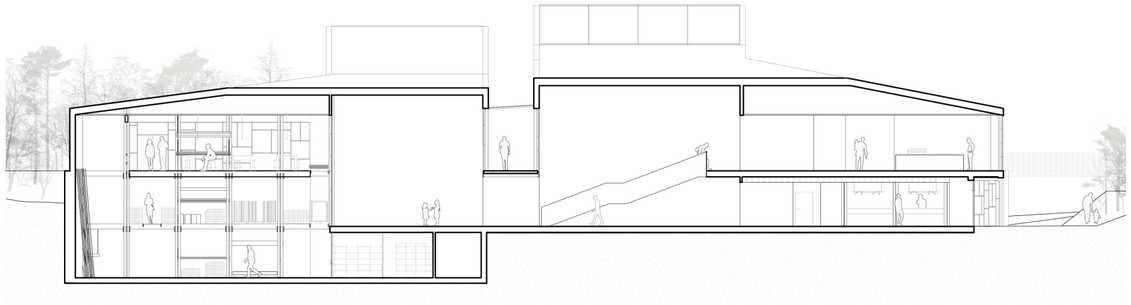
1:300



ill. 307. Section CC Scale 1:300

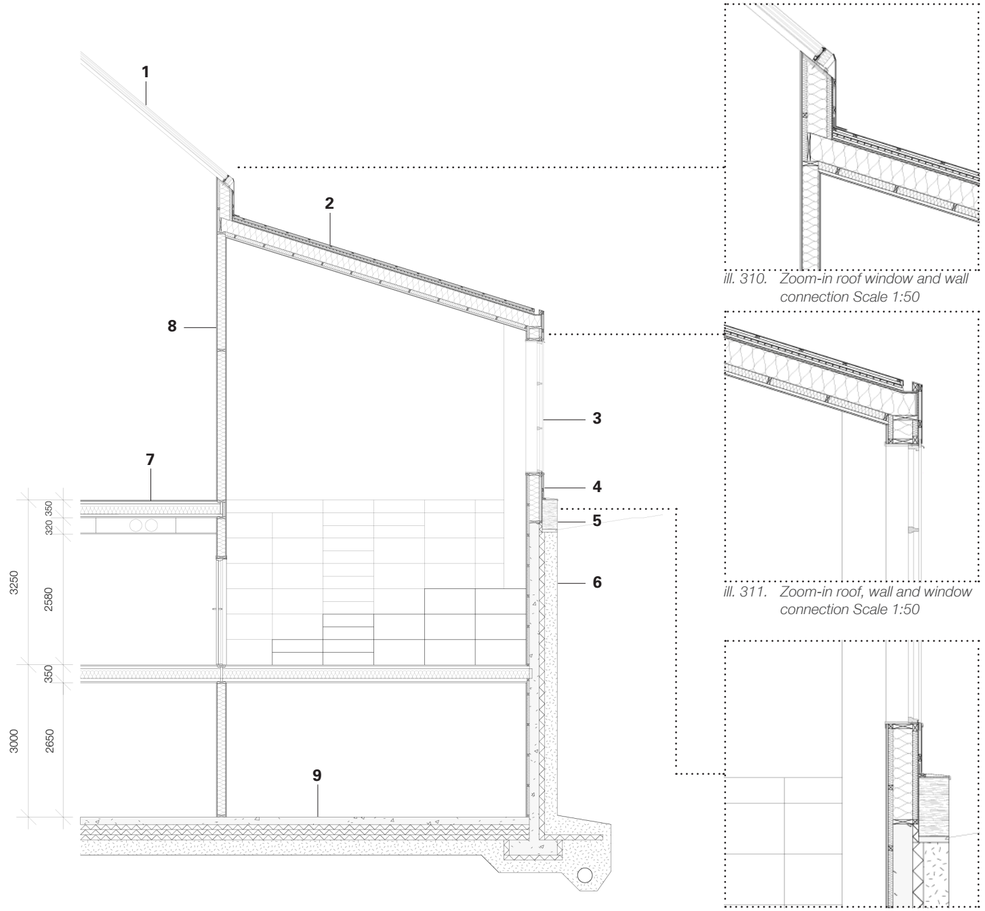


1:300



ill. 308. Section DD Scale 1:300

DETAILS



ill. 309. Detail section Scale 1:100

ill. 310. Zoom-in roof window and wall connection Scale 1:50

ill. 311. Zoom-in roof, wall and window connection Scale 1:50

ill. 312. Zoom-in window and wall connections Scale 1:50

1. Roof window
Focus: Thermal performance and daylight inlet
3-layered glazing of upcycled glass inserted into a Velux roof window frame

2. Roof
Upcycled wood // 10 mm
Installation gap // 28 mm
Wood fibre insulation & Wood battens cc 600 // 70 mm
Waterproof membrane
Wood fibre insulation & Wood trusses // 240 mm
Wood fibre wind-board // 22 mm
Ventilated air gap // 25 mm
Wood boarding // 22 mm
Wood battens // 25 mm
Wood counter battens // 25 mm
Upcycled steel sheets from the old fire station

3. Curtain wall
3-layered glazing in curtain wall of upcycled windows with new framing

4. Exterior wall – Steel sheets
Painted wood board // 11 mm
Wood board // 11 mm
Wood fibre insulation & wood joists cc 600 // 45 mm
Waterproof membrane
Wood Fibre insulation & Wood frame cc 600 // 195 mm
Wood fibre insulation // 45 mm
Wood fibre wind-board // 12 mm
Ventilated air gap // 28 mm
Upcycled steel sheets from the old fire station

5. Exterior wall – Gabion
Painted wood board // 11 mm
Wood board // 11 mm
Wood fibre insulation & wood joists cc 600 // 45 mm
Waterproof membrane
Wood Fibre insulation & Wood frame cc 600 // 195 mm
Wood fibre insulation // 45 mm
Wood fibre wind-board // 12 mm
Gabion wall filled with crushed bricks and concrete mortar from the old fire station and gymnasium

6. Basement wall
Painted wood board // 11 mm
Wood board // 11 mm
Wood fibre insulation & wood joists cc 600 // 45 mm
Waterproof membrane
Concrete // 195 mm
Pressure proof insulation boards // 105 mm
Draining granular backfill

7. Floor system
Floor finish // 14 mm
Wood board // 11 mm
Wood beams // 300 mm
Wood fibre insulation // 156 mm
Wood boarding // 25 mm
(Suspended ceiling to hide installed technique)

