

Architecture that belongs

How can material systems in architecture shape the conditions for spatial, and public belonging through the transformation of abandoned quarries?



Apeldoorn, S. (2026, may). Restaurant frontal [Render]

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Abstract

This research investigates how architecture can create conditions for spatial and public belonging. This is done through the transformation of an abandoned granite quarry in Colmenar Viejo, Spain. This research draws on theory based on material systems, co-optive and constructive making, material and spatial continuity, and situated practice. It is acknowledged that belonging is not a fixed result or something that can be created, but should be approached as a set of conditions. These conditions are translated into criteria based on the theoretical framework, which provides two principles: transform without displacing, and co-optive making before constructive making. To map the quarry, photogrammetry techniques are used. This provides a sufficiently detailed 3D model that can be used to study the quarry walls, edges, and level differences, allowing a co-optive approach. Further research was done into excavation techniques. Two methods are suitable for granite extraction, which are drill and blast and diamond wire cutting, both of which are used in this project. This results in gaining material that can be used for constructive making and spaces that can be co-opted. Research by design shows that there is a conflict between a co-optive approach and a program-led approach. The planned event space is flexible in program and can therefore easily be adapted based on the conditions of the quarry. The restaurant is less flexible in its program and was less suitable for a co-optive approach. Material continuity is achieved by using the excavated granite in the new building and by making the transformation of the material legible. The main finding of the research is that excavation can act as a mediator between co-optive and constructive making. Spatial conditions are continued by creating new spaces that can be co-opted, and material conditions are continued by producing granite, which can be transformed and used on site for new construction. This way, architectural belonging is approached by continuing the logic of the quarry.

Keywords

Material systems, Co-optive making, Abandoned quarry, Situated practice,



Apeldoorn, S. (2026, februari). Quarry view [Photograph]

Table of contents

Title page	1
Abstract	2
Keywords	2
Table of contents	2
Introduction	3
Scale	3
Theoretical framework	4
Methodology	6
Chapter one	7
Chapter two	8
Chapter three	13
Chapter four	14
Conclusion	27
Discussion	28
Academic reflection	28
Sources	29
Attachment: drawing set	

Introduction

Madrid is a city that is admired for its architectural expression. Expression that is captured in stone, timber, clay, steel, and concrete. But before those materials became architecture, they had to go through an extensive process of extraction, transformation, standardization, and transportation. This process often hides the origin of the material. The result is that it becomes harder to read the relationship between material, extraction site, and construction. Not only is there a material disconnection, but there is also a spatial one. Modern technologies and global supply chains have made it possible to use almost any material, almost anywhere on earth. When technological advances make it so that any type of architecture can be constructed anywhere, regardless of location, it risks becoming placeless. It raises the question of why architecture belongs there. While this does improve efficiency and generates flexibility, it has also contributed to an increase in generic architecture and a weaker relationship to local context. This development also led to the construction industry having a significant impact on the environment. According to research by United Nations Environment Programme and Global Alliance for Buildings and Construction (2025), buildings accounted for 32% of global energy demand and 34% of CO2 emissions in 2023, showing that changes in the material use in the construction sector remain urgent.

The starting point of this research is the relationship between Madrid and the granite landscapes around it. The quarries in the towns around the Guadarrama mountain range were responsible for most of the granite that was used to construct the city center of Madrid, starting in the 18th century. (Fort et al., 2013) Today, many of these extraction sites are either abandoned, covered up, or turned into parks. No longer are these sites visible in the architectural story of Madrid. This raises the question if architecture can transform these abandoned sites without erasing the traces of extraction that define them. Therefore, this project will focus on an abandoned quarry in Colmenar Viejo, a town just north of Madrid. The usually hidden story of extraction is now legible through the quarry walls, cut marks, fragments, and level differences. It is no longer a neutral natural site, but a site marked by human material and transformation. This offers the opportunity to investigate how architecture can respond to these specific material and spatial conditions, rather than treating the site as empty ground.

This research aims to investigate how architecture can improve a sense of place and belonging through the case study of an abandoned quarry. Belonging is not treated as something that can be directly created by architecture, but as a set of conditions that allow belonging to take place. Architecture that belongs to its site through material and spatial conditions, and supporting public use, recognition, and attachment over time.

This leads to the main research question:

How can material systems in architecture shape the conditions for spatial and public belonging through the transformation of abandoned quarries?

To answer this question, the research is divided into four chapters:

- I. From theory to design criteria
- II. Program and site analysis
- III. Process of transformation
- IV. Research by design

Chapter one will translate the theoretical framework of this research into design criteria for material, spatial, and public conditions as a lens through which the design proposal is evaluated. Chapter two will analyse the site of the quarry based on multiple relevant topics, and investigate a potential program. The third chapter will study extraction methods that can be used in order to make informed design decisions based on expected outcomes. The final chapter will test how the design process influenced the findings of this research, and it will evaluate the final design proposal based on the criteria set in the first chapter.

Scope and limitations

The location of this research deviates from the given location of the studio: Madrid. When it became clear that I wanted to investigate the quarry as a project site, I looked for quarries in Madrid. The ones I found were either still in use, protected, or covered, making it nearly impossible to use those sites for my project. During research into material systems around Madrid, I learned that historically, granite was excavated relatively close to Madrid, so I investigated those quarries, visited two, and eventually chose the one in Colmenar Viejo.

This research aims to test the theoretical principles introduced in the theoretical framework. The theoretical discussion is focused on selected concepts that support the main research question, which stems from my interest in architectural belonging. The aim is to provide a design framework that can be used in projects with unique or difficult terrain conditions. What this research won't provide is a complete theoretical debate on belonging, place-making, or material culture.

Practical limitations lie mostly in the available knowledge of the specific chosen quarry. The photogrammetry model provides sufficient support for design decisions, but it is not a precise survey of the site. A more complete understanding of the site would require drone-based, professional mapping techniques, and other studies, including ground, acoustic, and ecological studies. Community engagement would have provided a more precise assessment of the needs of the community, which influences the project's program. Online research was done to obtain some understanding of the needs of the community; however, in a real-life situation, this would not have been sufficient. For this research, the online studies were enough to justify a specific program.

These limitations define the scope of this research and project and serve as indications where further development would be necessary.

Theoretical framework

Belonging through material and spatial continuity will be the overarching concept of this project's theory.

That means the granite and the spatial conditions of the quarry are not the background but form the basis on which the architecture is built. While both material and spatial conditions are linked, they both require a principle that can translate theory into architectural interventions.

Principle 1: transform without displacing

Based on the method of the continuous process of transformation.

This method follows the theory that Tim Ingold (2000) describes in his book "Perception of the Environment".

Ingold (2000) discusses ideas about the separation between nature and humans; natural environments and man-made structures. Ingold (2000) is building upon the ideas of Heidegger (1971), who suggests that buildings are not applied onto passive environments; they emerge from an already inhabited world. Ingold (2000) extends this by suggesting that making doesn't impose a form on passive matter; rather, it unfolds through continuous engagement with materials. By applying this framework, human construction isn't separate from nature, but part of a continuous process of transformation. This process can be directly applied to granite as well, and while this process is continuous, architecture can either conceal or reveal this continuity. Every transformation humans apply to this material can be seen as a next step in its already ongoing process of transformation. The problem often is that the material is so much altered that it is no longer recognizable from its original state. But keeping the material and all its transformations at its extraction site can offer the unique possibility to highlight the material lifecycle, and therefore its continuity, in one building. Material is no longer separated from its extraction site, yet by the process of transformation, it can generate different experiences.

Where Ingold (2000) explains the material transformation as a process, Pallasmaa, J. (1996) explains how this transformation can be experienced. Pallasmaa, J. (1996) highlights the importance of the multi-sensory experience of architecture. While the multi-sensory experience seems obvious, because everything is multi-sensory, sometimes some senses are excluded in daily experiences. Touch, for example, is not always guaranteed. The quarry is able to offer the ability for visitors to touch the rough, unaltered granite. Because of that, there is now a new layer to the multi-sensory experience because there is also comparison. When the smooth granite is touched in this project, it can now be experienced in relation to the raw quarry wall. The origin of the material has become legible in the architecture.

Case study 1: Quarry No. 9: Stage Space by Dna

This case study shows how the principle of transformation without displacement can be applied in a project. It's especially relevant because this project is also about the transformation of an abandoned quarry. What you can see very well in this image is the gradient of refinement in the material. In one image, you see the rough stone, more refined stone, cut stone blocks, and smooth blocks of stone. It's all one material but in different stages of transformation. This project shows how one material can be applied in different ways, resulting in different experiences, while also making legible what transformations the material underwent.



Wang, Z. (2022). #9 quarry [Photograph]

Theoretical framework

Principle 2: Co-optive making before constructive making

Based on the method of co-optive and constructive making.

Right after Ingold (2000) suggests that making is a continuous engagement with materials, he describes two different methods of making: co-optive and constructive. 'In co-optive making, an already existing object is fitted to a conceptual image of an intended future use, in the mind of a user. In constructive making, this procedure is reversed, in that the object is physically remodelled to conform more closely to the pre-existing image.' Ingold (2000)

This method offers an approach for architecture to intervene in the abandoned quarry without overpowering it. Unlike situations where the terrain can be treated as neutral ground or a blank canvas to build pre-imagined architecture on, the quarry resists this approach through its irregular topography, exposed walls, and extraction traces. Therefore, a more co-optive approach is better suited, and only when needed, a constructive approach should be applied. Not just because the architecture would be too difficult to apply, but also to preserve the unique character of the quarry.

Frampton, K. (1983) warns about using universal solutions to architectural problems and argues that architectural forms and materiality should emerge from their surrounding environment, microclimates, and cultural structures. Situated practice, however, should not be confused with copying vernacular forms directly. A co-optive approach offers a way to avoid both universal solutions and copying vernacular architecture. A hierarchy between co-optive and constructive making is required to prevent one from dominating. While a co-optive approach is preferred, it cannot be applied completely. There will be things that need to be altered and added to conform to modern standards and regulations. In the case of this project, the constructive making will be dependent on the co-optive making. New spaces will be generated through the extraction of material, which results in new spaces that can be co-opted and new material that can be used to construct with. A co-optive approach doesn't mean that it refuses construction; it means that construction must be able to justify itself against what the quarry can already provide.

Case study 2: Ca'n Terra House by ENSAMBLE STUDIO

This case study highlights how effective a co-optive approach can be. They were able to co-opt an abandoned quarry into a house suitable for living, with just a few adjustments. Minimal interventions were needed to achieve maximum results. The shape of the extraction made it possible to create new spaces with minimal intervention, because there are a lot of carved spaces inside the rock, which is different from the open quarry in Colmenar Viejo.



Courtesy of ENSAMBLE STUDIO

Methodology

Multiple research methods will be used to answer the questions that this research poses. It should be clear what each research method investigates, what its outputs are, and how that informs this research.

Translation of theory into design criteria

The theoretical framework defines the overarching concept of belonging through spatial and material continuity, using the principles of transformation without displacement and co-optive and constructive making. Chapter one then translates those principles into architectural criteria, so that the design can be tested for spatial, material, and public belonging. The output of this chapter is a set of criteria, not as absolute requirements but rather as a set of lenses through which the design can be evaluated. This informs the research by connecting the theoretical principles to design outputs and then evaluating the outputs of Chapter 4 against its set criteria.

Site mapping

Site mapping and analysis will investigate the quarry and its surroundings on different scale levels. Accessibility, topography, ecology, and amenities will be analysed and will result in spatial constraints and opportunities. The results of the analysis will later inform design decisions and can be used as starting points.

Photogrammetry

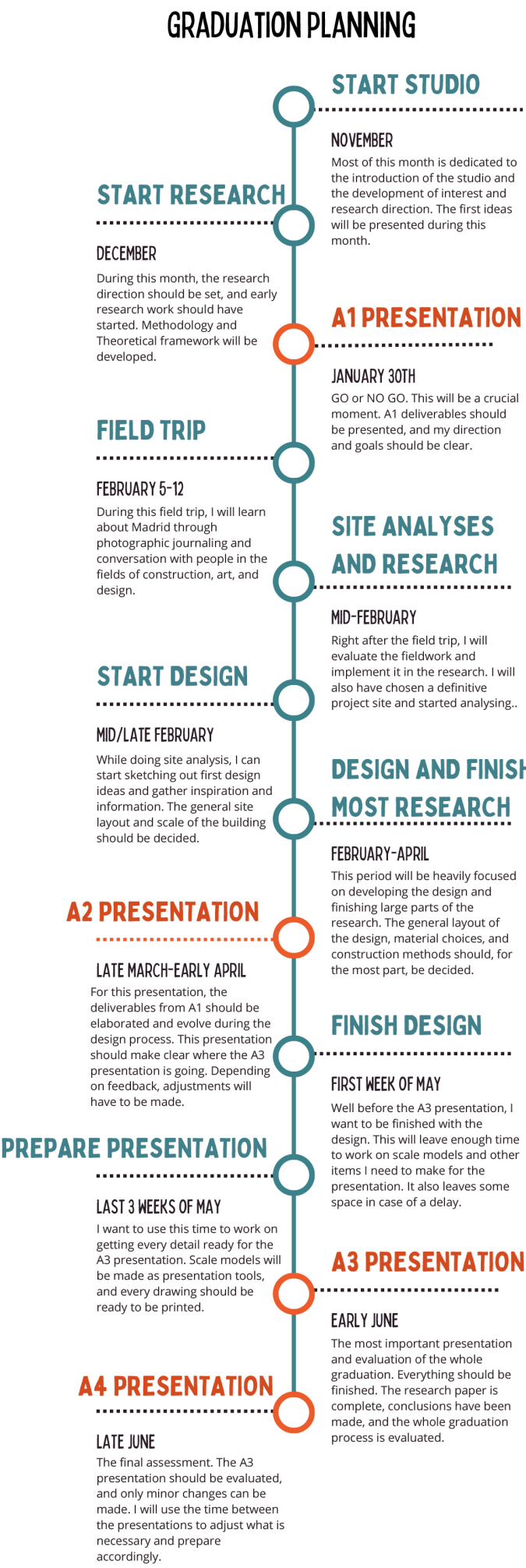
Because the terrain of the quarry is unique and difficult to map, photogrammetry is used to generate a 3D model of the quarry. Photos taken at the project site will be processed through photogrammetry software to produce a partial but sufficiently accurate 3D model of the quarry. This informs the research because it allows a co-optive design approach, whilst not having to physically be at the project site.

Extraction studies

Studies into extraction will be done to get a better understanding of what possible methods can be applied to generate new spaces through excavation. Extracting material and using that for constructive making is an important part of the design approach. Therefore, it is important to understand what the specific results are of each extraction method. The output is knowledge of transformation methods, which will later inform the research during the design phase.

Research by design

This part of the research will follow the design trajectory and evaluate several design iterations that are developed over time. Form and program will be tested for their architectural qualities and the criteria that are set in chapter one. Because research by design is iterative and doesn't follow a linear trajectory, theory, analysis, and design development inform each other, which means that at the beginning of the design process, not all the theory has been applied yet. Some theory and parts of the research only came in later during the design process. This chapter will inform the research through its evaluation of the main design principles and the architectural criteria that are formulated in Chapter One. The results of this chapter will reveal to what extent the criteria for belonging are met or not.



Chapter one: From theory to design criteria

This chapter will translate the theoretical methods and principles explained in the theoretical framework into design criteria. Because the criteria are qualitative, they are not to be evaluated as a fixed set of measurements. Instead, the criteria are meant to serve as indicators to assess the extent to which the visible design decisions relate to the theoretical framework. There are three sets of criteria, relating to the three conditions of belonging:

- Material conditions
- Spatial conditions
- Public conditions

Material conditions:

The criteria for the material conditions are extracted from the first principle described in the theoretical framework: transform without displacement. A key factor is that material is extracted, transformed, and constructed all on the same site to make this process legible. The granite and all its different states should be understood as one material system.

Criteria:

- All the granite that is used should come from the project site.
- Different states of granite should be visible, and where possible, touchable. This goes from the untouched granite wall to extracted granite rocks, cut blocks, textured surfaces, and smooth surfaces.
- New material should not conceal the relation between extraction, transformation, and architecture.

Spatial conditions:

The criteria for the spatial conditions are extracted from the second principle described in the theoretical framework: Co-optive making before constructive making. The core of that is that the existing spatial quality of the quarry does not get lost through architectural interventions. The quarry should be the guiding force in shaping entrances, routes, gathering spaces, and program.

Criteria:

- Co-optive potential needs to be studied before any constructive making is done.
- The main eventspace should be positioned where the quarry already offers critical spatial conditions.
- New construction should support the quarry and not dominate the existing quarry conditions.

Public conditions:

The criteria for the public conditions come from the theme of the studio: urban commons. The urban commons can be seen as a shared resource for public use. It is important that the program of the quarry should not be solely fixed on profit, but should offer a public place for people to gather, stay, and observe, without cost. That doesn't mean a monetary system can't be applied, but the quarry should be able to function independently of it.

Criteria:

- The quarry should function as a public space.
- The publicly accessible part of the quarry should be accessible 24/7.
- The program should support shared use and gathering.

Chapter two: Program and site analysis

To determine the program for the architectural interventions, three approaches were taken.

The first approach is co-optive. What does the quarry already provide?

The quarry is not a standalone object in a natural environment but is part of a whole system of smaller and bigger quarries. The landscape is clearly altered by the extraction of materials. It appears that vegetation growth is limited, most likely due to grazing pressure from cows. By simply preventing cows from this area, it could transform into a more ecologically diverse quarry landscape. A more park-like program can be realized by focusing on accessibility, while also leaving areas untouched to maintain ecological zones. The area of the quarry has now provided one of the programs.

The second approach is to learn more about the needs of the people living in Colmenar Viejo. For that, online research was done. Blogs, social media posts, comments, and forum discussions were analysed to learn what amenities were still lacking. The discussion generally was about a lack of entertainment and cultural space, for which a lot of people go to Madrid instead. There are smaller bars and restaurants where occasional live performances could be hosted. Larger events are usually done outside or in the bullring.

It appears to lack a dedicated space for cultural events and entertainment. To complement this theory, the municipal budget was analysed. The first two main investments that are mentioned are a four-million-euro investment into the improvement of parks and gardens, and a five-million-euro investment into a new cultural center (Guerrero, 2025). For this project, these two findings are sufficient to justify testing a cultural eventspace as a program. A restaurant is added to the program so that the quarry is usable year-round and to provide secondary needs such as a place to eat and drink, toilets, a backstage, storage space, and personnel.

