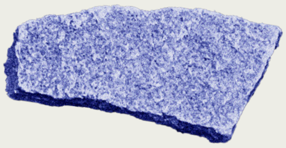
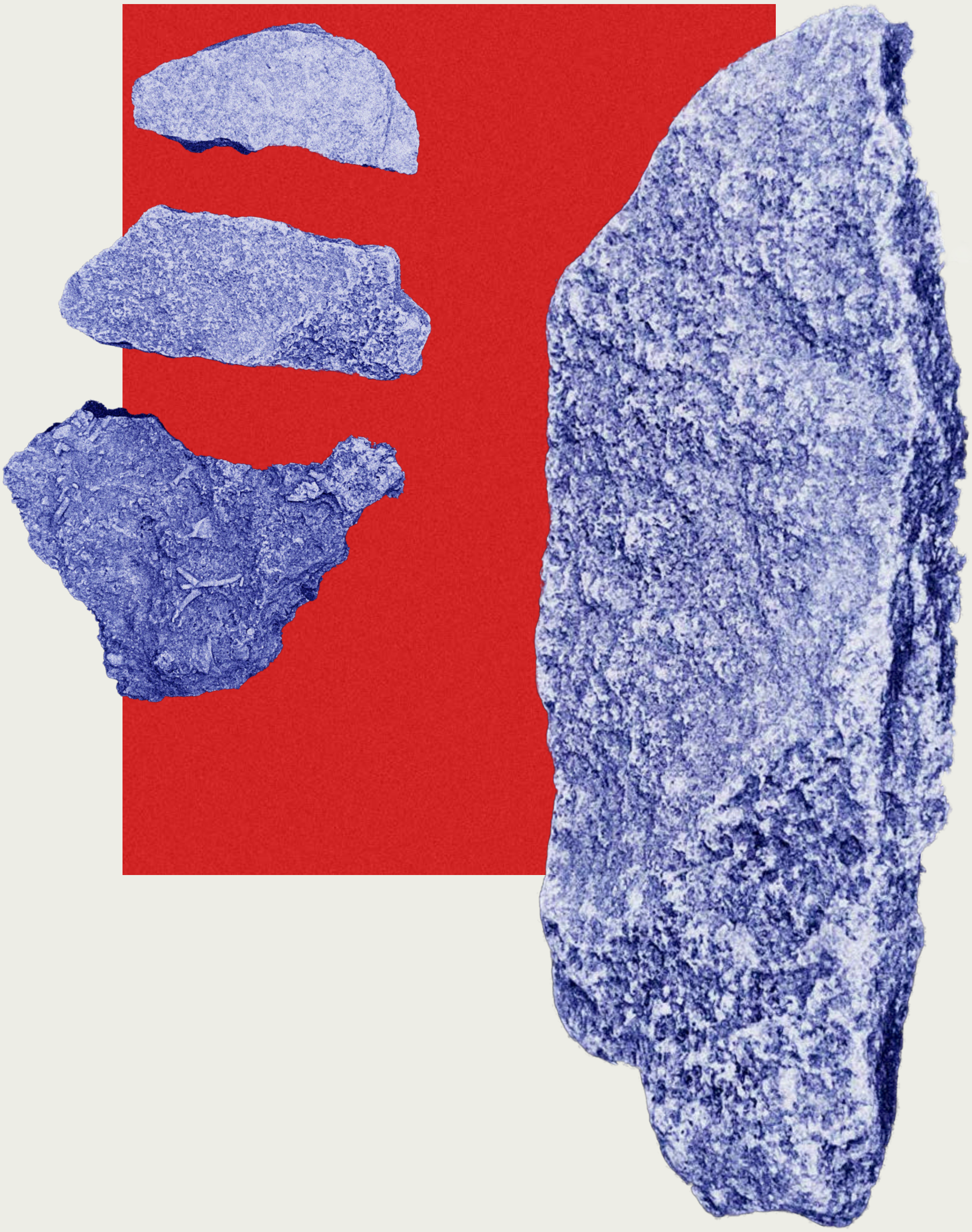


POST-EXTRACTION MATTERS

RE-PROGRAMMING SMÖJEN LIMESTONE QUARRY THROUGH LANDSCAPE-BASED DESIGN



Thanks to...

Nils, for challenging my ideas and for your continuous support in times of doubt.

Marco, for making me feel understood and deepening the discussions.

Mom, for the many late night discussions and for taking my messy mind seriously.

Yrr, for being my role model, showing that strong and kind is the ultimate combo, and for believing in me for both of us when needed.

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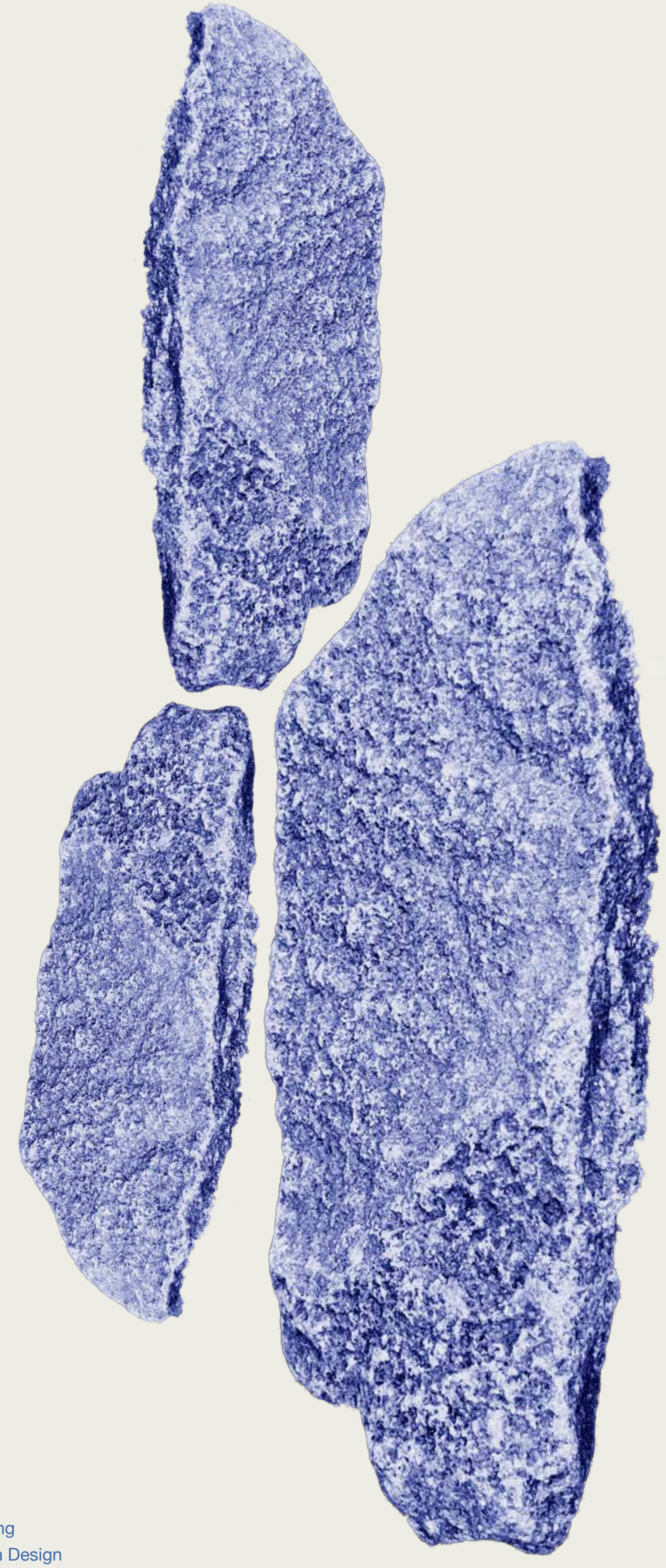
Kajsa, Alex, Sara and Agnes for checking in on good days and bad.

...and to all of you who have enriched this journey and kept me sane during these years.



CHALMERS
UNIVERSITY OF TECHNOLOGY

Post-Extraction Matters
Re-programming Smöjen limestone quarry through landscape-based design

Master's Thesis Spring 2023
Rurban Transformations
Chalmers School of Architecture
Department of Architecture and Civil Engineering
Master's Programme of Architecture and Urban Design

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ABSTRACT

With the disused quarry at Smöjen, Gotland as a context, this thesis asks the question *How can architects take responsibility for the use of materials when re-programming post-industrial landscapes?* The thesis aims at highlighting the necessity of conscious use of materials by utilizing the landscape. The argument is being made that the physical limitations that come with a landscape-based design could be formulated as a creative framework that opens up for interesting solutions while avoiding depletion of recourses.

As a result of mining natural resources on an ever-increasing scale, the amount of extraction sites have multiplied. Today, there are rules and guidelines for the rehabilitation of quarries, but quarries from before the 1970s have not been subject to rehabilitation in the same way. The harsh landscape alterations of dis-used quarries make the landscape-rehabilitation process slow, but the same barren landscape with its traces from past lives have proven to attract an increasing number of visitors. Smöjen is subject to this increasing tourism meanwhile in need of rehabilitation to prevent potential safety hazards. Regionally, Smöjen is defined as an area of development in the larger context of the Gotland archipelago.

The thesis proposes an intervention at Smöjen limestone quarry, focusing on three support structures for information, visits and accommodation, using the existing landscape and material remains as a design framework. Literature research, archive visits and extensive site explorations have informed the design proposal. In addition, an extension of the hiking trail S:t Olofsleden is proposed, adding context to Smöjen and other already established visitor destinations along the north-east coast.

The thesis focuses on the understanding of the material in the early phases of the design process. The proposal preserves and strengthens the identity of Smöjen, demonstrating concept development in relation to material use and circularity and contributes to the discussion regarding the architect as consumer of building materials.

Keywords :
Post-industrial, Non-extractive architecture, Landscaped-based design, Gotland, Limestone, Local resources, Tourism development, Waste hierarchy

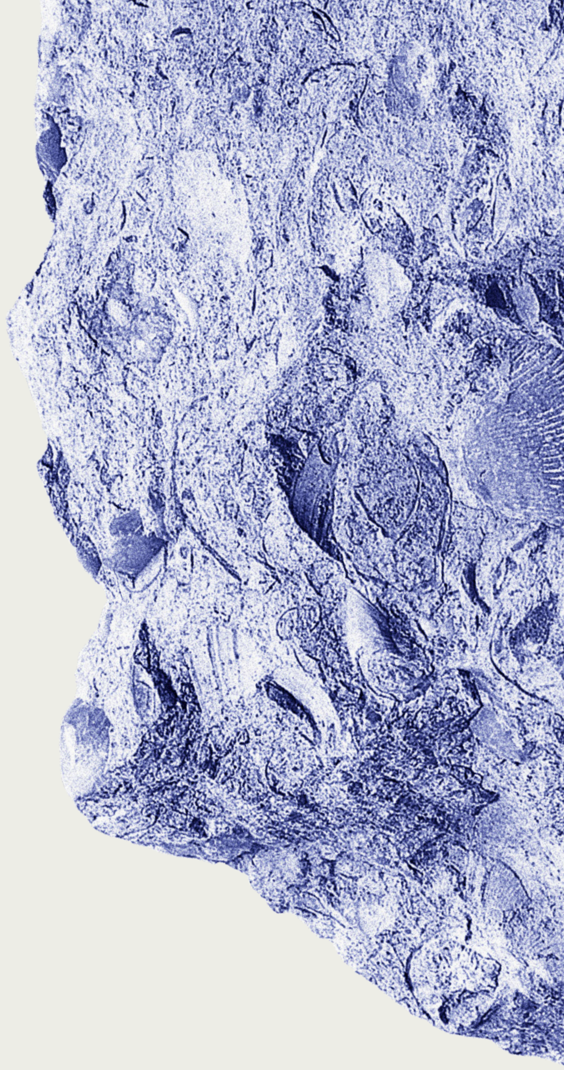
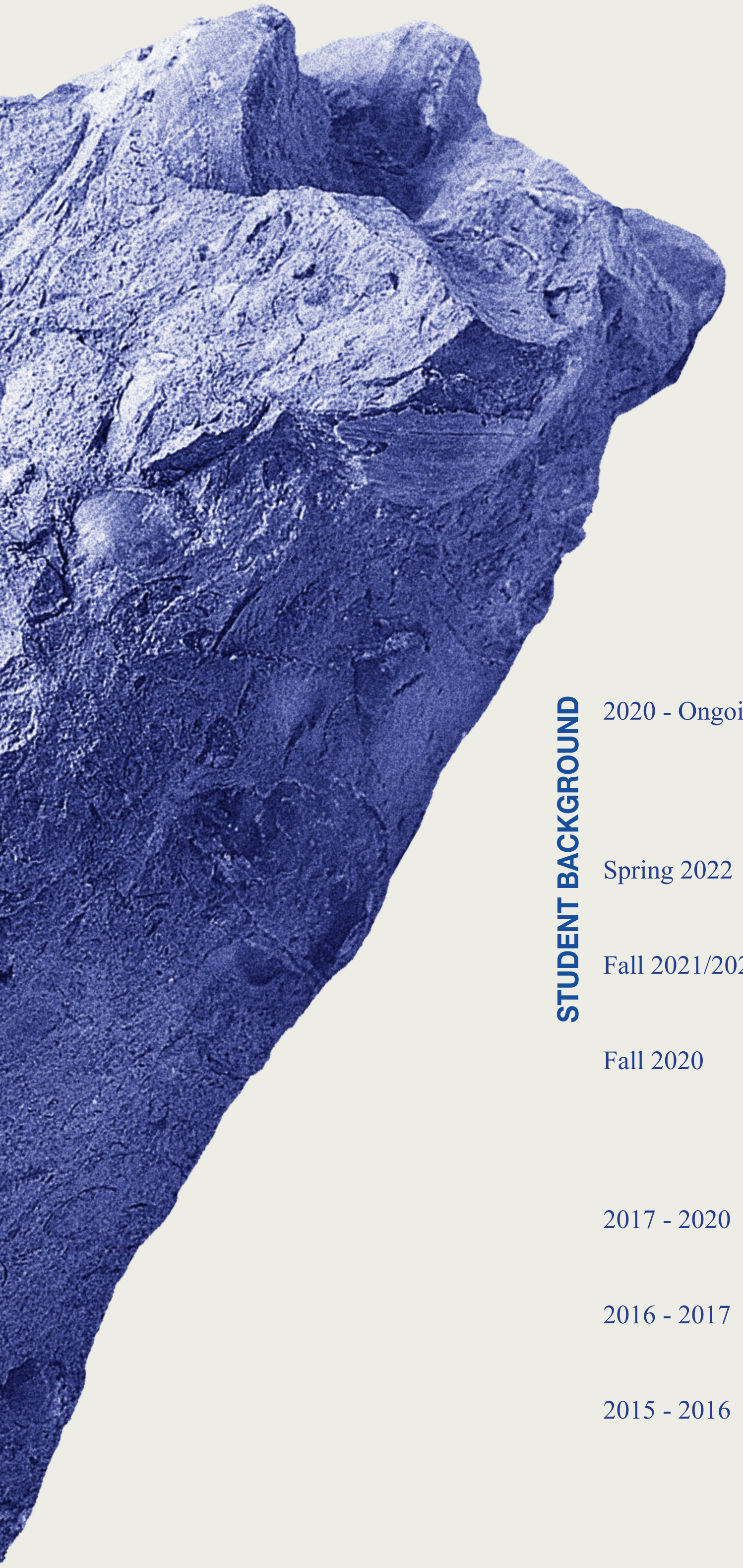


TABLE OF CONTENT



STUDENT BACKGROUND

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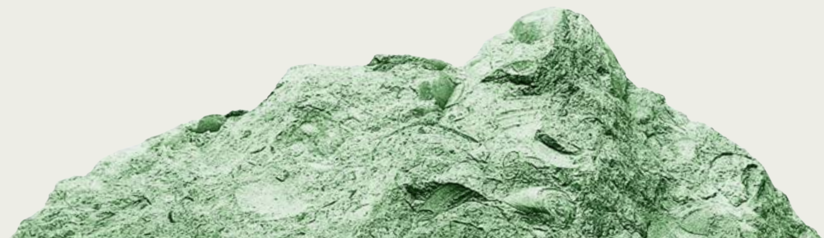
Fall 2020	*HDK - Academy of Art and Design* Independent course: Eat - Food Culture, Materiality and Design.
2017 - 2020	*Chalmers University of Technology* Bachelor in Architecture, 3 years
2016 - 2017	*Chalmers University of Technology* Technical preparatory, 1 year
2015 - 2016	*Lund University* Independent courses: - Room, Scenografy and Landscape - Visual Techniques

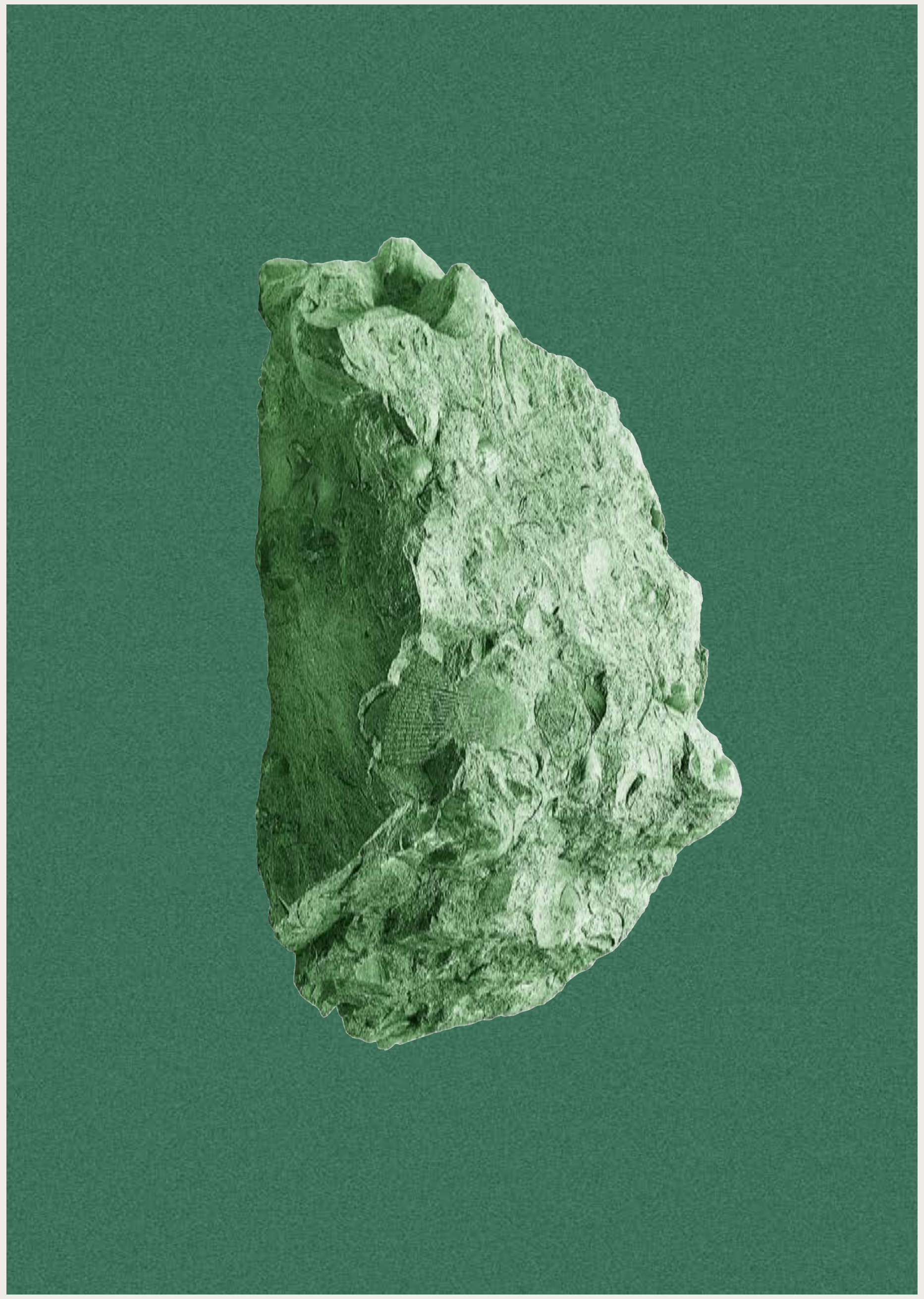
PREFACE

When I was a kid and visited my grandmother and grandfather on Gotland, one summer we visited the old waterfilled quarry the Blue Lagoon. I have had the fortune of growing up alongside the sea in southwestern Skåne, where the sea moves in green and petroleum tones. In the Blue Lagoon, the water was turquoise. Just as the dirt roads and landscapes of Iceland are dramatically black from volcanic ash, the landscape of Gotland is white from the limestone that forms the island. In summer, white dust lies like a veil over the dry barren landscape, creating a kind of haze even on a clear day. In the Blue Lagoon, the water turns bright turquoise against the white bedrock. I recognized myself in the pictures I had seen from my friends who had been on sun holidays at tropical seas far away from Sweden, and thought it was magical to have been transported to such a foreign place even though we were still in Sweden.

Many years ago, I went to the northeast side of the island, where there are several quarries within easy reach. I had researched that there would be a water-filled limestone quarry with an old demolition building extending straight down into the water, which you could swim into and jump from. As an adrenaline-seeking teenager it sounded like a dream, and indeed, the quarry had an exciting almost dystopian feel to it, and the building loomed large in the landscape, only a thin strip of land separating the quarry from the Baltic Sea. We drove further up the coast, visiting Furillen and Bungenäs, two other headlands with former, larger, limestone-industries, and on the way home we drove past Slite with its large active limestone quarry. With the scale of it and without the water it looked like an inverted mountain, with toy excavators on the quarry floor. We headed home towards the south side of the island, and after the accumulated experiences, I could not help but feel a slightly bitter aftertaste. What had previously felt like a foreign landscape in Sweden started to feel a bit like wounds. The dramatic scenery was an incredible experience, but two, three and four of the sama just kilometers from each other. I started thinking about how it works, do they just leave it behind afterwards or what happens *then*? What did these penisnulas look like before someone took the liberty of excavating their contents and re-sculpting the landscape for the benefit of growth?

These reflections served as some sort of subconscious basis when formulating something meaningful to explore as my final project at Chalmers. There is something exciting yet sad about all these sites of extraction. They somehow become related to each other because of their equal treatment, but at the same time completely dependent on their specific landscape. With the great changes that have already been made, one could perhaps see these places as a playground to test things and mold further. The place will never be the same as before, because large parts of what existed have been taken away. Instead, perhaps one can look at this landscape with playful eyes, and work with the site to further sculpt it in a way that does not enlarge the wound but instead lets it return to its natural scale.





01

INTRODUCTION / PROBLEM

Along the coast of north-eastern Gotland, there has been an abundance of limestone, and the stone has been frequently quarried and shipped away for centuries. The older quarries that have served their purpose and are no longer in use are today seen as charming visitor destinations. But when every headland has a limestone quarry, a hole, where nature used to own the land, how do we re-relate to that place after the massive alterations the mining industry leaves behind? Nature built up over hundreds of millions of years is extracted and abandoned in a few decades, and the increasing scale of industrialization creates deeper and deeper pits.

Today there is a consensus that we need to be better in terms of management of finite resources, and the requirements when planning for extractions and for the landscape that remains are greater. A couple of questions that remain, however, is what happens to the post-industrial landscapes from before those requirements existed? And with the climate crisis rapidly approaching architects have to ask if enough is being done to avoid overuse of finite resources?

1.1 // AIM

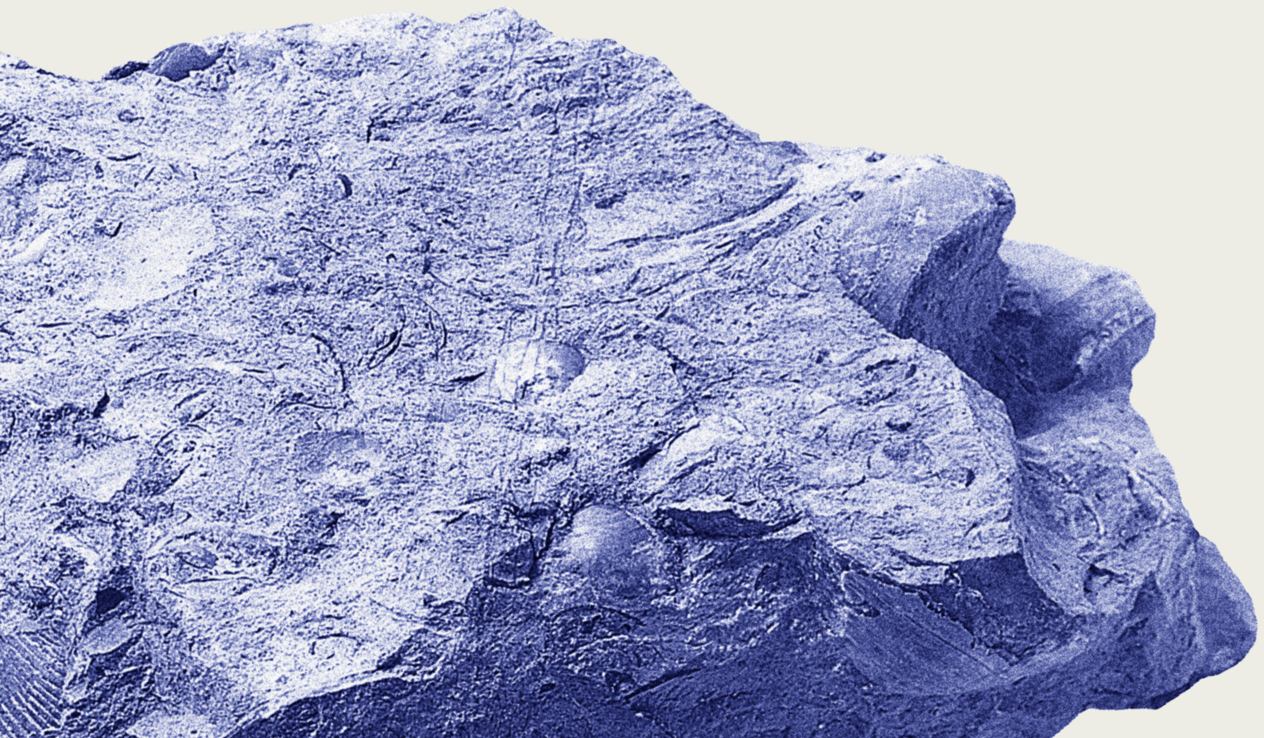
The aim of this thesis is to present strategies for how architects can approach a disused quarrysite from before rules for post-treatment of mines were in place. In the thesis Smöjen limestone quarry is used as an example of a disused quarry, and the site is thoroughly analyzed in history and present time to provide a basis for developing the site for future scenarios. The existing conditions and traces at Smöjen are inventoried as a material library, and used in the proposed interventions of the site. The proposal focuses on Smöjen as a new node for Nature tourism in the Gotland archipelago, but also takes into account sustaining further change in the future.

