Samsø Culinary Badehotel

Master Thesis Project

MSc04 ARCH   Aalborg University   February - May 2022

Group 2 - Arvis Brunavs, Clarissa Nazzaro, Sherunchsajan Yokarajah

Department	Department of Architecture, Design and Media Technology	
Semester	MSc04 ARC	
Project Period	01.02.2022 - 25.05.2022	
Supervisor	Luis Filipe dos Santos	
Pages	131	
Pages of Appendix	8	
Students	*Arvis Brunavs*	
	Clarissa Nazzaro	Clarissa Nazzaro
	Sherunchsajan Yokarajah	Y. Sherunchsajan

Reading Guide

The report of this Master Thesis project is divided into three main chapters: the program, the design process and the presentation. The Program collects all the analyses and theorical research which makes the point of departure for the development of the design proposal.
Here, the conclusion paragraph collects all the gained inputs into a functional and room program, and both the design criterias and vision are enounced.

Subsequently, the Design process chapter introduces the design strategies and different solutions, which are then synthetized and proved to be effective with the energy consumptions and LCA analyses.

In conclusion, the Presentation chapter presents the final proposal, collecting drawings and renderings to show the different features of the new culinary Badehotel.

Abstract

This Master Thesis Project is a proposal for the new Badehotel in the island of Samsø (Denmark). The aim is to use the site's potential and convert an existing cement factory into a structure devoted to tourism.

The Report collects all the research and the process on which the final proposal is based on. Hence, aspects such as cultural heritage, social and environmental sustainability and regenerative architecture are taken into account.

The project will have a special focus on Materiality and the Indoor Enviromental quality, utilizing simulations and softwares in order to understand the impact of the proposal on the environment and users well-being.

In conclusion, the new Samsø Culinary Badehotel will be a new touristic landmark for both locals and visitors, providing spaces for dining, a Spa, lounge areas and 18 private rooms.

Table of Contents

Program

The Program chapter is a collection of all the research and analyses on which the design is based on.
From the general research, conclusions are deducted in relation to the specific context, giving guidelines for the design development.

The conclusions are then collected into an initial functional and room program, and the vision and design criterias are enounced.

Introduction

Design Brief and Goals

This project takes the premise of the project proposal advanced by Tvedebrink (2021) as follows:

"A private investor has initiated the development of a new beach hotel as a replacement of a 113-year-old cement factory located in the middle of one of the best beaches and valuable natural cultural heritage sites on Samsø. Placement consists not only with amazing coastal scenery with wonderful nature and rare plantation, but also solid cultural heritage with magnificent archaeological sites belonging to the period of Vikings. The island is also increasingly known for its great food production. The aim of this project is to transform the site of old cement factory into a new beach hotel, focusing on attracting more tourists and open more workplaces for locals."

Within the frame defined by Tvedebrink (2021), the overall design goals are established. These are going to be the main elements and conditions on which the further design criterias will have to respond to.

- Design a beach hotel that attracts tourists, fosters tourism economic activity and engages the local community.
- The beach hotel will be economically and socially viable by fostering three main activities: sleeping, dining and leasure in the form of Spa and louge facilities.
- The design will address topics such as social, economical and environmental sustainability.
- The design should focus on material detailing adequate to reach a low energy and sustainable building.
- The design will focus on cultural heritage, and user well-being in a rural placement.
- The design will relate to the colours, features and materials of the natural landscape in which it is based.
- A research about the historical heritage of the island will be conducted, in relation to the period of Vikings and its archeological importancy on the island.
- An understanding of the cultural value of the existing cement factory and its importancy in the cultural heritage of the island will inform the design about the elements to preserve and restore.
- The cement factory footprint will be preserved, while the possibility of new additions should be investigated

Problem Statement

Hypothesis
The main hypothesis of the thesis is that it is possible to fully use the site's cultural, social, and environmental potential in regenerating and converting existing landmarks into a structure devoted to tourism.

To that end, and in the particular case of Samso, aspects such as the integration between visitors and locals, the understanding of the rich island's cultural heritage and food production tradition need to be considered and implemented in the design.

Problem Statement
How to convert an industrial building into a Badehotel ("Bathe Hotel") in a rural context (Samsø) that simultaneously supports tourism, fosters interaction between locals and visitors, focuses on cultural heritage, and promotes user-well being, without causing a significant impact on the environment?

Methodology

The Integrated Design Process

The Design Approach

The project is structured after the Integrated Design Process method, a process of iterative and transparent design implementation that integrates architectural and engineering intentions in five interconnected phases: Problem, Analysis, Sketching, Synthesis, and Presentation (Knudstrup, M. A., 2004).

This type of process is theorically usually described as linear, in which phases consequentially come one after the other. However, it is possible to notice that in practice all the phases are intersecting between one another and sharing methods. Therefore, as shown in Fig. 1, the design process can be rapresented with a Venn diagram, creating a complex network where phases and methods are connected without following a specific timeline nor consequentiality.

Initial Problem

The description of the problem or a project idea is the first step in the project work. As a guideline In this specific case, the introduced problem refers to the design of a Badehotel at Samsø for tourists.

Analysis

The analysis gather all the necessary information regarding the project site. The analysis for this project is made in order to gain an understanding and knowledge about the site context, climate, atmosphere. Nevertheless, research is conducted in order to better understand the specific cultural heritage of the site, especially in regards of its architectural, social and sustainable background.

Sketching

During the Sketching Phase, architectural and engineering knowledge are combined with an integrated and holistic approach, so that the energy and indoor comfort demands and requirements can be met. A great variety of design sketches will be produced through different tools such as hand drawings and 3D-models. Moreover, the design investigation will be further analysed through the repetition of the previous steps from the analysis phase.

Synthesis

In the synthesis, the different design proposals are analysed and tested, in order to verify if the initial goals and criterias have been fullfilled. Therefore, here the many aspects from the earlier studies are combined and tested, until reaching a final design. Throughout the phase, iterations ensure a detailed design, with documented qualities for technical, functional, and aesthetic aspects which have the objective to validate the optimized final solution.

Presentation

The presentation communicates the final outcome of the project. Using diagrams, illustrations, renderings, and models, a final design proposal of the Badehotel is presented.

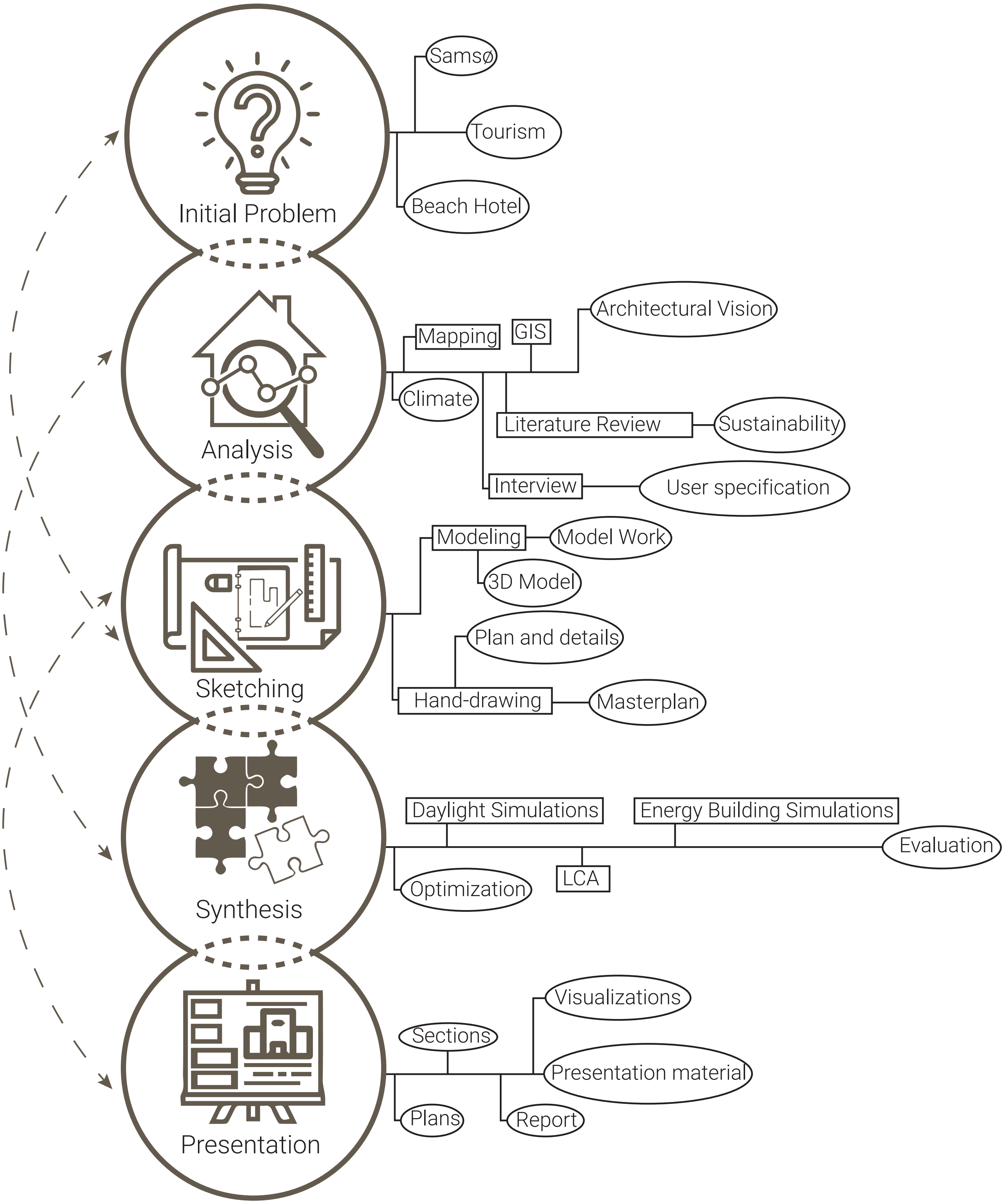


Fig. 1: The Integrated Design Process

The Site

The Island of Samsø

Introduction

Samsø is a Danish Island of 114 km² in the Jutland Peninsula. The local community of almost 3700 habitants is spread through around 22 different villages, the biggest of which is called Tranebjerg (830 habitants). The latest statistics of January 2021 counts 45 different nationalities living on the island. (*Website, VisitSamsø*)
With 120 km of coastline (Fig.4) and 8100 ha of cultivated land, Samsø offers a beautiful and diverse rural landscape (Fig. 2 - 3).
In general, the island is widely renowned for its Viking sites, its agricultural production and its research in renewable energy strategies.

The Food Tradition

Samsø benefits from a climate with plenty of sun and very little frost. (*Website, VisitSamsø)*
The island has been exporting its vegetables since the 19th century, especially cabbages, onions, asparagus, sweet peas, potatoes and fruits (Fig. 5).Therefore agriculture has been considered the most successful economical activity. (*Website, VisitSamsø)*
Samsø got famous especially for its potatoes production, which ripen earlier than elsewhere in Denmark. (*Website, VisitSamsø)*
For this reason, the island's chefs compete every year to make the best potato dish (Fig. 6), which has become part of the culture and tradition of the local community.

Around the island it is possible to find different farmhouses, and the owners usually place in front of the entrance stands with their vegetables so that visitors and locals can buy them (Fig. 7). This proves how much the local community is engaged in the production of goods.

From Harvard to the Vikings

Stephen A. Mitchell, a professor of Scandinavian languages and folklore at Harvard University, has organized a summer school programme called "Viking studies in Scandinavia" based in Samsø.
Young students from US are therefore coming to the island for three weeks in order to work in the excavation site near Tønnesminde, east of Brundby. (*Website, VisitSamsø*)
In fact, the numerous archaeological finds testify that this area was particularly active around the Iron Age (1200 - 600 B.C.) and the Viking Age (793 - 1066 A.C.), explaining the great interest of students and researchers in the historical heritage of Samsø.

The Renewable Energy Island

In 1997, Samsø was appointed Denmark's Renewable Energy Island. *(Jan Jantzen, 2018)*
In 2007, Samsø's inhabitants were able to declare their island 100% energy self-sufficient based on wind, solar and biomass energy. (*Website, VisitSamsø)*
The same year, in order to host the great number of professionals and tourists coming to the island annually, Samsø Energy Academy was opened. This academy functions as a professional and popular meeting place, where conferences and courses about Sustainability are held. *(Website, Energiakademiet)*
The new objective of the island is to become completely independent from fossil fuels before 2030. *(Jan Jantzen, 2018)*
The company "Biosamfund Samsø" is focusing on the project of a new biogas plant capable of transforming biowaste (scraps, wastewater, slurries and plant leavings) into biogas used to power the ferries that bring to the island. (*Website, VisitSamsø*)

Concluding Remarks

The room program will include spaces for food experience and production and further analyses will investigate the Vikings' architectural traditions. The design will focus on the limitation of energy consumptions and the implementation of passive strategies, getting inspired by the community's attention to Sustainable solutions.

Due to uncertainty on license copyright, the figure is visible at this link:

[https://www.visitsamsoe.dk/en/inspiration/isse-hoved-2/.](https://www.visitsamsoe.dk/en/inspiration/isse-hoved-2/)

Fig. 2: Northern Island's Landscape

Due to uncertainty on license copyright, the figure is visible at this link:

https://www.visitsamsoe.dk/en/inspiration/a-rolling-landscape-of-hill-and-dale/

Fig. 3: Inland Landscape

Due to uncertainty on license copyright, the figure is visible at this link:

https://www.visitsamsoe.dk/en/inspiration/maarup-oesterstrand/.

Fig. 4: The Seashore

Due to uncertainty on license copyright, the figure is visible at this link:

https://www.visitsamsoe.dk/en/inspiration-paa-samsoe/the-taste-of-samsoe/.

Fig. 5: Local Production

Due to uncertainty on license copyright, the figure is visible at this link:

https://www.visitsamsoe.dk/en/inspiration-paa-samsoe/the-taste-of-samsoe/samsoes-best-open-faced-potatosandwich/.

Fig. 6: Food Tradition

Fig. 7: Vegetables' Selling Stand

The Existing Cement Factory

The Quality of the Building for the Community

The existing building on site is a cement factory, where concrete is mixed for the production of tiles, structural elements, and road curbs. The facilities is operating since 1917.