The third approach is to connect it to the theme of the studio, the urban commons. For that, the quarry needs to serve as a shared city resource that can be used in different ways, by different groups at different times.



Chapter two: Program and site analysis

These maps of major roads, train connections, bus lines, and bus stops show that the quarry is very close to existing city infrastructure. The problem is that there is no clear entry into the quarry area. What is needed is a better connection between the city infrastructure and the quarry that can serve as a main entrance.



Apeldoorn, S. (2026). Analysis of train connection in Colmenar Viejo [Image]



Apeldoorn, S. (2026). Analysis of major roads in Colmenar Viejo [Image]



Apeldoorn, S. (2026). Analysis of bus lines and stops in Colmenar Viejo [Image]

Chapter two: Program and site analysis

Arrival and entrance mismatch

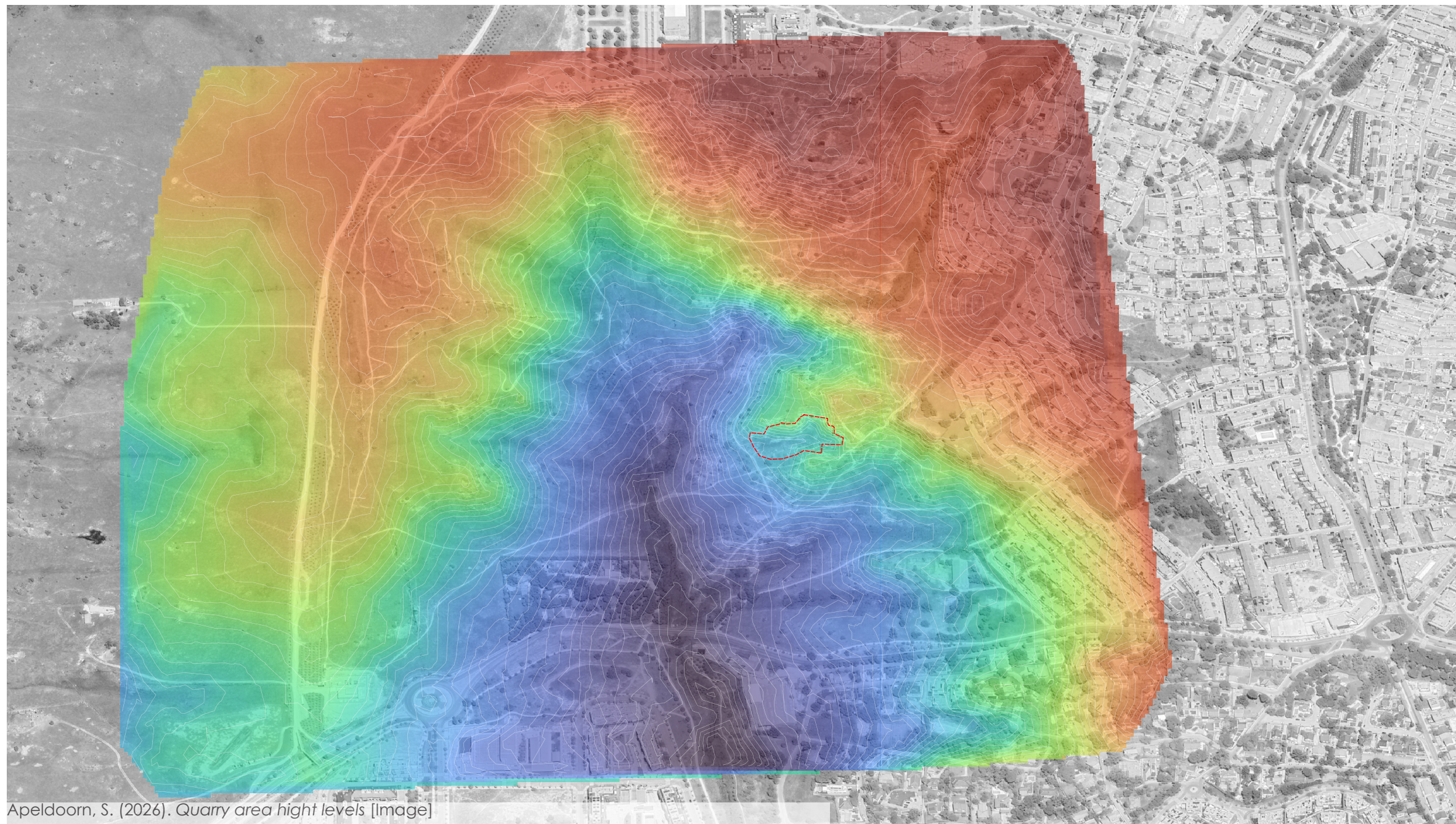
Currently, the quarry can only be entered on the west side and south side. The quarry wall on the south side has a sufficiently gradual slope for a small path that can be used to enter. On the west side, there are openings into the quarry. The interior floor of the quarry matches the height of the terrain outside the quarry at that point. The previous analysis already showed that the nearest city infrastructure is to the east of the quarry, meaning that the main approach will be from the east. An intervention is needed to establish a new main entrance on the east side of the quarry to allow better public access.



Apeldoorn, S. (2026). Quarry entries [Image]

Chapter two: Program and site analysis

This map shows the elevation levels of the quarry area. Publicly available data is not precise enough to accurately show the depth of the quarry itself. What can be seen in this map is a small "dent" in the landscape where the quarry is. To get a more precise image of the quarry elevation and the quarry walls, on-site research will need to be done. What this map does show well is that there is a lower part in the middle of this area where the water flows. Because the quarry naturally captures water, it has the potential to retain water, which could become ecological vernal pools.

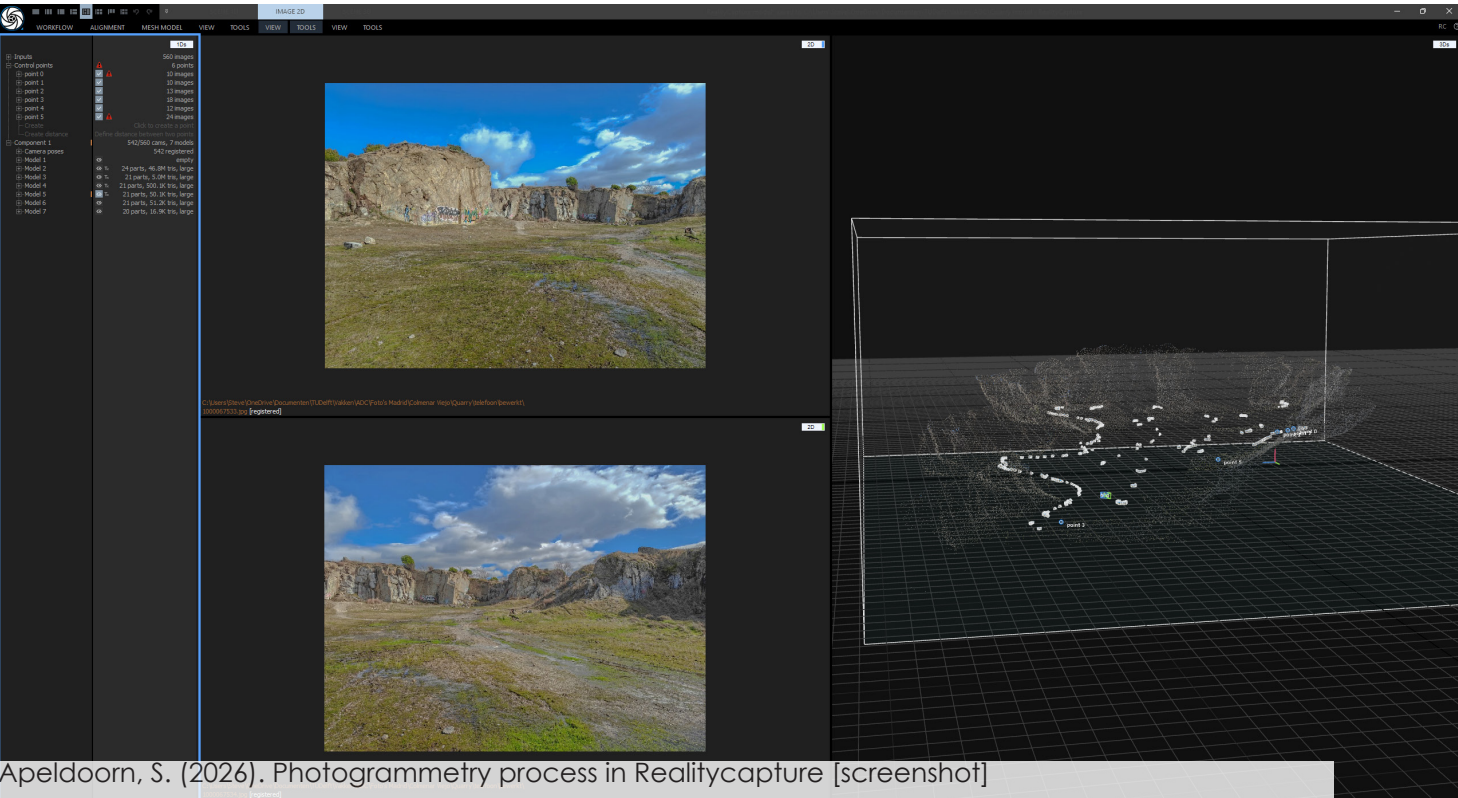


Chapter two: Program and site analysis

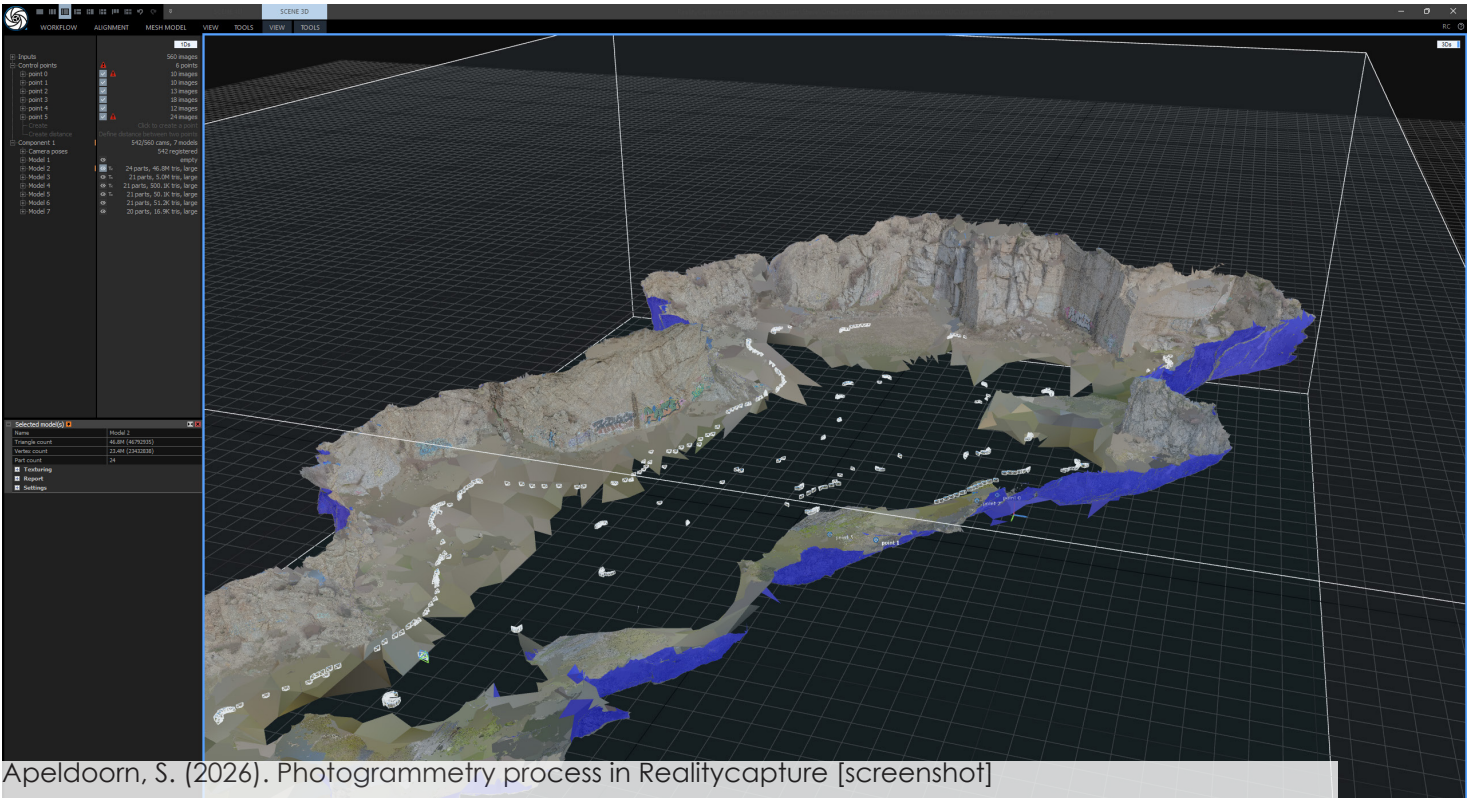
To understand what and how to transform, the quarry first needed to be documented more precisely than what the available topographic data allows. The quarry walls, edges, and internal level differences could not be mapped using public data; for that reason, photogrammetry was used. During the site visit, hundreds of photos were taken and later edited, processed, and converted into a 3D model using photogrammetry software. This resulted in a sufficiently accurate 3D model of the quarry wall. A more accurate model could have been made if more professional mapping tools were used, such as a drone, but the accuracy of the available 3D model was sufficient to support a co-optive approach.



Apeldoorn, S. (2026). Photo gallery [screenshot]



Apeldoorn, S. (2026). Photogrammetry process in Realitycapture [screenshot]



Apeldoorn, S. (2026). Photogrammetry process in Realitycapture [screenshot]

Chapter 3: Processes of transformation.

Methods of extracting

One of the core principles of this project is that the material that is available on site can be used as construction material. The extraction will now have two purposes instead of one. The main purpose is that the excavated area is now an architectural space. The second is the original function of the quarry: to gain construction material.

In order to extract, it is important to know which methods can be used and what results they deliver, both spatially and in terms of the quality of material. Because granite is one of the hardest types of rock, the extraction options are limited to two main methods:

- Drill and blast
- Diamond wire cutting

Both methods have their appropriate uses in this project.

Drill and blast method:

Quick and relatively controlled. This method results in a rough surface of the exposed rock, and what is left of the blasted rock, called muck piles, can be used in landscaping. There is a chance that larger boulders can be gained and further refined, but the amount of sufficiently sized rocks and boulders is very low.

Diamond wire cutting:

Slow, but very accurate and smooth. This method is mainly used to gain material in large, intact sizes, which can be further transformed into stones for construction. The downside is that not every space is suitable for a wire saw. Certain surface areas already need to be exposed in order for the saw to be put in its place.

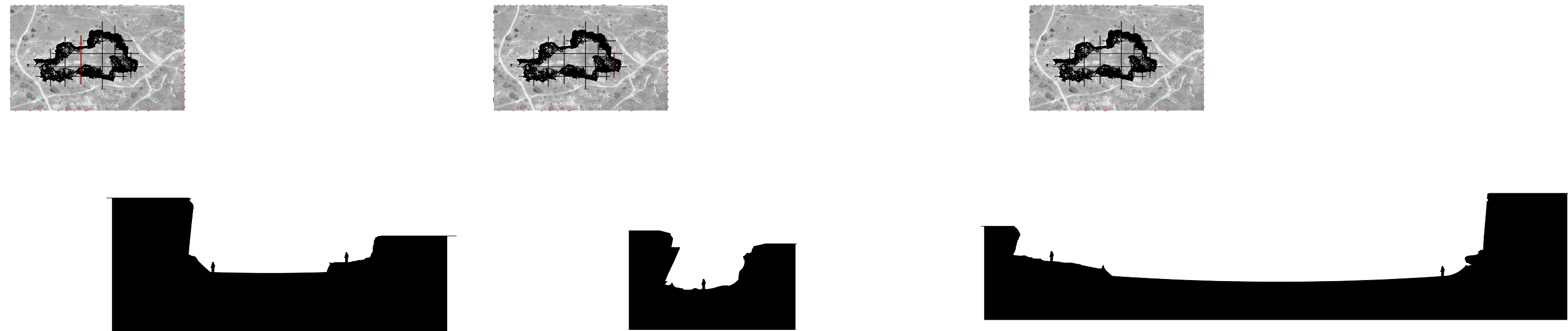
Chapter four: research by design

Reading the quarry in sections:

From the 3D model, sections were made to identify different spatial qualities of the quarry. The type of quarry wall, gradual or vertical, and the distance between them present different opportunities for co-optive making.

Early sectional tests were explored to understand the idea of space through extraction. These tests show that further research into extraction methods was needed to determine what can responsibly be removed.

