

REIMAGINING THE GRAIN SILO OF RONEHAMN: ADAPTIVE REUSE OF RURAL INDUSTRIAL HERITAGE

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ABSTRACT

In Sweden, numerous mid-20th-century concrete grain silos stand vacant. They represent both opportunities and challenges for the existing industrial heritage and our built typology. This thesis investigates a transformation of the grain silo in Ronehamn, a small village on Gotland, and researches the potential of adaptive reuse to prolong its lifetime.

Through a combination of literature studies, case analyses, site visits, and stakeholder interviews, a pragmatic design proposal grounded in practical realities is presented. It aims to align with local needs and is motivated by and analysed through technical and sustainable building practices. The theoretical framework relies on the theory of adaptive reuse and the 9Rs model of reuse, combined with design concepts of *aemulatio* and *genius loci*.

The core of this thesis is to demonstrate that transformation projects are crucial to ensure a sustainable development of the built typology. This practice reduces environmental impact by reusing existing structures, preserves embodied carbon, and minimises construction waste. Instead of demolishing and rebuilding, transformation extends the life of built resources and supports circular design principles. Apart from the ecological benefits, this practice helps to maintain cultural identity and revitalises communities by giving new purpose and value to obsolete buildings.

The presented design proposal demonstrates how such a transformation can be carried out, both concerning the technical building aspects and how the existing building structure, transformed into new functions, can create added value in the local context. This thesis contributes to the discourse on industrial heritage reuse, offering strategies to extend building lifespans, preserve cultural identity, and reduce environmental impact through an architectural proposal that makes an abandoned structure accessible.

KEYWORDS

transformation
concrete structure
aemulatio
coastal proximity

"The practice of adaptive reuse is much like playing the violin to the melody of the host building. It is a song of redaction in which the minor keys humbly and sweetly negotiate between existing context and new content"

Wong, 2025 (p.248)

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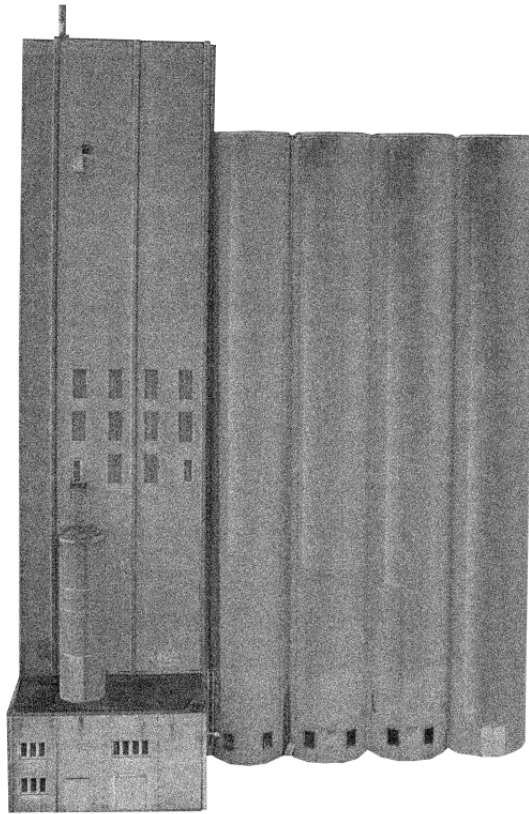


Figure 2. The silo of Ronehamn. (Lundberg, 2025). Revised with permission.

PURPOSE/AIM

This thesis explores the potential to transform the vacant and obsolete grain silo in Ronehamn, located in a south harbour on Gotland, the largest island of Sweden. The aim is to develop an architectural proposal that meets both current and future needs of the local community and visitors, while contributing to the broader discourse on adaptive reuse of silos in Sweden. The project investigates how silos' cultural and spatial values can be strengthened through an adaptive reuse transformation, where the existing volume is reconfigured, and a new program is introduced. Aiming to demonstrate the potential of preserving a landmark with historical significance and visual presence in a rural local context.

Gotland is a popular Swedish holiday destination during the summer months. Despite that, most rural areas on Gotland have significant challenges with their population development since they are often, like in Ronehamn, characterised by a negative migration chain and an ageing population. This affects both the needed housing typology and, besides that, its general low-season attractiveness.

Although increasing interest in adaptive reuse in architecture, silo transformations in Sweden remain rare and are often hindered by regulatory, structural, and financial challenges.

Through different discussions, interviews and research, this thesis seeks to identify the potential that these silo structures hold and tries to highlight possible obstacles to look out for when transforming concrete silos. It also aims to understand how the building industry approaches transformation in practice, particularly when dealing with robust concrete structures in silos.

RESEARCH QUESTION

How can the grain silo in Ronehamn be transformed through the concept of adaptive reuse into an architecturally attractive, unique and functional place that extends the building's usable lifetime?

How can key lessons identified through interviews, research and discussions be translated into a guiding and easy-to-read handbook for concrete silo transformations in Sweden?

BACKGROUND

In Sweden, many mid-20th-century concrete grain silos remain unused, relics of an agricultural system that has since evolved. These structures, once vital to local economies and infrastructure, are now often viewed as obsolete and face increasing threats of demolition (SVT nyheter, 2025). This trend raises critical questions about how we value and manage our built industrial heritage in the context of sustainability and resource efficiency. Demolishing robust concrete buildings such as silos is problematic on multiple levels. Environmentally, it results in significant loss of embodied carbon and material resources, undermining efforts toward circular architecture and responsible resource management. Culturally, it risks erasing local identity, history and memory tied to place (Douet, J. 2013).

Many silos are landmarks that shape the character of their surroundings. Despite their structural potential, there is a lack of built examples and practical strategies for transforming silos in Sweden, which represents a clear knowledge gap in both theory and practice.

This project idea was born from our personal interest in utilising unused structures. The subject reflects a strong sense of responsibility in our role as future architects. To care for our surroundings and engage with existing structures rather than defaulting to new construction. Transformations have long been part of architectural history, but today it is more urgent than ever. By working with silo typologies, our interest is to contribute to a broader discussion about how industrial heritage can be reimagined in ways that are socially, environmentally, and architecturally meaningful. Positioning us as knowledge holders, in our vision, of the role for the future architect.

DELIMITATIONS

This thesis will be limited to specifically focus on the transformations of unused concrete silos in Sweden, focusing on the silo in Ronehamn. While findings may be relevant to other types of large-scale concrete structures, these are not included in the scope of the investigation. All design decisions are rooted and limited to the Swedish context. International examples are referenced for inspiration and comparison, but the analysis of transformation barriers and design strategies will be grounded in Swedish planning regulations, construction practices, and cultural conditions. Furthermore, the project does not aim to deliver a fully detailed construction proposal, cost estimate or legal property assessments, but it will be considered to the extent that they inform the architectural concept, possibility and strategic framework.

There are risks involved with transforming buildings' functions and structures that have to be presented when analysing the feasibility of transformation projects. In this case, there is a risk in changing an industrial building used for food storage into a function that renders it irreversible for that purpose. Although this risk exists, it is not considered in this thesis since the structure in any case needs extensive renovation if it is to return to its initial function, and there has therefore been no need for this function since 2007.

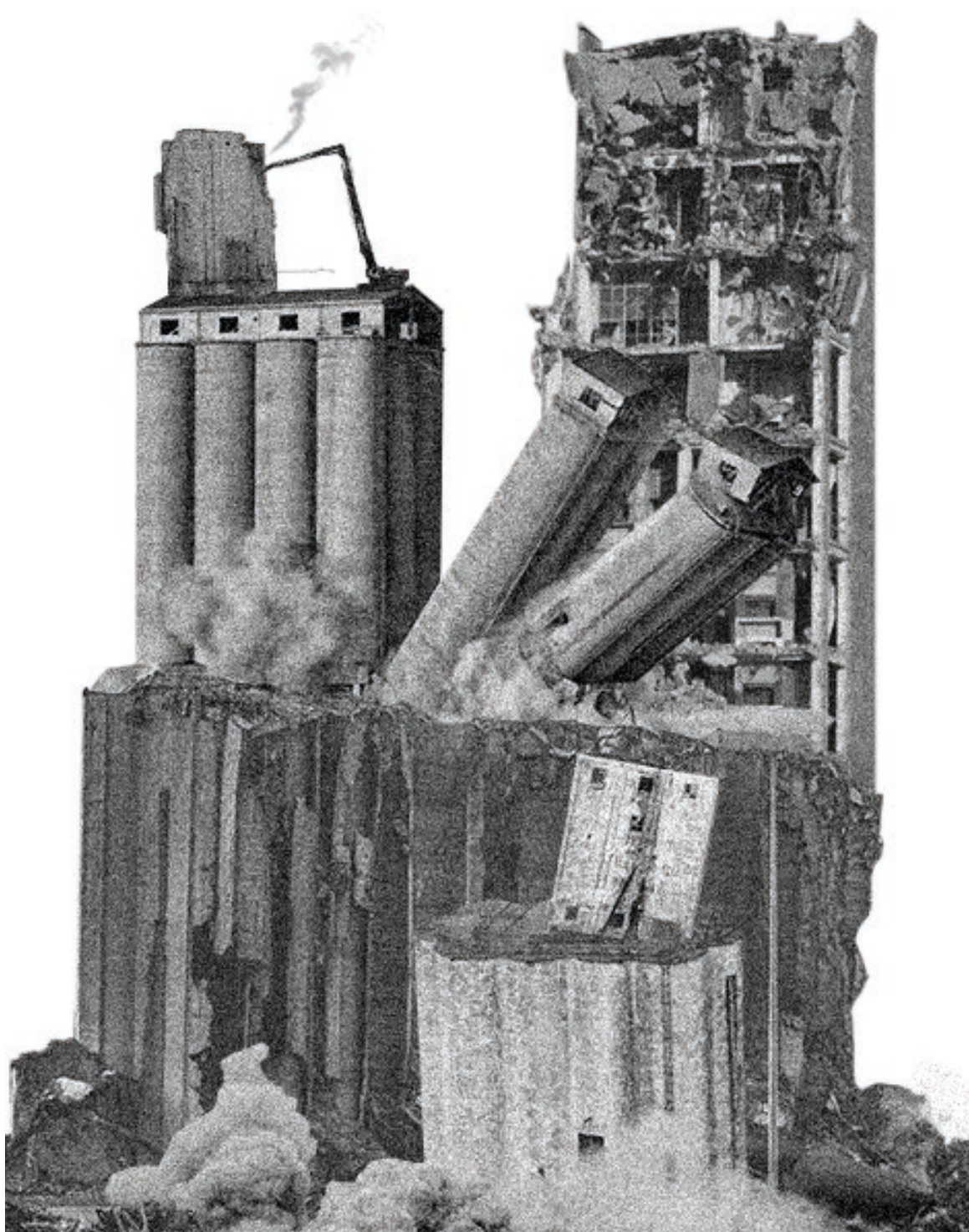


Figure 3 (Collage). Silos in demolition. References in figure list.

THEORY

The following theories and terminologies provide the academic and theoretical framework for this thesis. Some of these terms can vary within the field of architecture. Therefore, we present them and their meaning in this thesis below to avoid interpretive divergences.

ADAPTIVE REUSE + SUSTAINABILITY

The background for this thesis project, as described earlier, is to present a possible way to utilise an empty and vacant building. Reimagination of this building is achieved through transformation, informed by the theory of adaptive reuse.

According to Plevoets and Cleempoel (2019), the terminology of adaptive reuse has emerged from a historical practice of restoration, adaptation and conservation of antique and medieval buildings. At that time, these practices were carried out through obvious and spontaneous processes driven by economic and practical considerations. They explain adaptive reuse as a theory and practice that involves a built structure's change in both function and physical aspects, possibly radical or subtle.

Transforming buildings through adaptive reuse can prolong a building's lifetime, reduce the amount of construction waste and avoid parts of the environmental footprint associated with new construction and building development. Concluded, these practices correlate with responsible resource management by

minimising waste. Apart from the ecological benefits, this practice helps to maintain cultural identity and revitalises communities by giving new purpose and value to obsolete vacant architecture. Through the act of keeping and transforming a building instead of demolishing it, it enhances cultural heritage and its continuity through the act of saving historic and social narratives created in a building's physical presence, which promotes its identity and sense of belonging. (Mehan, 2025)

Further, according to Aigwi et al. (2023), applying the strategies of adaptive reuse on existing, underutilised buildings contributes substantially to achieving sustainability within the built environment. Adaptive reuse demonstrates how existing built resources can be sustainably transformed, managed, and developed without the need for total demolition or disposal.

The silo in Ronehamn is a local landmark and has shaped the identity of the surrounding area. Nevertheless, as it currently reminds the viewer of the past, it sparks engagement for locals to bring it back to life instead of leaving it unused. Transforming this building through adaptive reuse practices can provide that positive aspirational change. And eventually, our project can contribute to the field of adaptive reuse and how it can promote a sustainable architecture practice in terms of caretaking, preservation and utilisation of our industrial heritage in a rural context in Sweden.

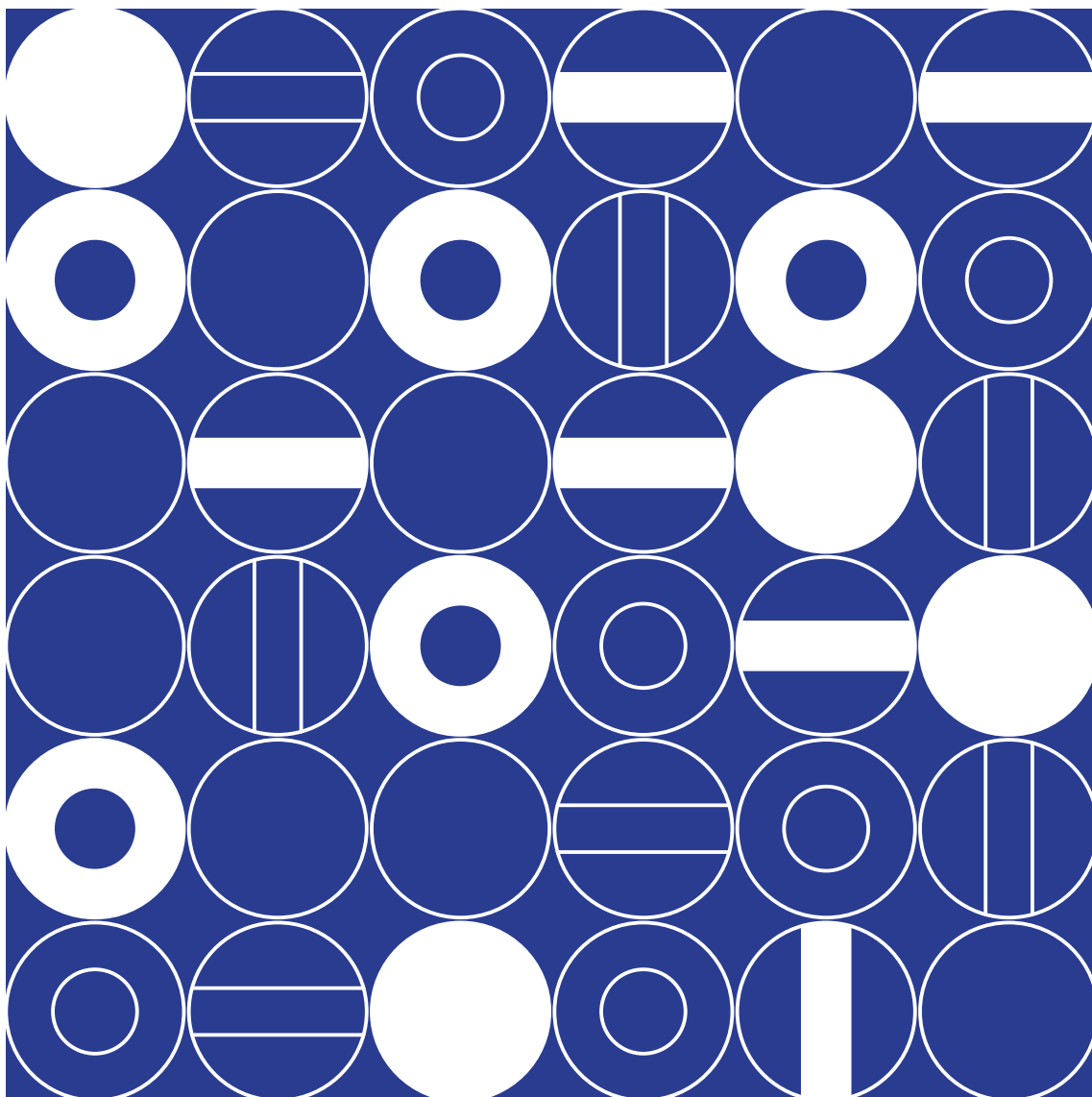


Figure 4. Geometric concept.



**REFUSE.
RETHINK.
RECYCLE.
REDUCE.
REUSE.
REPAIR.
REFURBISH.
REMANUFACTURE.
REPURPOSE.**

Figure 5. Concept of circular economy.

GENIUS LOCI

This terminology describes the perceived spatial identity of a space and environment, often enriching the authenticity through historical or cultural values. Genius loci could be used to enhance and argue for the importance of adaptive reuse and transformation of built structures instead of demolition. (Plevoets & Cleempoel, 2019)

Keeping the terminology of genius loci in mind in the design and material choices, as well as in the creation of a contextually appropriate program for the silo, was crucial in developing a relevant proposal in this project due to the dominant spatial and emotional position in Ronehamn's otherwise small-scale typography.

AEMULATIO

One design strategy within the concept of adaptive reuse is aemulatio. Plevoets and Cleempoel (2019) describe it as a design strategy where old and new parts are visually divided. The reasoning behind the strategy is to honour and respect the history through, with a clear, comprehensible explanation for the viewer to observe old and new, and their combined composition.

Using this design strategy is a natural part of our design and material choices since one aim is to enhance the concrete structure's existing

visual presence and its created tangibility and roughness. Separating new parts from the existing, mostly with other materials, is one of our ways to honour the existing.

9 R'S OF REUSE

A concept within circular economy where nine actions starting with the letter R form a guiding hierarchy to reduce resource consumption, mitigate climate impact, and extend the lifespan of buildings. The nine R's, which encourage reuse instead of demolition and new construction, include: Refuse, Rethink, Reduce, Reuse, Repair, Refurbish, Remanufacture, Repurpose, and Recycle (Rahla, Mateus, & Bragança, 2021).

To adapt the model to our project, we will focus on five of the R's. Refuse, as in avoiding demolition. Rethink, as in reevaluate the building's function and potential. Reduce, as in minimise the need for new resources through strategic design. Reuse, as in finding new solutions with existing building elements. And repurpose, as in assign the building a new function and use. This theory creates awareness of our choices through the project, both design-wise and programmatically. It has motivated us to make our choices with as little impact as possible, within the framework of a sustainable and relevant building transformation, extending the building's usable lifetime.

METHODS + TOOLS

This thesis is conducted with methods and tools learned throughout earlier architecture studies. For us, these methods create a basis to conduct design proposals and can be used and applied to all types of architectural projects.

INTERVIEWS + DISCUSSIONS

Through discussions and interviews with different experts in fields such as adaptive reuse, building technology, and stakeholders within the context of Ronehamn, a knowledge base has informed us about the practical transformation process in Sweden and a possible program for the silo in our project. The learnings were integrated into the proposal to showcase possibilities for the local community and the feasibility of transforming silos.

SITE VISITS

The site visits were a crucial part early on in our process to create an inventory of the built structure and its surrounding typology. It developed a comprehensive understanding of the site-specific conditions to see what the project can or cannot contribute to. As well as an updated understanding of tangible and physical values, limitations and status through observation, photographing and experiencing existing spaces and volumes.

LITERATURE STUDIES

Researching and finding design approaches, strategies and concepts through literature has been crucial to provide a theoretical framework and knowledge about the current state, discussions, problems and success factors regarding adaptive reuse projects. Most of these studies were conducted in the early work, but since our theories, methods,

and strategic frameworks have been adjusted throughout the thesis, literature studies have continued to a lesser extent even later on.

DRAWINGS

One starting point for this project was receiving and redrawing the physical original drawings into a digital format. New and old plans, sections, perspectives and details have been drawn by hand, digitally and combined to provide a tangible, technical and aesthetic understanding of the architectural proposal throughout the whole process and its design iterations.

DIGITAL MODELS

Visualisations and 3D models have been created to gather a dimensional understanding of the spaces and forms. Also, allowing us to run simulated tests against our design. Our building is in a section complex, and this tool has been highly helpful in understanding this complex structure and finding appropriate design solutions.

CASE STUDIES

During the first part of our thesis, we looked into a wide range of different transformation projects. They have been analysed to offer an understanding and inspiration of solutions, interventions and design strategies for our project.

MODEL BUILDING

We have built models of the landscape and the building. This method, carried out in varying scales, provides reasonable fast physical and tangible understanding of scale and form for a viewer and for ourselves. Additionally, models have been used as a tool for design iterations along with conventional drawings.

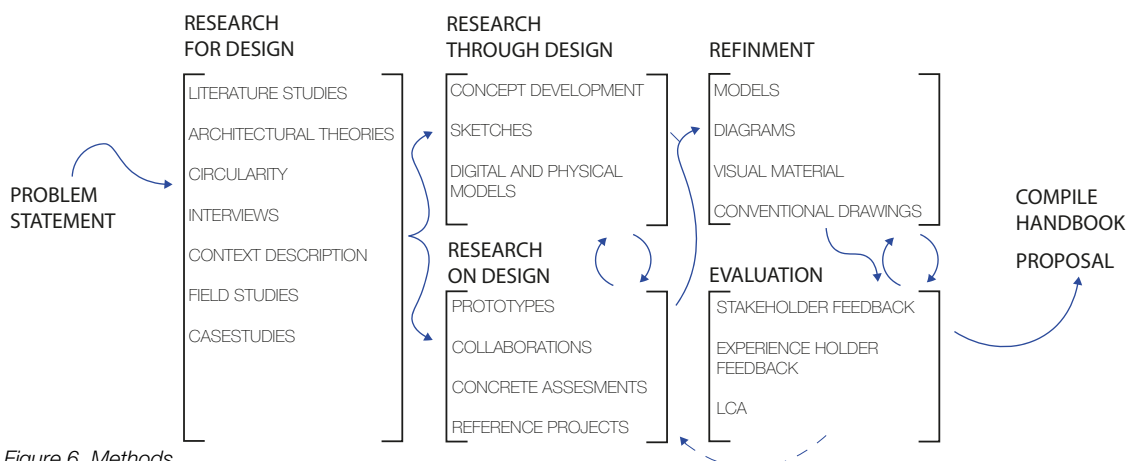


Figure 6. Methods.



Figure 7. Handbook.

HANDBOOK

As a methodological tool to compile our gained knowledge, a guiding handbook for future silo transformations is created, informed by the interviews and discussions. The handbook is designed to give insights from both theory and practice, serving as a framework for understanding the complex topics that will be touched upon in the process of transforming a silo. Combined with the knowledge gained through academic research and practical experience through interviews with architects,

structural engineers, reuse specialists and property managers with experience from previous transformation projects. The book identifies key lessons learned throughout the project, as well as challenges, and possible strategic approaches when transforming concrete silos. It is organised into thematic chapters, each offering guiding principles, examples and reflections from people with experience within the topic, combined with our personal learnings from this project.

KUNSTSILO

location:	Kristiansand, Norway
architect:	Mestres Wåge Architectes + MX_SI Architectural studio
year:	1930s(2024)
size:	10 300 sqm
function:	public art gallery

Kunstsilo in Kristiansand demonstrates how an existing silo structure can be transformed into a public and cultural space without losing its original industrial character. By preserving the silo's functional design, structural logic, raw materiality, and its vertical expression, the project creates spatial experiences that are difficult to replicate in new construction. The way large volumes are carved out through strategic openings and subtractions in the concrete is particularly inspiring. An example is the Silosalen, where daylight enters through the tops of the silo cells and filters down into the vertical space extracted from the heart of the silobattery. (Architectural Heritage Intervention - Archive - Kunstsilo, n.d.)

Kunstsilo shares a very similar volumetric expression with the silo in Ronehamn and is likewise positioned close to the water. This parallel in both form and context makes it a highly relevant reference for our project, showing how industrial heritage can be reimagined as a public space while retaining its presence.



Figure 8. Kunstsilo silosalen. (Mestres Wåge /BAX/ Mendoza Partida, 2024). Used with permission.

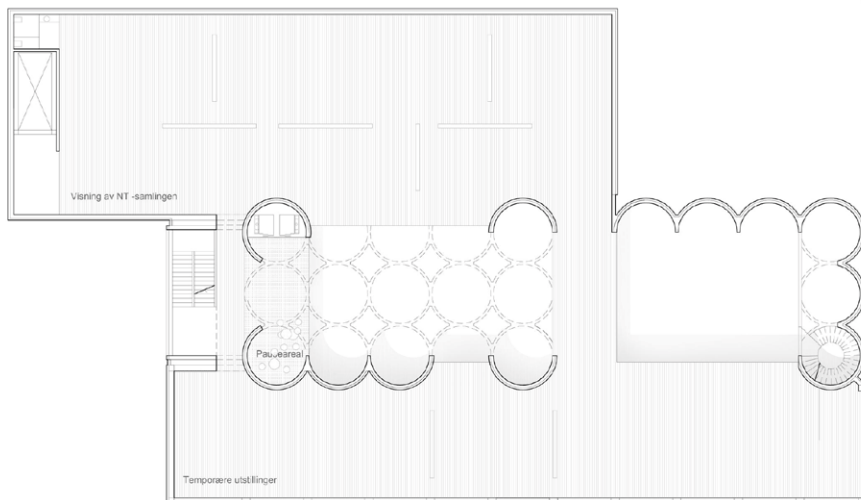


Figure 9. Kunstsilo floor 2, (Mestres Wåge /BAX/Mendoza Partida, 2024). Used with permission.

SILO-TOP

location: Guangzhou, China
 architect: O-office Architects
 year: 1960s (2013)
 size: 621 sqm
 function: office

The project Silo-top demonstrates how a reinforced concrete structure can be transformed into a new function to prolong its lifetime. The building is a former silo for a beer factory and rises 38 meters beside the Pearl River in the city of Guangzhou. Now, 50 years later, it is repurposed as an office for O-OFFICE Architects. Only the upper rectangular volume is transformed, which shows that transformations can be successful through partial conversion. On the downside, one might posit that the structure is underutilised. But partly used is still more used than not at all. The design language is clearly defined through the raw texture of concrete, glass and steel, creating an atmosphere resembling the industrial roughness of the built silo structure. (Team, 2023)

The idea of partial conversion can reduce the temporary financial strain. Which, for the silo in Ronehamn, could be a possible way towards an actual transformation since it raises its feasibility.

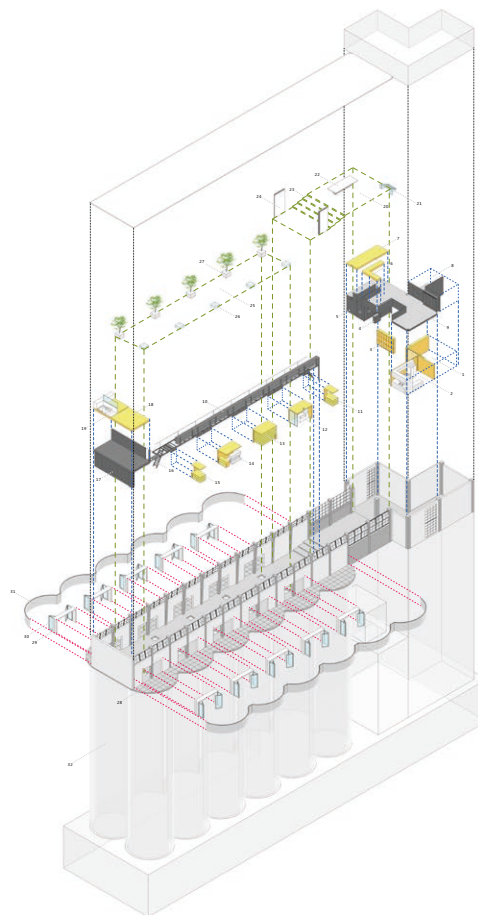


Figure 10. New intervention. (O-office Architects, 2016). Used with permission.