The cement factory is clearly part of both the municipality and local community heritage. It has become a landmark for its location close to the seashore and its relation to the landscape. Part of the reason of making this building a cultural and touristic attraction is related to its deep connection with the local history and culture. Such deep connection was significantly demonstrated in a photography contest promoted by the municipality, where both locals and visitors have been asked to take pictures of the building. *(Visitsamsø 2021, campaign "instaspotsamsoe")*

The Municipality has classified the architectural quality of the building. On a scale from 1 to 10, the building is graded as a 5, usually rapresenting buildings where maladaptive replacements and alterations have changed the overal aestethic. It is described as a building worthy of preservation, and therefore it presents some quality which could be preserved. (*Website, Dingeo Boliga*)

Condition of the Existing Building

Since the entire or part of the building might be preserved in any potential intervention, it is crucial to observe in which state the existing building is currently, and its evolution over the time. Preserving and reusing the building as much as possible is a sustainable measure, since it mitigates the environmental impact of demolition and introduction of a new structure. Moreover, the environment where the building is located needs to be investigated in order to specifically understand the site's conditions, geology and landscape and which strategies should be implemented in the design.

The building is laying at the location which is classified as Radon class 3, reaching 200 Bq/m³ or more. The World Health Organisation suggest that radon gasses should not exceed 2100 Bq/m³. As the building was built in 1917, no radon protection membrane was used, as this only first came into requirement in year 1998. (*Website, Dingeo Boliga*)

The existing building is made from brick, with cement tiled roofing finish. (*SamsøKommune documents)*

The existing structure contains Polychlorerede Biphenyler (PCB), which is a highly toxic material and therefore very dangerous for both the environment and people. This substance is used in joints around windows and paint. Heavy metals have been used as an additive in paint, floors and joints, which could cause indoor pollution if not firmly treated. No risk of Asbestos has been pointed out in the building. (*Website, Dingeo Boliga*)

Concluding Remarks

The site visit has pointed out the overall bad maintenance of the building structure. The building presents mold spots caused by the humid climate, the roof has curved invards and there are many cracks in the facades. (Fig. 9 - 16)

According to their specific condition, the building various elements and materials can be reused or recycled (e.g. timber battens and planks as board plates and floor, roof rafters as flooring). Hence, the interior magnificent wood trusses (Fig. 17) and the existing patinated materials from the building are given new life.

As the previous analysis clarified, windows and and both floors and walls paints need to be replaced, due to their toxicity risk.

Fig. 8: Outdoor View

Fig. 9: Gutter Detail

Fig. 10: Roof Connection Detail

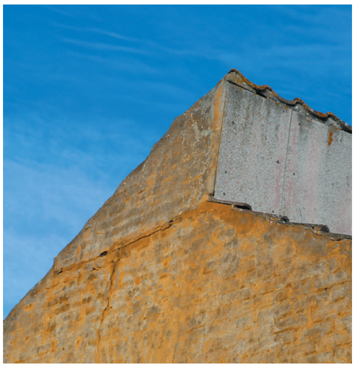


Fig. 11: Roof Detail

Fig. 12: Threshold Detail

Fig. 13: Exterior Brick Walls Detail

Fig. 14: Water Collection Detail

Fig. 15: Window Frames Detail

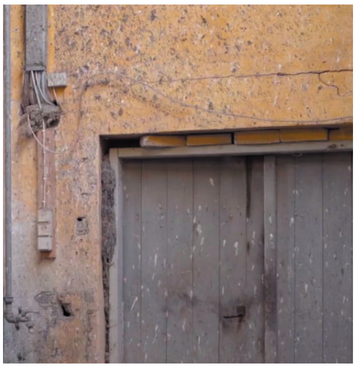


Fig. 16: Existing Gate Conditions

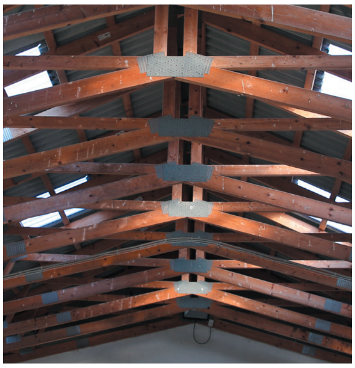


Fig. 17: Roof Wood Structure Detail

The Evolution of the Factory

The History of the Addition

From 1948 until today, the cement factory has drastically been changing. Thanks to research through historical pictures, and a few drawings provided by the Municipality, it was possible to understand the volumetric evolution of the factory during time. In general, two main design actions have been performed on the building after 1988: addition and elevation. While the majority of the volumes have been continuously modified, only the main one facing the street have remained the same.

The initial factory was formed by detached volumes, which have been unified with additional shapes over a century (Fig. 18 - 21).

Historical Layers

Not only addition has been performed on the site, but also modifications on the gable roof's height and on the materiality of the external walls (Fig. 19). The roof of the factory's central body has been uplifted 1m, creating a huge discontinuity between the different gable roofs. This action is proved by some section drawings from 1992 (App. 1), and it is quite visible on the building.

For example, usage of concrete blocks instead of bricks clearly expresses where the elevation has been made (Fig. 20). Although the quality of the concrete bricks could be critized compared to the original bricks, they mark a process of transformation in time; thus, being elements of interest and analysis.

Concluding Remarks

The historical analysis helps the process to fully understand the evolution of the building and, therefore, informing possible design avenues to follow.

The main design actions focus on the addition of new volumes to adjust the existing structure and as well as on adjusting the height of the existing volumes, which have been changing over the time. All the modifications are going to be visible by using different materials, for the authenticity of the building to be preserved. The already performed modifications could be criticised, as they break the continuity of the existing fabrics' appearance. However, they will still be equally important to preserve *(C. Brandi, 1963).*

All the additions and elevations that are going to be performed on the existing factory will have to be visible and easily distinguishable over time. (E+N Arkitekter, 2007)

Due to uncertainty on license copyright, the figure is visible at this link:

http://www5.kb.dk/danmarksetfraluften/images/luftfo/2011/maj/luftfoto/object312550/

Fig. 18: Existing Cement Factory, 1948

Fig. 19: Cement Factory Modifications, 1992

Fig. 20: Additions to the Existing Cement Factory, 2022

Due to uncertainty on license copyright, the figure is visible at this link:

https://skraafoto.kortforsyningen.dk/oblivisionjsoff/index.aspx?project=Denmark&lon=10.2027929&lat=56.1277927

Fig. 21: The Existing Factory, 2022

The Municipality Plan

Planning Act and Environmental Act

The project site's development is currently limited by the *Planloven* (Danish Planning Act). The points that should be assessed during the design process are stated in the chapter 2A "planning in coastal areas", as follows: (*LBK nr 1157, 01/07/2020*)

- *Point 5A*: the coastal proximity zone outside development areas shall be sought to be exempted from buildings and facilities that are not dependent on coastal proximity.
- *Point 5B*: those new areas may only be included in the urban zone and planned for facilities in the rural zone, if there is a special planning or functional justification for coastal location.

In addition, the *Miljøbeskyttelseloven* (Danish Environmental Act) includes limitations when planning near the seashore:

- *Point 15*: No change may be made in the condition of shorelines or of other areas that lie between the shoreline and the beach protection line, cf. 2. For example. no buildings, planting or terrain changes are placed, fences are established or caravans etc. are placed, and no subdivision, matriculation or area transfer may be carried out, whereby boundaries are established.
- *Point 15B*: The prohibition in point 15 does not apply to minor maintenance work on buildings, including replacement of windows and roofs, etc., when the building height is not thereby increased or only increased to a negligible extent.

According to the adopted Samsø Municipality plan, the project site is placed within the beach protection line, meaning that the development of the area and the existing building is limited by the laws stated above. (Fig. 22)

The Existing Competition Frame

Thanks to its great location, features and cultural heritage, the chosen projects site has already been part of a competition for the realization of a Strandhotel. The design is still in development, but both the main investors and the Municipality agree on the great potential of the project.

In order to prepare a new local plan and apply changes to the existing building, a permission from the national authorities is required and can be requested every 4 years. Therefore the investor is willing to take the following three approaches in order to get an approval for the project:

- *Conversion and change of use*. The current company's activities as a cement factory have been sold out, therefore a conversion of use on the property can be applied, making possible to apply functional changes to the building.
- *Revision of the Planning Act and coastal areas limitations*. Converting the existing commercial properties close to the coast.
- *Designation of the project site as a coastal development area*. The Municipality has already applied for this request, which has been rejected by the National authorities, but the contractor and owner of the site is willing to reassess the case legally.

Concluding Remarks

As shown in Fig. 23 *(KortSamsoe)*, the site is defined as a Business area. From the map, is possible to notice that the areas reserved for the summer cottages expansion are planned in close proximity to the seashore. Therefore, new additions on the project's site could be designed as small detached houses, in order to be closer to the seashore. As stated in point 15B, changings to roofs and windows for the existing building are permitting if the height is not changed.

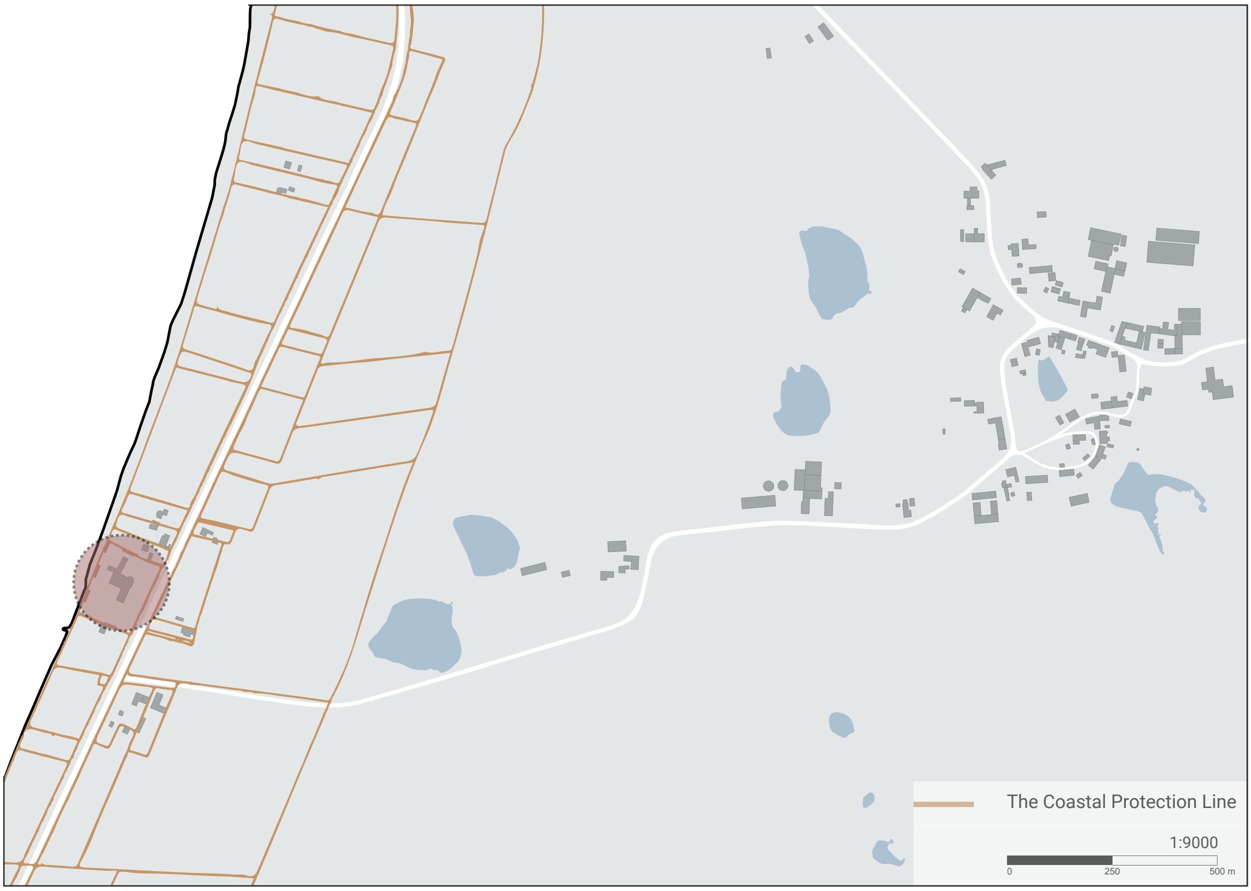


Fig. 22: Zoom in Map

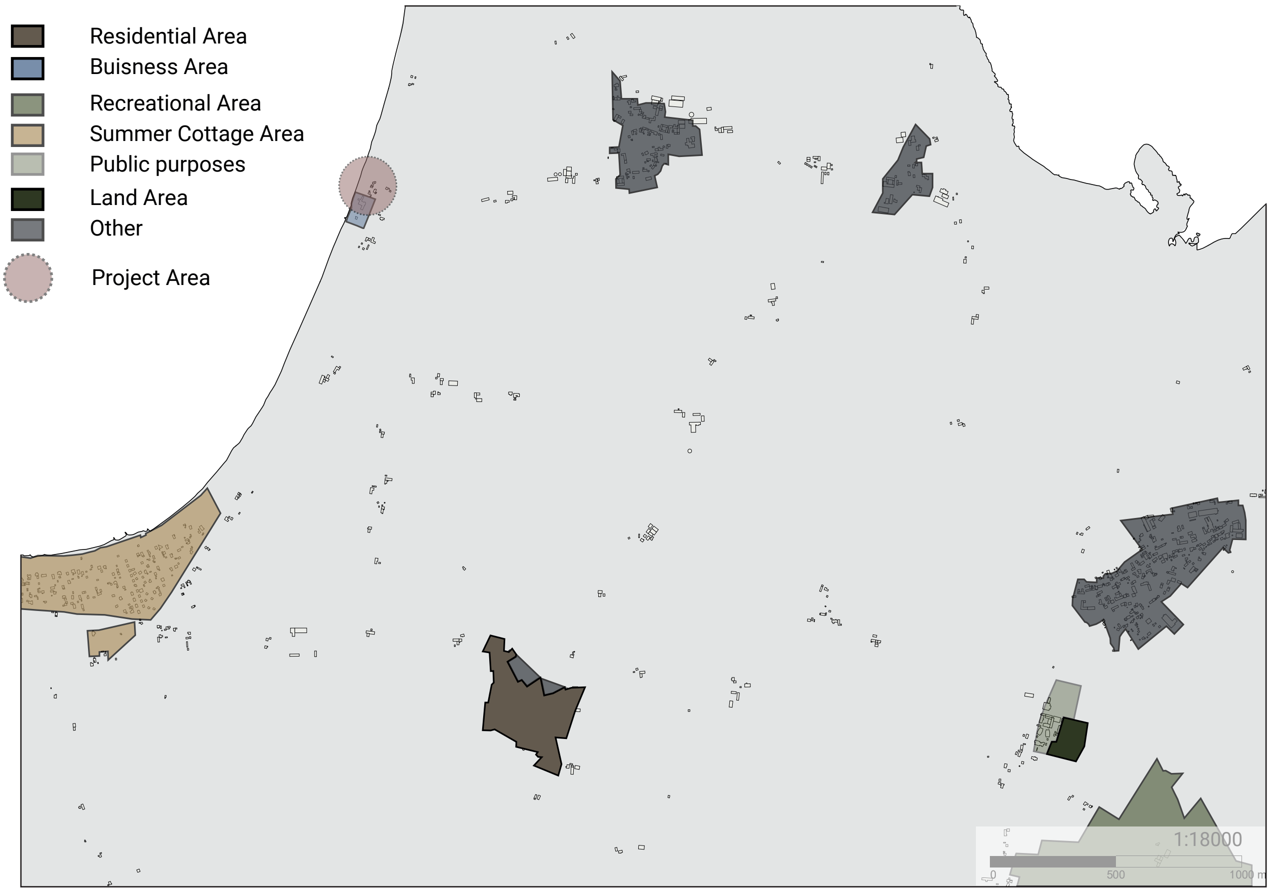


Fig. 23: Zoom in Map

Mapping

Introduction to the Method

The key elements to understand the territory form and its legibility have been longly theorized, especially in the urban context (e.g. "The image of the city", Kevin Lynch). Mapping is one of the most critical visual method that aims to provide a wider vision and understanding of the territory in which a project is based. This crucial analyses contribute to relate a design to the specific physical and spatial characteristics of the environment. For this reason, the mapping method is going to be used and translated into the rural context, to inform the design site strategies and the relationship between the project site and the sourroundings.

