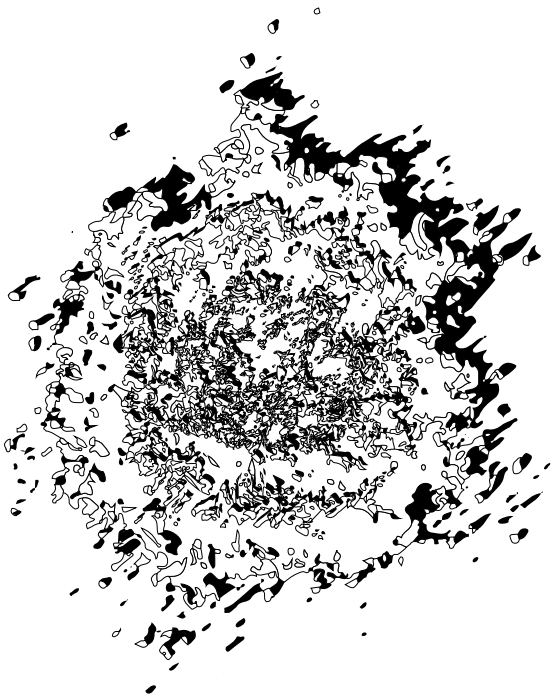
Material

The Embassy of Waste
Building Technology Report



North Sea: Landscapes of Coexistence
Transitional Territories Studio 2019-2020

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Tranditional Territories Studio
2019-2020
TU Delft
Architecture Track

I want to thank my tutors Taneha, Kaveh, Sjap and Francesca, for making me step out of my comfort zone and supporting me as I ventured into the unknown. Thank you for the challenges, but above all, for the encouragement.

Thanks to the long distance and unconditional support from my family and to the companionship and growth from the good friends I have made in Delft.

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The Embassy of Waste
Longyearbyen , Svalbard

Abstract

In the current geopolitical climate, where Arctic nations are at the brink of conflict in their pursuit for influence and resources, mining has acquired a political character, establishing a delicate equilibrium between resource claims and the protection of the territory. This equilibrium is manifested in the Svalbard Free Zone, where all nations are free to make use of its resources, yet the presence of Norwegian population, and mining as raison d'etre of inhabitation, has acted as the entity of governance and ambassador for the best interests of the region. Nonetheless, with the ongoing end of coal mining in Svalbard, and the demise of Norwegian presence in the archipelago, the 'free zone' will face a state of uncertainty, vulnerable to the interests and disputes amongst the Arctic nations (Pedersen, 2017).

As the 'free zone's' uncertainty threatens the stability of the entire region, mining waste becomes a glimpse of hope towards a new form of political representation. While the Arctic communities face the havocs of such waste, its potential reuse makes it a novel resource and a chance for cooperation to counterbalance both its environmental effects and the political crisis that is about to unfold. Hence, the Embassy of Waste is a political manifesto that introduces the recollection and recycling of mining waste in the decaying mining community of Longyearbyen, Svalbard, in an attempt to become a novel tool towards the governance and self-sufficiency in the region.

Pedersen, T. (2017). The Politics of Presence: The Longyearbyen Dilemma. Arctic Review on Law and Politics, 8(0), 95–108. https://doi.org/10.23865/arctic.v8.682

Mining Waste

Waste as a Resource

Waste as a Resource

Mining waste is one of the biggest waste concerns in the world, specially with the increase projection of mining activities as cause of the pursuit for a global sustainable development (Bian, 2012) Therefore within this "global sustainable development" it is key to address the sustainable disposal of such waste. For this it is important to understand waste as a resource, as an opportunity rather than a problem, so instead of discussing where and how this waste should be disposed, the discussion should be about why we should dispose of it, instead of reusing it.

Therefore, by addressing waste as a resource it is possible to understand that the geological conditions of such waste already have the potential to be reused for other purposes. Activities such as construction industry, craftmanship , interior design and energy could be highly benefited by the management of mining waste. Depending on the composition of the waste, which is directly related to the kind of mineral that is extracted, it could be used for different purposes. For example, mineral rich waste can potentially be used for industrial tools, crafts, and porcelain , rocks and sandy waste can be used for the construction industry and clay rich waste for tiles and bricks. (Lottermoser, 2011)

Within the construction industry it has been proven that not only can mining waste become a potential replacement for the aggregates used for the production of concrete, but it can even increase the thermal capacity of the material.

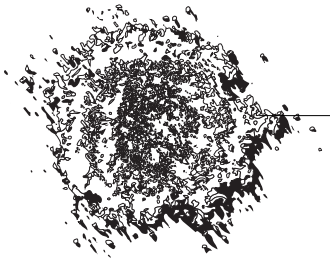
Therefore, the different properties of mining waste could potentially become a resource for the construction industry, where it-could be used to build everything from the structure to the facade and interior appliances.

"Cast in Carbon"
iaacblog

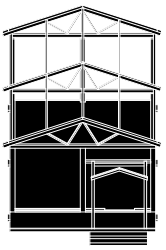
Lottermoser, B. G. (2011). Recycling, Reuse and Rehabilitation of Mine Wastes. Elements, 7(6), 405–410. https://doi.org/10.2113/gselements.7.6.405

Bian, Z., Miao, X., Lei, S., Chen, S. -e., Wang, W., & Struthers, S. (2012). The Challenges of Reusing Mining and Mineral-Processing Wastes. Science, 337(6095), 702–703. https://doi.org/10.1126/science.1224757

Mining Waste

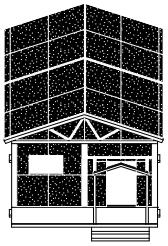


Sand, Clay, Rock. Mineral



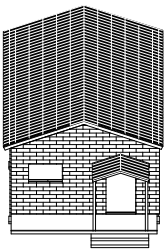
Concrete

Ultramafic, Coal Tailings



Insulation

Iron, Coal, Sand, Mineral, Clay



Tiles - Bricks

Clay, Mineral Rich, Iron Rich

Crafts and Appliances

Mining Waste Management and Reuse

The management of mining waste is a necessity in today's epoch of waste. The process of recycling follows almost all the same specificities of mining. The rock needs to be recollected, transported, stored, separated and eventually processed. The main difference lies in the result, becoming the raison d'etre of this research. While mining produces minerals, recycling produces product, not waste.

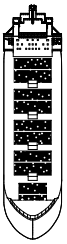
The similarities between the mining process and the management of waste is indeed a potential, as mining sites could try to manage as much of the waste on site. Nonetheless most of the mining companies don't do this because of efficiency and costs. Hence, the potential of introducing this active cycles of recycling into former mining communities, where the knowledge, logistics and infrastructure are wating to be reactivated.

Therefore, by introducing cycles of waste management into these communities it would be possible to address several of the issues specified above. On one hand, both the societal and environmental impacts of mining in the Arctic, on the other, the local restructuring and self sufficiency of Arctic communities.

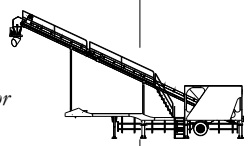
Arctic Nations

Mining Waste

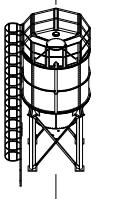
Recollection



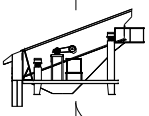
Conveyor



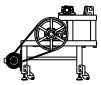
Silo



Feeder

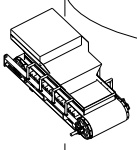


Crusher

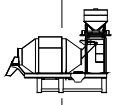


Crafts

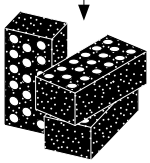
Landfill



Magnet



Casting



Product

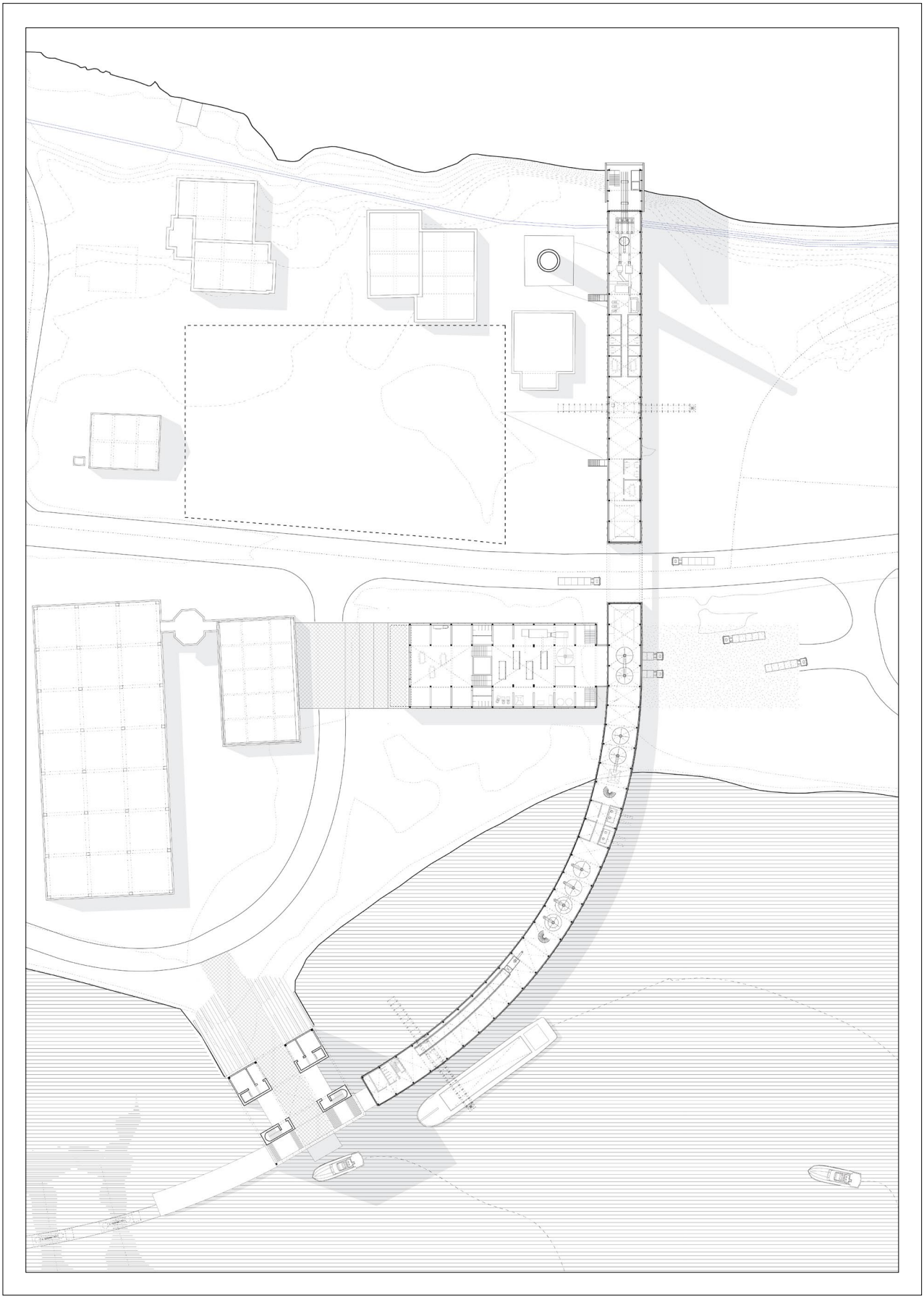
Structure

Building in the Arctic

Project

Given the invisible yet important political value of mining , the Embassy domesticates its externalities on the territory, aiming to restore the energy, production and governmental processes that are soon to face total oblivion. Embedding itself within the existing mining and energy infrastructure of the city, the Embassy extends from the sea to the land introducing the linearity of mining waste management as an infrastructural, non human spine that articulates the project and stitches the territory. Furthermore becoming the border of the 'free zone" and the cardo and decumanus for the future growth of the city

Along this border, embracing the urban mesh, three architectural buildings become the manifestation of the politics of waste by intertwining the non-human process with the public character of the Embassy. The Gate, The Factory and The Tower, represent the converging point between the different governmental scales and the industrial process. Thus, by bringing the public face to face to the management of mining waste, the project becomes a political act in itself as it blurs the existing threshold between the community and the industrial imagery, strengthening the notion of waste as a means for political representation.