The thesis further aims to showcase the value of utilizing the resources at hand as far as possible to avoid unnecessary transportation and depletion. By utilizing local crafts and skills, and keeping resources, production, and maintenance local, the chances of maximizing the lifespan of buildings are increased while providing employment for the surrounding community. The intention is to emphasize the benefits of seeing the landscape as a creative framework for interesting architecture, and take agency over the whole process of a building and its impact in a wider context by keeping the material close to the source.

1.2 // PURPOSE

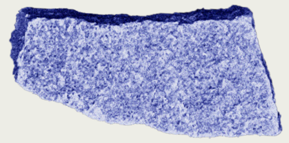
The purpose of this thesis is to highlight the role of the architect as a key contributor to a more sustainably built world. Seeing the value of creative design as part of problem solving strategy in the work to achieve the climate goals. By taking a broader perspective and dealing not only with the site of construction but also with the site(s) from which the building components are extracted, architects can show that creativity and resourcefulness go hand in hand. Architects cannot shoulder the responsibility for changing the behavior within the building-related professions alone, but can show that professionalism and creativity go beyond aesthetics.

In a larger context the purpose of the thesis is to emphasize the importance of acting with care and reflection when planning, using and post-treating big interventions of a landscape. Quarries and mines can have long lasting effects on essential parts of an eco-system such as ground-water and biodiversity, and it is hard to know what the effects from profit driven decisions of today might result in the long-term. That also motivates the concepts of investigating all other options before planning for new extractions, and rather leaving those extractions to be made by future generations where other possible paths may already be demolished.



1.3 // THESIS QUESTION

How can architects take responsibility for the use of materials when re-programming post-industrial landscapes?



1.4 // EXPECTED OUTCOME

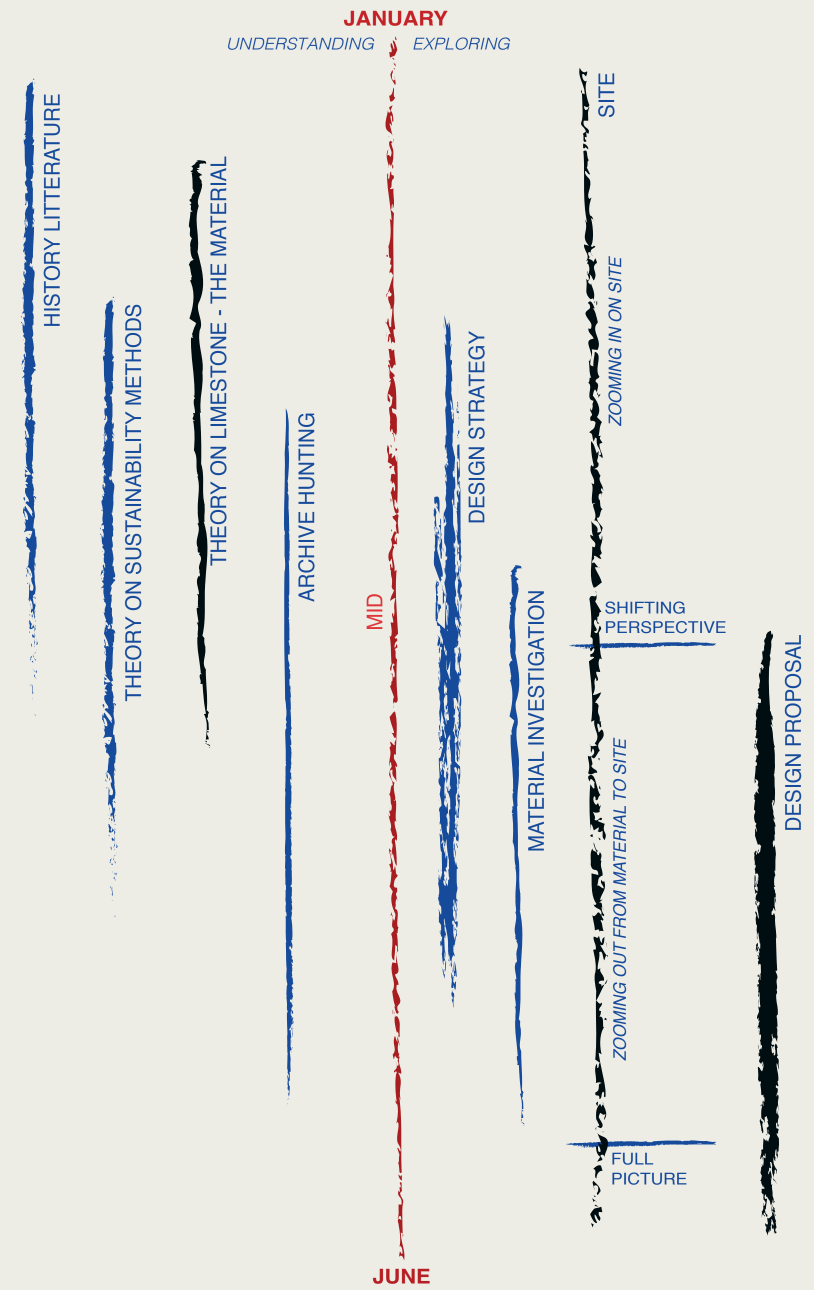
The expected outcome of this thesis is a comprehensive understanding of the benefits of using locally-sourced materials in architecture as a method to ensure avoiding the depletion of recourses when designing new. The outcome is a landscape-based design proposal that utilizes raw, renewable and abundant materials and explores the benefits of using low-tech construction methods, such as traditional techniques and local material knowledge, creating architecture that closely interacts with its surroundings. By demonstrating the feasibility and creative benefits of site-focused design practices, this thesis aims to contribute to the broader movement towards less extractive and more environmentally responsible architecture.

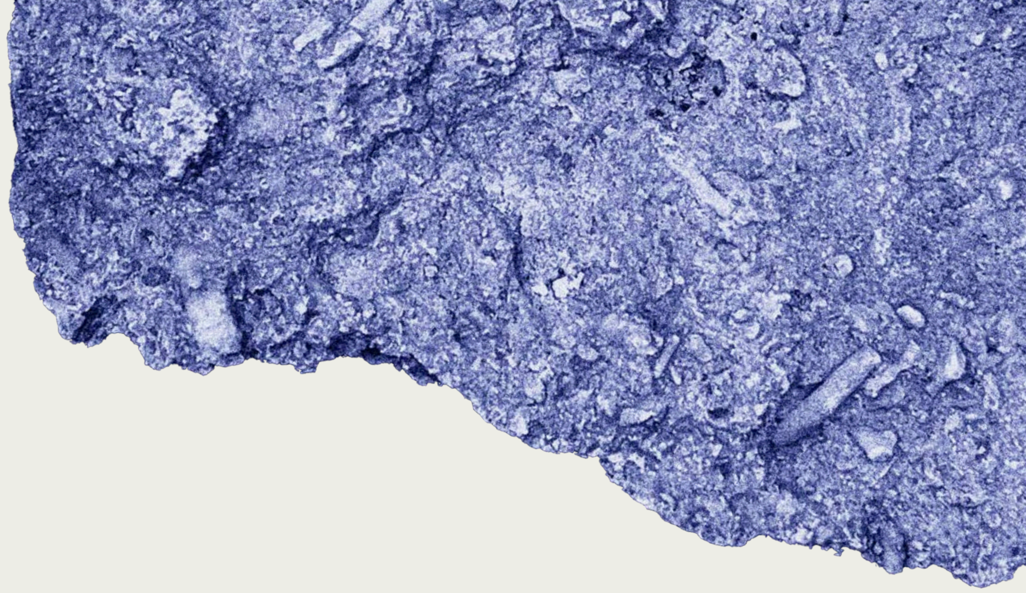
1.5 // SCOPE & DELIMITATIONS

Is about:
Local recourses as a point of departure for the design process, Strategies for circular thinking with material resources, Landscape-based design, Limestone, Closed loop construction, Sustainable use of materials, Post-treatment of disused quarry-sites.

Will touch:
Daymining of limestone in the past/present/future in Sweden, History & heritage of Gotland, Life Cycle Analysis (LCA), Non-extractive architecture, Recreation, Land ownership, The role of the architect, Waste hierarchy

Is not about:
Proposing precise construction solutions, Solving the climate crisis, Restoring a landscape to its original state, Stopping all material extraction,





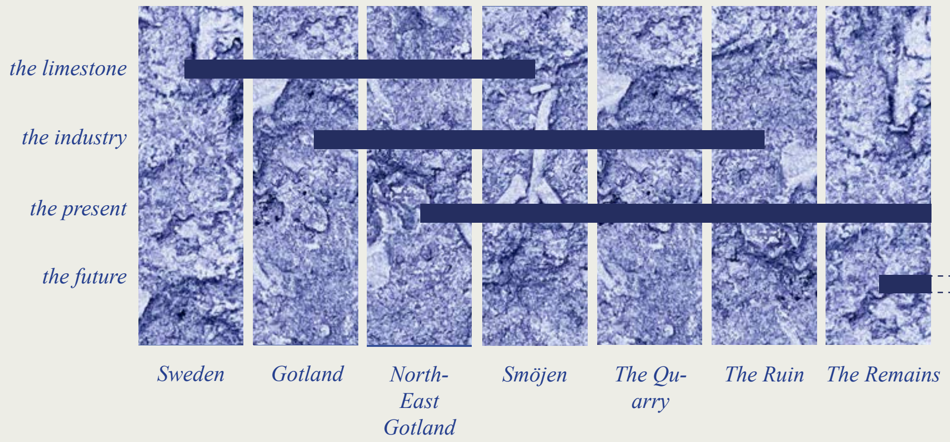
1.6 // METHOD AND PROCESS

The methodology for this thesis involves a multi-faceted approach to gaining a deep understanding of the design problem and context. To achieve this, the thesis will include a comprehensive literature review, archive visits, site visits to understand the situation and context and collect a detailed material inventory.

The literature research will provide the theoretical framework for the thesis and will be used to identify gaps in knowledge and practise that the thesis project can address. Additionally, the literature will contextualize the thesis project within the broader field of architecture and establish a foundation for the design proposal that is both innovative and contextually appropriate. Archive visits will provide access to historical documents, maps, and other materials that can help gaining more knowledge of the historical and cultural factors that may have influenced Smöjen limestone quarry, the focus area of the thesis.

Site visits have been vital in the development of this thesis. focused on understanding the situation and context, as well as the materials on a detailed level. Site visits provide an opportunity to observe and analyze the site's characteristics, challenges and observe how people interact with the site today. They are the prerequisite for the creation of the material inventory, and without the site explorations this thesis would have had no substance to develop a realistic design proposal. Material studies provide a deeper understanding of the value, properties and potential of the materials that are used in the design proposal. They are focused on appearence, texture and tactility rather than on technical properties associated with the materials.

The knowledge gained from these combined studies will inform the design proposal and help create a comprehensive thesis that can further the discussion on what is sustainable architecture and how architects can relate to extractive landscapes.



1.7 // SCALES

This thesis covers a range of scales in order to demonstrate the importance of thinking both on a broad and detailed scale so that the various scales can mutually support each other's functions. The project proposal for Smöjen is intended as an example for the architect, but also as a proposal for how the specific site can have a clear purpose and become a node, where it both supports and is supported by the surrounding landscape. By using a larger range of scales, it is possible to better identify challenges and opportunities at different levels and thus ensure the value of the addition for small and large stakeholders.

1.8 // GLOSSARY

Heritage

Things that have been preserved through time they can be immaterial, such as stories and traditions, or tangible elements, such as texts or buildings. (Golinowska, 2021)

LCA

(Life Cycle Analysis) A method that evaluates a product's environmental impact throughout its lifecycle. It examines impacts like resource depletion, greenhouse gas emissions, and pollution to identify ways to reduce environmental impacts and improve sustainability (US EPA, n.d.).

LIS-area

(Rural development in coastal areas, (Swedish: Landsbygdsutveckling i strandnära lägen)). Areas for rural development in coastal locations that municipalities can designate in their master plans. (Naturvårdsverket, n.d.)

Local

Adjective: from, existing in, serving, or responsible for a small area, especially of a country. Noun: a person who lives in the particular small area that you are talking about (Cambridge Dictionary, n.d.).

Natura 2000

EU initiated network of rare and endangered species' core breeding and resting sites, as well as rare natural habitats, protected to ensure their long-term survival. It covers 27 EU countries, both on land and at sea, and is listed under the Birds and Habitats Directives (European Commission, n.d)

Non-extractive architecture

A way to describe architecture understood as the practice of guardianship of the environment, both physical and social, rather than an agent of depletion. An approach that seeks to minimize the negative impact of the built environment on the natural world and communities, and promotes responsible land use practices (Grima, 2021)

Quarry

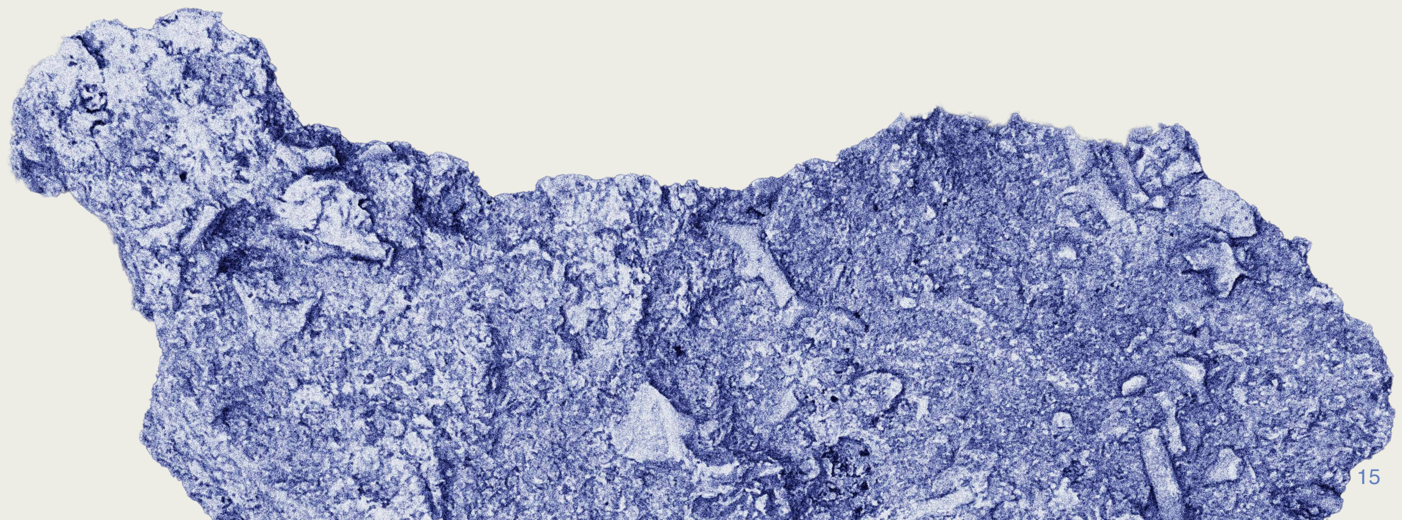
Noun: a large artificial hole in the ground where stone, sand, etc. is dug for use as building material, Verb: to dig stone, etc. from a quarry (Cambridge Dictionary, n.d.).

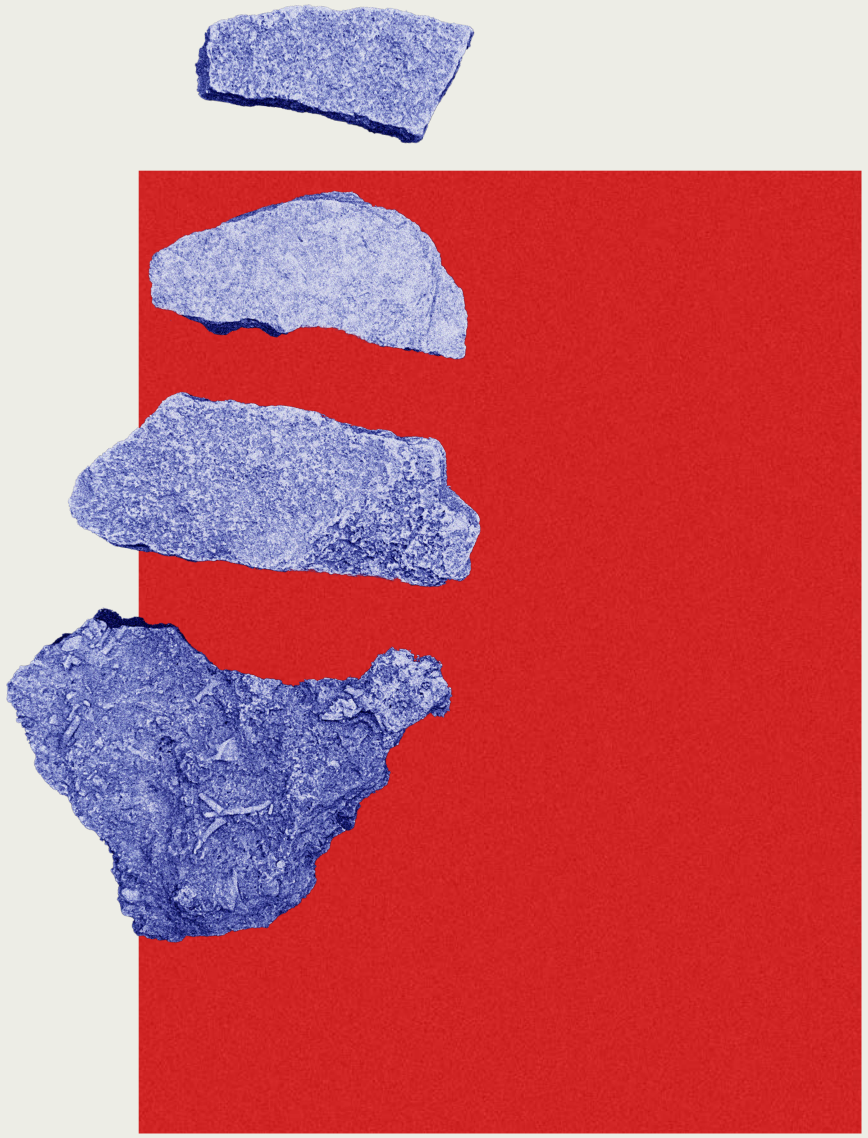
Regenerative Design

Aims to create built environments that actively regenerate ecosystems and communities, with a net positive impact on the environment and local communities (Kerd, 2021).

Waste hierarchy

a five-step process established by the European Union to reduce the environmental impact of waste disposal. The steps are prevention, reuse, recycling, other recovery, and disposal, with an emphasis on waste reduction, reuse, and recycling (European Commission, n.d.).



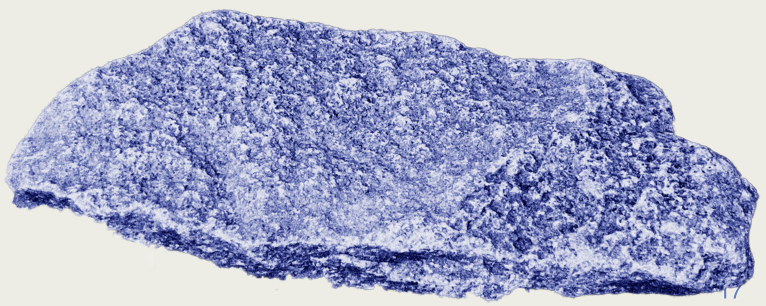


" Every decision designers take in a project has an impact not only on the site of production, but also on the site of extraction. "
- Malterre-Barthes (s.87)

02

THEORY

This chapter is focused on understanding the value of a material. Architects today are faced with an important responsibility when it comes to sustainable development in the built environment. As the world continues to grapple with the impacts of climate change, architects must consider their agency in avoiding new material extractions and promoting environmentally conscious design practices. Landscape-based design as a method from both an artistic and sustainability point of view is addressed to highlight the opportunities in combining the different approaches. The chapter is concluded by presenting strategies for architects to use in their design process to minimize the extraction of new materials.



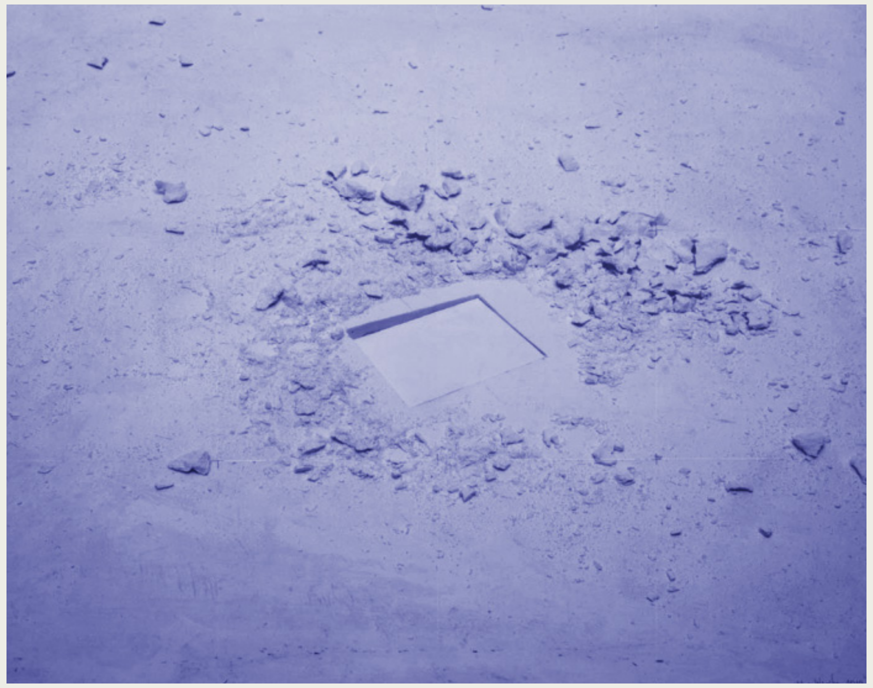


Fig 1: ”Earthwork” by Alan Wexler, 2012 (http://www.allanwexlerstudio.com/works

”The extractions that produce our cities multiplied more than twenty-fold over the twenthieth century (Jones, 2021, s123)”

2.1 // ARCHITECTS - AGENTS OF CHANGE?

In the present day, the depletion of natural resources is a pressing concern. The European Union has recognized the need for a transition to a more sustainable economy, one that is based on the principles of circularity. This means moving away from a linear model of production and consumption, in which resources are extracted, used, and then discarded, to a model in which resources are kept in use for as long as possible, and waste is minimized. Looking to the future, it is clear that leaving resources for future generations will be crucial. The global population is expected to grow significantly in the coming decades, and there will be increasing demand for natural resources such as water, energy, and minerals.

As professionals tasked with designing and planning the built environment, it is the responsibility as architects to consider not only the aesthetic and functional aspects of design but also the impact on the world at large. While there is a shared understanding of the need to be responsible with the finite resources of our planet, the reality is that extraction processes continue to increase rapidly in most parts of the world, driven by population growth and societal development. However, with climate change posing a significant threat, we must question whether we are asking the right questions in response to these challenges.

Charlotte Malterre-Barthes is an architect, urban designer, and Assistant Professor of Architectural and Urban Design at the Swiss Federal Institute of Technology Lausanne (EPFL). In the Chapter ”The devil is in the details” in *Non-extractive Architecture, Designing Without Depletion* Malterre-Barthes states that all elements of a built environment are products of extractive processes, regardless of whether sustainable materials are used or not (2021). She claims that the process of extraction often is considered a detached area that is not integrated into the education or practice of architects. Malterre-Barthes contends that the focus of architecture is on "sustainable materiality," with the finished product being the main concern. She further argues that maintenance and preservation of existing structures are the real sustainable options, which are often overlooked and considered a ”niche” within contemporary architecture.

> *”A single window unit contains dozens of components, composed of multiple layers of glass and maninate coatings, filled with gas, sealed with siliconeand rubber gaskets, held together with stainless steel-clips and fasteners, framed and anodized or coated aluminum, steel or wood. (...) Many of their extraction proces ses - the mines in particular - irrevocably chew up and alter the earth” (Carlisle and Pevzner, 2021, s.98)*

According to Carlisle and Pevzner (2021) a potential solution to the issue of extractive architecture could be to extract materials with less force and trauma, and that it may be feasible to satisfy the demands for economic growth and development by repurposing what has already been extracted, ”forming new cities on the carcasses of the old” (Carlisle and Pevzner, 2021, s.100), through reuse and recovery.

The *Climate Justice Alliance, a organisation xxxxxxx* refers to this shift from an extractive

to a regenerative economy as a ”just transition.” Rather than designating certain areas as sacrifice zones for the benefit of others, resources and power should be redistributed to communities, enabling self-determination, respect for cultures, traditions, and sacred land, and the implementation of energy democracy (Climate Justice Alliance, n.d.). Carlisle and Pevzners reasoning is in line with this, stating that even though decarbonisation is a crucial component of sustainable development and our future, if the field of architecture succeeds in this objective while neglecting to address the extractive mindset of colonialism, capitalism, racism, and oppression, it's a failed task. It is therefore necessary to consider social and environmental systems comprehensively.

In order to maintain control over the material process and prevent unsustainable use of resources, one potential approach is to prioritize local production and avoid long material chains, argues Lars-Erik Mattila (2021). Mattilla suggests that the current norm of material complexity may place an excessive burden on future recycling systems, mentioning Building Information Modeling (BIM)-components as an example. While BIM can be a valuable tool for architects in designing buildings and infrastructure, they may also lead to a detachment from the material process (Mattila, 2021). Due to the complexity of modern building systems and structures, there is a need for division of labor among professions. However, one means of taking responsibility for the full footprint that architecture leaves and minimizing resource depletion, could be to avoid excessive complexity in building processes. Attila argues that the environmental impact of any material is dependent on future conditions such as the availability of recycling facilities or carbon capture technology in the case of incineration. To address this issue, he advocates for the restriction of building materials to timber, clay, glass, steel, stone, and lime, based on their possibility to be safely returned to the geobiosphere.

Luke Jones agrees that using a restricted material palette can lead to a relatively manageable set of impacts, but questions its feasibility on a larger scale. However, Jones does agree with Attila on the importance of architects reclaiming their connection to materials (Jones, 2021).