8. Load-bearing interior wall
Painted wood board // 11 mm
Wood board // 11 mm
Wood fibre insulation & wood frame cc 600 // 156 mm
Wood board // 11 mm
Painted wood board // 11 mm

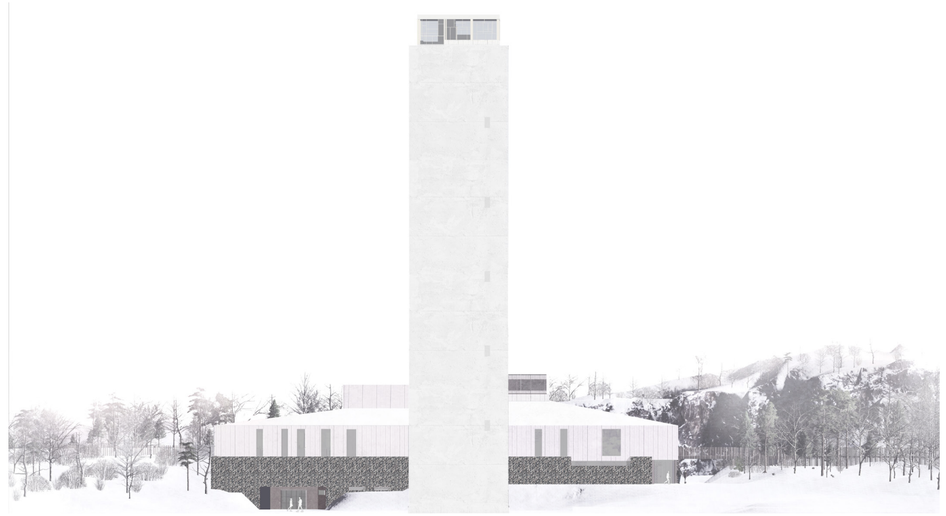
9. Basement floor
Concrete slab // 150 mm
Pressure proof insulation boards // 3x100 mm
Draining granular fill

ELEVATIONS

ill. 313. Elevation SE Scale 1:600

ill. 314. Elevation NW Scale 1:600

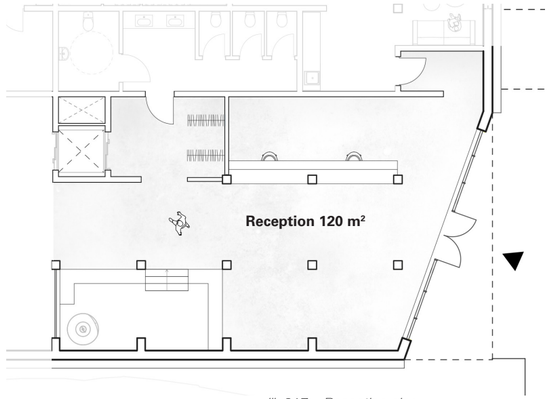
ill. 315. Elevation NE Scale 1:600



ill. 316. Elevation SW Scale 1:600

ARRIVAL

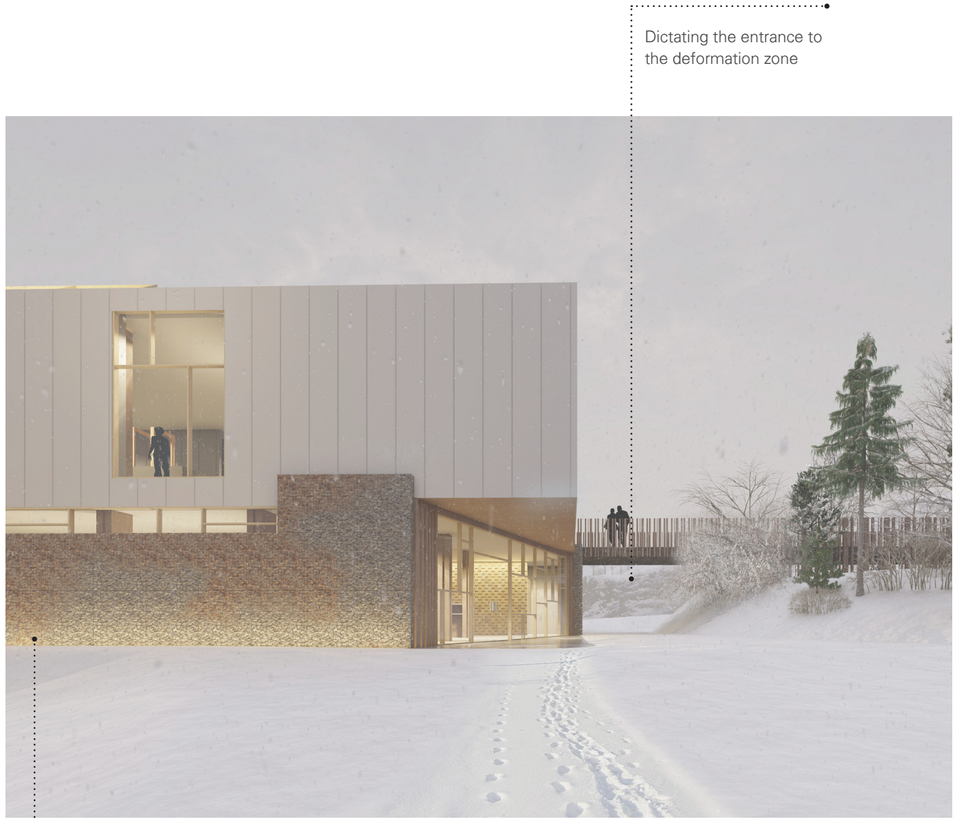
The reception serves as a warm and welcoming entrance space, clearly visible from the passing path. Warm light and material tactility crate an atmosphere that stands in contrast to the outside.