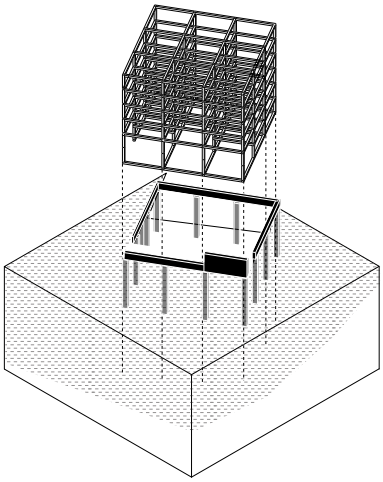
Site Conditions

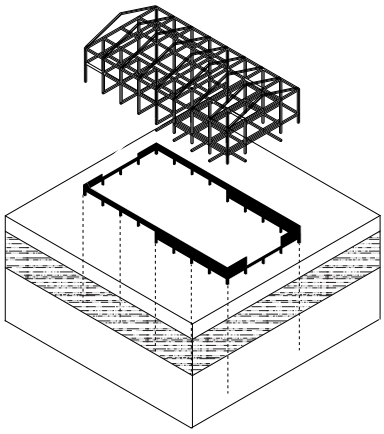
Due to the scale of the project which extends from the shore to the cliff, the bar becomes the spine and articulator, and the satellite buildings an example of the three different ways of building on the site:

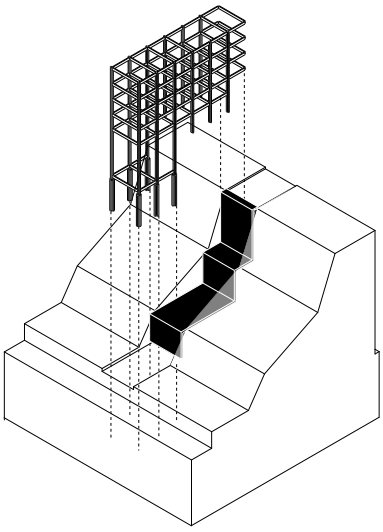
The Gate, built half on the shore and half on pillars above the sea due to its condition of internationality and port logistics.

The Factory, built on the flat industrial ground. It lays above a concrete bed that elevates the building and protects the permafrost from thawing. Pillars are used to cross that permafrost and achieve stability.

The Tower, position towards the cliff, generates a stepped excavation contained by a reinforce concrete wall.



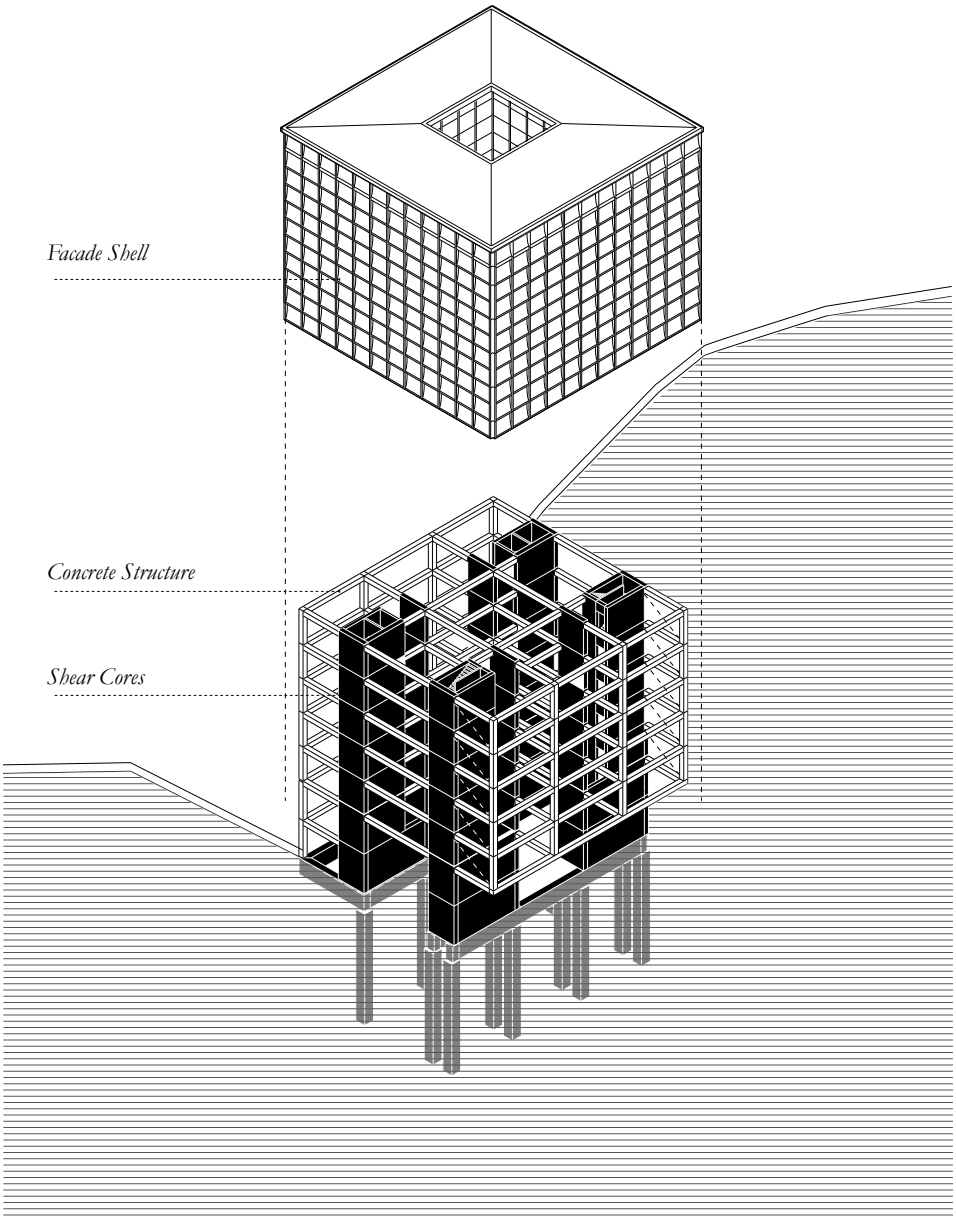




The Gate (Human)

As the Gate to the city and to the Svalbard Free Zone, this building is located towards the sea. To enhance the international character of the Embassy and the public quality of the building, the building is cantilevered above the sea. Four shear concrete cores serve as legs for the governmental building that lies above. This cores lay both on the shore and on the sea.

The 4 structural chores allow a flexible layout of the habitable floors and to free the ground floor, becoming a pier and public space for guests and citizens.

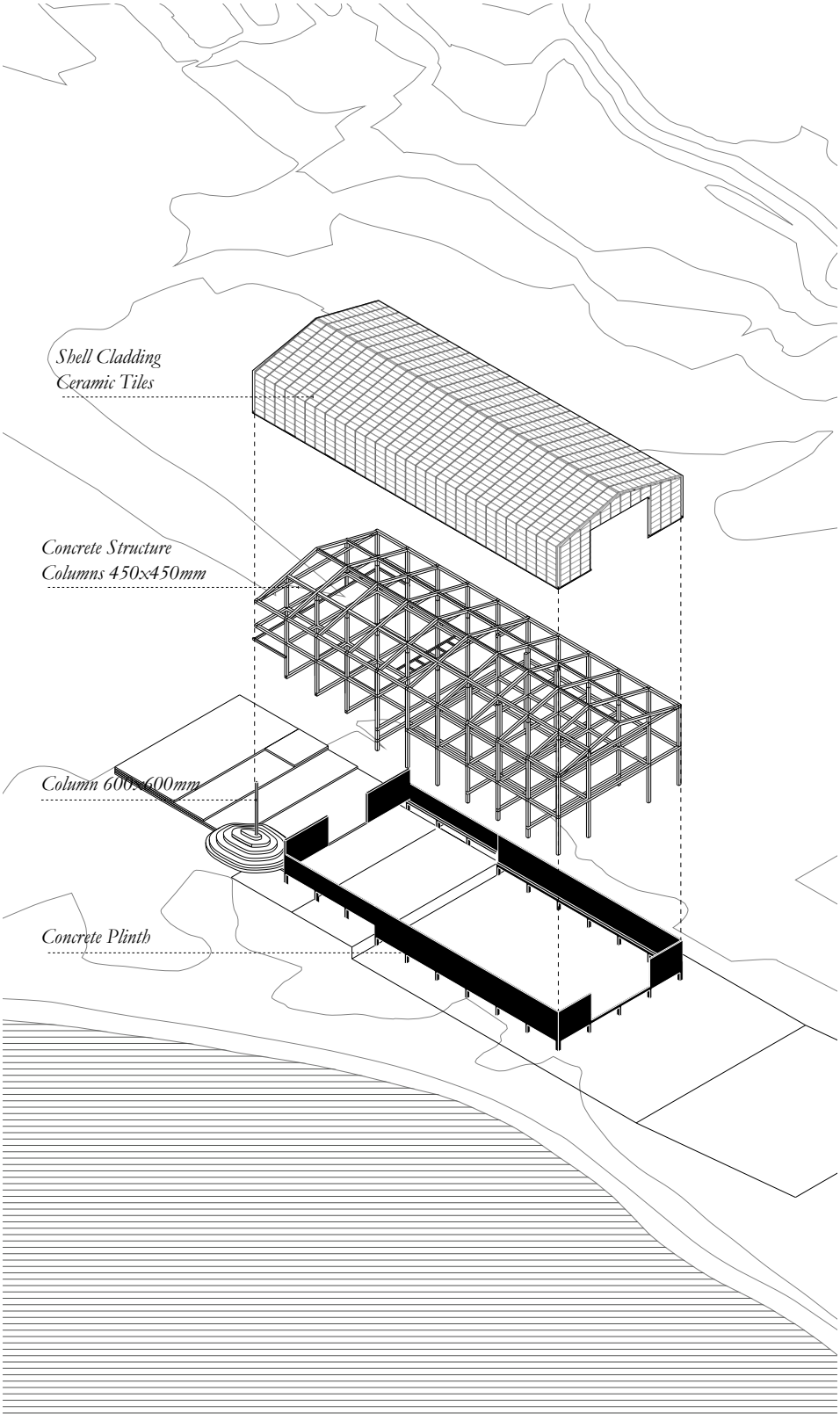

Facade Shell
Concrete Structure
Shear Cores

The Factory (Human)

As both an industrial building yet workspace for citizens, the structure of this building aims towards a traditional concrete structure. As the place where the material is produced, the concrete structure becomes educational in itself, as an example of the results of the recycle of mining waste.