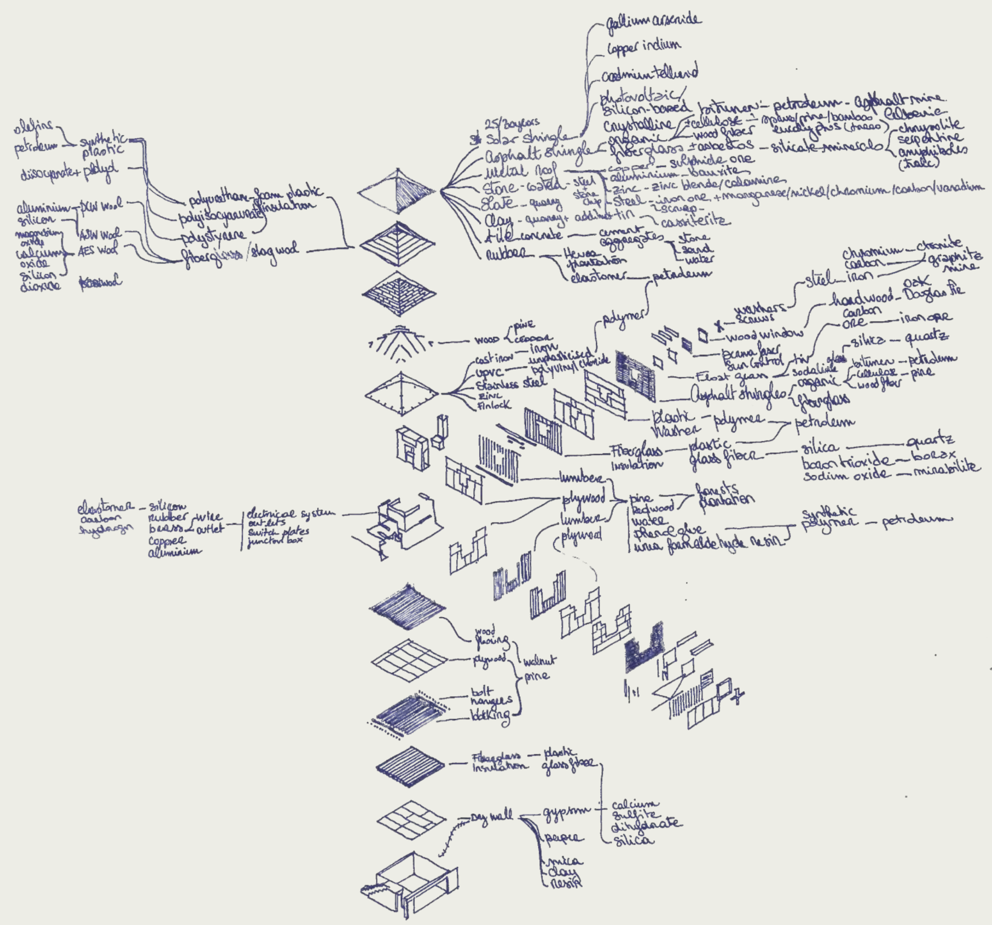


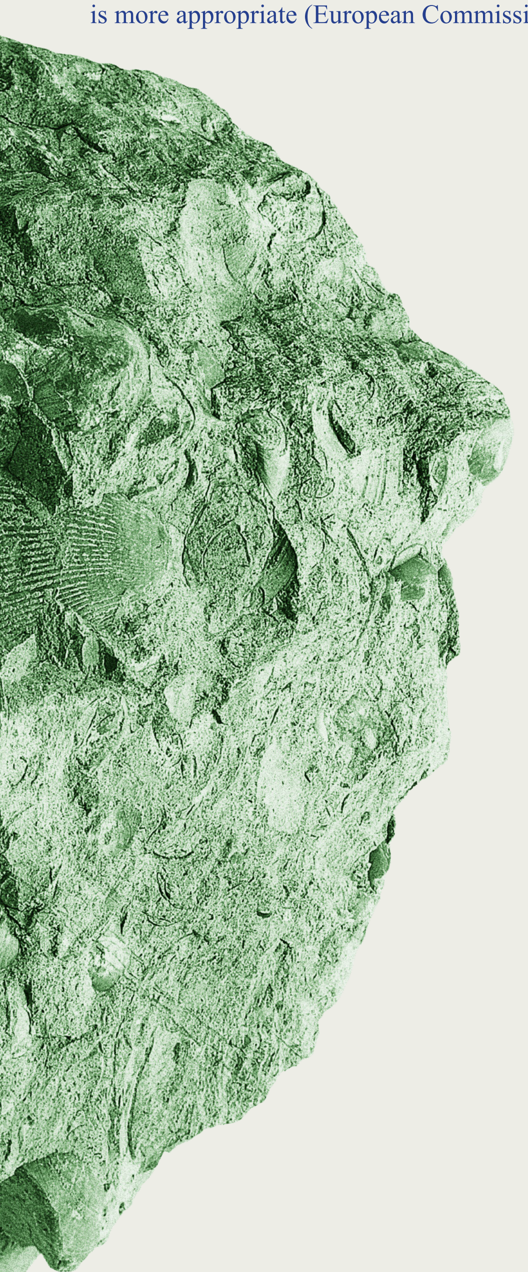
Fig 2. Charlotte Malterre-Barthes, Scales of Extraction, After Morphosis, 2-4-6-8 House Parts drawing.

DESIGNING THE FUTURE

By adopting a holistic approach that considers the entire life cycle of a building, from sourcing to demolition, and exploring alternative techniques and materials, architects can reduce their reliance on limited resources and contribute to a more sustainable built environment (European Commission, 2020).

Life Cycle Assessment (LCA) is an essential tool for achieving a more sustainable future by informing decisions that balance environmental, social, and economic factors (European Commission, 2018). By taking into account the environmental impact of the entire life cycle of a building, from production of materials to demolition and disposal, architects can make informed decisions about which materials and construction methods to use in order to minimize the building's impact on the environment (European Commission, 2019). LCA examines the environmental impact of a product or service from the cradle (extraction of raw materials) to the grave (end of life) (European Commission, 2020). Cradle-to-gate and cradle-to-grave are two LCA approaches that differ in the scope of the assessment. Cradle-to-gate analyzes the environmental impact of a product or service from the extraction of raw materials to the point of leaving the manufacturing plant. On the other hand, cradle-to-grave examines the environmental impact of a product or service from the extraction of raw materials to the point of disposal.

Cradle-to-cradle advocates for the creation of products and services that can be continuously cycled in the economy without producing waste or harming the environment. This concept emphasizes the use of renewable materials and the reduction of energy and resource consumption during the product's life cycle. The use of cradle-to-gate or cradle-to-grave depends on the objective of the LCA study. If the goal is to identify the most significant environmental impacts in the manufacturing phase of a product or service, cradle-to-gate is more appropriate. On the other hand, if the goal is to evaluate the product's overall environmental impact, including its use and disposal, cradle-to-grave is more appropriate (European Commission, 2018).



THE LANDSCAPE AS A CREATIVE FORCE

Landscape-based design offers an opportunity for architects to create innovative and sustainable structures that integrates with their surroundings. By incorporating existing structures and materials from the site, architects can relate to the landscape while minimizing the environmental impact of their projects. One of the artistic and creative benefits of landscape-based design can be found through close analysis of the site, leading to new and unexpected discoveries. The use of raw materials, such as stone, wood, and other natural materials, can create a sense of connection between the building and its surrounding landscape, emphasizing the harmony between the built and natural environment (Smith, 2017).

Reusing existing structures, such as abandoned buildings, industrial sites or other remains from previous existences, can also be seen a source of creative inspiration. As the architect Louis Kahn stated, "The nature of a site determines what can be built, and the art of architecture lies in its ability to find the form that is latent in the site, that is part of its essential nature, and at the same time gives expression to the human experience" (Kahn, 1991, p. 10). The architect Peter Zumthor also stresses the importance of building on a site's history and creating a sense of continuity between past and present. He believes that a building should be designed to harmonize with its surroundings, rather than imposing itself upon them. In his book "Thinking Architecture," he states that "architecture is always the design of a place in the world. It is the articulation of the relationship between nature, man and the place" (Zumthor, 2006, p. 13).

Louis Kahn and Peter Zumthor both believe that a building's design should be responsive to its site and context, both physically and culturally. According to Kahn, "The character of the place and its history must be recognized and given meaning in the form. You cannot do anything without a site. The building grows out of the site and the act of building is the establishment of a relationship between the site and the building" (Kahn, 1991, p. 10). Zumthor emphasizes the importance of materials and their ability to convey a sense of place, stating that "material is not a dead matter, but has a life of its own that becomes part of the building and speaks of its place and time" (Zumthor, 2006, p. 29).

In conclusion, landscape-based design can offer a range of artistic and creative benefits. The use of raw materials, the incorporation of existing structures, and the building of new structures on old structures all offer unique opportunities to create architecture that is in harmony with its landscape.

WASTE HIERARCHY

The concept of *Waste hierarchy,* formulated by the United Nations (UN), refers to a set of priorities for managing waste, with the aim of reducing its environmental impact (European Commission, 2018). The hierarchy consists of five steps: **prevention, preparing for re-use, recycling, recovery** and **disposal.**

From an architectural point of view, the waste hierarchy can be applied in the design and construction of buildings. Designing buildings with materials and systems that minimize waste generation, such as unprocessed materials or prefabricated construction, can support the prevention and reduction of waste (European Commission, 2019). Also, the incorporation of reused or recycled materials can contribute to reducing waste (European Parliament & Council, 2018). In addition, designing buildings with a flexible and adaptable structure can support the reuse and deconstruction of buildings, preventing them from becoming waste at the end of their life cycle (European Commission, 2019).

Overall, the waste hierarchy can provide architects with a useful framework from which the design and construction of buildings can be approached in a more sustainable manner. By prioritizing prevention, reduction, and reuse, architects can contribute to the creation of a more sustainable built environment. The key factor is avoiding consumption as a habit and instead utilizing resources in a way that invites for use again after, and avoiding disposal and sending products to landfill.

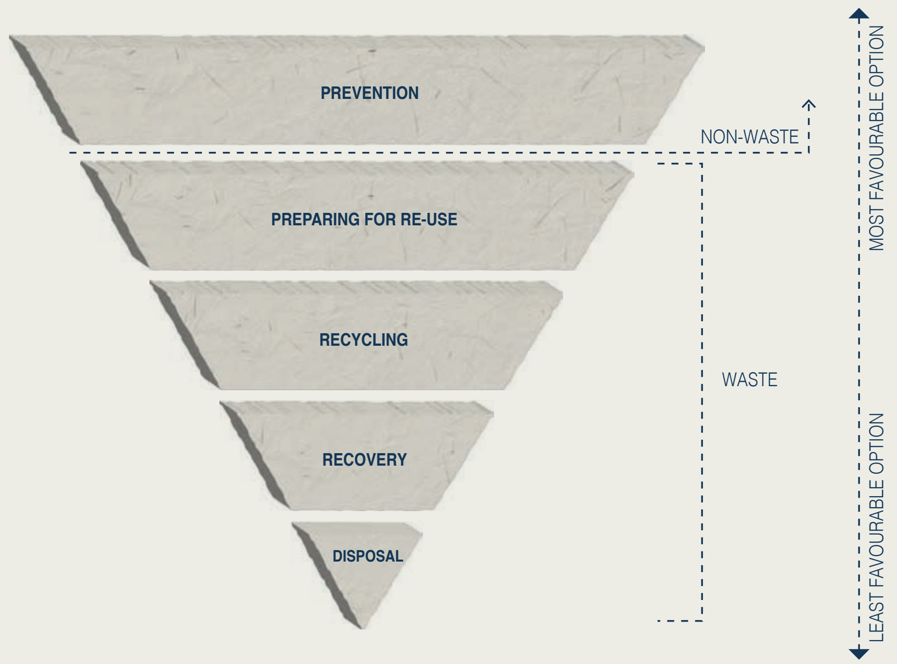


Fig 3. Illustration by author, based on the Waste Hierarchy formulated by EU

IT'S ABOUT TIME

When considering the process of constructing a building, or even the lifespan of a building, the focus is often on the time of the construction itself and how long it can stand. However, the time it takes to create the building materials, usually significantly longer, rarely seems part of the discussion. Several sources and studies suggest that the more we understand and relate to a subject, the more likely we are to care about how we act in relation to it. A study published in the *Journal of Environmental Psychology*, found that people who had a stronger connection to nature were more likely to engage in pro-environmental behaviors (Mayer & Frantz, 2004). The study suggests that building a connection to nature can lead to increased concern and care for the environment. It is well-established in the field of environmental psychology that individuals who identify strongly with their community or social groups are more likely to engage in pro-environmental behaviors. This concept, known as social identity theory, suggests that when people strongly identify with a particular social group, they are more inclined to adopt the values and norms of that group, including environmental concerns.

This supports the concern about the importance of understanding and knowing the material, and could mean that a distancing from materials and building components, both in experience, legibility and geographical distance, could also distance the architect from the sense of responsibility and involvement in the chain that leads to the built outcome.

On that note, Read below about limestone and the history of Gotlandic bedrock.

2.2 // LIMESTONE - BUILDING A RELATIONSHIP

Gotland, located in the Baltic Sea off the eastern coast of Sweden, has a rich history due to its strategic placement. The island is largely composed of lime, a natural material that has been used by humans since the Stone Age and is still the island's most important industry today (Gotlandia, 2021). Gotland's bedrock consists of fossilized reefs and sedimentary deposits dating back to the Silurian period, which lasted over 24 million years about 433-423 million years ago (Erlström & Magnusson, 2016; Geological Survey of Sweden, 2015).

Gotland's bedrock is one of the best-preserved Silurian reefs in the world, divided into 13 formations that were formed through sedimentation processes, characterized by alternating limestone and marl (Erlström & Magnusson, 2016; Geological Survey of Sweden, 2015). The shallow shelf sediments with reef formation have gradually been built up towards the south during the depositional phases of the cycles, which explains why these Silurian strata become younger and more powerful in the Southeast direction (Geological Survey of Sweden, 2015).

The high-altitude areas up to 25 meters above sea level are dominated by harder limestone bedrock, while intermediate lowland parts of Gotland are dominated by rock types less resistant to erosion, such as marl and alternating marl, marlstone and limestone (Erlström & Magnusson, 2016).

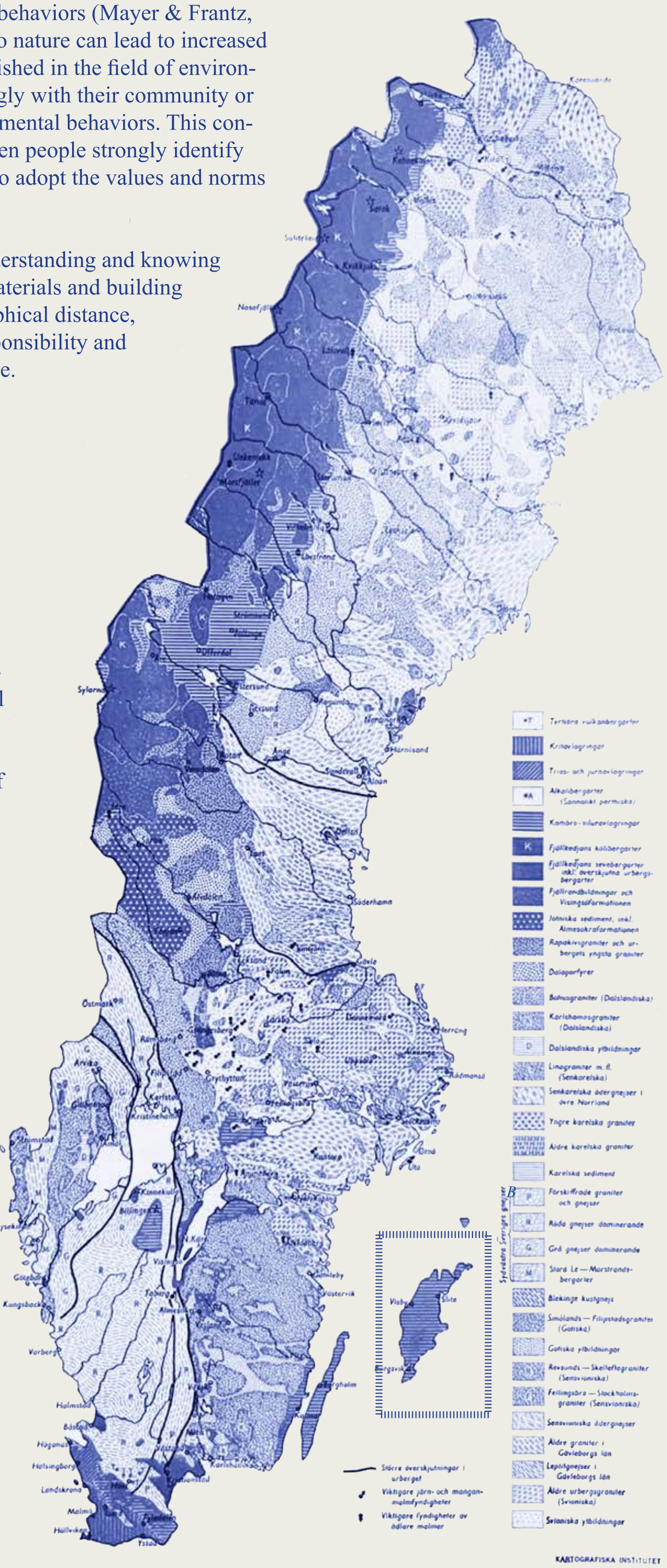
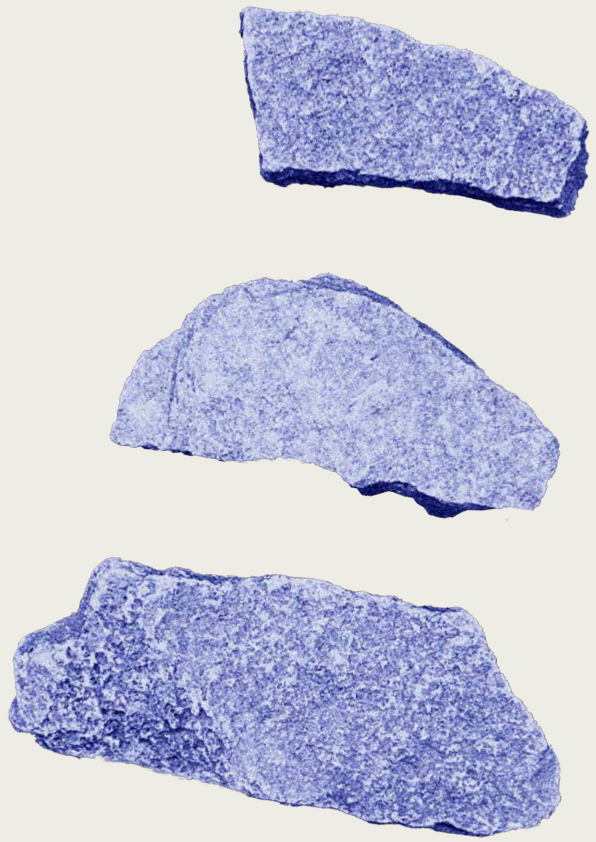


Figure 4. Map showing the bedrock of Sweden, Source Stenhandboken, 2003



LIMESTONE

Limestone is a type of sedimentary rock primarily composed of calcite, a mineral that forms from the remains of marine organisms such as algae, corals, and mussels that accumulate on the ocean floor over time. Over millions of years, these layers of organic material become compressed and hardened into solid rock. In Sweden, the age of limestone found in quarries ranges from 80 to 2,000 million years old (Larsson, 2014).

Sedimentary rocks are formed through sedimentation, where sedimentary grains are transported by water or air and then deposited and eventually cemented into a solid rock. Some sedimentary rocks are also formed chemically, biochemically, or organically by enrichment or precipitation. Reef limestone is a type of limestone made up of fragmented remains of fossil reefs, such as corals, bryozoans, and sponges, along with organisms that live in and around reefs. The oldest known reef limestones were established in early Cambrian time, approximately 540-520 million years ago (Palmer & Wilson, 1985).

Marlstone, a type of sedimentary rock, is often fine-grained and dense due to its clay content. It can be composed of calcareous claystone or vice versa. Marl is the term used for calcareous clays that have not been fossilized into rock. Calcareous fossils are often well-preserved in marls and marlstones. The lime and clay content in marl can vary between 25% to 75%, while a pure limestone contains at least 95% lime and a mudstone contains at least 95% clay (Hansen, 1991).

NOT ONLY FOR BUILINGS

Larger units of limestone
Landscaping, design of public spaces, building material, interior, furniture design, ornaments, sculpturing,

Limestone
Agriculture, animal feed, soil improvement, soil manufacture, water treatment, pH stabilization, putty, cement, concrete, paint, paper, plastic, rubber, asphalt, steel, lake liming, flue gas cleaning, glass, filling material, roads, tunnels, viaducts, storm water treatment, in the sugar process, glass fibre, mining industry, food, anti-slip.

Quicklime
Paper, water treatment, sludge stabilization, steel, prevention of phosphorous leakage, process water treatment, soil stabilization, flue gas treatment, hygienization, remediation, precipitation of metals, mining industry, feed, agriculture, slug dynamite.

Quicklime is produced by heating (calcination) limestone at about 1,100 - 1,300°C in a shaft or rotary kiln. The limestone ($CaCO_3$) is then transformed into calcium oxide, i.e. quicklime (CaO) and carbon dioxide (CO_2). Different limestones are more or less suited to being burned due to the different properies of the stone.

Slaked lime
Flue gas treatment, water treatment, process water treatment, sludge conditioning, phosphorus precipitation, precipitation of metals, prevention of phosphorus leakage, decontamination (against salmonella, anthrax, Newcastle, etc.) neutralization, masonry lime, lime cement (KC), painter's lime, lime paint, putty, sewage treatment plants, soil stabilization, private sewage, mining industry, agriculture, feed, asphalt.

Slaked lime, calcium hydroxide, $Ca(OH)_2$, is produced by adding water to the burnt lime until a fine powder or paste is formed. The calcium oxide reacts with the water and turns into calcium hydroxide. The extinguishing process releases heat.

ISLAND OF LIME

The rural landscape of Gotland, is characterized by the remnants of past and present limestone mining activities. Prior to industrialization, the extraction of limestone involved exploiting natural differences in elevation where stone layers were exposed and could be extracted using simple methods. In certain areas of the Gotland coast where land and water levels have significant variations, the topography has been shaped in part by limestone mining (Kloth & Lovén, 2001). While the traces of this may not always be immediately apparent due to the relatively smaller scale of earlier operations together with natural erosion over time, its mark remains. The mining industry in Gotland has undergone a gradual expansion over time.

POST-TREATMENT IN HISTORY

Prior to 1952, Swedish society had no regulations for the mining of gravel, rock, sand, stone, clay, soil, and peat. Landowners and developers were free to open mines almost anywhere and to stop extraction completely without any post-treatment. This has led to the destruction of landscapes, loss of geological values, and damage to natural/cultural environments.

In 1952, the Nature Conservation Act gave the County Administrative Board the power to prohibit quarrying activities in specially designated areas and to prescribe how quarrying should be carried out. In 1959, the Act was tightened up, and it was decided that new quarries could not be opened without prior notification to the County Administrative Board at least one month before quarrying began. There were major shortcomings in the provisions of the Nature Conservation Act, and nature conservation had a low priority in the county councils.

With the 1965 Nature Conservation Act, Sweden succeeded in obtaining real regulation of quarrying. It was then forbidden to mine without the approval of the County Administrative Board (Länstyrelsen), and the board could demand a mining plan on how the mining was to be carried out and aftercare provided (Hultkvist, 2007).

Today, the way a Swedish limestone quarry is rehabilitated depends on the wishes and conditions of County Administrative Boards, municipality, and can be influenced by the local population and local organizations. Normally, it is a question of replicating the nature that existed before the quarry was used, with a focus on habitats for local plant and animal life. However, there are possibilities for other uses such as a water reservoir, swimming area, fishing waters, recreational area, amphitheater, concert arena, nature reserve, etc (naturvardsverket, n. d.).

EXAMPLE OF EXTRACTION

The mining of limestone is today often done with a large blade saw that divides the pile into layers. The depth of the saw is adapted to the natural cloves (horizontal layers) in the rock. The livers are then wedged into blocks of a size suitable for further processing.

Example from Slite Stennhuggeri

1. The stone is cut with a blade and wire saw in the rock.
2. The overburden is carefully blasted away and removed before the actual quarrying of the stone begins.
3. Horizontal and vertical grooves are cut in the rock so that the wire can be inserted into these grooves, then the wire is cut out at the bottom so that the blocks can be lifted out with a loader.
4. The size of the blocks is around 2500 x 1000 x 1000 mm, but size varies in both direction depending on layers and demand (the weight of the stone is about 2700 kg/m3 so a block of the above size weighs about 6500-7000 kg.).
5. The blocks are sorted by area of use, the better blocks become countertops and the slightly worse ones are sawn down to smaller blocks and used for flooring.
6. All residual stone, whether it is scrap already in the rock or in further production, is used in some way, either for smaller products or ultimately for gravel.

(Lövgren. P, personal communication, february 10, 2023

Figure 5. Aerial photograph of the File-hajdar Quarry on Gotland, (n.d.)

TO EXTRACT OR NOT TO EXTRACT

In the Swedish day-mining industry, Cementa, a subsidiary of HeidelbergCement, has been a controversial topic on the island of Gotland in recent years. The extraction of limestone on Gotland, and Cementa in particular, has been subject of a major debate due to its potential impact on the island's biodiversity and groundwater resource. Environmental groups such as Urbergsgruppen* have criticized Cementa and their applications for pursuing further extractions, and for not taking enough consideration to negative impacts on the nearby areas, many times protected nature reserves included in the natura-2000 network and home to several endangered species. (Urbergsgruppen, n.d.). In addition to this, Cementa criticizes plans for a new Natura 2000 site extending into the sea along the entire eastern coast of Gotland and argues that it could hamper operations in and around the port of Slite (SVT nyheter, 2023).

Cementa, on the other hand, argues that they have taken necessary measures to mitigate their impact, including the implementation of groundwater monitoring systems and reforestation efforts. Opinions on the issue are divided. On one hand, there are those who argue that the quarry and cement factory provide important jobs and economic benefits for the island. Others argue that the potential environmental impacts outweigh these benefits and that the island should focus on sustainable tourism and other industries, protecting biodiversity and the unique landscape of the island (Kronstrand, 2022). The controversy surrounding Cementa and the extraction of limestone on Gotland highlights the complex and often competing interests involved in balancing economic development and environmental sustainability.

** **Urbergsgruppen** is a Swedish non-profit organization that focuses on preserving the country's geological heritage and promoting the protection of natural areas. They promote the long-term management of the Earth's natural resources and the reduction of the extraction of finite raw materials from the Earth's crust. The organization is also advocating for the protection of natural areas. (Urbergsgruppen, n.d.)*

OR HOW TO EXTRACT?

Mining with Nature is Sweden's first industry roadmap for biodiversity. Mining with Nature was adopted by the Svemin (the trade association for mines, mineral and metal producers in Sweden) board in 2020. The initiative aims to promote biodiversity conservation in mining and quarrying activities: "By 2030, the mining and minerals industry will contribute to increased biodiversity in all regions where exploration and mining and minerals activities take place." (Svemin, n.d.).

The roadmap sets out several principles and measures for minimizing the environmental impact of mining operations, such as reducing greenhouse gas emissions, promoting ecological restoration, and minimizing soil and water contamination. The ultimate goal is to balance economic development with biodiversity conservation, creating a sustainable future for both the mining industry and the environment.(Svemin, n.d.).