ill. 317. Reception plan

ill. 318. Reception

upplyst entré



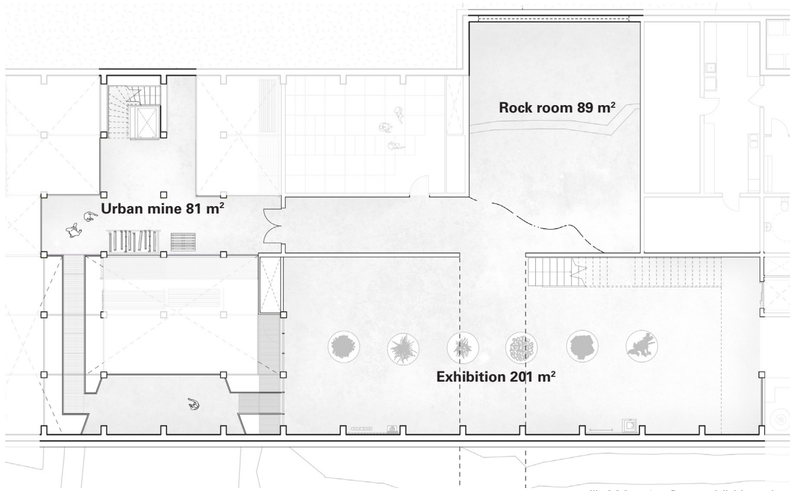
lit entrance

Gaboin walls of crushed reused bricks and concrete: 270 m²

Upcycled steel plates on facade and roof: 1380 m²

ill. 319. Entrance

EXHIBITION 1ST FLOOR



ill. 320. 1st floor exhibition plan

Exhibiting construction components from specific buildings

Exhibiting raw materials from demolition

ill. 321. Raw exhibition

Exhibiting the remains of the former mining activity

ill. 322. Rock room

Use of daylight to highlight the exhibition

ill. 323. Address wall

Address wall from demolished areas

URBAN MINE

ill. 324. Urban mine

Structure as part of the storage system

Path among upcycled materials

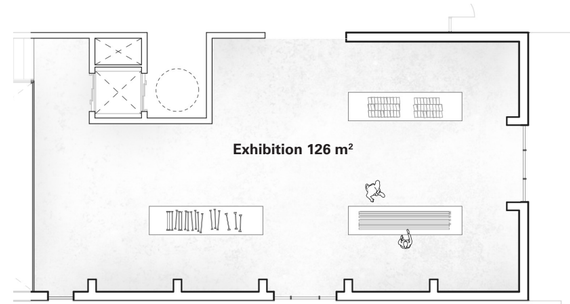
Upcycled wood panels as ceiling: 1213 m²

utställning av material

exhibition of materials

EXHIBITION 2ND FLOOR

The 2nd level exhibition focuses on inspiring the future by providing engageing material displays. Along with upcycled principles displayed as wall elements.



ill. 325. 2nd floor exhibition

Engaging exhibitions for a hands-on experience

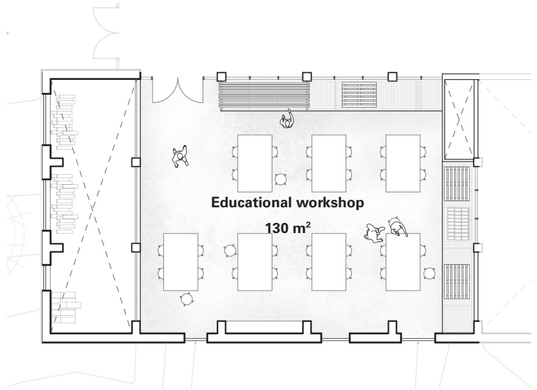
Views as part of the exhibition

Upcycled material principles

ill. 326. Hands-on material display

EDUCATIONAL WORKSHOP

The educational workshop give the possibility to hold classes focusing on educating the coming generations in upcycling of materials. Here can educational groups be part of creating and curating the next exhibition and use the materials that enters the urban mine.



ill. 327. Educational workshop plan

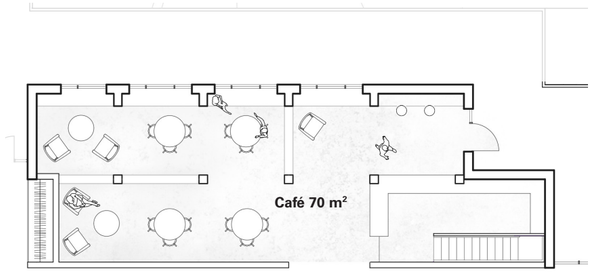
Using upcycling material principles in hands-on education

Connection to the urban mine bellow for easy access to materials

ill. 328. Educational workshop

CAFÉ

The café is directly connected to the scenographic path, making it a perfect spot to stop by for a cup of coffee before or after a walk around the deformation zone. By combining the café with a library, there is a room where people can sit down and read about the latest events in the relocation of Kiruna.



ill. 329. Café floor plan

Panoramic views over the deformation zone

A library as part of the café can inform about the latest events in the relocation process

ill. 330. Café

WALKING ALONG THE TOWER AXIS

ill. 331. Axis view to tower

Entrance to the mining tower and observation room

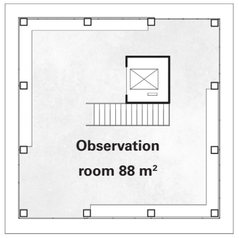
Upcycled windows as exterior curtain walls: 217 m²

Upcycled windows as interior curtain walls: 152 m²

OBSERVATION TOWER

The observation room is placed on top of the square tower. It serves as a view platform looking over both the new and the old city centres on one side and on the other side over the deformation zone.