Landmarks

A landmark is usually a static and unique object which acts as a reference point in the way-finding process *("The image of the City", Kevin Lynch).*

In the rural territory where the small built areas are sourrounded by vast unused areas, these elements are the ones playing an important role on the territory in order to ease the localization of specific places.

Samsø's landmarks have also a cultural and historical impact. Here landmarks usually refer to churches, mills (Fig. 25 - 26) and lighthouses, as very visible constructions in a low density built territory.

Another important landmark is Kanahavekanalen (Fig. 24), a very popular destination where the oldest structure of a Viking ship is found. It is placed at around 4km from the project site (Fig. 27). Most of the touristical recognized Landmarks are placed in the middle and north of Samsø *(Website, VisitSamsø)*.

Concluding Remarks

The project site is placed in between the most important landmarks of the island, although any of them is visible from the site itself. Therefore the new Hotel on the site could become a focal point in order to connect the northern and southern touristic stops of Samsø.

Fig. 24: Kanahavekanalen

Due to uncertainty on license copyright, the figure is visible at this link:

https://www.visitsamsoe.dk/inspiration/langoere-kirke/

Fig. 25: Langøre Kirke

Due to uncertainty on license copyright, the figure is visible at this link:

https://www.samsoemuseum.dk/kultur-i-landskabet/brundby-stubmoelle/

Fig. 26: Brundby Stubmølle

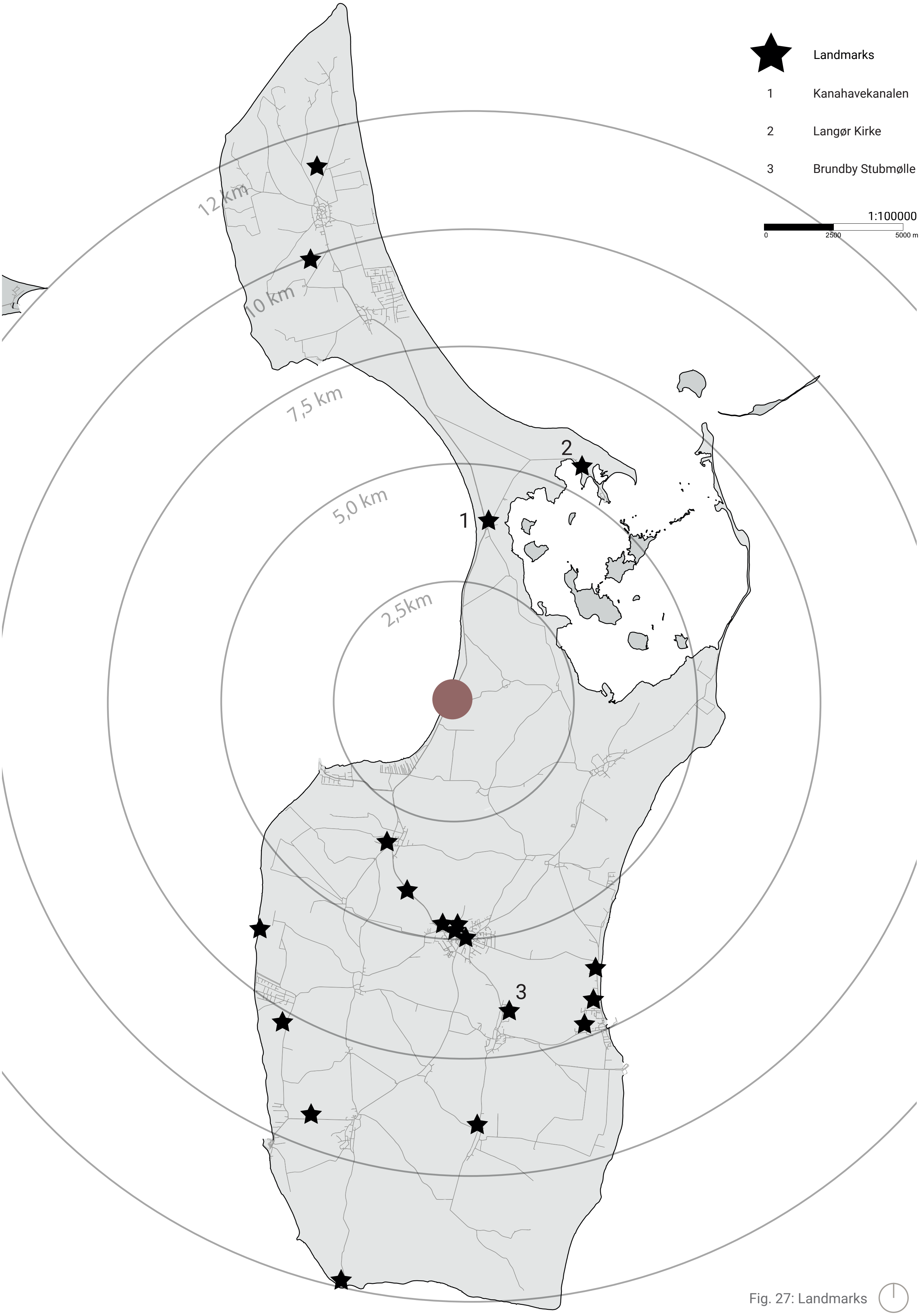


Fig. 27: Landmarks

Access to the Island

The following analyses is made in order to understand the connections between the project site and the rest of the island, especially in regards of means of transportation to reach the building.

Fig. 28 shows that it is possible to reach the island both from Zealand and Jutland by taking maritime transportation (i.e. ferries).

- The tourist reaching the island from Zealand need to take a ferry from Kalundborg to Ballen (1 hour and a half).

- The tourist reaching the island from Jutland need to take ferry from Hou to Sælvig (1 hour).

- There is a new ferry from Aarhus - Sælvig for turists reaching the island from Jutland, which will increase the number of visitors. However, it is not possible to bring the car on this rute (1 hour).

Access to the Site

The project site is located in Havvejen 131. We examined the access to the project site using Google Maps and Rejseplanen, a popular Danish public transit route planner. As previously mentioned, the island is mainly reachable from the ports of Ballen and Sælvig. The closest port is Sælvig (3 km), while the one of Ballen is located approximately 10 km from it. (Fig. 28)

The following analysis introduces the main paths (car, bike and pedestrian) connecting the ports to the project site.

- Ballen – Havvejen 131 (Fig. 28)

1. Bus routes: it was not possible to find connected busses to our site. The closest bus stop is Toftebjerg, which is 1,5km walking distance from the project area. In the future, it could be possible to have a bus route passing by the Hotel, in order to facilitate tourists to reach the site.
2. Bike routes: three different bike paths are highlighted, of which the fastest route is 10,4km from the port taking approximately 30 minutes. The site is also connected to the largest village of the island (Tranebjerg), with a bike path of 11 km.
3. Car routes: the fastest car route is 10,8km from the port and takes approximately 13 minutes. The route goes through Tranebjerg, reinforcing the connection of the site with the biggest village in the island.

- Sælvig - Havvejen 131 (Fig. 28)

1. Bus routes: similarly to Ballen, the project site has no bus stops connecting it to the port of Sælvig for the time being.
2. Bike routes: one bike path of 3,9km, taking approximately 12 minutes.
3. Car routes: one car route runs parallel to the bike path, taking approximately 6 minutes to reach the site.

Concluding Remarks

The previous analyses show that the main means of transportation to reach the site are cars and bikes. Therefore, the site strategies should focus on the definition of parking areas for both, while the design could provide spaces for bike sharing and renting. Furthermore, an accurate analysis of the users will be conducted, and the cyclists specific requirements and needs will be explored in relation to the great cycling tourism present on the island.

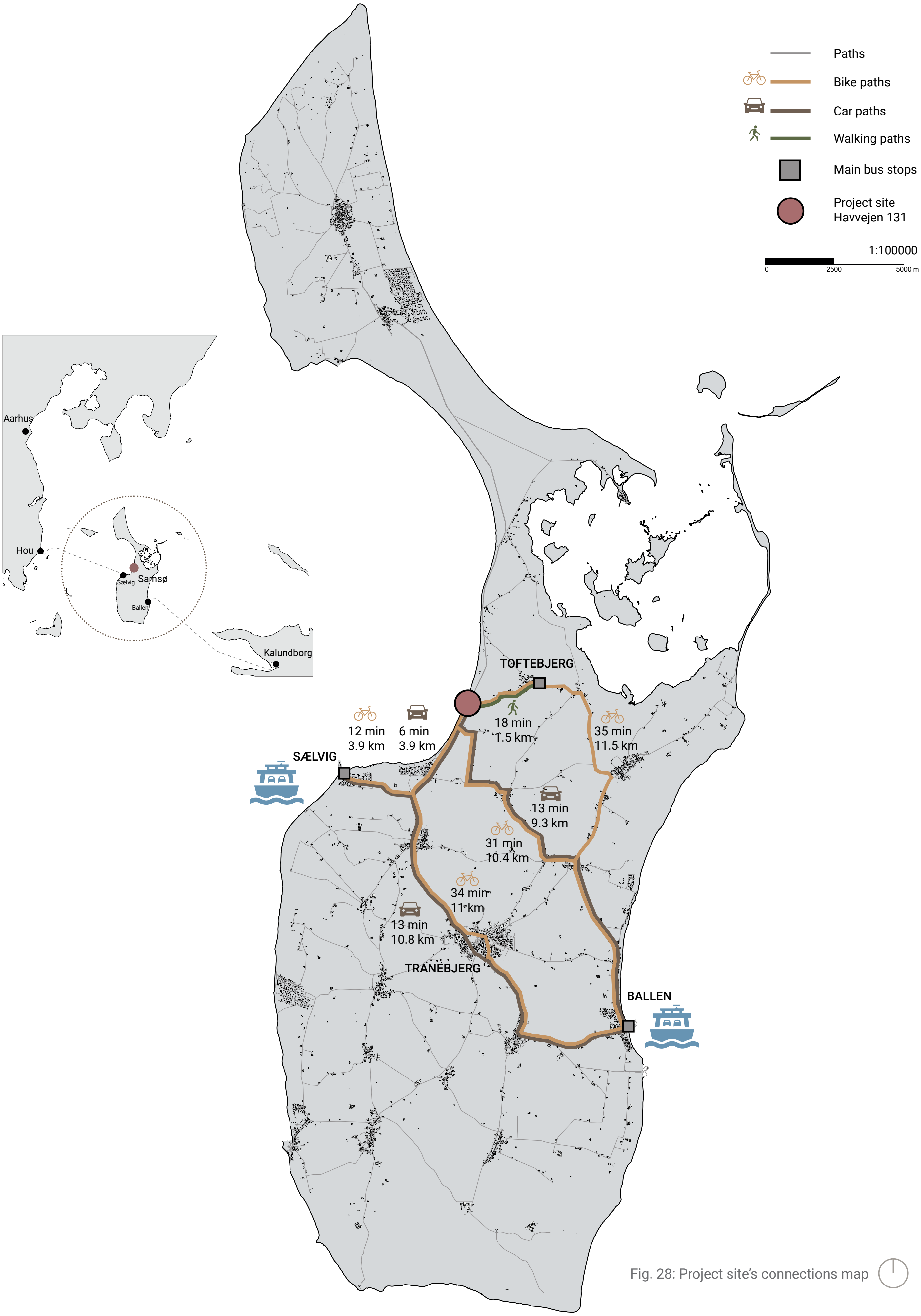


Fig. 28: Project site's connections map

The Dune System

The great majority of the danish coastline is defined by a sand dune landscape, which is chacaterized by a large accumulation of sand grains blown onto the land by the wind. This type of landscape is both extensive (it requires a wide area of dried beach) and active since in constant evolution in response to natural forces and modifications. *(Website, CoastalWiki)*
The European Union for Dune Conservation (EUDC) prepared the "Sand Dune Inventory of Europe" in 1991, with the objective of providing a list and description of the sand dune systems throughout Europe. *(Website, CoastalWiki)*
In this Inventory, the island of Samsø is not classified as a sand dune system. (Fig. 29).

The Morain System

Numerous studies have confirmed that a part of the Danish coastal land has to be reffered as a moraine landscape, formed by glacial processes. *(Tomasz A. Łabuz, 2018)*

On the kort.Samsø, the soil properties of the island of Samsø are stated, and the moraine clay is introduced (Fig. 30). While a dune system is defined as a landform composed of sand moved by the wind or waves which usually then takes the shape of a hill, the moraine system is instead an accumulation of clay, rocks and sand carried by past glaciers. As it is known, the island has been covered in ice at least three times during the Ice Age. (*Website, VisitSamsø*)
When the ice started melting, the produced great amount of water washed away the covering layer of morain clay, leaving a mixture of grey and brown marine sand and gravel on the surface. Therefore, the terrain in proximity of the site is now composed by a mixture of marine sand and pre-existing morain clay from the glacier times (Fig. 30).