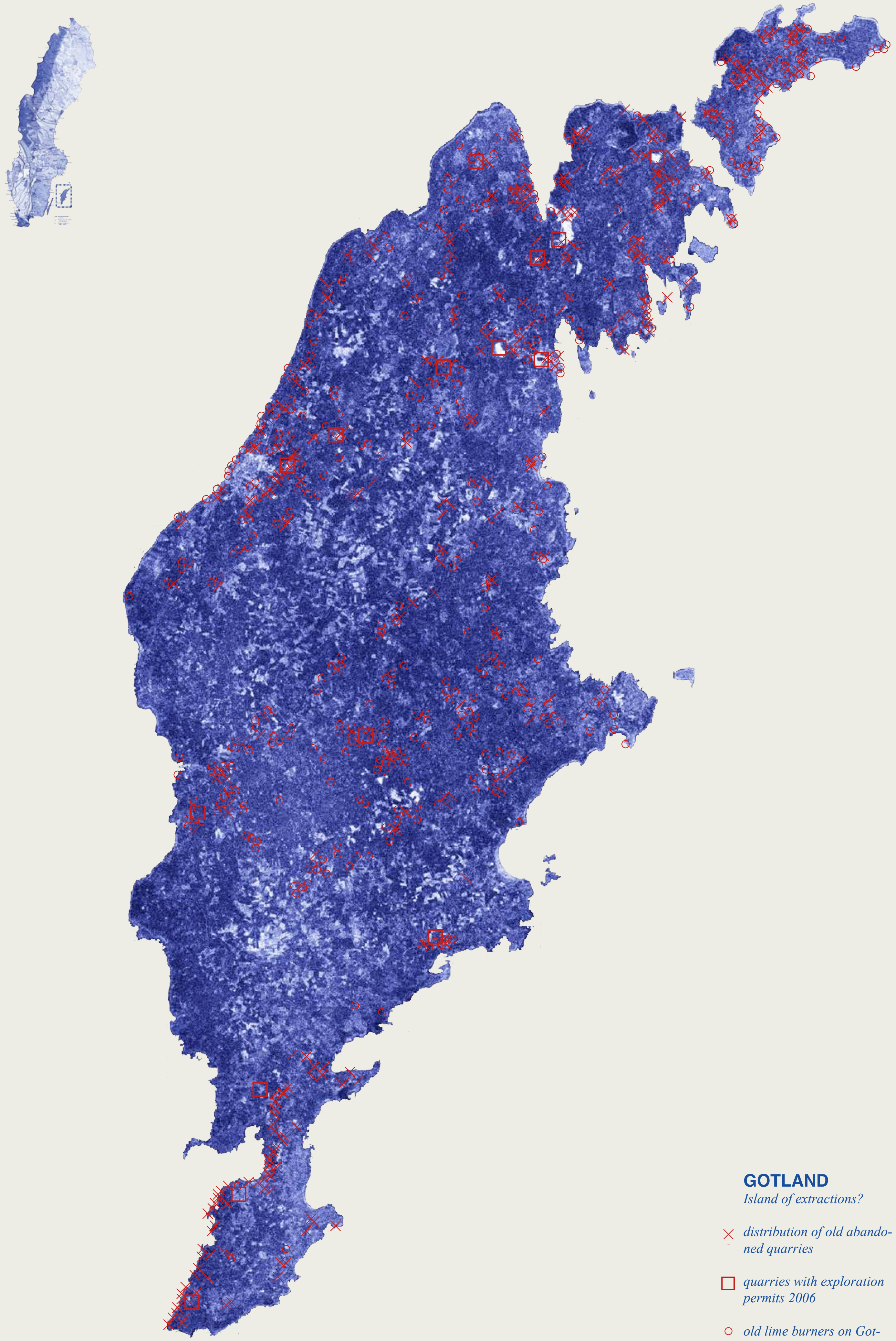
SUMMARY-BOX

- The extraction of limestone by Cementa has sparked a debate due to concerns about its impact on biodiversity and groundwater resources.

- Environmental groups like Urbergsgruppen criticize Cementa for pursuing extractions without considering the negative impacts enough.

- The issue divides opinions and highlights the challenge of balancing economic development and environmental sustainability.

- "Mining with Nature" is Sweden's first industry roadmap for biodiversity, aiming to achieve a sustainable future by balancing economic development with biodiversity conservation in the mining industry.



GOTLAND
Island of extractions?

× *distribution of old abandoned quarries*

□ *quarries with exploration permits 2006*

○ *old lime burners on Gotland, until 1942*

2.3 AVOIDING UNNECESSARY EXTRACTIONS

STRATEGIES FOR ARCHITECTS

USE LOCAL MATERIALS

One of the most effective strategies for reducing the environmental impact of building materials is to use locally sourced materials. The European Commission recommends the use of local materials as a way to reduce the environmental impact of construction and building products (European Commission, 2014). According to the Architects' Council of Europe (2020), using local materials can also support local economies and reduce the carbon footprint of transportation.

RE-USE AND RECYCLED MATERIALS

Another strategy for reducing the environmental impact of building materials is to reuse and use recycled materials (European Commission, 2014). In fact, retrofitting and reusing existing buildings can reduce greenhouse gas emissions by up to 90% compared to new construction, while also preserving cultural heritage and saving energy (European Commission, 2018).

CONSIDER THE ENTIRE LIFECYCLE OF MATERIALS

Architects should consider the entire lifecycle of materials when designing a building, from the extraction of raw materials to the disposal of waste. Life cycle assessment (LCA) can help architects identify the environmental impact of building materials and make informed decisions (European Commission, 2011).

DESIGN FOR DECONSTRUCTION

Designing buildings that can be easily disassembled and the materials reused can reduce the need for new material extractions. The European Union encourages the use of materials that can be easily disassembled and recycled (European Union, 2014).

USE RENEWABLE MATERIALS

Architects can use renewable materials like timber as alternatives to non-renewable materials like concrete or steel. The European Union encourages the use of renewable materials in construction as a way to reduce greenhouse gas emissions (European Union, 2018).

MINIMIZE WASTE

Minimizing waste during construction and demolition can reduce the need for new material extractions. The European Commission encourages the use of waste prevention measures to reduce the environmental impact of the construction sector (European Commission, 2018).

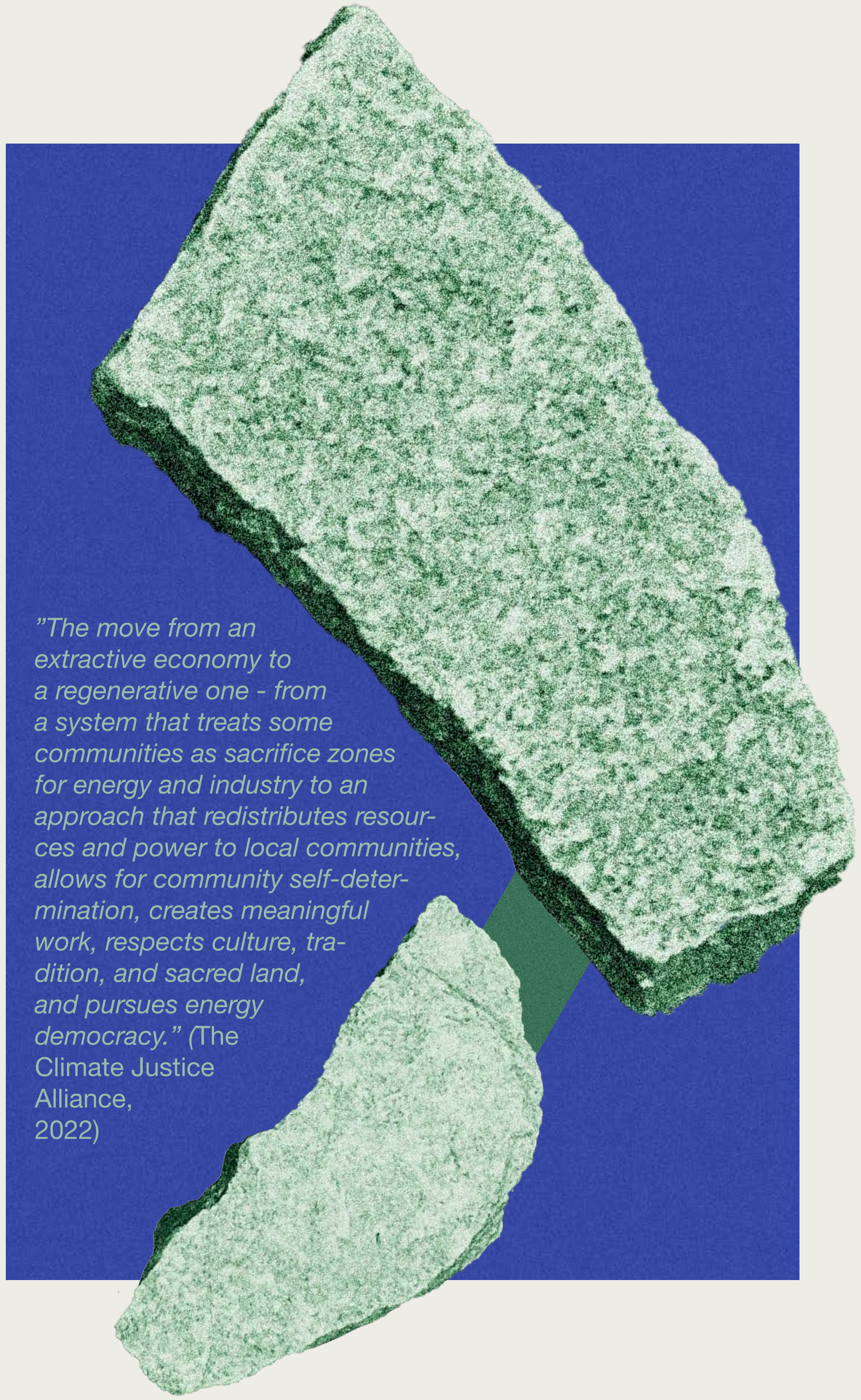
Potential benefits of locally sourced materials

Reduced carbon footprint: Using locally sourced materials can reduce the carbon footprint associated with transportation and distribution. According to a report by the European Environment Agency, "the environmental impacts of transportation are often overlooked, but they can be substantial... transport is responsible for around 25% of global CO2 emissions from fossil fuels" (European Economic Area, 2013).

Supporting local economies: Designing with locally sourced materials can also support local economies and communities. The European Commission notes that "using local materials can be beneficial to the economy and society of a region, as it supports local employment and economic activity" (European Commission, 2020).

Preserving cultural heritage: Using locally sourced materials and traditional building techniques can also help to preserve cultural heritage and traditional practices. According to the Council of Europe, "the sustainable use of cultural heritage contributes to the preservation and transmission of knowledge, skills, values and traditions" (Council of Europe, 2017).

Higher quality materials: Locally sourced materials may also be of higher quality, as they are often selected based on their suitability for local conditions and climate. As the European Commission notes, "local materials can be more adapted to the specific climate and geological conditions of a region, and can therefore offer better performance and durability" (European Commission, 2020).

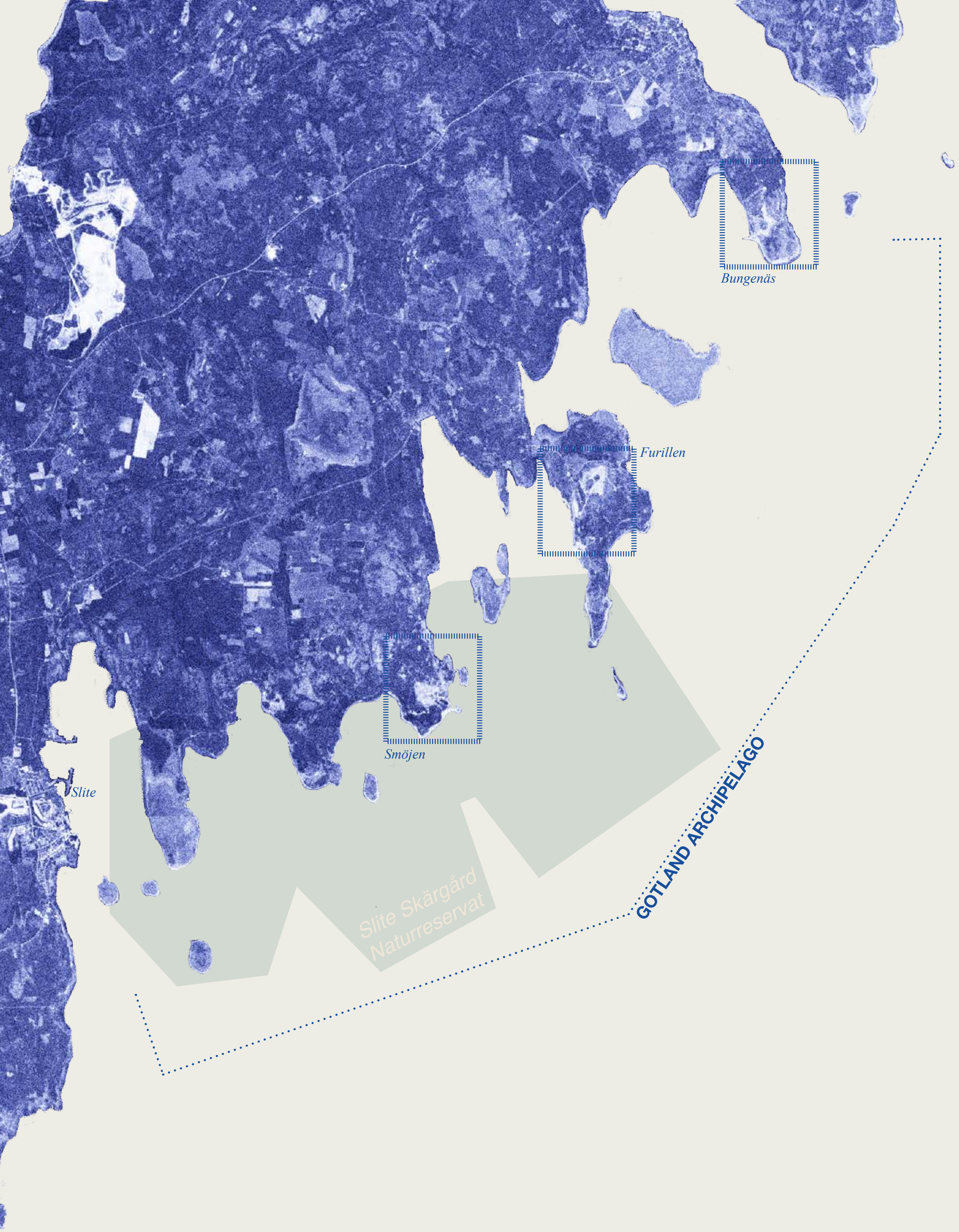


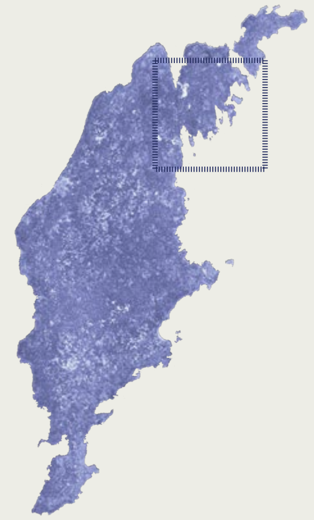
"The move from an extractive economy to a regenerative one - from a system that treats some communities as sacrifice zones for energy and industry to an approach that redistributes resources and power to local communities, allows for community self-determination, creates meaningful work, respects culture, tradition, and sacred land, and pursues energy democracy." (The Climate Justice Alliance, 2022)

03

CONTEXT

Zooming in on the Context we are now moving to the northeast side of the island, where the landscape is vastly altered by past and present extractions. The municiplaity of Gotland have pin-pointed this are as a point of interest, with the landscape, natural and post-industrial- mentioned as valued sites for visitors. In the spirit of limestone, well-established visitor attractions such as Bungenäs and Furillen rub shoulders with still undeveloped sites such as Smöjen in what is referred to as the Gotland Archipelago. Region Gotland is hoping to develop the area further as a destination for visitors through-out the year.





3.1

GOTLAND 2040

Our Gotland 2040 is the regional development strategy (RUS) for long-term sustainable regional development for Gotland (Gotland, 2021). The introduction of the the development strategy reads that ”Gotland has fantastic conditions. Vibrant rural areas and a vibrant city, unique natural and cultural values, strong entrepreneurship and people with a great commitment to their region and the development of society.”. The implementation program for climate, environment and energy for the regional development strategy for Our Gotland 2040 is expected to be completed in 2023, but parts, including objectives for sustainable tourism development on the island at large, have been formulated. One goal for the implementation program is to provide conditions for the development of the tourism sector. The major development challange is how the tourist season for mobile tourism can be extended and create more guest nights all year round.

GOTLAND ARCHIPELAGO

The limestone industry heritage is mentioned in the program, with the Gotland archipelago set as a proposed area where, by developing it as a visitor destination, rural development in the area could be supported and by that strengthen regional development overall. The objective formulated by region Gotland is that the Island as a tourist destination should offer diverse experience values and forms of accommodation. (Gotland, 2021). The Gotland Archipelago includes thea coastal area from Fårösund in the North to Slite in the south, including Bungenäs, Furillen and Smöjen. The plan proposal suggests that several LIS-areas* within this coastal area together will contribute to rural development and can strengthen regional development here. The focus should be on development of the entire archipelago. Fårösund in the north and Slite in the south are important service towns for the archipelago area. Development should take place with a focus on marine guests, the target group from the sea, seaside tourism based on, for example, hiking, seaside tourism and travel incentives, sustainable tourism and pop-up events. Make the coast accessible for marine traffic, e.g. kayaks, canoes, small boats. (Region Gotland, 2021)

Points from *The implementation program for climate, environment and energy* for the regional development strategy for Our Gotland 2040, relevan for further development of Smöjen:

2.6 - Shift to sustainable consumption and production
A transition to a circular economy is needed to reduce emissions, waste and the extraction of finite resources. It is also an opportunity for innovation, competitiveness, economic growth and job creation. A circular economy is based on closing cycles, being resource-efficient, reusing, repairing and considering waste as a resource (Region Gotland 2021).

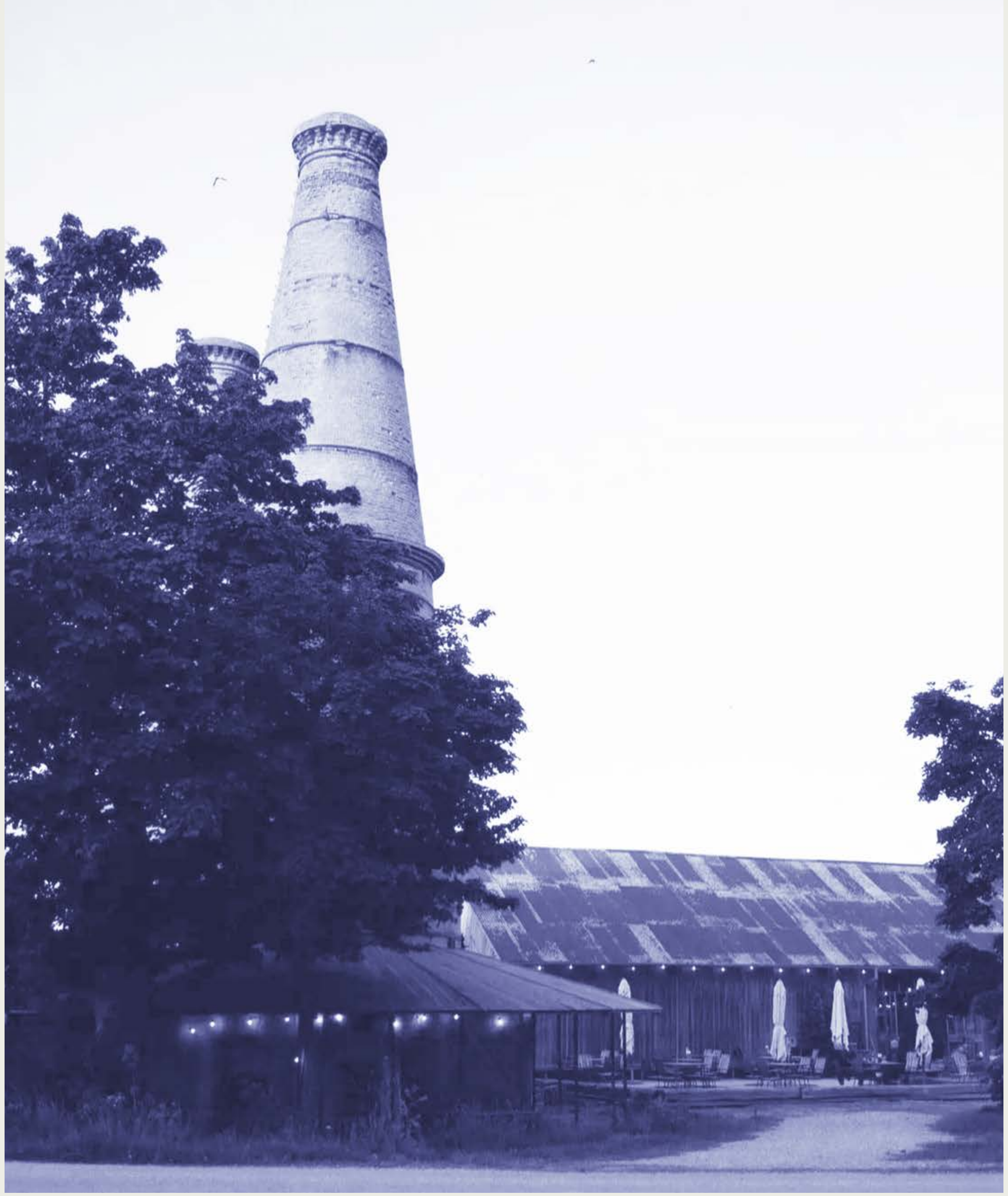
2.10.4 - Strategy for tourism development
The continued development of tourism and the hospitality industry requires a transition to a sustainable hospitality industry. Gotland has good opportunities to become one of Sweden’s most important travel destinations. This will be reflected in the form of increased turnover and profitability of tourism companies, a higher degree of year-round employment and increased tax revenues. At the same time, the basis must be that development takes place in a sustainable manner where social, environmental and economic aspects develop hand in hand. If Gotland is to succeed in this, clear priorities and new ways of working are required (Region Gotland 2021).

* Described in Glossary. page 6

3.2 FURILLEN

Furillen is a small island on the northeast side of Gotland. The limestone industry operated here until the 1970s, and the island was then closed to the public for 30 more years by the Swedish military. Today Furillen is a nature reserve and part of Natura-2000* (Gotland, n.d.) , and the industry is still very present in the bare landscape with piles of gravel stating the memories of past times. During summer Furillen is a popular destination for visitors, and industrial buildings have been transformed into a hotel with accomodation and a resturant.

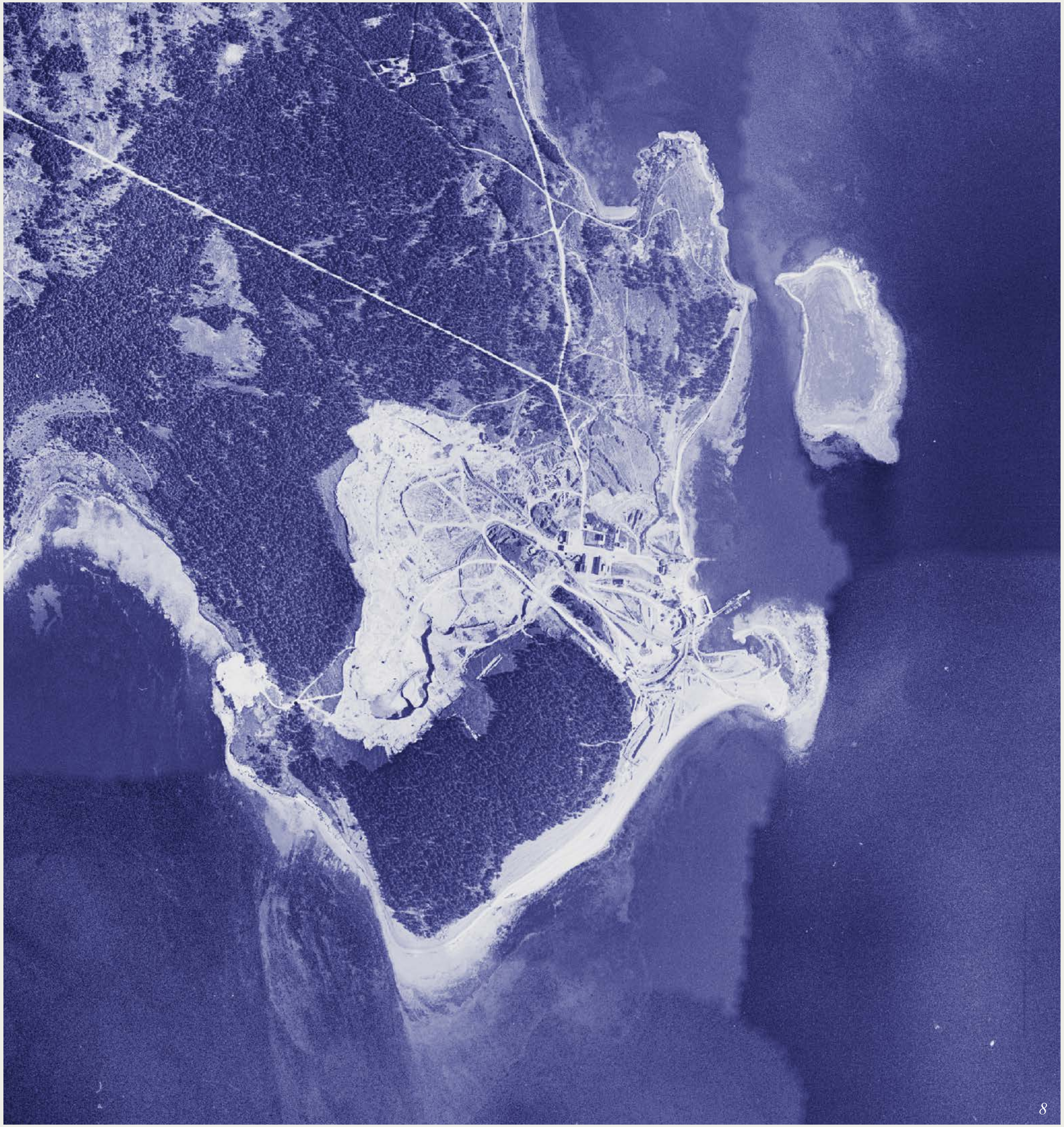
* Described in Glossary. page 6



BUNGENÄS

Bungenäs is a peninsula north of Furillen and three kilometers from Fårösund. The 165 hectar peninsula housed the biggest limestone-quarry in its active years, and when it closed in 1963, the military used it as a training area. In 2006 Bungenäs became a nature reserve and opened to the public. These two eras have left the landscape heavily scarred by human impact: deep limestone quarries, hundreds of covered bunkers, rock shelters, shell craters, half-ruined loading docks, flattened shorelines and a number of buildings from the different eras (Gotland just nu, n.d.) Skälsö Architects developed a complex design program for Bungenäs, where both nature and human traces from the different eras were carefully treated in the re-programming of the area (Region Gotland, 2011).

Figure 6. Bunker at Bungenäs, transformed by Skälsö Architects (n.d.),
Fig 7. Postcard from Aktiebolaget Bungenäs of the extraction site at the peninsula during its active years (n.d.).



8

SMÖJEN

Smöjen is a Peninsula situated in the parish of Hellvi on the North East of Gotland. The landscape on most of the peninsula is charachterized by the previous limestone-industry, surrounded by old crooked pine-trees and spruce and an otherwize barren landscape. The Smöjen coast is lined with a pebble beach, interupted only by the long industrial jetty, a node for all the transportation and export of the quarried stone during the heydays of Smöjen Kalkbrott AB. The sea surrounding Smöjen is a marine nature reserve since 2017. The reserve, named Slite Archipelago, is a large nature reserve of over 6000 hectares, most of which consists of water. It is Gotland's only area with an archipelago character and there are high natural values both in the water and on land (Länsstyrelsen, n.d.)