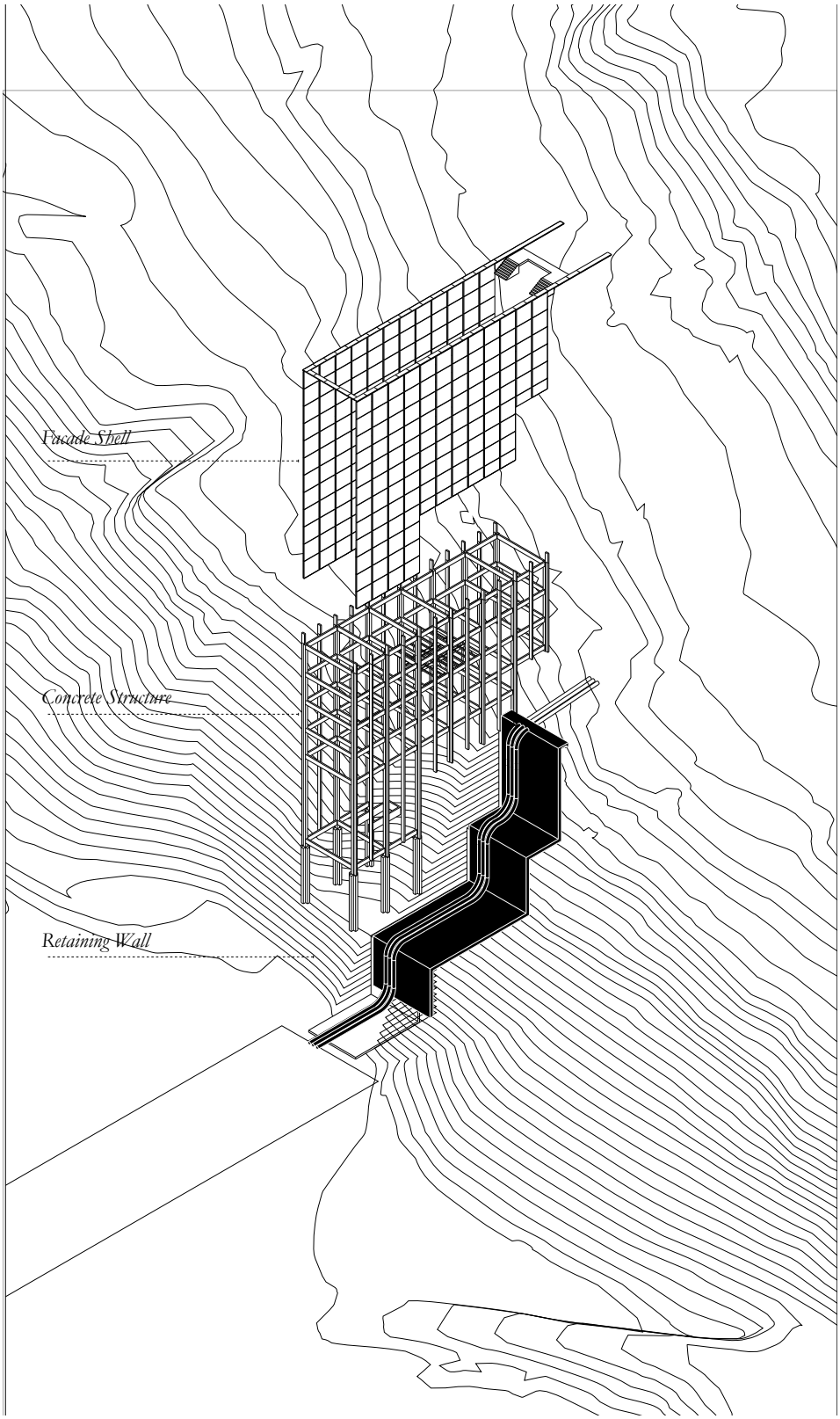
In response tot he Arctic conditions, the building lays above a concrete bed that elevates it, distancing from the permafrost. If positioned directly on the ground, the year long frozen layer could potentially melt, leading towards structural damage and sinking.

Therefore a concrete bed elevated the building, acting as both the foundation and plinth of the facade.


Shell Cladding
Ceramic Tiles
Concrete Structure
Columns 450x450mm
Column 600x600mm
Concrete Plinth

The Tower (Human)

As the ends towards the cliff, the Tower acts as anchor of the project towards the landscape. As it is rock, the permafrost is not an issue, therefore the building generates stepping excavations retained by a reinforced-concrete contention wall. The building lays on this contention wall leaving a maintenance gap in between.


Facade Shell
Concrete Structure
Retaining Wall

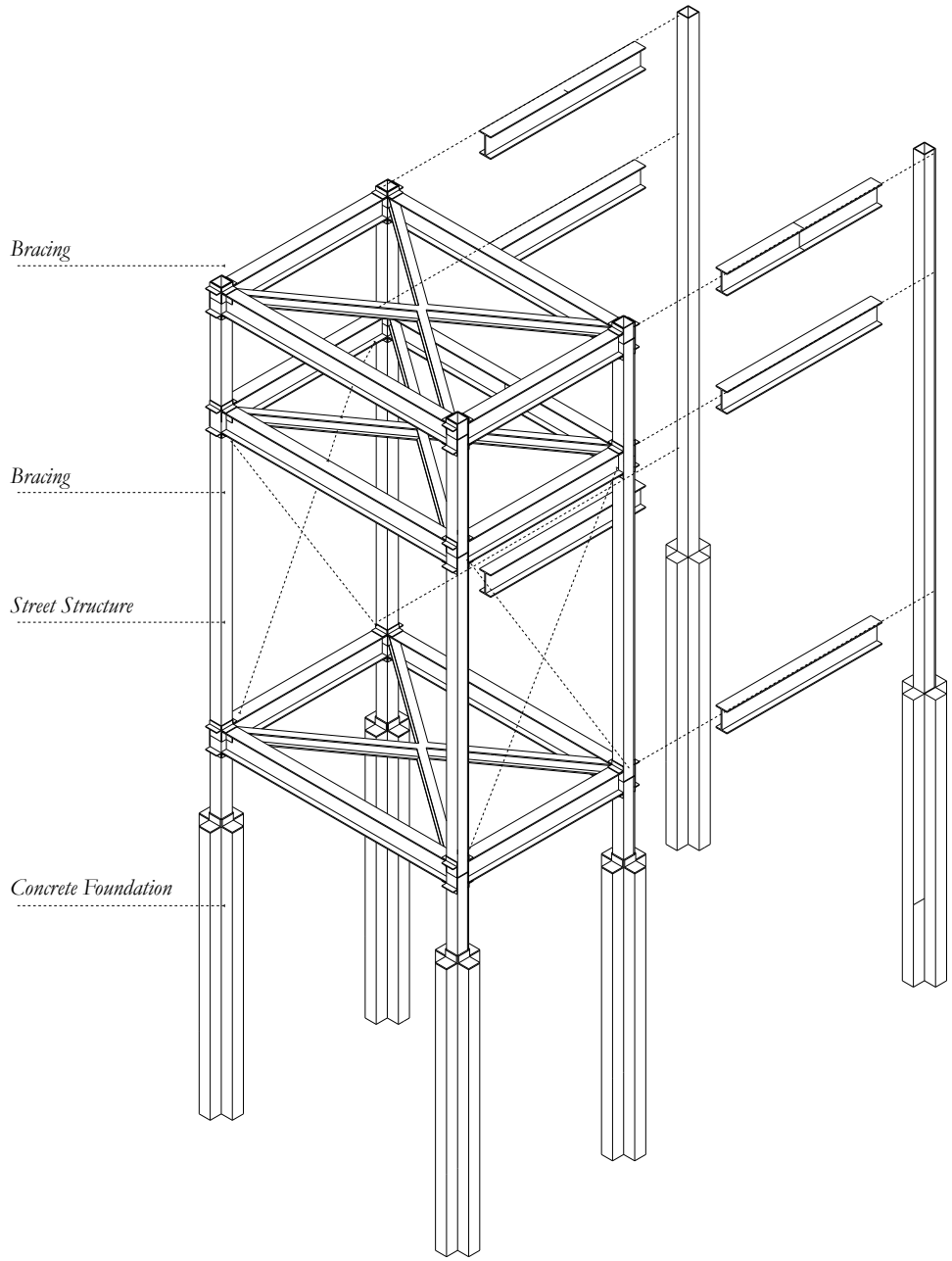
The Bar (Non - Human)

As the spine and articulator of the project, the Bar hosts the industrial and infrastructural dynamics of the territory. There fore it is essentially a non human building, where conveyors transport the mining waste from the port to the landfill through the different recycling process.

At the same time, *The Bar* domesticates the heating, energy and water pipelines of the small Arctic city of Longyearbyen.

Therefore the structure had to answer accordingly. As an infrastructural element, an array of portals every 6m allow for a solid structure, flexible space and for the linearity of the waste recycle.

This portals are in steel, due to the industrial character of the building, efficiency and possibility of further disassembly. This structure invisible to the eye, as it is entirely wrapped by the facade due to the specificities of the climate. The only thing visible to the eye is the cross shaped concrete foundation that adapt to the direct condition along the site. This foundations act as pillar on the sea and get shorter in height as the terrain goes up.