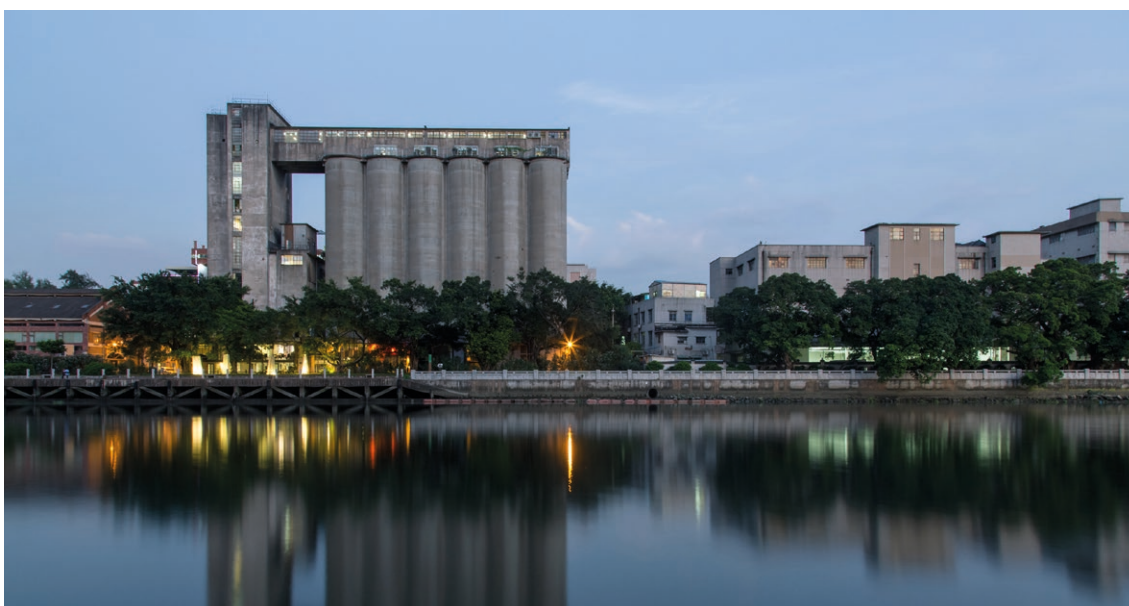


Figure 11. Silo-top outside perspective. (LIKYFOTO, 2014). Used with permission.

PROJECT

This project aims to transform the grain silo in the harbour of Ronehamn into a facility that nourishes the surrounding area, acting as a landmark with functions accessible to use by both locals and tourists.

HISTORY OF SILOS

Silos emerged as a response to the industrialisation of agriculture. Farmers needed a more efficient way to store, dry and process their harvested grain. In the United States, large concrete silos began appearing around 1900, replacing earlier structures made of wood, metal, or brick. This new typology quickly spread to Europe, influencing both engineering and architectural thinking. The first concrete silos in Sweden were built in the 1910s in Malmö and Gothenburg. They soon became symbols of modernity and functionalist design ideals. (Borg et al., 2013)

During the mid-20th century, between the 1950s and 1970s, Sweden saw a boom in silo construction. These tall, cylindrical structures, often reaching 50-60 meters, became a prominent feature in the landscape, earning the nickname "slättens skyskrapa". Their placement near railways and ports reflected their logistical role in the national economy and their importance in infrastructure. The silos in Sweden were usually built by agricultural cooperatives and bigger associations like Lantmännen. Slowly, the silos were refined not only as storage facilities but also as complex machines that cleaned, dried and distributed grain. Despite that, many of these silos became obsolete due to changes in farming practices. Today, many stand unused,

and their future is uncertain. Some have been demolished, and a few, in Sweden, have been repurposed into a new function. (Carlquist et al., 2006)

On Gotland, the agricultural landscape is distinct. A network of silos was built and typically managed by Lantmännen. The island's silos were strategically placed near harbours to facilitate export and distribution. One of those silos is the one in Ronehamn. This was built by Lantmännen in 1971 to prevent a local entrepreneur's business proposal to sell, store, and distribute grain from the surrounding area on their own. The reason for its construction and placement was accordingly, from the beginning, not set to make a profit, but to keep territory. Located by the harbour in southern Gotland, it served as a reception and storage point for grain from nearby farms, later exported to Poland and Germany (Dahlberg, 2012). The silo is a landmark in the local landscape of southern Gotland. Though no longer in active use, it remains a powerful symbol of the region's past. Its future, like many silos across Sweden, raises a discussion about preservation, reuse and the cultural significance of built heritage. Can it be reused, reimagined, or simply remembered? Its value lies not only in its form but in the collective memory it holds. Though the silo now stands silent, its presence still resonates deeply with the landscape and offers identity and orientation. It carries a symbolic weight as a marker of a past shaped by cooperation, production, and history. Its future invites us to ask: what can we do with it now?



Figure 12. Wheat field.

THE STORY OF RONEHAMN

Ronehamn is a village in the parish of Rone in the southern part of Gotland, an island located in the Baltic Sea. Historically, the small village has progressed from serving as a small local harbour of Rone, then known as Ronevik, to a large commercial hub in the 1900th century. It was used for trading and transporting fish and agricultural products, but also for immigration and emigration from and to the mainland. Around the 1950s, the harbour and roads in Ronehamn were developed and modernised, and it became a society of welfare. Approximately 20 years later, the harbour was further developed, and the grain silo was built on a constructed harbour. The proximity to the coastline and sea has strongly characterised this small village, its history and its role along the east coast of Gotland. (Dahlberg, 2012)

”The proximity to the coastline and sea has strongly characterised this small village, its history and its role along the east coast of Gotland.”



Figure 13. Ägare:/1974-78/: Lars-Åke Hartzell. Hemort: Ronehamn, (Löfstedt, N.d).
CC BY-SA 4.0

SITE DESCRIPTION

Today, the 54m high massive concrete grain silo stands in the harbour, the heart of Ronehamn. The area is still characterised by its coastal environment and the functions it supports, nowadays mainly leisure boats and some marine activities. The fish industry closed in 2023 due to increased electricity prices and the loss of customers, as well as a significant contraction in the fish stock (Engström, 2023). The facilities of the industry and the grain silo were sold in the summer of 2025, and the old fishing industry building has been transformed into a crisps factory (Radio, 2025). Oliver Lundberg, the new owner of the silo, also owns the warehouse next to the silo and the old fish factory. In these, potatoes are stored, chips are produced, but a plan for the silo is not yet set.

For the parish of Rone, the main event is the yearly Kubb VM, a traditional Swedish lawn game where a couple of hundred people from all around the world come to play and compete (Om Kubb-VM – KUBB-VM, n.d.). South of the village lies Ålarve nature reserve, where there is a longer accessible walking route. The parish of Rone has approximately 400 inhabitants (SCB Statistiskdatabasen, n.d.), and Ronehamn has fewer than 85 (A. Pettersson, personal communication, 2 October 2025).

The harbour is mainly used as a dock for leisure boats and by a few fishermen. There are two remaining nearby historical fishing settlements as well as a variety of ancient remains from different periods, including the Bronze and Iron Ages (Ronehamns Båtklubb, n.d.).

The regional housing market analysis, published by Gotlands Länsstyrelse, written by Jacobsson & Sander (2025), mentions some of the challenges in the housing market. The motivation for the analysis is to be able to strategically work against the difficulties to improve opportunities and

conditions for residents on Gotland. Today, there is a substantial seasonal disparity in the population, since it doubles during the summer season. The island is popular for holiday home buyers, which increases the pressure on the market for specific objects and pushes up the housing prices, which are among the highest in Sweden. This creates a difficult situation and shortage in housing for economically marginalised groups like young people, students, new arrivals, the elderly and people with disabilities. Simultaneously, there is a challenge in a declining population, which generally makes it crucial to strengthen factors that increase the attractiveness of moving to Gotland. It is therefore important to find solutions that create an attractive housing market while providing a framework for the tourism industry, to enable their sustainable coexistence. (Jacobsson & Sander, 2025)

10-MINUTE CAR RADIUS

Hemse
Groceries
Kindergarden
Elementary school, 1st-9th grade
Restaurants
Retail - books, clothing, paint, second-hand, construction supplies, car repair
Bakery
Boat dock
Sports facility & ice rink
Healthcare center
Archaeological remains
Protected nature area
Beach
Coastal fishing site

60-MINUTE CAR RADIUS

Visby
Hospital
Airport
Ferry to the mainland
Highschool
University
All types of shops & stores
All types of companies & services



HOTEL

RONEHAMN
85 INHA.

HUS
FISHING VILLAGE

CRISPS
FACTORY

POTATO
STORAGE

GUEST
HARBOUR

PUB

CAMPING +
BEACH

HARBOUR
ACTIVITY

← SILO

YTTERHOLMEN

ÅLARVE
NATURE RESERVE

VISBY

ROMA

HEMSE

✗ RONEHAMN

0 100 200 500m



SITE DIAGRAM

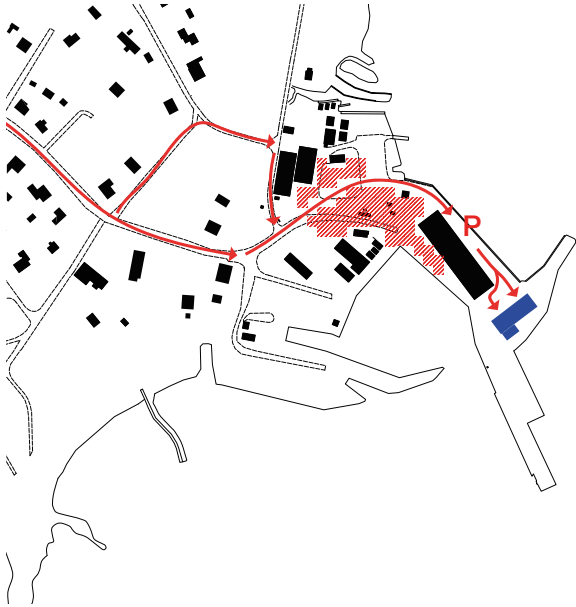


Figure 15. Red arrows indicates access to site, red area indicates dock activity.



Figure 16. Existing view of new entrance.

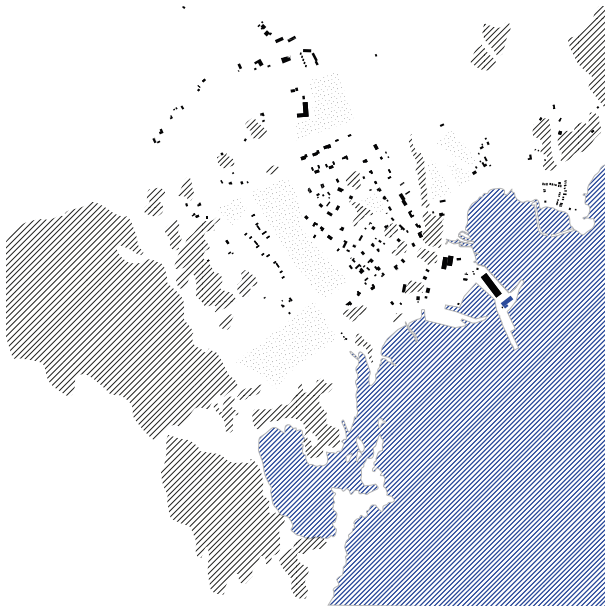


Figure 17. Blue indicates of water, black lines indicate greenery and dotted area indicates cropland.



Figure 18. Exterior view, south beach point.

SITE SEQUENCE



Figure 19. Sequence photograph from distance 2 km.



Figure 20. Sequence photograph from distance 1,3 km.



Figure 21. Sequence photograph from distance 350 m.

The silo is a prominent feature in the landscape around Ronehamn due to Gotland's flat topography and its outstanding height compared with other buildings, which mainly consist of cottages and villas. The silo is visible from a far distance, reachable by car and by boat from the sea. This has been considered while making decisions on the material's colour palette for the outside material cladding. We suggest a natural colour palette for the exterior since it is already a prominent object in surrounding views, which could resemble the existing weathered concrete. Landmarks such as the silo play an important role in shaping collective identity and cultural memory. They act as physical reminders of local history, connecting present-day communities to past industries, activities, and ways of life. Beyond their practical function as points of orientation, landmarks contribute to a sense of belonging and continuity within the landscape.

STAKEHOLDERS

To ground our project in the actual needs of Ronehamn, we use an influence - interest matrix. It helps to identify and understand which stakeholders have influence over the project and which ones are affected by it. By mapping influence and interest, we can make decisions that are rooted in the local context, informed by people living and having a strong relationship to the site, and responsive to those directly impacted.



REGION GOTLAND

Through walking around in Ronehamn and having conversations with residents and people connected to the silo and harbour, two key conclusions emerged. First, there is a lack of smaller apartments for older residents wishing to downsize while remaining in the parish (Jacobsson & Sander, 2025). Second, there is a shared ambition to make Ronehamn a more active and public destination beyond the summer season (A. Pettersson, personal communication, 2 October 2025).

Many groups are connected to the project, from residents and tourists to developers and visitors attending the Kubb World Championship. However, the project primarily focuses on stakeholders with the strongest interest and influence on the site: the property owner Oliver Lundberg and his vision, Ronehamn's development company and their idea of Ronehamn's future, tourists, and senior residents wishing to remain in the area.

↑ INFLUENCE



LANTMÄNNEN



FISHERMEN



LOCAL KIDS

LESS INFLUENCE

LESS INTEREST →



TOURISTS



OWNER



REALESTATE
DEVELOPER



SENIOR CITIZENS



RONEHAMNS
UTVECKLINGSBOLAG



KUBB PLAYERS

INTEREST

MORE INTEREST

Figure 22. Influence-interest matrix. Skalgubbar: (Javanaud Emdén, 2025).

BUILDING INVENTORY



Figure 23. Exterior view, north fishing point.



Figure 24. Exterior view, south beach point.



Figure 25. View on west facade.



Figure 26. Roof.

EXISTING FACADES

The existing facades are characterised by rough, weathered concrete, giving the silo a monolithic and almost monumental presence. Rising high above the surrounding landscape, the structure overlooks the harbour area with a strong industrial expression. Details such as doors, windows, and later additions are, to some extent, worn and vandalised, reinforcing the feeling of an abandoned structure no longer in use.

The facades reveal the silos' former industrial function. Many of the openings are not windows, but air intakes once used to dry or clean the grain stored within the silo. Pipes and ventilation elements extend across the

facades, creating layered and sometimes unexpected compositions that strengthen the impression of the building as a machine rather than a conventional building. The existing window patterns form distinct vertical fields across the facades. Their vertical proportions create an upward-stretched expression that resonates with the silos' tall volumes within the landscape. In contrast, the rounded silo batteries remain almost entirely closed, clearly expressing where the grain storage once took place. Along the northern facade, an added extension forms the only actively used part of the structure today, functioning as storage for equipment, boats and cars.

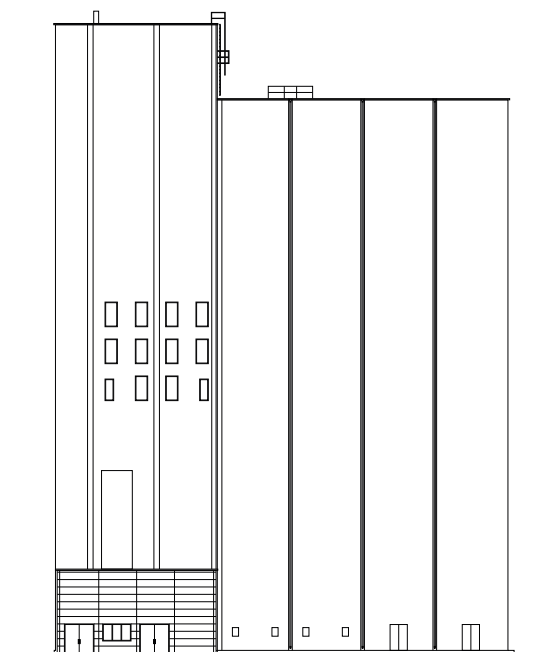


Figure 27a. Drawing of existing south facade.

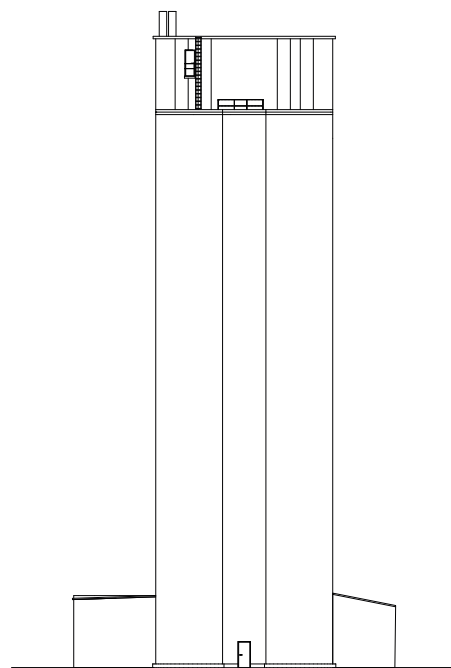


Figure 27b. Drawing of existing east facade.



Figure 28. Photograph of south facade.



Figure 29. Photograph of north facade.



Figure 30. Photographs of west facade.



Figure 31. Photograph of east facade.

INTERIOR INVENTORY

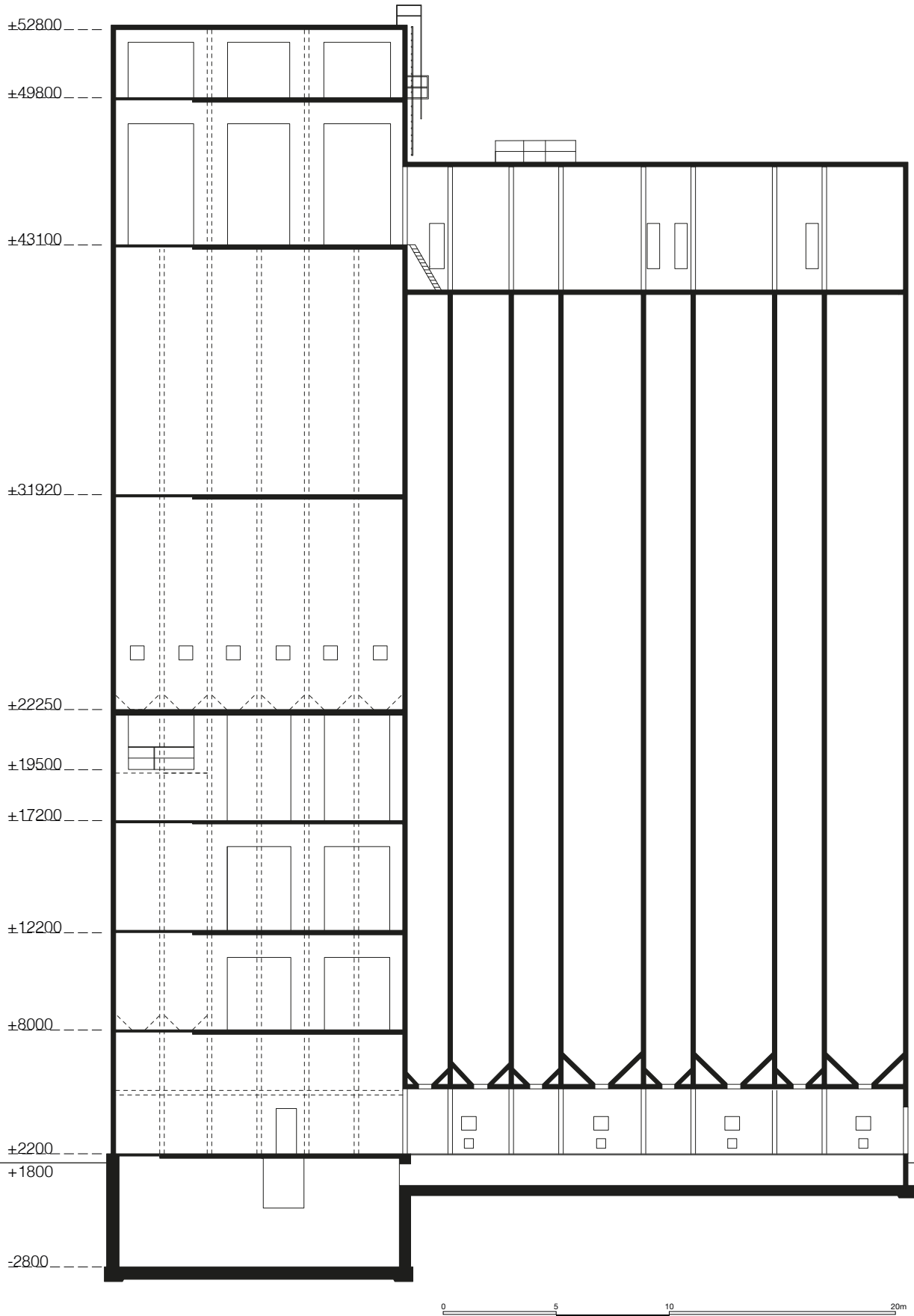


Figure 32. Digitilised original drawing, sektion A-A, scale 1:250.

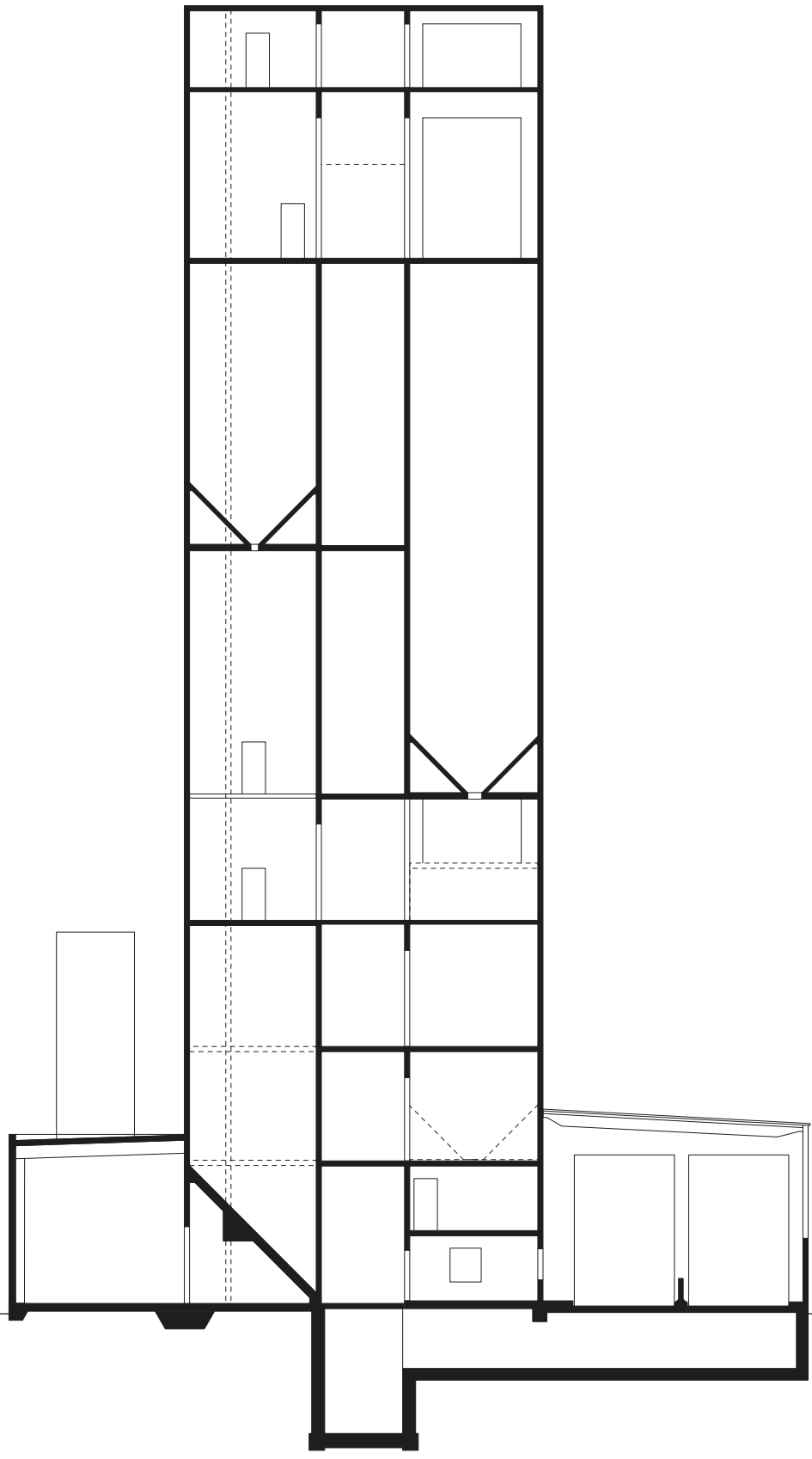
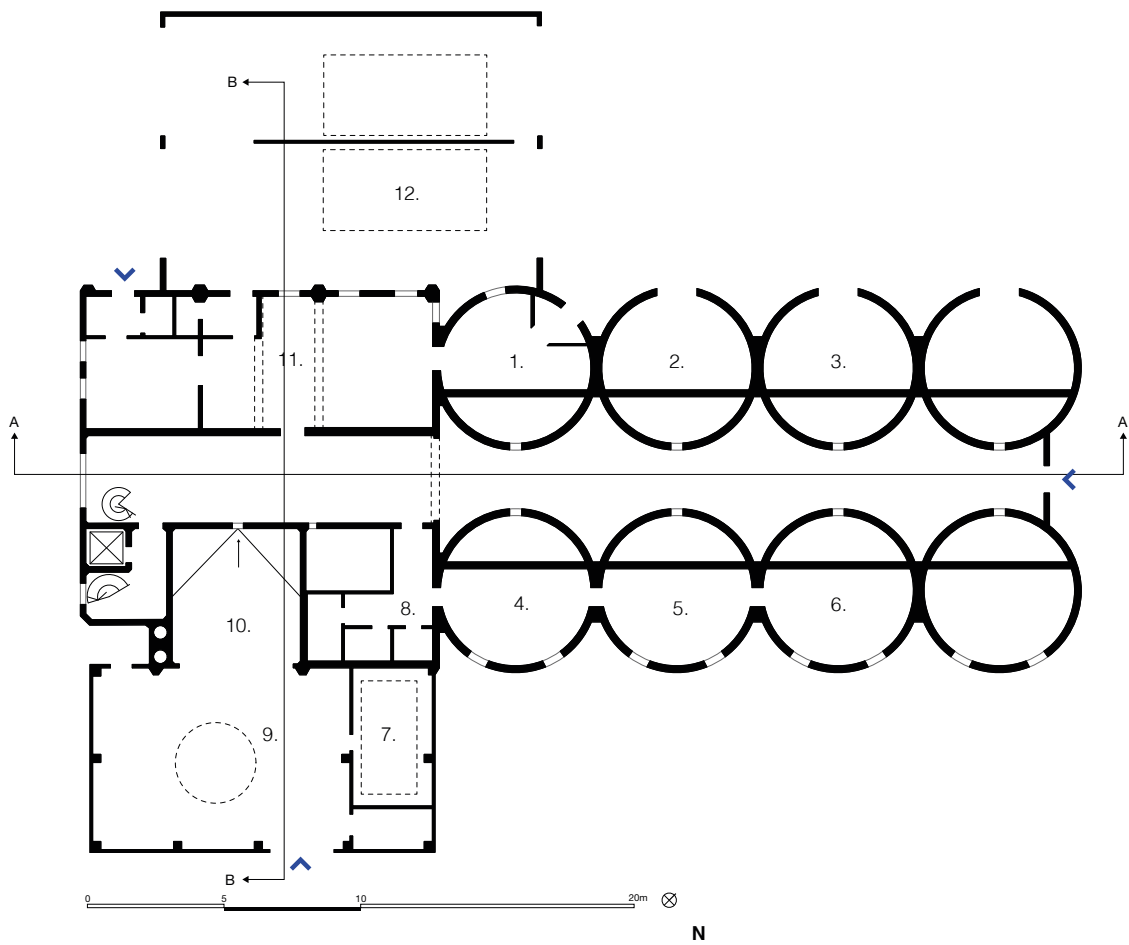


Figure 33. Digitilised original drawing, sektion B-B, scale 1:250.