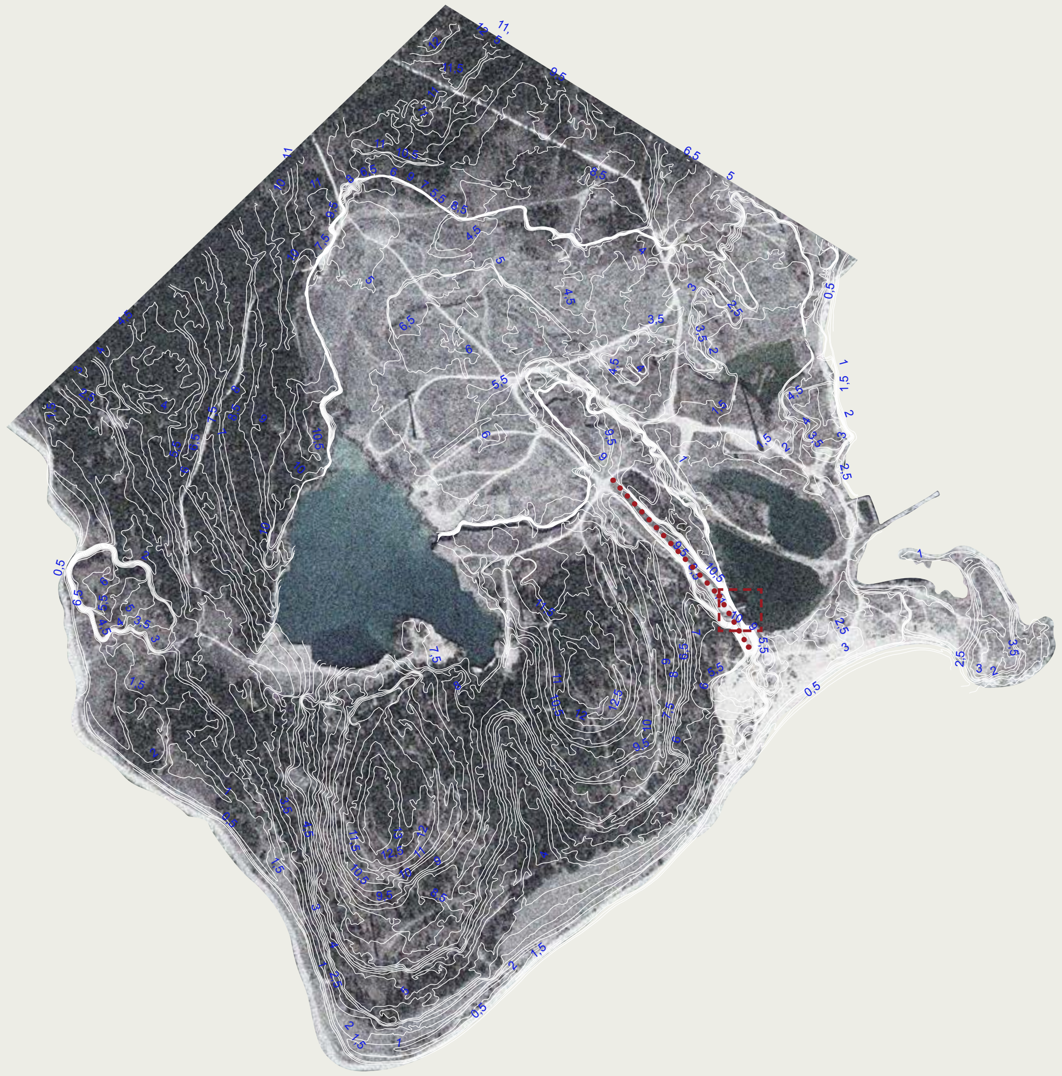
There is very little accessible information about Smöjen Limestone Quarry. When searching the web, there are blog posts and pictures showing the abandoned building and happy bathers, but information about the history and decisions that led to the site looking the way it does today is practically non-existent. In order to find information about Smöjen limestone quarry, several visits have been made to the national archives. However, Smöjens archive is incomplete. Most of the documents concerning the company can be found in the archives of Bungenäs limestone quarry or in the archives of the Svenska Sockerfabriksaktiebolaget (SSA) head office. Even there, the majority of the information is on shipping activities and the use of lime in sugar mills. Very little information about buildings before mechanization in 1948 has been found, possibly as a consequence of a fire in 1931 (Emilsson, Kavonius, 2000).

Mining in Smöjen began in 1906 within Södertälje Kalkstens AB and the company's headquarters were originally in Stockholm. In 1921 the operation was taken over by AB Smöjen's Kalkbrott, a subsidiary of AB Bungenäs Kalkbrott. Bungenäs also became a subsidiary of SSA in 1921. The purpose of AB Smöjens Kalkbrott was to mine limestone in order to extract sugar from sugar beets. SSA bought the limestone quarries to increase its control over the means of production. Previously there had been problems negotiating good prices for the limestone, which was largely owned by Skånska Cement. In 1948, Smöjen Kalkbrott became the first mechanized limestone quarry, with a stone-crushing plant. In 1955, Skånska Cement and SSA merged their limestone quarry companies to form AB Gotlands Förenade kalkbrott. AB Smöjens Kalkbrott was liquidated and the last documents in the archive are from 1957. The operations finally stopped in the 1960s, and all buildings on the site except the stone-crushing plant have been demolished since.(AB Smöjens Kalkbrotts arkiv, varied dates)

Fig 8. Aerial photograph from 1960 showing the quarry landscape of Smöjen just before the shutdown of the operations (lantmäteriet, 1960)

Fig 9. Photograph from the archive of the Swedish Railway Museum with the desciption "Industrial building at Smöjen limestone quarry, Gotland."

9



Gravel Ridge

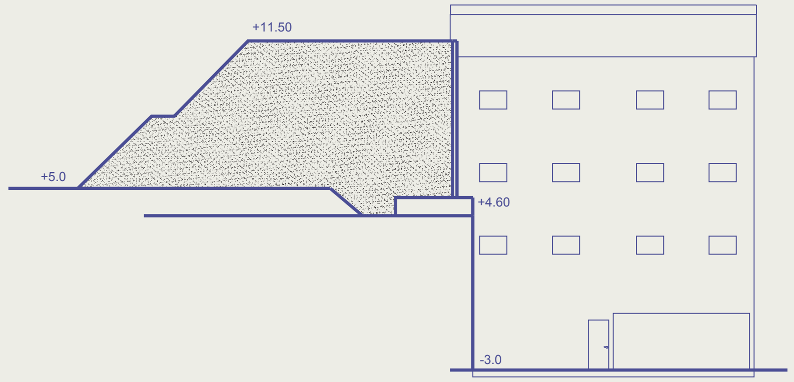
Stone Crushing Plant

Topography contour lines over Hellvi Smöjen 1:1, Hellvi Hemmungs 1:21 samt Rute Lörgeholm och Grautar 1:3 (The contour lines are created from the 2012 laser scan of the National Land Survey.).

THE LAST ONE STANDING

The one structure that remains is a Stone Crushing plant, sitting on the edge of the quarry situated closest to sea. The plant was built in 1948, when the quarry was mechanized. The shape and site of the Stone crushing factory was of utmost importance due toe its central role in the process of making the gravel in the correct sizes to be transported to Skåne for burning and then being used in the sugar industry. Before the factory the people working in the sugar industry had to make the right sized gravel by hand before the burning, and because the stone-industry was not their area of work, this was often a heavy and not very efficient process that stagnated the rest of the industry. The work of crushing stone was hard, anc as time went by, many workers did not agree to to it anymore. and it became increasingly difficult to find workers willing to do the job.

Behind the building is a constructed gravel ridge that extends about 12 m above sea level. The purpose of the ridge was to allow to drive the large wagons, which were also part of the 1948 development, with coarse stone on rails, releasing the stones through the factory to the ”floor” of the quarry, which crushed them into small pieces for further processing (Landsarkivet, 1942-1947).



Drawing of sourheast elevation showing the connection between the stone crushing plant and gravel ridge, with retaining wall to the quarry in the northeast and natural gravel slope to the southwest. Based on archived drawings from Smöjens Archive (Landsarkivet, 1946

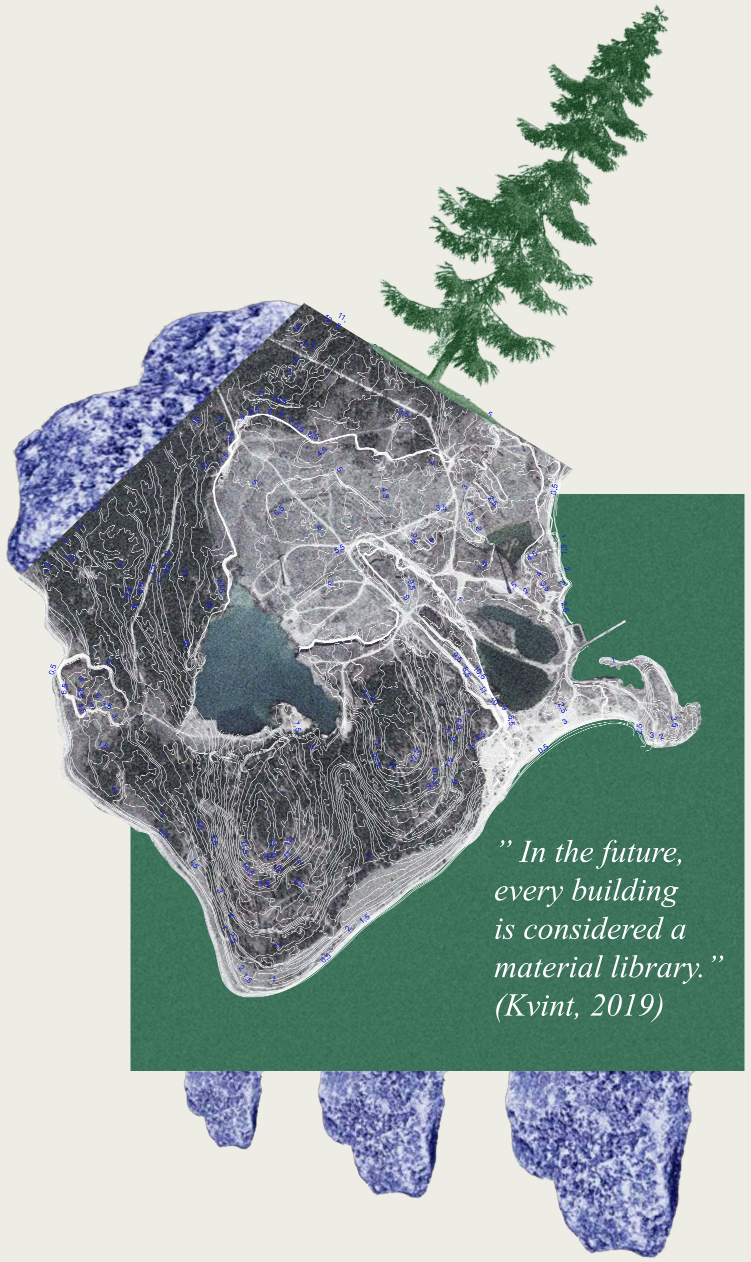
Fig 10. Photograph from the archive of the Swedish Railway Museum with the description ”An Orenstein & Koppel made steam locomotive at Smöjen Limestone Quarry so either Smöjen Limestone Quarry 4 or 5 with staff.”

Fig 11. Photograph from the archive of the Swedish Railway Museum with the description ”View of Smöjen lime quarry and port.”

Fig 12. Photograph from the archive of the Swedish Railway Museum Showing ” Two workers with a filled freight wagon in the harbor at the Smöjen limestone quarry, Gotland.”

Below: ”The Node”; The stone crushing factory probably responsible of a lot of the gravel in various sizes found on the site, where the bedrock is not exposed all the way through to the surface.

Fig 13. Aerial photo of Smöjen peninsula 2018



04

MATERIALITY

IN THE LOCAL CONTEXT

This chapter emphasizes the use of materials that are abundant and easily available in the surrounding area of the project, reducing the need for transportation and associated carbon emissions and make interventions of Smöjen feel at an ease with the site. Materials from the site are mapped and collectively create a library of both loose materials and site-specific elements such as building foundations or previously altered landscapes. In relation to this, historical material-context, craft methods and other references that could provide inspiration for the use of the inventory from Smöjen are presented.

Fig 15. Lantmäteriet, 2019

4.1 // SCALES

The Extraction Site

the total area of extraction. Within this area, an abundance of material can be found. Piles of larger stones and gravel. Crushed concrete, brick-remains and steel-wires are a few examples.

The Quarry

What will be referred to as ”the quarry” from hereon, is the water-filled parts of the post-extraction site that are situated closest to the shore. It is the main subject of this thesis as it holds significant value of the site today and provides a strong foundation for proposed additions in the following chapter. This area contains usable materials, and due to its location close to the pier it is particularly rich in traces and remains from demolished built structures.

The Building

The old stone-crushing factory is one of the remaining structures within the quarry and is one reason why visitors stay within ”the focus area”. It serves as a node and viewpoint, making Smöjen a unique destination, due to the fact that it is the only quarry on Gotland where a built structure stands on the edge of the quarry and descends straight into the water. It is no surprise that the building, slowly falling into decay, is a source of fascination and curiousity for visitors.

4.2 // LANDSCAPE MATTERS

The Smöjen area today is owned by Cementa. There is currently nothing to prevent a change in land use, but Cementa has no plans for further development of the area (Enetjärn Natur, 2017).

The former limestone quarry at Smöjen contains large areas with little vegetation and four water-filled ponds due to past mining activities. Additionally, there are traces of previous work such as ditches, rock piles, and spoil heaps where some vegetation has grown. The area is surrounded by a pine-dominated forest with spruce, rowan, alder, and various shrubs, and the east side is adjacent to beaches and the open sea. The beach consists of low cliffs and a pebble beach with sparse vegetation.

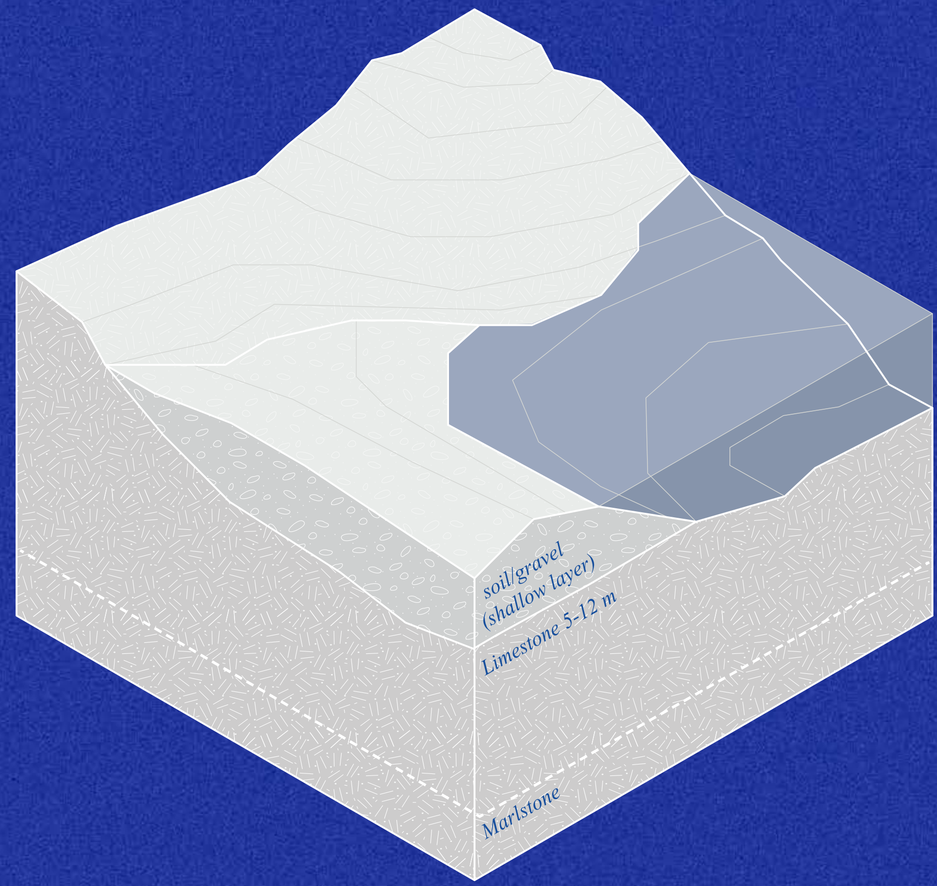
Smöjen attracts tourists with caravans, anglers, and swimmers. The forest south of the former quarry has motocross tracks. In addition to these features, there are various limestone gravel fractions and areas with limestone rocks. Frost phenomena have sorted some material into polygons, and moss is growing on the rocks while the gravel is sparsely covered with several plant species, including white buttercup, honeysuckle, light sunflower, sheep's fescue, thistle, earth thistle, purple knotweed, tulewort, blue fireweed, and grasshopper. Some parts of the area are gradually developing alvar vegetation, and young pines and other trees are growing.

The soil moisture varies throughout the area, with dry patches, shallow ponds, and open ditches that drain parts of the land. There are piles of gravel and large stones, and some finer piles, possibly rubble, are overgrown with grass and heather. There is a slow process of natural succession towards greater biodiversity in certain areas of Smöjen, and this could be supported and expedited through targeted interventions.

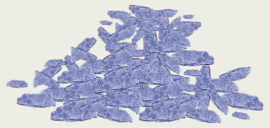
Implementing measures to establish alvar vegetation, increase floral diversity, and create a sparse windbreak of trees and shrubs in some parts of the area could accelerate the biodiversity. Such actions would benefit vascular plants that thrive on alvar soils and insects that depend on floral diversity. The development of alvar soils and an older shrub layer and mature pine trees is a long process that takes centuries (Enetjärn Natur, 2017).

Left: Vegetanion-free surface variations of Smöjen quarry-landscape with trainers for scale. Exposed bedrock, gravel and/or sand in different sizes and combinations.

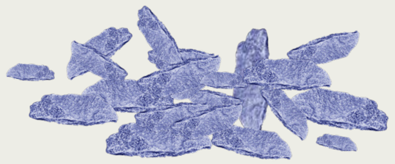
Below: "The Node"; The stone crushing factory probably responsible of a lot of the gravel, in various sizes, found on the site whe re the bedrock is not exposed all the way through to the surface.



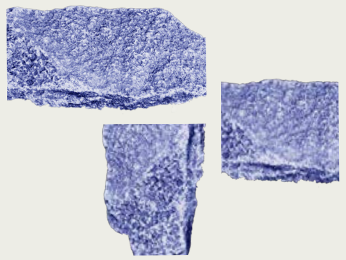
Bedrock diagram - Smöjen



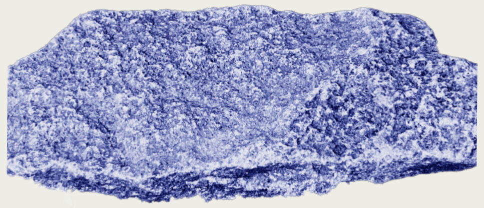
Gravel
width ca 2-4 cm



Coarse Gravel
Width: ca 4-6 cm



Smaller Stone
ca 6x6x2 to 15x12x7 cm



Stone Block
From 20x15x15 cm

Spruce
Height:5-8 m
Girth: 60-90 cm (Diameter ca 20-30cm)

Pine
Height: 8-10 m
girth: 70-90 cm

"The careful use of resources from the site itself, or of those that arise as by-products of nearby landscape management, lessens the environmental impact of construction works and can even make a positive difference locally – these materials have lower embodied energy, lower transport miles and their use can reduce waste and contribute to a circular local economy."
- Local Works Studio, 2019.

Windmill, St Olofsholm
From17th century, periodically used by local farmers. At the beginning of the 20th century, workers from the nearby limestone quarry lived in the mill. Constructed by masonry limestone and wood.

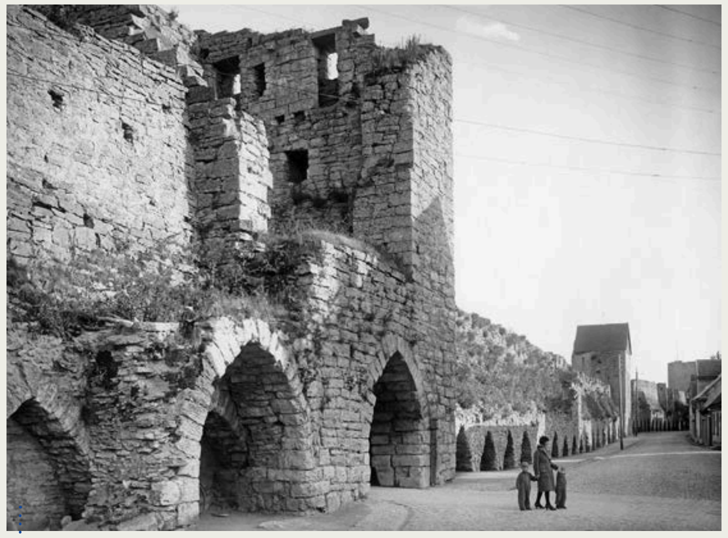


Fig 16. People at the inside of the eastern part of Visby medieval city wall, with the Eastern City Gate and the Mill Tower. The Hanseatic town of Visby is today a UNESCO World Heritage. Photo from 1931

Drywalled limestone with wooden support over entrance, Lörje, Gotland

Stone structure in change. Masonry limestone structure where previous opening is filled with drystoned limsetones, Gotland

4.4 // NMATERIAL HERITAGE

Most of the best kept building remains on Gotland are made of stone. Limestone and sandstone began to be used seriously as a building material in the 12th century. Masonry and vaulting techniques became known on the island and many stone buildings of various kinds were built over the coming 200 years, both in Visby and in the countryside. The stone was quarried as close to the building sites as possible. Lime for the production of lime mortar was burned in lime kilns, after which the packs (unquenched lime) were placed in lime pits in the ground to self-extinguish for several years.

The masonry lime in buildings was usually layered with shells, fossils, straw and clay, depending on what could be sourced locally. Wooden components such as faltak and supporting structure over openings in the wall are common features in built structures for both human and animal shelters.

Gotland has a long heritage and pride in local businesses based on typical Gotlandic materials and techniques. In the areas surrounding Smöjen there are many smaller businesses that could potentially help support the cretaion of new built structures in sustainable and non-extractive ways. There are nearby businesses focused on stonemasonry, high quality wood for furniture, sheet-metal workshop and sheep-farms. Looking within an hour of trasportations there is glass blower that already today uses recycled glass in their production. All this knowledge could be utilized and used as help to make the project more coherent in the landscape from the inside out, and an engaging way for different professions to meet, possibly with new interesting ideas and solutions, both for the development of the area, but also as an opportunity for businesses to meet each other and create cooperation.

4.5 // REFERENCE PROJECTS

This spread presents some relevant references chosen. The selection is based on their relation to the material on site and possible aestetic outcomes relating to a circular design process and rawness as detail. The references will be used as inspiration or as ideas for representation of processes interpreted in the form-finding of the new program at Smöjen.

CHARACHTER

Fig 17
LIKNON // K-STUDIO
Photo: Breba

One with landscape,
materiality,
3-dimensional movement,
spatiality
Subterrainian

Fig 18
ALILA YANGSUO HOTEL // VECTOR ARCHITECTS

Materiality,
transparency,
inside/outside,
old/new,
scenic,
material exploration,
handicraft

Fig 19
CA'N TERRA HOUSE //ENSAMBLE STUDIO

Rawness,
tactility,
simplicity,
Inside/outside,
3-dimensional movement
Space

Fig 20
LÙ CHATARME TRANSFORMATION // DESCHENAUX FOLLONIER

Landscape-perspectives,
Framing through simplicity,
Privacy,
Materiality

MATERIAL APPROACH

Fig 21
MUSICAL STUDIES CENTER //ENSAMBLE STUDIO
Stacked limestone facade, constructed from the raw blocks directly from the limestone quarry. Natural openings are created through gaps between the blocks.

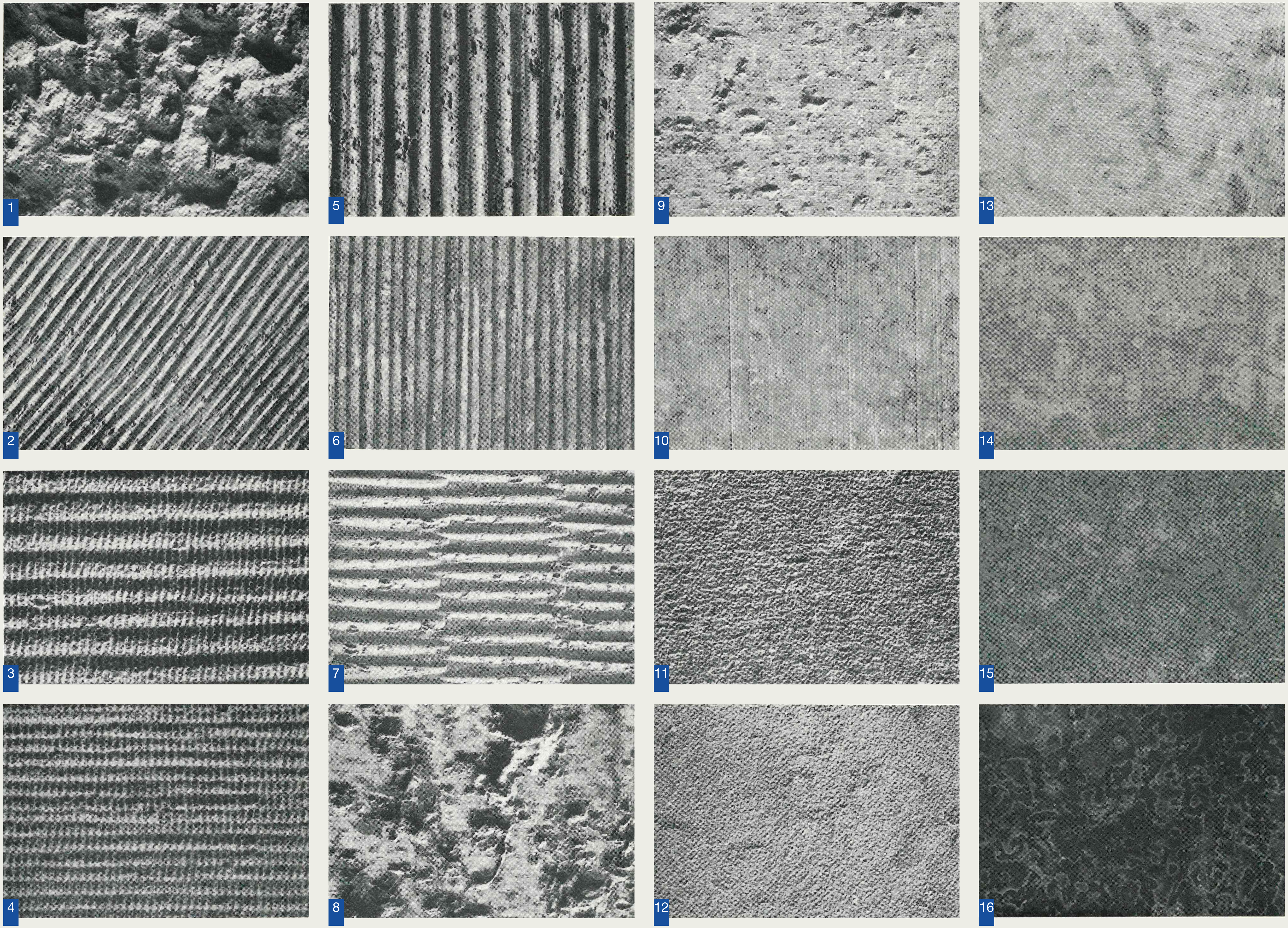
Fig 22.
HOUSE IN MOLEDO // EDUARDO SOUTO DE MOURA
Masonry stone, where smaller and larger units coexist in their different roles.