Sections:



Medium distance, overhanging quarry wall, and a gradual wall

Short distance, overhanging enclosing quarry wall

Long distance, gradual, overhanging, and vertical quarry wall

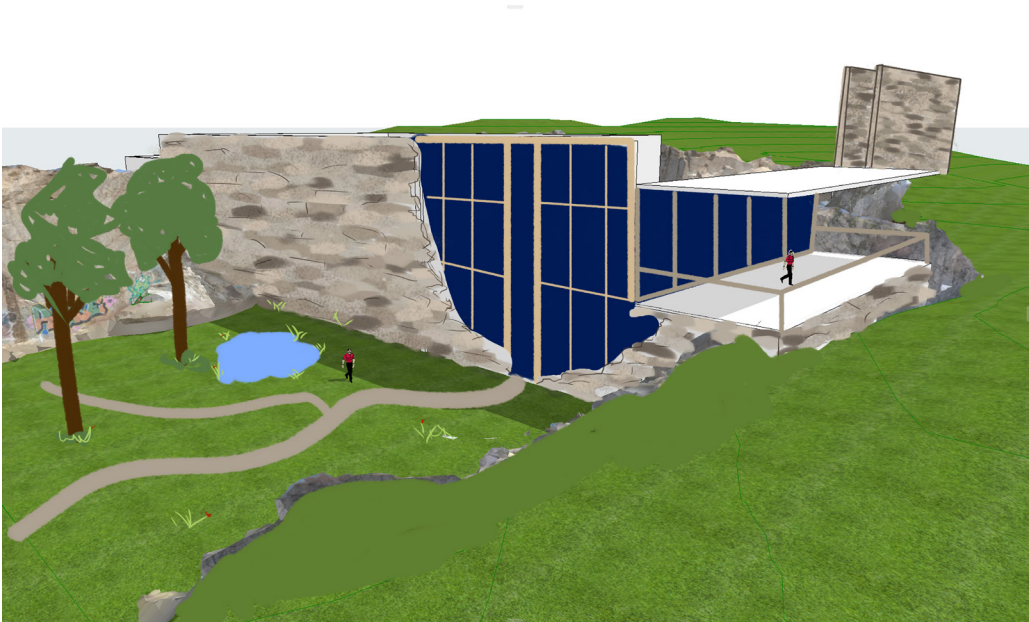
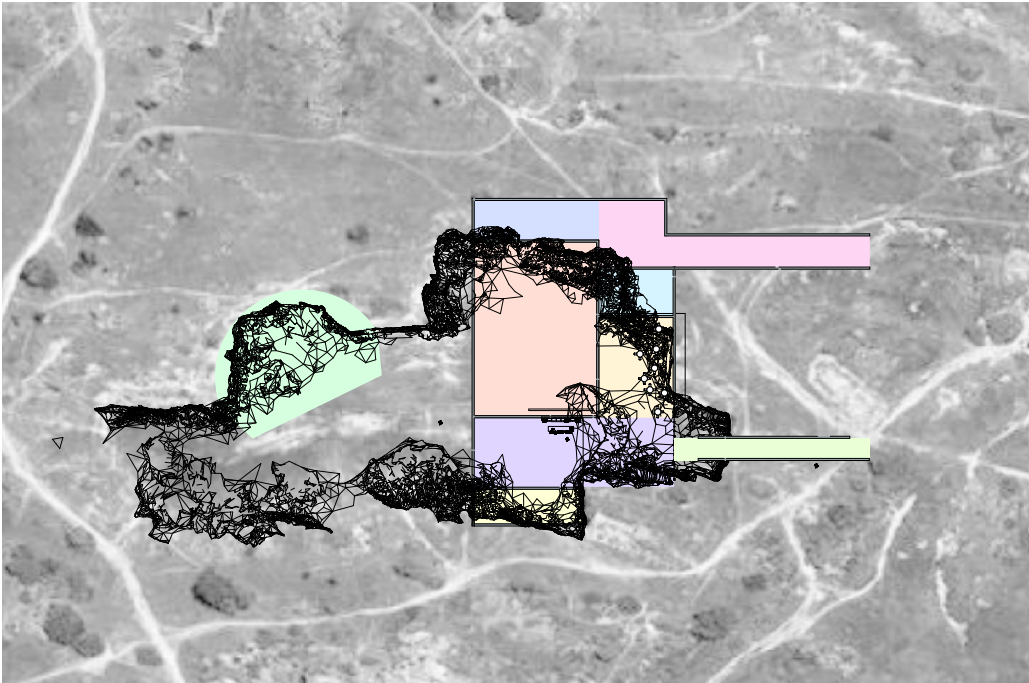
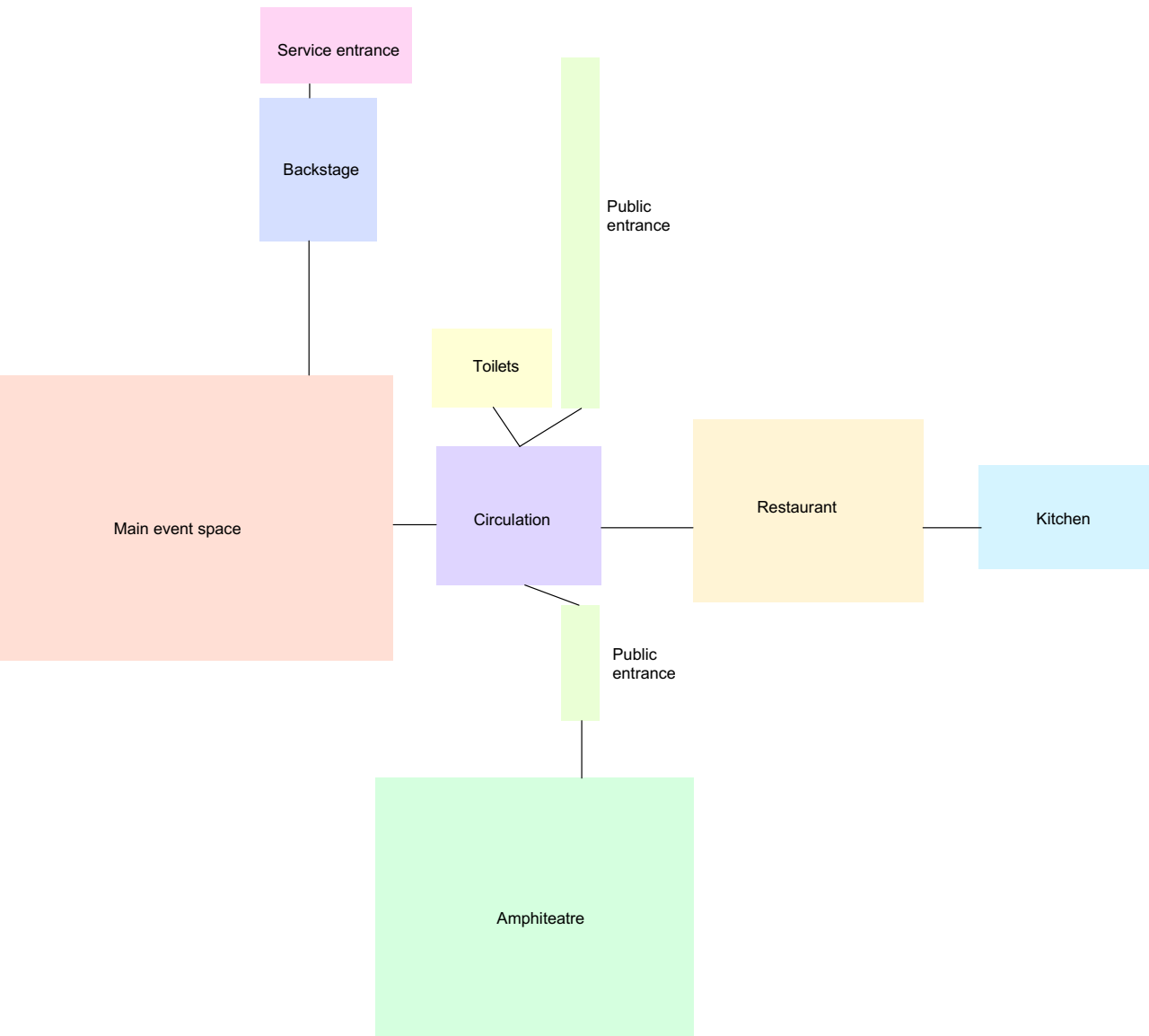
Early section tests:



Chapter four: research by design

Iteration with programmatic dominance

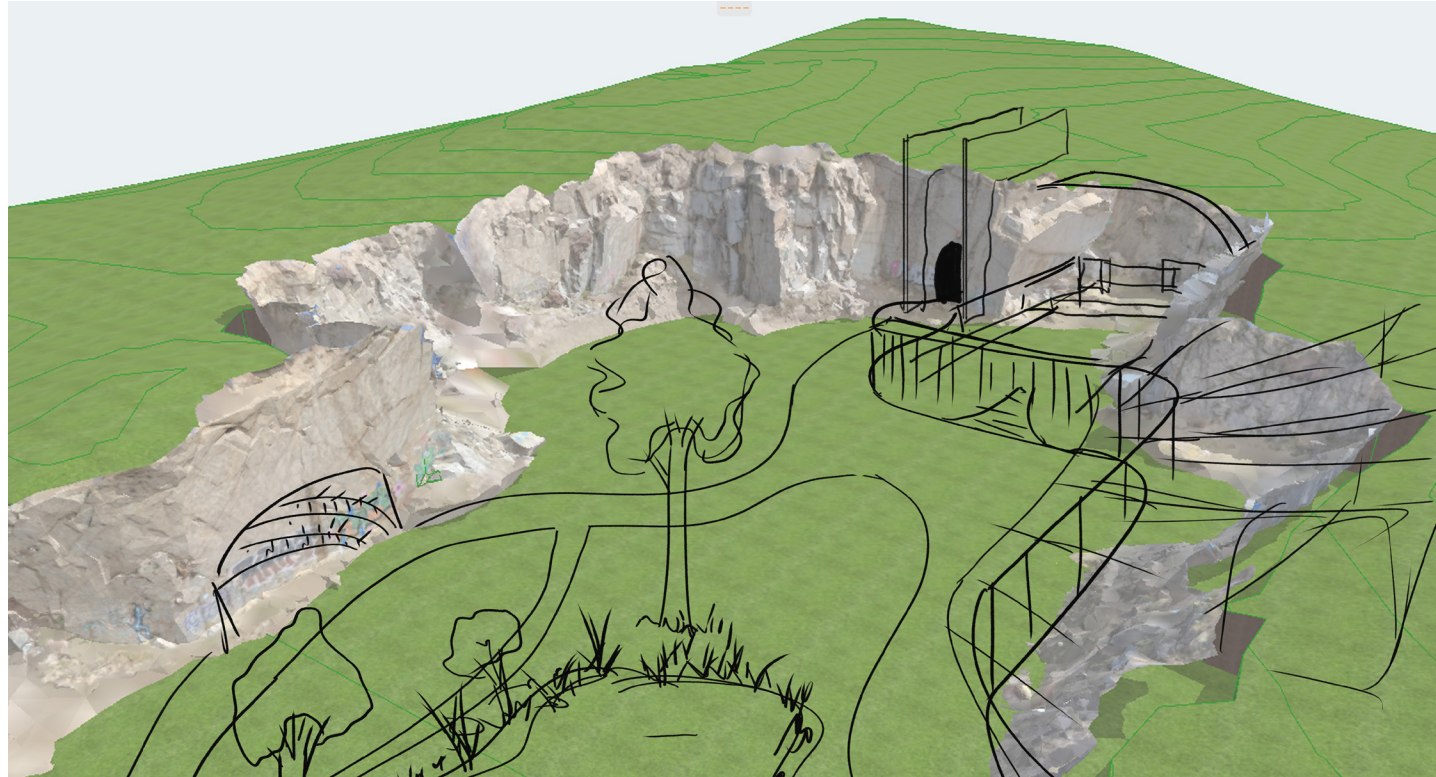
The early design process was not yet focused on a co-optive approach; instead, a more programmatic approach was taken. I was testing whether the quarry could contain a large space for events with optimal sound and climate control for the best technical experience. Around the large event space, other functions were added as support. Personal experience helped to identify which functions were needed and how they should be connected to each other. However, when these functions were architecturally shaped, it became clear that programmatic adjacency alone is not sufficient. This iteration revealed that the constructed architecture dominated the quarry, reducing the quarry walls to indoor backdrops, rather than maintaining the quarry as the central element. The failure of this iteration became a turning point in this research. From here on out, the question wasn't how the program could fit into the quarry, but what the quarry already provides for a future program.



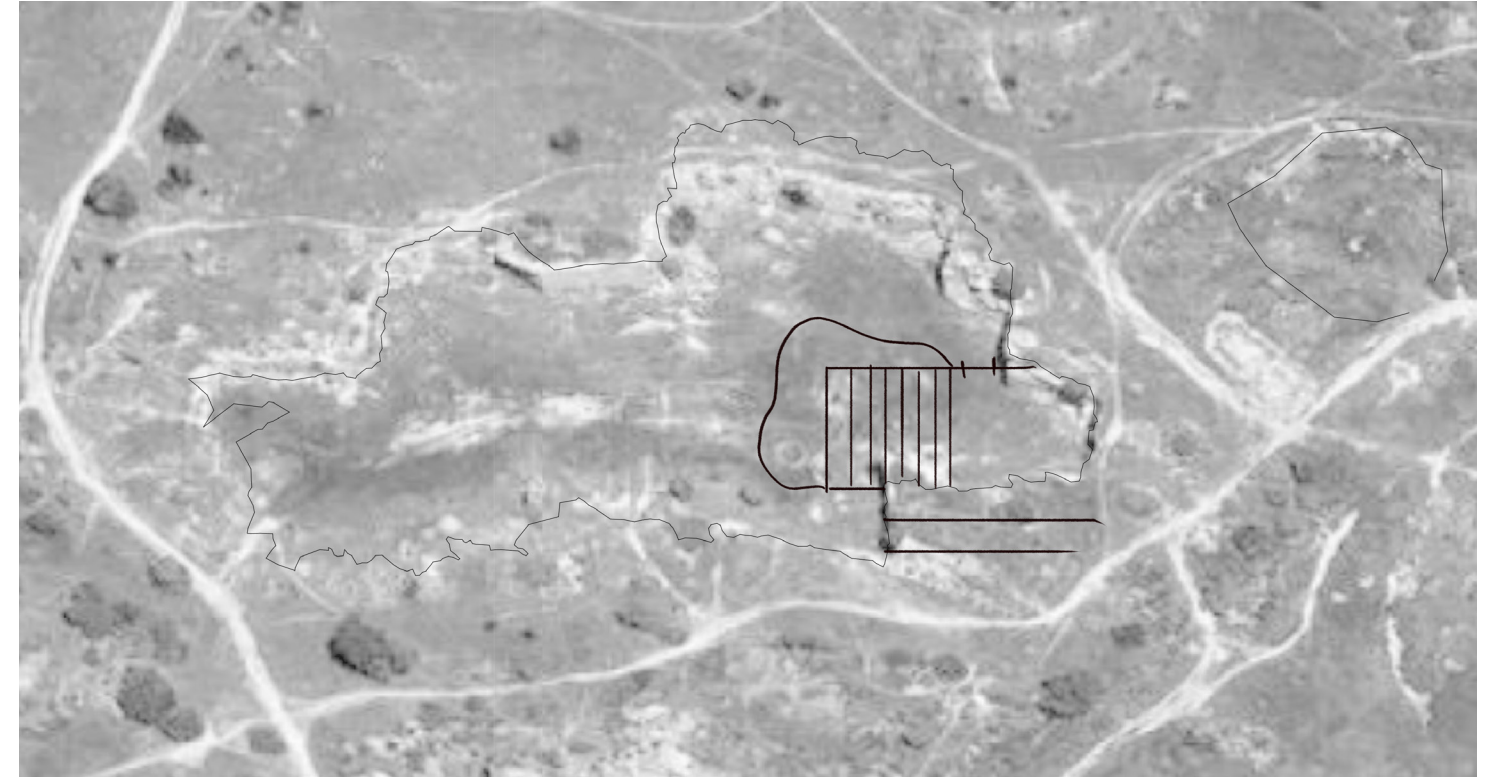
Chapter four: research by design

Quarry-led placement of the amphitheatre:

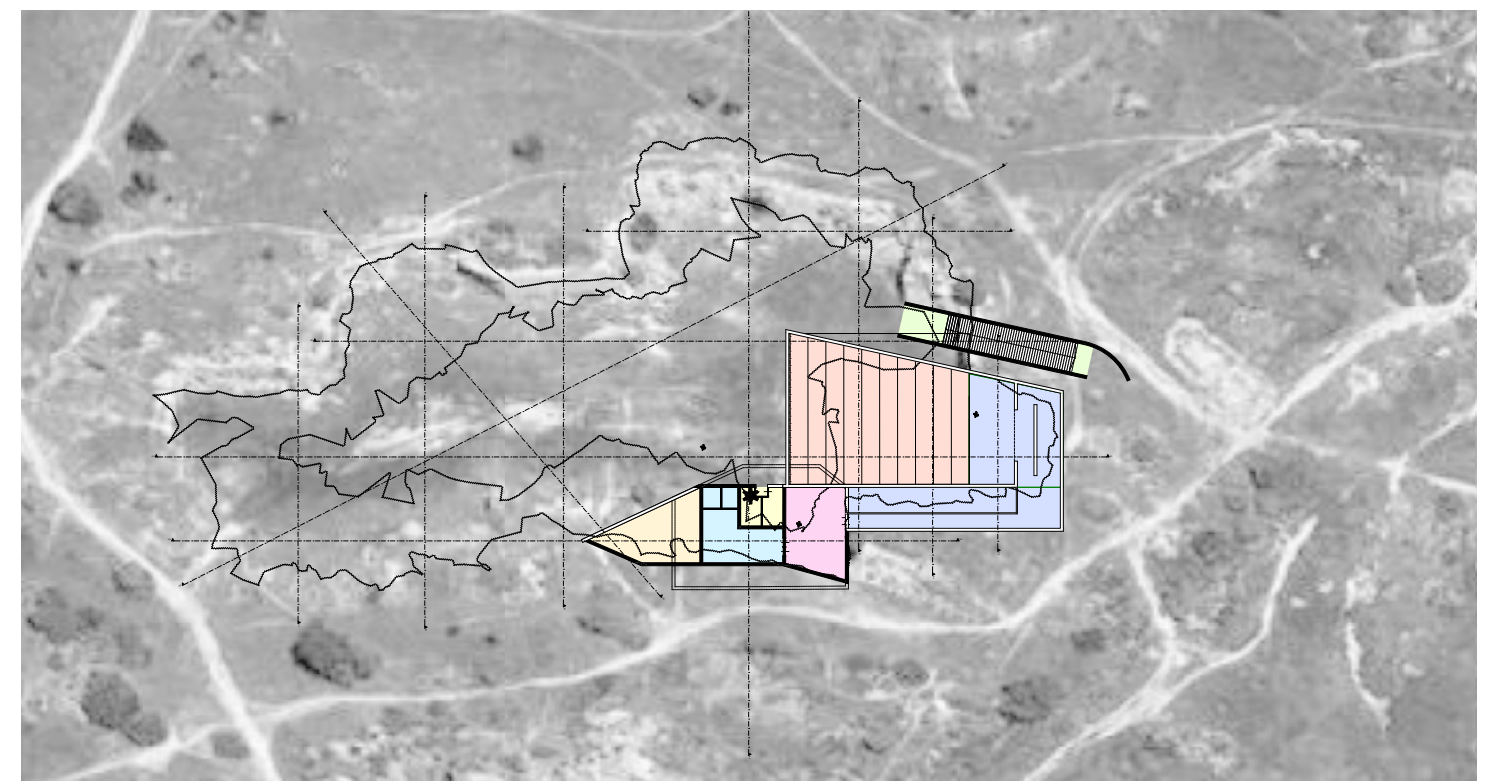
At this point in the research, the co-optive making theory came into the design process. The point was to look at what the quarry provided, instead of trying to fit a predetermined program. The decision to make the event space an amphitheatre was made to reduce the scale and improve accessibility to the public. Three criteria guided the placement of the amphitheatre: The shape of the quarry wall should support an amphitheatre, the orientation of the seating area cannot face the south, and the quarry wall should be sufficiently enclosed for acoustic qualities. The most suitable spot the quarry provided was in the south-east corner.