1. laboratory
2. low-voltage control room
3. high voltage control room
4. storage room
5. laundry & changing room
6. canteen
7. oil tank
8. wc
9. boiler room
10. pump room
11. control center
12. loading pocket
13. grain storage in all cylinders

Figure 34. Digitilised original drawing, entrance floorplan, scale 1:250.

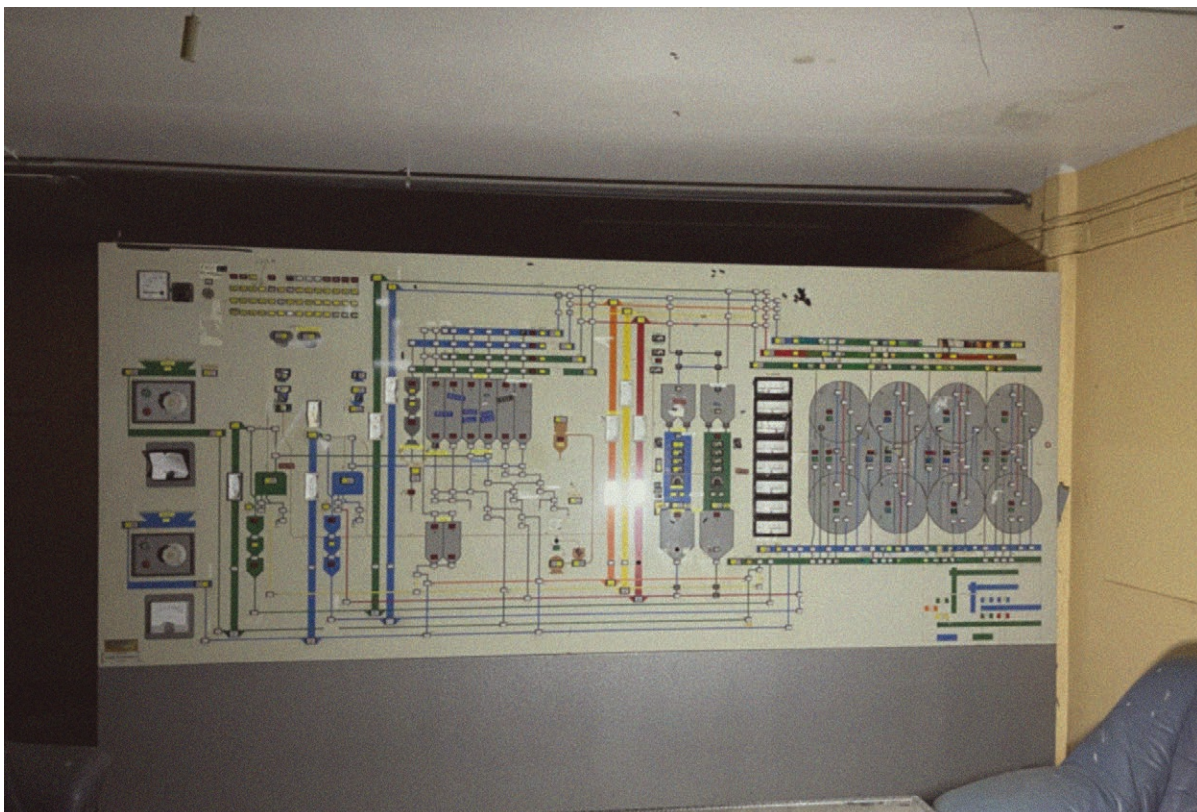


Figure 35. Interior photograph, grain control panel.



Figure 36. Interior photograph, corridor windows.



Figure 37. Interior photograph, mezzanine.

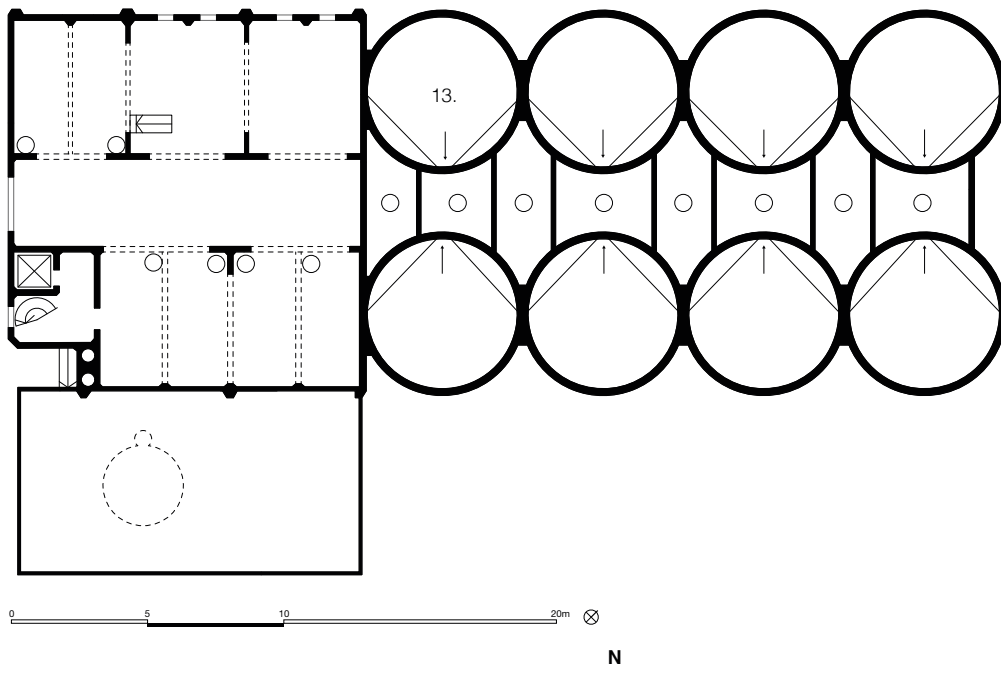


Figure 38. Digitilised original drawing, +13.000m floorplan, scale 1:250.



Figure 39. Interior photograph, center corridor.



Figure 40. Interior photograph, machinery.



Figure 41. Interior photograph, existing light intake.

PROGRAM

The departure point of a space program for the Ronehamn silo is formed by the site description and the theoretical framework. The context of Gotland and Ronehamn is strongly influenced by the seasonal division, its tourism in relation to the local challenges and opportunities.

The proposed functions should create attractive housing solutions for senior and young adults, enhance local and public benefit, while providing a space for tourists and locals to enjoy Gotland's southeast coast from a new perspective. The balance between tourism and housing is shaped by a mixed-use that provides long-term sustainable adaptation to the current situation's needs. The framework is outlined by the theoretical approach of the 9 R's, using local resources most effectively, providing functions that counteract local difficulties, while having the concrete structures' potential as a physical limitation for technical solutions and architectural opportunities.

The architectural challenge lies in creating inviting spaces that feel welcoming, spark curiosity, while revealing industrial character, history and making use of the inherent spatial qualities of a silo, characterised by vertically oriented spaces.

The program is informed by interviews with stakeholders and research into local needs and relevance. It is divided into two main parts, a public destination and residential housing.

The public section consists of an exhibition hall of approximately 880 m² distributed across three levels. Visitors are invited to experience the silos' unique spatial qualities by moving through and up within the former storage cylinders. The spaces are designed to be flexible and multifunctional for future demands, but also for temporary exhibitions, performances, concerts, and events to take place within the silo hall, where audiences can spread vertically throughout the structure and view activities through openings in the silo batteries. A key ambition is to establish the silo as a year-round destination. In addition to the exhibition spaces, the program therefore includes a restaurant, 105 m², and three overnight apartments for visitors, creating reasons to visit beyond the summer season.

The second major component of the program is housing. The proposal includes 20 apartments ranging from 30 m² to 70 m², together with shared social spaces and a communal south-facing terrace. The housing responds particularly to the need for smaller apartments for seniors wishing to downsize while remaining within the parish.

SPECIFICATIONS:

Existing floor area:	2300 m ²
Area after added floors:	3150 m ²
Exhibition area:	730 m ²

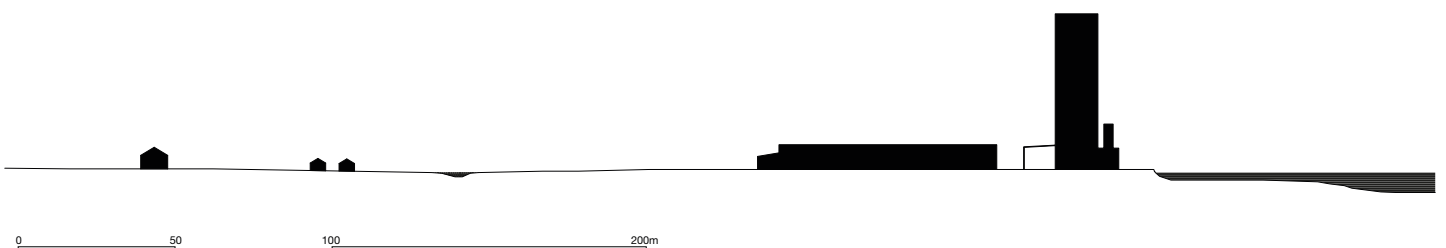
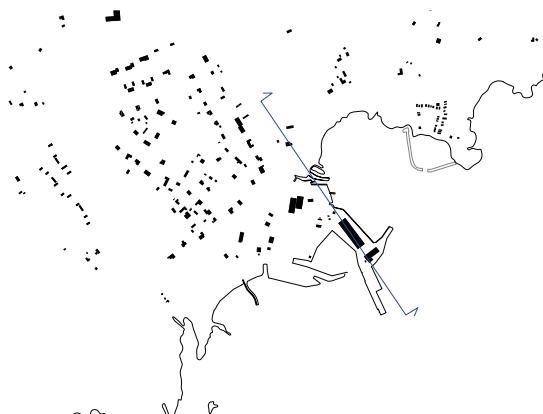
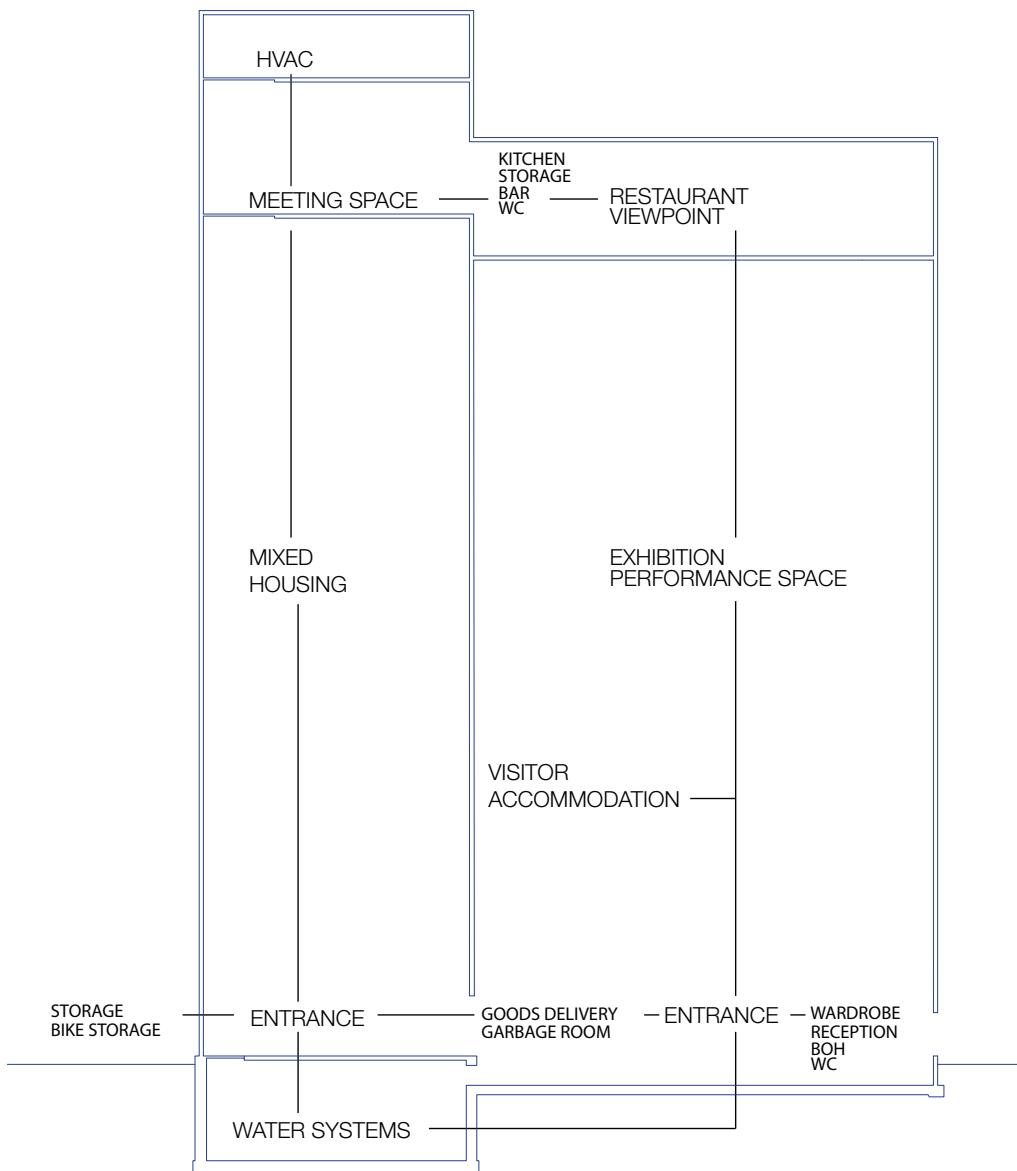


Figure 42. Landscape section, scale 1:2500.



PUBLIC BENEFIT:

Function- restaurant, bar, viewpoint, exhibition
 Target group - locals, tourists, all

ATTRACTIVE ALL-YEAR-ROUND HOUSING:

Function - rental apartments in different sizes
 Target group - young adults, seniors

RENTABLE SPACE:

Function - meetings, bookable space, events,
 visitor accommodation
 Target group - companies, local associations,
 tourists

Figure 43.(Upper) Draft of program diagram, Figure 44.(Lower) Schwarzplan.

HANDBOOK WITH IDENTIFIED KEY LESSONS OF SILO TRANSFORMATIONS

This part of the thesis identifies key lessons and learning outcomes from different discussions, interviews and research done throughout the project and gathers them in a handbook for silo transformations. The scope and manner of conducting interviews and discussions have varied greatly depending on the people we have spoken to. This has involved different numbers of meetings and different formats, such as team meetings, in-person meetings, and telephone meetings. The handbook in its entirety can be found in Appendix A with a description and points to consider under the following headings: inventory, the concrete, context + programming, inherent geometrical values, HVAC, exterior layers, load bearing structure, added joists + slabs, fire, economy, and regulations. The learnings have been incorporated into the following proposal.

The following bullet lists are points called points to consider. These points belong to each heading and are summarised as the most important parts to examine if you should transform a silo according to our research. The full evaluation is included with the handbook in Appendix A.



Figure 7. Handbook.

INVENTORY

- + have access to the inside of the silo
- + compile existing material of the silo (drawings, investigations, history, etc.)
- + investigate the silo through photos, initial thoughts, and physical measurements
- + conduct a site analysis

THE CONCRETE

- + conduct a detailed condition assessment of the reinforced concrete structure
- + verify the reinforcement layout, for example, by using ground penetrating radar or other suitable non-destructive techniques
- + investigate whether the structure has been properly maintained and identify any signs of deterioration (cracking)
- + assess carbonation depth and chloride + ingress testing, especially since the silo is located close to the sea
- + evaluate the current load-bearing capacity in relation to the proposed new use
- + establish a maintenance plan to ensure long-term durability after transformation

INHERENT GEOMETRICAL VALUES

- + look out for symmetrical axes
- + look out for unique volumes, which can be accessed through the transformation

CONTEXT + PROGRAMMING

- + keep the site analysis in mind
- + rural placement- consider thorough analyses of the context to propose a function or a multifunctional program that enhances the area
- + urban placement - consider analyses but in general could housing, offices and public functions, separately or multifunctional be successful
- + be aware of the change of function and its possibility of gentrification

LOAD-BEARING STRUCTURE

- + minimise the number of new openings
- + reinforce new openings to redirect loads around them
- + align new openings with existing openings whenever possible
- + identify efficient load paths with the help of a structural engineer early in the design process

EXTERIOR LAYERS

- + if insulated, insulation is to be put on the outside, covered with a sheet material, both for thermal reasons, and to protect the concrete structure from further degradation and weathering
- + scaffolding will be required when the exterior layer is being installed

HVAC

- + investigate existing HVAC systems
- + investigate dimensions of existing electrical connections, water and sewage pipes
- + investigate the size of the needed room HVAC systems and check it against the size of the cellar and the top floor (cellar for water + sewage, top floor for air handling and heat recovery units)
- + when planning floors, provide generously with space for piping for water, sewage and ventilation
- + research the potential to reuse grey water and rainwater as water flushing solutions

ADDED JOISTS + SLABS

- + the concrete structure is structurally strong enough to withstand the load of the added elements

FIRE

- + involve a fire safety engineer when doing the space program and planning vertical connections
- + reduce large vertical open rooms to avoid having a strong stack effect in case of fire

ECONOMY

- + important to have the right investor and developer
- + concept, location, the proposed program, and the target group are important factors for its success
- + if the project is divided into different phases, it may be more economically feasible
- + be aware of the economic risk

REGULATIONS

- + investigate the opportunities in the detailed development plans for the location of transformation
- + establish early contact and dialogue with regulatory and decision-making bodies within the municipal planning and building processor
- + look into the local municipality's general plan to identify arguments that support your project that align with the municipality's vision

CONCEPT

Already today, the silo of Ronhamn accommodates qualities, views and perspectives beyond the ordinary in its surrounding proximity. Nevertheless, these unique qualities have not been utilised in the last 20 years in any way.

The concept of this proposal is to bring the silo back to life, not to its initial use, but to something unique, accessible for both locals and tourists. The silo is meant to become a home for locals with extraordinary architecture and views, without compromising closeness to the local context. Simultaneously, it

can, through its special qualities, create an attractive destination for external visitors. The main motivation behind the concept is to enhance and create further identity and utilisation of the existing. That includes working with existing materials and forms, how orthogonal forms meet circular and how these qualities can be enhanced and experienced by a broader crowd.

Always asking what the structure could house to be utilised to a larger extent, while creating a sustainable long-term destination with a possibility to adapt to future uses.

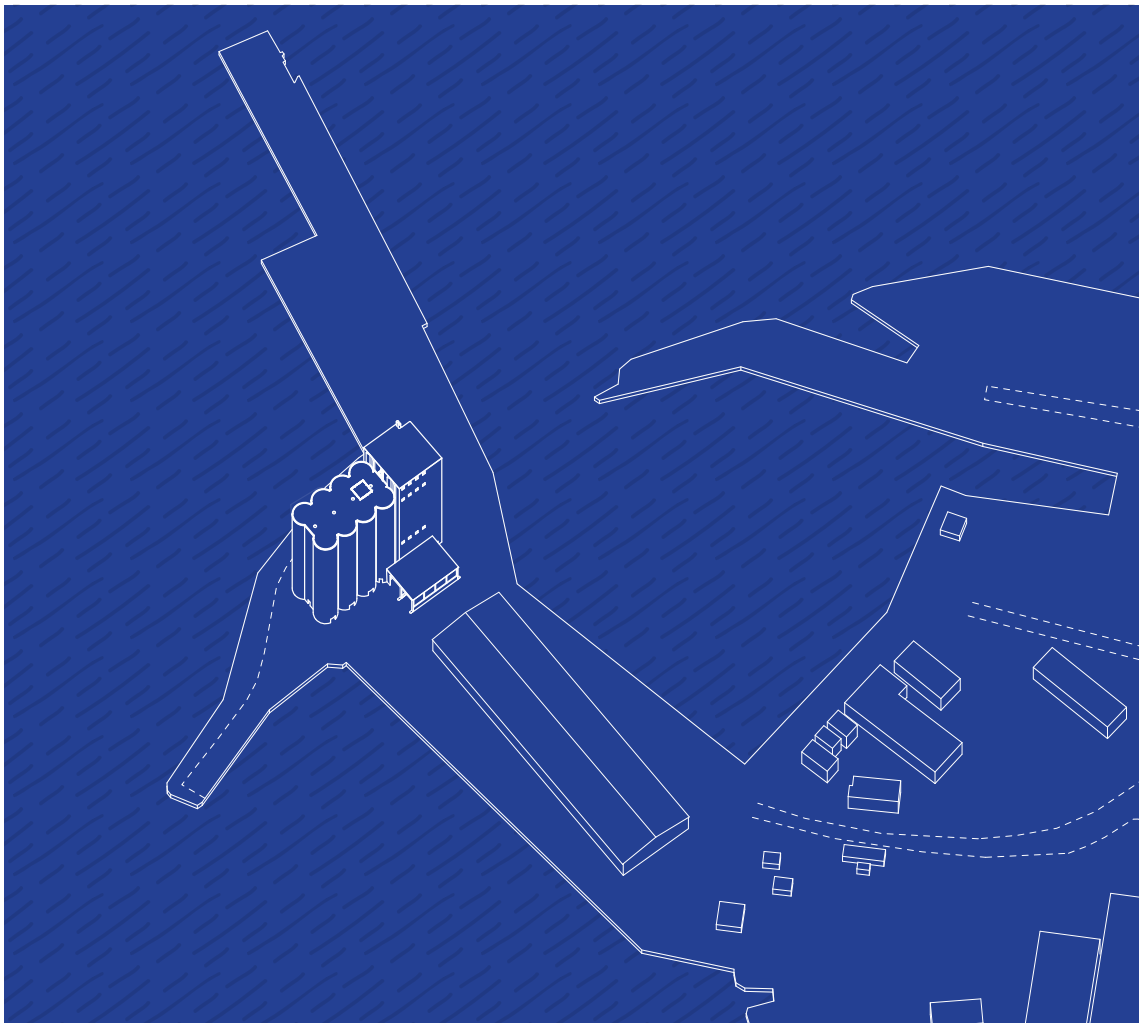


Figure 45. Perspective of Ronehamn harbour.

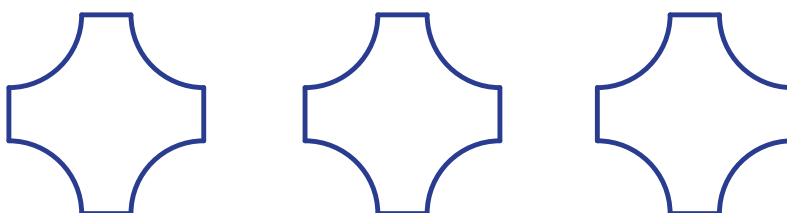
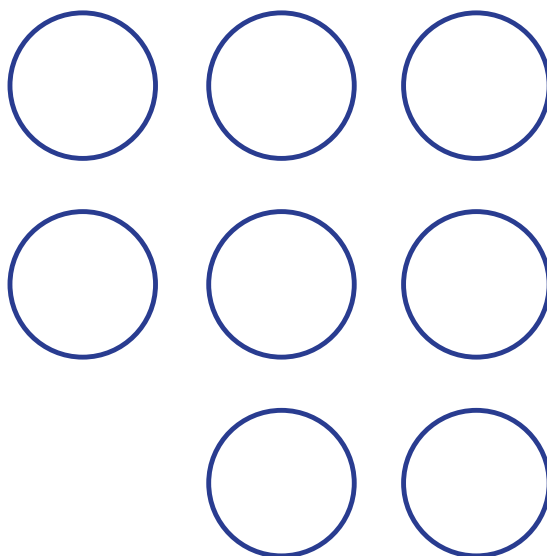
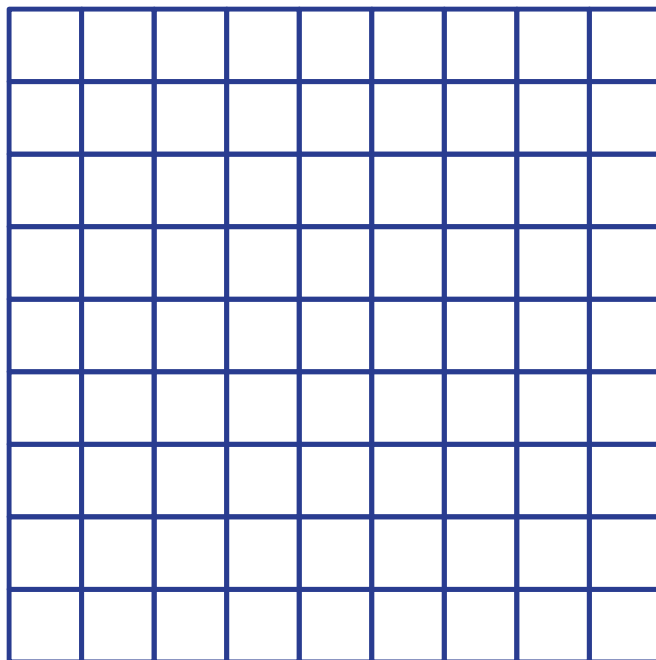


Figure 46. Existing geometric elements.

PROJECT PROPOSAL



Figure 47. View from northern bay.



DEMOLITION + ADDITION

To make room for a new program, changes to the existing structure are required. To create good residential conditions, access to daylight is essential, and to experience the spatial qualities of the silo, movement between, through and up inside must be enabled through the silo exhibition promenade.

The starting point of the project has always been to preserve as much as possible, while introducing a new function that extends the life of the silo. It is a balance between preserving through transformation while minimising intervention. If too much is altered, one must ask, what is it that we are preserving? The most important aspect is to maintain the character of the silo by minimising the removal of concrete. Of the approximately 2420 m³ of concrete in the structure, 5%, around 140 m³, is cut away to create openings. This is a small

figure in relation to the opportunities created by the approximately 260 new openings. Minimising demolition leads to two key outcomes. First, it reduces the release of approximately 650 tonnes of CO₂eq. embodied in the existing concrete. Second, it preserves more of the patina and character that have developed over many years on the concrete surfaces. Qualities that are in themselves tied to the place, its history, soul, and Ronehamn. The new openings are primarily introduced for windows. As with all interventions, they are positioned in relation to the existing. Both to avoid altering the load-bearing paths within the concrete and the 220 tonnes of reinforcement it contains, and to relate to the distinct fields formed by the existing window pattern. These fields form the basis of the facade strategy and serve as a framework for new interventions.

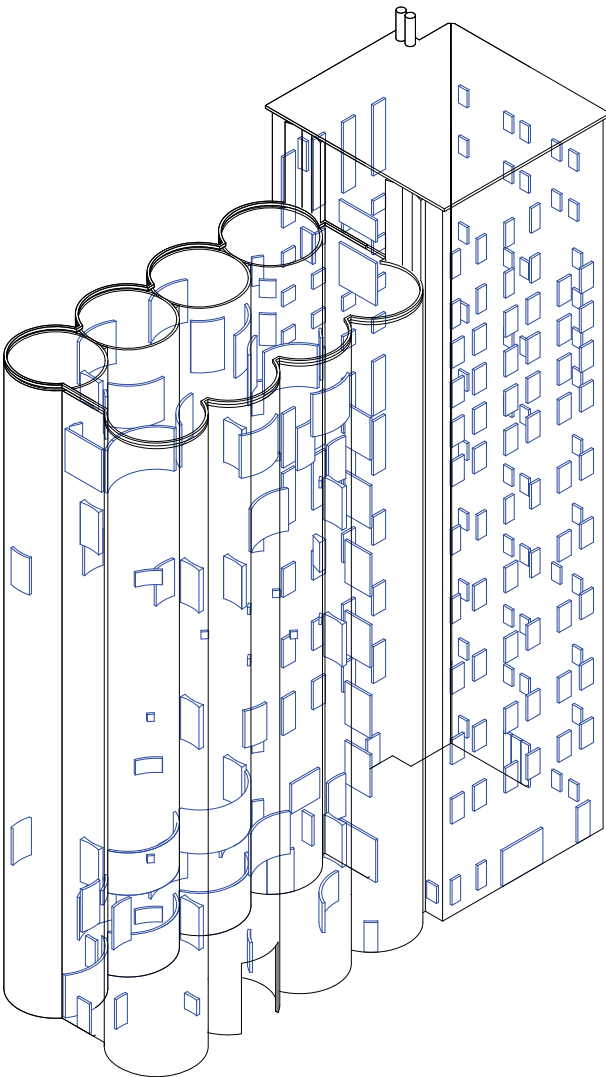


Figure 48. Blue shows removed elements.