ill. 333. View from the observation room



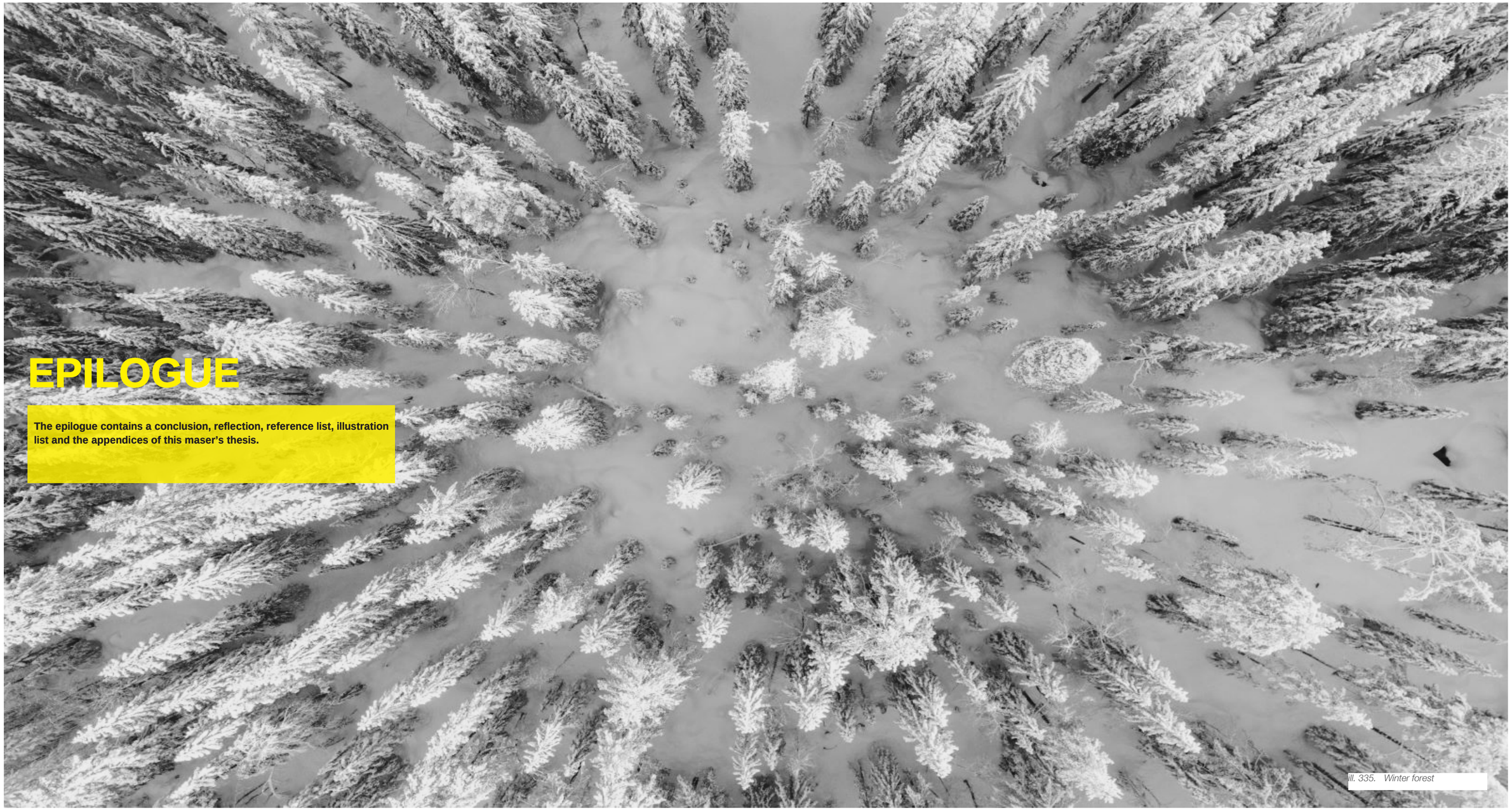
ill. 332. Observation room plan

Wood lamellas as facade on the terrace: 60 m²

ill. 334. Access the centre from the forest

EPILOGUE

The epilogue contains a conclusion, reflection, reference list, illustration list and the appendices of this maser's thesis.



Ill. 335. Winter forest

CONCLUSION

Kiruna; the city that is about to undergo a billion-dollar relocation process of the entire city centre due to centuries of iron ore excavation, is not only facing the difficulties with the tangible issues of physically moving a city, but also the intangible complication of how to preserve the local identity. With the initial problem formulation, "How can an Interpretation Centre create a sense of belonging and identity to Kiruna and its heritage through a sustainable architectural approach within the conditions the city has" this thesis seeks to explore just that by looking into three sub-questions.

What defines a sustainable architectural approach within the conditions of Kiruna?
The Interpretation Centre has been designed through a sustainable approach, partly focusing on climatic adaptation and embedded energy, to ensure environmental sustainability, and user belonging, to contribute to the social sustainability of the city.

The centre is emphasizing the local climatic conditions by the low roof pitch utilizing the insulating capabilities of snow, the placement strategy in the terrain and the focus on inviting daylight from all angles. This along with the orientation of the terrace, shielded partly by the building and partly by the landscape and trees.

The relocation process is based around the concept of tearing down the old and building up the new, with no current suggestions on material upcycling or recycling. As a result, an abundance of materials is going to end their life cycle as either landfill or incineration material. The Interpretation Centre utilizes materials from four buildings of varying sizes and functions as material banks for both exterior and interior materials. The urban mine further adds a function that makes it possible to extend the lifetime of certain materials by allowing locals to swap materials. The urban mine is integrated as a structural backbone in the centre to engage the locals through comprehension, exploration and use. This with the aim to inspire the local community to push the boundaries and aspirations for lowering the embedded energy of their new building stock. The utilization of local building materials as upcycling and recycling principles also contributes to preserving materials contributing to the feeling of belonging. These materials can help connect the past with the present through their atmospheric attributes in terms of visual expression, texture and maybe even smell. Furthermore, it engages the locals in the preservation of their local identity.

What is an Interpretation centre and how can it create a sense of belonging to a city?
The 2300 m^2 Interpretation Centre of Kiruna serves as a place to understand the heritage of the city and a place that preserves the identity of the city for future generations. The typology is defined as being the interpreter of a site through first-hand experiences relating to the heritage of the site. Placing the centre on a inactive and currently inaccessible mining site, a new connection between the visitors and the natural and industrial remnants of the past is created. This connection is articulated through axis paths integrated into the design concept, creating the:

NW / SW axis, a clear separation between the city and the mining area. This axis integrates the fence as a part of the path and thereby creating experiences through views on top of what previously was considered forbidden territory.

NE / NW axis, a direct linkage between the square mining tower and the deformation zone. This axis makes it possible to (re)activate and utilize the heritage elements as part of the exhibition.

What is the heritage of Kiruna and how can architecture facilitate the preservation of it?
The rich heritage of Kiruna is a complex overlay of extremes. On the one hand, the city has one of the biggest mining operations in the world, while on the other it is placed in a subarctic region where indigenous Sámi people has lived in harmony with nature for centuries. However, the local identity revolves around the mining heritage and the relocation process is a direct result of mining activity. Therefore, it is clear to state that Kiruna's mining heritage is vital to address as it directly affects both the natural, industrial, cultural and built heritage of the city.

The natural heritage of the city is dominated by massive deformation zones that cannot be accessed currently. The Interpretation Centre opens the deformation zone in the TGA-area to the public allowing people to experience those aspects of heritage through a dictated path. This way it allows them to gain a positive relationship with the unique nature.

The industrial heritage, which primarily includes mining structures and remnants, are also present on the site as two former elevator towers. The round tower serves as the entrance monument to the site whereas the square tower articulates the narration of the past which culminates in the observation room at the top.
The cultural and built heritage revolves around personal memories and traditions along with the local buildings and architecture. These two have been challenging to clearly define, but sought to be preserved through the acquisition and conservation of tangible proof of the past utilized in a narrated exhibition that seeks to explain the past and inspire the future.