The quarry wall here is mostly vertical with a slight overhang in some places. The quarry wall also protects the audience from the southern sun, and in the afternoon, the podium faces the sun, not the audience. The fan-like shape of the quarry wall provided a suitable outline for the amphitheatre. Instead of constructing the height difference for the seating, the difference was extracted. This went back to the idea of using extraction to generate space and to gain building material. The restaurant would be adjacent to the amphitheatre on the south because the quarry wall is the lowest here, reducing the height equipment and goods would need to take.



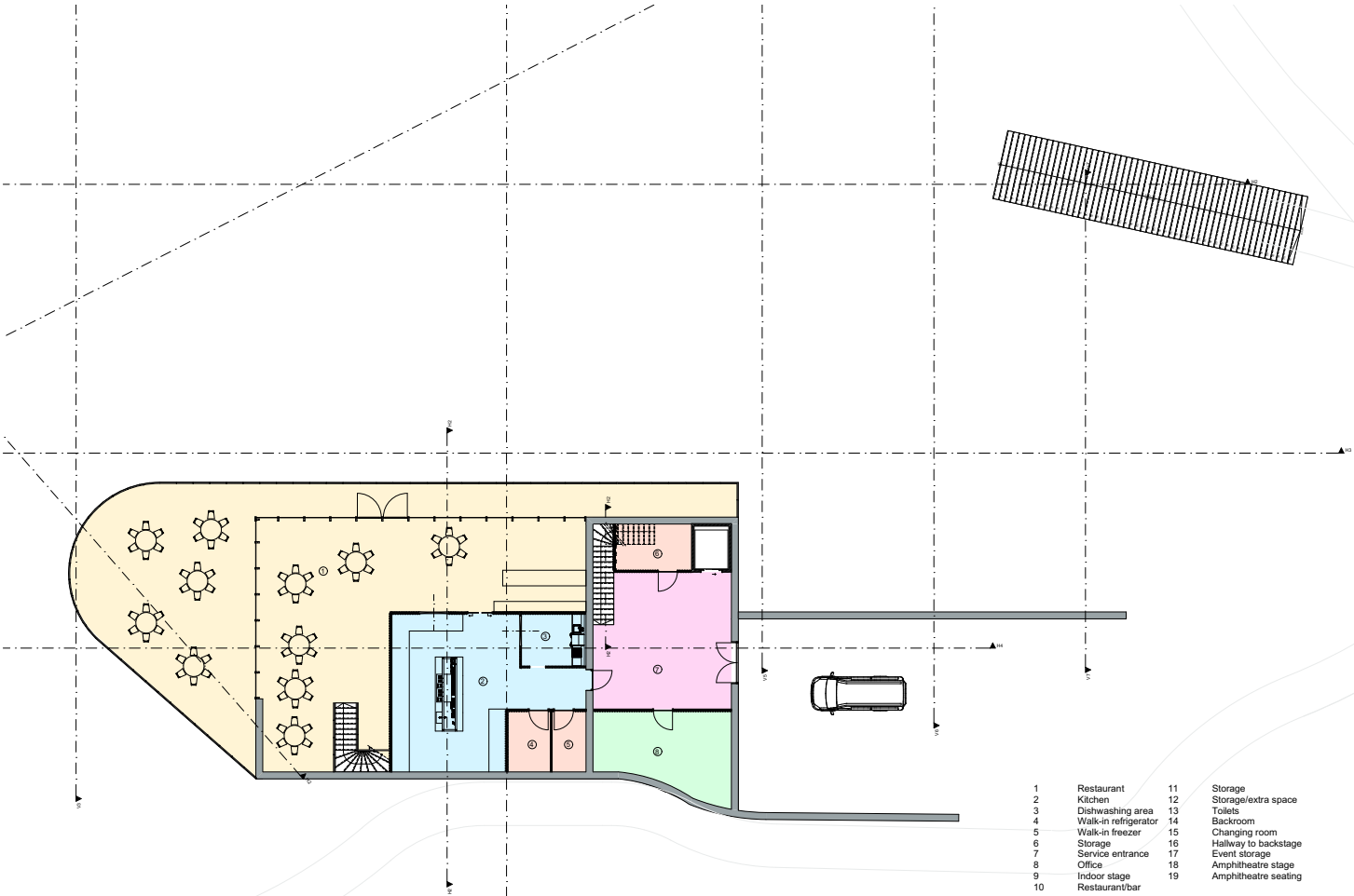
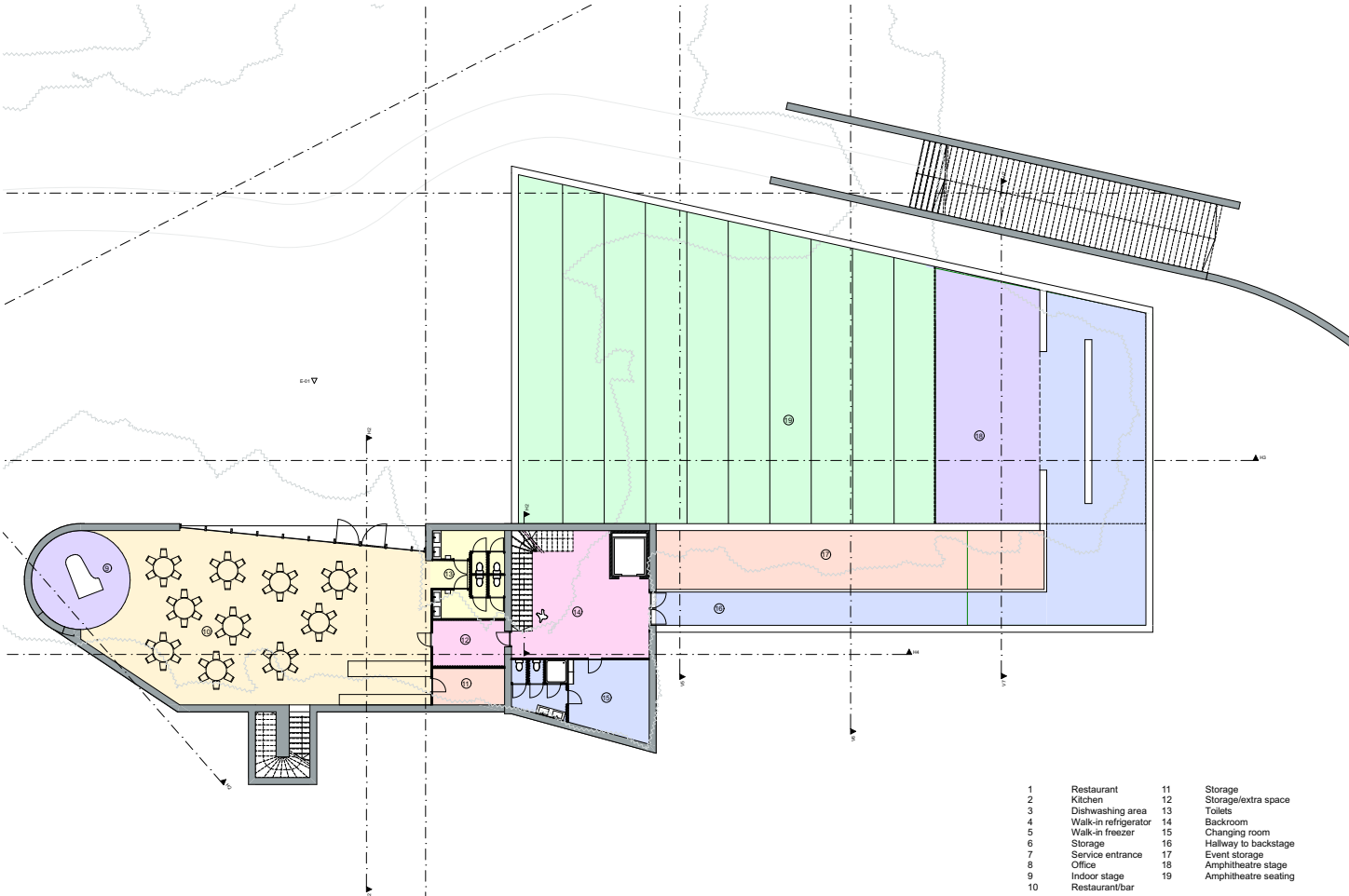
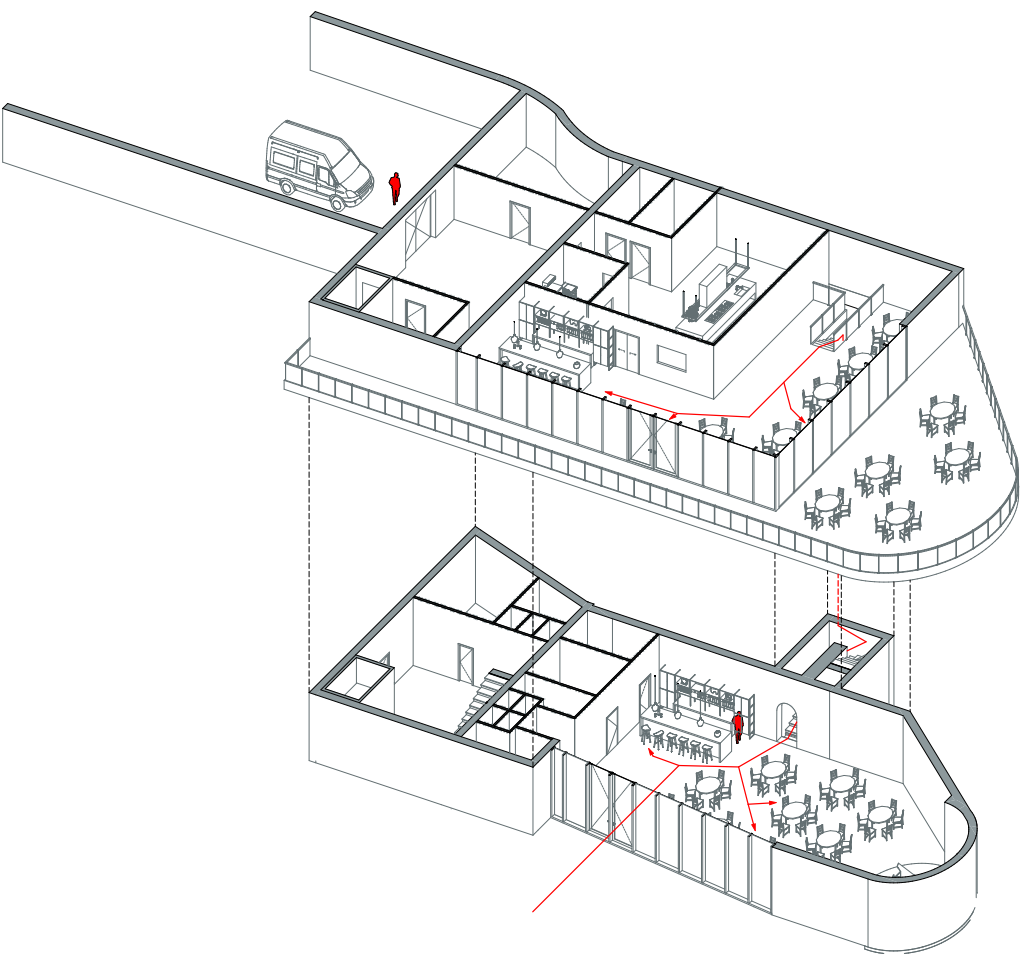
Apeldoorn, S. (2026, april). *Early section of the amphitheatre* [Render]



Chapter four: research by design

Program efficiency versus quarry continuity:

The first main design iteration after taking a more co-optive approach had the amphitheatre still in the south east corner of the quarry and the restaurant directly adjacent to it. The complex routing for the public and services led me to design it with a program-led approach. Like previous iterations, the spaces function well next to each other, and the routing made sense, but it lacked in continuing the spatial and material conditions of the quarry. While granite was being used, it didn't sufficiently make all the different transformations legible. Additionally, the smooth, rounded form of the restaurant made it so that it felt more like a normal building that was added into the quarry, instead of a building that felt integrated into the quarry.





Final design

The evaluation and explanation of the final design will be done by following the route a visitor has to take, starting from the top of the quarry, down to level zero.

When walking from the parking lot towards the quarry, the visibility of the building is important because the analysis showed that the quarry isn't visible from this approach due to height differences. What you see in the drawing and render is the highest level of the building, which primarily serves as back of house. At the top of the building, on the north side, there is space for a van to deliver goods or technical equipment for performances. While that path is public, most visitors won't take that route because they would pass the main entry into the quarry and restaurant. A large set of stairs is carved out of the granite by using diamond wire cutting techniques. Right next to the stairs is an elevator that allows less mobile people to reach the restaurant level and the quarry floor. A key can be used by personnel to access the stage level so that the same elevator can also be used to move equipment up and down, eliminating the need for a second elevator.

Chapter four: research by design



Apeldoorn, S. (2026, may). view towards quarry [Render]