Bracing
Bracing
Street Structure
Concrete Foundation

Climate Scheme

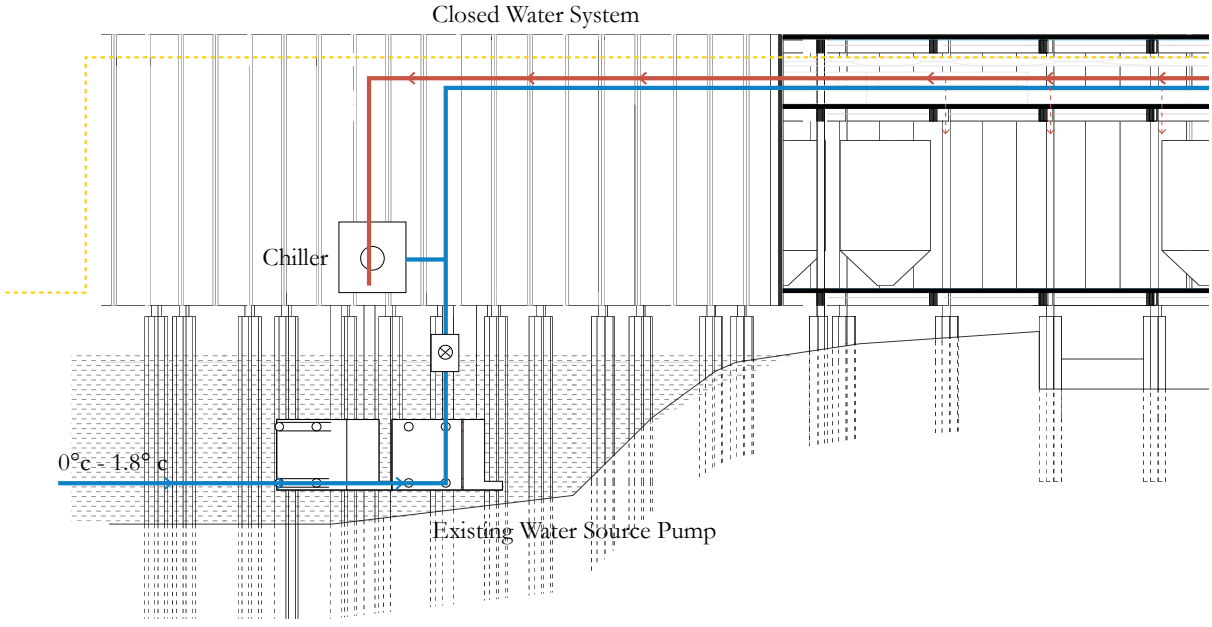
Symbiotic Relationship

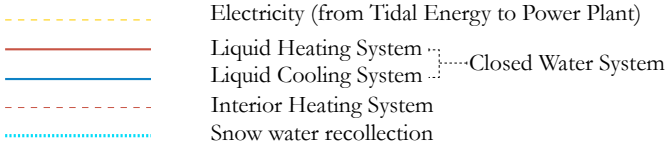
Symbiotic Relationship

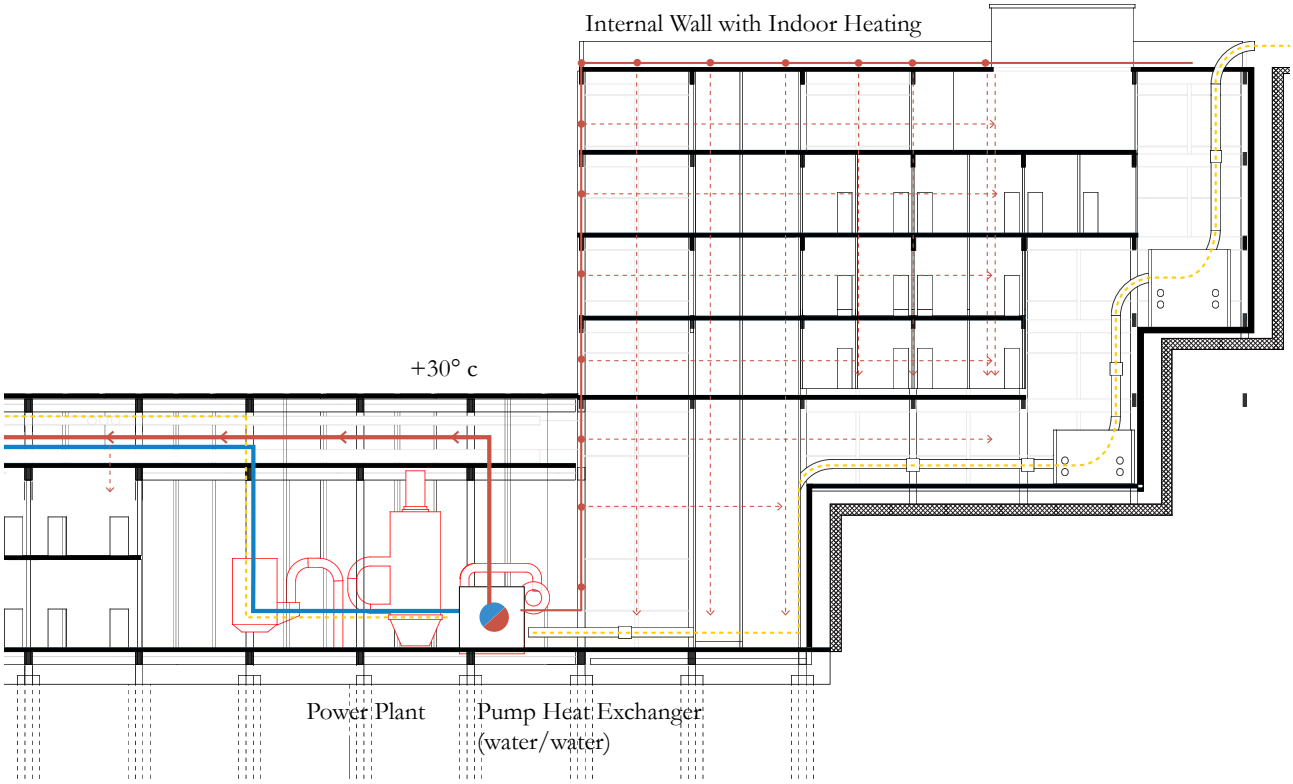
As the project replaces the coal power plant for Tidal energy, it domesticates the existing energy infrastructure within the building. Therefore the bar becomes an energy producing building, where the water pumped from the bay to cool down the machinery heats up, creating closed water system.

By using the existing pump the water coming into the building heats up through the entire process of energy and processing of waste, becoming the heating system for the satellite buildings.

Therefore creating a symbiotic relationship between the different parts of the project. The “active” bar where energy and water is constantly flowing, and the “passive” habitable buildings that require climate comfort from the extreme Arctic conditions






Internal Wall with Indoor Heating
+30° c
Power Plant
Pump Heat Exchanger
(water/water)

Symbiotic Relationship

1. Existing pump pumps water from the bay at 0 - 1.8 degrees.

2. Pump heat Exchanger (water/water). Through the current energy infrastructure inside the building water gets heat up to 18 degrees. The heat exchanger raises it to 30 degrees.

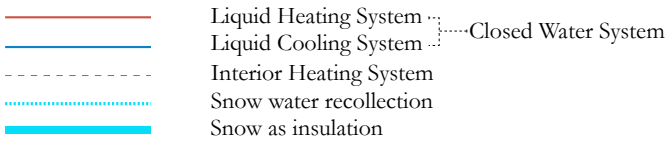
3. Liquid heating system travels through the bar.

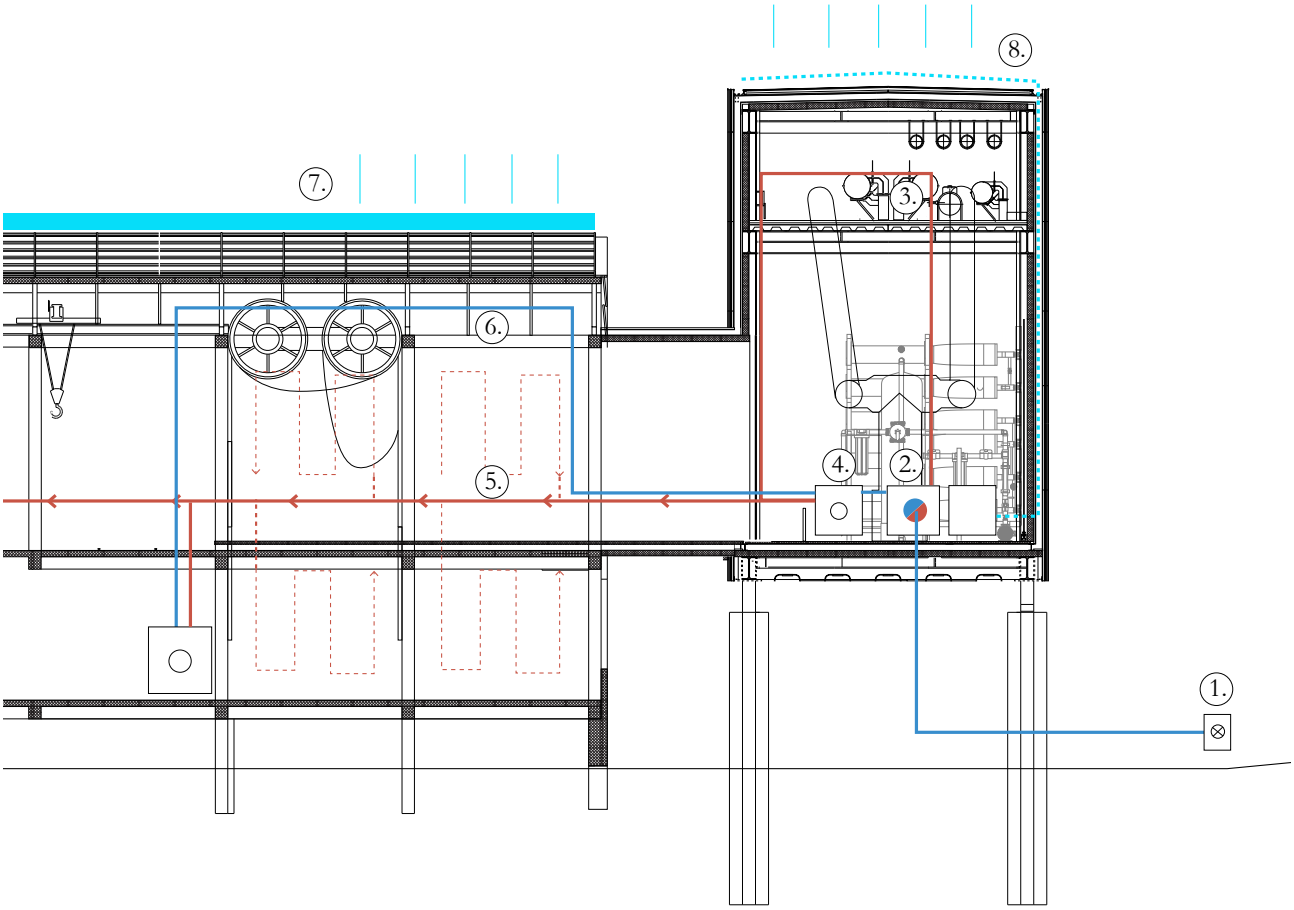
4. Closed Waster System: As the water travels through the building it ends in the chiller where it is used as liquid cooling system. This is used specially in summer because given that the temperatures are still low , it helps lower the temperature of the heating system and hence consume less energy.
5. When in connection to the satellite buildings the liquid heating system travels in pipes through the pre cast elements in forms of interior heating system. With temperature around 30 degrees, the interior heating system generates temperatures around 22 degrees. By activating the concrete structure of the satellite buildings its thermal mass delays the cooling down in case of failure of the system.

6. The liquid cooling system is used to maintain a cold attic in order to avoid ice dams.

7. With snow as an abundant resource it acts roof insulation for the satellite building.

8. Nonetheless, given the warm character of the infrastructure bar, the snow melts and is recollected for further use.

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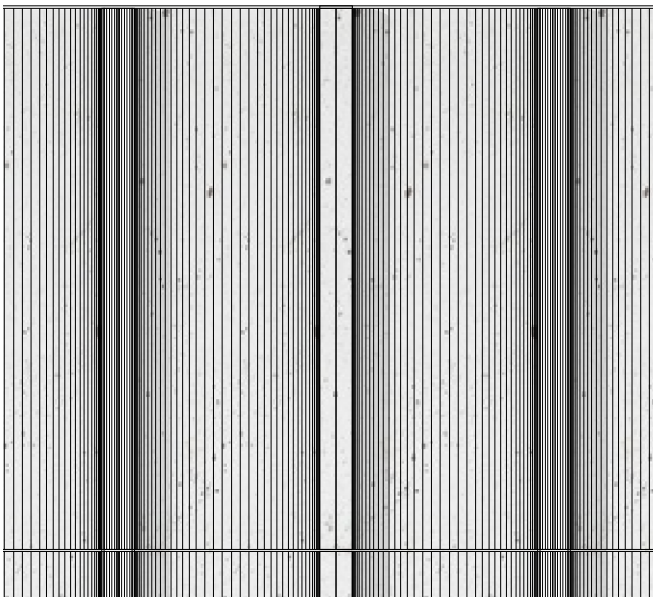
Façades