REFLECTION

Working with a new typology
Interpretation centres are not a commonly applied building typology, but rather a niche offspring from traditional museums with a larger focus on local identity. Choosing the interpretation centre typology, allowed adapting the typology and project to the situation in Kiruna and the challenges of the loss of local identity due to the demolitions. However, making a philanthropical attempt to deal with the identity of an entire city and the scale of it, proved to be challenging and complex within one single building. Therefore, it has been a continuous theme to implement and unfold both cultural, built, natural and industrial heritage of a local community into the building throughout the process. The main challenge lies within the fact that the heritage terms have been proven hard to separate in this project, as they are heavily affected by each other and thereby a focus on any one of them separately would seem unjustified.

Relating to the site and existing structures
The TGA-area chosen for the site provided many interesting possibilities on where to place the building. These many possibilities and the wide variety of scenes at the site created a challenge to find a spot where many of the qualities could be utilized by the Interpretation Centre. A lot of time was, therefore, used just to find the location on where to place the building volume. The many unique qualities at the site made it hard to deselect any of them, leading to a concept that wanted it all.

The relation to the large mining towers, existing at the site, also provided a challenge with the scale of the building volume. The question of whether all functions for the Interpretation Centre should be placed within either of the towers was never really an alternative, making the towers the neighbouring volumes that dictated the scale of the site in relation to the Interpretation Centre. When we decided to interact as little as possible, while still activating the square tower, the question on where the limit of too much interaction appeared. Not only does the interaction to the tower dictate much of the design to the new building volume, but it also raises the question of how the meeting between new and old is made with the most respect and whether we could have done it more humbly.

Upcycling a city?
We initiated the thesis with a pre-set romantic notion about the process of reusing materials and upcycling in practice. This unique scenario of a city being moved raises high potentials for developing circular thinking in practice and to create a pilot project in sustainable transformation. However, even though the current situation is starving for strategic managing of reusable materials from the demolished buildings the tackling of the materials remains as an ambition rather than something integrated that can be practically accomplished. During the process, we acknowledged the challenges at the different stages of reusing and upcycling processes, for instance evaluating materials according to the presence of toxins. When practising urban mining it is close to impossible to verify the materials according to current standards, which means that it would require a high level of processing and energy to make them compatible for usage. At the scale of this thesis, we acknowledged the complexity and limitations of the technical evaluation of these measures resulting in doing it on a principal rating system of 'high, medium, low' estimations. Parallel to this, as the process developed, the aspects of heritage slowly became more prominent in the narration of the centre, meaning that the symbolic value to the materials became in focus rather than the uncertain and assumption based technical evaluations.

The characteristics of the urban mine have been altered iteratively to merge with the concept of the centre. Consequently, it has orbited from the idea of having the capacity to possibly house all the materials from the demolition to a smaller scale idea of showcasing the principle of urban mining and material swapping. However, in both cases, it is challenging to verify the pondus of it as a future reuse and upcycling catalyst. Therefore, it was guided by the process of articulating the heritage aspects through the exhibitions and thereby becoming an active part of the narration. Nonetheless, it raises the discussion of the function of being a practical workspace with machinery and exhibition space with visitors coming through. Will this create synergy, communication and inspiration between the user groups or work against each other.

A centre for whom/ the user hierarchy
The initial thought of focusing on both tourist, locals and educational groups could also be discussed in terms of the hierarchy of the users. Although cultural tourism is in high demand, the overall intention of preserving the local identity is primarily aimed at the locals and educational groups but could present less meaning for tourists as they do not have any relation to the heritage of Kiruna. Furthermore, tourist might not have the respect needed to walk in a mine deformation zone, even on a dictating path. It can therefore be discussed whether the decision to open the area is too dangerous and puts too high pressure on the safety means that it will disturb the experience of the natural heritage.
The evolution of the project
The decisions made throughout the design development are based primarily on the design drivers that derives from the previous chapters. As many of them are based on heritage, which is up to the individual's interpretation, the decisions have been concluded difficult to verify with solid evaluations, such as calculations leading to a numbered result. It is instead the symbolic and assumed values, as well as symbolism, that are the arguments for most of the design decision made. These soft values are, however, hard to evaluate if they are being reached.

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APPENDICES

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Appendix 2: Masterplan over the new city centre in Kiruna

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Appendix 4: Urban mining in Kiruna

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APPENDIX 1

Questionnaire regarding the TGA Area

1) Vilket förhållande har du till TGA-området? Om du inte har ett förhållande till området får du också gärna skriva ner det

Jag sommarjobbade på industriområdet när jag var tonåring.

Inget speciellt

En viktig siluett över hemorten för mig, det är på dem man pekar när man visar vars Tuolla är från toppen av Luossabacken.

Cyklat förbi där när man var liten

Som liten har man vart in i tornen å kollat, vart ett landmärke som sagt att snart är man hemma, sen kommer jag ihåg en glödande grej på ena taket

Kommer ihåg att det var verksamhet i gruvan när jag var tonåring . Inget förhållande.

Jobbat innom området i många år

2) Vad tycker du om de två gruvtornen?

De är ganska fulsnygga torn som berättar lite om den gamla smutsiga industritiden.

Att de är en del av historien

Fina, de betyder mer för mig än hela stadsflytten

Tycker de är ett riktmärke att man kommit in till Kiruna. Tycker om dem fattar inte någon gör ett kafé eller nått kul med dem.

Extremt fula

Nostalgi

Tycker att de ska bevaras och hade gärna sett att de kom till användning som utsiktstorn, kafé, restaurang eller hotell om det var möjligt .

Tycker de är rätt fula men de är ju ändå en del av Kirunas historia.

En stor del av Tuolluvaara och Kirunas gruvhistoria.

3) Vad skulle du tycka om de två tornen blir nedrivna?

Det beror på vad man har tänkt använda området till. Kan det nyttjas till något som för Kiruna mot framtiden så är det bara att riva ned dem. Har man bara tänkt sig en grönyta så tycker jag att man ska behålla dem.

Skulle tycka att det var trist

Vi bör bevara dem och få invånarna att nyttja dem på något vis. Jag skulle bli bedrövad om de skulle rivas.

Väldigt tråkigt

Att allt har sin tid

Skulle vara jätte tråkigt, dem har ju vart där så länge gör nå kul av dem istället .

Det hade varit tråkigt .

Skulle inte sörja dem.

Inge bra, en stor del av gruvepoken i Tuolluvaara skulle försvinna.

4) Vad associerar man som kirunabo tornen med? Något positivt/negativt?

Negativt, miljöförstöring som på den tiden var stor. Positivt, industri och produktivitet som byggde
Kiruna.

Positivt, dock har man ej fått komma dem speciellt nära pga. Staket. Men de visar upp en historia av vårat gruvsamhälle.