The Marine Sand and Clay Soil

The project site presents a soil of marine sand and clay, (Fig. 30) which is usually considered problematic for engineering requirements due to the existence of high moisture content. (Mohammed Al-Bared and Marto, 2017)
The marine sand is a soft soil with an umpredictable bearing performance for foundations and pavements to be placed on.
Usually the bearing properties of this specific type of soil are stabilized with different methods such as: cement grouting or the addition of environmental friendly additives. (Mohammed Al-Bared and Marto, 2017)
Usually the best foundation system when building on a coastal site are the pile or pier foundations, in order to reach the deeper load-bearing layer of the ground. *(Gedeon Gilbert, 2017)*

Concluding Remarks

The site's terrain is composed by marine sand and morain clay. As the morain clay is tipically transported by water and not by wind as a dune system, the terrain's dunes and present conditions are more permanent. This means that the site conditions are not going to drastically change due to high wind exposure, as the morain system appears to be more stable in this extreme conditions than a dune system.
However, important considerations must be taken into account regarding the moisture content and softness of the marine sand terrain. The studies above are useful in order to understand which type of foundation and strategies to use on a marine sand and clay terrain. As suggested, the best option would be a pile foundation, usually used when the load-bearing layer is lying deeper in the ground and if needed, cement or environmental friendly additive are going to be added in the terrain to improve the stability properties of this specific type of soil.
Moreover, the eventual designing of a basement should be avoided.

Fig. 29: Dune system coastal land *(Sand Dune Inventory of Europe", 1991)*

Fig. 30: Soil classification *(kort.Samsø)*

Genius Loci

Introduction

The term Genius Loci is often related to the Architectural phenomenology theory, and refers to the intrinsic quality of a place, perceived both physically and spiritually. *(Article, Phenomenology and Space in Architecture)*

As architects, one of our main responsibilities is to design spaces for experiences, which should involve all human senses. Therefore, different methods are used in order to get a deep understanding of the identity of the site, and emphasize its features and human perception in the design.

Serial Vision

The serial vision method is theorized by Gordon Cullen *("In The Concise Townscape", 1971)*. It is described as a series of pictures which represent how the viewer experiences the site from its different access routes.

The purpose of this analysis is to investigate the site and its near context with a phenomenological approach. It allows to observe the different atmospheres and senses involved when approaching the site.

The number of impressions is processed with a dynamic approach, depending on how the site has been reached (either by car, bicycle or foot).

Concluding Remarks

From all its point of access, the project site is mostly surrounded by unbuilt land (Fig. 33 - 35).

Wildness, simplicity, accessibility, are the words describing the main features of the place, and which should be implemented in the design to fit the design in the context.

Fig. 33: Arriving from Ballen

Fig. 34: Arriving from Sælvig

Fig. 35: Close to the project site

Fig. 36: Serial Vision Map

The Topography

By examining the site and axamining its topography in a plan view, it is possible to observe how the landscape and terrain change, particularly when approaching the water.
Understanding the terrain is crucial in order to work with it towards a more integrated design in the site.

The site is quite flat, although it slopes downwards towards the sea (Fig. 38). The buildable area on the western side is elevated two meters above the sea level, safeguarding the existing structure from the expected sea level rise. On the site's Southern and Western part, there are quite interesting elevated points (Fig. 39), which works very well on protecting the projects site from neighbouring buildings, protecting them from possible noise and vice versa.

Concluding Remarks

The site is characterized by different sand dunes. Further investigations regarding the flooding risks and the soil properties must be conducted in order to understand the best strategies regarding new volumes' foundation system construction on the site.
As the existing dunes can reach very high levels, the terrain has to be modified in proximity of new volumes solutions and in order for the new Badehotel to be easily accessed by guests.

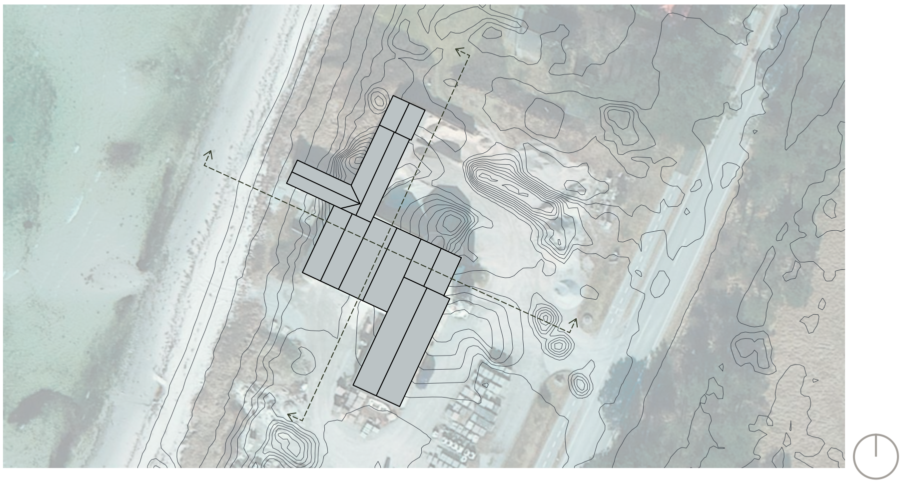


Fig. 37: Site plan

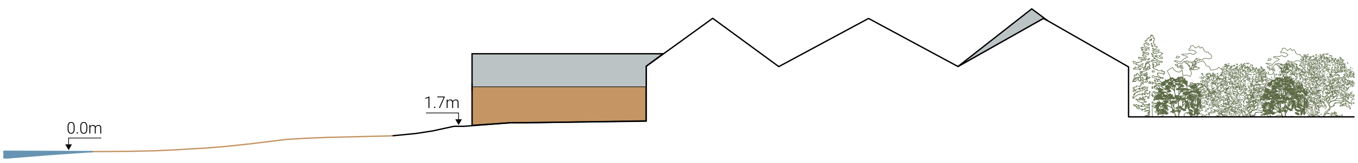


Fig. 38: Trasversal Section

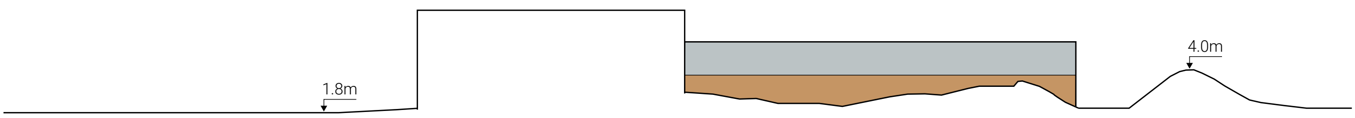


Fig. 39 Longitudinal Section

The Landscape

The site is located by Sælvig bay, a seven kilometres beach on the Western side of Samsø, connecting the southern bay to the Mårup port in the North. Most of the bay is covered with a soft and white sand (Fig. 41), the sea water is clear (Fig. 40) and its temperature ranges from 2.5 °C in February, to 18 °C in August *(Website, Climatestotrave)*

The line of the sea, the one of the sand and the one where the mare straw vegetation begins are clearly distinguished. This linear separation of layers remarks the longitudinal expansion of the landscape (Fig. 42).
The beach meadow also includes wind angled conifer trees, mainly pines (Fig. 43).
The landscape behind the beach is characterized by rocks and a mixture of sand and clay (Fig. 44).
The wild natural features of the site are interrupted by small existing summerhouses and small detached family houses, which are located both on the south (Fig. 45) and north sides of the project site.

Concluding Remarks

Although its wild features, the elements of the landscape follow lines which call for a longitudinal extension. Therefore, the design will focus on a longitudinal expression, while emphasizing views towards the sea and the pine trees. The possibility of working with detached rooms related to the existing close houses will be investigated.

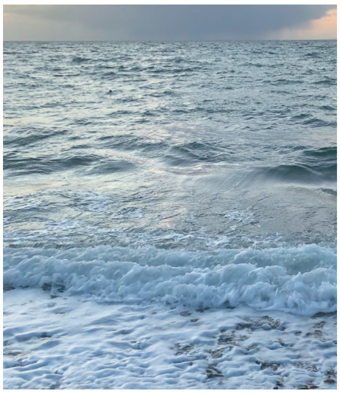


Fig. 40: Sea

Fig. 41: Sand

Fig. 42: Mare Straw and Landscape Lines

Fig. 43: Pines

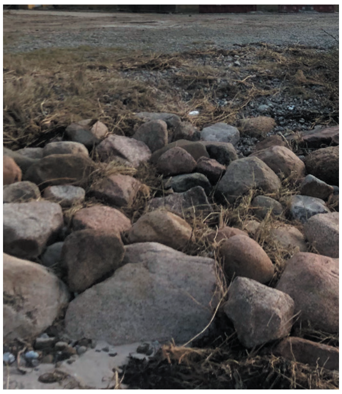


Fig. 44: Rocks and Clay

Fig. 45: Summerhouse near the Site

Atmosphere

The phenomenological analysis of atmospheres offers a new perspective of design and Architecture, making the human experience of the special a central focus of the design. The term Atmosphere is therefore defining the sense that arises from the sensory human perception of an object or a space. *(Böhme, 1998)*

A great example of how to relate the concept of Atmosphere to the field of Architecture is the work of the Swiss Architect Peter Zumthor. According to his vision, the most important aspect in Architecture is to stimulate the whole spectrum of senses, with atmosphere as the main driving force. Designing a space capable of stimulating every human sense has a large impact on how we perceive a specific site and built environment.
As a critical regionalist, Zumthor suggests that the understanding of the site is the architects most crucial piece of work. Every building placed in a specific context has a specific purpose, and therefore the site and building enter a relationship in which they can benefit from each other. Infact, placing a building on a site transforms it inevitably, and therefore it is essential to create a beautiful piece of architecture. *(Zumthor, 2010)*

The existing cement factory fits very well with the natural surroundings. Although the building mass is in contrast with the quiteness and isolation of the nature, its chromaticity and longitudinal expression fits with the overall landscape expression.

The site itself provides a lot of different atmospheres which are changing drastically depending on the season. In a calm summer day, the water's surface warms up, the sand absorbs the heat from the sun and you can walk on it barefoot feeling at one with nature.
When the weather is windy and cold, you can smell the salty water from the sea, hear the impetuous waves, hear the wind whistling through the surrounding pine trees. Now the sand seems hard to walk on, almost like on a paved pathway. (Fig. 46 - 49)

Concluding Remarks

The dynamic changing of atmospheres are making us questioning: would users want to feel at one with nature in all its different stages with appealing outdoor functions, or rather be in inside the building and experience them only visually? Understanding atmospheres in this wild context will help creating functions in the building, and make designers think about what experiences to bring into them.

Due to uncertainty on license copyright, the figure is visible at this link:

https://www.tv2ost-jylland.dk/samfund/lasse-vil-lave-112-ar-gammel-fabrik-om-til-hotel-en-beslutning-af-gor-det-hele

Fig. 46: View in Summer

Fig. 47: View in Winter

Fig. 48: View in Winter, Shore

Fig. 49: View in Winter, Sunset

Materials and Colours

The surroundings of the site are very wild, and the variety of building constructions and materials that the new design could relate to is very limited. Despite that, the landscape is offering very contrasting colours and textures to begin with, which are surrounding the appealing existing yellow cement factory. Therefore, an analysis of the features of the site is conducted.

The contrasting nature consists of turquoise blue sea water, light beige beach sand and brownish mare straw, which will turn green with warmer seasons. (Fig. 50)
Around the projects site, there are dark green pine trees, bended by the strong west winds, a feature that emphasizes the wildness of nature. The existing cement factory is a yellow painted brick building (Fig. 51), covered with a grey sloping roof. The structure is complemented with white window frames and wooden gates, which are supported by contrasting black metal elements. Despite the massivity of the existing building's material, its longitudinal development and moderate scale makes it blend with the landscape.

Concluding Remarks

The findings of this analysis give the design a point of departure for further investigations. Should the new Beach Hotel use the building's already existing materials and the site's colours in order to fit in the landscape? Or is the scale of a project enough to define is relationship to the context?

Fig. 50: The Colour Palette of the Site Landscape

Fig. 51: The Colours of the Materials on Site

The Climate

Weather Data Analysis

Method Introduction

To conduct climatic analyses in a site, there is need for data which describes the weather conditions of its specific location. This data contains information about sky cover, solar radiation, temperature, wind speed and more. This data is collected in a weather station *(De Luminae, n.d)* and then post-processed into a typical metereological year, which represents the typical climate in the weather station location for a year.

Due to the fact that there are no weather stations at Samsø and this kind of data was not recorded, the authors need to choose datas from a closer weather station with similar geographical features. After investigating different coastal weather stations available, we selected the Sletterhage Lighthouse's data for climatic analyses on the projects site (Fig.53).

Sletterhage Lighthouse is located just 25 kilometres from the projects site and is based on the west coast, which means that is plausible to assume that both wind and solar conditions are similar. Both places have also a fairly similar distance to Jutland's peninsula. Therefore, those parameters assures that the weather conditions on both locations should be fairly similar and can be used to conduct climatic analyses.

Fig. 53: Coastal Weather Station Location

Weather Data Analysis

When designing a building, it is worth considering climatic conditions on the site and island in general. As the newly built beach hotel is expected to be a seasonal destination for most of the visitors, warm months will be analysed more in detail. Besides that, also yearly climate will be looked at the climatic analyses will be looked at through out design process, in order to offer building users the best experiences.

In the summer period, July is the month of interest since it is when most people will take their holidays. Although it appears to be the warmest month with dry bulb temperatures, it doesn't reach discomfort values (less than 30 degrees). This month is interesting to focus on: half of the month is defined by strong drier winds from the west, while the other half has slower more humid winds from the east and more cloud cover.

Concluding Remarks

The analyses are helpful to understand the placement of functions when designing the building. The wind speed from East and West rarely reaches more than 6 m/s during July, which is considered to be a comfortable value for people. Therefore open outdoor spaces and activities can be placed on the western and eastern side of the building. Due to the high peaks of relative humidity in summer, it is going to be necessary to integrate a mechanical ventilation system in order to keep a balanced indoor environmental quality.