SPECIFICATIONS:

Calculations carried out with stages A1–A5, assumed low-carbon C30/37 concrete (Boverkets klimatdatabas, 2025).

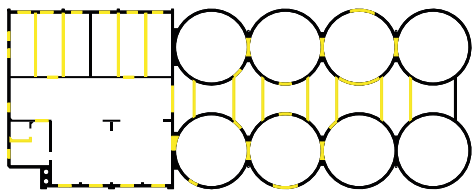
Existing concrete: 2420 m³
5680 ton
655 ton CO₂eq.

Existing reinforcement: 220 ton
195 ton CO₂eq.

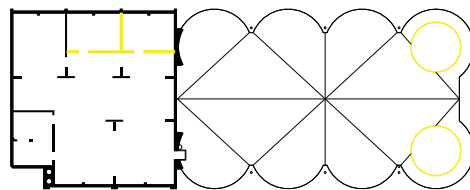
Removed concrete: 140 m³
329 ton
38 ton CO₂eq.

Added concrete, floorslabs : 150 m³
352 ton
40 ton CO₂eq.

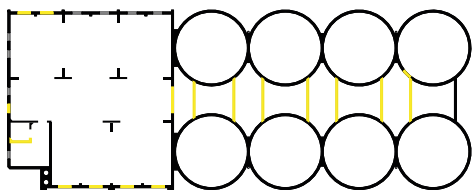
Floor 4, +22.2m



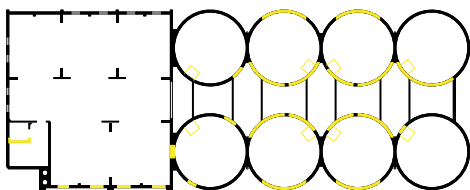
Floor 9, +49.8m



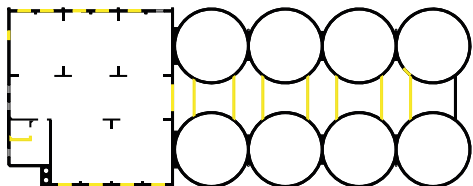
Floor 3, +17.2m



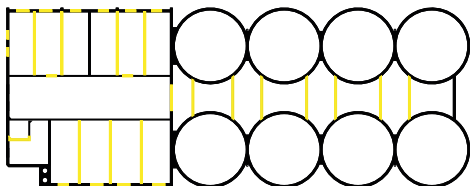
Floor 8, +43.1m



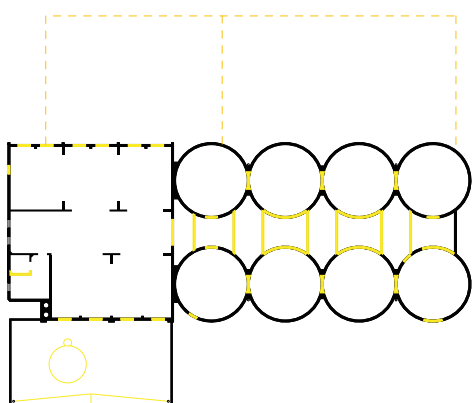
Floor 2, +12.2m



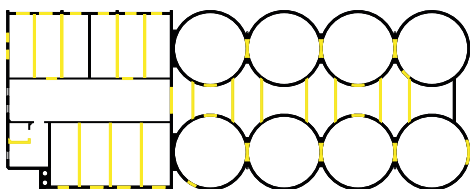
Floor 7, +34.9m



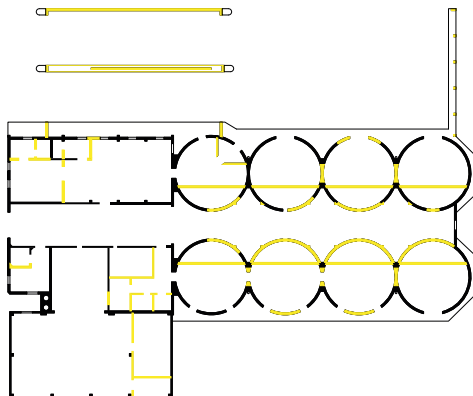
Floor 1, +8.0m



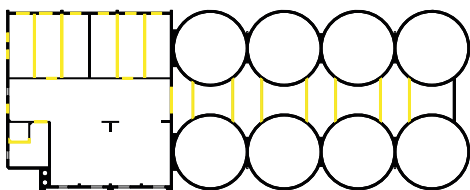
Floor 6, +31.9m



Entrance floor, +2.2m



Floor 5, +25.2m



Removed concrete

Figure 49. Demolition plan, entrance floor-ninth floor. scale 1:600.



Figure 50. Entrance floor, silo hall.



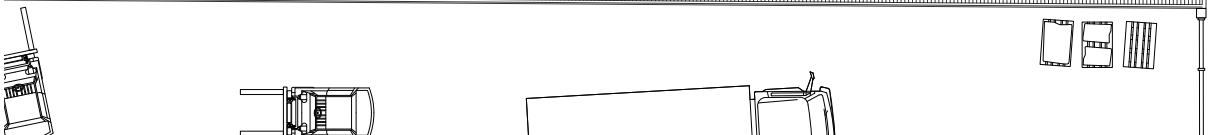
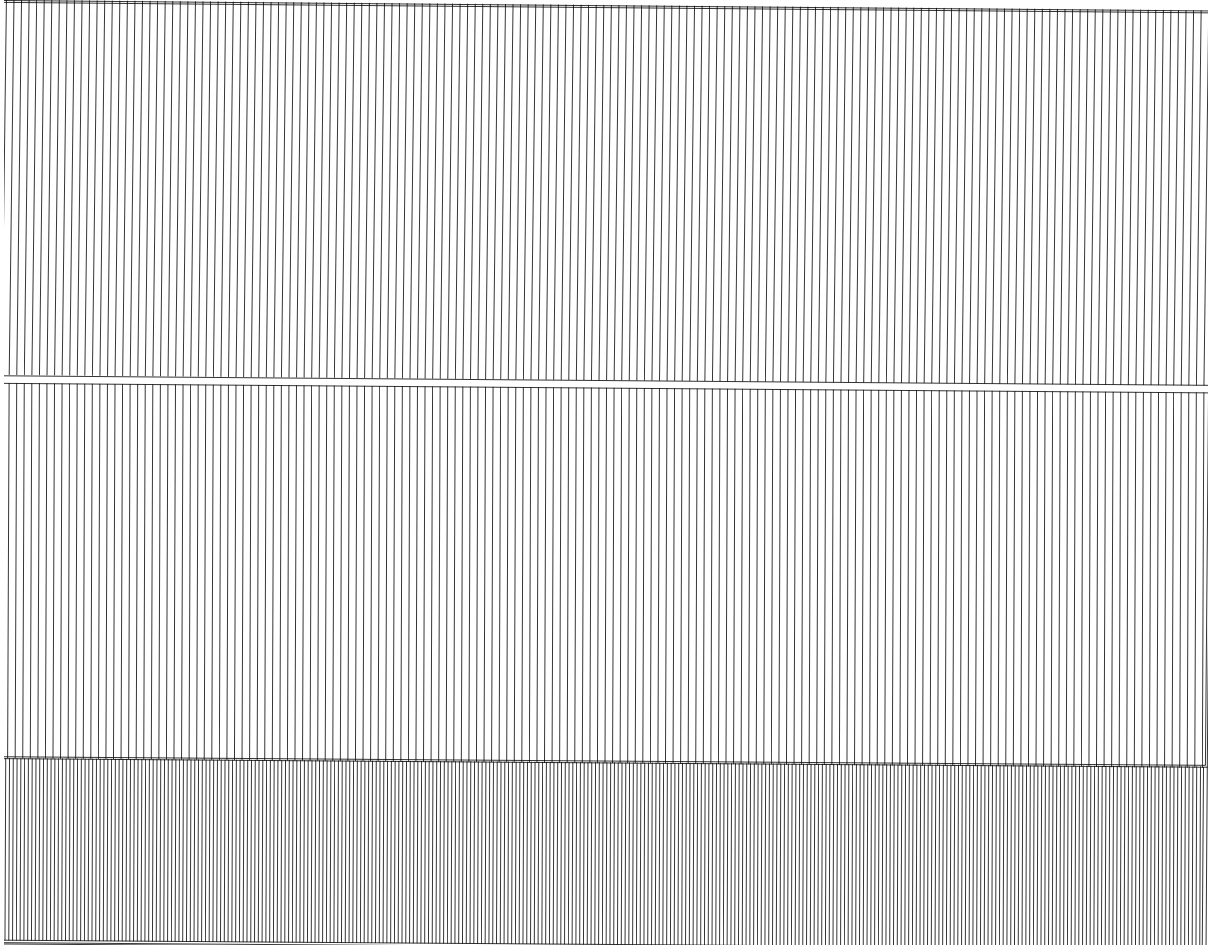
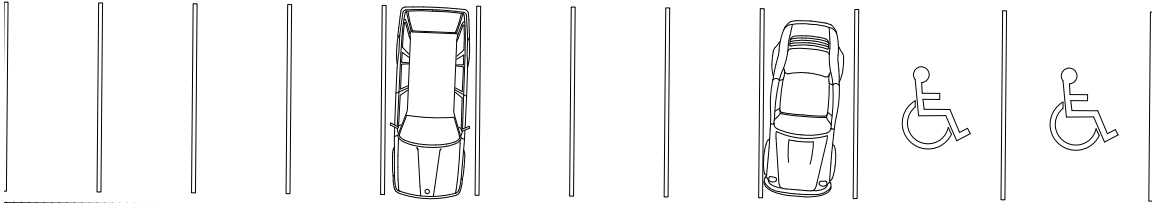
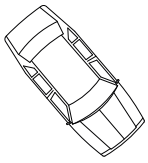
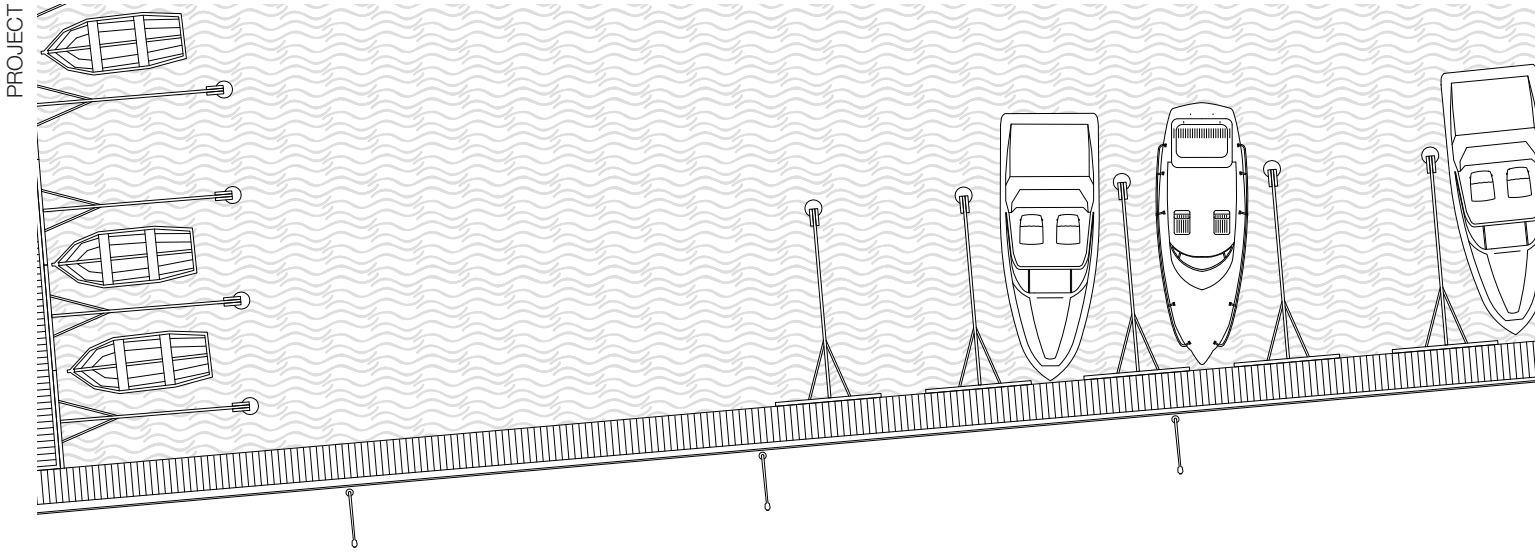
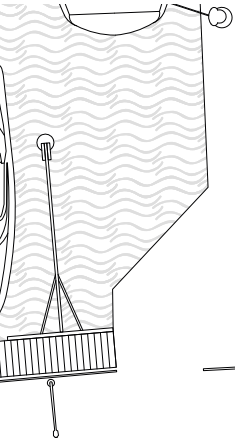


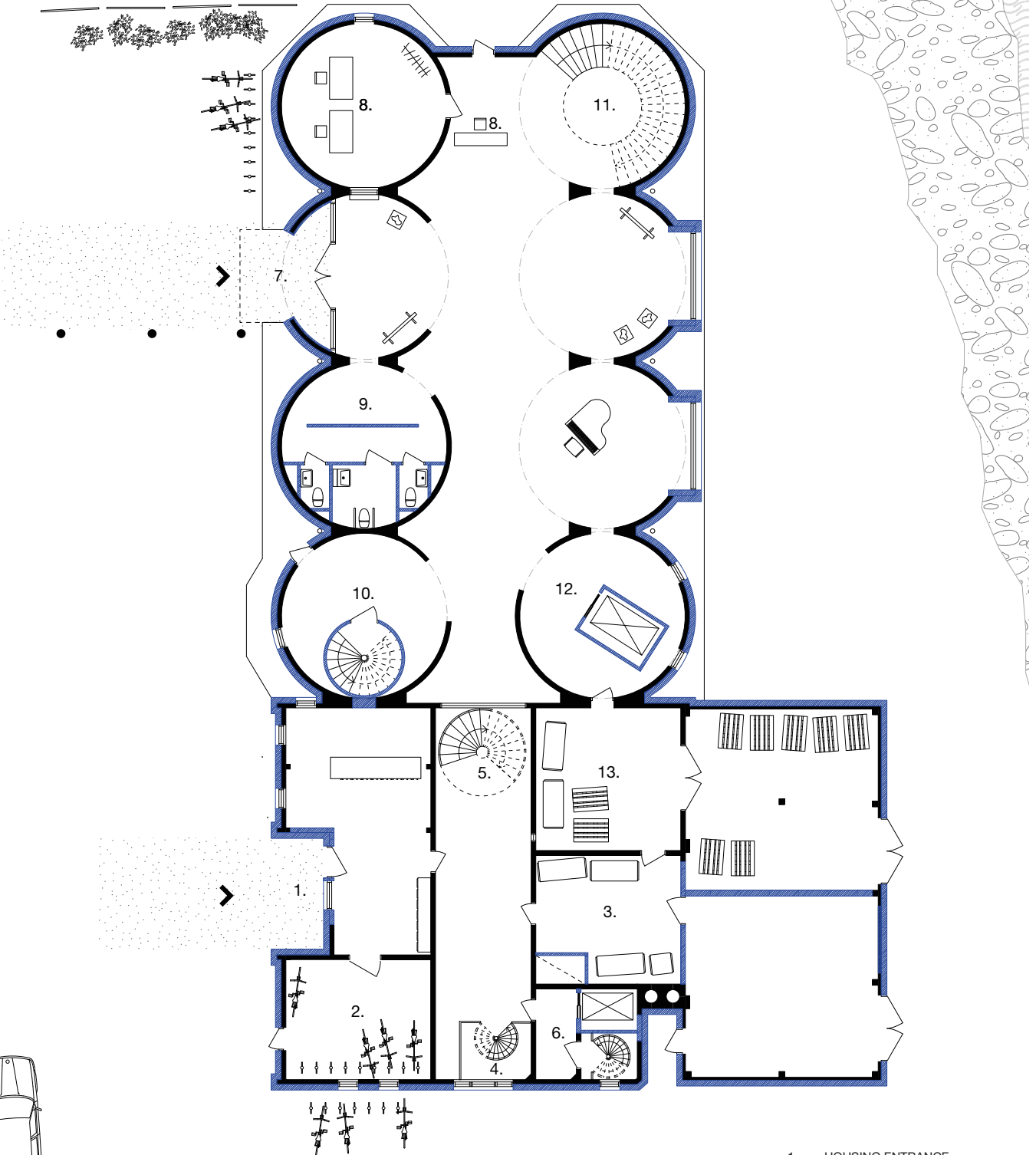
Figure 51. Entrance floorplan, scale 1:200.



+2,0 m

+1,0 m

+0,0 m



- 1. HOUSING ENTRANCE
- 2. BIKE STORAGE
- 3. GARBAGE ROOM
- 4. STAIR TO MECHANICAL ROOM
- 5. MAIN STAIRCASE
- 6. ELEVATOR + EMERGENCY STAIRCASE
- 7. PUBLIC ENTRANCE
- 8. RECEPTION + OFFICE
- 9. TOILETS
- 10. EMERGENCY STAIRCASE
- 11. MAIN EXHIBITION STAIRCASE
- 12. ELEVATOR
- 13. STORAGE + DELIVERY ROOM

■ EXISTING
 ■ ADDED

0 5 10m



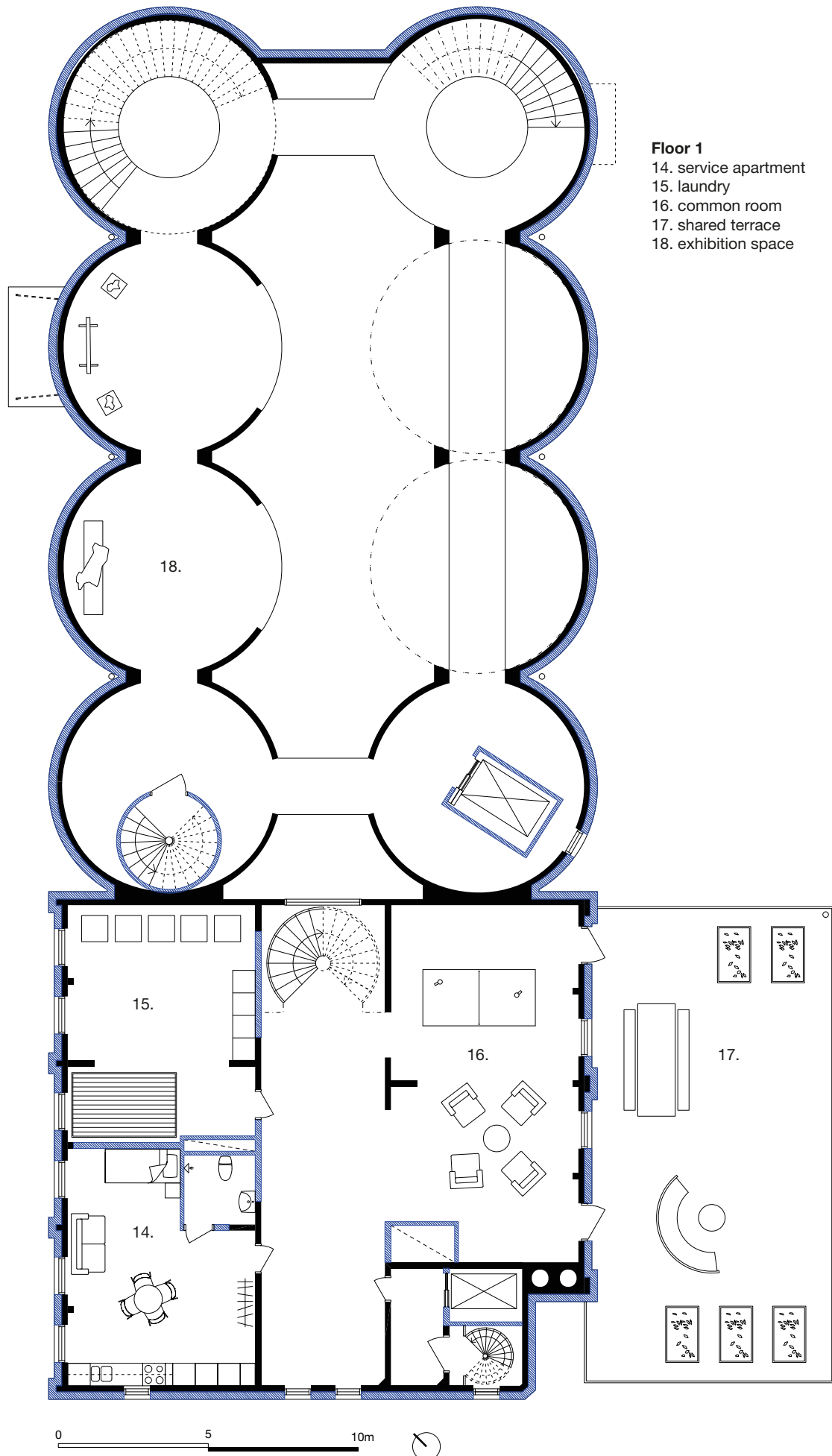
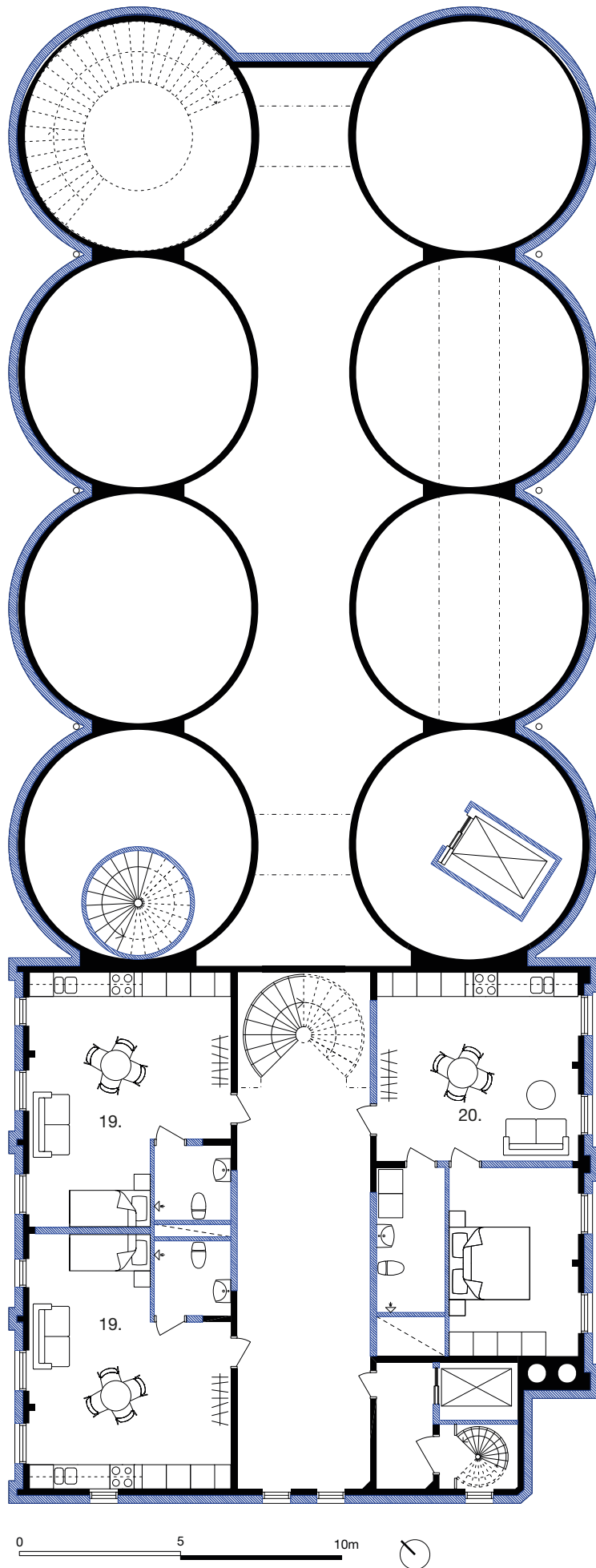


Figure 52. Floor plan 1, scale 1:150.

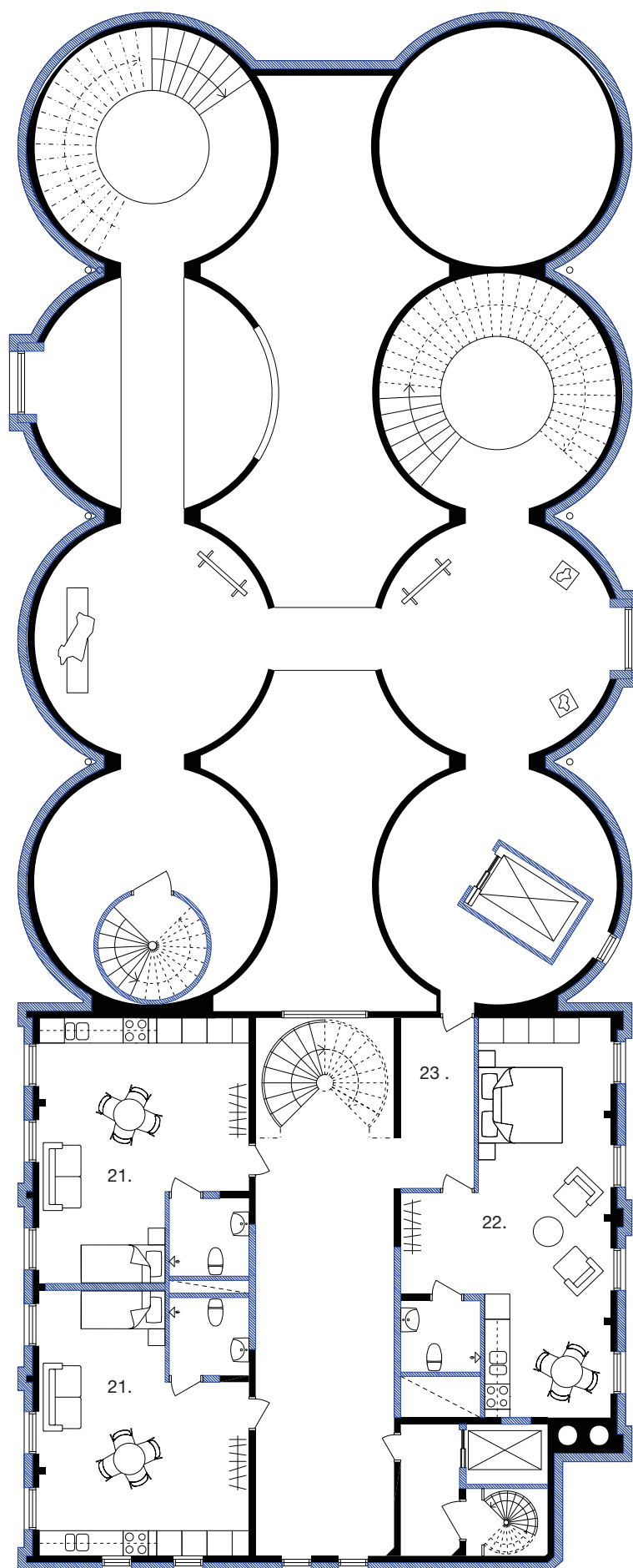


Figure 53. View towards ceiling in silo hall.



Floor 2 + 3 + 5
19. apartment 30 sq.m.
20. apartment 45 sq.m.

Figure 54. Floor plan 2 + 3 + 5, scale 1:150.