Chapter four: research by design

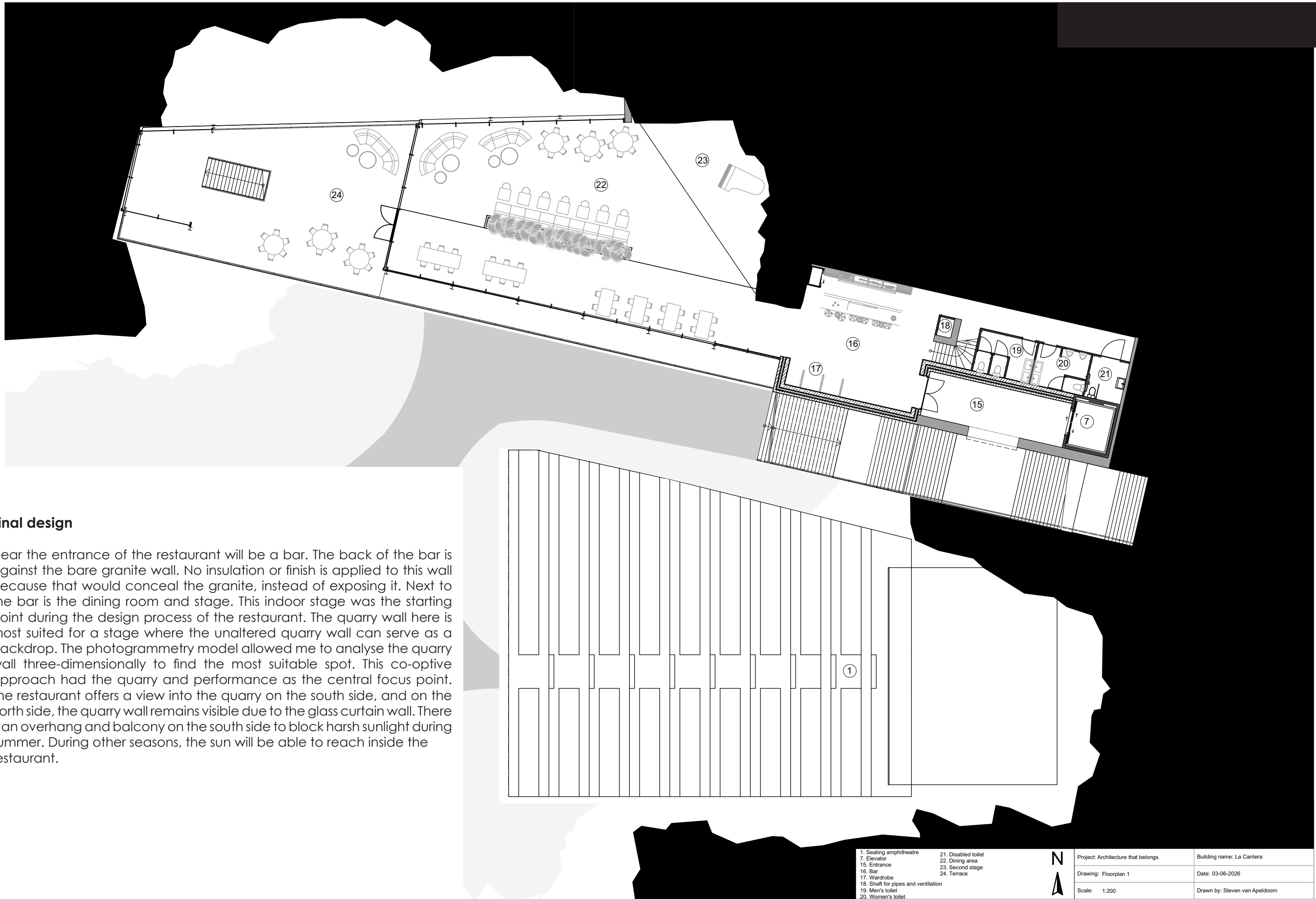
Final design

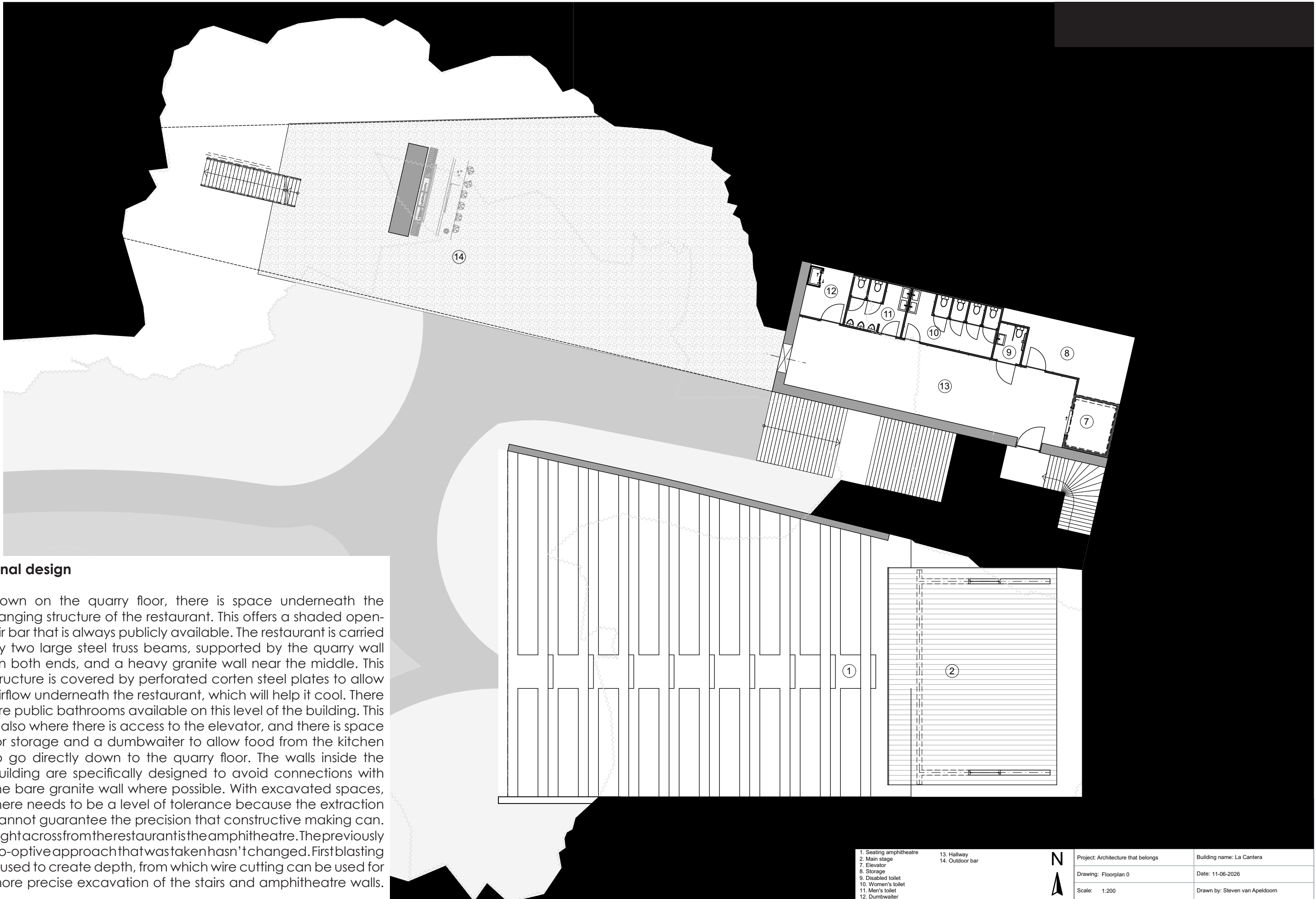
When visitors take the stairs to go down, they are surrounded by granite in three different levels of transformation. On the left is bare granite, showing the excavation marks of the wire saw. On the right, there is the façade of the building, which is made of stacked pieces of rough granite. These pieces come from the blasting that is needed for the amphitheatre. The stairs themselves are cut out of the quarry with the wire saw, and then the surface is refined to make it more suitable to be used as stairs.

The entrance of the restaurant is marked by corten steel, which cuts an opening into the granite wall. The use of corten steel is a reference to the steel machines that were used to excavate the granite. Now, instead of carving granite, the steel carved openings into the building.



Apeldoorn, S. (2026, may). View from entrance of the quarry [Render]

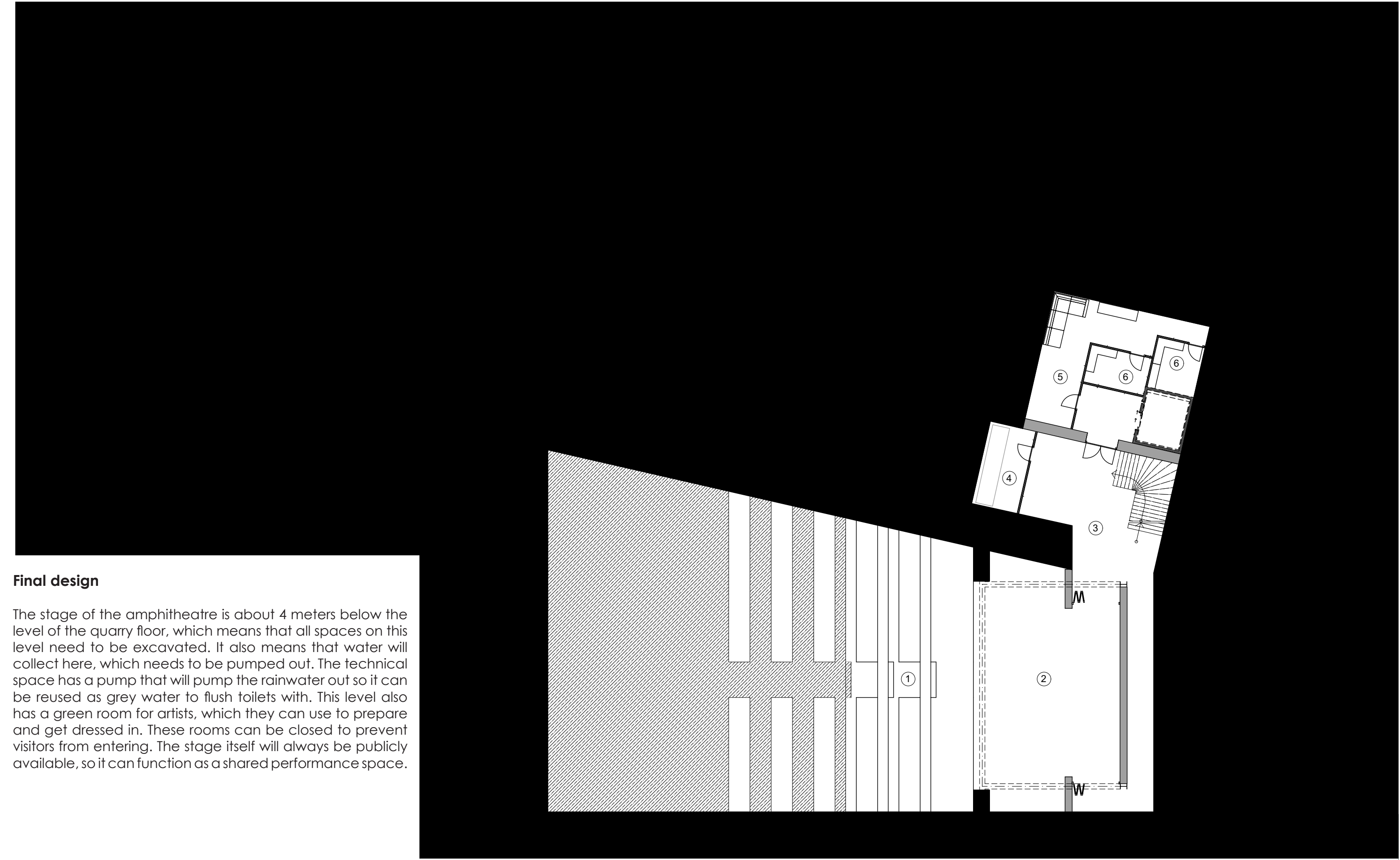




Final design

Down on the quarry floor, there is space underneath the hanging structure of the restaurant. This offers a shaded open-air bar that is always publicly available. The restaurant is carried by two large steel truss beams, supported by the quarry wall on both ends, and a heavy granite wall near the middle. This structure is covered by perforated corten steel plates to allow airflow underneath the restaurant, which will help it cool. There are public bathrooms available on this level of the building. This is also where there is access to the elevator, and there is space for storage and a dumbwaiter to allow food from the kitchen to go directly down to the quarry floor. The walls inside the building are specifically designed to avoid connections with the bare granite wall where possible. With excavated spaces, there needs to be a level of tolerance because the extraction cannot guarantee the precision that constructive making can. Right across from the restaurant is the amphitheatre. The previously co-optive approach that was taken hasn't changed. First blasting is used to create depth, from which wire cutting can be used for more precise excavation of the stairs and amphitheatre walls.

1. Seating amphitheatre	13. Hallway	Project: Architecture that belongs	Building name: La Cantera
2. Main stage	14. Outdoor bar	Drawing: Floorplan 0	Date: 11-06-2026
7. Elevator		Scale: 1:200	Drawn by: Steven van Apeldoorn
8. Storage			
9. Disabled toilet			
10. Women's toilet			
11. Men's toilet			
12. Dumbwaiter			



Final design

The stage of the amphitheatre is about 4 meters below the level of the quarry floor, which means that all spaces on this level need to be excavated. It also means that water will collect here, which needs to be pumped out. The technical space has a pump that will pump the rainwater out so it can be reused as grey water to flush toilets with. This level also has a green room for artists, which they can use to prepare and get dressed in. These rooms can be closed to prevent visitors from entering. The stage itself will always be publicly available, so it can function as a shared performance space.

1. Seating amphitheatre	N ↑	Project: Architecture that belongs	Building name: La Cantera
2. Main stage		Drawing: Floorplan -1	Date: 11-06-2026
3. Backstage		Scale: 1:200	Drawn by: Steven van Apeldoorn
4. Technical space			
5. Artist lounge			
6. Changing room			

Chapter four: research by design

Final design

The evaluative lenses made in the first chapter can now be used to determine whether the conditions for belonging are met. The first set of criteria concerns the material conditions. Enough excavation is done to ensure that there will be sufficient granite available to construct the building. Granite will be visible and touchable in several forms of transformation. The quarry wall, rough-carved granite, textured granite, smooth granite, and polished granite can be experienced throughout the whole project.

New material that is added does not conceal the relationship between excavation and architecture; in fact, it tries to reverence it by using it to cut through granite, just like is done when excavating. However, a visitor might not understand that reverence immediately. Physically, the excavated granite walls are not covered up by any material, so the excavation is still legible.

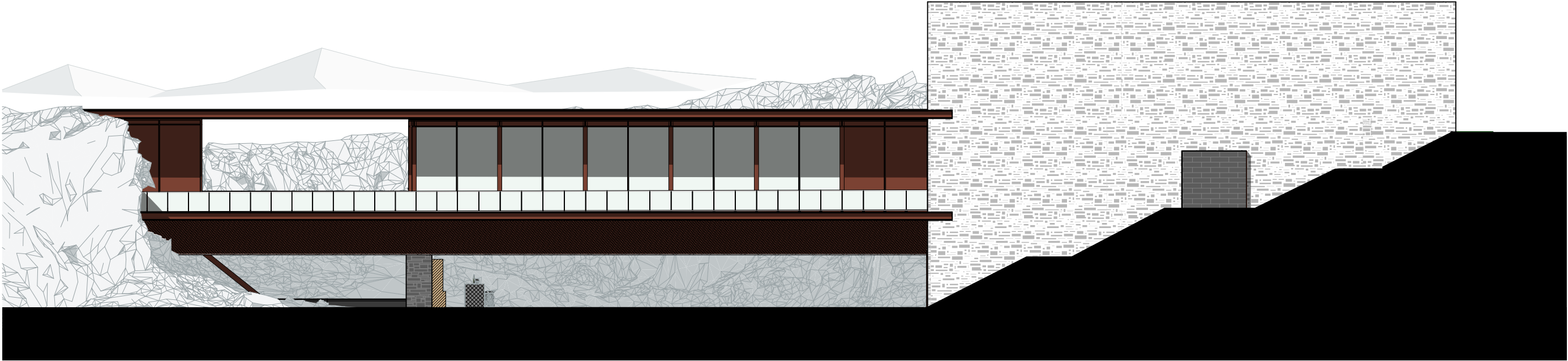


Apeldoorn, S. (2026, may). View inside restaurant [Render]

Chapter four: research by design

Final design

Spatial continuation required a co-optive approach. This has been used at times during the design process, mainly for the amphitheatre and indoor stage, but it was difficult to apply to the whole project. A more flexible program could have allowed for a more co-optive approach. Even though the restaurant is not small, it does respect the hierarchy of the quarry by aligning its roof to the top of the quarry. Structurally, it could feel light because of the way it hangs between the quarry and the rest of the building, but visually, it can feel imposing.



Project: Architecture that belongs	Building name: La Cantera
Drawing: South Elevation	Date: 11-06-2026
Scale: 1:200	Drawn by: Steven van Apeldoorn

Chapter four: research by design

Final design

Public accessibility is achieved by ensuring that the quarry is always open and accessible to wheelchair users. The amphitheatre is open to be used by anyone when there is no official programming. That way, it can serve as an urban commons. Local talent can be displayed and enjoyed freely by visitors. The restaurant is less public because it has to make money to sustain itself and therefore requires a monetary system. Food does help to gather people in public spaces for a longer time, compared to spaces without food, so it does serve to gather people, albeit not without cost.



Apeldoorn, S. (2026, may). View of the quarry, restaurant, and amphitheatre [Render]

Conclusion

This thesis investigated how material systems in architecture can shape the conditions for spatial and public belonging through the transformation of an abandoned quarry. It also concludes that belonging develops over time and cannot be forced or created. This research doesn't claim that architecture can directly create belonging as a fixed result; it approaches belonging as a set of conditions that architecture can influence. Theory, case studies, and the specific quarry conditions resulted in the following conditions: Material continuity, spatial continuity, and public accessibility. These conditions served as evaluative lenses during the design process and the final design proposal.

The research shows that an abandoned quarry should be treated as both a site and material, and not as an empty ground on which a new architectural object can be placed. There is architectural potential in the existing characteristics of the quarry. Its walls, level differences, spatial enclosures, and extraction potential should be treated as design guidelines. The architecture should not replace the quarry but continue its material and spatial logic.

Two principles guided this approach: transform without displacing, and co-optive making before constructive making. By using the first principle, the granite can be understood as a part of an ongoing process of transformation. The granite gained through excavation is to be used on site. The lifecycle of granite becomes legible when the architecture uses granite in different forms of its transformation: raw granite, cut stone blocks, textured surfaces, and smooth elements. Architecture has the potential to conceal or reveal the material continuity of the quarry. This project aims to make the material lifecycle legible. The material changes form but remains on site, connected to its origin.

The second principle of co-optive making, before constructive making, is used to continue the spatial quality of the quarry. The quarry walls, slopes, level differences, access points, and extraction potential guide the architectural interventions. New construction is not to be rejected, but it becomes secondary. It must be able to justify itself against what the quarry is already providing. During the design process, there was a continuous hierarchical negotiation between the intended program and the co-optive approach. The first iterations were designed with a focus on a functional program and spatial configuration. This resulted in a scale that was not in balance with the quarry, and a discontinuity of the quarry's spatial conditions. As soon as the core principles were considered during the design process, and the quarry guided architectural decisions, the hierarchy between the architecture and the quarry improved.

While a co-optive approach is an effective way to maintain the quarry's spatial conditions, it quickly encounters obstacles. The main problem is the lack of covered spaces. The quarry used for this project is a rather shallow open-pit quarry, without any underground spaces or deep caverns. That means the quarry provides only a floor and walls, not roofs. Therefore, co-optive making should be seen as a starting point, not as a complete solution. It becomes more complicated when excavation is added to the design process. It is hard to define excavating as co-optive or constructive approach, because there is an argument for both. The position of this research is that excavation functions as a bridge between the two approaches. For both approaches to work, excavation is necessary because it not only generates material that can be used for constructive making, thereby continuing the quarry's material conditions, but also creates new spaces that can be co-opted, thereby continuing the quarry's spatial conditions.

The answer to the research question cannot be understood as a universal formula to create belonging, but as a design approach for this specific quarry and other quarries with similar spatial conditions. Material systems can shape conditions for belonging when excavation is seen as a mediating intervention. Excavation allows the existing conditions of the quarry to continue by generating new spaces that can be co-opted, while also producing granite that can be transformed and reused on site. Excavation, therefore, connects the two main principles used in this research. Through it, the quarry is not erased or transformed into something completely different, but extended both spatially and materially. That is how this abandoned quarry can transform into a public cultural landscape while also remaining legible as a place of extraction.

Discussion

A central limitation of this research lies in the subjective nature of the research question. Therefore, a difference between architectural belonging and experienced belonging has to be made. Experienced belonging is not something that can be created or evaluated, which this research acknowledges. Architectural belonging is understood through its connection to the site. This research evaluates whether the architecture belongs to the quarry, but it cannot prove that people will experience belonging there. The distinction between experienced and architectural belonging affects how the results of this research should be read.

A second discussion point concerns excavation and its position in the theory of Ingold (2001). When Ingold's distinction between co-optive and constructive making is strictly followed, excavation would belong closer to constructive making because it physically remodels the quarry according to design intention. However, in the context of a quarry, excavation can also be seen as a continuation of the process through which the site came to exist, unrelated to an architectural intervention. The fact that excavation in this case is not only done to gain material and continue the spatial and material conditions of the quarry, but also to create a new space with a pre-existing specific architectural intention, makes it ambiguous whether it is purely co-optive or constructive. Therefore, the position of this research is that excavation mediates between the two forms of making. It stretches the original theoretical distinction and should be seen as a project-specific adaptation.

A third point of discussion is the tension between a program and a site-led design. A true co-optive approach would allow the site to determine the program. However, for this project, the program was also influenced by the nature of the assignment, which included cultural ambitions. Through research into public needs, the conditions of the site, and the theme of urban commons, a program was formulated. What became apparent is that the degree of adaptability became dependent on the flexibility of the program, instead of the site. The event space was capable of adapting because events can take shape in many different forms. The site-based approach to the event space resulted in it becoming an amphitheatre. The restaurant was less adaptable because it required a higher level of comfort and more back-of-house related spaces, resulting in a more constructive approach. This tension highlights a more realistic approach to dealing with the specific conditions of the quarry than the theory would have allowed.

Academic reflection

What I learned through this research is how easy it was for me to fall into the old habit of using a program-led approach. This became especially clear in the earliest design iterations. I focused too much on functional relationships and spatial configurations before I understood what the quarry could provide. That approach limited the site-specific qualities I was looking for in my design. The new approach I learned is something that I will take with me to other projects with very special or unique site conditions and requirements.

There are a few practical things I would approach differently next time, for example, surveying and mapping the quarry. Between the time I decided that the quarry should be my project site and the subsequent site visit was very little time. I knew photogrammetry would be my best method to map the quarry, but I had never used that technique before, so I had no clear image of what its limitations would be. While the 3D model was sufficient for most of the design decisions, a more complete image of the quarry would have helped. In addition, more studies were needed to examine the ground, acoustic, and ecological conditions of the quarry for a better developed proposal.

My position as an architect has changed in a way that I am more conscious of the material lifecycles and origins, and how that influences my design decisions. This research has shown me that a material study before the project has even started is helpful to understand the context in which you are working. Not every project will require the same depth of material research, but I do think that having knowledge about traditional material use, current material availability, extraction, transport, and transformation can be helpful for architecture to be more specific to its site.