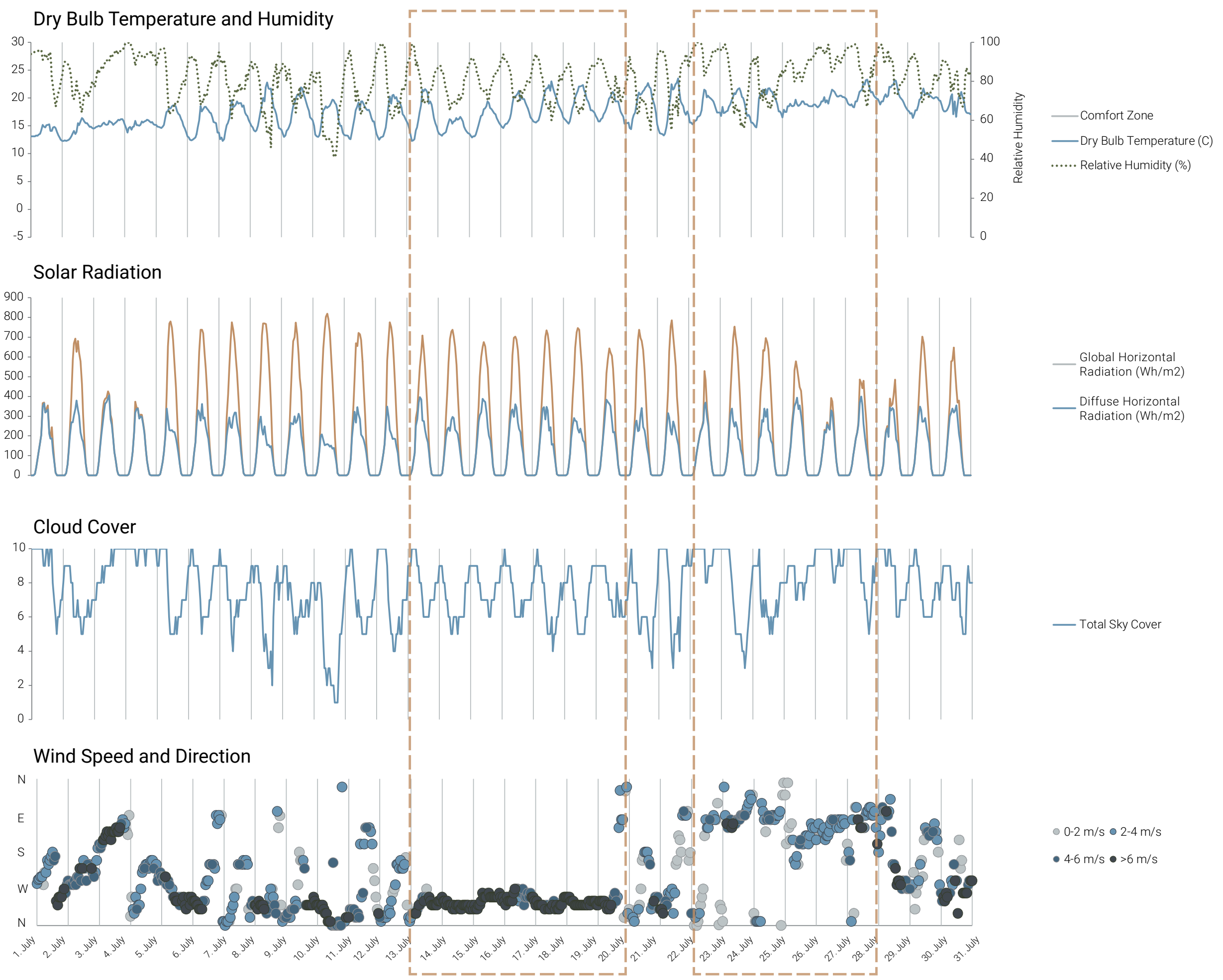


Fig. 54: Weather Data for July at Sletterhage Weather Station

Solar Radiation

Solar Conditions

In Denmark, the sun is very low during wintertime, and quite higher in the summer. Therefore, it is very important to investigate solar conditions on the site, which will further help to shape the building and functions.
The incident Solar Radiation is the amount of solar radiation that hits a specific surface per unit of time and area. It is considered to be a renewable energy source, due to the possibility to be collected and transformed in useful forms of energy (i.e. heat and electricity).

As shown in Fig. 55, the surfaces that collects higher values of solar radiation are the east slopes of the roofs and the facades facing West. The datas are collected from October to March, in order to test the months in which the solar radiation is usually lower.

As the new Badehotel is going to be mainly used during the summer time (May - September), the direct sun analysis has been made in this specific timeframe. This analysis is useful to understand which spaces are more keen to be exposed to natural daylight, and also which one should be shielded. (Fig. 56)

Concluding Remarks

The solar study can actively be used to shape the building for the best placement of passive strategies, for orienting the windows, for creating pleasant outdoor functions, and for shaping the roof.

According to the graphs, solar panels should be placed on the East slope of the existing roofs in order to have a high performance to produce energy for both heat and electricity. Moreover, the north-east facades lack of direct sun hours, therefore functions which don't need direct sunlight (i.e. kitchen, storages, toilets) should be placed in this areas.

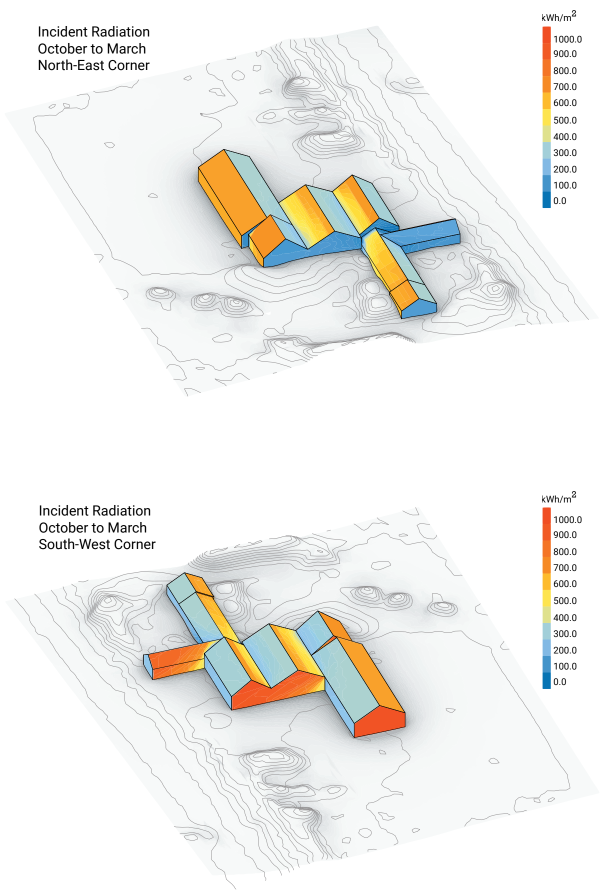


Fig. 55: Incident Radiation Studies, October to March

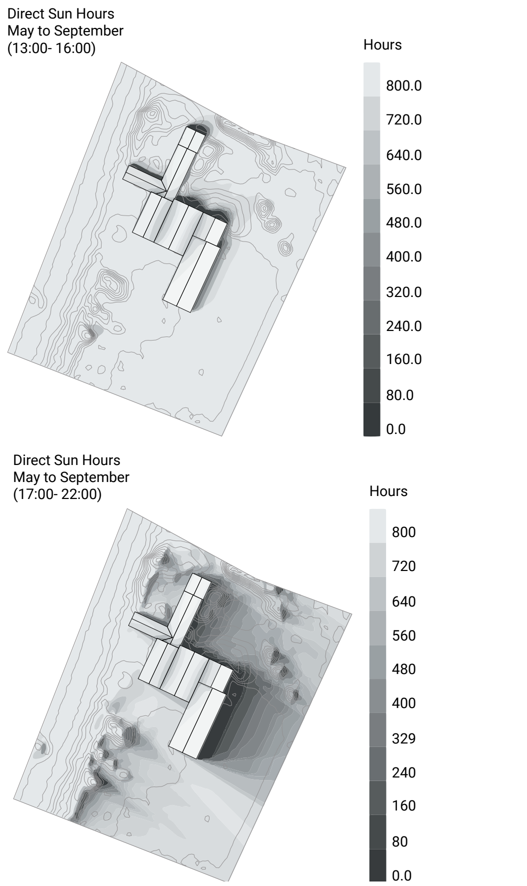


Fig. 56: Direct Sun Hours, May to September

Wind exposure

Wind Analysis

When designing a building close to the beach, it is important to look at the wind conditions, since typically there is no natural or manmade protection against it from the waterfront. The following analysis focuses on the tourist seasonal months, the May to September period. In this range, the authors analyzed different timeframes: morning, midday, and evening. Separating the analysis in the shorter time periods can inform about the functions' placement in the building.

When designing a building with passive strategies, the wind conditions are very important, in order to create sufficient natural ventilation, especially at times when thermal buoyancy will not be the main driving force for it. The thermal buoyancy will not be possible during the warm days, at the same time when the most visitors will settle at the hotel. Therefore, it is crucial to understand wind conditions at the building's location.

Concluding Remarks

The dominant and strongest winds are blowing from the west side, where the site has no natural wind protection, and it is the hardest direction to protect the building, due to the site's location. The western extension will work as wind protection. There is also tendency, when wind blows with higher speeds from East, Southeast directions, but this is not seen as a larger threat, due to natural protection from surrounding trees.

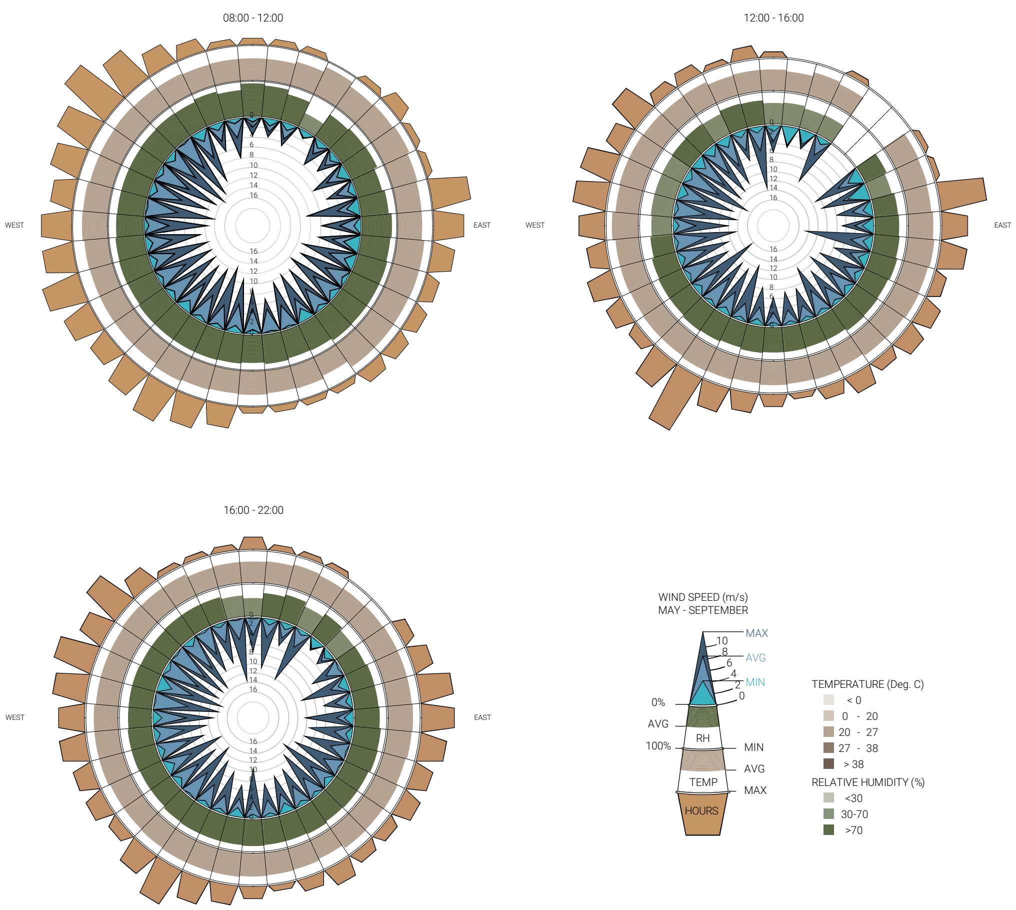


Fig. 57: Wind Analysis, May- September

Flood

Introduction

Over the last century, global warming has caused the raising of the sea water level of about 17 cm. *(Climatechange post, 2019)*
Therefore, the flood analysis is an useful method to detect critical areas in which the sea level could rise and undermine the building. As research suggests, the sea water level will rise around 1,1 meters until year 2100 *(Videnskab, 2021).*
Therefore, it is important to foresee those problems, so the best construction techniques could be used. The building is build around 1,7 m above the sea level, while the analysis is considering a rising of the sea level of 1,5 m.
This means, our building will not be under water for at least next hundred years. Despite this, sea level can rise due to strong winds.

Concluding Remarks

The building doesn't need to be uplifted and the existing foundations can be used if in good conditions.

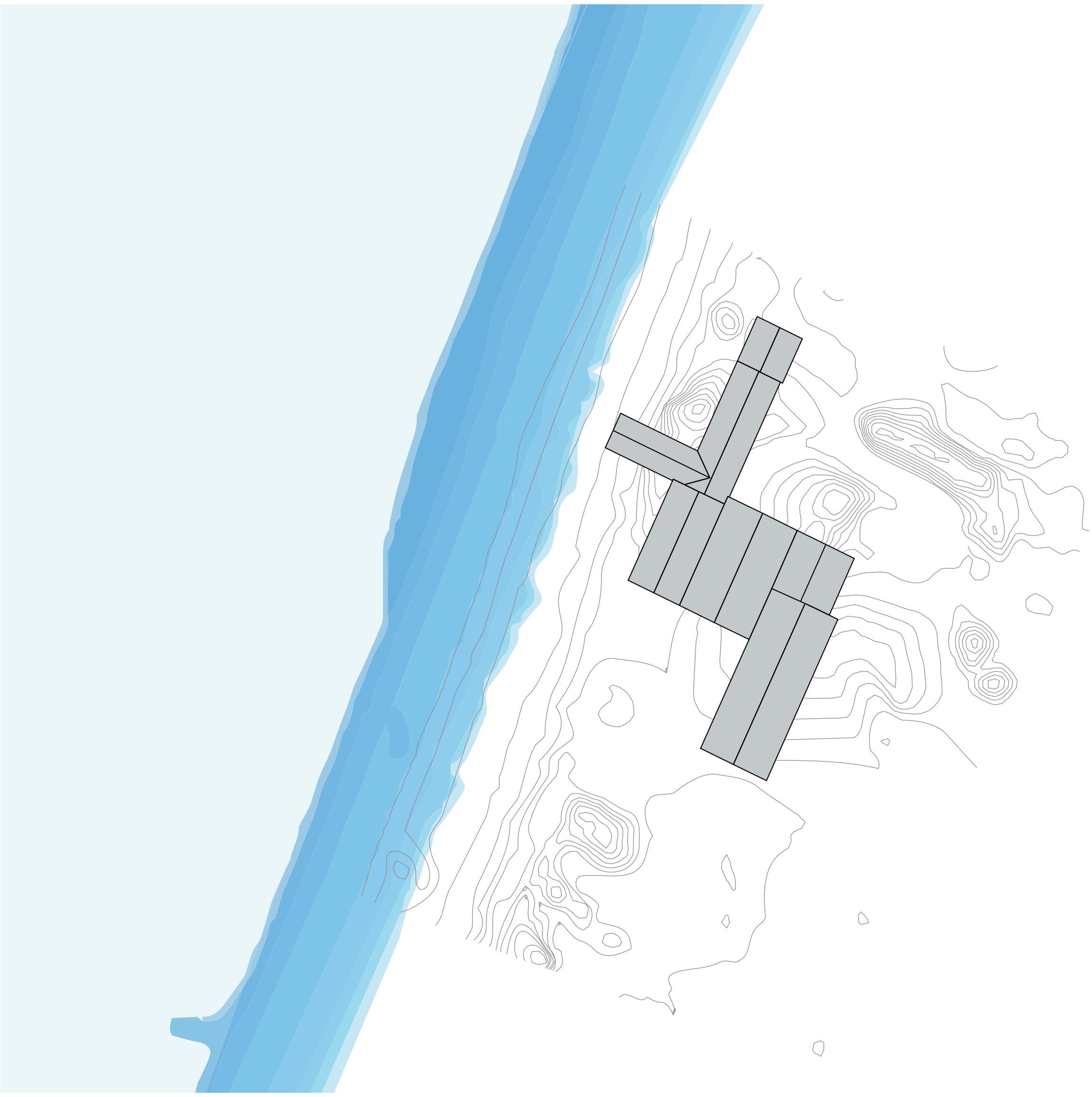


Fig. 58: Plan view 1.1000

Blue Spot

Introduction

The Blue Spot analysis is showing critical parts on the site in case of heavy rain, where rainwater is collecting. This can be problematic issue, but it is possible to also take advantage of it. The analysis showcases the strategical possibilities of placing outdoor gardens, where they would have natural water supply.