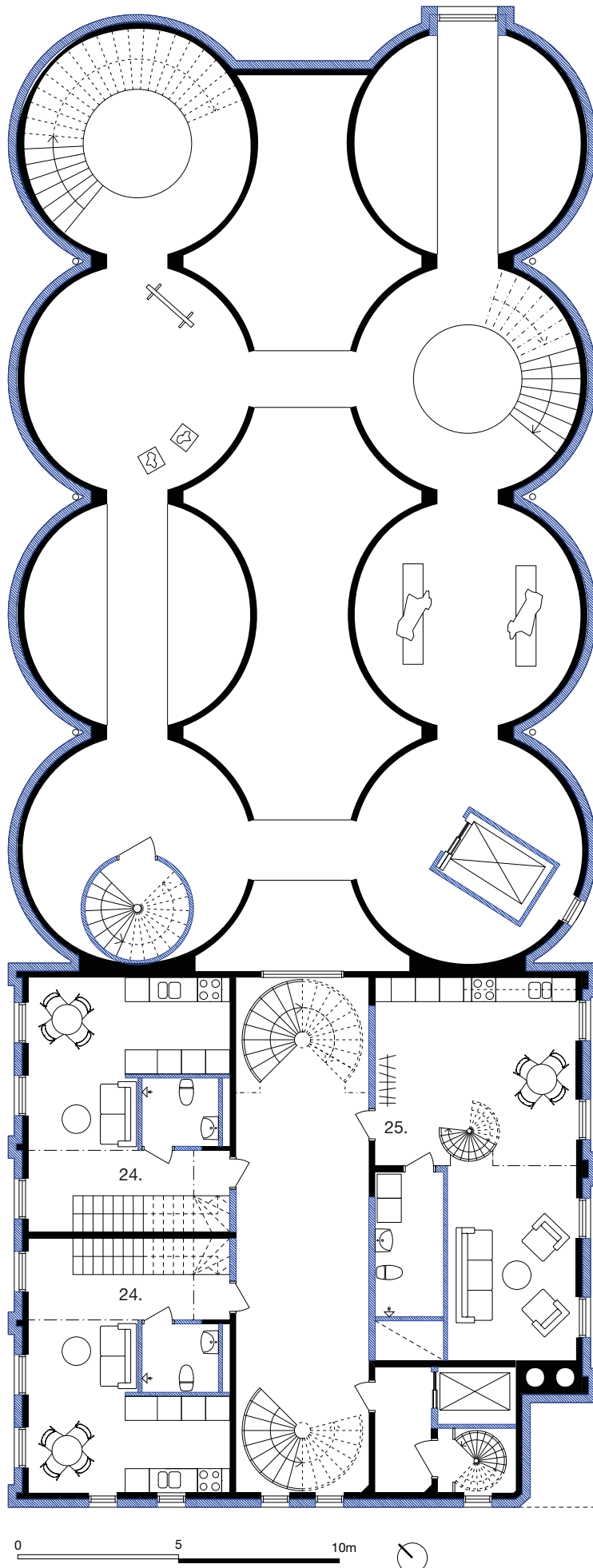
**Floor 4**

21. overnight apartment 30 sq.m.

22. overnight apartment 45 sq.m.

23. overnight visitors passage

Figure 55. Floor plan 4, scale 1:150.



Floor 6 + 7

24. apartment 50 sq.m. *
25. apartment 70 sq.m. **

SPECIFICATIONS:

Calculations carried out with stages A1–A5, assumed Sawn timber, u 16 %, coniferous (Boverkets Klimatdatabas, 2025).

Mezzanine floor slabs:

Apartment *: C24
35m/ apartment
0,043 kg CO₂eq /apartment

Apartment **: C24
40m/ apartment
0,049 kg CO₂eq /apartment

wooden walls: 100 m³
75

Full floor slab: C24
235m/ floor
0,29 kg CO₂eq /floor

Figure 56. Floor plan 6 + 7, scale 1:150.



Figure 58. Large mezzanine apartment.

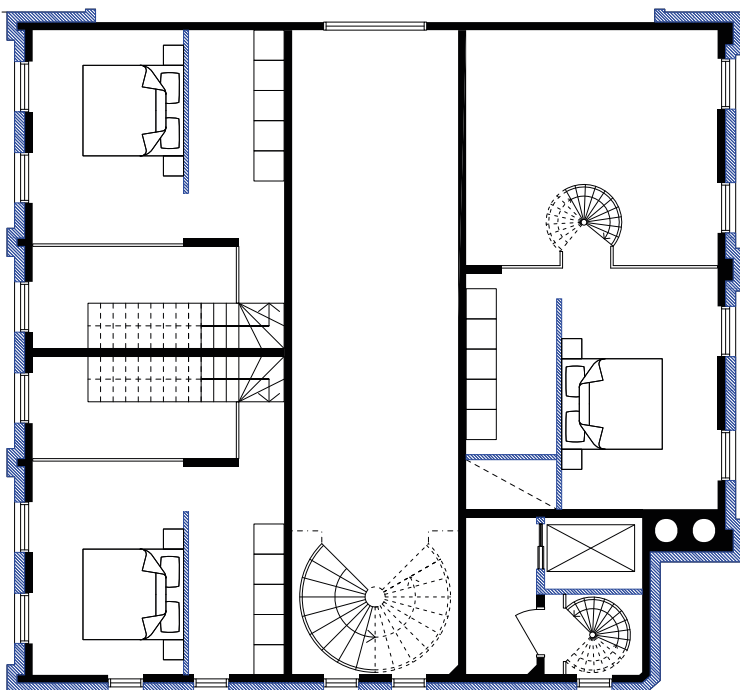


Figure 57. Floor plan 6 + 7 mezzanine, scale 1:150.

MEZZANINE APARTMENT FLOORS

The silo's unique verticality creates opportunities for distinctive spatial qualities. The existing fifth floor has a total ceiling height of 11 meters. In the new layout, this level is divided into two main floors, levels 6 and 7. Through the addition of a new floor slab. Both of these floors have ceiling heights of approximately 6 meters, allowing for the introduction of mezzanine levels in each apartment. These unique apartments capitalise on the generous vertical dimensions of the silo, creating spatial qualities with intrinsic value. The added materials are deliberately contrasted with the raw concrete, clearly expressing what is new in relation to the existing structure. This creates unique residential characters with astonishing views.

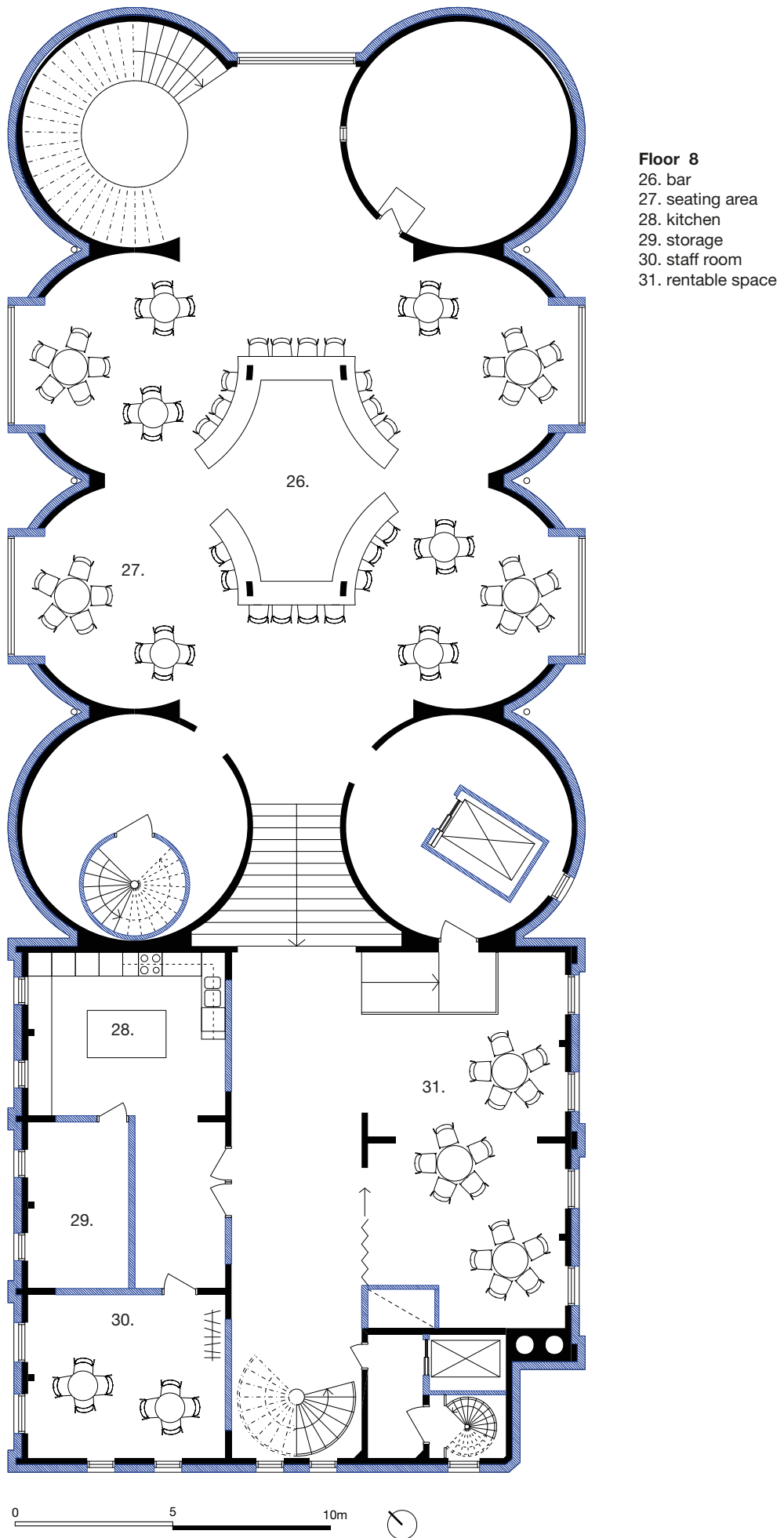


Figure 59. Floor plan 6 + 7, scale 1:150.



Figure 60. Restaurant, view on bar.

RESTAURANT FLOOR

The existing sixth floor features varying floor levels between the rectangular tower and the circular silo batteries. The tower's floor is positioned two meters above the batteries floors and is currently connected by a small ladder. The proposal retains these differing floor levels but replaces the ladder with a proper staircase and an elevator, ensuring full accessibility. The program inserted in the rectangular volume includes a restaurant kitchen, staff facilities, and a flexible space that can function either as an additional dining area, office space, or a bookable room for larger events. From this section, a staircase wraps around the cylindrical shapes, leading down to the main restaurant area. The light load on the upper level allows for large openings, creating opportunities to move freely through and between the cylinders on this floor. A bar is formed from the negative space of the inner circular geometries, establishing circulation around it. Five large windows open up views toward the sea, the mainland, and the coastline, views that can be enjoyed during a meal, here 40 meters above ground level.

SPECIFICATIONS:

<i>kitchen</i>	35 sq.m.
<i>seating area</i>	105 sq.m.
<i>bar</i>	20 sq.m.
<i>staff room</i>	20 sq.m.
<i>rentable space</i>	50 sq.m.
<i>storage</i>	10 sq.m.

PUBLIC ENTRANCE

A generous and clearly defined entrance is positioned on the building's north-east facade, aligning with the pathway running along the back of the potato storage. The intervention is conceived as a tall, distinct opening. Visible from a distance and proportioned in relation to the silo's verticality. A precise 3 × 5 meter cut is made in the concrete, forming a sheltered threshold space. Set two meters in front of the main entrance to the silo hall, this space provides protection from wind and rain while marking a transition between exterior and interior. The removed concrete section is then reused by rotating it and suspended to the existing structure using steel cables. This creates a cantilevered, gently undulating gesture that welcomes visitors upon arrival. The entrance itself consists of a timber door framed by glazing, offering a glimpse of the views beyond.

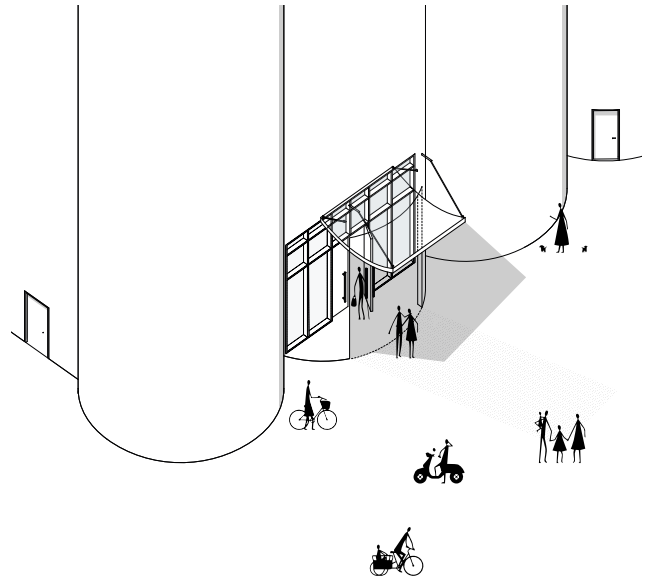


Figure 61. Isometric view public entrance.



Figure 62. Public entrance.

TERRACE

In the building's southwest corner, the roof of the former boiler room is transformed into a shared terrace, directly connected to the residents' common room on floor 1. Elevated 8 meters above ground and surrounded by views of the sea and coastline, it becomes a private outdoor space for those living in the silo. It offers a place to watch the sky turn red at sunset to the sound of the Baltic Sea. As the former boiler room is repurposed, the large chimney no longer serves its function. A 1.5-meter high half cylinder is cut out from it, creating a sheltering bench that references the site's industrial past. The terrace also gives opportunities for planting vegetables. This is meaningful in the context of Gotland's constrained housing market, where older residents seek to downsize from houses that have become difficult to maintain. While moving to a smaller dwelling may reduce the burden of upkeep, the ability to cultivate even a modest amount of greenery can offer joy.

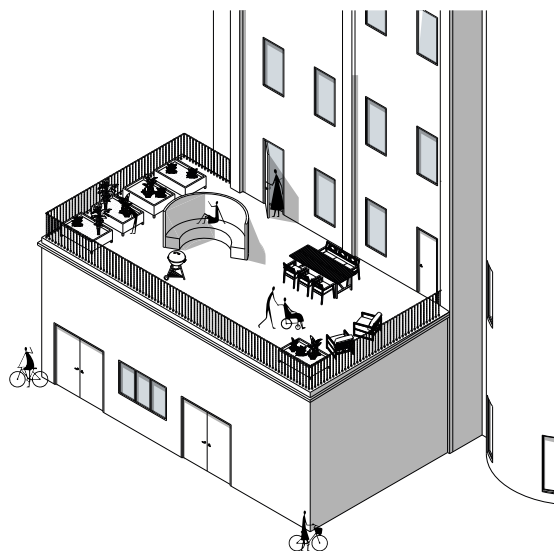


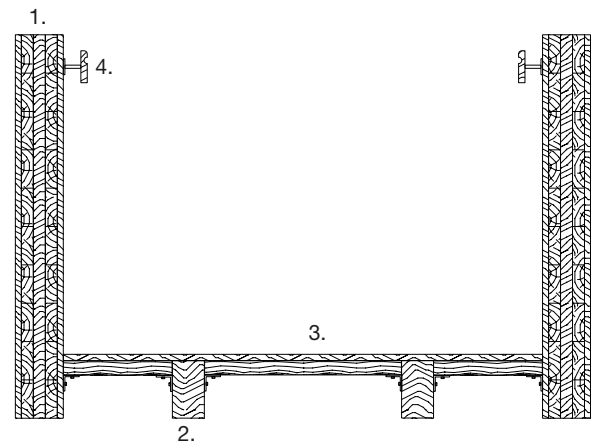
Figure 63. Isometric view terrace.



Figure 64. Terrace view.

FOOT BRIDGE

The footbridges are the primary element enabling visitors to experience the unique spatial qualities of the silo batteries. They allow movement through the structure, offering views down into the cylinders while also revealing the height for the spaces below, in some cases, 40 meters. The bridges connect the two rows of cylinders, enabling visitors to flow between them. Visitors can pause to take in the scale and atmosphere of the large central silo hall, which occasionally hosts performances. The bridges embody the project's core idea of making the silos' unique spatiality accessible through minimal and precise interventions. A sequence of walkways gently guides visitors through exhibition spaces, to astonishing views, and upwards to the restaurant. The structure is primarily constructed from CLT, which also functions as guardrails. Together with two beams anchored into the existing concrete, they support the secondary structure, which carries the timber decking where visitors bravely set steps, elevated high above the ground. This simplicity contributes to a sense of lightness and playfulness, enhanced by openings into the silo hall. While walking along the bridges, visitors may catch glimpses into adjacent exhibition spaces or meet the gaze of someone else across the void, 20 meters away, on another bridge.



1. Cross-laminated timber 100x1100
2. C24, pine beam 80x150
3. Wooden flooring
4. Wooden handrail

Figure 65. Detail foot bridge.



Figure 66. Isometric view foot bridges.



Figure 67. Exhibition walk view from solid joist.

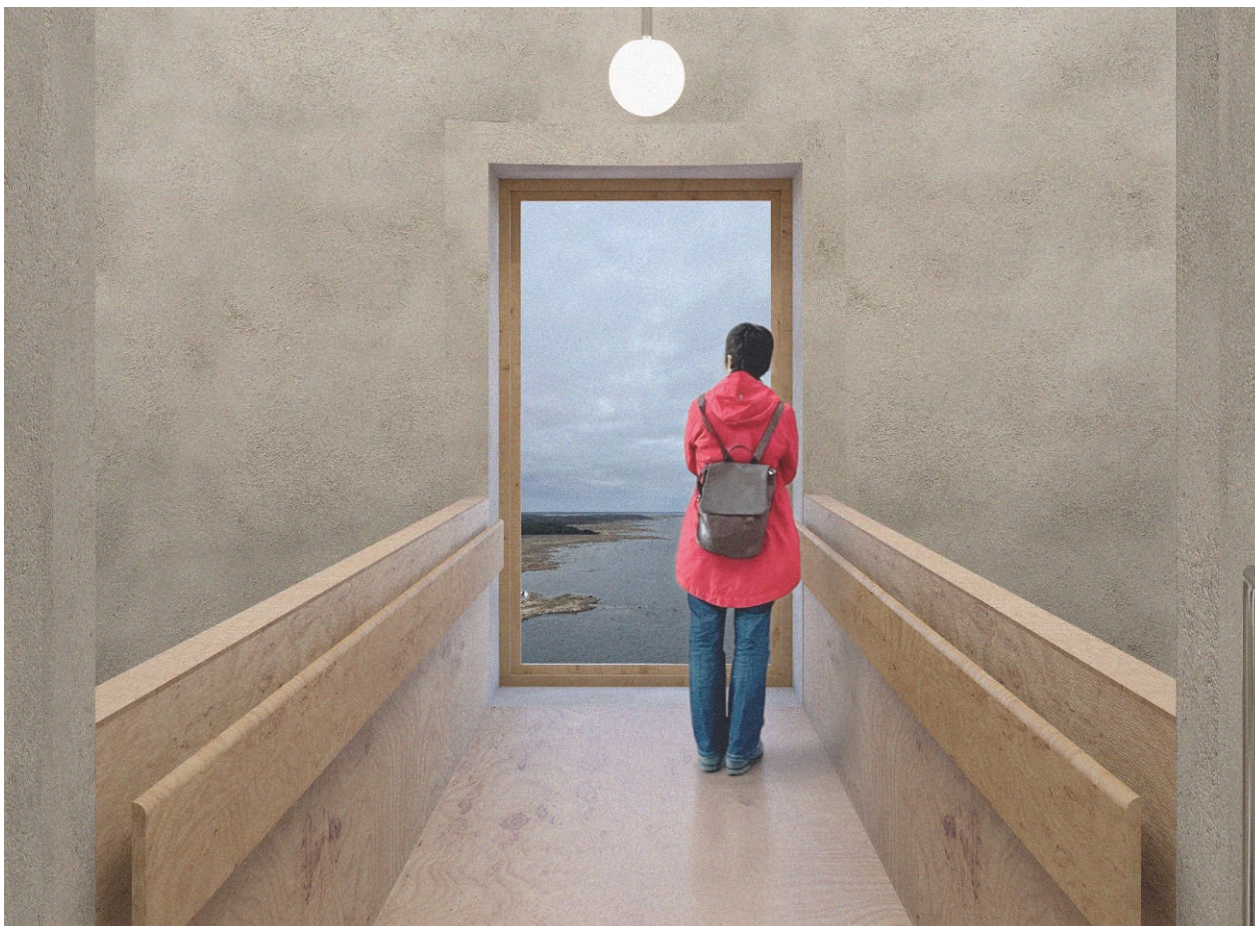


Figure 68. Exhibition walk view out from foot bridge.

BAY WINDOWS

To create a comfortable indoor climate, the silo is insulated externally, forming a protective layer against the often harsh maritime conditions. Within the silo battery, orthogonal elements in the form of bay windows are introduced. These create opportunities for straight glazing along the otherwise curved surfaces of the cylindrical volumes. At the same time, they reinforce the cylindrical form through contrast. Where the orthogonal additions meet the curved surfaces, the intersection reveals the defining curve of the cylinder, further emphasising the original structure. From the interior, these bay windows meet the floor seamlessly, extending the room outward toward the view and allowing occupants to stand precisely at the point where the straight geometry of the bay intersects with the tangent of the circular form.

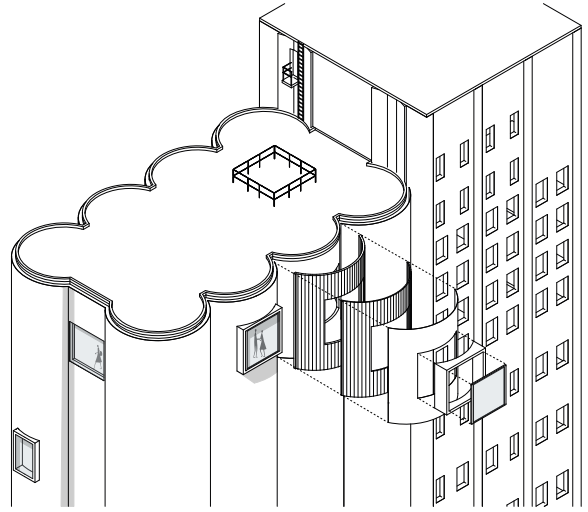


Figure 69. Isometric view insulation layers.



Figure 70. Entrance floor view out of window.

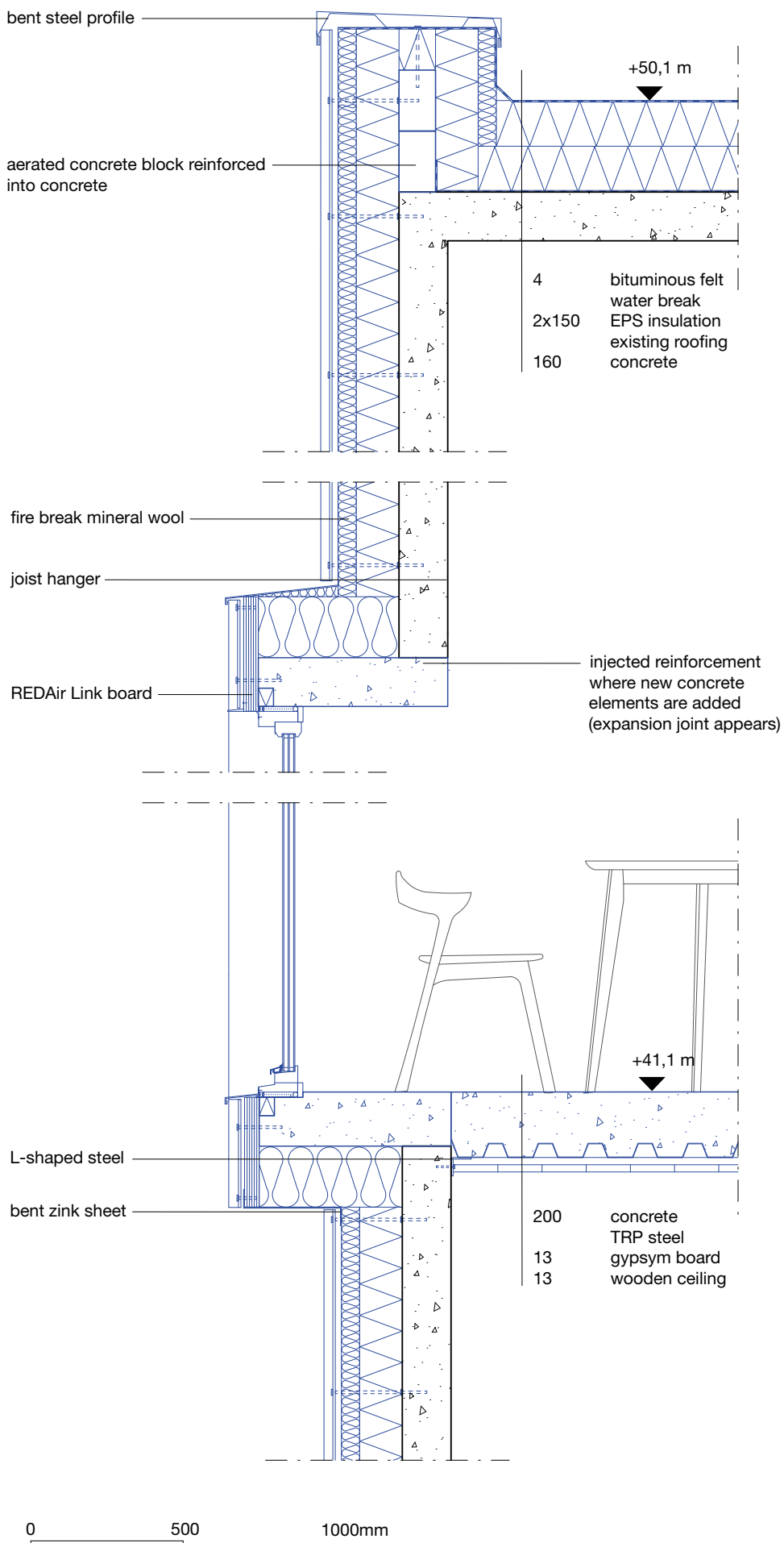


Figure 71. Roof and bay window detail, scale 1:20.

APARTMENTS + INSULATION

To achieve a comfortable indoor climate, particularly for the apartments, the existing concrete structure requires insulation. The building is therefore insulated externally, using 140 mm of EPS for thermal performance and 60 mm of mineral wool for both thermal and fire resistance. This approach allows the raw concrete surfaces to remain exposed within the interior spaces, preserving the material character of the original structure while meeting contemporary performance requirements. The insulation is protected and secured by an outer layer of sheet metal cladding, which shields the building from the harsh marine environment.

Given the potential cost of insulating the entire structure at once, a phased approach is proposed. By insulating selected parts of the building, such as those indicated in the adjacent diagram, investment can be distributed over time, improving overall feasibility. This strategy also enables an earlier return on investment, as the residential units can be brought into use first, potentially supporting the subsequent transformation of the silo batteries into exhibition spaces.

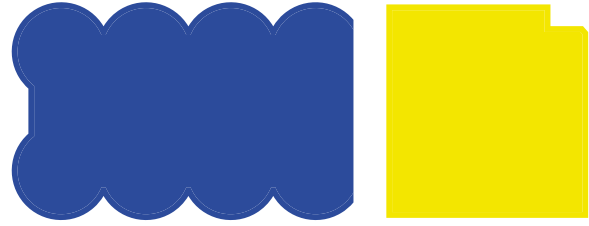


Figure 72. Two step insulation.

SPECIFICATIONS:

Calculations carried out with stages A1–A5, (Boverkets klimatdatabas, 2025).

EPS: 430 m³
1850 kg CO₂eq.

Mineral wool: 185 m³
325 kg CO₂eq.

Zink sheet: 3080 m²
82200 kg CO₂eq.



Figure 73. View from harbour.