Fig 23
GREEN CORNER BUILDING // ANNE HOLTROP
Sand-casted concrete, constructed on the building-site.

Fig 24
PARQUE VENECIA // HÉCTOR FERNÁNDEZ ELORZA AND MANUEL FERNÁNDEZ RAMÍREZ
Cyclopean wall/cyclopean concrete, is a mix large stone blocks and concrete/cement. Traditionally "cyclopean refers to large blocks assembled with little or no mortar.

Fig 25 & fig 26
Carefully orchestrated assembly of materials. Wood, stone, masonry each plays its own part.

4.6 // TACTILITY - STONEMASONRY



These are examples of traditional Stone-cutting techniques for limestone. These techniques involve different tools and methods, each yielding a unique finish and texture to the stone.

Fig 27. Images of stone-cutting textrues from "stenhandboken, xxxx

Rough cutting - This technique involves using a chisel or hammer to roughly chop the stone into a desired shape. It is typically used as a preliminary step in the stone-cutting process.

Fine cutting - Fine cutting involves using a chisel or blade to create fine lines or grooves in the surface of the stone. This technique is often used to add detail and texture to the stone.

Toothed cutting - This technique involves creating a rough texture on the surface of the stone by using a chisel or toothed blade. This creates a more natural, organic look to the stone.

Milling - Milling involves using a machine to cut the stone into a desired shape or size. The process is typically automated and can be used to create intricate designs.

Broadaxe hewing - This technique involves using a broadaxe to hew the stone, creating a roughly textured surface. This technique is often used for creating a rustic or traditional look.

Planing - Planing involves using a machine to create a smooth, even surface on the stone. This technique is often used for creating countertops, flooring, and other flat surfaces.

Splitting - Splitting involves using a chisel or blade to split the stone along its natural grain. This technique creates a unique, irregular texture on the surface of the stone.

Polishing - Polishing involves using abrasives and other materials to smooth and shine the surface of the stone. This technique can create a variety of finishes, from a high gloss to a more matte finish.

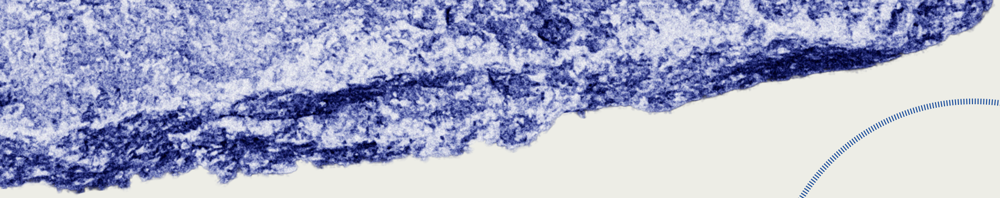
1. Roughly chopped - Råkopp
2. Coarsely chopped / Roughly milled - Skrädhuggen / Råmejslad
3. Roughly toothed - Grovt tandhuggen
4. Finely toothed - Fint tandhuggen
5. Roughly hewn with a broadaxe - Grovt lågerhuggen
6. Finely hewn with a broadaxe - Fint lågerhuggen
7. Split along the grain - Narvhuggen
8. Planed on one side - Topphyvlad
9. Roughly planed - Grovhyvlad
10. Smooth planed - Släthyvlad
11. Roughly sawn - Råsågad
12. Sandblasted - Sandblästrad
13. Roughly polished - Grovslipad
14. Normally polished - Normalslipad
15. Finely polished - Finslipad
16. Polished - Polerad

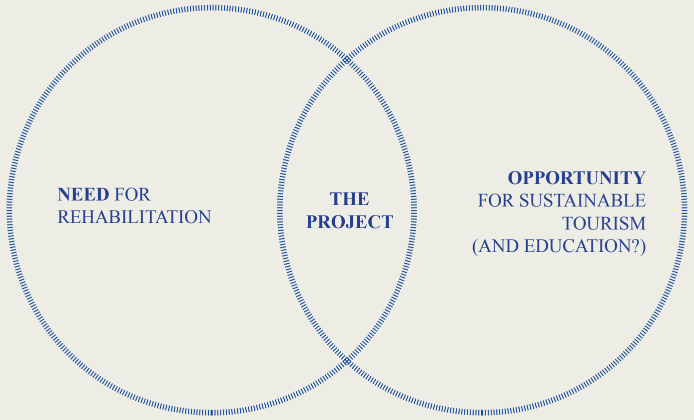
” Architecture has centered on ”sustainable materiality”, focusing on the performance of architecture as a finished product. But a truly sustainable architecture would concern itself with the maintenance of what already exists.” (Malterre-Barthes, 2021, p.87)

05

PROPOSAL

In this chapter the proposed interventions are presented. We are moving through scales, the detail affecting the bigger picture, the bigger picture informing the program and the details informing the additional structures. Here, the theory, history and site together create the context for the proposed additional structures and the way the matter is moved and assembled. The scales and the design-strategies contribute in different ways to the development of the site in the immediate future and beyond.





STEP 1.
HIKING TRAIL
(DEFINING CONTEXT)

Not a design proposal. A proposed landscape-strategy creating a bigger context and relationship by connecting multiple attracrive visitor destinations to support each other and the rural context as a whole. The proposed hiking trail connects to another well established one, that in itself connects the most well known nodes on Gotland, supporting newer nodes on its way. The connection makes it possible to hike from Fårösund all the way to Visby in a few days, seeing, doing and learning on the way, and supporting the rural areas and existing structures for tourism in doing so. Just like designing a site based on its landscape, we must see the possibilities for working simoultanesly from both directions.

STEP 2:
REHABILITATION
(REINFORCING CONTEMPORARY VALUES)

Zooming in on the yet-to-be-developed peninsula of Smöjen. The site is subject to an increasing amount of visitors while having many natural values in need of protection. Here, supportive structures to balance nature/tourism-interests are lacking. Additions that create more defined zones for visitors would be a welcome not only for development-purposes, but to make sure that biodiversity in the area is protected. There is also safety hazards on the site. The very prominent stone-crushing plant invites curious visitors/ climbers and is used as a ledge to jump into the water from, but at the same time it is falling into decay. The quarry that meets the plant also contains big stone blocks with sharp edges and could cause harm for bathers. There is also a risk that waste-products from the military still remains in the quarries. The site is a valued destination today, but there is great opportunity for further development to preserve and enhance the values of the site. The goal is to make the site more accessible and connect the experience of Smöjen to the larger context of the archipelago, in a natural way.

STEP 3:
RE-STRUCTURING MATTER
(ADDING VALUE)

Using the landscape, traces and remains as framework for design while keeping the circle of production as close to home as possible, as raw as possible and avoiding shortening the lifespan of the material by processing it if not necessary. Here, referring to the waste hierarchy, prevention and reuse comes first. The site, altered by past extractions, could be approached in a way that prevents further harm on the landscape by using what we already have. This is achieved by avoiding new extractions, using remaining structures and seeing all components of the site as possible assets.

For this step we look mainly on the surrounding areas of the quarry-lake that connects with the stone-crushing plant. Most remains of old buildings are situated here, and three sites have been defined for further development. The sites have been chosen where built structures are considered to have the prerequisites to support interesting design qualities. The sites are all well situated both in the landscape and for visitor purposes, utilizing remaining structures and/or traces there-of, and have the potential of helping each other as sources of material. These sites could also be seen as examples of different landscape strategies conceptually translatable to other similar contexts. The sites all represent different material approaches referring to history and aiming towards the future.

PROGRAM AIM

For Smöjen to become a place to pause, stay over, use, get creative and find relevant information. Use as base for small adventures. Become a destination that conveys knowledge about Gotland's nature and culture for visitors and the local population. Adaptive program that invites visitors throughout the year. In a wider context help make the surrounding rural areas, nature reserves and cultural landmarks more accessible.

MAIN CHALLANGES

- Keeping the chain of construction local
-Attracting visitors throughout the year
- Balancing nature/human interests
- Avoiding today's building norms as habit

5.1

HIKING TRAIL

At St Olofsholm, a pilgrimage trail all the way to Visby, begins. To connect the archipelago landscape, with its special nature and many remains from Golands most important industry, a proposal for a connecting trail is made. Except for making Smöjen, Furillen and Bungenäs included in a wider context, it will also create the first continuous non-vehicular route from Fårösund (and Fårö) to Visby. By connecting two important nodes on Gotland, the route has potential to become an important path for tourists with a wide range of interests.

Combined trail 80 km, Fårösund - Visby , estimated time 4-5 days

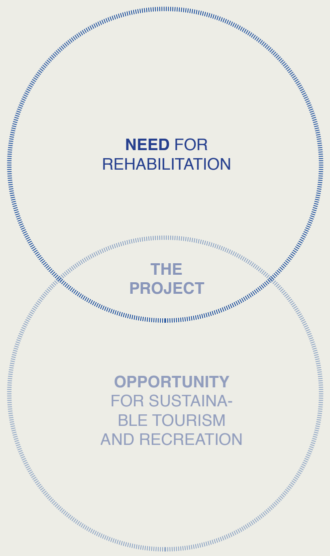
ST OLOFSLEDEN

St Olofsholm - Visby
50 km, Estimated time: about 3 days

"Walk through forests, fields and alvar land, with the sea in sight both at the beginning and the end. The pilgrimage trail stretches from St. Olofsholm on the east coast of Gotland to St. Mary's Cathedral in Visby, passing several beautiful medieval churches and other sights along the way." (Svenska kyrkan).

Proposed Connecting Trail
Fårösund - St Olofsholm
30 km, Estimated time: 2 days
Easy/moderate hiking along the coast with several nature and cultural values, rauks, historical limestone quarries and lime kilns, nature camping and swimming spots on the way.
Sub-targets with accommodation and service facilities:
Bungenäs: *Limestone quarry and historical defense area with many remains, hotel, restaurant and cafe, shops, pier and beach.*
Furillen: *Limestone quarry and industrial remains, hotel, restaurant, beach*
Smöjen (project focus-area): *Industrial remains, service building, cabin rental, cafe/resturant, atelier, information center, limestone quarry bath, beach, pier with small boat mooring.*

The focus area at Smöjen is an important node when planning for accessibility of the archipelago. Development here will by complementing a weak point in the larger context and create an attractive functioning whole.



5.2 REHABILITATION

Interventions of the landscape could accelerate the establishment of vegetation and add to the natural values of Smöjen. The following examples are based on Cementas strategies for smöjen as a "compensation-area" to compensate for further extractions in other locations (Enetjärn Natur, 2017).

Repair of Trenches and Soil Damage

In the former quarry area, there are old trenches and soil damages that divert water away. Since water is an important resource in the natural environment, it is crucial to discourage water diversion. One way to address this is by levelling the ground to fill in trenches and landslides or by damming them to prevent surface water run-off. This measure can improve the conditions for establishing a varied soil flora. However, it is important to adapt the timing, space, and execution of the measures to avoid the risk of new soil damage.

Soil Supply

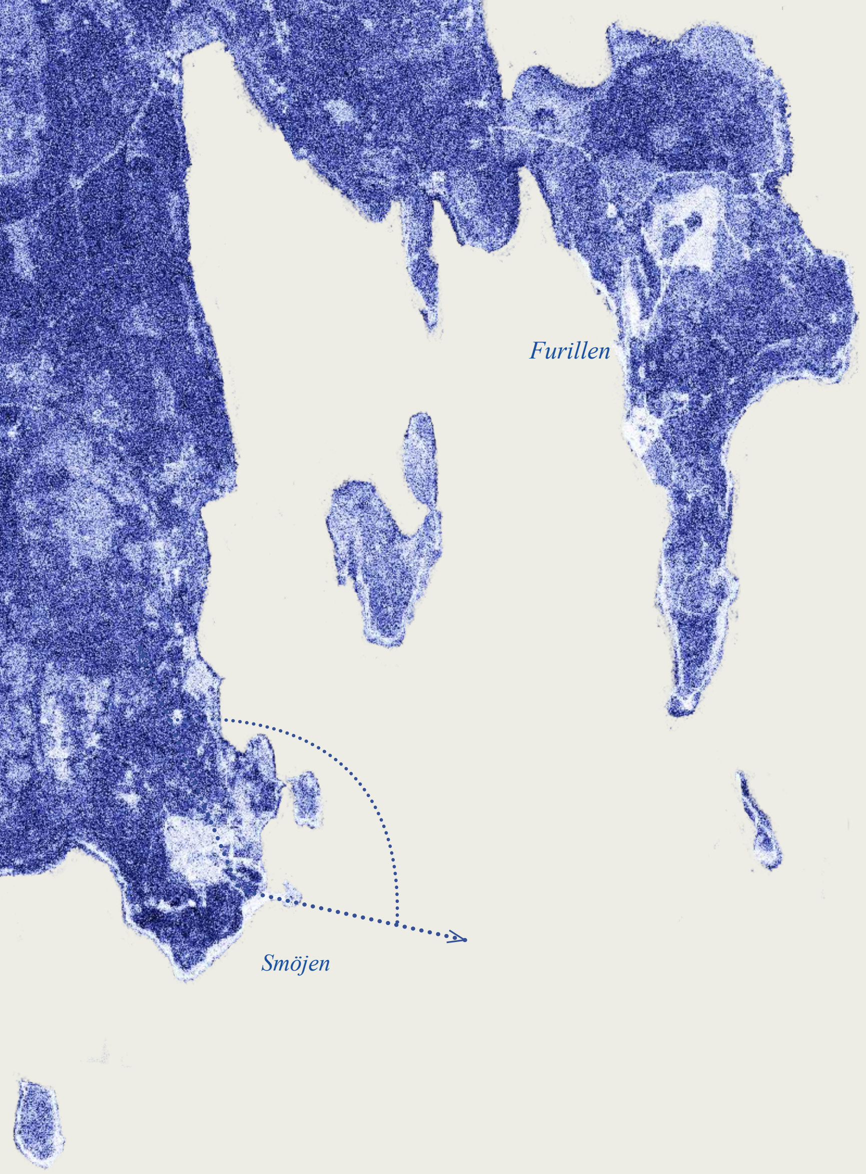
Smöjen lacks a significant number of soil layers in which plants can root, and the soil consists mainly of stones and gravel. To facilitate the establishment of aquatic vegetation on the previously disturbed soil, adding a thin layer of finer material in parts of the area is necessary. This measure involves placing excavated soil, limestone clay, and possibly mineral soil on land where limestone mining has taken place and where vegetation is largely absent today. The added masses are placed in a way that follows or creates a natural topography. The choice of soil depth and mixing of different masses have been tested previously in the Western Quarry in Slite, where it has been shown that seeds and plant parts found in the excavated masses from the File-Hajdar quarry have started to germinate and vegetation has established itself in the new area. The same principle could be applied at Smöjen.

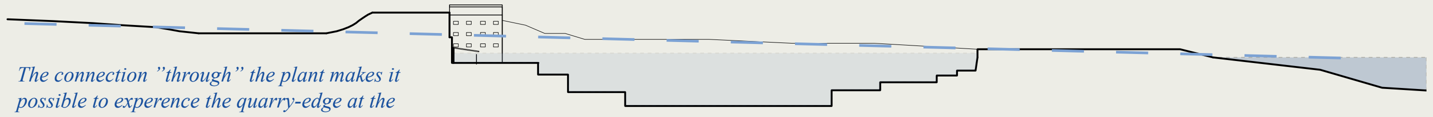
Establishment of Shelterbelts of Trees and Shrubs

The aim of establishing a sparse tree and shrub layer is to create wind-sheltered, warm glades, hedgerows, and small habitats that benefit species from several species groups, such as many butterflies. The measure involves saving some existing trees and shrubs and/or planting suitable trees and shrubs on parts of the open land. Suitable species to be used are pine, white beam, oak, rowan, buckthorn, hawthorn, rose, and juniper. The plant material used should be of local origin and consist of species native to the area. The measure will increase the structural richness of the open land. The presence of trees and shrubs will benefit not only butterflies and other insects but also different bird species.

Sowing and Planting of Alvar Vegetation

To accelerate the establishment of herbs and grasses, supplementary sowing, and possibly planting will also be carried out at Smöjen. Species selection will be adapted to the conditions of the site. The measure can be carried out on soil where material from File hajdar and Västra brottet has been added. The aim of the measure would be to facilitate and accelerate the establishment of alvar vegetation on the previously disturbed land and at the same time increase the richness of flowering herbs. The measure involves the collection of seeds of alvar plants from other excavation areas, Smöjen, and its surrounding areas, and the subsequent spreading of the seeds on the sites where a thin layer of soil has been added for the plants to root in. Seeds from, for example, bluebells, bull-thistle, grasshopper, goat's rue, groundsel, thistle, moorflax, St. John's wort, and field horsetail are used. The measure may also involve the transfer of plants from the additional quarry area to the Smöjen area, such as plants of backthistle, light sunflower, white buttercup, and mountain crab. The measure will eventually facilitate the spontaneous establishment of species other than those introduced in connection with the project. Furthermore, insects dependent on flowering herbs will use the area more than at present.





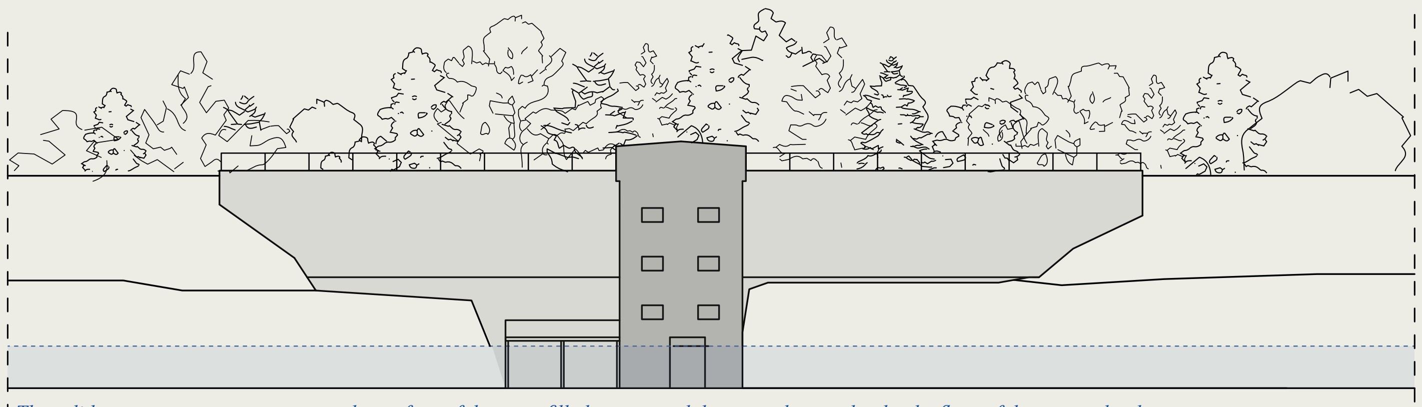
The connection "through" the plant makes it possible to experience the quarry-edge at the natural height of the landscape.

TODAY
The Stone crushing plant is the last standing body from the quarrie's active days. The exterior walls are still standing strong since the construction 1948, though the inside has fallen into decay. As the building makes the site what it is, the strategy here is not to change things that make it special, but enhance its accessibility to visitors and see it as a part of the landscape experience rather than an object to be admired from a distance.

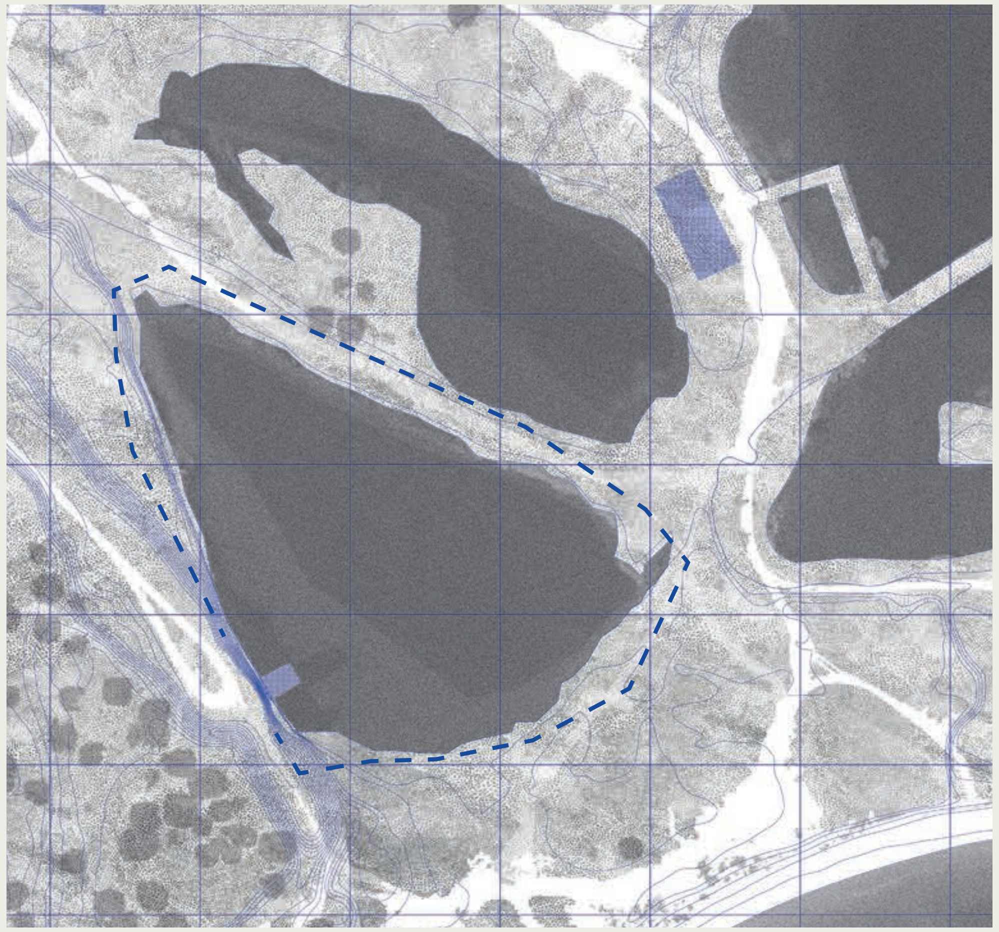
DESIGN STRATEGIES
Use the old structure as framework and create a supportive inner wooden structure with plateaus, 3-dimensional connections and intentional directions. Make it possible to interact with the built structure as a way to experience the site; walk around the quarry, enter the quarry-lake, jump from roof into the water, and as viewpoint to see the landscape from above. Keep and promote present activities and invite for added qualities.

RUIN / VIEW

The ruin as instrument: Supporting a structure that already has a clear value. Adding materials that will eventually leave the original structure to its own again. interacting with the building as a living structure. Patina as detail.



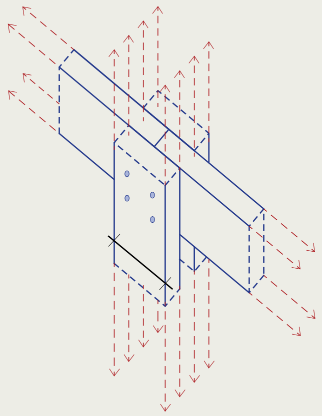
The solid concrete structure goes past the surface of the waterfilled quarry and down to what used to be the floor of the quarry-landscape.



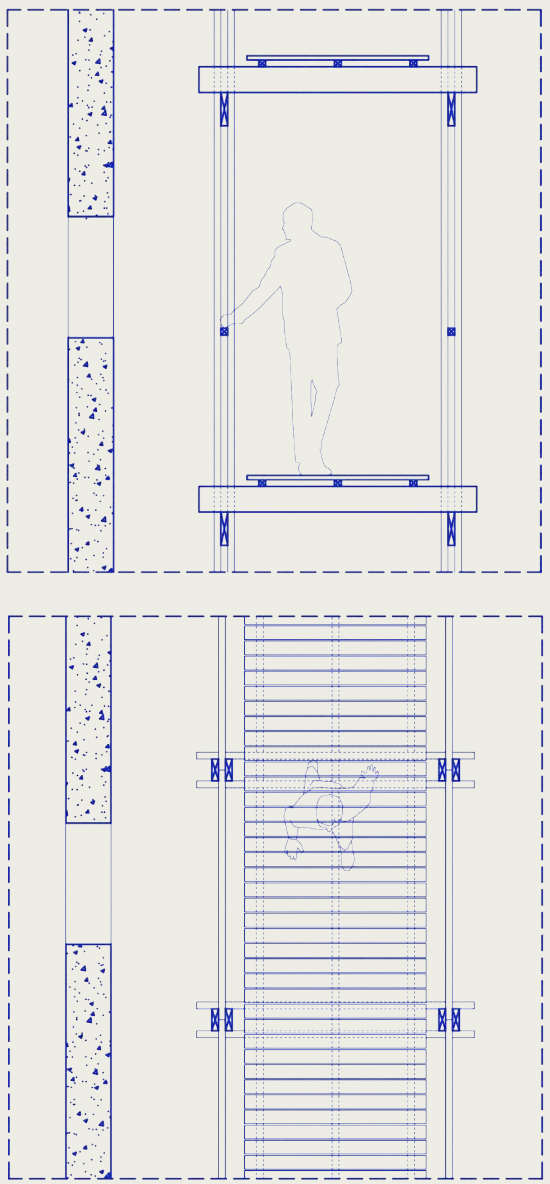
The additional structure to- and inside the plant will activate the site at large, translating dead ends and unsafe paths to circular movements in the landscape.

Material Strategy

Use of spruce from the *Pile/Encave* as far as possible for interior ”tower”, and reuse of the iron railings for the exterior additions. Additional components in pre-extracted raw limestone primarily and recycled concrete from the site of *Void/Space* if needed.



1:50 - Wooden Structure - an example. Distanced from existing concrete wall, moving freely in between the natural and man-made levels in the landscape.