As research suggests, the precipitation, if following the current rise, will increase by 15% in next hundred years. Also, amount of heavy rain downpour will increase. The heavy downpour in Denmark is considered when it rains more than 15mm over period of maximum 30 minutes, therefore, the base of Blue Spot analysis is taken as 15mm rain downpour in a shorter period of time. (Ringgård Christiansen, 2020)

Concluding Remarks

The analysis is useful to understand in which areas the precipitation rain can be collected and reused. For the site strategies, these areas can also have plantations to grow, related to the culinary experience.

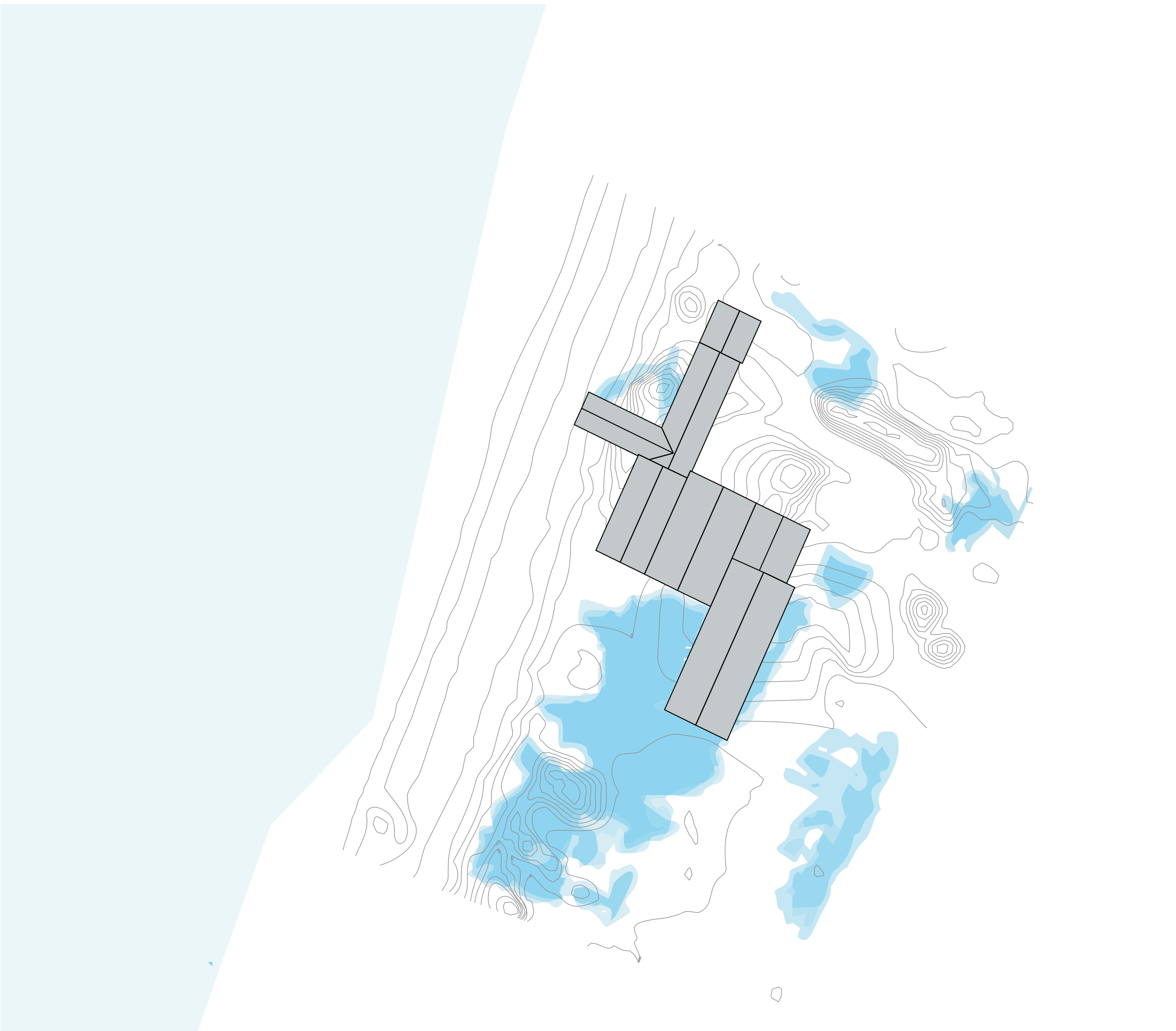


Fig. 59: Plan view 1.1000

The users

Personas

Introduction

The "Personas" method is based on the creation of fictional characters which will help to understand the needs and goals of the design according to a specific users' category.
(L. Nielsen,, 2012)
Therefore, here is a list of the users that the authors consider to be important for the design's development.

The Cyclist

The travelers on bike are usually geotourists, meaning they are interested in experiencing characteristics of place, including specific culture, landscape, and history. Those people tend to create meaningful connections with locals and spend locally. *(Adventure Cycling Association, n.d.)*
Travelers on bike would leave from the hotel early in the morning and would only arrive late in the evening, where they expect a good dinner and relaxation at the hotel's spa. Cyclists could expect food package from hotel's restaurant for the time away, depending on their diet, or they would get food on the go, depending on where they are located at lunch time.

Concluding Remarks

People travelling with their bike would expect safe place for their bike, preferably inside the building, or closed space.

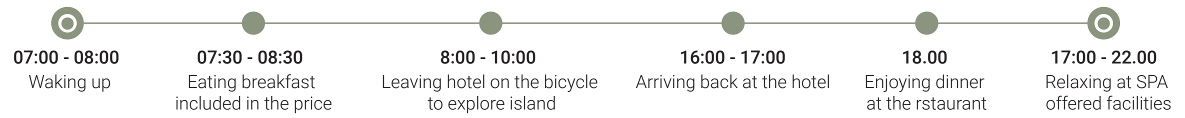


Fig. 60: The Cyclist Daily Routine

The Family

A family travelling with children is seeking for relaxation from the everyday life. While adults love to experience Samsø's nature, kids are keen on different, fun activities and spend most of their time at the beach.
As families are seeking relaxation, they might wake up later on their holidays. Therefore, it is important to offer breakfast until a little later hour in the morning. After breakfast they would go to explore Samsø's nature or stay at the hotel to relax at the SPA facilities, depending on the weather. After lunch, when the outdoor temperature is higher in the summer (p. 34), they would enjoy the beach right next to the hotel.
The families would enjoy learning about food culture and new ways how to prepare traditional recipes with local ingredients. This would also create qualitative family time together in a fun way, where they later could enjoy their own prepared food in a great company.

Concluding Remarks

As the family is traveling by car, it is important an easy access to the hotel, where they could also park their car. The family would also enjoy rooms with the possibility of placing an extra bed, depending on the number of children.

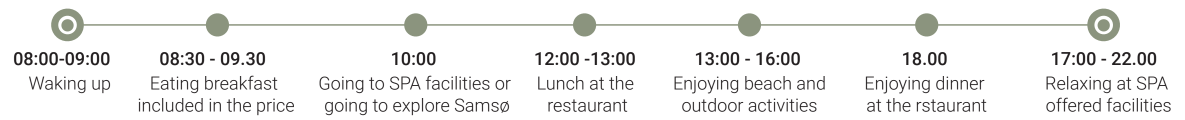


Fig. 61: The Family Daily Routine

The Gastronomic Visitor

The gastronomic visitor’s stay at the Hotel is looking for spaces where they can taste the local gastronomical products of Samsø.
Therefore, the guest expects to be provided of spaces where to have breakfast, lunch and dinner in the Hotel.
As this type of visitor is usually very interested not only on food tasting, but in general on food culture and production.
During the day, the visitor's activities could go from having a walk on the beach, exploring the island, relaxing in the Spa or as well reading a good book while tasting small snacks and a drink at the bar.

Concluding Remarks

The Hotel should provide dining rooms for the tasting of seasonal menus prepared by a trained staff, but as well spaces were guests can learn and prepare food for themselves.
It is important that the Hotel provides spaces for different activities related to relax, such as a reading area and a bar space.

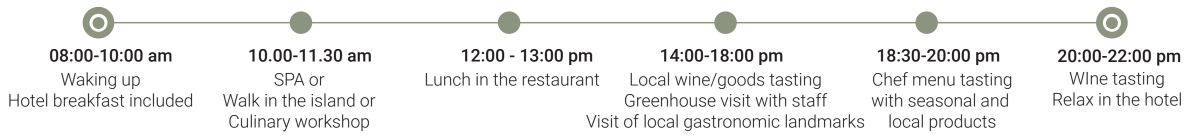


Fig. 62: The Gastronomic Visitor Daily Routine

The Culinary Staff

The daily routine of the culinary staff doesn’t involve only cooking, but as well making an inventory, preparing the service and managing both the staff and the goods production/supply. The main Chef of a restaurant could have as well shifts of 12 hours per day, as it is considered as the main captain and scheduling/budgeting organizer.

The working day usually begins early in the morning, with the first inventory and the “mise en place”: all the ingredients and main preparations for the service are taken care of, with the chef supervising and scheduling the work of each member of the staff.

The main services are the one of the mid-morning (usually from 11:30-14:30) and of the mid evening (usually from 18:00-21:00). The time in between the services is occupied by the cleaning and the preparation of the next service. In this range of time, it is as well important that all the staff can explore new recipies and have a brief together.

Concluding Remarks

The main kitchen should have spaces for the staff to gather and have a meal all together during the day. It is very important a clear distintion between the preparation area, the cleaning area and the storage one.

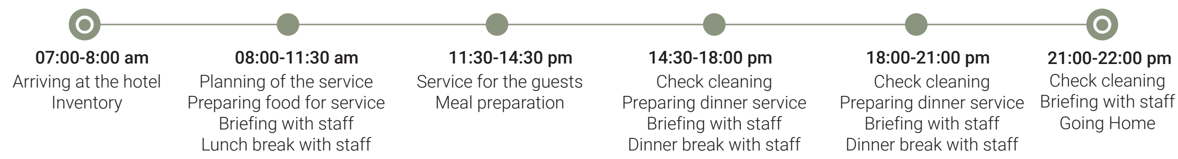


Fig. 63: The Culinary Staff Daily Routine

The Hotel Typology

Introduction
In order to better understand the main type of visitors on the Island, an analysis of the existing Hotels organization and room typologies is helpful. Therefore, the existing Badehotel of Samsø has been taken as an example (Fig. 65).

The Users and Experiences
The Badehotel closes from November until the end of February, but it organizes different booking packages and offers in order to convince specific types of travellers to choose their services:

- Gastronomic staying: 1 to 4 nights single room + gastronomic lunch and dinner for 2 people.
- Golf staying: 1 to 4 nights for couples, including the pass for golf court.
- Vacation staying: 2 nights in summer, Easter, Pentecost for 2 people.

The hotel offers culinary experiences to attract visitors, focusing on the usage of seasonal fresh and local ingredients. (Website, samsoebadehotel)
Moreover, the Hotel offers its guests yoga classes, massages and the possibility to rent a bike to explore the island.
Regardind the rooms typoligies, it presents both rooms inside the main building and detached rooms, in order for the guest to completely merge into nature (Fig. 66 - 68).

Concluding Remarks
The existing Badehotel shows which strategies are economically and socially successful when designing an Hotel in Samsø. The design is going to investigate the detached rooms typology, while focusing on the culinary experience. As yoga and massages are usually the leasure experiences that Hotel provides in Samsø, the design will find other activities to engage guests, such as Spa areas and a communal kitchen.

Due to uncertainty on license copyright, the figure is visible at this link:

https://samsoebadehotel.dk/galleri/

Fig. 65: The Badehotel Outdoor View

Due to uncertainty on license copyright, the figure is visible at this link:

https://samsoebadehotel.dk/vaerelsestyper/barn-house-suites/

Fig. 66: The Barn House Suite Typology

Due to uncertainty on license copyright, the figure is visible at this link:

https://samsoebadehotel.dk/vaerelsestyper/

Fig. 67: The Classic Room Typology

Due to uncertainty on license copyright, the figure is visible at this link:

https://samsoebadehotel.dk/vaerelsestyper/

Fig. 68: The Luxury Tent Typology

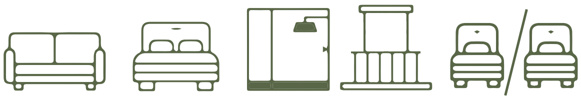
Room Typologies

The existing Badehotel is provided of a great variety of rooms typologies, which usually can host between 2-4 guests. *(Website, samsoebadehotel)*
The rooms are usually structured very similarly, but can differ with the addition of a small living or the possibility of adding an extra bed.
All of them are provided of a private toilet, and a view towards the sea or the outdoor garden.
However, the Hotel has also special rooms which provide guests with an unique experience. These are usually in close relationship to nature and are larger compared to the other rooms. As an example, the Hotel has 4 Luxury tents where guests can really be at one with the natural landscape (Fig. 68).