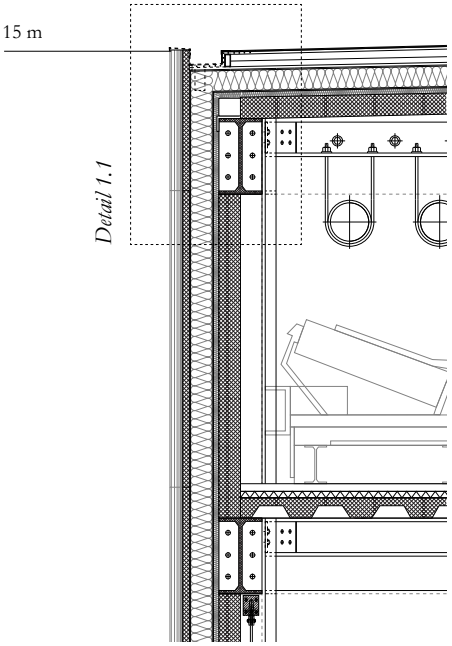
The Bar & The Factory

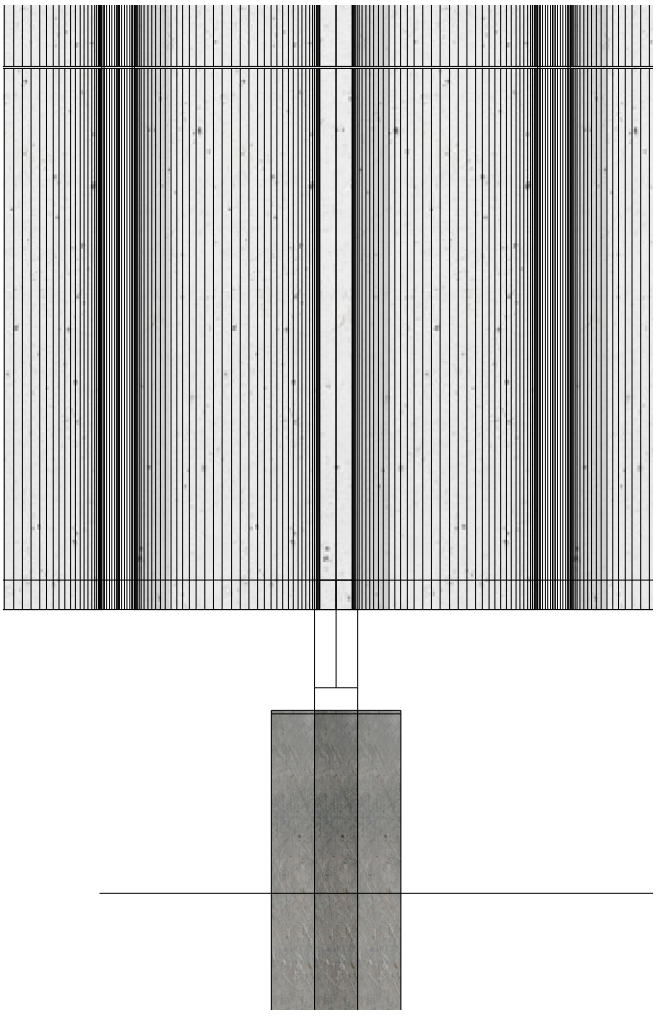
The Bar (Non - Human)

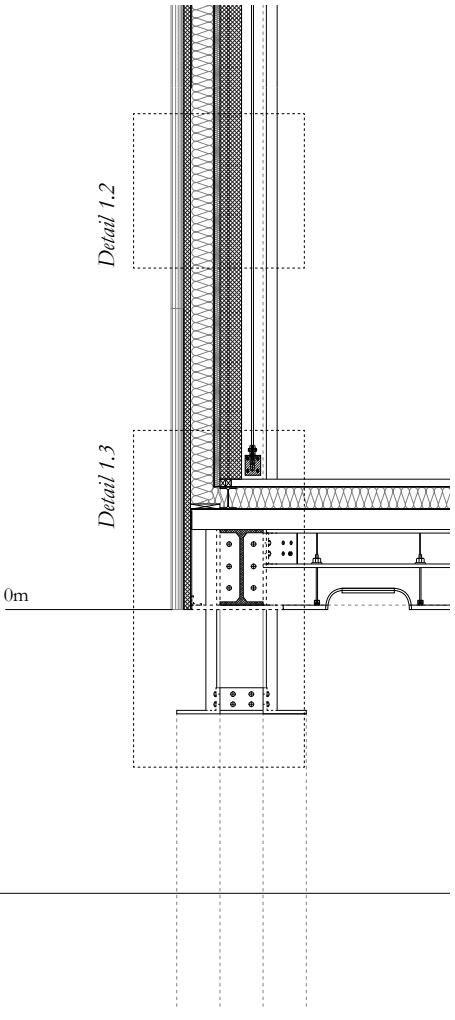
As the infrastructure spine of the project, the steel structure allows for flexibility and easy assemblage. As a non human building, the facade is almost completely blind with the exception of some logistical openings. Yet as part of the symbiotic process towards the climatic comfort of the habitable buildings, it complies with the specificities of the Arctic climate. It is entirely wrapped, with a considerable insulation layer. The facade is a composed of prefabricated elements made with the concrete produced in the building. This concrete replaces the cement for mining waste an reduces CO2 emissions to 70%, both due to the new composition and to the fact that it doesn't have to be imported from the mainland.

The blind 15m high undulated facade aims to achieve a certain monumentally and condition of border towards the city.





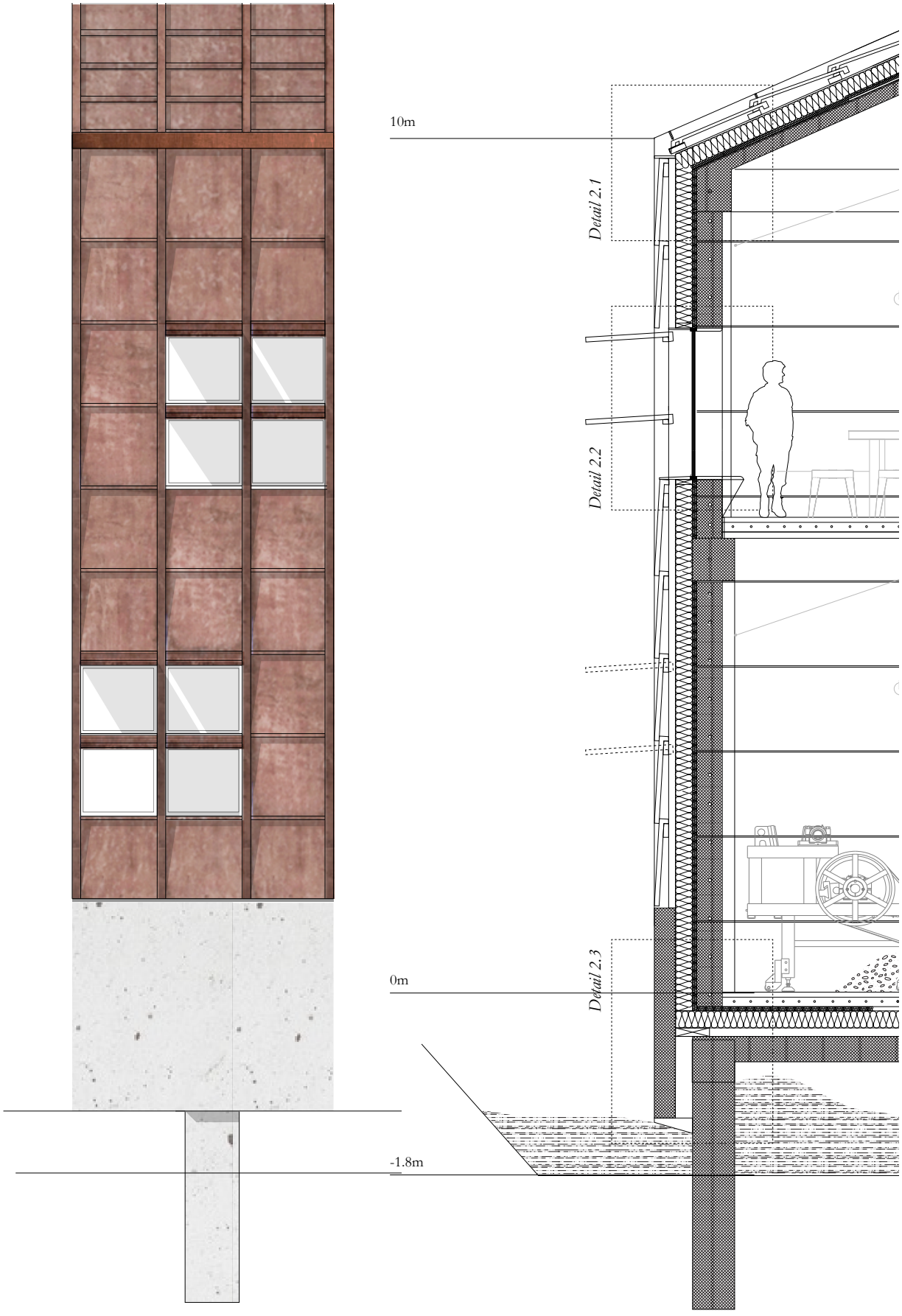




Terrain Level Relative

The Factory

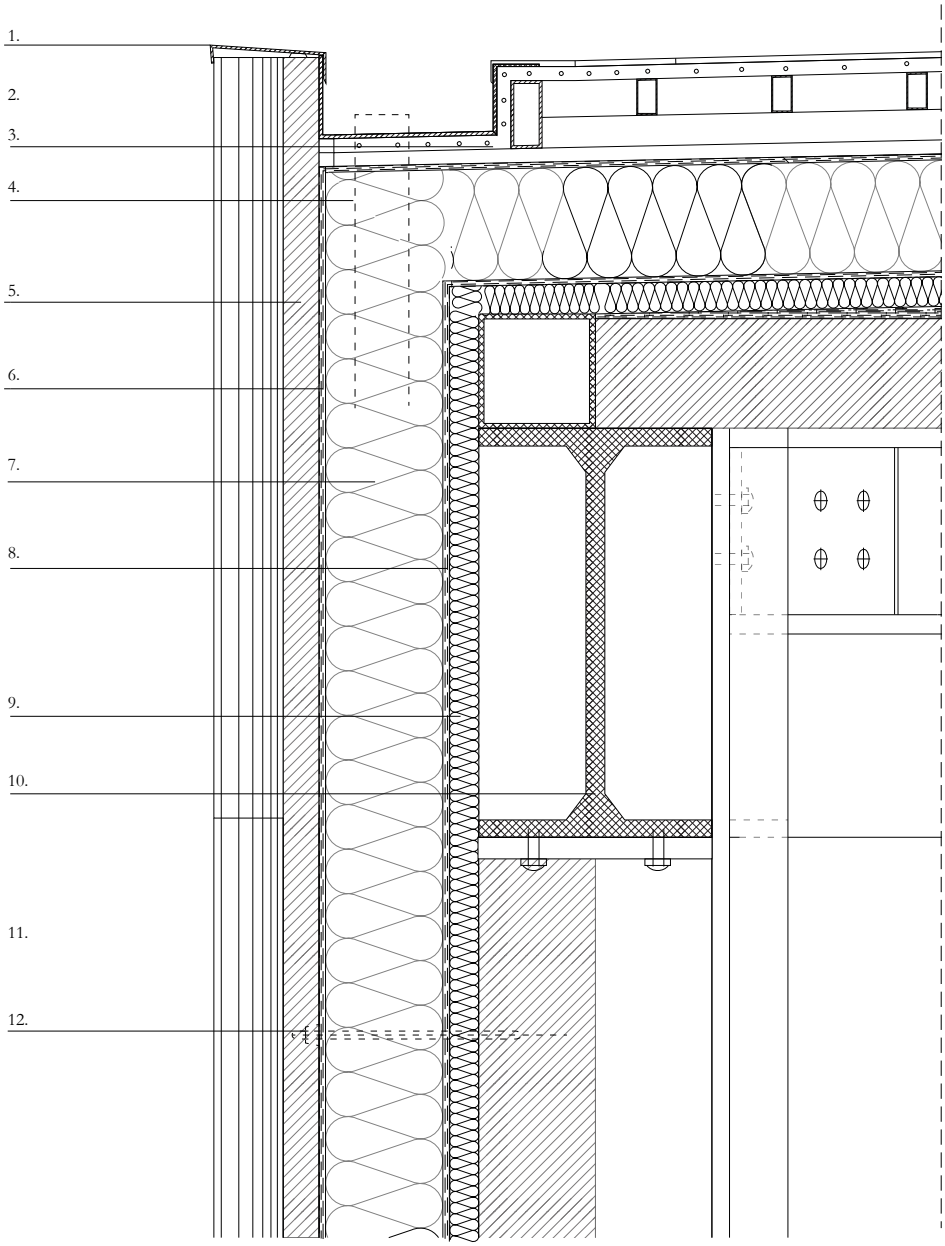
As the workplace for both miners engaging in the production of material and the public engaging with the community workshop, the factory requires an ideal level of climatic comfort. Therefore, contrary to the fixed, blind and monumental facade of the bar, the factory facade is made of ceramic tiles from the same recycling of mining waste. Its light weight sand size allows to have continuous cladding all over the building, complying with the "shell"condition required in the Arctic. By having ceramic tiles, these can become operable to allow daylight to come in (from February to November).