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Architecture that belongs

How can material systems in architecture shape the conditions for spatial, and public belonging through the transformation of abandoned quarries?



AR4DC100 Architectural Design Crossovers Graduation Studio
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Architecture that belongs

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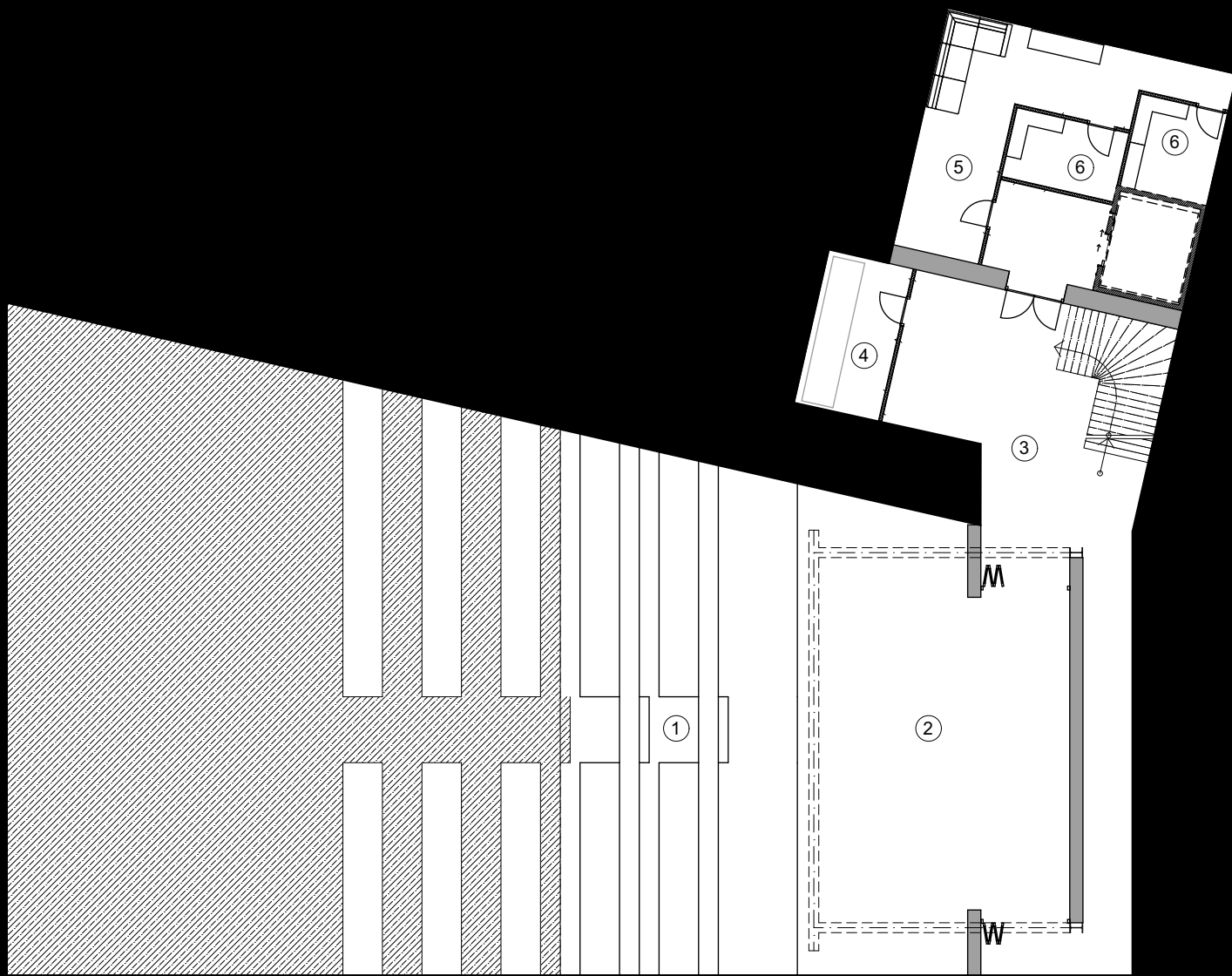


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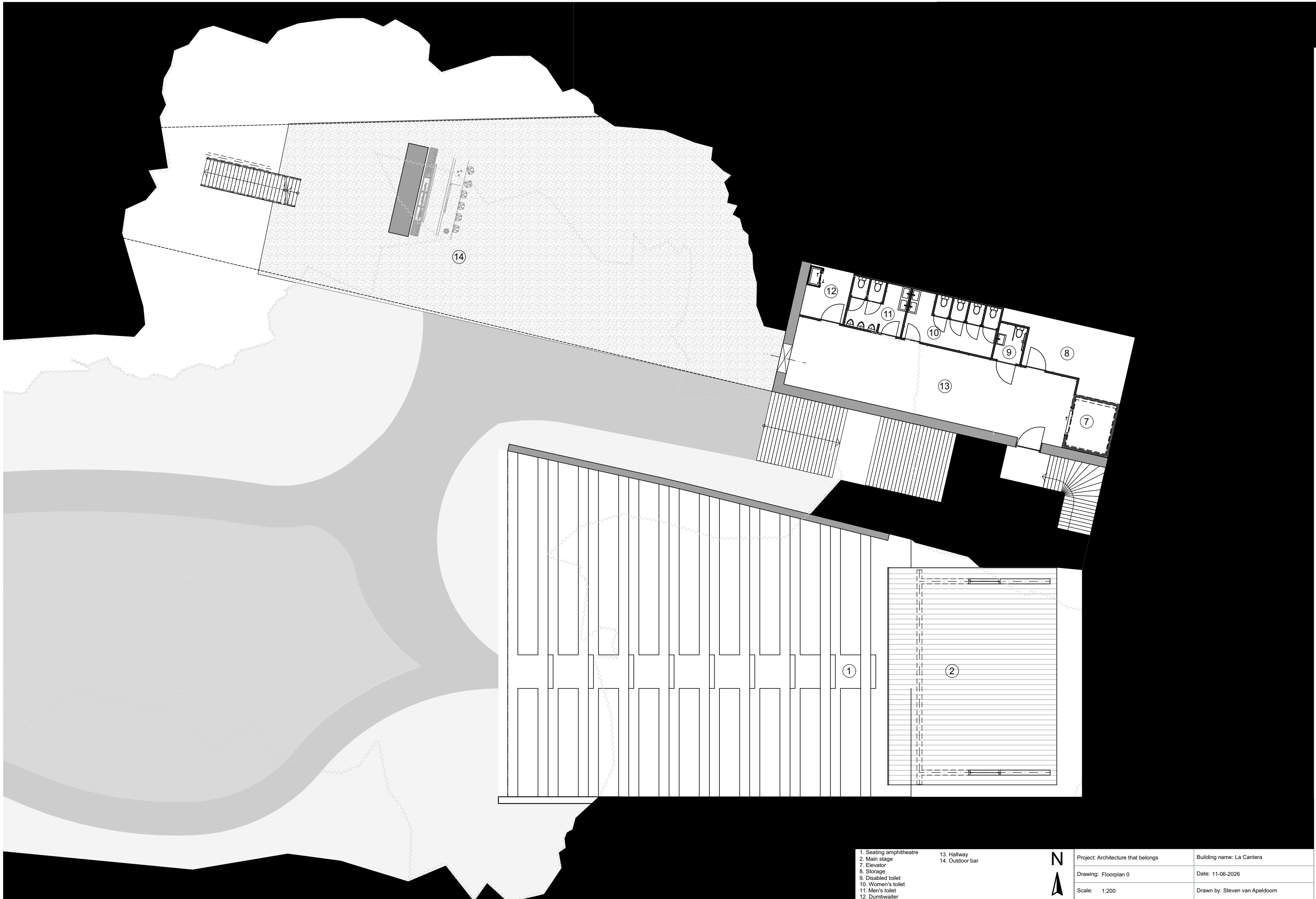
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- 2. Main stage
- 3. Backstage
- 4. Technical space
- 5. Artist lounge
- 6. Changing room



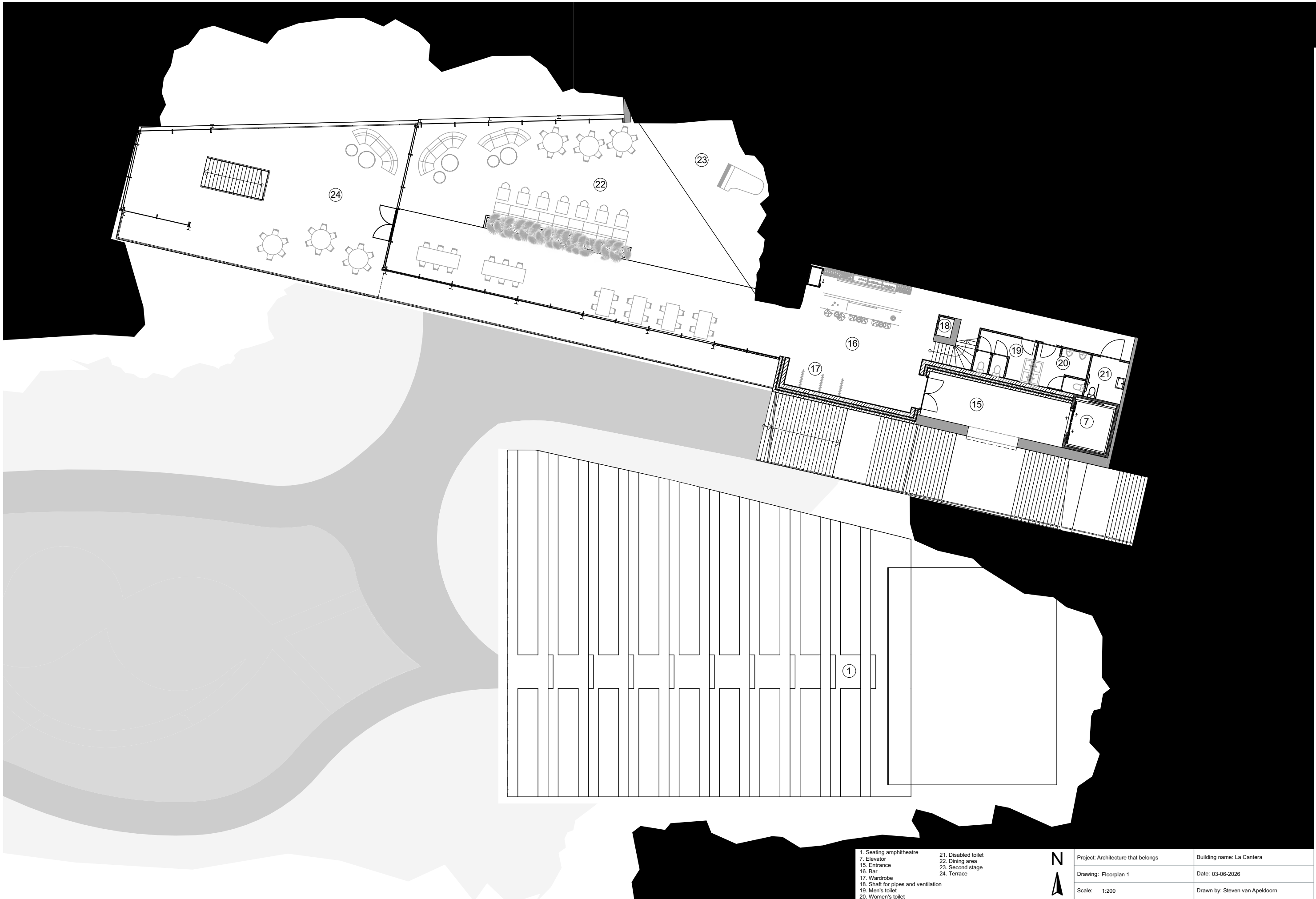
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- 1. Seating amphitheatre
- 2. Main stage
- 7. Elevator
- 8. Storage
- 9. Disabled toilet
- 10. Women's toilet
- 11. Men's toilet
- 12. Dumbwaiter
- 13. Hallway
- 14. Outdoor bar



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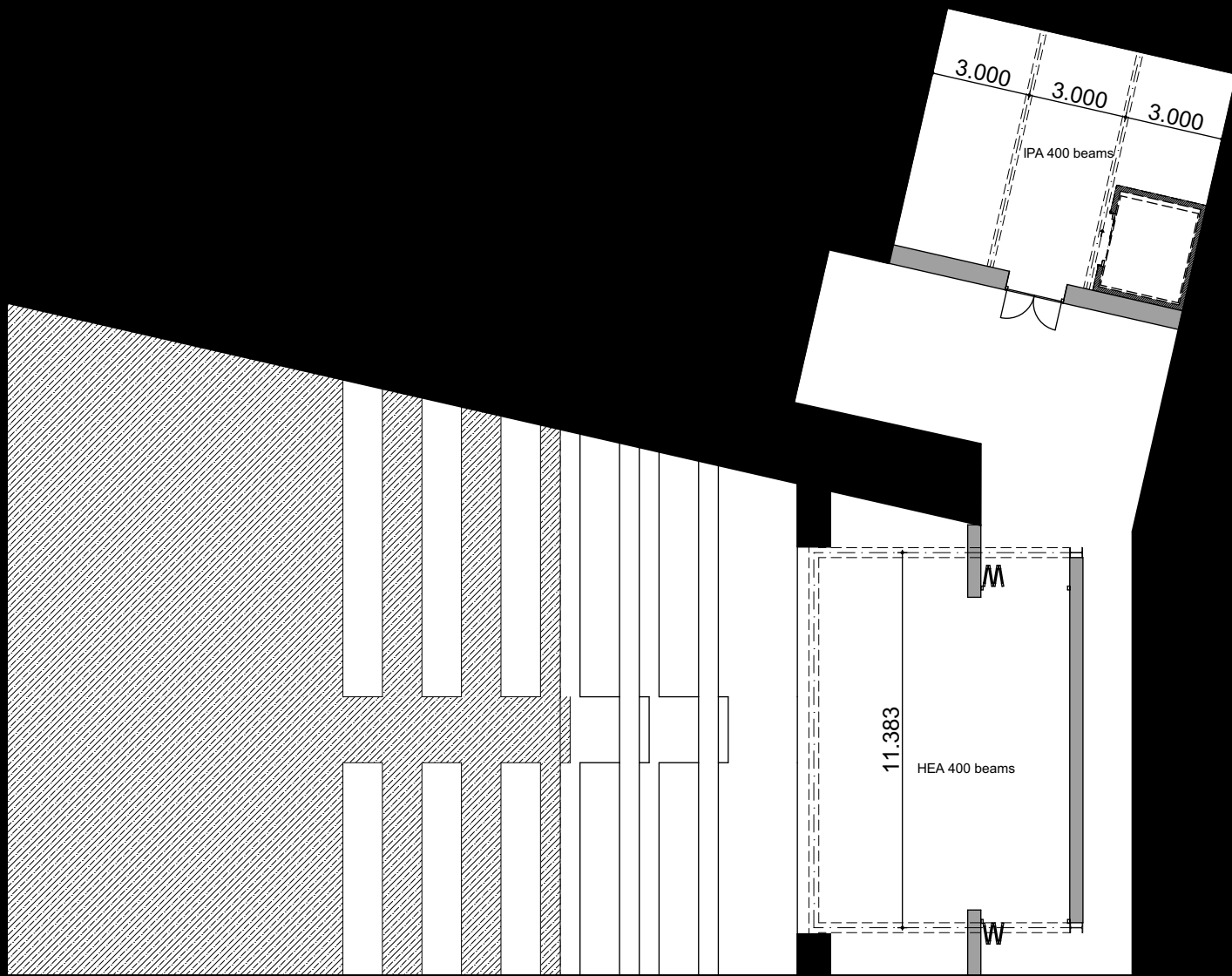
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- 16. Bar
- 17. Wardrobe
- 18. Shaft for pipes and ventilation
- 19. Men's toilet
- 20. Women's toilet
- 21. Disabled toilet
- 22. Dining area
- 23. Second stage
- 24. Terrace