Positivt det har bedrivits en gruva och man förstår många ton har gått igenom ett av tornen. Nu vet jag vad tornen har använts till men tycker de visat open gruvverksamhet

Ett gammalt gruvhål

Att det varit gruvverksamhet där . En del av Kirunas historia och det är väl positivt .
I och med att de är något av det första man ser av Kiruna framkallar de väl någon form av hemkänsla när man rullar in i stan. Men annars känns det som att de associeras mest med gruvdriften, och det finns det väl andra påminnelser om.

Positivt ett tydligt riktmärke

5) Ser du ett bevaringsmässigt värde i de gamla gruvbyggnaderna på TGA-området?
Ja, se svar vid punkt 3 ovan.

Absolut! I andra städer bevarar man gamla industrier och hittar ett nytt användningsområde för dem. Kiruna bör bevara sina för att visa sin historia, och inte bli av med allt det ”gamla” i och med stadsomvandlingen

Ja och tycker man kan tänka utanför boxen och göra något med dem Vissa utav stenbyggnaderna har en viss charm kan kanske användas till något annat

Ja absolut !

Absolut och typ ett museum om gruvans historia vore inte dumt .som jag skrev högre upp bör bevaras och restaureras för kommande generationer .

Nej i mina ögon kommer nya stan få nya finare landmärken.

Ja, en del av Kirunas profil

6) Hur skulle du vilja att TGA-området används i framtiden?

Jag tycker att man ska använda alla tänkbara markområden till bostäder. Om man inte kommer igång med det så kommer Kiruna snart bara vara en ”flight in flight out”-stad. Det är nog inte försent än men snart.

Kanske en glashiss på utsidan vars man kan se ut över hela nya stan när man åker upp, och ett café högst upp med panoramautsikt. Med trappor upp som alternativ också såklart. Fantastiskt träningspass.

Turism och fik fixa till det snyggt och prydligt med gräsmattan och snygga grusgångar med grillplatser mm

Skulle ha varit fint med bostadsområden nära centrum men tror att de blir för dyrt att genomföra just där

Ja , man hade fast kunna göra en besöksgruva centrumnära, bra för turismen .

Som ett museiområde med kaféer och Restauranger .

På sätt och vis känns det som att det Kiruna saknar mest av allt är bostäder. Så mitt önskemål skulle vara miljövänliga bostäder med mindre lägenheter, typ 1-, 2- och 3- rummare.

Bygg hotell eller restaurang i byggnaderna.

7) Vad har du för förslag för att bevara Kirunas identitet när staden rivs ner och förnyas?

Jag tycker man ska fortsätta som man börjat. Ta lite detaljer från sådant som inte går att bevara. Fotografera och gör snygga digitala och fysiska presentationer som ska finnas på nätet och i stadshuset.

Flytta sådant som man kan göra men till rimlig kostnad.

Tycker inte att det finns nån speciell identitet

Öppna och säkra upp alla gamla gruvbrytarområden för att få invånarna att nyttja vår fina natur. I dagsläget är alla fina områden avspärrade med staket. Tänk en gångbana runt luossasjön, tänk om man kunde göra ett fint stråk i gamla gruvhålet på luossa, likt canyonen i Abisko. Även nukutus har varit avspärrat, ännu en fin plats vi varit berövade på.

Ett annat landmärke är Kyrkan och den hoppas jag den kommer synas bra. Stan har rivit fina byggnader när jag var liten och de husen tog man aldrig och efterapade någonstans i stan. Kan tänka mig man gräver i arkiv och återskapar många av även de byggnaderna.

Återskapa en del av de områden som rivs
TGA området vore ju perfekt för ett museum ovan jord med allt om Kirunas historia .

Jag hoppas de satsar på utomhusaktiviteter genom anläggning av motionsspår, klätterväggar och sådant. Sen tycker jag det är jättebra att gamla viktiga hus flyttas med centrum. Hoppas de flesta butiker får platser i nya centrum också för en spökstad hade varit grymt tråkig.

Behåll och restaurera profilbyggnader där det går.

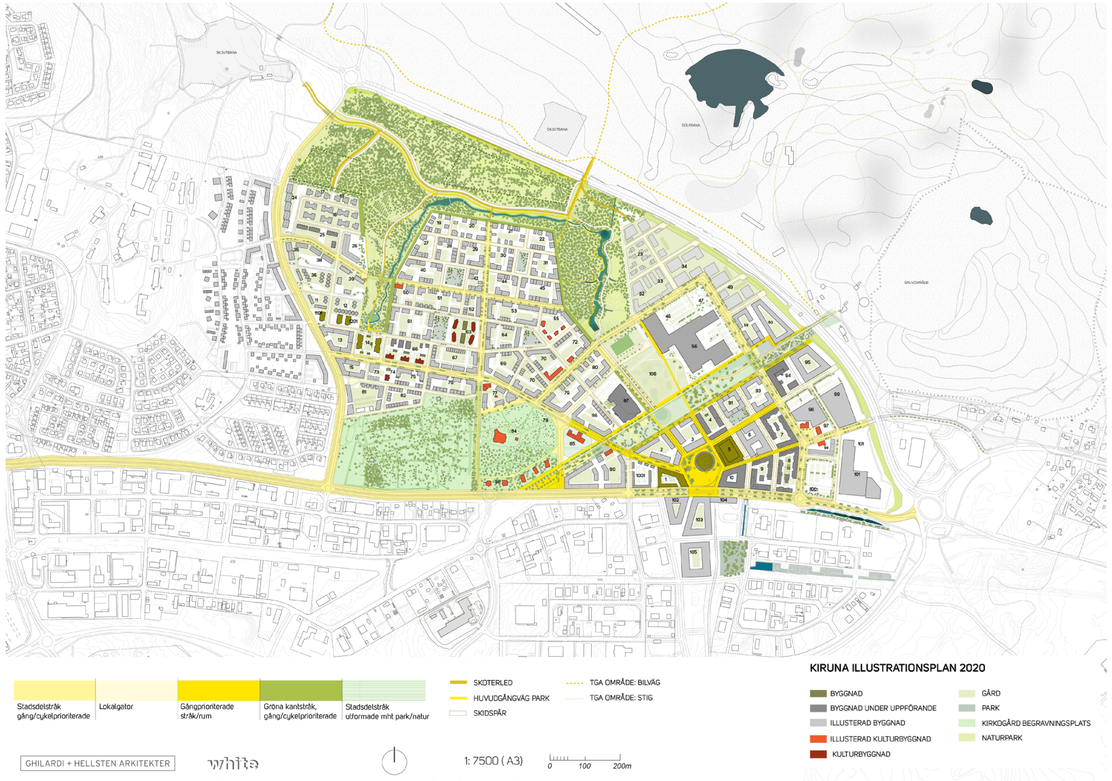
8) Har du några övriga kommentarer du vill dela med dig av?