10m
Detail 2.1
Detail 2.2
Detail 2.3
0m
-1.8m

Details

Detail 1.1

1. Alluminium Rain Profile
2. Alluminium Gutter
3. Active Thermal Roof Membrane
4. Snow Water Recollection Pipe
5. Precast Element Concrete + Waste
6. 10mm vapour permeable asphalt panel
7. Mineral Wool Insulation 200mm
8. Soft Insulation - Mineral Wool
8. I Profile Steel Beam
9. Concrete Wall
10. Polyester Rebar Anchor Type TA-H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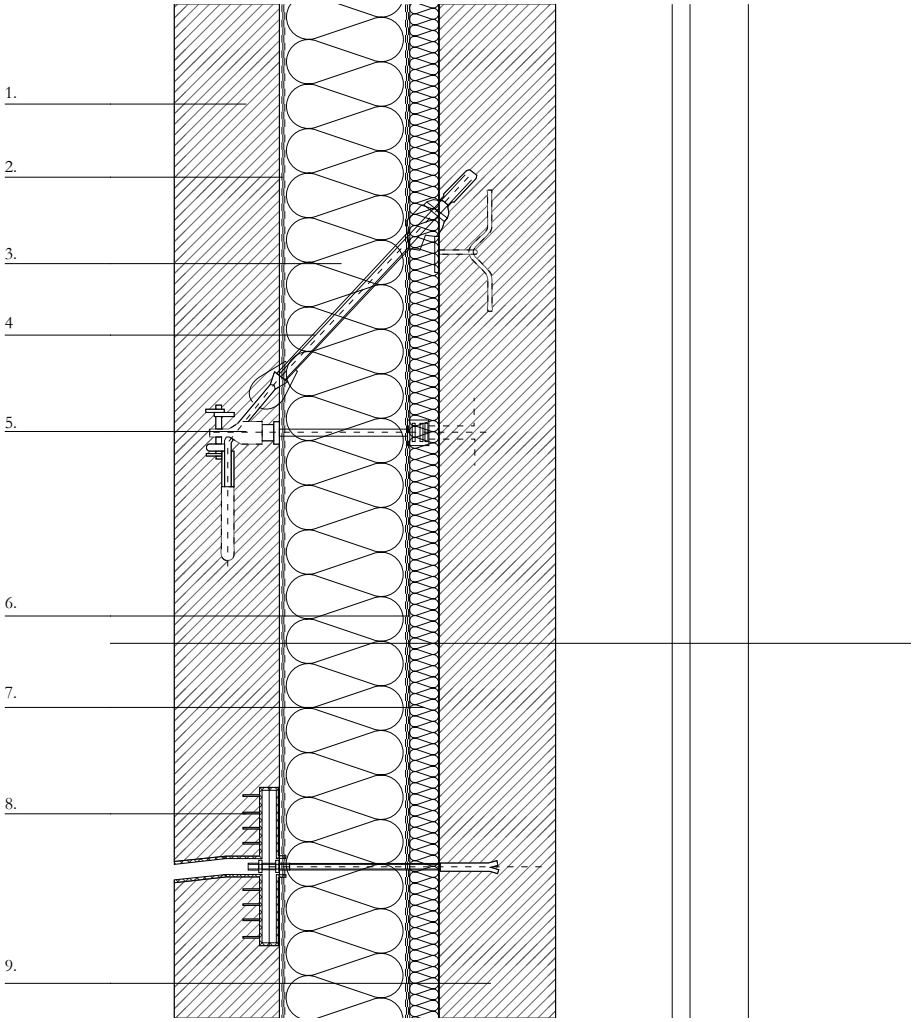
Detail 1.2

1. Precast Element 200mm Concrete + Mining Waste Aggregates
2. Vapour Barrier 10mm + Asphalt
3. Thermal Insulation - Mineral Wool Insulation
4. Schöck Type TA-H - Polyester Isulated Rebar
5. Anchor to Precast Element - Concrete Wall
6. Vapour Barrier
7. Soft Thermal Insulation
8. Retaining Anchor for Tolerance Gaps - Precast Cladding
9. Concrete Wall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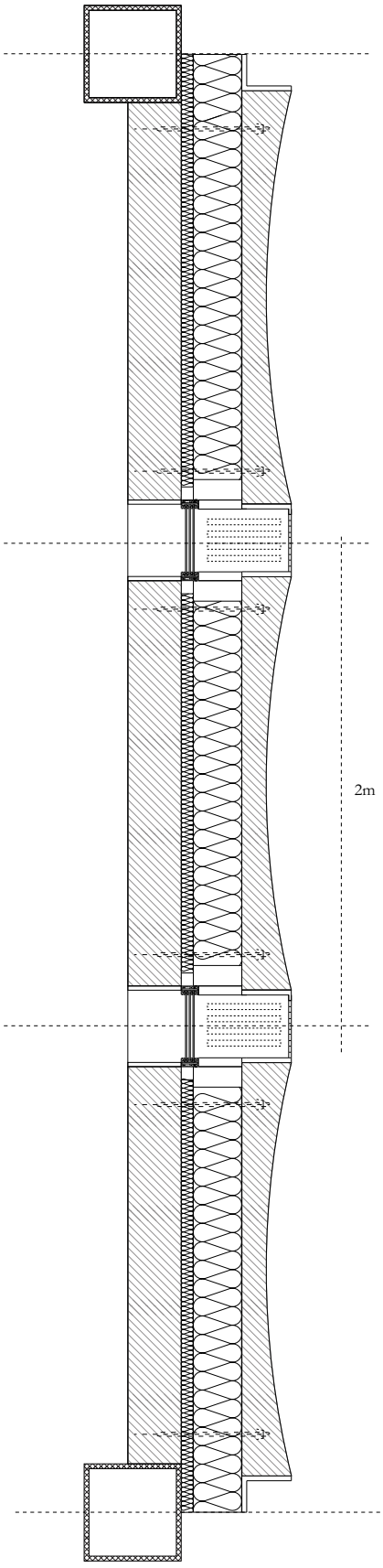
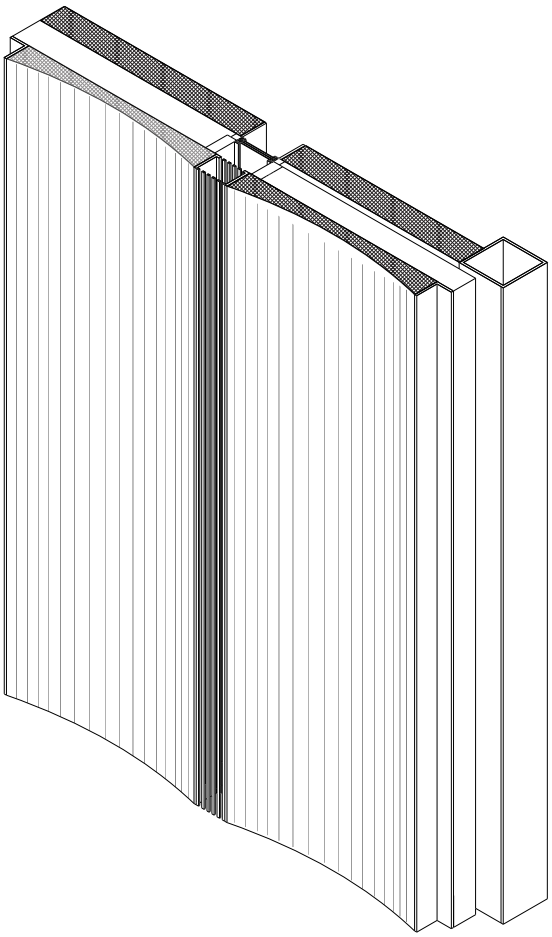
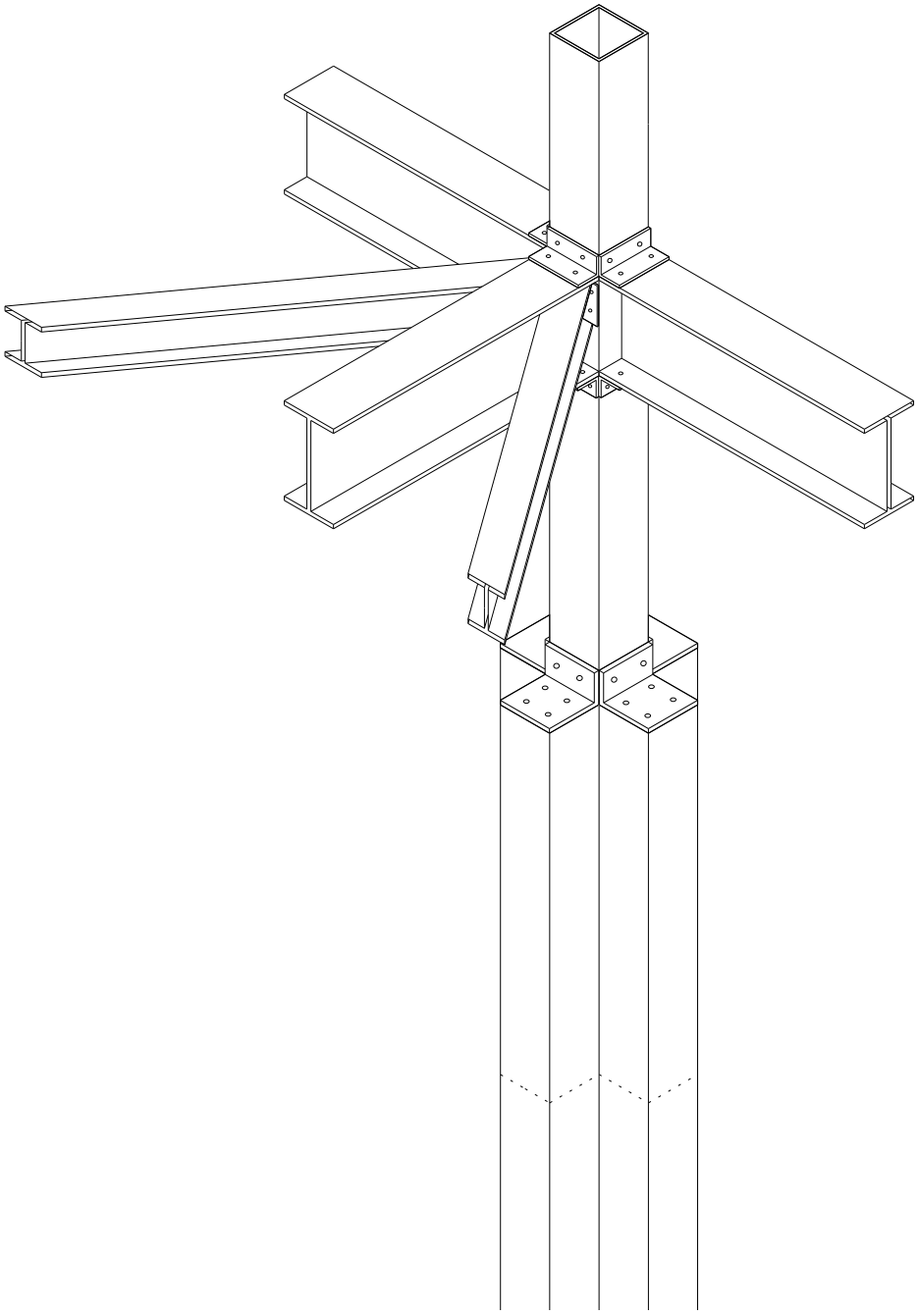
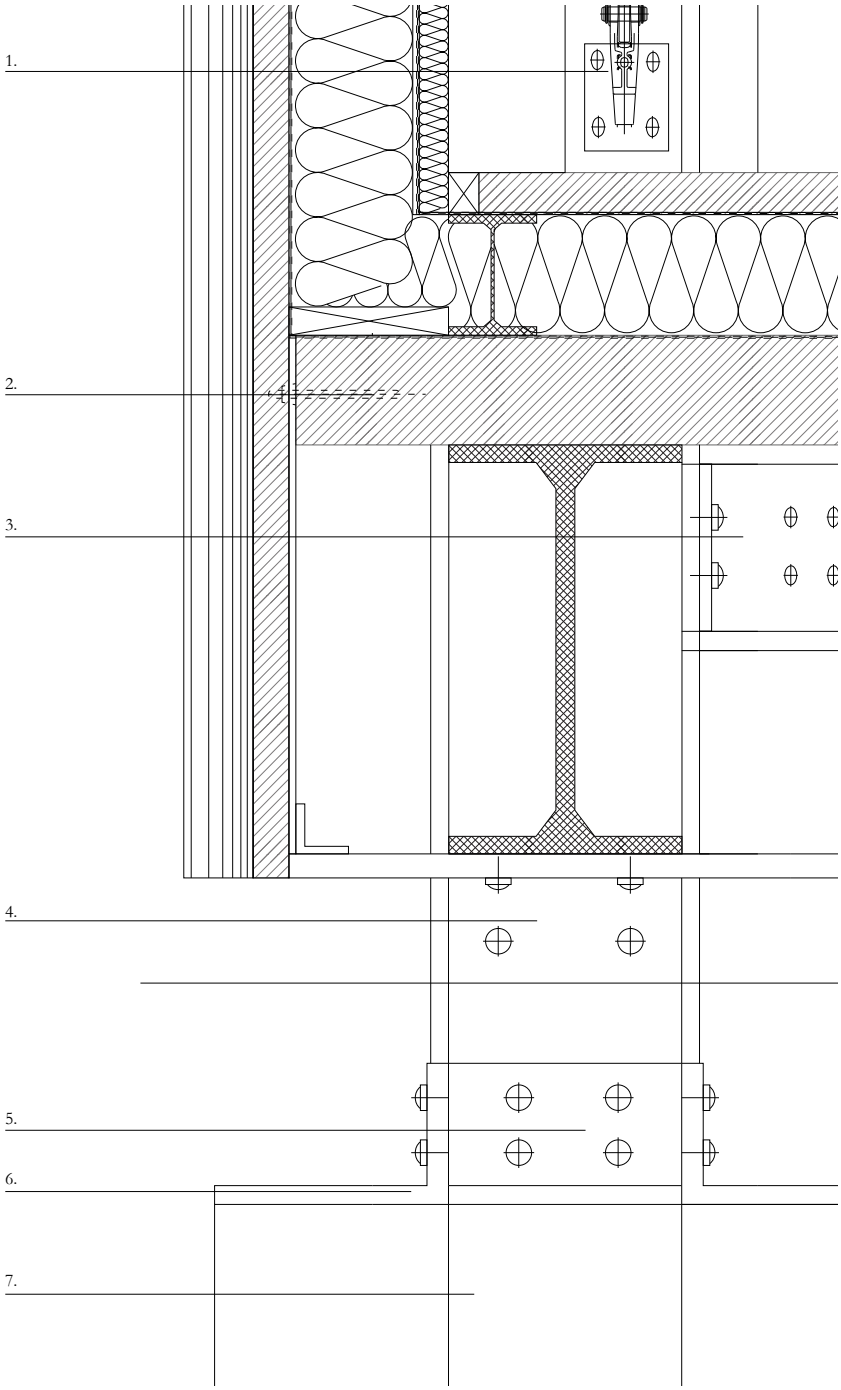