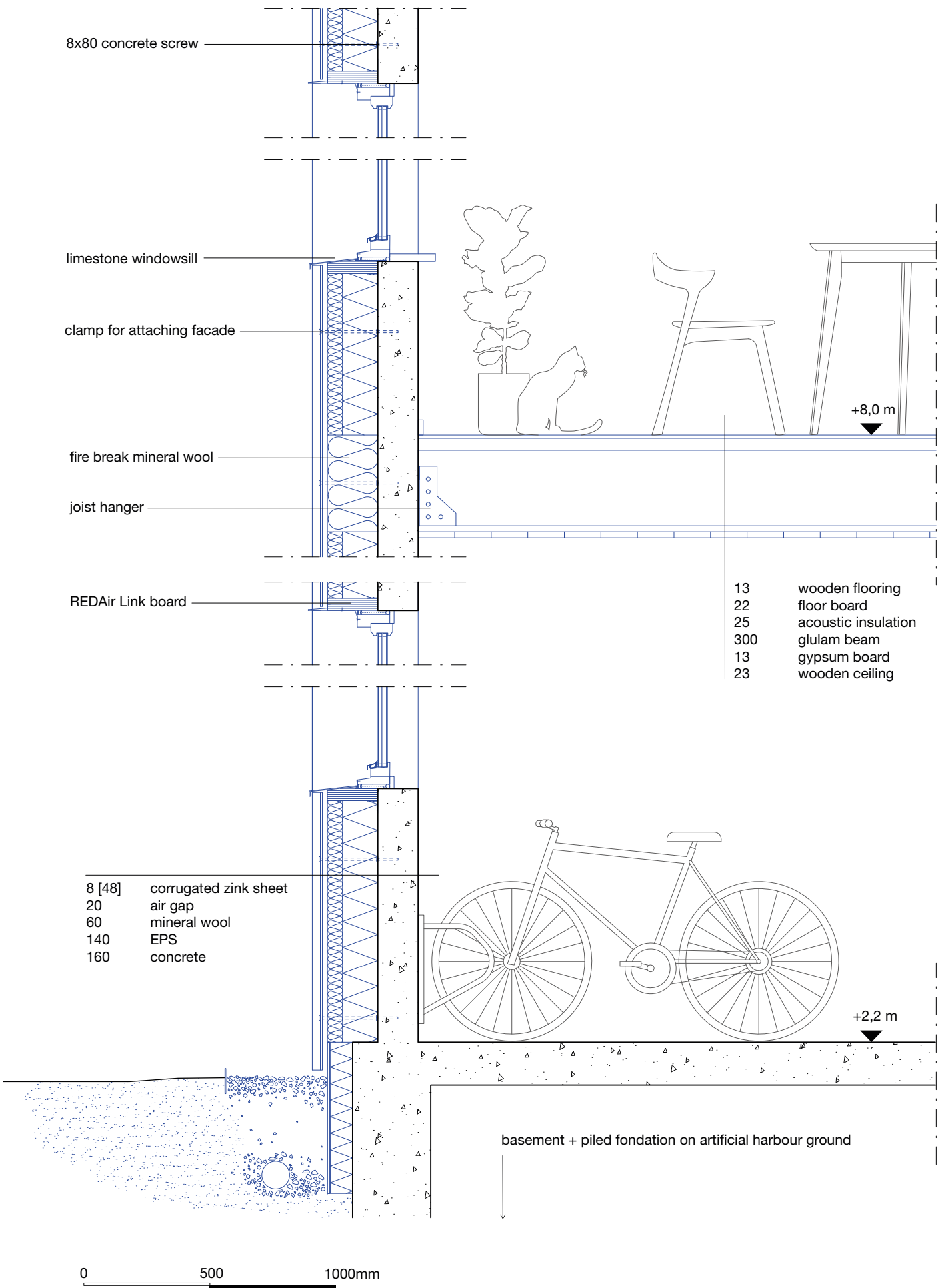


Figure 74. Ground and apartment window detail, scale 1:20.



Figure 75. Material composition.

MATERIALITY

The selected materials respond to a fundamental question before earning their place within the project's palette: in what way do they complement the existing concrete structure, and how can the genius loci of the site motivate that choice?

From the beginning, the ambition has been to preserve and reinforce the distinct character of the Ronehamn silo and its surrounding harbour environment. The project understands this character, or as said, genius loci, as industrial, precise, robust, functional and beautiful. Rather than competing with the existing structure, the new materials are carefully chosen to support and enhance these qualities. As the silo requires external insulation to achieve a comfortable indoor climate and protection against weather exposure and further decay, the building is clad in untreated corrugated sheet metal. The material continues the industrial language already present within the harbour context and relates naturally to the history of utility structures. Beyond its contextual qualities, the cladding also provides a durable and cost-efficient solution. Our aim with added materials is to, through the concept of *aemulatio*, not to precisely resemble the structure's existing material but to contrast it with materials that still refer to the site's genius loci in this site. It should be possible

for a visitor who has always known the silo to know that it is the silo, but with a new disguise and see the interventions that are being carried out.

The detailing follows the same material logic. Elements such as handrails, handles, flashings, and railings are fabricated from zinc, where possible or stainless steel, materials which are chosen for their durability and ability to age well in a maritime environment. Together, the sheet metal and zinc contribute to a coherent architectural expression defined by precision and repetition. In contrast to these colder and more rugged materials, selected interior and smaller elements are introduced in wood, primarily pine and oak. Window frames, doors, and certain interior surfaces bring warmth and softness to the spaces, creating a deliberate contrast against the raw concrete and corrugated metal surfaces. These wooden additions not only enhance the building's atmospheric qualities but also make the new interventions clearly legible. Through this contrast, the transformation of the silo becomes understandable: the industrial structure remains present and dominant, while the warmer materials signal its adaptation into spaces intended for habitation, gathering, and public life.

FACADES

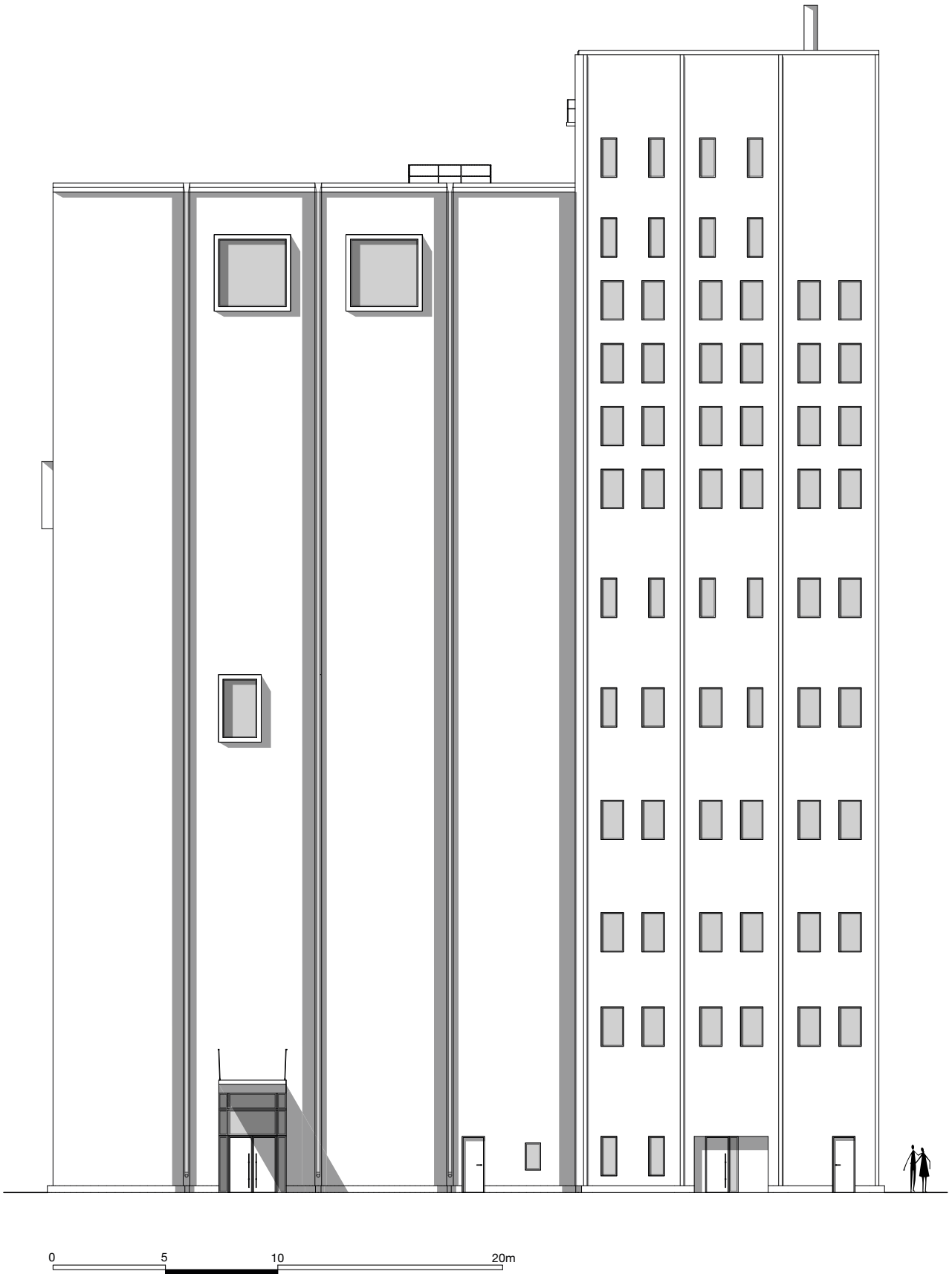


Figure 76. New north facade, scale 1:250.

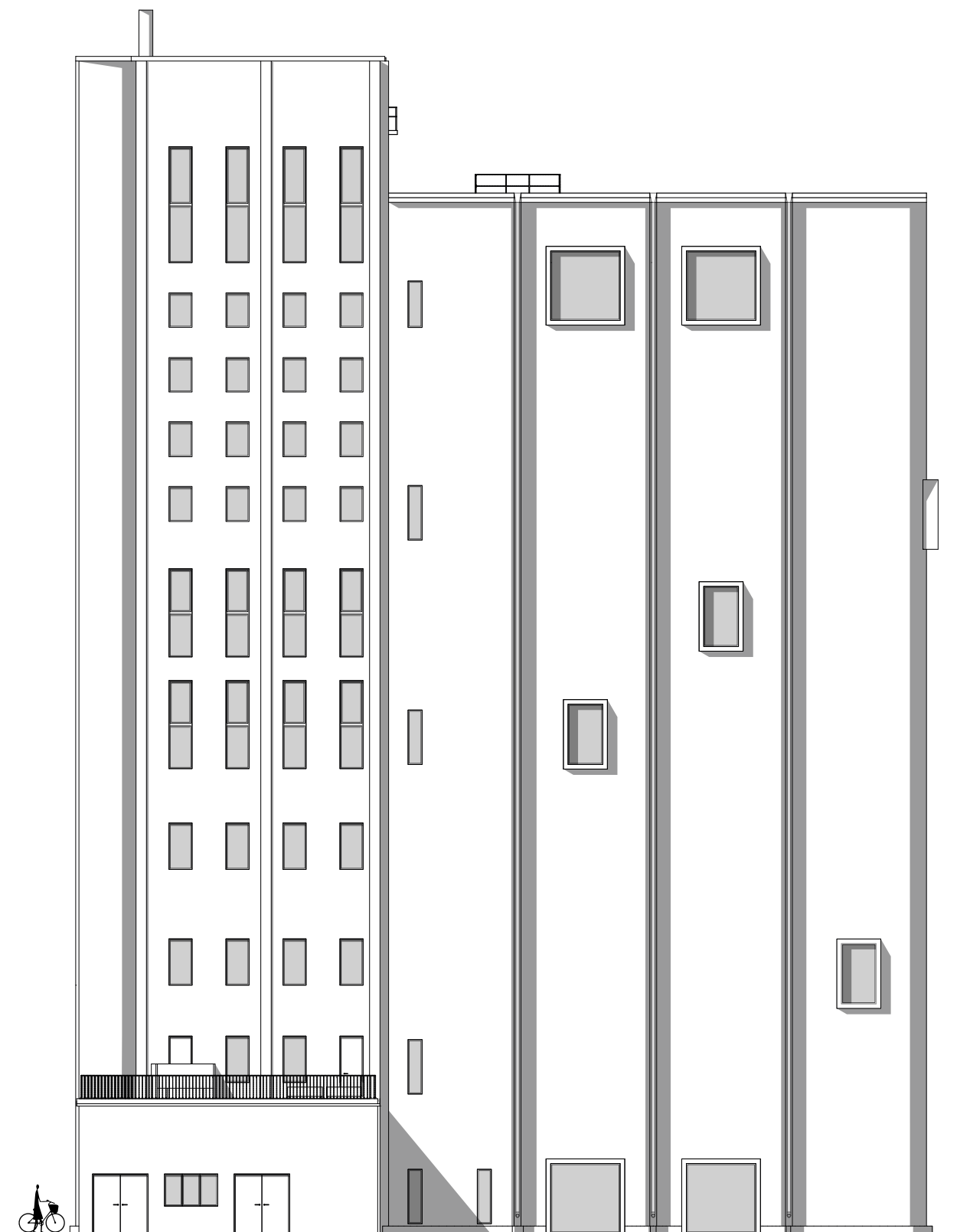


Figure 77. New south facade, scale 1:250.

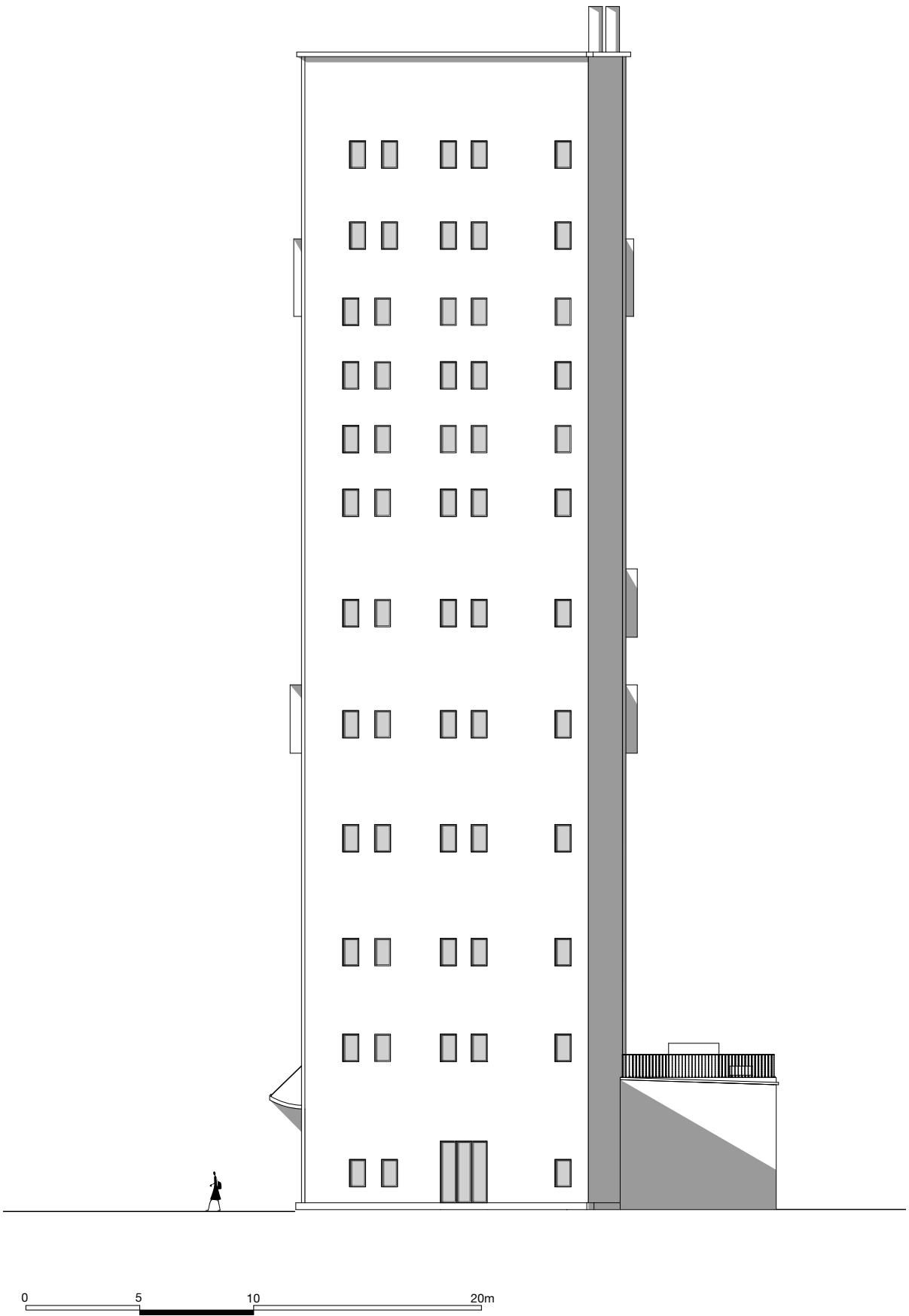


Figure 78. New west facade, scale 1:250.

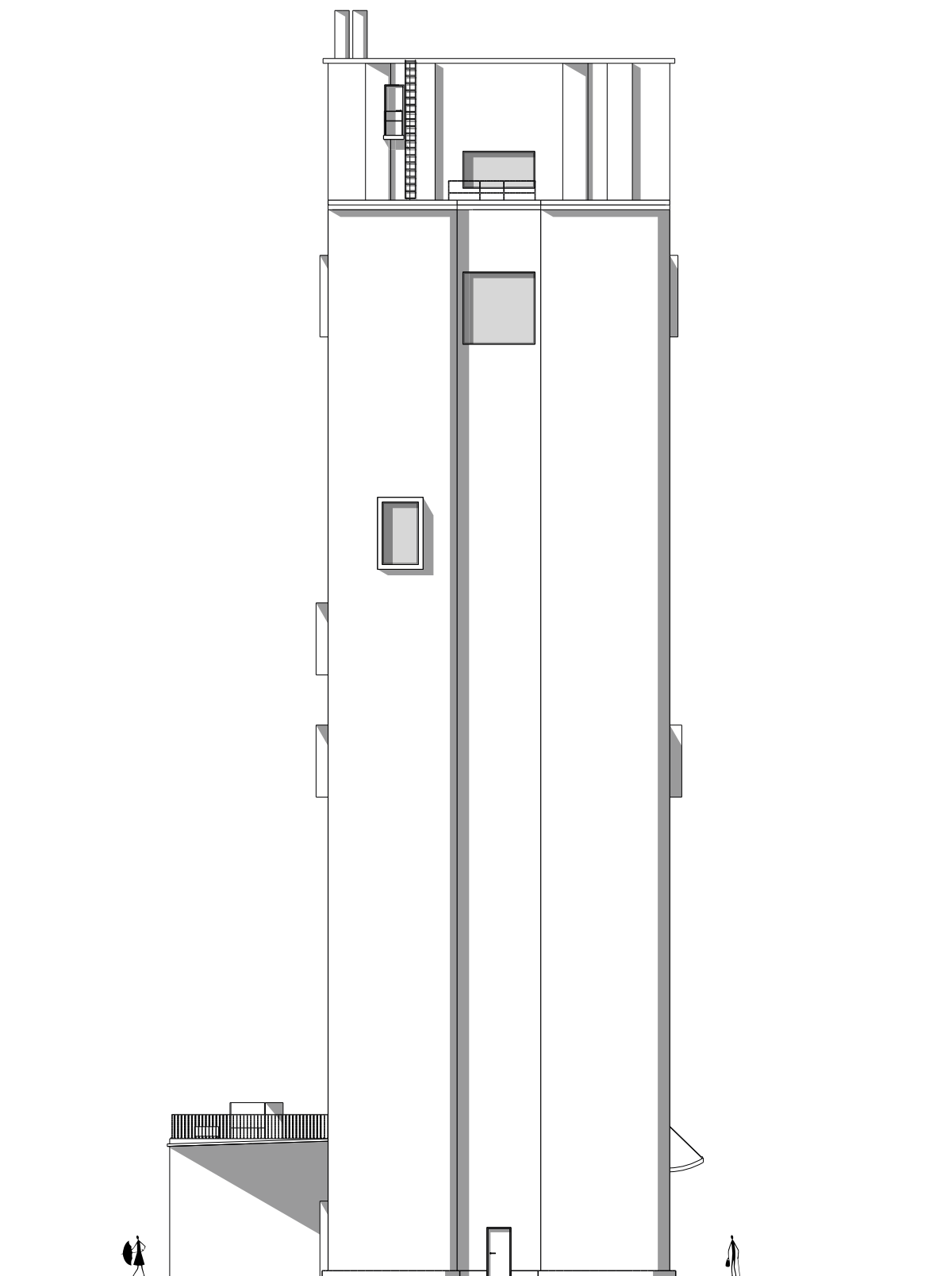


Figure 79. New east facade, scale 1:250.

SECTIONS

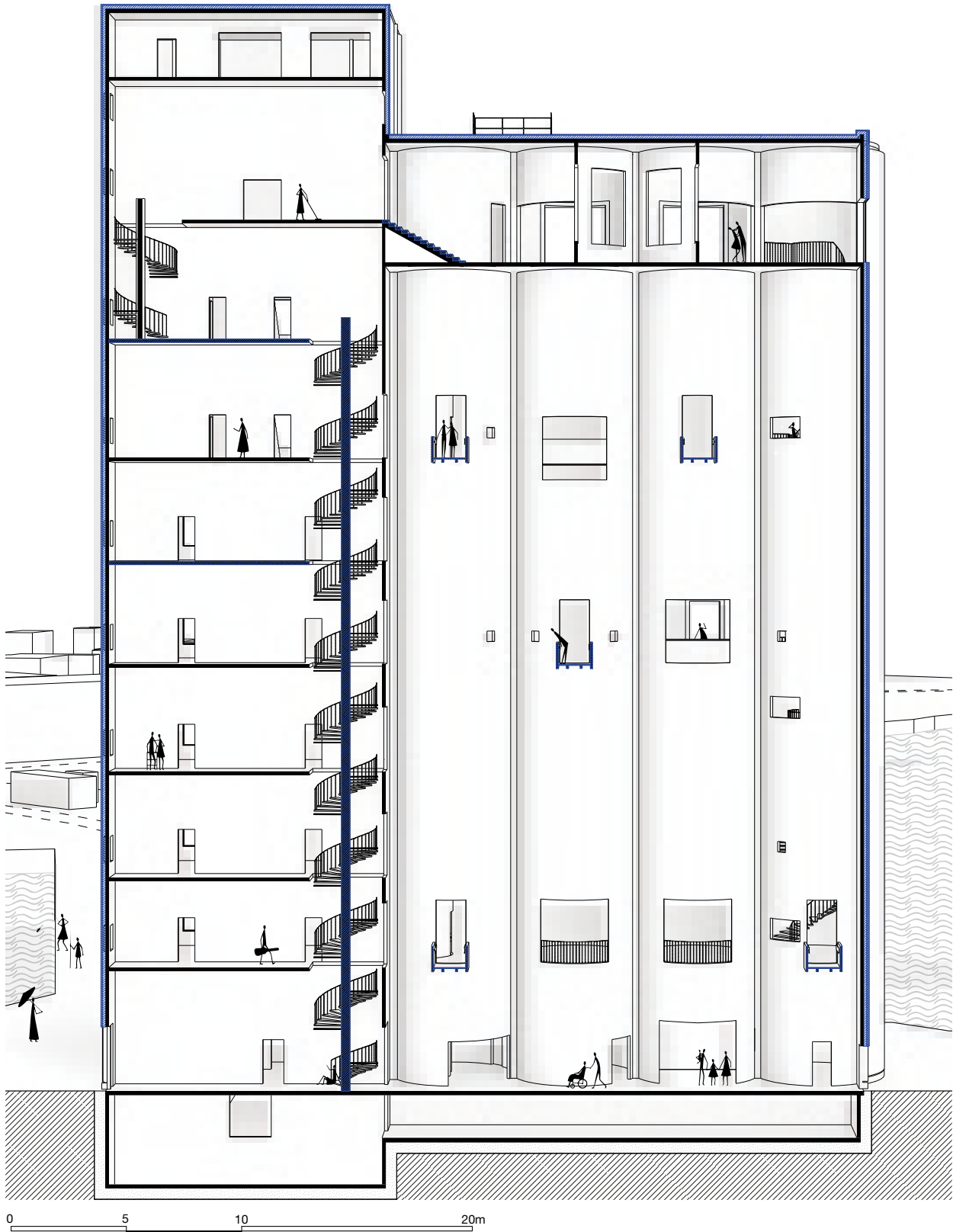
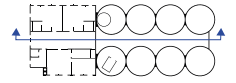


Figure 80. New section through corridor + open silo hall, estimated perspective scale 1:250.

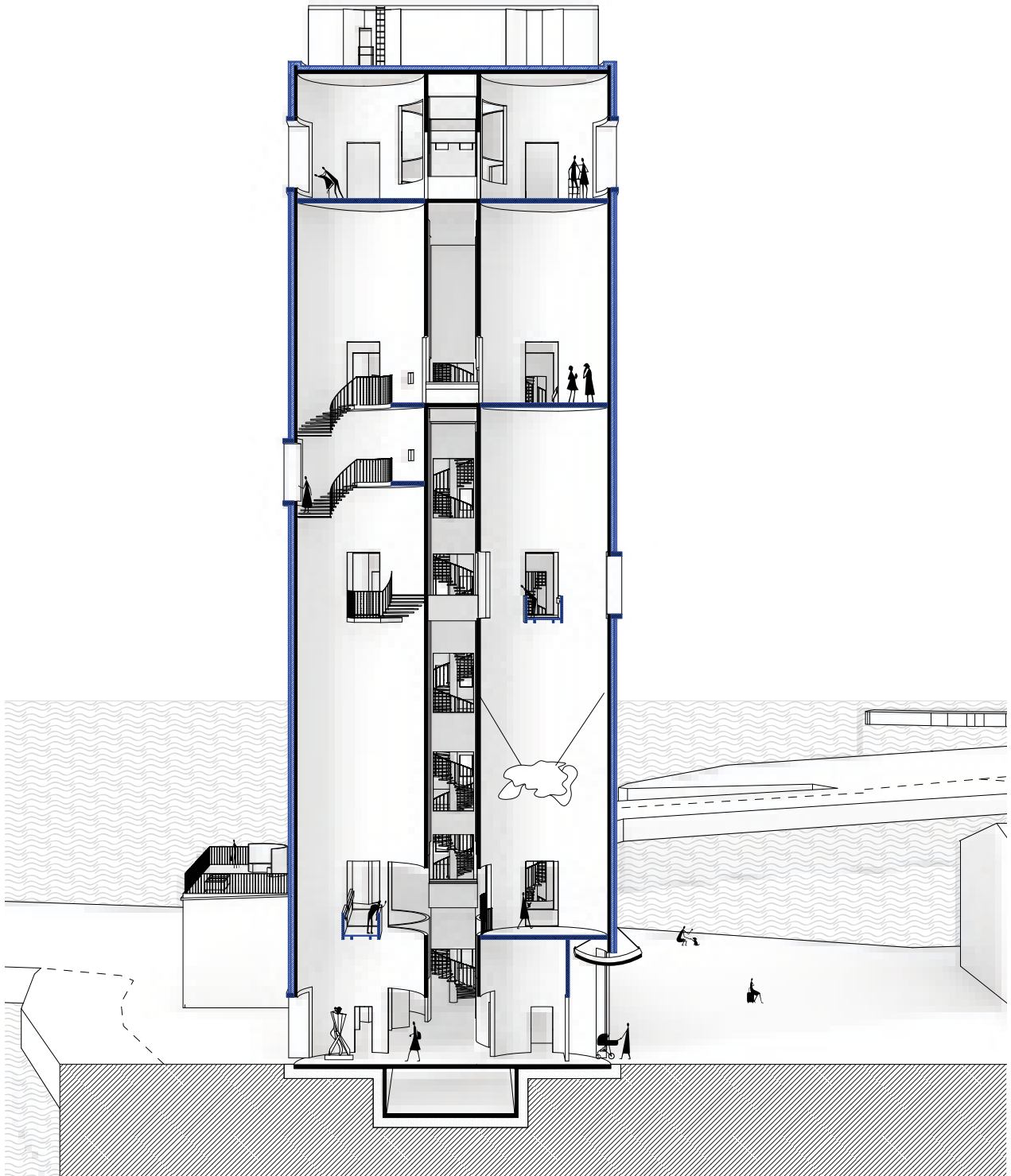
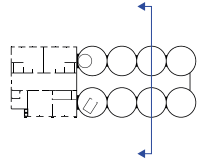
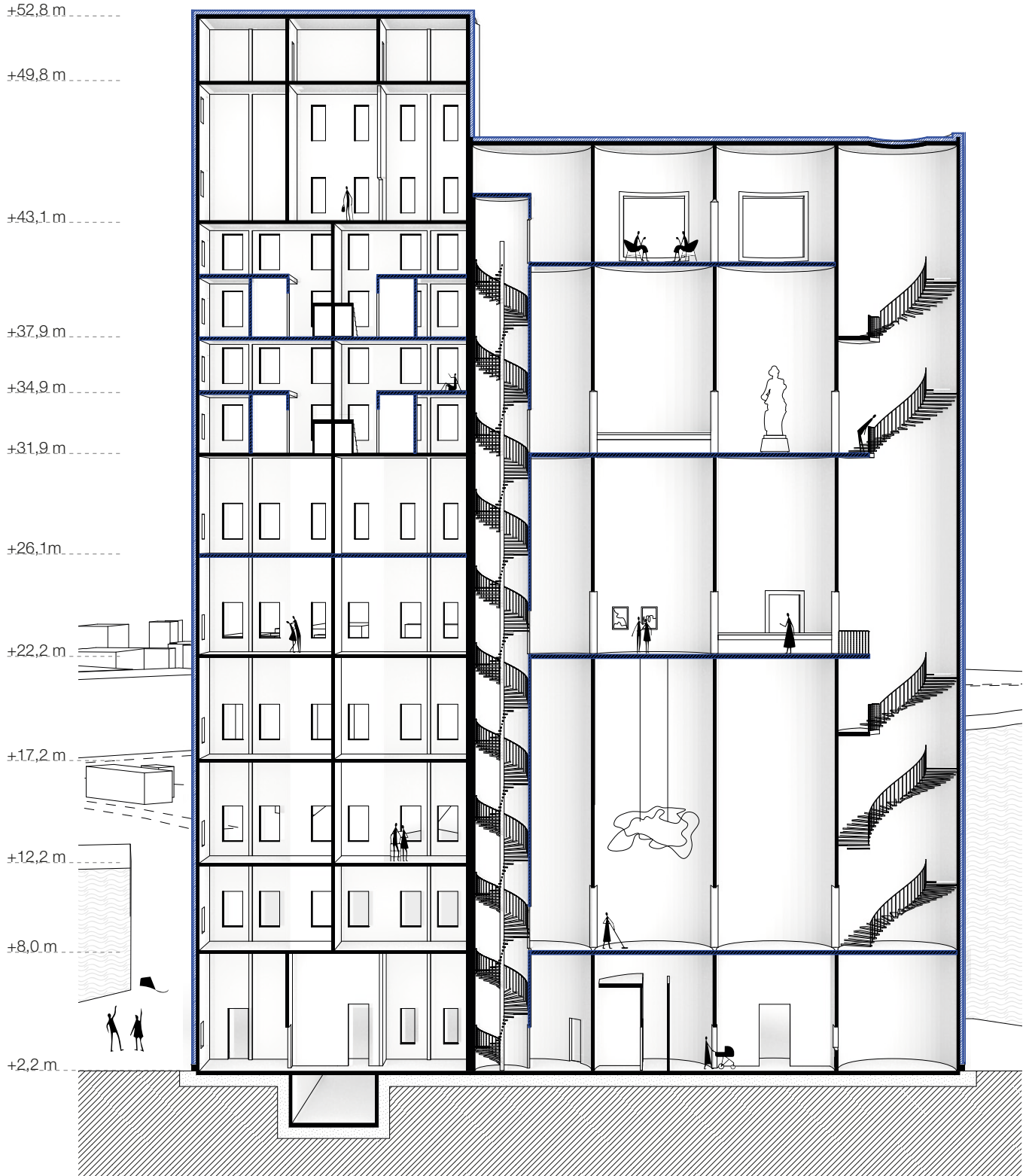
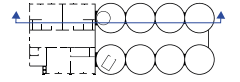


Figure 81. New section through cylinders, estimated perspective scale 1:250.