Jobba på att hålla den fulsnygga traditionen. Kiruna är en gruvstad. Låt den få ha en del grova arkitektoniska inslag blandat med inspiration från den samiska traditionen. Allt detta i samklang med den fantastiska fjällvärlden.

Just nu känns det trist att komma till Kiruna kommunen satsar inte att laga vägar belysning mm Som att de väntar att nya statsdelen ska vara klar men det ser så trasigt ut och skitigt Satsa på fina ställen för familjer mm att kunna vara ute tillsammans Ett bra resecentrum behövs jobbigt att komma till stan och att förflytta sig utan bil är inte lätt

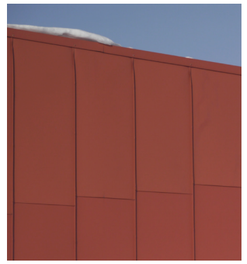
APPENDIX 2

Masterplan over the new city centre in Kiruna



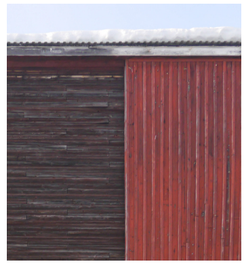
APPENDIX 3

Local material potentials in Kiruna

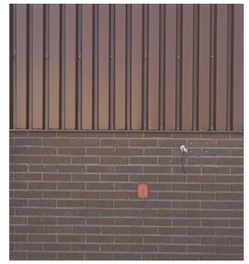


Metal sheet roof

Natural stone foundation



Two types timber clad



Brick & metal facade

Wood shingles

Wood window detail

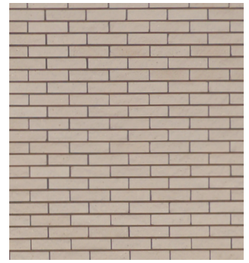
Metal sheet facade

Timber facade & detail

Clay roof & timber clad

Brick & concrete

Form worked concrete

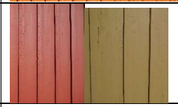


Limestone bricks

(own illustrations)

APPENDIX 4

Multi-family apartment 1920s

		Amount	
Clay roof tiles		386,4 m2	
Timber cladding		489 m2	
Solid plank wall		489 m2	
granite foundation		163,2 m2	
Large white window		41	1,1x1,5
Small square window		6	0,6x0,6
Arch window		4	0,9x0,3
Symmetric white window		4	1,35x1,5

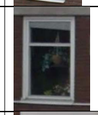
Multi-family apartment 1920s

Steel sheets		547,2	
Timber cladding		499	
Solid plank wall		499	
Concrete foundations		256	
Trible glass window		8	2,6x1,8
Double glass window		24	1,6x1,5
Single glass		8	1,2x1,6

'Brandstationen'

Clay bricks concrete mortar		1100 m2	
Steel sheets		3918 m2	
Concrete foundation		888 m3	
Green gate		19 pcs	3x3,5
Square windows		27	0,8x0,7
Long windows		31	1x1,1
Double window		4	1,8x1,4
Green window		11	0,9x1,2
Large green		4	1,7x3,5

'Hjalmar Lundbohmsskolan'

Brick	2627		
Roof felt	5737		
concrete			
Multiglazed window		122	2,6*1,4
Red window		16	1,4*1,8
Single glazed		18	1*1,1
Double glazed		156	1*1,4
Side by side		11	1,3*1,2
Square		4	0,9*0,64
Glass hallway		96	1,2*1,8
Basement low		4	2,7*0,4
Brown basement		8	1,2*1,9
Basement brown		15	2,4*0,5

APPENDIX 5

The mine towers

Conceptual drawings of the mining towers presents the functions and the assumed content of the towers.

Skip motor
Motors that drives the elevators.

Crane
Used to lift up spare parts through up in the tower.