2m





Detail 1.3

1. Interior Tension Rod
2. Retaining Anchor - Precast Cladding - Slab
3. Steel Plate with Anchor Bolts
4. End Steel Plate with Anchor Bolts
5. L Shape steel Plates
6. Base Steel Plate 500x500mm
7. Cross Concrete Pillar Foundation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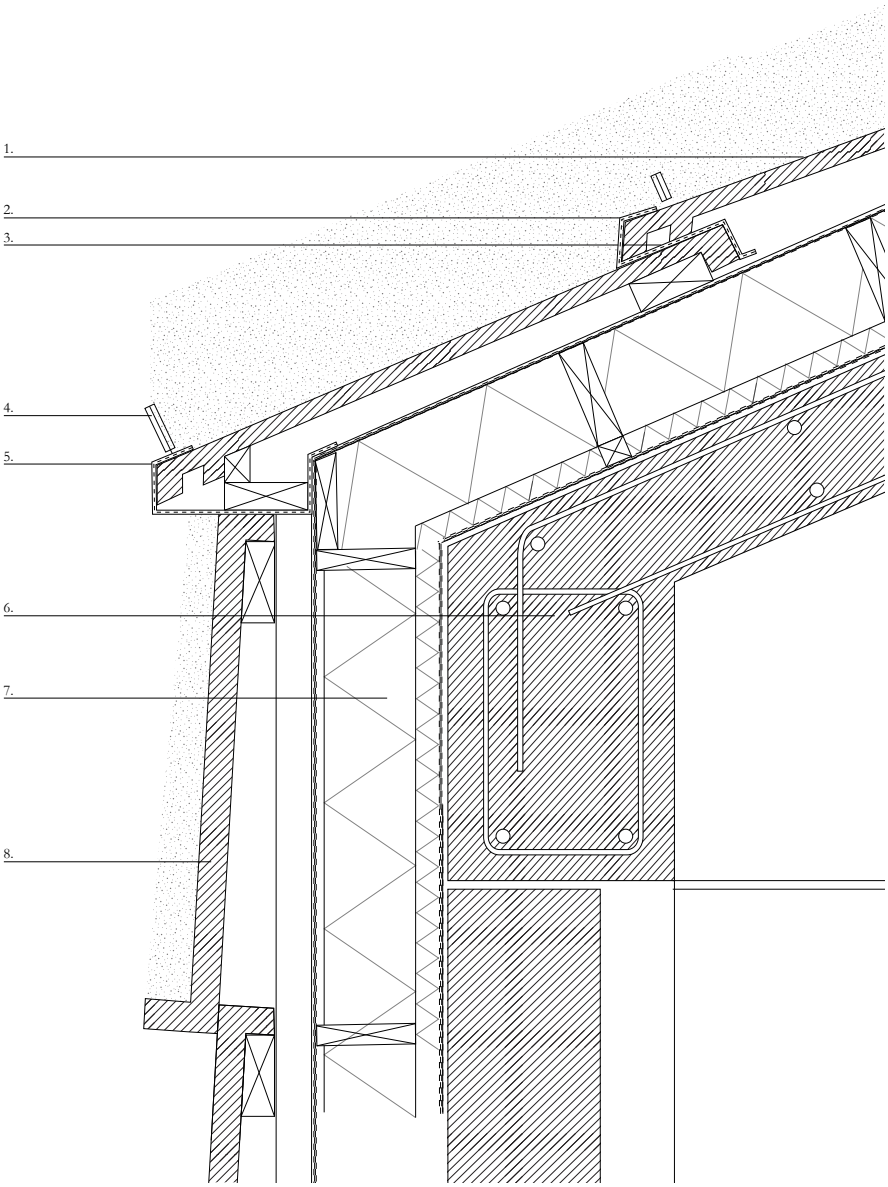
Detail 2.1

1.
1.1 Precast Roof Cladding
1.2. Wooden Battens Cladding Substructure
1.3. Back Ventilation Space
1.4. Water Proof Roofing felt
1.5. Rigid fibre insulation 200mm with battens
1.6. Soft Insulation
1.7. Vapour Barrier
1.8. Interior Finish
2. Fixed Aluminium Gutter
3. Rubber Seal
4. Aluminium Snow Guards
5. Aluminium Flashing + Dripper
6. Reinforced Concrete Beam
7. Rigid fibre insulation Mineral rock wool
8. Precast Facade - Ceramic Tile Cladding 1.2x1.2m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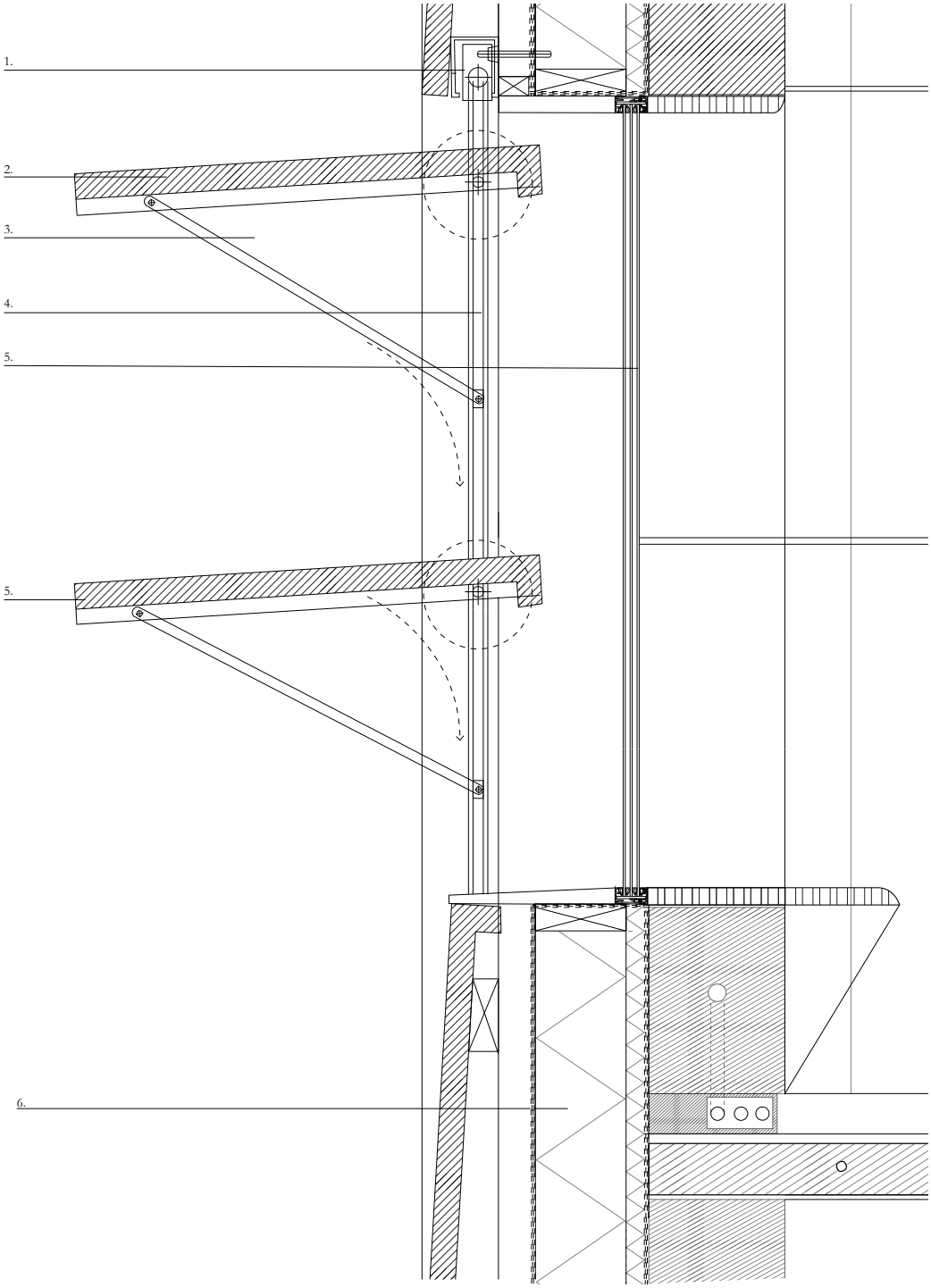
Detail 2.2