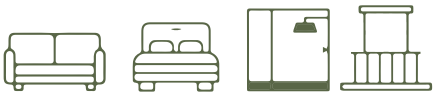
Concluding Remarks

The new Badehotel will provide rooms for 2-4 guests. The rooms' typologies will differ one to the other for additional living spaces or the possibility to add an extra bed, especially thought for families (p. 38).
All rooms will have the view towards the sea or towards nature.
A special room typology will be designed to have the best view towards the sea and the nature, providing guests of a unique experience.

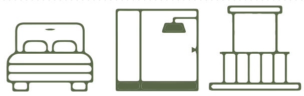
- Deluxe Suite: it has a separate bedroom, a large living room with a fireplace and a private toilet. Located on the ground floor, the room as access to a private terrace. It has the possibility to add two extra beds.



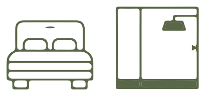
- Classic: the room has a double bed, a small living area with the possibility to add an extra bed, a private toilet and a balcony.



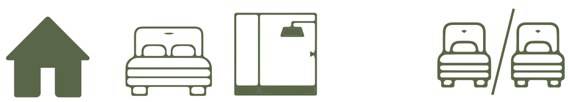
- Deluxe: the room has a double bed, its own toilet and a private balcony. It is a one space room.



- Standard: this typology is the smallest room available, which includes a double bed room with its private toilet. It is located at the ground floor, with a view on the outdoor garden.



- Barn house suites: this typology is a private small apartment with a sloping roof and located in the garden area. It is a one space large room with a double bed and the possibility to add two extra beds and a private toilet.



- Luxury tents: 4 well decorated tents for two people are offered to the visitors that want to be completely sourrounded by nature. The toilet is shared in the main building.

Framework

Sustainability

Introduction

The "Brundtland Report" *(Report of the World Commission on Environment and Development ,1987)*, introduced the concept of Sustainability and how it could be achieved, focusing on the balance between economic growth, social equality and environmental protection.
A sustainable development should meet the needs of the present without compromising the ability of future generations to meet their own needs. *(COST Association, 2018)*
Hence, Sustainability can be defined as a state of equilibrium, in which any used resources in any human enterprise is offset by the activity itself.

Nowadays it is recognized the significant contribution of the building sector on the climate and pollution breakdown of our cities and ecosystems. This is accounted for 36% of the total EU CO_2 emissions and 40% of the total EU energy consumed. *(Sustainia, 2012)*
Therefore, it is a priority to integrate strategies able to limit the overall constructions' impact.

Sustainable building certifications are tools used to compare and measure the sustainable performance of a building, based on its environmental, economic and social impact.
These tools are becoming integral parts of the design process worldwide. In Denmark, DGNB, BREEAM and LEED are currently the most popular ones. *(Realdania, 2018)*
All the certifications decline 13 sustainable aspects within three sustainable dimensions: the environmental Sustainability, the Economic Sustainability and the Social Sustainability.

However, the Sustainability concept is still evolving, and the design approach is trying to combine more diverse and mindful topics to the more traditional ones stated in the certification systems (Fig. 69).

Fig. 69: The language of Sustainability (*"Sustainability, Restorative to Regenerative"*)

Environmental Sustainability

The Environmental Sustainability referres to the direct impacts of the building sector on resources, energy consumption and wellbeing. *(Realdania, 2018)*

According to “The Domestic Chemical Cocktail” paper *(Gaia Group, 2008)* and “The Living Building Challenge Red List” *(International Living Future Institute, 2021)*, only 3% of the 55.000 available building materials on the market have been tested for their toxicity on humans.
Some of these are therefore used in the building sector, even though they are classified as unsafe and unhealthy (i.e. asbestos compounds found in wall insulations, Chlorinated Polymers as PVC).
With the introduction of the building certification systems (i.e. LEED, BREEAM, DGNB, LBC, WELL), guidelines and standards are provided to choose materials more consciously and to address the whole life cycle from the cradle to grave repurposing of the building structure. These include as well measures oriented to human's wellbeing, providing standards for daylight and indoor environmental quality. *(COST Association, 2018)*

Concluding Remarks

The design is going to focus on both the reduction of energy consumptions and embedded carbon. Therefore, the Life Cycle Assessment (LCA) tool is going to be used. The assessment is widely reknown for its quantitative analyses of the environmental impact of a specific material over its entire life cycle (Fig. 70).
The LCAByg software is going to be used for the analyses.

For the material choice, three main aspects are going to be assessed:

1. The availability of the material on site, in order to reduce the transportation costs and emissions.
2. The possibility of reusing and upcycle the existing building structure and materials, as a strategy to reduce embedded carbon.
3. The use of natural materials with a smaller ecological footprint (i.e wood cladding and reeds) and avoid the usage of the toxic materials stated in the LBC Red List.

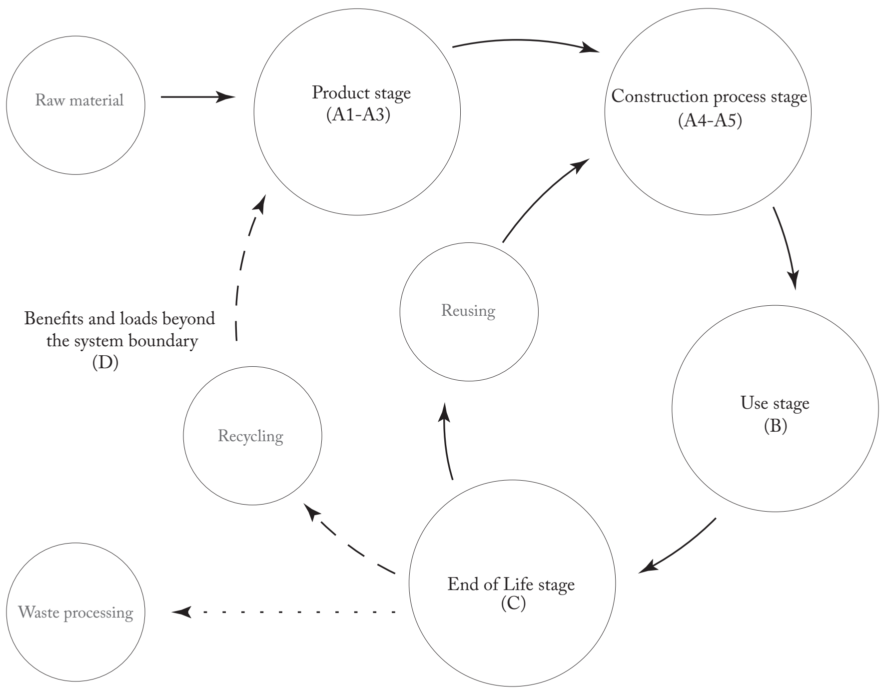


Fig. 70: Life cycle Assessment Phases

Socioeconomic Sustainability

In the Socioeconomics of Sustainability, the social and economic aspects are tied together, as the economics of the society have a large influence on the well-being and vice-versa.

The report prepared by Visitdenmark (2020), shows enormous rise in the overnight stays in Hotels in Denmark in 2021 compared to 2019, accounting around 32% for the locals and 12,3% for foreigners. These are great numbers for Denmark's statistic. The data shows, that Covid 19 pandemic didn't have a huge impact on the local tourism. The statistics shows that people from neighbouring countries, like Germany, Sweden and the Neatherlands are increasingly coming to visit Denmark.

These are good news for local tourism, as the local people from Denmark try to find alternative tourism possibilities - instead of going abroad, they start to explore local tourism possibilities. In year 2021 alone, Samsø was visited by approximately 350.000 people, a large number for a comparably small island of approximately 3500 inhabitants.

Although Samsø has been highly visited in the recent years, it seems that the visiting rate is highly dependent on the season. This is best shown in the unemployment rate on island (Fig. 71), where it is possible to see that unemployment rate is the highest from November to March, which is therefore considered the off-seasonal period. This means that facilities like Samsø Badehotel might also be highly dependent on seasonability. This is something that needs to be done considering the island's community.

Infact, during our in site interviews, a local business owner mentioned that they are trying to have their businesses open few days a week, in order to show visitors that Samsø has activities to offer also off-season.

Concluding Remarks

The new Badehotel will provide stay rooms for both locals and visitors.

In order to also attract visitors in off-seasonal periods (November - March), it is crucial to investigate functions and activities operable all year. This would make possible for the new Hotel to respond to the high level of unemployment (Fig. 71).

Therefore, the BadeHotel will have a Spa and Restaurant area, which should be designed assuming that they run all year long.

Due to uncertainty on license copyright, the figure is visible at this link:

https://businessregionaarhus.dk/media/39142/frekvens-samsoe-kommune.pdf

Fig. 71: Percentage of unemployment 2017-19 *("STRAN and Denmarks Statistik")*

Social Sustainability

The social aspect of sustainability in designing buildings focus on the well-being and health. However, we can expand this focus to the local community where the building is created at. It is essential that the building provides an easy access to all the facilities, in order to prevent the building to be itself a source of division and discrimination.

As Samsø is highly dependent on tourism, the local community is really open and friendly towards the island's visitors.
The main users of the new Samsø Badehotel will be “outsiders”. Thus, it is of high importance to investigate spaces that the building can provide to engage also the local community, an improve their quality of life.
Besides creating new workplaces for locals (p. 44), it is important to focus on creating facilities also for the community. This will connect both parties, generating a common place where they can gain from each other’s. For example, short conversations with the locals could provide valuable information about the island, while visitors could do the same about their origin.

Creating interactions between locals and visitors could provide a unique experience for visitors and enhance social interactions of Samsø local community.

Concluding Remarks

The new Badehotel should provide spaces for activities that can create a connection between the local community and visitors.
The building will focus on spaces for culinary experiences and a Spa area, which will be the first one on the island. This will attract the local community in a new activity, which can run all year long.
Moreover, the design will introduce the concept of the communal kitchen on Samsø, designing a space where both locals and visitors can engage and experience the culinary tradition of the island. Here they can learn and understand the food production's phases, from the harvesting to the tasting.

Hence, users are going to exchange knowledge and advices about food culture, while putting in practice what they have learnt in workshops and cooking together.
The communal kitchen becomes the connecting point between community and "outsiders" (Fig. 72).

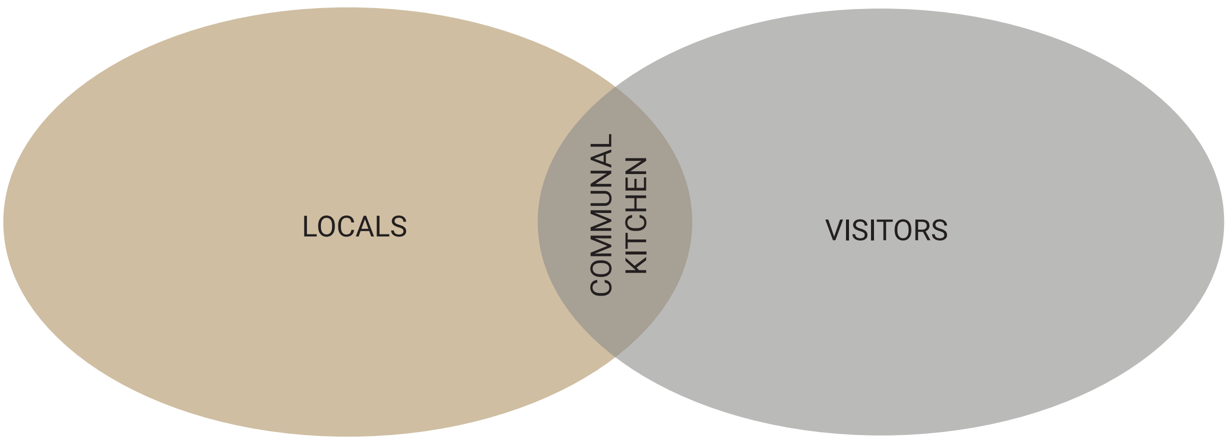


Fig. 72: Social Sustainability categories

Regenerative Architecture

Introduction

Akturk (2016) defines the regenerative design as an approach to shape a building which creates a positive impact to promote the wellbeing of both humans and the ecosystem. *(COST Association, 2018)*

The regenerative Architecture aim is to design with a holistic approach a building able to be a catalyst for an improvement of the place in which it is located.
The result is a building which enhances human life quality and is integrated in the natural environment, restoring a site's natural features and heritage and generating a positive impact.

While a restorative development is reversing the damages caused by humans or natural events, a regenerative development is also creating better conditions to support the connection between the building and the specific landscape qualities in which it is based (Fig. 73).

Regenerative buildings should improve the health and wellbeing of humans (i.e. providing adequate natural light, fresh air, comfortable interior temperatures), while reconnecting people to the natural environment (i.e. restoring a site's plant habitat or natural hydrology).
This buildings should be able to produce their own energy, capture and treat precipitation water, and engage to the surrounding ecosystem.

Concluding Remarks

Taking as a point of departure the approaches listed by the COST association (2017-2021), the design of the new culinary BadeHotel will focus on creating the opportunity on the site for the Hotel's new restaurant to grow its own food, in order to reconnect the role of the building to the natural ecosystem.
Strategies for the collection and reuse of precipitation water and the integration of systems using renewable energies (solar panels, heat pumps) should be implemented in the design.

Due to uncertainty on license copyright, the figure is visible at this link:

https://www.eurestore.eu/wp-content/uploads/2018/04/Sustainability-Restorative-to-Regenerative.pdf

Fig. 73: Linear diagram of Regenerative Architecture *(REthinking Sustainability TOwards a Regenerative Economy, 2020)*

Regenerative Heritage

Introduction

The term "heritage" usually refers to buildings with unique features and historical or architectural value. The aim of a Regenerative heritage approach is the reconversion of an existing space which is able to revitalize the context where it is placed. *(COST association, 2017-2021)*

To understand how to reach Restorative and Regenerative Architecture for our future built environment, it is fundamental to consider the existing constructions as living buildings, which collect memories and as well provide lessons for the future. Therefore, respecting the existing permits to maintain cultural richness and ensures a sustainable development of the built environment.

Different approaches should be taken into account when addressing the transformation of existing living buildings.