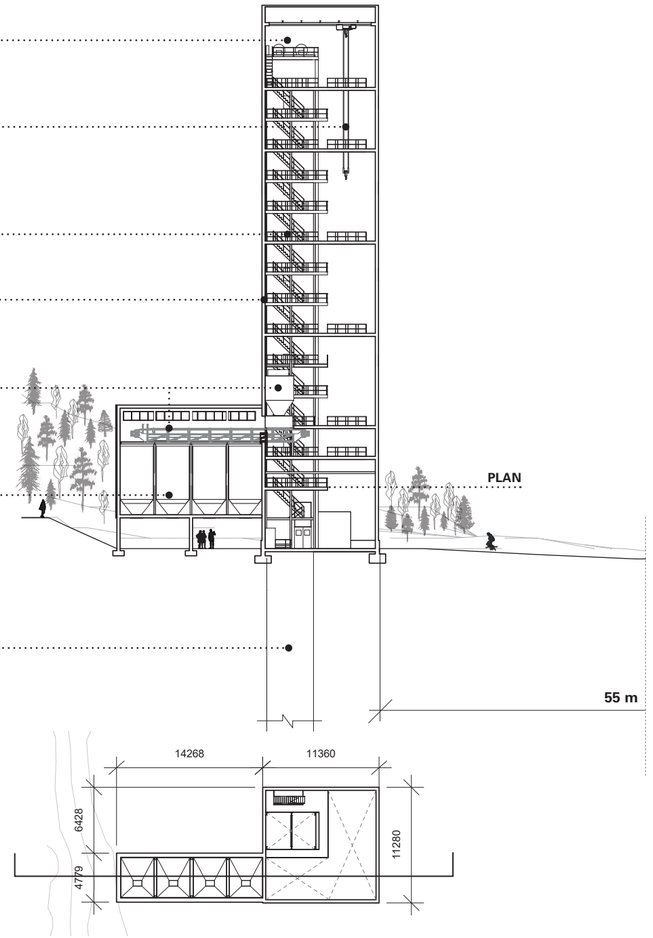
Stairs and structure in steel

Load bearing concrete walls

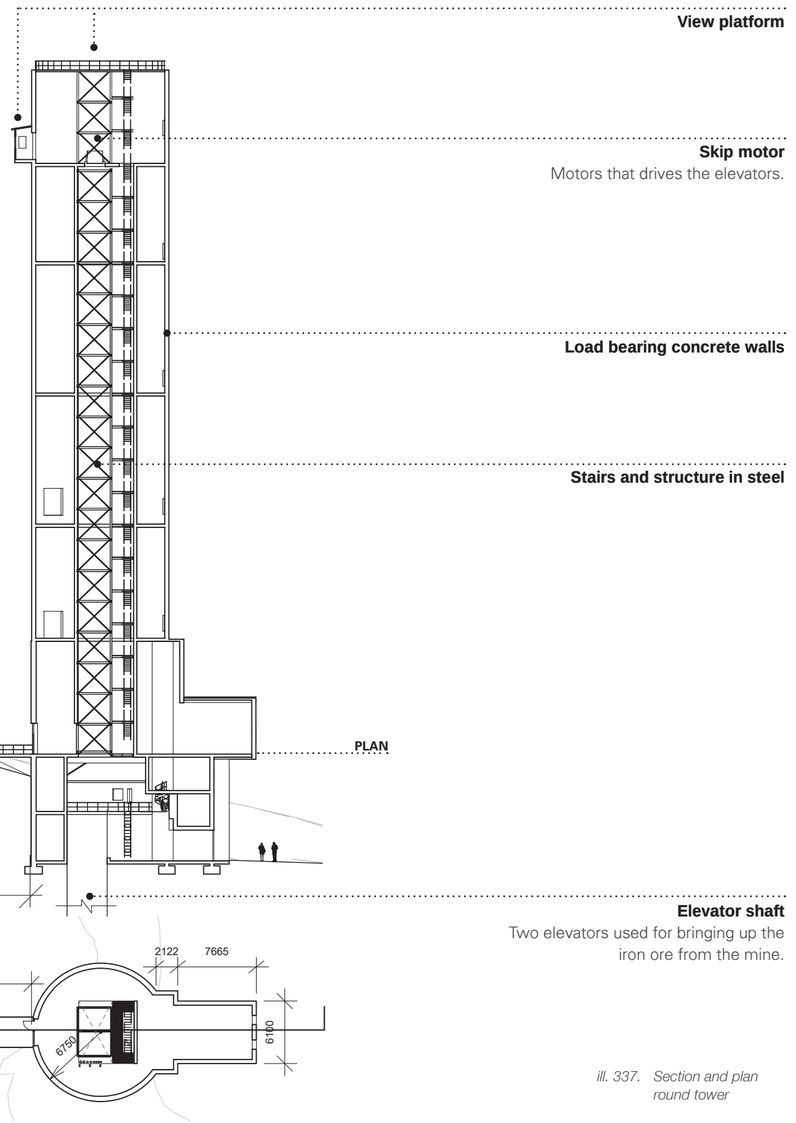
Loading & Conveyor belt
Transports the stone from the mine into the four silos.

Silos
Used for storing and loading gravel from the mine onto trucks.

Elevator shaft
Used for two types of elevators; staff/ materiel elevator and commercial worth-less minerals elevator, also called skip.



ill. 336. Section and plan square tower



ill. 337. Section and plan round tower

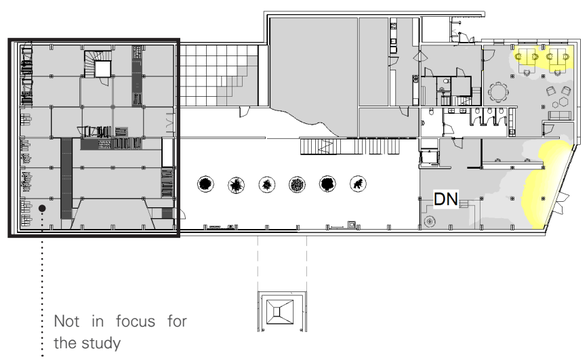
APPENDIX 6

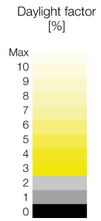
Daylight analyses

Starting-point

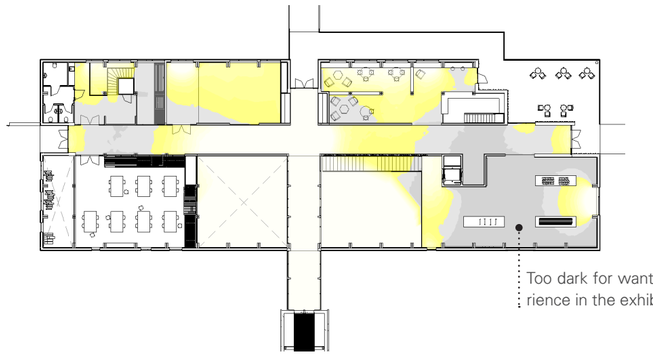
Level 2

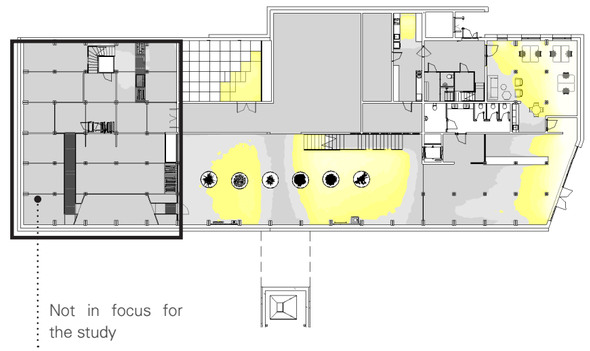
Level 1

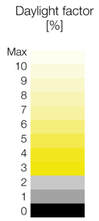




Adjusted

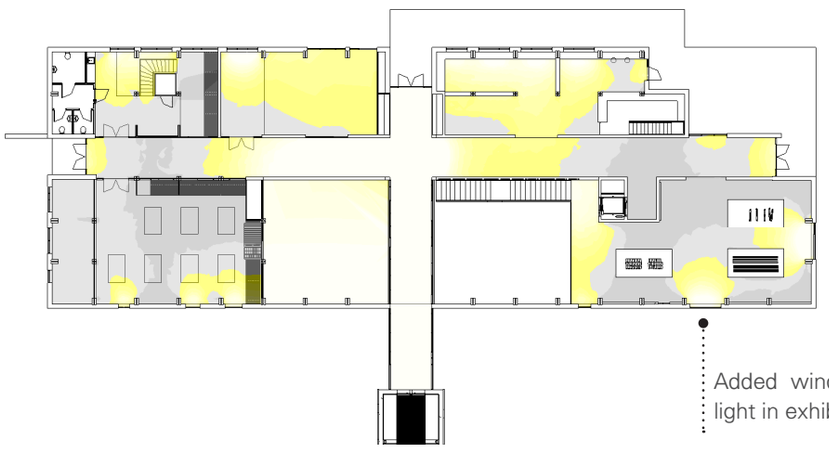






Final

Level 2



Level 1