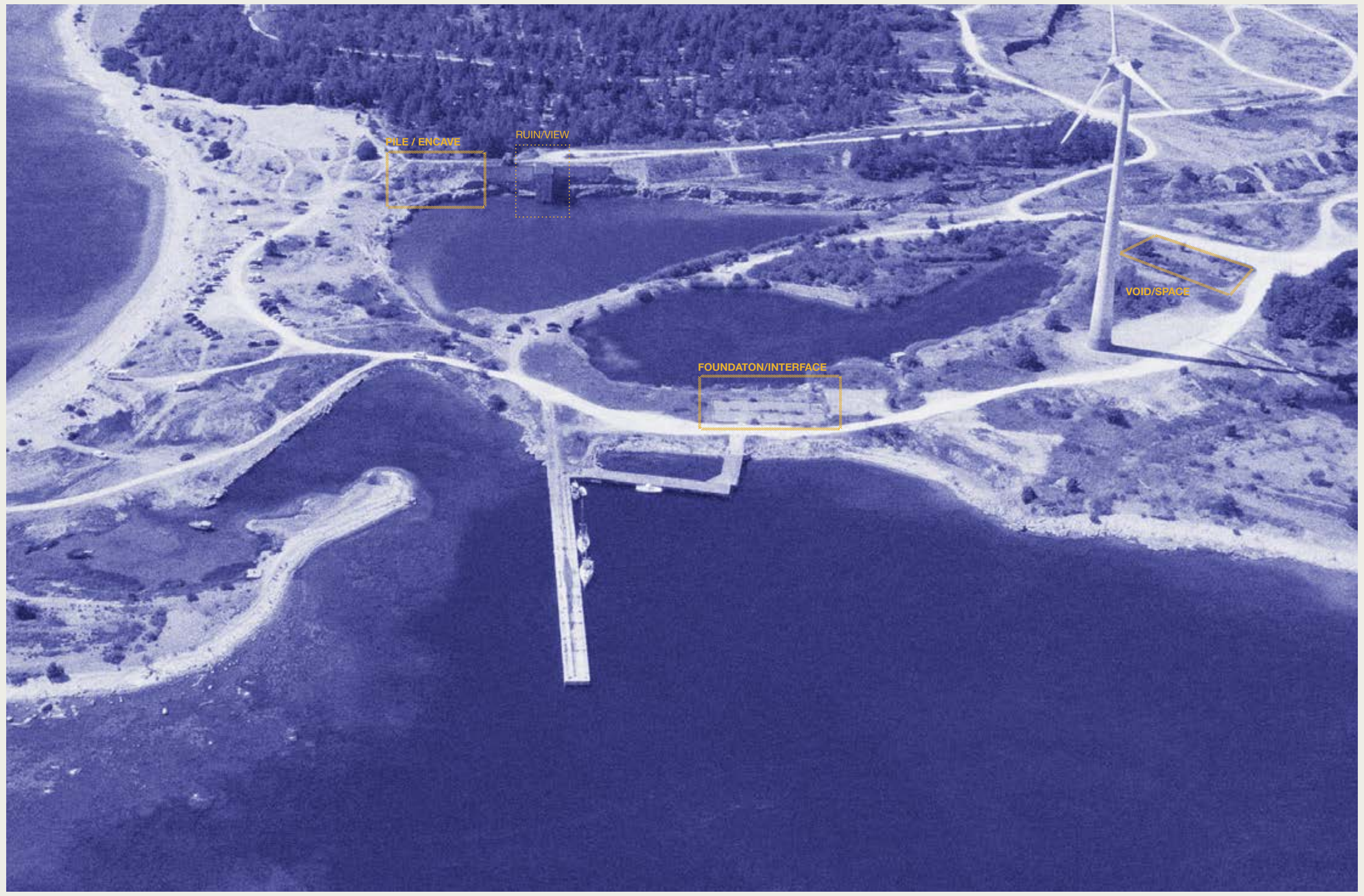
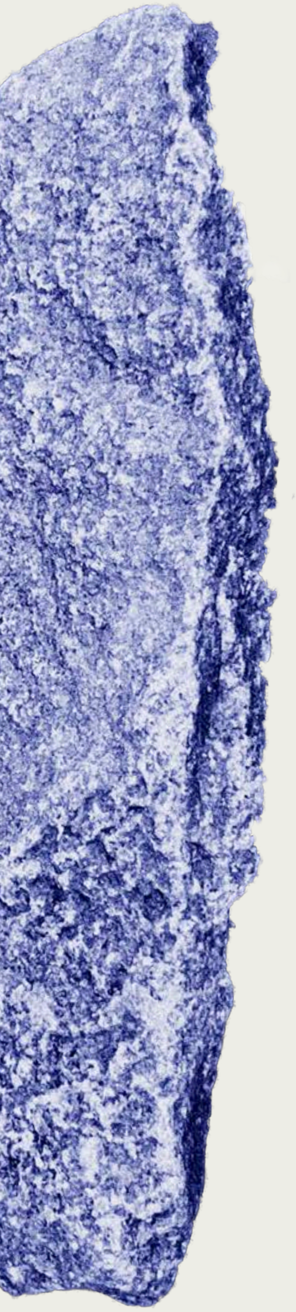


Fig 29. Aerial photograph of the site on a summer day. Annotations marking the identified areas of intervention for Step 2 and 3

5.3 RE-STRUCTURING MATTER

The sites and the program have been selected taking into account the way the area is being used today, and in accordance to what Region Gotland wishes to achieve in their plan for 2040. By close site ananlysis three sites have been selected to be part of further explorations. The sites are well sitauted, both in terms of centrality/privacy, and the landscape prerequisites. Through the traces of its old life the chosen sites also have their own unique identity, that become fundamental principles for the concept and design of the proposed additional structures.

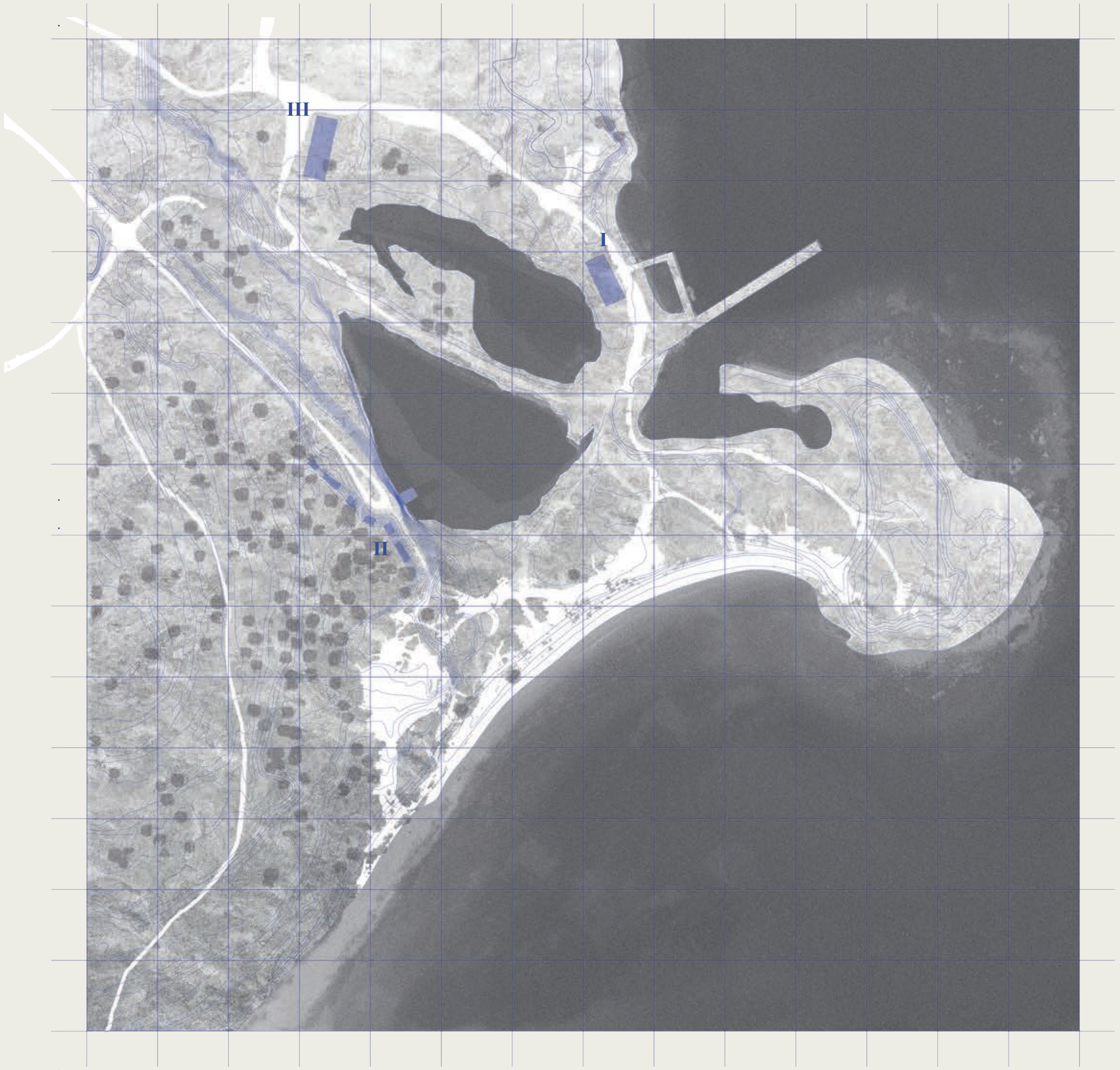


THE STRATEGY

Stay close to the source:
Keep stones as big as possible for as long as possible, to promote as long life as possible.

Design for deconstruction:
Combine matrials in a way which allows for the reassembly of the material into its various components if/when the need changes with time.

Look more than one step ahead:
Approach the site of one intervention as a possible recourse for something else.



Program

I. FOUNDATION /INTERFACE
- The resturant and reception
Resturant with kitchen and seating area outside and inside. Toilet and garbage-disposal. Information/reception for cabin rental, boat-docking and camping.

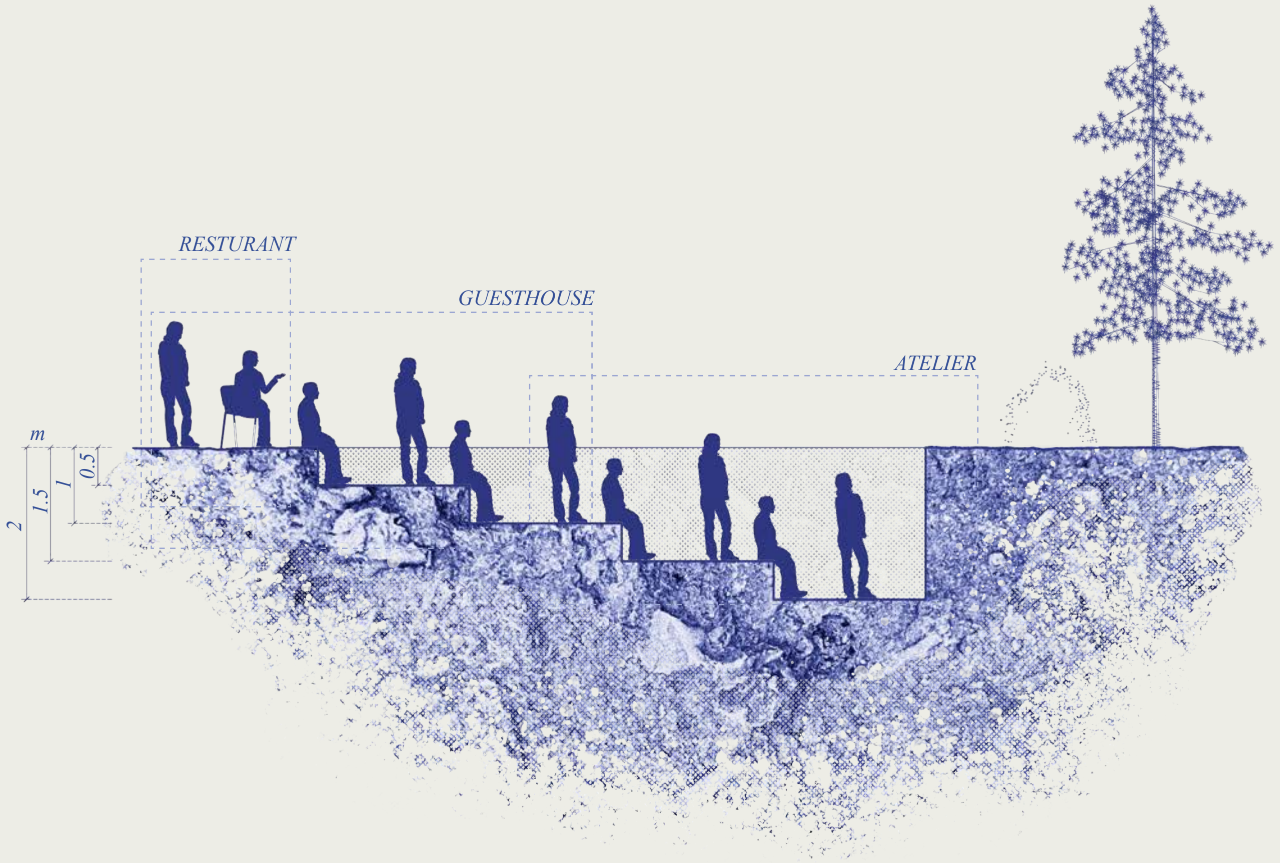
Summer Season: Café, Resturant, Reception for cabin-rentals and information, toilet
Fall/Winter/Spring: Kitchen and dining for onference/course activities. Outdoor shelter and toilets for visitors.

II. PILE/ENCAVE
- The guest-houses
Subterrainian Accomodation in 4-5(?) separate units.
2-4 or 4-8 beds available. Bedroom with working-space, Bathroom with bathtub, outside-shower. Kitchen and dining-area,loungearea inside and outside.

Summer Season: Rental for shorter stay.
Fall/Winter/Spring: Long-term and short-term accomodation (examples: artist recidency, accomodation during course activities and conference).

III. VOID/SPACE
- The atelier
Partly embedded space *Showcasing Design, arts and crafts inspired by local context. Showroom and shop during summer, atelier and creative workshop during off-season.*

Summer Season: Showroom and store (Gotlandic handicraft design and art/history related to Smöjen/Gotland)
Fall/Winter/Spring: Atlier for artist staying long-term, flexible space for conference/ course activities).



DIFFERENT WAYS OF APPROACHING THE MATERIAL

I: Restaurant/Reception: The stone as an artifact. Roughness. weight. Referring to traditional shapes and techniques. Seing the raw stone as detail.

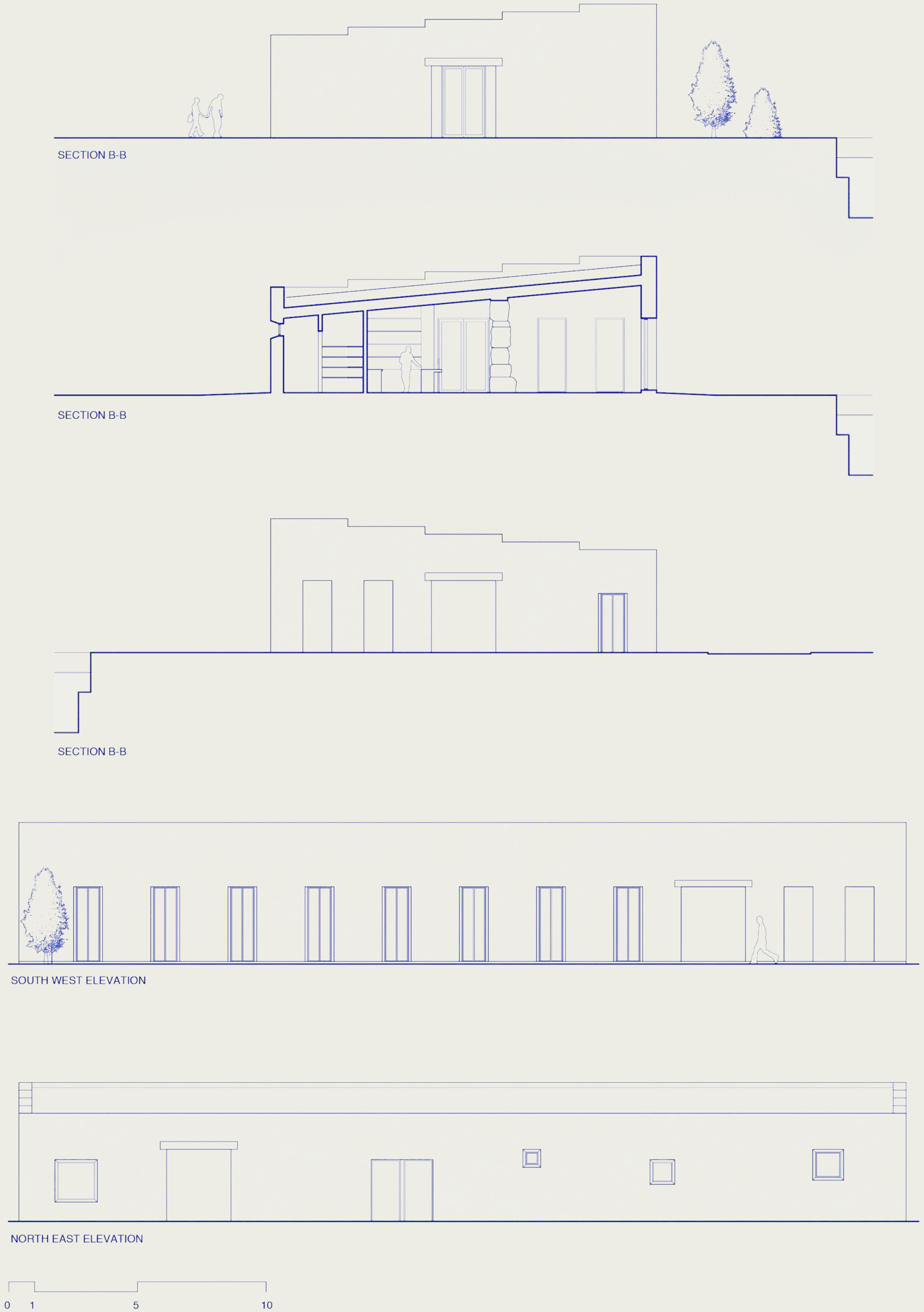
II: Guest houses: The stone as craft. Stereotomy and transparency. Stonemasonry techniques as detail.

III: Atelier: The stone as memory: Recycling/ Appropriating. Mix-use material strategy from already processed stone. The terrain as detail.

FOUNDATON / INTERFACE - **RESTURANT/RECEPTION**

Main element: The remaining foundation as an interface between landscape and addition.

Material approach: Raw limestone will be moved from the water nearby to promote bathing and to be used in the building. Together with stones from the Gravel ridge and from other designated material-areas on site this building will contain all sizes of the raw limestone found at the site. Complement with spruce from the site of *Pile/Encave* for openings in the wall. Vegetation-roof taking care of the plants that are moved in the building process.



RESTURANT / RECEPTION
DRAWINGS
1:200 (A4)

0 1 5 10

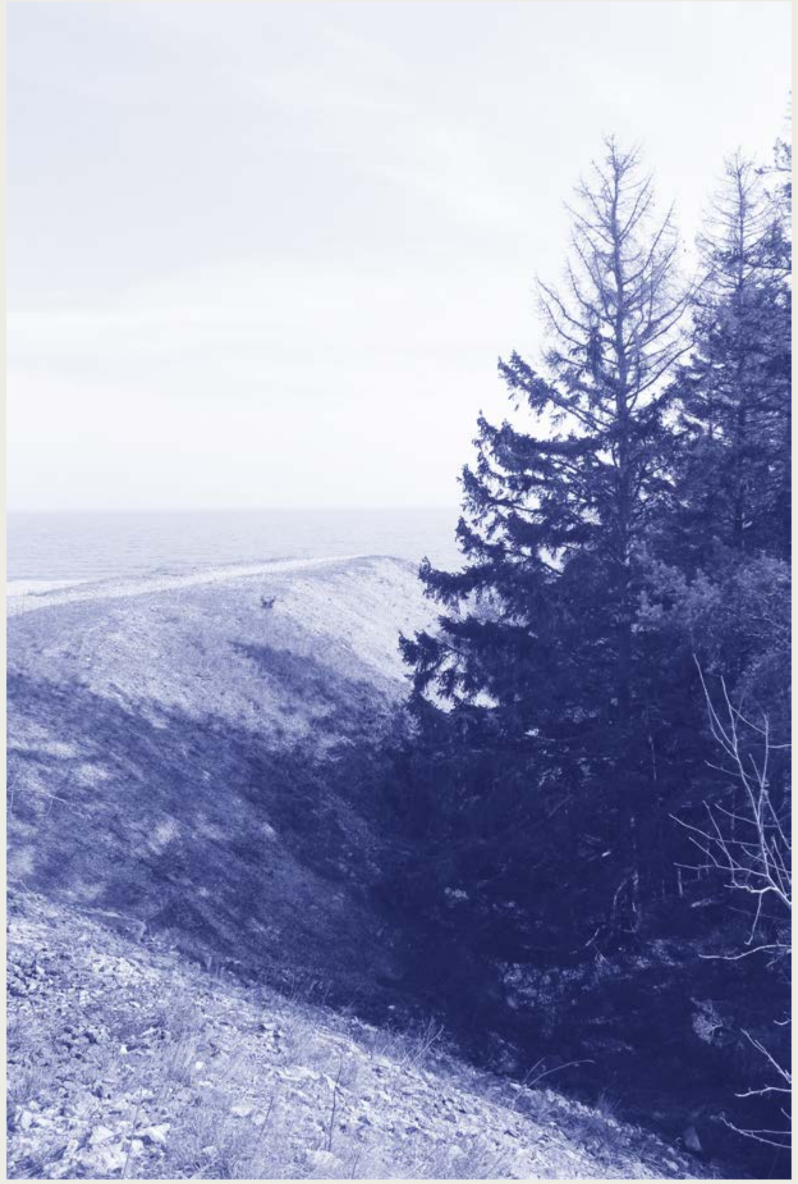
RESTURANT / RECEPTION
FLOOR PLAN
1:200 (A4)

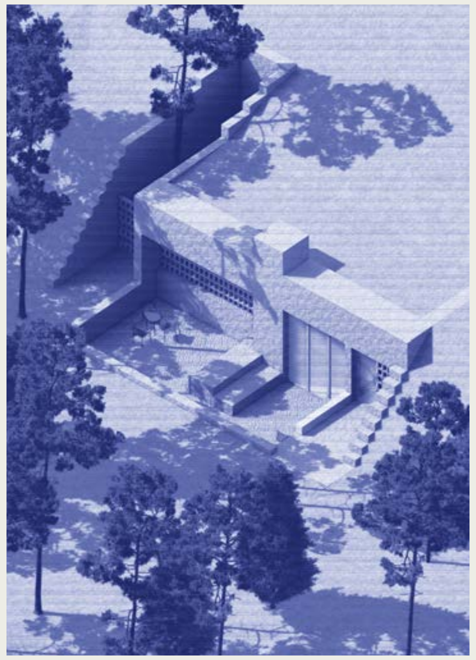
1. WINDBREAK / ENTRANCE
2. BAR/CAFÉ COUNTER
3. WARDROBE
4. SEATING AREA
5. OUTDOOR SEATING AREA
6. RECEPTION / INFORMATION
7. PUBLIC RESTROOM
8. ACCESSIBLE RESTROOM
9. GARBAGE ROOM
10. STAFF ENTRANCE
11. CHANGING ROOM
12. FOOD STORAGE
13. COLD STORAGE & FREEZER
14. KITCHEN
15. WASHROOM
16. OFFICE
17. CLEANING ROOM
18. TECH/STORAGE

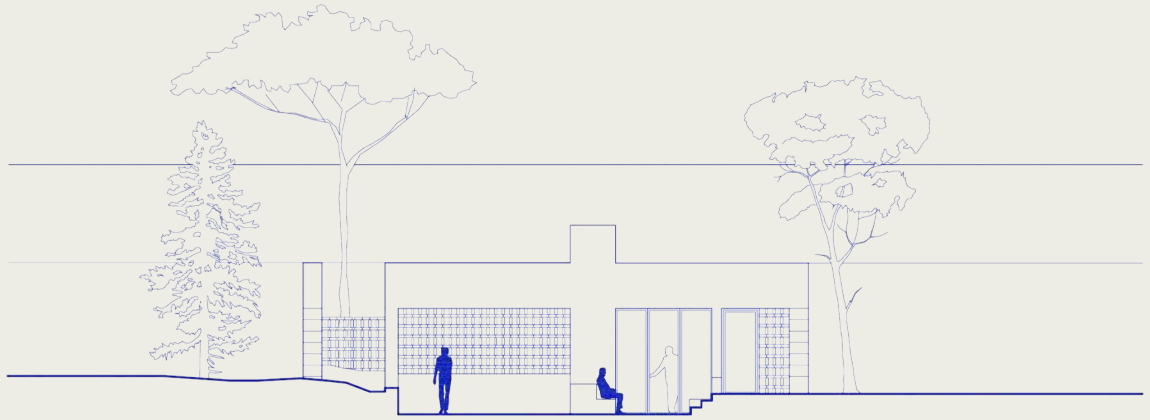
II *PILE / ENCAVE* - THE GUESTHOUSE

Main element: The gravel ridge.

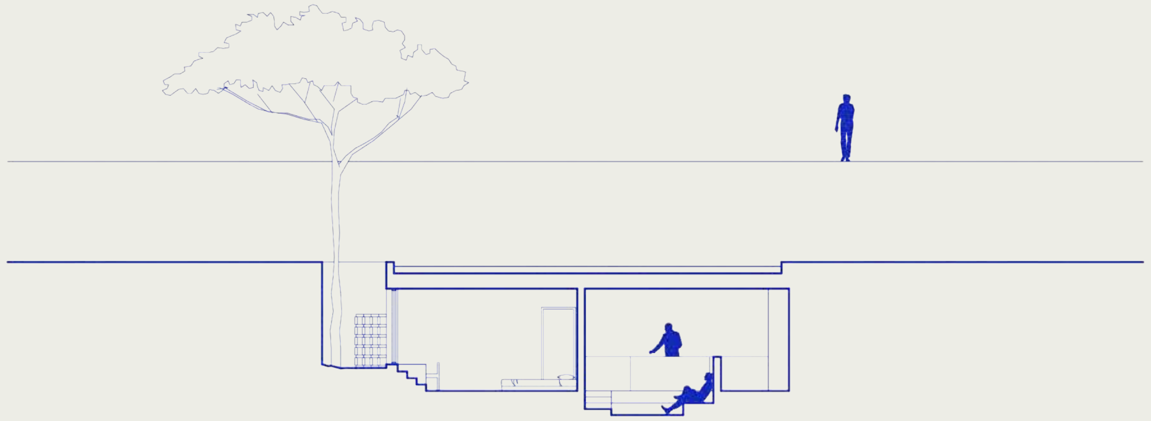
Material approach: Coarse gravel to larger stones from the gravel ridge will be moved from the ridge to make space for the Guesthouses. The material will be used for building the Guesthouse, and redundant material can be used for *Foundation/Interface*, repairing roads and making the site more accessible overall.