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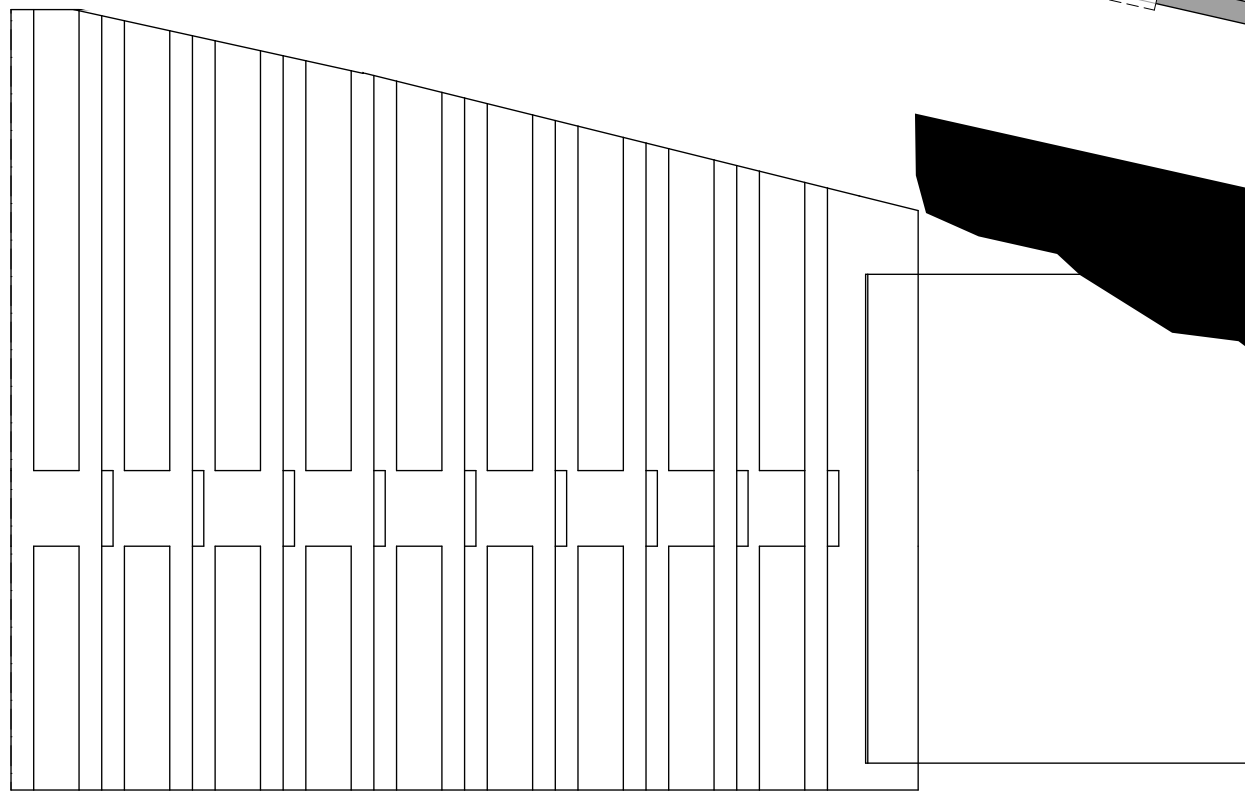
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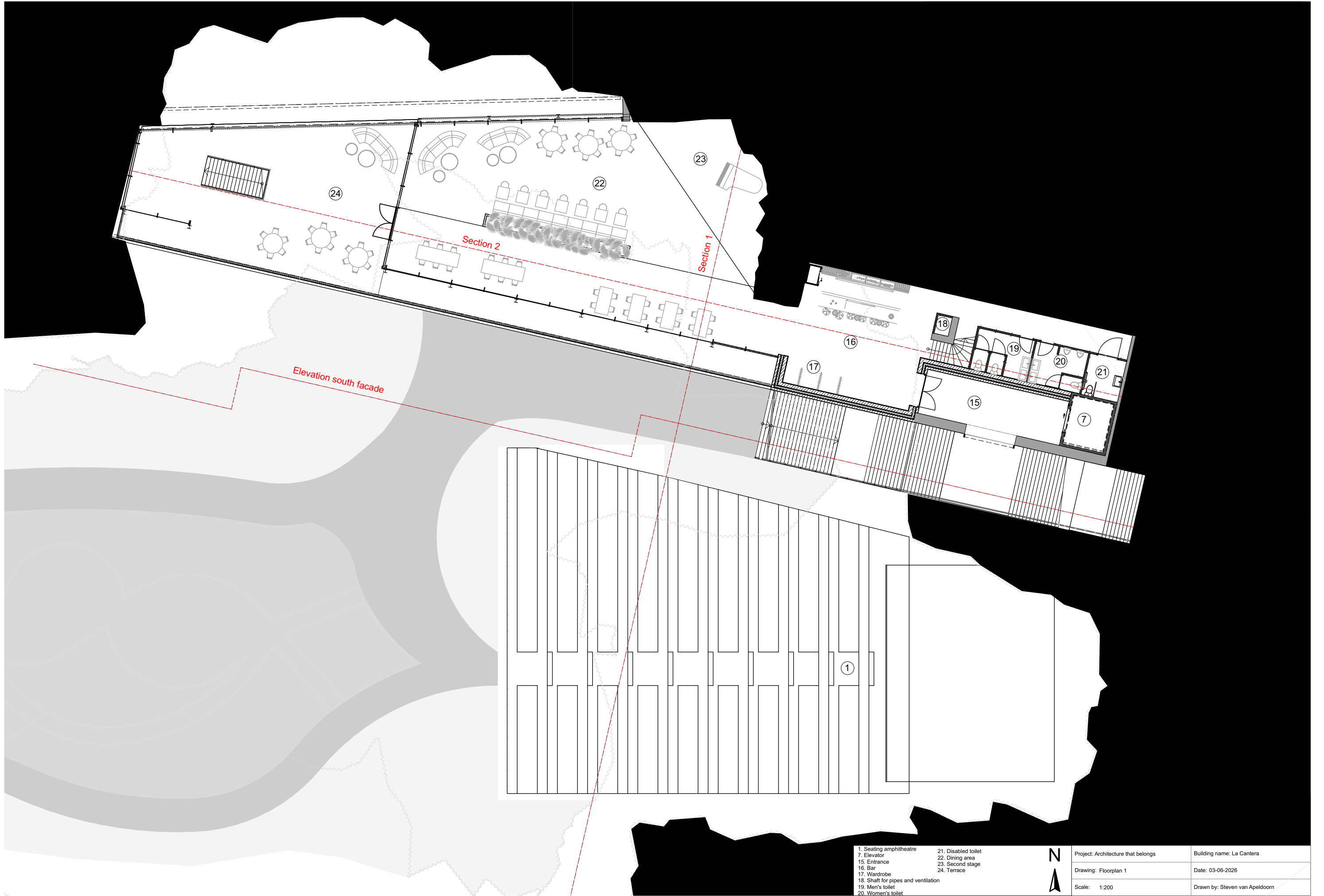
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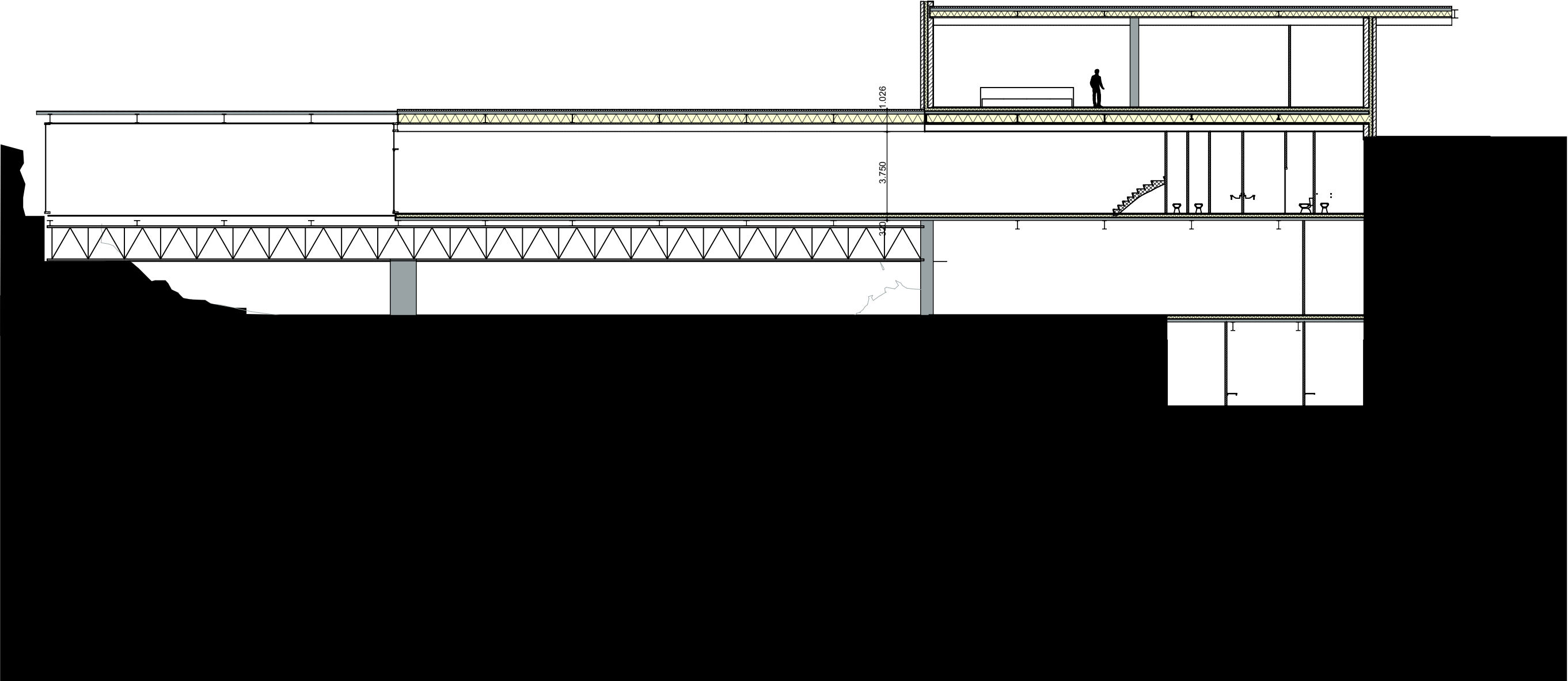
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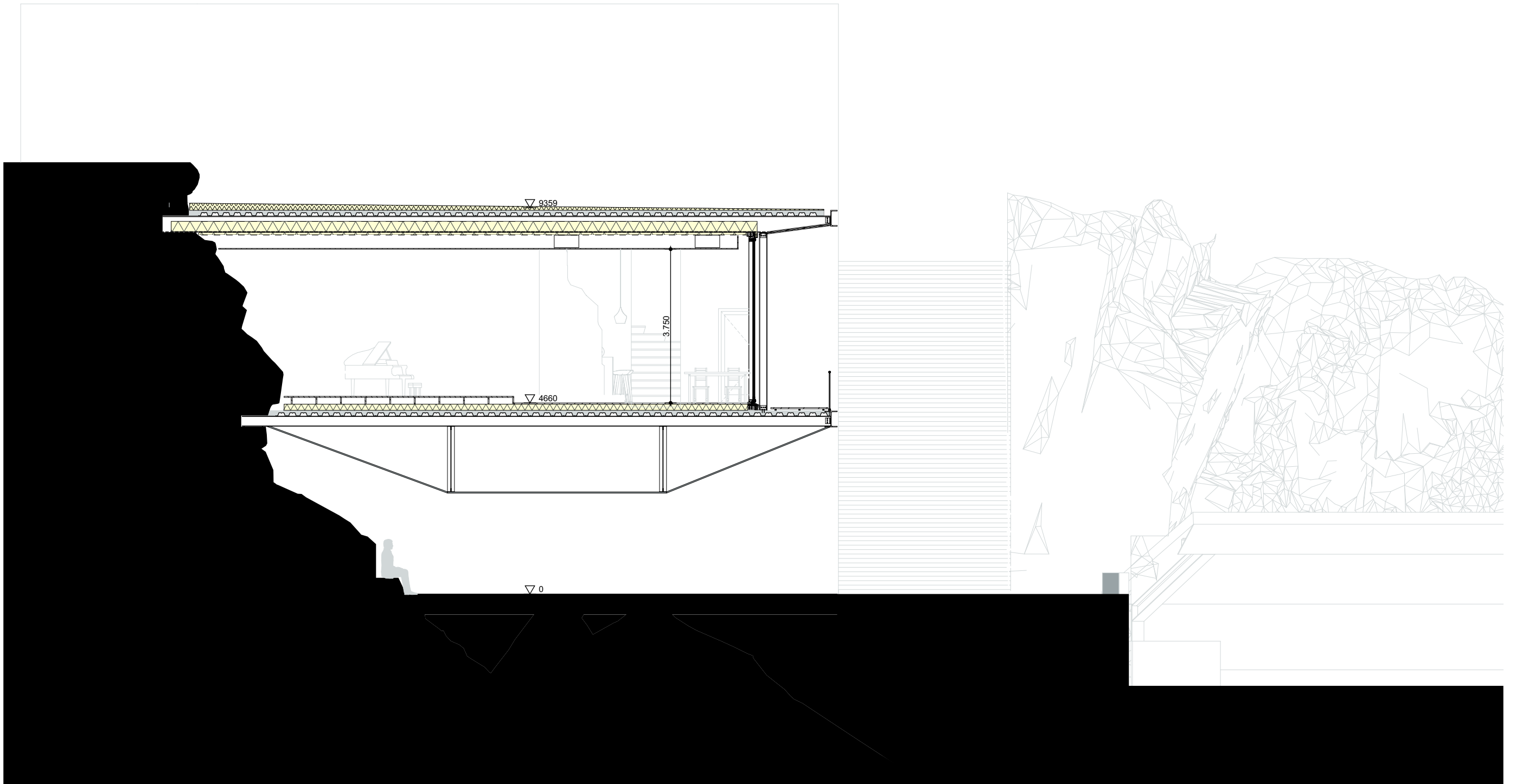
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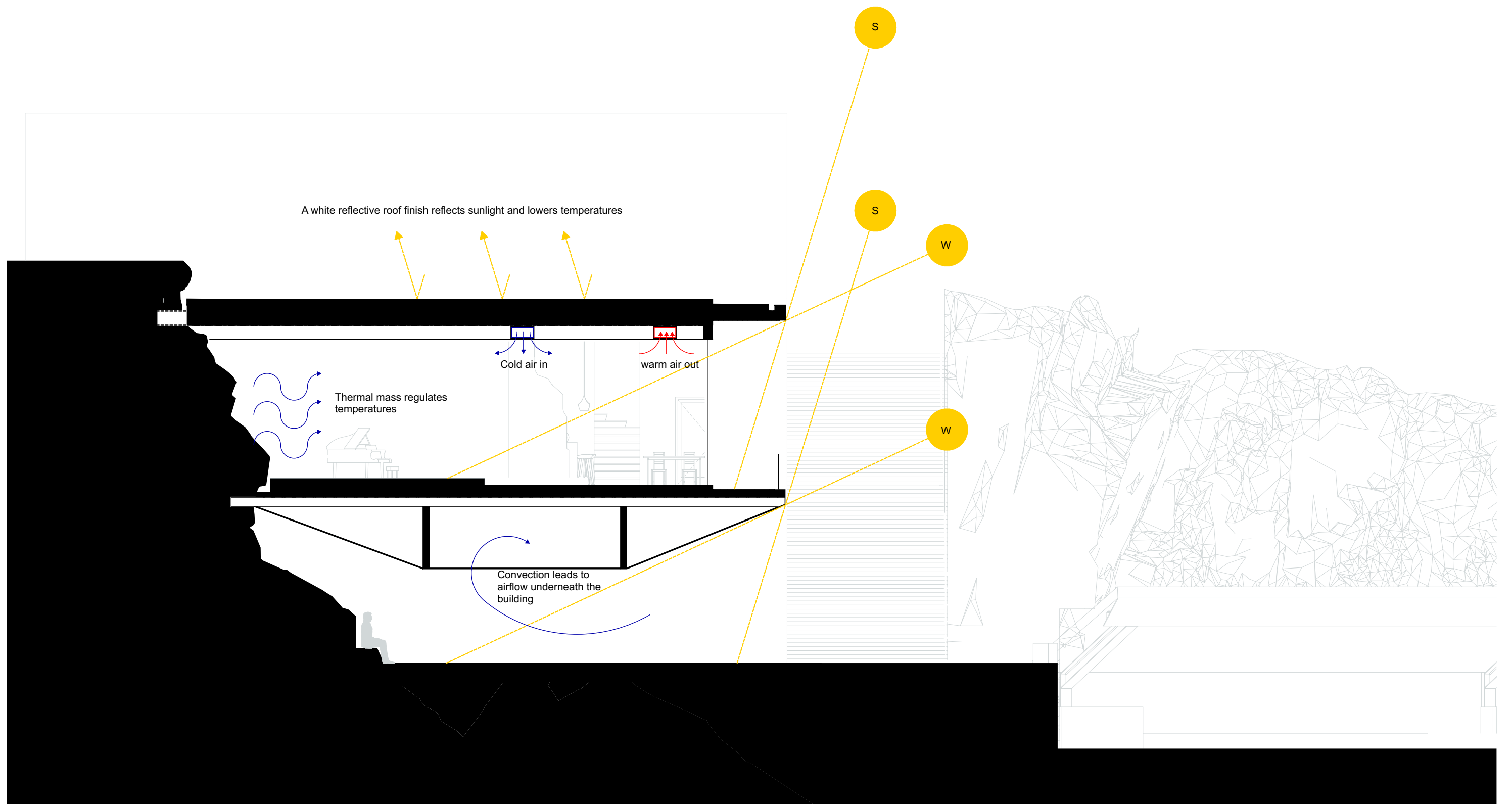
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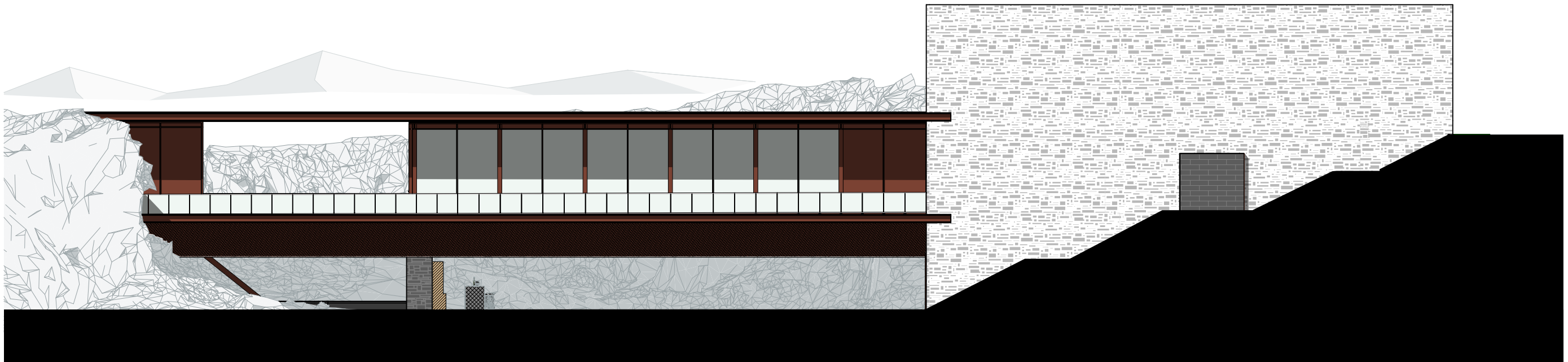
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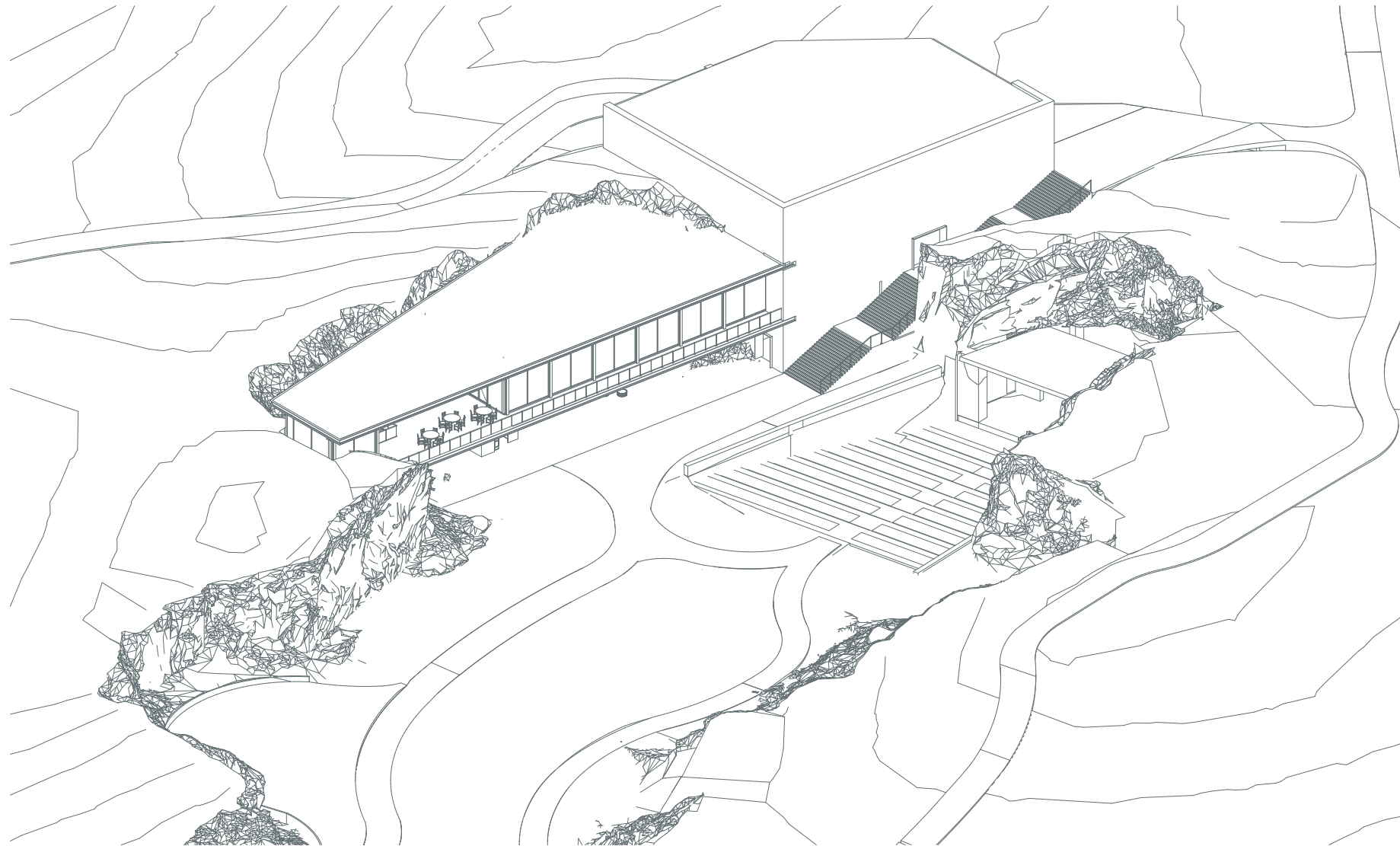
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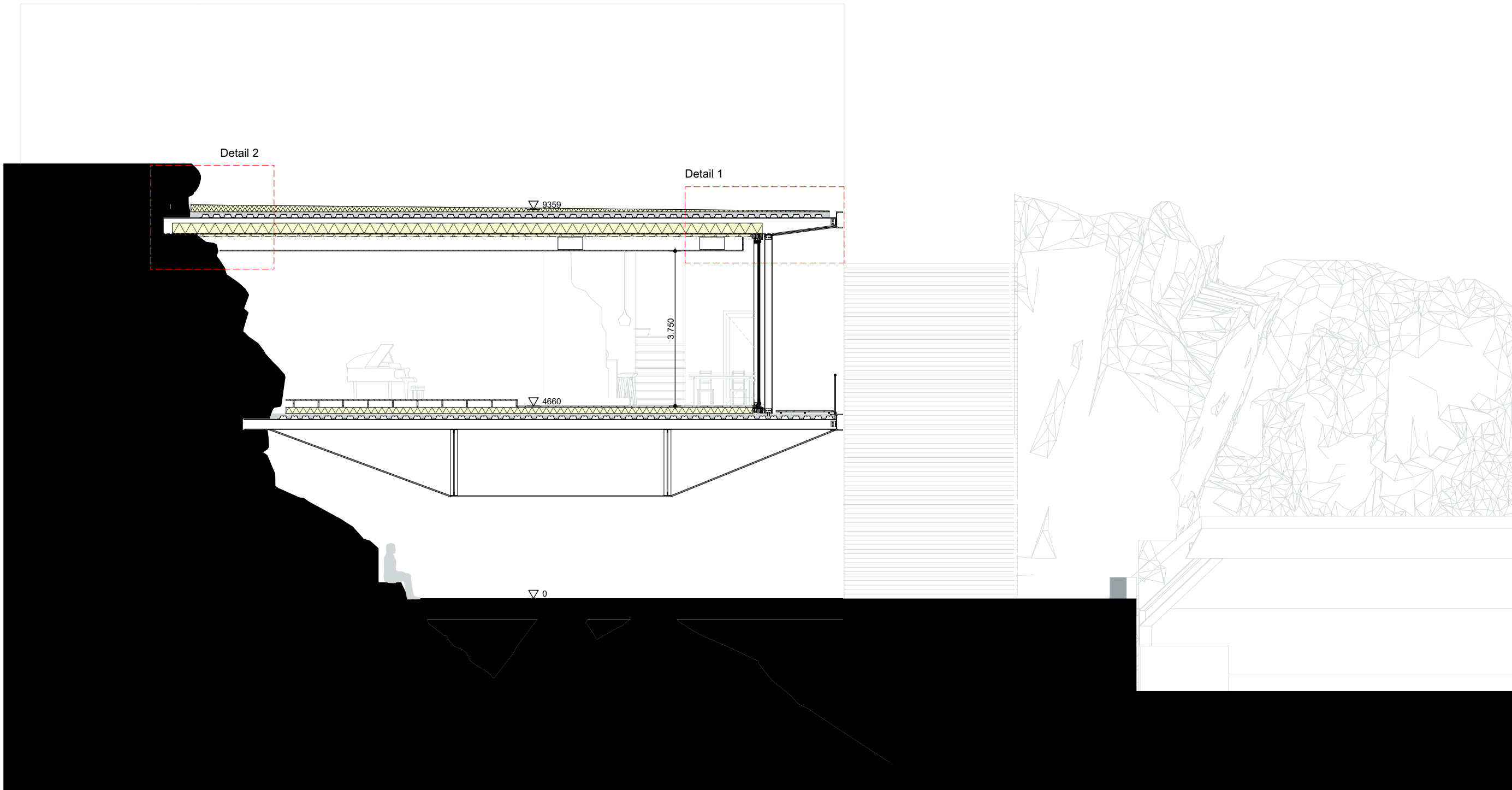
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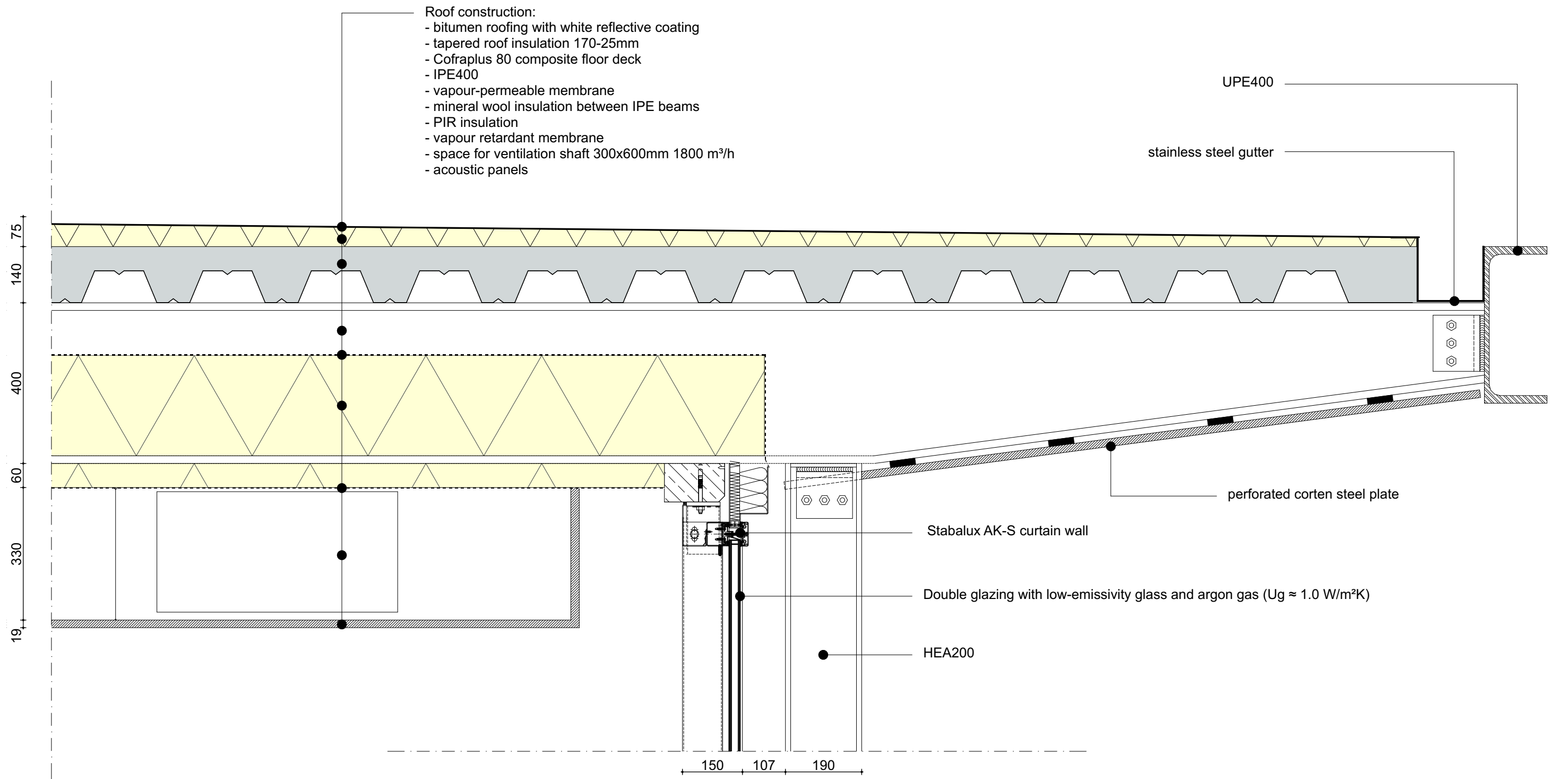