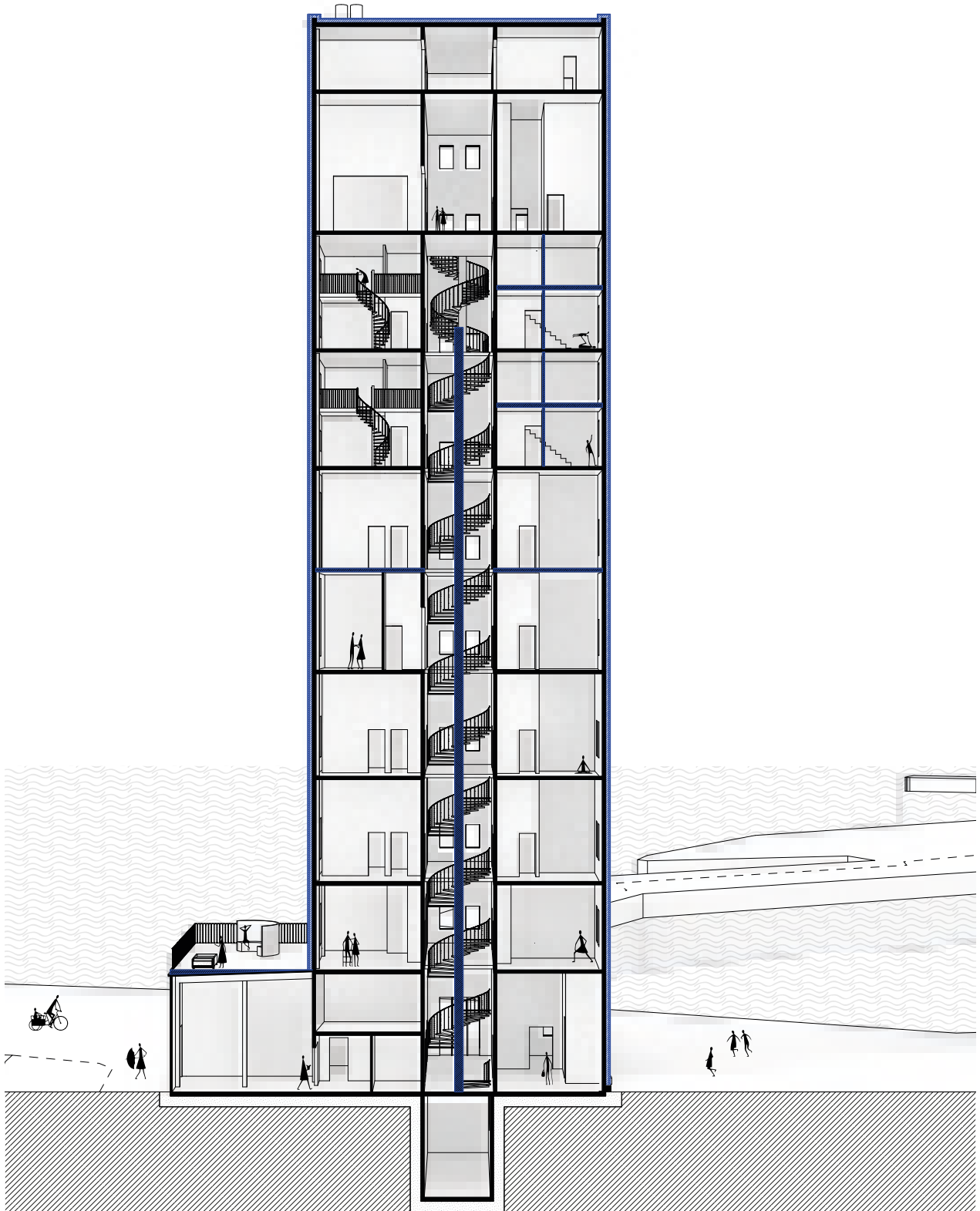
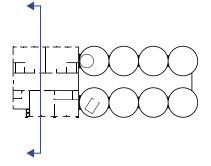


Figure 83. New section through apartments, estimated perspective scale 1:250.



Figure 84. View from parkinglot.

DISCUSSION

This master's thesis investigates how the grain silo in Ronehamn can be transformed through adaptive reuse into an architecturally attractive, unique and functional place that expands the building's potential uses and extends its lifespan. The project is grounded in the specific conditions of the site, the existing structural and spatial qualities of the silo, and the broader discussion surrounding the reuse of industrial structures.

The architectural concept builds largely on the inherent spatial qualities of the silo. The vertical scale, the large internal volume, and the material presence of the concrete structure create spatial conditions that would be difficult to reproduce in contemporary construction. The introduction of a circulation route through the building, conceived as a spatial journey through the silo, was therefore developed as a way to activate and reveal these qualities. Rather than concealing the industrial character of the building, the proposal aims to highlight and integrate it into the overall spatial experience, strengthening its *genius loci*.

This approach is informed by the theoretical frameworks of adaptive reuse and the 9R principles. The scale of interventions and structural alterations is continuously weighed against how the spatial experience can be enhanced and how the proposed functions may contribute positively to the local context of Ronehamn, while aiming to preserve as much of the original structure as possible. That only 5% of the existing structure is ultimately removed in the proposal could be seen as proof of this mindset. By working with the strategy of *aemulatio*, new elements are introduced that contrast with the existing structure in materiality or form. While such contrasts risk overpowering the expression of the original structure, carefully balanced interventions can instead clarify and emphasise the qualities of the existing building, which is the ambition of the project. Programmatically, the proposal combines a

more rational component, primarily housing, with more flexible and public functions like the exhibition walk and the restaurant. This responds both to local needs and to the ambition of creating a destination that can contribute to activity and attractiveness in the area.

At the same time, this strategy raises questions regarding programmatic clarity. The concept may be perceived as broad or somewhat undefined, and its success partly depends on whether the public functions generate sufficient interest and thereby income. In a more urban context, the building might have been able to function solely as housing. In Ronehamn, however, the monumental scale of the silo creates a natural tension between the large industrial structure and the relatively small surrounding community, making it more difficult to identify a single obvious use.

At the same time, this condition also highlights the unique value of the silo. A structure of this size and spatial quality would most likely never be constructed today in this location. Through adaptive reuse, these otherwise inaccessible spatial qualities can instead create unique architectural opportunities and, in this case, also shed light on broader local challenges, such as negative migration patterns and housing dynamics.

Because the typology of the concrete grain silo is so structurally defined, the interviews, discussions, and case studies conducted in this project also provide insights that may be relevant for other silo transformation projects.

Overall, the thesis demonstrates that the transformation of the Ronehamn silo is not only a technical or programmatic challenge, but also an architectural opportunity. By working with the building's specific spatial and material characteristics, adaptive reuse can both extend the lifespan of existing structures and create architectural qualities that would otherwise not be possible.

STUDENT BACKGROUND

We got to know each other during our time as Architecture and Engineering students at the bachelor's, where we developed a similar working approach and shared work ethic. Today, however, we are enrolled in different master's profiles: MPARC and MPDSD. Both profiles have a strong building design focus and incorporate the possibility of

transforming existing structures. The MPDSD profile focuses on the sustainable practice and feasibility of transformation, while the MPARC focuses on its structural and technical solutions. Collaboration between these two profiles has heavily strengthened our master's thesis and its grounding in reality.



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Mikael Ekegren	Supervisor, Chalmers
Emiline Elangovan	Doctoral Student, Chalmers & ACAN
Arne Pettersson	Board member, Ronehamn utvecklingsbolag
Elise Grosse	Sustainability manager, Sweco
Josefin Dorkhom	Architect, Ombyggnadsbyrå
Cia Heldtander Färnlöf	Architect, Cia byggkonsult
Emy Tiderman	Construction supervisor, Sweco
Angela Sasic-Kalagasidis	Professor building services engineer, Chalmers
Johan Gate	Property developer, Gate Group
Paula Femenias	Examinator, Chalmers

And a special thanks to the Nordin family for opening their home to us during our site visit to Gotland.

// Daniel + Linnea

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FIGURE LIST

Figure 1. Authors own image. The silo of Ronehamn.

Figure 2. Lundberg, O. (2025). The silo of Ronehamn, [photograph]. Unpublished.

Figure 3. Authors collage (2025). Silos in demolition, [collage].

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Figure 4. Authors own image. Geometric concept.

Figure 5. Authors own image. Concept of circular economy.

Figure 6. Authors own image. Methods.

Figure 7. Authors own image. Handbook.

Figure 8. Mestres Wåge /BAX/Mendoza Partida, (2024). Kunstsilo silosalen. [photograph]. <https://mestreswage.com/project/kunstsilo/#gallery-4>

Figure 9. Mestres Wåge /BAX/Mendoza Partida, (2024). Kunstsilo floor 2. [drawing]. https://divisare.com/projects/335549-mestres-wage-arquitectes-mx_si-architectural-studio-kunstsilo-competition-a-hub-for-arts-and-culture#l-g=1&slide=6

Figure 10. O-office Architects (2016). New intervention, [drawing]. Unpublished.

Figure 11. LIKYFOTO (2014). Silo-top outside perspective, [photograph]. Unpublished.

Figure 12. Authors own image. Wheat field.

Figure 13. Löfstedt, E. (N.d). Ägare:/1974-78/: Lars-Åke Hartzell. Hemort: Ronehamn, [photograph]. <https://digitaltmuseum.se/021015723578/agare-1974-78-lars-ake-hartzell-hemort-ronehamn>

Figure 14. Min karta (2026). Satellite site plan of Ronehamn processed, 1:5000, ©Lantmäteriet [satellit photography]. <https://minkarta.lantmateriet.se/>

Figure 15 - 21. Authors own image. Site analysis.

Figure 22. Javanaud Emdén, T. (2025). Skalgubbar, [photograph]. <https://skalgubbar.se/>

Figure 23 - 84. Authors own image. Project.

APPENDIX A



May, 2026

Congratulations!
If you are reading this and are planning to transform a grain silo. The following text will give you some insights from our thesis work and maybe help you find the right way towards a transformation. Enjoy the reading and remember that every project always has its own challenges and advantages. This is a general guide that aims to help you along the way, or, of course, for you if you're totally into concrete grain silos.:)

// Daniel Escabarte Svärd + Linnea Brose

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INVENTORY

When starting a transformation project, early analyses are important to propose a feasible and realistic proposal. Through initial discussions with Ekegren M. (2025) regarding transformation projects, it became clear that an inventory is the first important step to find out the current condition of the building. It involves visiting the site, taking photos, measuring elements and distances, experiencing volumes and spaces inside and out, and investigating the physical shape. It is also suggested to investigate what physical materials, such as drawings and other types of records, exist that can be accessed digitally or physically in different archives. In the silo of Ronehamn, we first assumed that since it had not been used for grain storage for 20 years, it would be an empty structure in solid concrete from what was possible to see from the original drawings. This was not the case, it was filled with big machinery and piping for the grain to dry and travel around the building to the right storage unit. It is therefore crucial to have access to the inside.

Further, we suggest speaking to people in the surrounding area and examining the

local housing market. As well as mapping out existing businesses, activities, public transport, infrastructure, sewage and water systems, ancient remains, natural areas, and sports facilities. In short, create an inventory that shows the status of your silo and the surrounding area. What is there, what is not there, in what condition is the silo?

POINTS TO CONSIDER:

- + have access to the inside of the silo
- + compile existing material of the silo (drawings, investigations, history etc.)
- + investigate the silo through photos, initial thoughts, physical measurements
- + conduct a site analysis



THE CONCRETE

Concrete structures are commonly designed for service lives of 50-150 years, depending on their intended use, exposure conditions and design requirements. To achieve this, durability considerations must be incorporated already at the design phase. Over time, maintenance, repair and renovation may be required to preserve structural performance and extended service life. When continued use is no longer technically or economically feasible, the structure may require extensive rehabilitation or dismantling. (Prieto et al., 2023)

According to Jacobsson (2025), detailed inspection and condition assessment of the concrete are necessary to determine whether the silo structure can be safely repurposed. He also notes that original construction drawings may not fully reflect the as-built condition of the structure, particularly regarding the actual placement and extent of reinforcement. This further supports the need for a detailed condition assessment, for example including ground penetrating radar scanning, to verify the reinforcement layout.

Alhede (2025) also highlights the importance of assessing carbonation and chloride ingress. The latter is particularly relevant in this case, as the silo is located in a marine environment where chloride exposure may increase the risk of reinforcement corrosion. These deterioration mechanisms should therefore be considered as part of the condition assessment when evaluating whether the silo structure can be safely repurposed.

Depending on the original function of a concrete structure, its load-bearing system may provide favorable conditions for repurposing. In the case of the Ronehamn silo, information about the original structural design should be reviewed, if available, to assess how the existing structural capacity relates to the proposed new use. For example, the silo batteries were reportedly designed to withstand a maximum horizontal load of 8,000 tons. According to Alhede (2025), the original structural function of the silo suggests that its load-bearing system may have sufficient capacity for a new use such as housing, since such structures are generally designed for

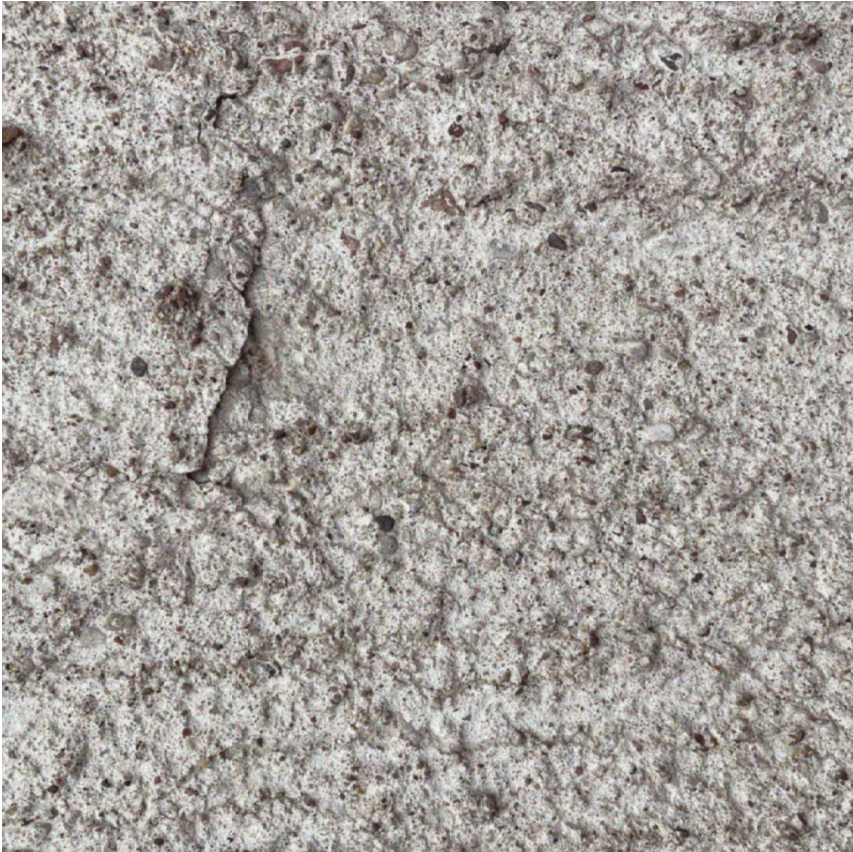
substantial loads from stored material. However, this must be verified through structural assessment, considering both the current condition of the silo and the load demands associated with the proposed new use.

POINTS TO CONSIDER:

- + conduct a detailed condition assessment of the reinforced concrete structure
- + verify the reinforcement layout, for example, by using ground penetrating radar or other suitable non-destructive techniques
- + investigate whether the structure has been properly maintained and identify any signs of deterioration (cracking)
- + assess carbonation depth and chloride ingress testing, especially since the silo is located close to the sea
- + evaluate the current load-bearing capacity in relation to the proposed new use
- + establish a maintenance plan to ensure long-term durability after transformation



6



5

INHERENT GEOMETRICAL VALUES

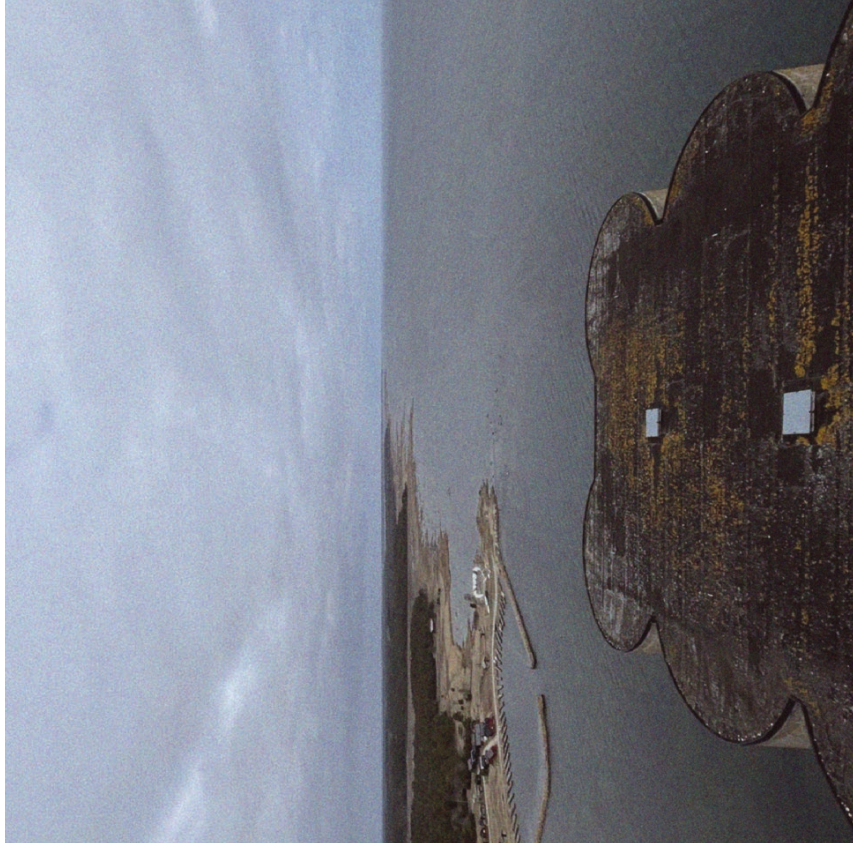
The silo in Ronehamn is mainly composed of rectangular and circular geometrical forms and is approximately symmetrical along its main axis. According to Alhede (2025), such symmetry can be structurally favourable because it may allow vertical loads to be distributed more evenly through the load-bearing walls and foundation. Furthermore, when the centre of gravity and centre of rigidity are located close to each other, torsional effects from horizontal actions, such as wind loads, may be reduced. Silos are also typically designed to resist horizontal pressure from stored grain, which acts outward on the silo walls and may cause bulging. These characteristics may make the original load-bearing system favourable for repurposing, provided that the present condition and structural capacity are verified.

Beyond the structural advantages of the inherent geometry, the geometric forms provide architectural qualities that cannot be easily replicated through conventional construction methods or economically justified in a new-build project. Through a silo transformation project, these volumes and spaces can

be made accessible to a wider audience, offering an experience that is both unique and majestic. If carefully reimaged, architectural qualities of this kind can enhance the site's attractiveness to visitors when the aim is to transform the building into a popular destination.

POINTS TO CONSIDER:

- + look out for symmetrical axes
- + look out for unique volumes, which can be accessed through the transformation



CONTEXT + PROGRAMMING

Each site, regardless of the project, differs. Despite this, the location of silos that were erected around the middle of the 20th century in Sweden share several similarities. According to Carlquist et al.(2006) report it can be seen that almost all their investigated silos are located and constructed around transport nodes or industrial areas. These locations are often located near water, like the silo in Ronehamn, or railway transportation nodes, both in rural and dense urban areas.

To create a suitable program, the difference between an urban and rural context is of great importance, as it concerns the demand and supply of the area's stakeholders. To propose a sustainable long-term program for buildings that aim to benefit the surrounding area, thorough analyses must be conducted before developing proposals. When discussing with Ekström (2026), it became clear that silos placed in urban areas, with only rare exceptions, have a higher demand for spaces like housing, offices and public functions in comparison with buildings in a rural context due to the population density.

A silo in a rural context, as Carlquist et al.(2006) state, is a misplaced skyscraper, which automatically makes it a prominent landmark in its surroundings, compared to an urban area where it has a higher possibility to blend in. It is important to keep in mind that a transformation of a silo in a rural context creates a visually more prominent feature in the landscape than in an urban one.

POINTS TO CONSIDER:

- + keep the site analysis in mind
- + rural placement- consider thoroughly analyses of the context to propose a function or a multifunctional program that enhances the area
- + urban placement - consider analyses but in general could housing, offices and public functions, separately or multifunctional be successful
- + be aware of the change of function and its possibility of gentrification



LOAD-BEARING STRUCTURE

Concrete silos are designed to withstand enormous loads. One cubic meter of wheat weighs approximately 800 kg, and even a relatively small silo, such as the one in Ronehamn, can store up to 10000 m³, corresponding to roughly 8000 tonnes of material. Their ability to resist these forces is largely due to the substantial amount of reinforcement used in the concrete. Silos are specifically engineered to withstand significant horizontal pressures generated by the stored grain pushing against the cylindrical walls. In circular silos, these forces are primarily resisted through compression rings, within the walls. The continuous cylindrical geometry is therefore fundamental to both the load-bearing capacity and the overall structural stability of the silo.

When adapting or repurposing a silo, it is essential to understand how loads are transferred through the structure. If a silo is converted from grain storage to supporting floor slabs instead, the structural behaviour changes considerably. The dominant load shifts from large outward horizontal pressures to mainly vertical loads transferred

downward through the walls. This is not only a significantly smaller load magnitude, but also generally a more favourable structural condition. Nevertheless, the new load case must be carefully analysed, as the structure was originally designed for a different and highly specific loading scenario. (Tiderman, 2026)

To preserve the structural integrity of the silo, interventions in the cylindrical walls should be minimised, as large openings can significantly reduce the structure's ability to distribute and resist loads. Cutting through the hoop reinforcement may, however, be necessary to allow access within the silo cells. In such cases, it is crucial to reinforce the upper edge of the opening so that forces can be redirected around it. This can, for example, be achieved through carbon fibre reinforcement or steel banding curved along the surface to redistribute stresses around the opening. Another possible solution is the installation of a steel or concrete lintel, or embedding new reinforcement bars diagonally above the openings' corners to reduce stress concentrations and

prevent crack formation (Ahlhede, 2026). Where existing openings are already present, new openings should ideally align with them in order to maintain the most efficient and continuous load path possible through the structure.

In summary, reinforced concrete silos possess a very high inherent load-bearing capacity due to their massive construction and structurally efficient geometry. Because they are originally designed for extremely large loads, they are often well-suited for adaptive reuse and transformation. At the same time, their structural performance is highly dependent on the continuity of the cylindrical form and the way loads are transferred through. Any modifications should therefore be carried out with careful consideration of the silos' original load paths and structural principles.

POINTS TO CONSIDER:

- + minimise the number of new openings
- + reinforce new openings to redirect loads around them
- + align new openings with existing openings whenever possible
- + identify efficient load paths with the help of a structural engineer early in the design process



EXTERIOR LAYERS

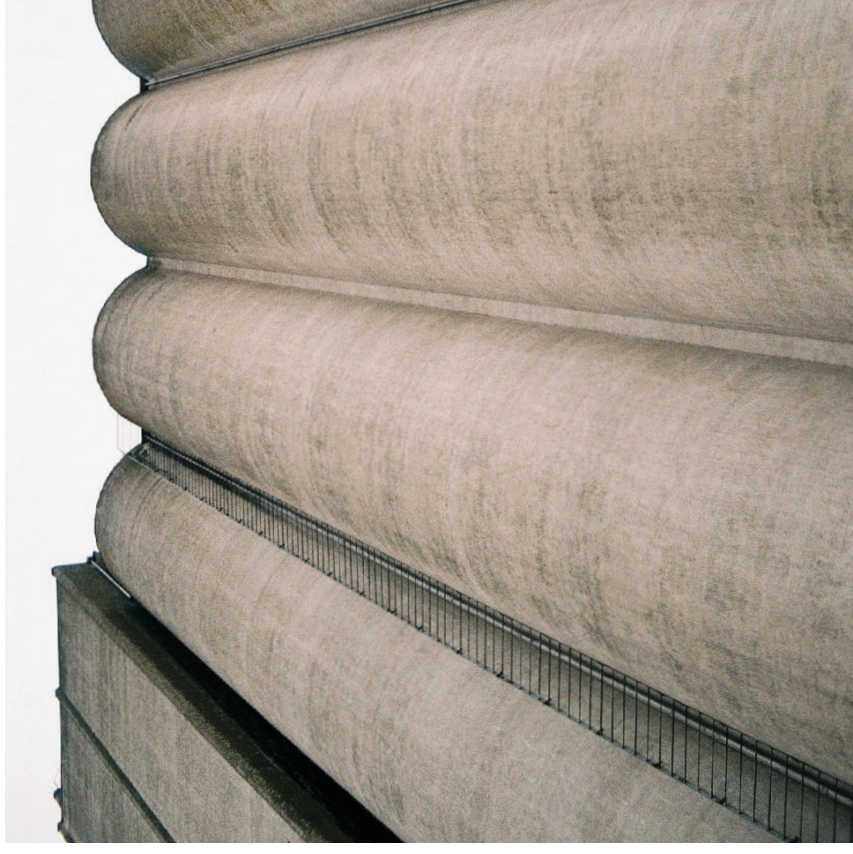
If a concrete silo is transformed into, for example, housing, a higher indoor comfort is required than before, which means that the structure must be insulated. Sasic-Kalagasidis (2026) states that if you insulate a concrete structure from the outside and leave the inside exposed without being covered by panels or cladding, the high thermal inertia of the concrete is used in the most energy-efficient way and can create a comfortable indoor climate. The reason, concrete has a high capacity to function as a thermal storage system for heat and cold. To reach a thermal transmittance level of $0,15 \text{ W/m}^2\text{K}$ for a 160mm thick concrete wall in a Swedish location, a layer of approximately 200mm insulation material with a thermal conductivity of $0,035 \text{ W/mK}$ is needed. Both EPS and mineral wool have this property, the choice may therefore depend on the economic possibilities.