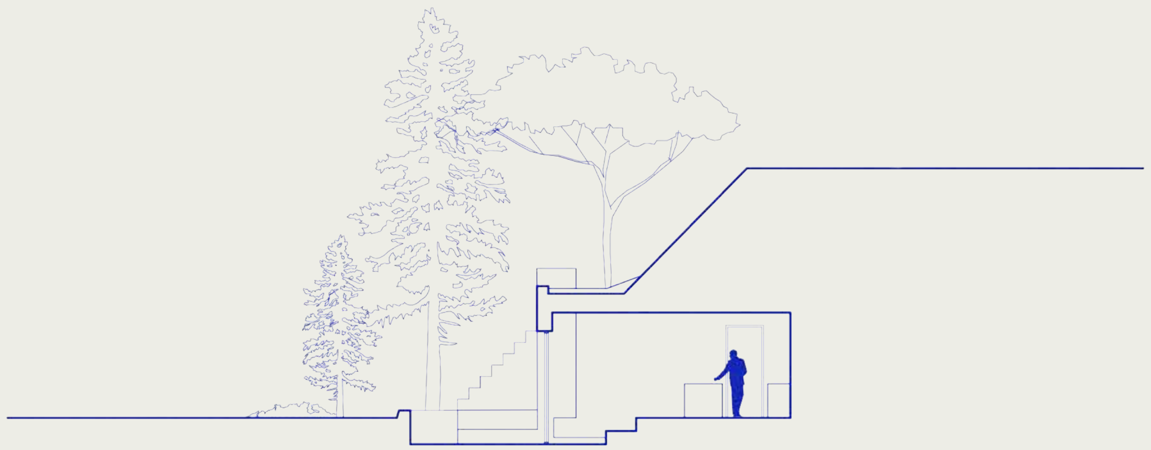




SOUTH WEST ELEVATION

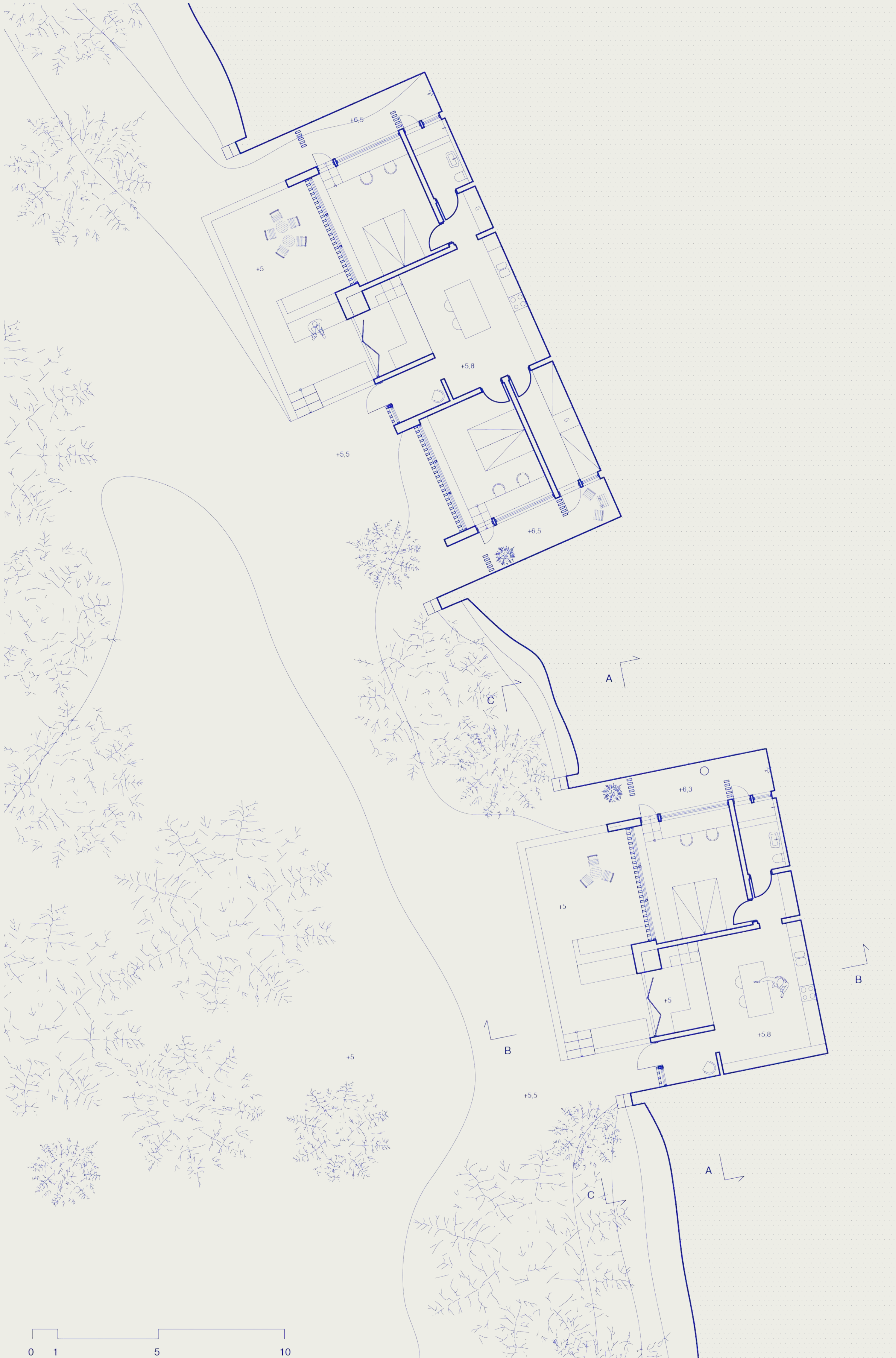


SECTION A-A

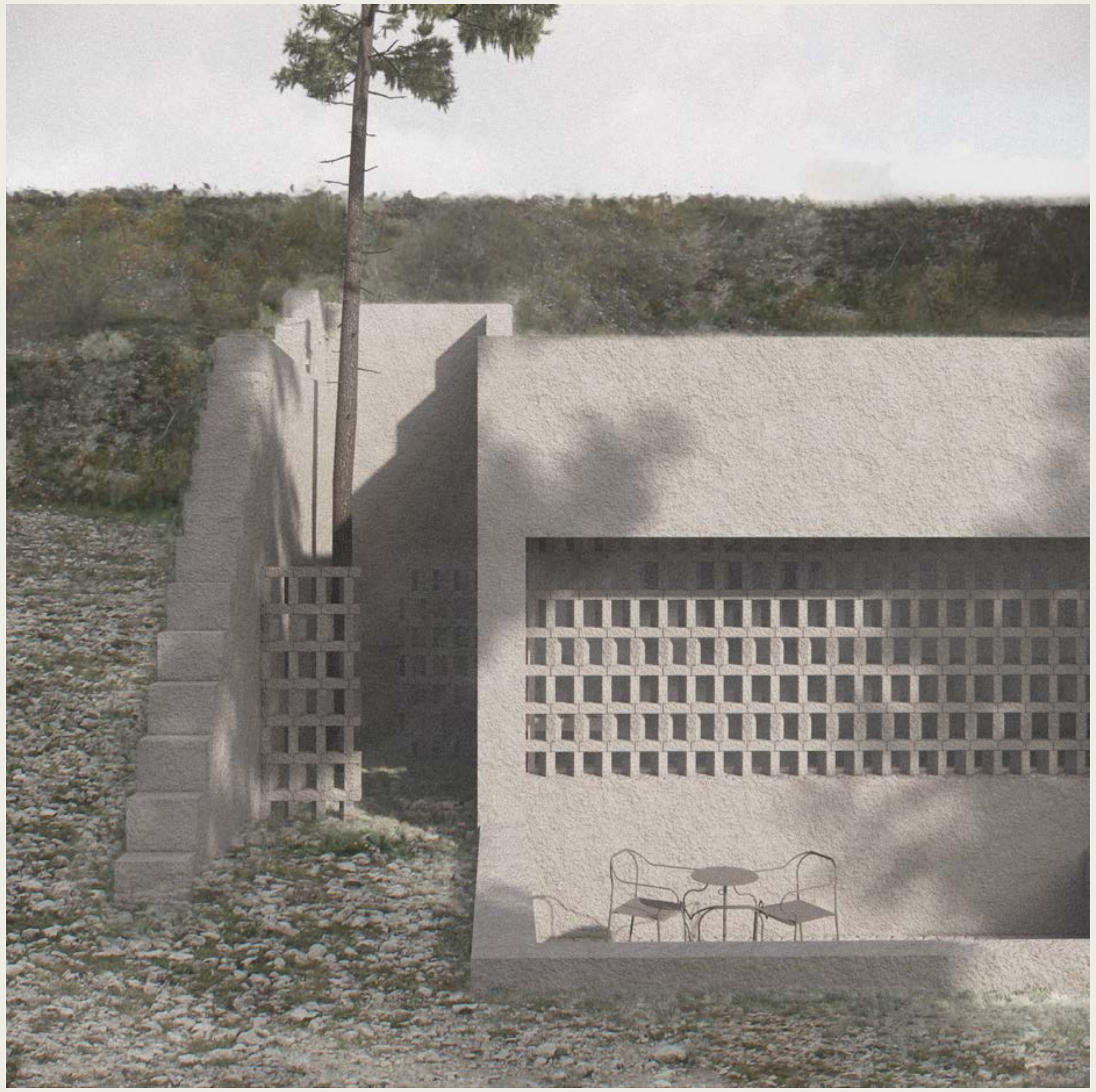


SECTION B-B

THE GUEST HOUSE
DRAWINGS
1:200 (A4)



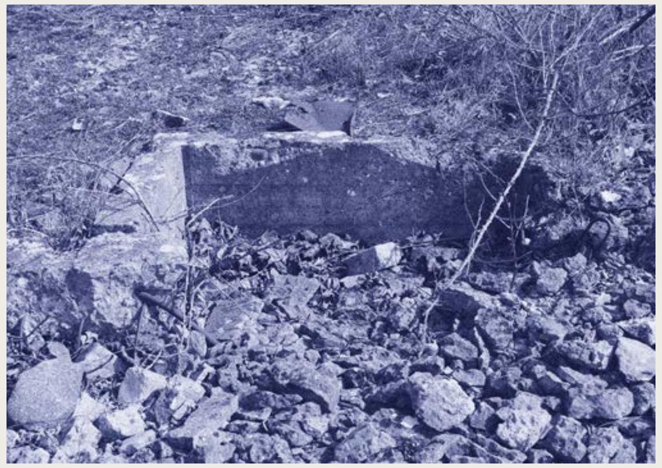
THE GUEST HOUSE
FLOOR PLAN
1:200 (A4)



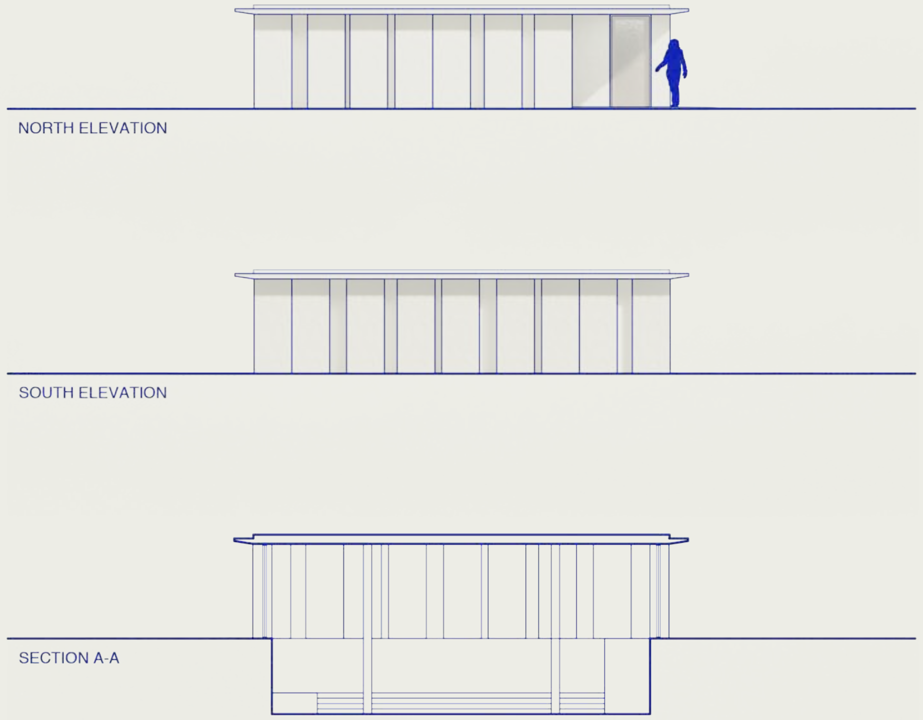
III *VOID / SPACE* - **THE ATELIER**

Main element: The basement, filled with crushed concrete blocks and brick

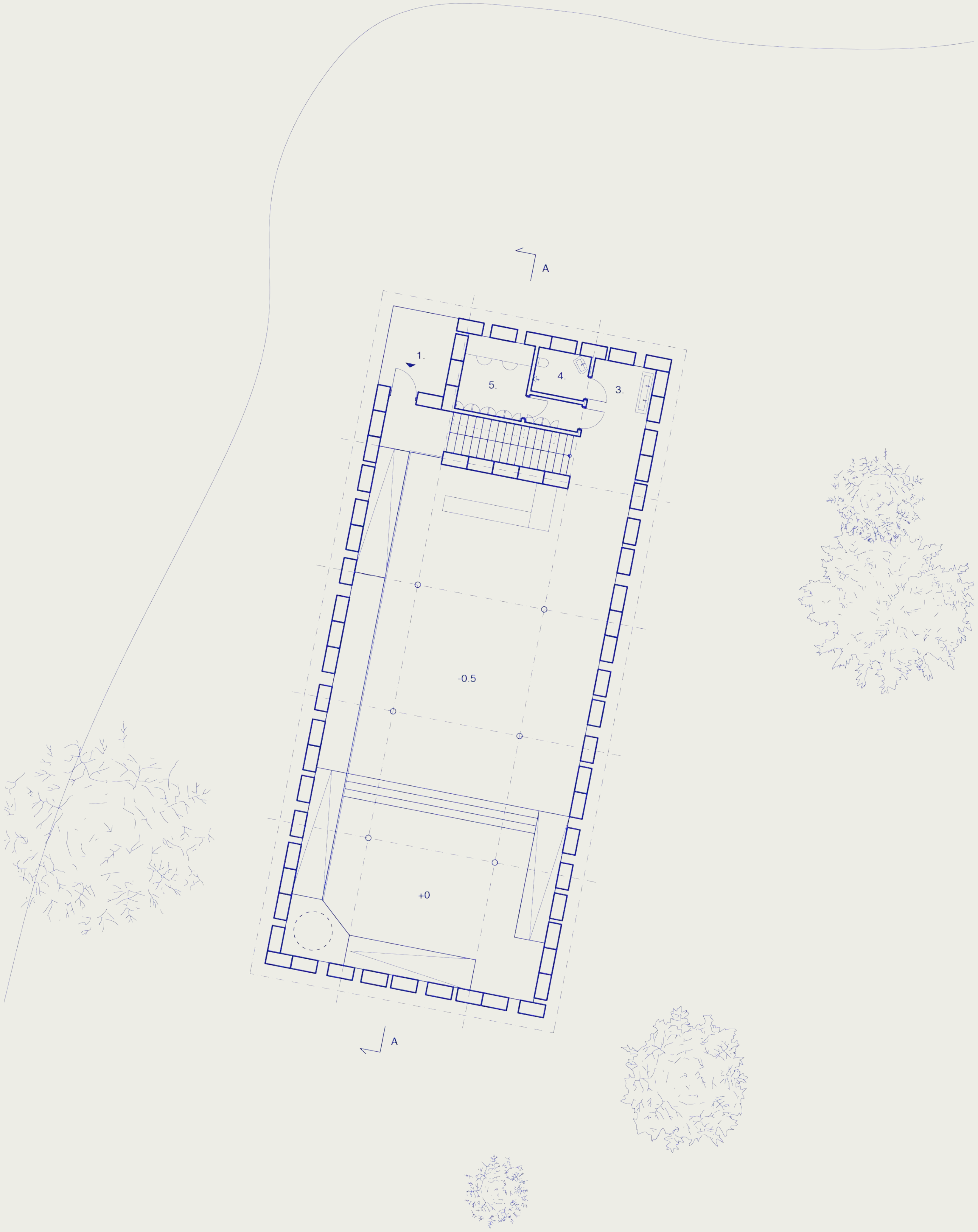
Material approach: Build spacious room without building high, viewing the landscape from new perspectives. The material bank within the basement can support other structures on the site if recycled in efficient ways. Possibility to use the concrete ”rocks”, also filled with material. Also make recycled concrete and combine (showcase more ways of combining recycling and reuse to minimize further processing when possible). Using the fine gravel on site as a mold to mimic the ground and create interesting surface and texture.



In the memory of the quarrying the cast concrete elements are appropriating the dimensions of raw stone-blocks that are quarried on site in Slite at the extraction site for Slite stenhuggeri. A representation or metaphor for the volume of the stone that is taken from the landscape. 2500x1000x500mm



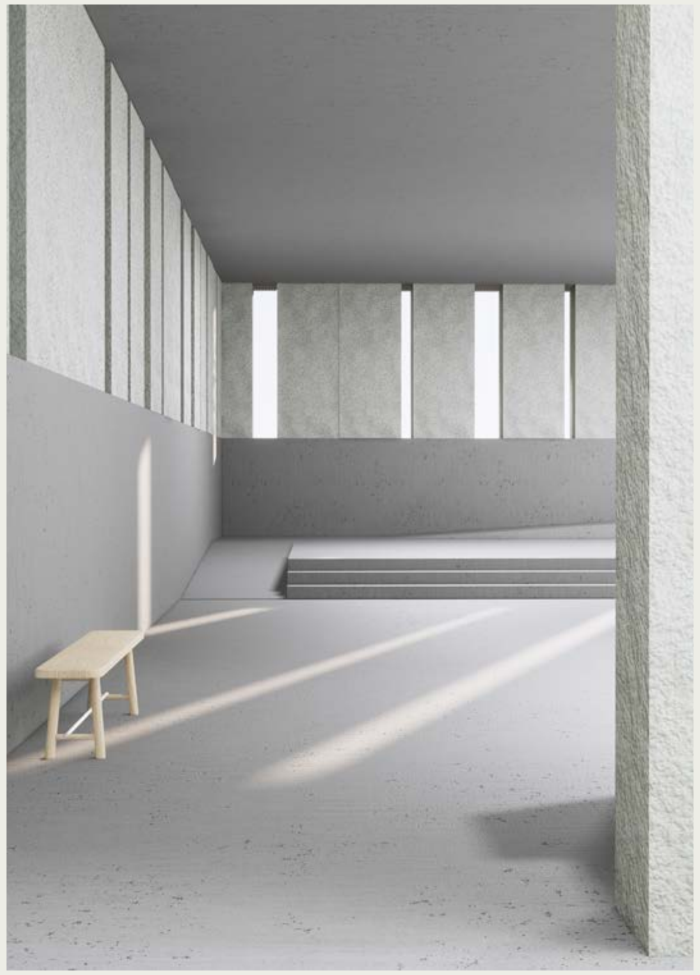
ATELIER
DRAWINGS
1:200 (A4)

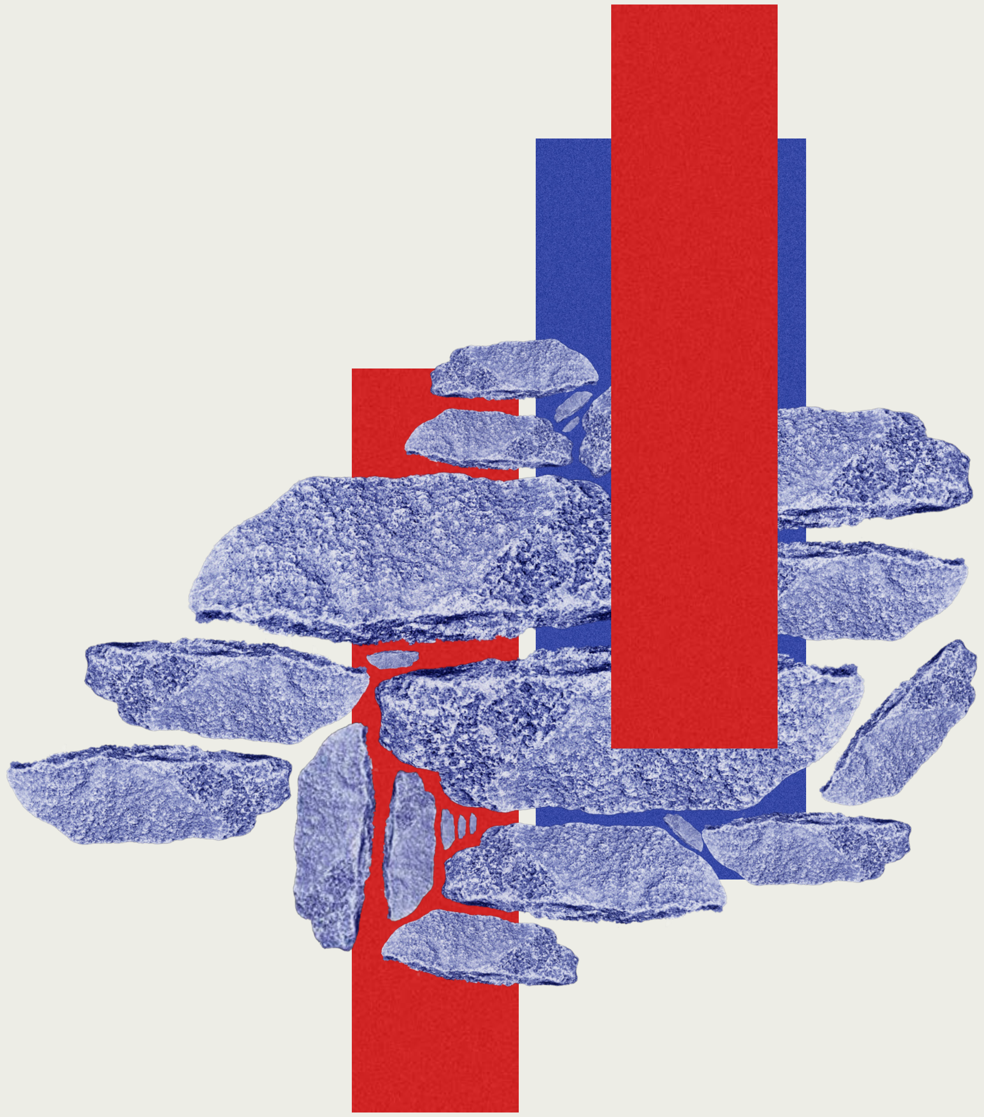


0 1 5 10

ATELIER
FLOOR PLAN
1:200 (A4)

1. WINDBREAK / ENTRANCE
2. ATELIER/SHOWROOM
3. HAND-WASH
4. ACCESSIBLE TOILET
5. STUDY/OFFICE





06

DISCUSSION

To understand an extraction-site we need to understand what was being quarried, what it was used for and its context today. We also need to understand what the mining of the material affects, close-by and broadly. The proposal in this thesis should be seen as a creative example of how the architect can approach a post-industrial landscape when reprogramming for further development. It should not be seen as a final solution, but as an inspiration to use the landscape as a creative accomplice.

So, *how can architects take responsibility for the use of materials when re-programming post-industrial landscapes?*. There are many ways of taking responsibility for the use of materials, and one solution is using the landscape as the material provider and the local communtiy as resource for implementation. In that way the material-cycle and the effect the production has on its surrondings can be controlled.

The challenge of ensuring that the elements that form architecture are sustainably produced can be approached from several angles, but eventually, all angles need to be covered for it to fully work. One starting point could be designing the building and resolving every construction aspect to ensure that every material chain is under control. However, for this method to work in a resource-efficient way, this approach needs to be introduced in the very start of a project. In the same way, working from a conceptual starting point, representing the early stages of a project, won't work if the execution and practical details are not pursued in line with the original concept.

Most actors dealing with finite resources seem to agree that methods to translate ”waste” to resources is of great importance. The approach of this thesis is to better see the value of pre-used or pre-owned and use the features as a design framework. It is also clear that existing structures play an important role for the future of architecture. It is worth considering if the concept of maintenance can be challenged and include a broader interpretation in the future.

A starting point for encouraging the longevity of materials is changing how it is referred to. Talking about ”waste” for example, indicates a product's worth or lack thereof; it is already decided to be discarded, and other treatment than disposal is seen as something outside of the ordinary. In an article last year Annika Kvint wrote: ”In the future, every building is considered a material library.”. Pre-used materials and objects created for a sertain purpose that is no more has to be appoached as part of a big library of components with potential value.

It is said that constraints breed creativity, and as an operator at the intersection of the artistic and the technical, there is an opportunity here for architects to be a creative force in the implementation of circular strategies. However, it would be both presumptuous that the profession on its own could change consumption-based behavior. A wide range of professions and skills are needed to ensure sustainable production chains and development that are not at the expense of other landscapes and communities. Architects are not constructors, geologists, archeologists, historians or LCA-engineers, but can be an important part of the composition and space creation that incorporates these elements in a design context. As planners of the built environment the future will most likely include those structures or traces of them. Consciously choosing the way these spaces are created and taking ownership of how they are achieved *is* orchestrating the future. In terms of saving resources and enabling reuse the life after the anticipated one also has to be taken into consideration from the very beginning. Use, change and even decay can be anticipated. Even decay can be seen as a conscious choise of withdrawn maintenance. It is all about changing the perspective.

As Malterre-Barthes claimed ”Every decision designers take in a project has an impact not only on the site of production, but also on the site of extraction. ”. Not addressing something is also a conscious decision and a clear indication of priority. We cannot afford *not to* adress the scars created in both nature and society as a result of the overuse of finite resources.

CLOSING WORDS

When seeing the building as part of its landscape, it may also be possible to see the built environment as the movement and rearrangement of materials instead of something final. This avoids the linear approach of consuming something to produce something else. Answering a time-bound question with permanence seems like a bad solution. It might solve that isolated problem in some ways, but with new and bigger problems as a result. Decisions on how to build today can have irreversible effects on what can and cannot even be considerd in the future. Architects *should* care, and lack of awareness is ignorance.

Don't assume, Ask
Don't consume, Use

...and keep in mind that the particularities of a landscape offers a breeding ground for creativity.

EPILOGUE

One of the greatest takeaways from this experience is that the more you learn, the more you realize that there is so much more to learn and somehow always limited time. One semester feels so long in the beginning and so short when looking back, and somehow I almost feel like I know less about the extractive world now, maybe since I understand the great complexity of the subject and thereby see this new world of things that I have yet to learn. However, I also understand that I know more now than I did when we drove around Gotland searching for turquoise water in my childhood. I realize that I with these 80 pages barely have touched the surface, and I could probably spend a lifetime continuing the project at Smöjen; solving the details, measuring rocks, comparing numbers, re-evaluating and doing it all again.

When i start my professional journey I hope to continue to immerse myself in the relationship with the landscape and its intrinsic values. When I eventually get to see a project through from concept to built, I would very much like the opportunity of walking parallel with the structure during its lifetime and hopefully also successful next life or afterlife. To plan, implement and evaluate to keep learning from the process, getting to see the matter in movement. I see the stone, the pile and the remains with different eyes now than I did five years or even two months ago, and I feel excited for the eyes which I will see these matters with in years to come.

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