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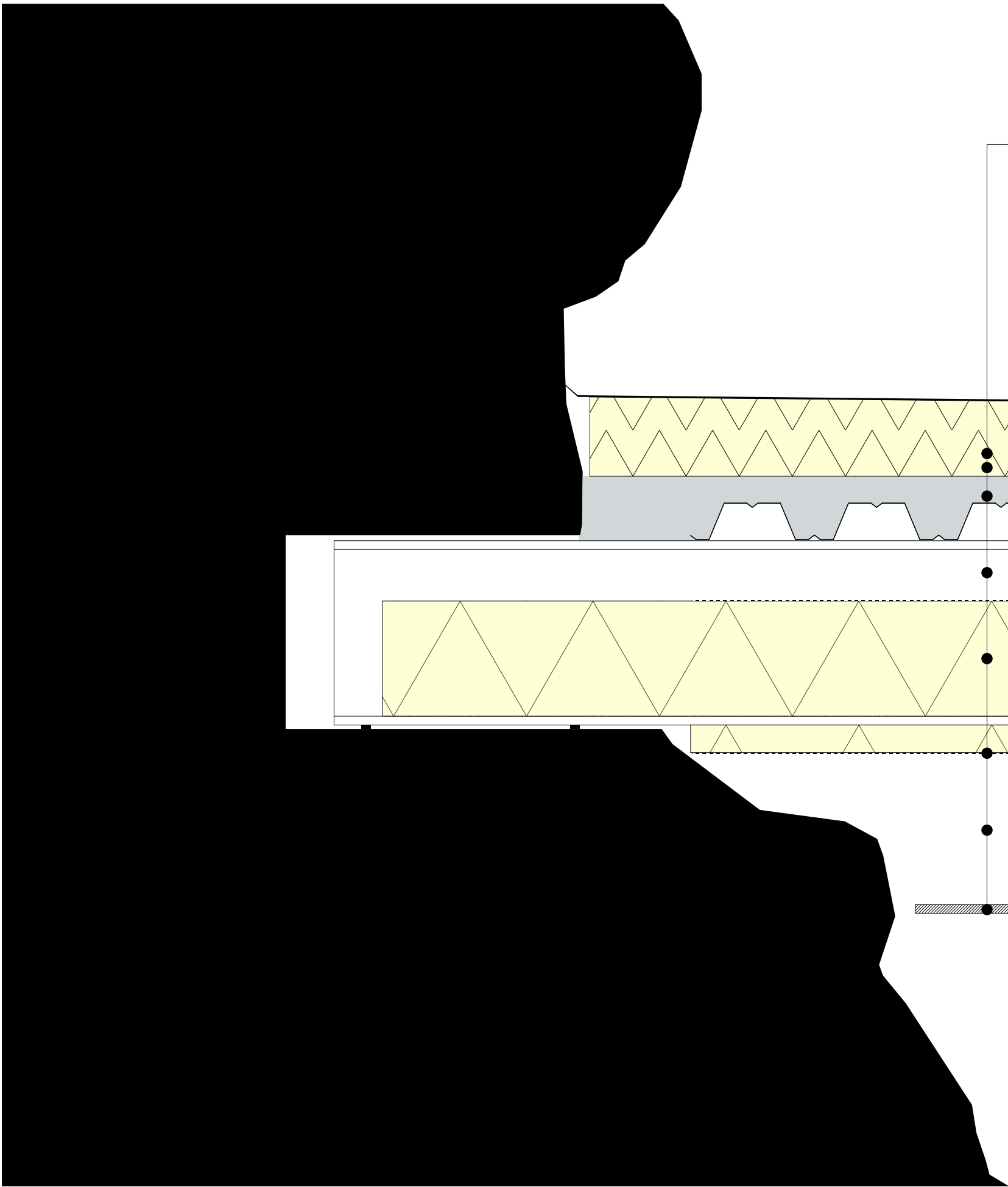
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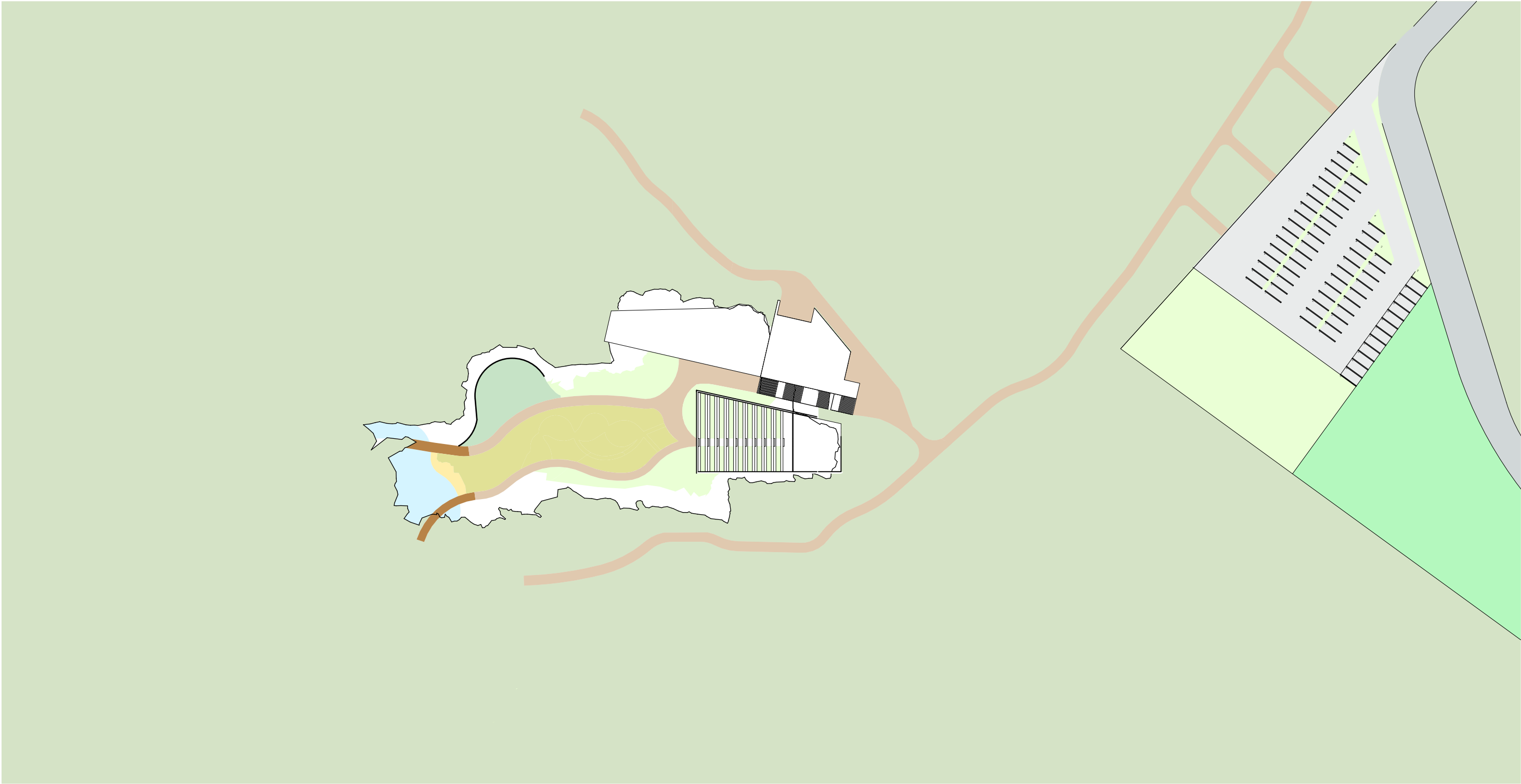
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 - tapered roof insulation 170-2
 - Cofraplus 80 composite floor
 - IPE400
 - vapour-permeable membran
 - mineral wool insulation betw
 - PIR insulation
 - vapour retardant membrane
 - space for ventilation shaft 30
 - acoustic panels

1900
160
140
400
60
330
19

Project: Architecture that belongs	Building name: La Cantera
Drawing: Detail 2	Date: 11-06-2026
Scale: 1:10	Drawn by: Steven van Apeldoorn



Project: Architecture that belongs	Building name: La Cantera
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