1. Aluminium Bracket - Substructure Operable Mechanism
2. Operable Pre-cast Panel - Ceramic Tile Cladding 1.2x1.2m (Copper Slag) With steel framing .
3. Aluminium Mechanism Support Panel
4. Aluminium Rail
5. Triple Glazing Window
6. Wall Composition
6.1. Pre-cast Ceramic Tile Facade Cladding
6.2. Wooden Battens Cladding Substructure
6.3. Battens in different Direction
6.4 Vapour Permeable asphalt panel
6.5 Rigid fibre insulation 200mm with battens
6.6. Soft Insulation
6.6. Soft Insulation
6.7. Vapour Barrier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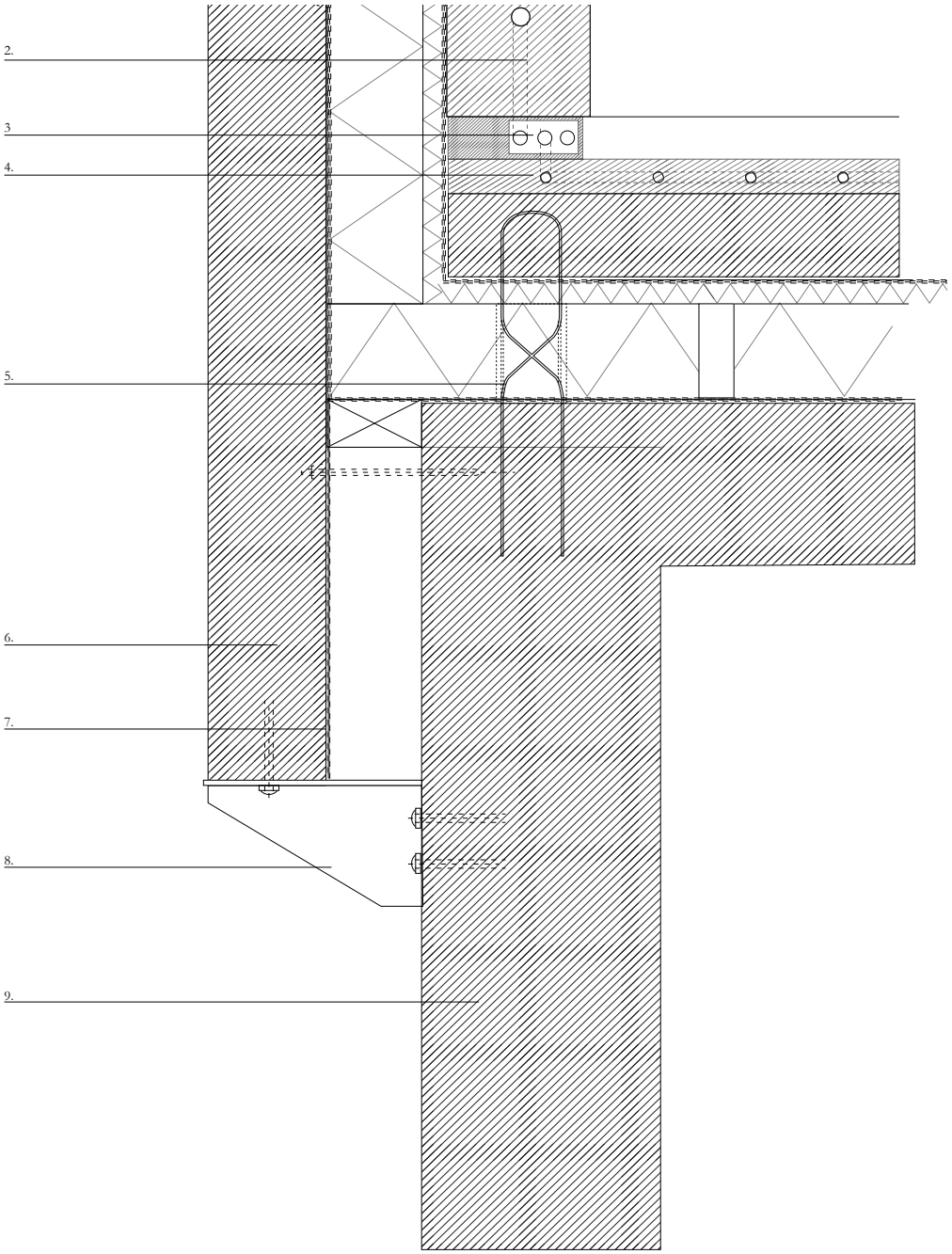
Detail 2.3

1. Schock Polyester Re-bar : facade panels Anchor
2. Interior Thermal Heating Embed on Pre-cast Panel
3. Floor Plinth with heating pipes
4. Slab Composition
4.1. Floor Heating
4.2.Vapour Barrier
4.3. Rigid Fibre Insulation Rigid fibre insulation 200mm with battens (Rock Wool)
5. Schock Isokorb type A
6. Exterior Concrete Plinth
7. Waterproof Line
8. Steel Plate Anchored to Foundation
9. Concrete Foundation



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Material

Ambassador of Self Sufficiency

Properties of Waste

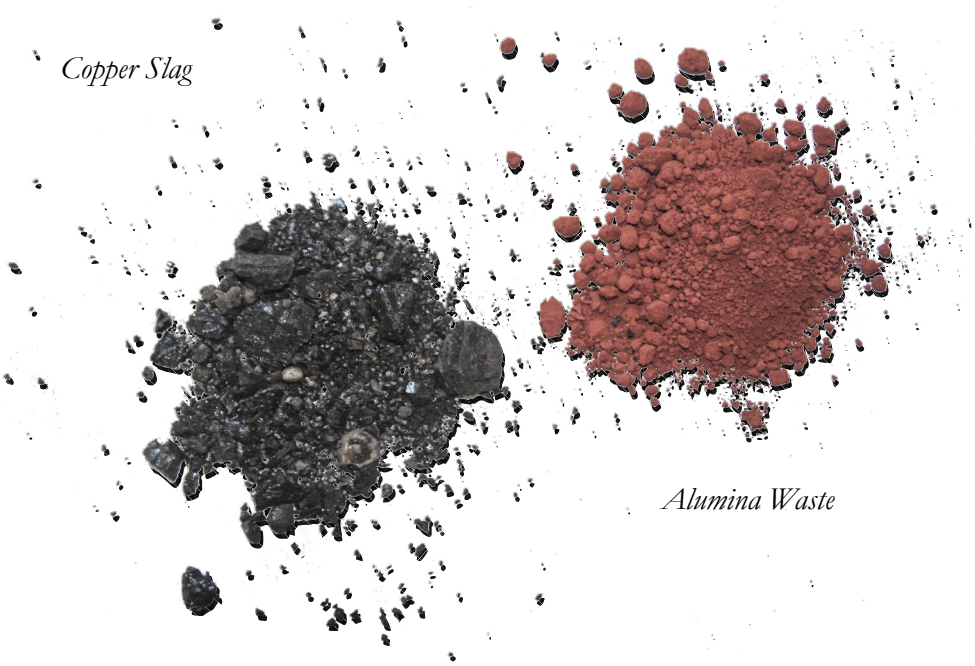
It is proven that the recycle of mining waste can result in the production of insulation, ceramic tiles, crafts, cement and even porcelain. The Properties of the waste depends on the type of waste, hence on the type of extraction. In the context of the Arctic it would be metals including aluminium, Iron, Copper and others. Hence, as the Embassy of Waste, the project recollects mainly metallic ores which have specific properties towards reuse.

Slag: It is the wasteful result of the separation of metals from the rock extracted at the mine. The properties of Slag, mainly from Copper and Iron, are mainly towards the replacement of cement in the production of concrete. By replacing cement, it reduces co2 emission in 70% and it is proven to increase thermal capacity.

On the other hand, Bauxite Residue is the result from Alumina industry.. It is characterized by a reddish colour and it can be used in the production of ceramics.

Source: Glossary — studiothusthat. (2020). Retrieved from https://thusthat.com/Glossary

MINING WASTE



Pre Fabricated Elements

As a result, the project showcases the product material in its façades. The bar, showing the recycling of waste towards a local production of concrete, and the three satellite building becoming a catalogue of the colourful prefabricated elements that could potentially result from the mixing of certain kind of waste.

Gate
Ornament

Factory
Operable Tiles

Tower
Functionality

Conclusion

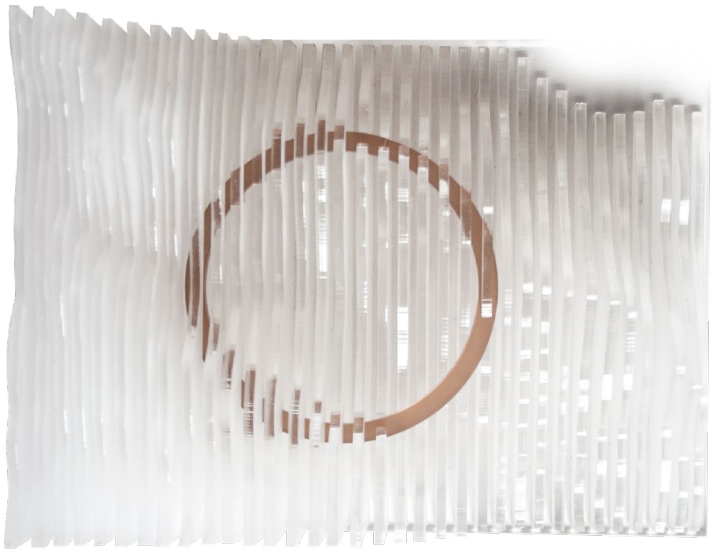
Circularity and Self Sufficiency

The Embassy of Waste

Although the project's main focus is the politics of waste, and the importance of such in the political representation amongst Arctic nations, the starting point and result aims toward the circularity and self sufficiency of the Arctic communities. Due to climate change and remoteness, the life in the Arctic is becoming highly pollutant in itself. Pollution due to the import of material, increasing over-extraction of resources and growing cities, are threatening the pristine ecosystems of the Arctic. Hence the importance to aim towards the circularity and self sufficiency of those communities. In the project, the import of mining waste recollected through the current trading routes across the Arctic, becomes a local resource. Through the recycling of such waste not only is the project dealing with the impacts of waste on the ecosystem, but it is creating a new local material to become the supply of the inevitable future of the Arctic cities.

Image: Concept Model

The project in the territory is just the visible portion of a circularity loop of energy and recycle of material.



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Embassy of Waste
Svalbard , Longyearbyen
78°13'N 15°38'E