Sasic-Kalagasidis (2026) suggests that, to provide thermal insulation from the outside that is both cheap, fire-resistant and moisture-proof, EPS and mineral wool can be combined. Approximately a 60mm layer of mineral wool on top

of the EPS is enough to reduce the spread of fire throughout the facade, when additional firebreaks in mineral wool are placed around every joist. It is further suggested to clad the facade in a sheet material like steel with a ventilated air gap. It is discouraged to plaster on top of the insulation, even if it is the most cost-efficient solution, due to the quick installation cost. This results from when EPS and plaster are put in a highly exposed coastal environment, the plaster easily cracks or flakes, especially on large surfaces and at high altitudes. Such a facade will require extensive maintenance, a cost driver, especially given that large parts of it are difficult to reach without scaffolding or a crane.

POINTS TO CONSIDER:

- + if insulated, insulation is to be put on the outside, covered with a sheet material, both for thermal reasons, and to protect the concrete structure from further degradation and weathering
- + scaffolding will be required when exterior layer is being installed



HVAC

HVAC, as in heating, ventilation, and air conditioning, is a lacking feature in silo structures since only a few people are located in the building where it is operating in its initial function. In this spread, water management and sewing will be added to the discussion. In the silo of Ronehamn, there are some facilities on the bottom floor, like bathrooms, showers and offices, shown in the original entrance floorplan on page 32.

Sasic-Kalagasis (2026) highlights the need for added ventilation with an air handling system on top floors when transforming a silo. Preferably, a heat-recovery ventilation system with a bypass and double piping to the ventilated spaces. The bypass allows cool, fresh air at night in summer to bypass the heat exchanger and recovery system, which saves energy in both winter and summer.

Further on, if the silo is placed in a sunny location, there is a risk of overheating during summer due to the high number of sun hours. It is therefore important to provide sun protection even if the building's thermal inertia is helping to hold lower temperatures inside.

If the silo has cellars like in Ronehamn, see appendix C, heating systems, water storage and wastewater treatment plants could be placed there. To provide sustainable and efficient in-house water management, we suggest that the possibilities of using grey water for toilet flushing is researched, as well as other solutions that can minimise the waste of freshwater. A result of that could be that the building becomes self-sufficient for water, which is especially important for locations where fresh water is scarce.

If these suggested systems are placed, the shaft size has to be generously planned. Since the ventilation bypass system needs double air piping, and if both grey water and freshwater are used in bathrooms, double water pipes have to be added as well.

The suggested location for HVAC in the silo of Ronehamn can be seen in appendix C.

POINTS TO CONSIDER:

- + investigate existing HVAC systems
- + investigate dimensions of existing electrical connections, water and sewage pipes
- + investigate the size of the needed room HVAC systems and check it against the size of the cellar and the top floor (cellar for water + sewage, top floor for air handling and heat recovery units)
- + when planning floors, provide generously with space for piping for water, sewage and ventilation
- + research the potential to reuse grey water and rainwater as water flushing solutions

ADDED JOISTS + SLABS

One large intervention that needs to be considered when transforming a silo is to add new joists and slabs to make use of the spaces with high ceiling heights. As a reference, in Ronehamn, the highest open vertical room goes up to 40 meters and has a floor area of 25 square meters. Tiderman (2026) suggest doing two different solutions in the round and rectangular parts since other principles are efficient in their different geometrical shapes. The two solutions that are proposed in discussion with Tiderman (2026) can be seen on page 63 and 65 in the main booklet. If these solutions are considered, the structure has to be strong enough to withstand the payload and dead weight of the added elements.

When adding new joists in rectangular parts of a concrete structure, a common solution with gluelam beams can be used due to the geometry. It is an established industry practice and an efficient way to construct joists on concrete structures. (Tiderman, 2026)

The added joist in the cylindrical spaces requires a special solution. The proposed solution is designed in consultation with

Tiderman (2026). The joist consists of a composite slab system formed by trapezoidal profiled steel sheeting and cast-in-place concrete. To attach the system to the wall, steel reinforcement is injected into the old concrete and put in the cast-in-place concrete slab.

POINTS TO CONSIDER:

- + the concrete structure is structurally strong enough to withstand the load of the added elements.



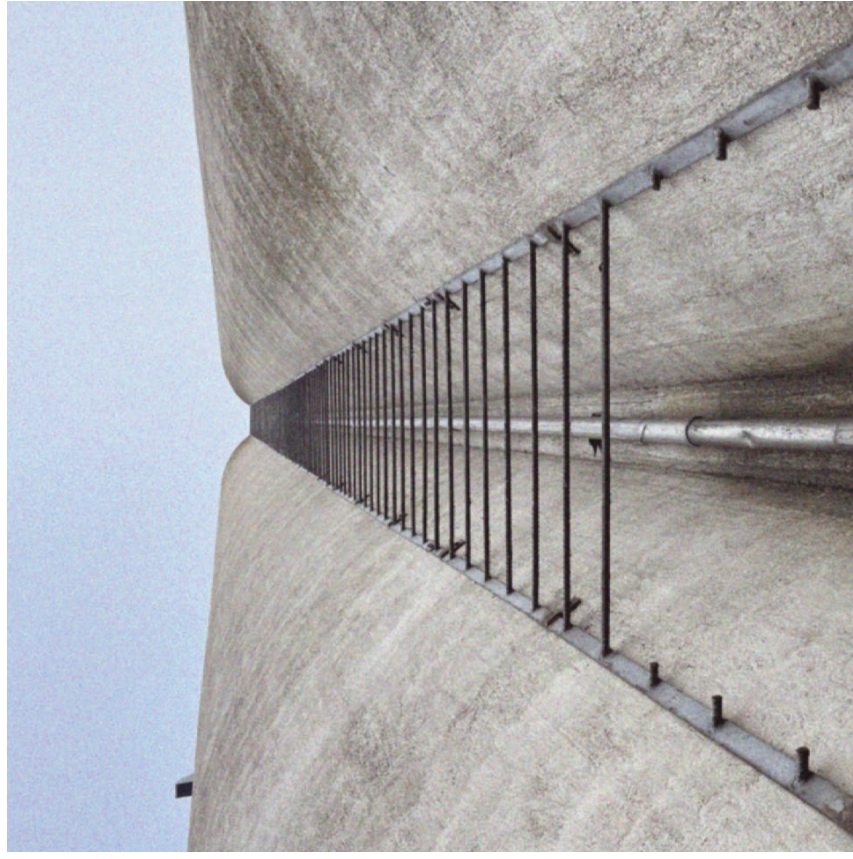
FIRE

When changing the function of a high-rise structure, specifically when adding floors, several additional fire safety requirements have to be taken into account. Sasic-Kalagasidis (2026) suggests involving a fire safety engineer as early as possible when working with the space program. This is to manage and design the transformation in a safe way, ensuring that fire regulations are fulfilled early on and do not cause problems with the proposal and its design further on. Since silos are high-rise buildings, vertical communication, like stairways and elevators, will take up a lot of space and have to be planned effectively. She further points out that these large communications have to be fireproof units and to provide fire cells for each floor, which could be as simple as areas closed off with concrete, which already exists and with fireproof doors. For the vertical communication units is important to consider the building's airflow and ensure the stack effect can be blocked off in case of a fire. Otherwise, there could be a need for a sprinkler system, which is contributing to increased costs, and its water storage needs space.

Fire safety needs to be thought of when choosing, for example, insulation material, since different uses require different fire classification levels. The cheapest choice is EPS, but if it is used solely, fire classification rules are not reached due to its melting point at approximately 60 degrees, which can cause fire to spread rapidly across the entire building. Instead, EPS and mineral wool could be combined to create a fire-resistant facade. Additionally, a barrier of mineral wool should be placed around windows and joists to further adjust the risk of fire spreading. On the larger facade parts, there is a lower risk of the EPS insulation catching fire, but the facade openings are critical. (Sasic-Kalagasidis, 2026)

POINTS TO CONSIDER:

- + involve a fire safety engineer when doing the space program and planning vertical connections
- + reduce large vertical open rooms to avoid having a strong stack effect in case of fire



ECONOMY

Through a conversation with the property developer and manager Gate (2026), it became clear that a silo transformation, with current conditions, will always be more expensive than a new construction from scratch if looking at building the same function. To have a reference for this, Kustsilo transformation in Kristiansand mentioned in the booklet, which was finished in 2024, had a budget of approximately 700 million sek (Mestres Wåge Arkitekter, n.d.).

Investing in silo projects will always be a risk, especially if it is placed in an off-grid location. The advantage of silos is that they are existing structures that already have an anchor in their local area and can, through that and a transformed function, create values that would never have been possible with new constructions. According to Gate (2026), the challenge to make silo transformations, especially in rural areas, is to create a destination for the right target group and an attraction for buildings that can create long-term economic growth. One possibility to make silo transformation more economically feasible for an investment with economic constraints could be to divide the

transformation into different steps. With the right idea, investor, developer and location, it can be successful. But it is always accompanied by an unavoidable economic risk.

POINTS TO CONSIDER:

- + important to have the right investor and developer
- + concept, location, the proposed program, and the target group are important factors for its success
- + if the project is divided into different phases, it may be more economically feasible
- + be aware of the economic risk



REGULATIONS

When proposing a change in function for a silo in Sweden, regulations in the detailed development plan must be taken into account to realise a transformation. Heldtander Färniöf (2026) explains that if an area like Ronehamn harbour has to be transformed, there is a need to change or renew the detailed development plan(DP=detailedplan).

This can create problems in the Ronehamn case, as the renewal of the detailed development plan can create a return of the coastal protection law. An additional factor that Heldtander Färniöf (2026) points out is that for the silo in Ronehamn, the building is below the two-meter sea level rise line, which in other cases would prevent new construction and could lead to delays or difficulties when changing the detailed plan.

Beyond that, it is important to have in mind that the process of changing or renewing the detailed development plan is a time-consuming process, which in many cases in Sweden takes at least a couple of years. The suggestion from her is to early start a conversation about

this kind of transformation with the local municipalities and also see how a transformation can fit into their general plan (OP=översiktsplan), to have more underlying arguments to be able to adjust the detailed development plan and make the project feasible.

POINTS TO CONSIDER:

- + investigate the opportunities in the detailed development plans for the location of transformation
- + establish early contact and dialogue with regulatory and decision-making bodies within the municipal planning and building processor
- + look into the local municipality's general plan to identify arguments that support your project that align with the municipality's vision



THANKS TO YOU,

for generously sharing knowledge, ideas,
insights and taking time to help us shape this
thesis and handbook.

// Daniel + Linnea

Oliver Lundberg
Arne Pettersson
Mikael Ekegren
Mikael Jacobsson
Andreas Alhede
Martin Ekström
Angela Sasic-Kalagaidis
Josefin Dorkhom
Emy Tiderman
Cia Heldtander Färnlöf
Johan Gate

Owner of the silo, Gotlandschips
Board member, Ronehamn utvecklingsbolag
Supervisor, Chalmers
Concrete structural investigator, Northscan
PhD structural engineer, Chalmers
Owner of silo in Hjo, Hjo Bygg & Anläggning
Professor building services engineer, Chalmers
Architect, Ombyggnadsbyrå
Construction supervisor, Sweco
Architect, Cia byggkonsult
Property developer, Gate Group

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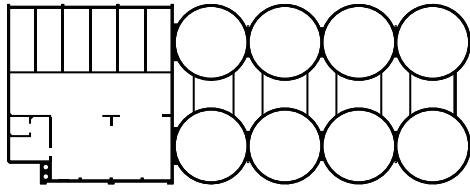
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This handbook is appended as appendix A to the master's thesis:

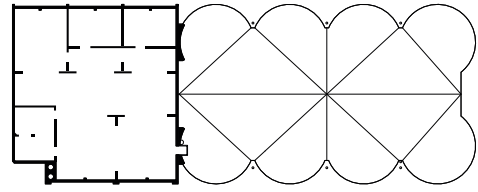
**REIMAGINING THE GRAIN SILO OF RONEHAMN:
ADAPTIVE REUSE OF RURAL INDUSTRIAL
HERITAGE**

APPENDIX B

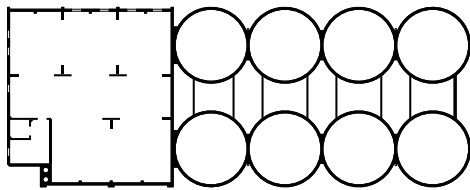
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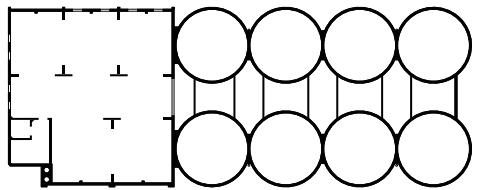
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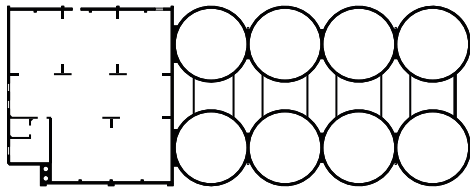
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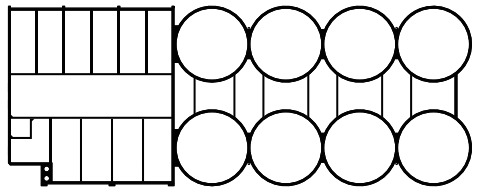
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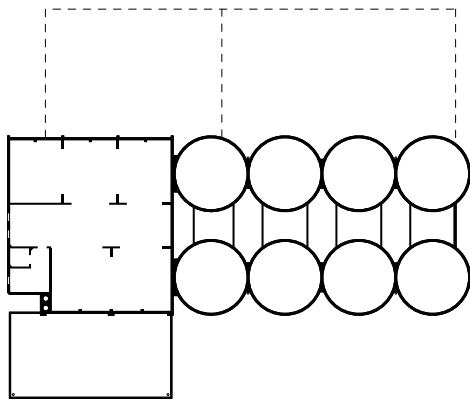
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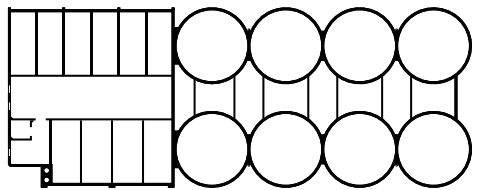
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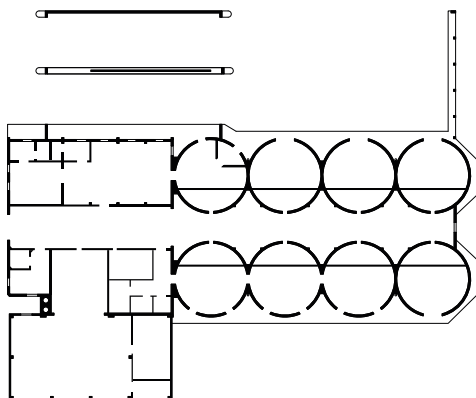
Floor 1, +8.0m



Floor 6, +31.9m



Entrance floor, +2.2m



Floor 5, +25.2m

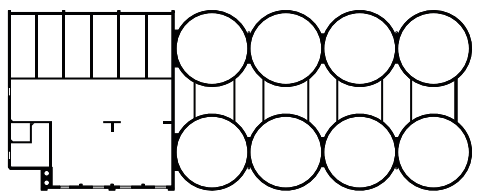
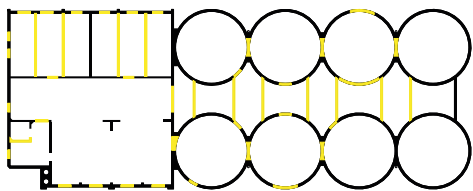
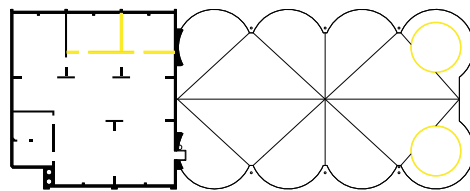


Figure 1(appendix A). Floorplans of existing structure, scale 1:600.

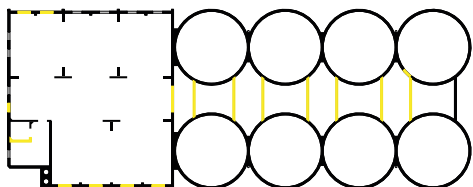
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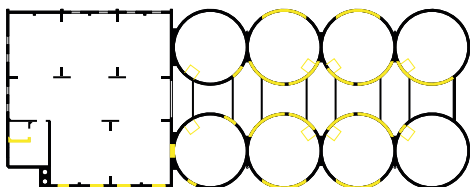
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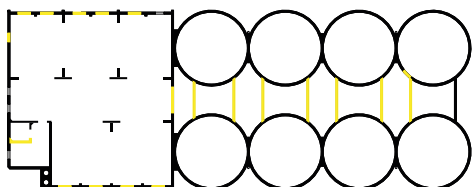
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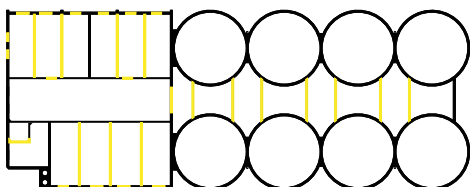
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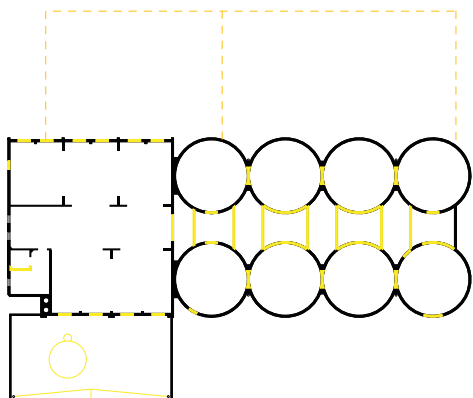
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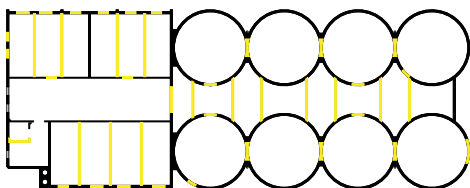
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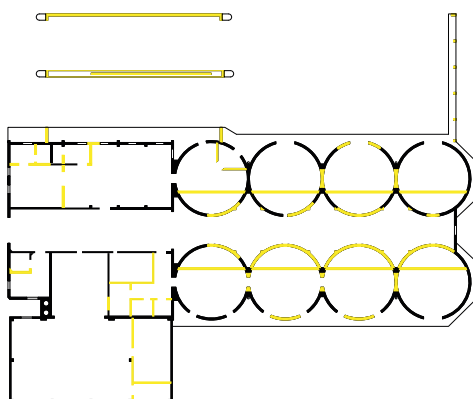
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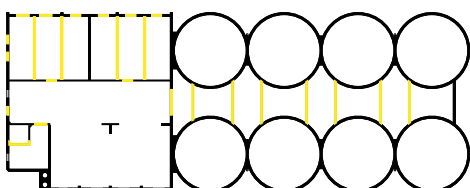
Floor 6, +31.9m



Entrance floor, +2.2m



Floor 5, +25.2m



Removed concrete

Figure 49. Demolition plan, entrance floor-ninth floor, scale 1:600.

APPENDIX C

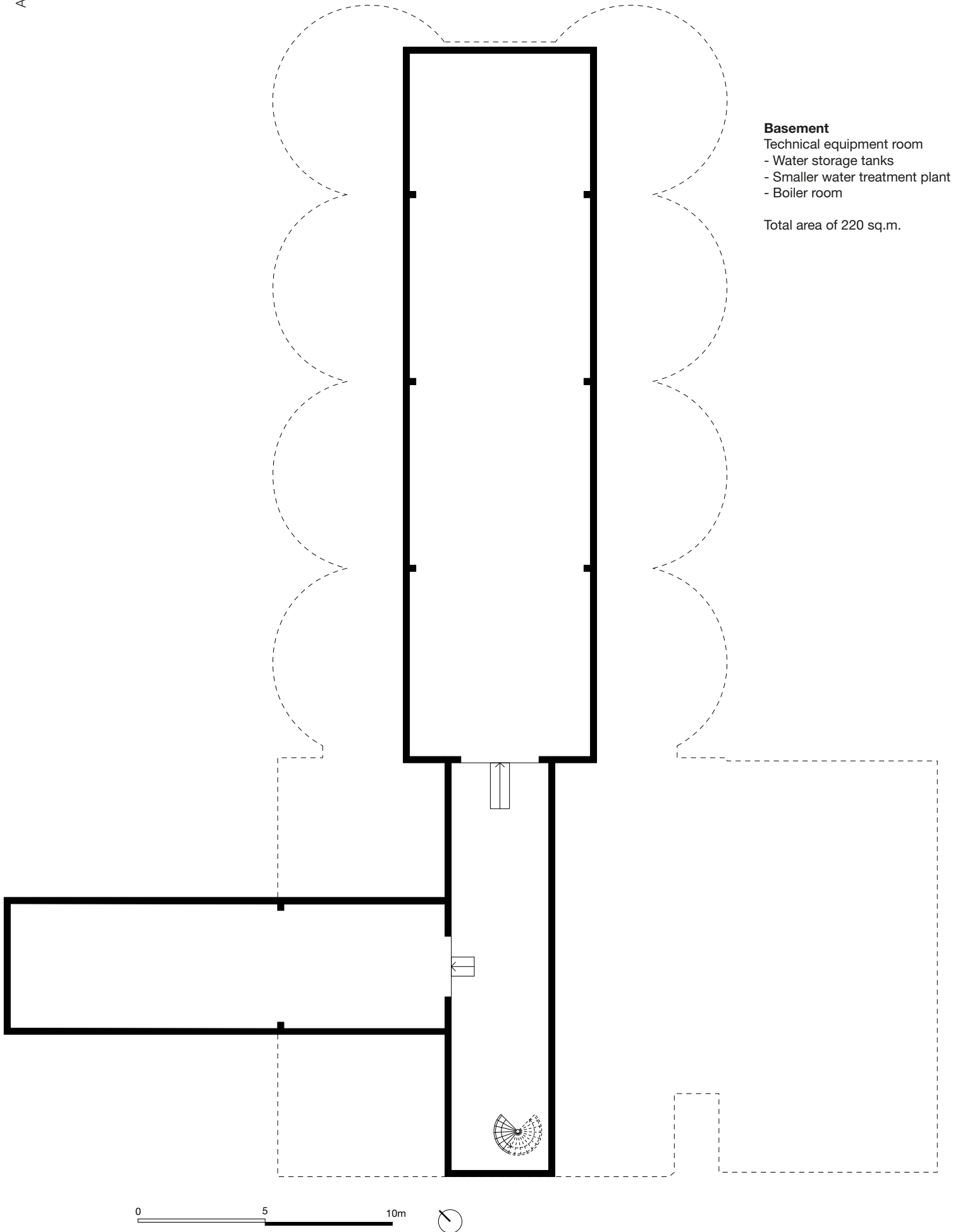
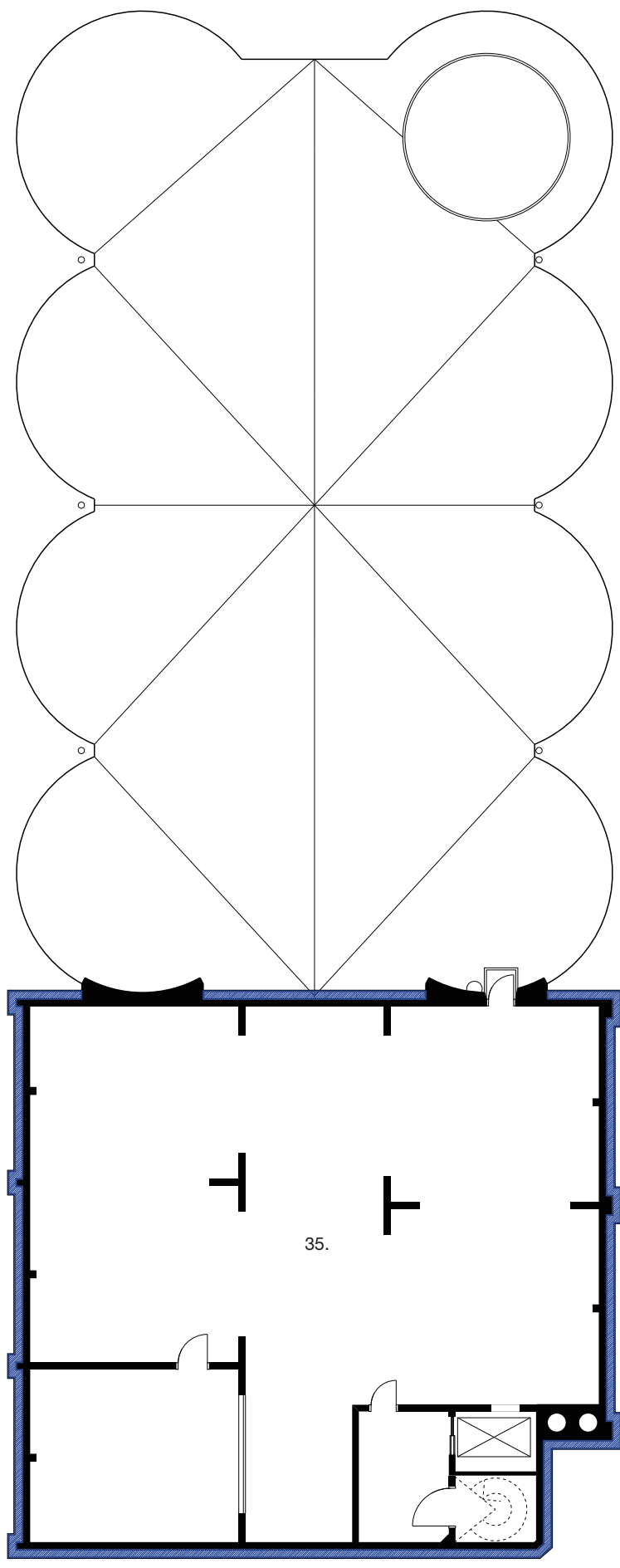


Figure 2(appendix C). Basement, scale 1:150.



Floor 9
35. ventiation room 170 sq.m.
[HRV + bypass]

Figure 3(appendix C). Floor plan 9, scale 1:150.

APPENDIX D



Figure 4(appendix D). Building model, scale 1:100.



Figure 5(appendix D). Building model, scale 1:100.



Figure 6(appendix D). Building model, scale 1:100.



Figure 7(appendix D). Building model, scale 1:100.



Figure 8(appendix D). Landscape model, scale 1:1000.



Figure 9(appendix D). Landscape model, scale 1:1000.



CHALMERS
UNIVERSITY OF TECHNOLOGY

Master thesis
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