- Maintenance: the continuous protection and care of a building throughout time, in order to prevent the accumulation of damages and the need of drastic actions.
- Restoration: returining an existing building to a known earlier stage by removing the adjusted layers while avoiding the introduction of new materials. (Viollet Le Duc, 1844)
- Preservation: maintaining a building in its existing state and delaying its deterioration. In the *"Seven lamps of Architecture" (1849),* John Ruskin enforces the concept of the ruin against the falsity of Restoration.
- Conservation: all the processes made to retain the cultural significance of a building, critically assessing the actions to make and equally considering the historical and aesthetical qualities of it. *(C.Brandi, 1963)*
- Re-use: continue to use the existing building with the same function.
- Re-vitalization: using the existing structure but with a different function.

These theretical approaches can be associated to both the Restorative and the Regenerative Architecture (Fig.74).

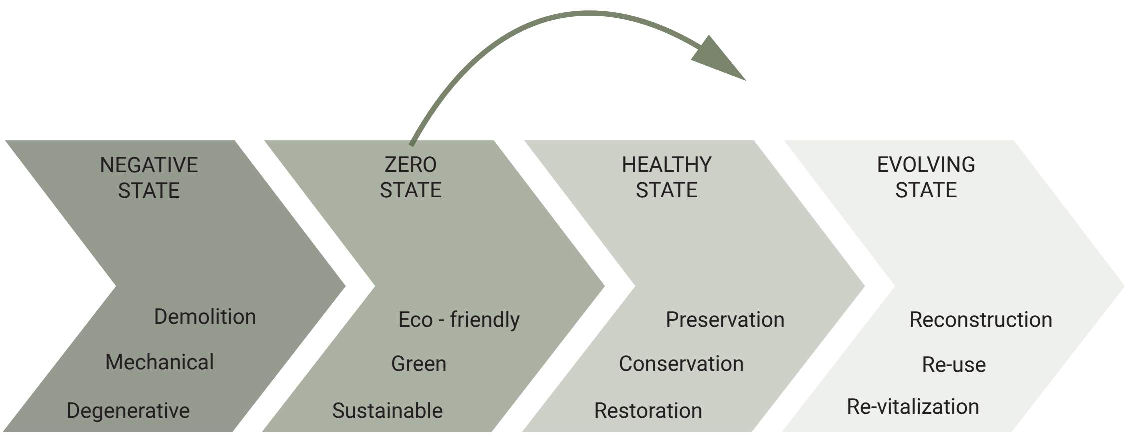


Fig. 74: The different stages towards a regenerative design *(REthinking Sustainability TOwards a Regenerative Economy, 2020)*

The Four Keys of Transformation

The theory and method of Professor Johannes Exner, founder of E+N office in Aarhus, deals with the transformation and conservation approach of buildings (p. 47) specifically in the Danish context.
The theory describes buildings as living beings which are evolving and changing over time. The historical identity of the building is therefore not only given by its initial appearence, but is formed also by the influences, changes and additions made during its life. *(E+N, 2007)*
Four points are enounced and used as a guideline when assessing the conservation of existing buildings (Fig. 75):

1. Originality: It is important to preserve all the building's layers to ensure the authenticity of the building. Later architecturally significant additions or alterations are historically equally important.
2. Identity: the intrinsic appearance and features that the building has acquired during its life.
3. Authenticity: all visible architectural parts, details, surfaces and building archaeological traces must be preserved. *(The Venice charter, 1964)*
4. Narrativity: the history that the building itself tells or what can be read from its qualities.

All the physical operation and transformations that are performed on the building should be easy to remove on a later stage without damaging the building, which then appears as intact as before the operation. This is a mandatory feature of the conservative approach, which is called "reversibility".

Concluding Remarks

The design is going to use the re-vitalization theoretical approach, reconverting the existing cement factory into a culinary BadeHotel.
The existing building is going to be transformed and renovated, following the conservation theoretical approach *(C.Brandi, 1963)* and the Four keys of Transformation *(E+N, 2007)*.
Further analysis will need to investigate which are the valuable elements that identify the cement factory and should be preserved.

Due to uncertainty on license copyright, the figure is visible at this link:

http://eplusn.dk/restaureringsfilosofi

Fig. 75: Diagram of the 4 keys of transformation *(E+N Restaureringsfilosofi, 2007)*

Industrial Heritage

Introduction

From the second half of the 1800s, Denmark transformed from an agricultural country to a nation state focues on industrial production. Massive building developments have started becoming part of the cultural landscape of the country. Therefore, industrial buildings became predominant in some areas, shaping and changing drastically our environment into an "Industrial Landscape".

The discussion on industrial environment as part of the Danish historical and heritage debate is recent. In 2007 the Danish Agency of Culture conducted a special research on the industrial heritage. *(C. Jorgensen, 2014)*
From the research mentioned before, 25 industrial sites have been declared of national importance and several studies have been conducted in order to understand the cultural and architectural interest of this often massive buildings. Hence, the interest towards Industrial landscapes increased and, in the recent period, industrial buildings have been largely observed as heritage *(McDowell, 2008)*

In general, when the values of the Industrial Heritage are identified in the social and cultural context, since it provides an important sense of the history and identity of a determined community. That may relate to a specific company, community, or technological value in the history of manufacturing, or also derived from aesthetic qualities of its Architecture (Fig. 76). These values are intrinsic to the site itself and in intangible records in human memories and traditions. Industrial Heritage may therefore offer identity to a community or become the signature of a place. *(COST association, 2017-2021)*

Concluding Remarks

The existing yellow bricks and wooden trusses are going to be reused, while both the existing Silo and concrete mixer are going to be renovated. This actions will keep the aesthetical and historical features of the building intact, in order for the community to recognize the cement factory's previous identity and its re-vitalization (p. 74) to the new Culinary Badehotel.

Due to uncertainty on license copyright, the figure is visible at this link:

https://www.eurestore.eu/wp-content/uploads/2018/04/Sustainability-Restorative-to-Regenerative.pdf

Fig. 76: Industrial Heritage approach and phases *(Evaluation scheme for industrial heritage. Luca, E. 2017)*

The Architectural Background in Samsø

Introduction

The Architectural culture in Samsø frames back to Viking times up to the modern Nordic Architecture (Fig. 77)

Considering such a wide timeline, it is worth to consider the building traditions on the island since the Vikings day to the modern Nordic Tradition. Such study informs the design process on how the new Samsø Badehotel will dialogue with such tradition, particularly in the tectonic arrangement of typical constructions and traditional spatial elements. To that end, this section will focus on the archetypical buildings and spatial constructions that can be adopted and reinterpreted in this contemporary design solution.

The Viking Architecture

The period of the Viking Age is approx. 800-1050 AD. The Vikings had a well-developed building technology tradition that had been developed over generations and which was the foundation of their travels. *(Vikingetid, n.d.)*

Aside from building ships, the Vikings were also skilled at building homes and fortifications. *(National Museum, n.d.)*

The Viking Age is not as well preserved as the prehistoric period, but it is possible to see remnants or traits of their constructions in some places in Denmark, specifically on Samsø (p. 20).

Within circular earthworks, roads and houses were arranged in a geometric design. The ring forts were positioned in strategic locations and close to a stream, which made them ideal for sailing and for defending against attacks (Fig. 78).

The Viking longhouses are well known in Denmark and have been found in nearly all parts of Denmark to some degree. These longhouses were made of wood with basic stone footing or pounded earth instead of built floors. (Fig. 79).

Fig. 77: The Timeline

Due to uncertainty on license copyright, the figure is visible at this link:

http://medieval.mrugala.net/Architecture/Danemark,_Slagelse,_Trelleborg/

Fig. 78: The circular fortification

Due to uncertainty on license copyright, the figure is visible at this link:

http://www.vikingdenmark.com/viking-houses-architecture-inside-layout.html.

Fig. 79: The Viking 's traditional long house

The preferred type of wood used was oak. In plan, the longhouses had bowed walls forming a ship-like outline. There were either walls lined with clay or wooden planks placed vertically into the ground, which supported the roof along with two rows of internal posts. This created an interior that was as intriguing as its exterior. The house was supported by sloped posts on the outside, and the roofs were often thatched or wooden. In parts of Scandinavia where wood was unavailable, turf was used to build exteriors of houses (National Museum, n.d.).

An oblong fireplace was placed in the centre of the house – a long fireplace. It was here that the food was prepared. Along the walls, there were plank beds for the Vikings to sit on or sleep on. If there were no stables on the farm, the animals were housed in stalls at one end of the house (Viking Houses, 2010). They constantly repaired their houses. As, damp was one of their greatest enemies as it caused rot. In addition, they also knew how to protect the wood by scorching the posts of their houses (National Museum, n.d.). According to other archaeologists, Viking households, or at the very least the royal halls, were painted all white (Ahsan, 2021). A white house is a prestige symbol and a landmark that can be seen from a distance. In addition to providing light during the dark winter months, using quicklime both outside and inside the house would have provided effective insulation and a comfortable indoor temperature (Ahsan, 2021).

Concluding Remarks

Due to the great importance of the Vikings' cultural heritage on the island, the authors investigated the architectural elements which defined this ancient tradition. Points of interests for further investigations have been found in the circular shape of the fortifications, and the interior open spatial organization.

Due to uncertainty on license copyright, the figure is visible at this link:

https://elgaardarchitecture.com/en/project/the-kings-hall-at-lejre-land-of-legends/?fbclid=IwAR2OAnyOR_QYrD0UKtumXME0bMgwpsXZbo9TDUAkcLPsEVsljePELfNwgxc

Due to uncertainty on license copyright, the figure is visible at this link:

https://elgaardarchitecture.com/en/project/the-kings-hall-at-lejre-land-of-legends/?fbclid=IwAR2OAnyOR_QYrD0UKtumXME0bMgwpsXZbo9TDUAkcLPsEVsljePELfNwgxc

Fig. 80: Long house interiors

Building Tradition on Samsø

Even though Denmark is a relatively small country, there are still large differences in the older rural settlements from region to region. The design and location of the buildings are adapted to the landscape and climatic conditions and are most often constructed from the building materials that could be obtained locally. (Kulturstyrelsen, 2012)

Many of Samsø preserved half-timbered houses are mainly four-length houses. Over time, some living rooms lengths have increased by several cross formed houses (Fig. 81). The use of the straw ridge to keep the thatched roof at the top and the colour attitude with whitewashed boards and tarred timber show kinship with the East Jutland building customs. As for the thatched roofs, they are reminiscent of Zealand. Seaweed was also used for roof ridge on farms near the island's coasts. (Trap Danmark redaktion, 2020)

It is also notable that on the gables of the island's larger farms, there are several carved lads that stand on vertical pieces of timber and carry the occasionally protruding board-clad gable triangle. The top of the gable is sometimes adorned by a rod with a weathercock. As in most other parts of the country, brick-built wall replaced the half-timberwork after approx. 1850. (Trap Danmark redaktion, 2020)

On the island, small brick buildings, which produced mostly yellow stones, appeared after approx. 1850 and left their mark on the farmhouses (Fig. 82 - 83).
Tile and slate took over the thatched roofs, just as the new material cement was taken into use. (Trap Danmark redaktion, 2020)

Concluding Remarks
In order to blend with the building tradition on Samsø, the different materials here introduced are going to be further analysed especially in regards to the LCA analyses.

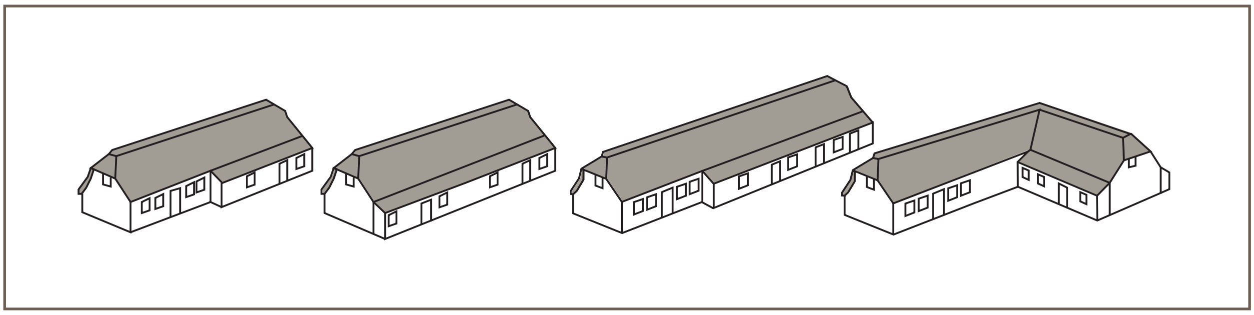


Fig. 81: The Traditional building shapes in Samsø

Fig. 82: The Viking Museum

Fig. 83: Yellow Bricks and Thatched Roof

Nordic Architecture

While experiencing the location, and designing a building in the Nordic context, it seems obvious to get inspiration from Nordic architecture. Nordic Architecture is known as simple and functional design and is influenced by modernist aesthetics, with minimal structures and the use of locally available materials.

It can be hard to point out exact elements that define the Nordic architecture, but while looking into several authors and the work of several Nordic Architects, the main elements that stand out are the following: the relationship between nature and building, the usage of local materials and the close attention to light. “In the North, we live among things instead of in confrontation with them.” *(Norberg-Schulz, 1996, p. 15)*

“We experience the North spontaneously upon arrival. Another mood envelopes us but we are not immediately aware of what has happened: is it light, is it the land itself, is it the vegetation, or it is the built environment that is somehow different?” (Norberg-Schulz, 1996).

Norberg-Schulz (1996) reveals that it is certainly all those elements. Kjeldsen (2012) also argues that surroundings, functionalism and materials are the elements of sensing architecture, in a way what can be seen and what can be experienced. Norberg-Schulz (1996) emphasizes the importance of light for buildings.
Depending on the weather, the source and the use, lights creates transient atmospheres. It can be diffuse and direct, as well as one needs to be aware, that in northern countries light is changing significantly, depending on the time of year, as well as hour of the day.

Nature is also very important in Nordic architecture. “In the north man feels part of nature, not an ecstatic spectator of nature” (Gennaro Postiglione, Mareike Henschel, 2002). By designing with respect for nature and surroundings, it is possible to create awareness, that man is an essential part of it, not only being as an aesthetical viewer or just a consumer. An important aspect when designing a building, where it is surrounded by charming nature, in order to fit in and adjust (Fig. 84 - 85).

When looking at buildings, it is often possible to understand architectural language of the culture and how it is described through shape, materials and specific placement. By this, one wants to distance oneself from The International Style, where ideally buildings appear as uniform, meaning there is no difference in appearance, no matter where in the world they are built.

Concluding Remarks

The design of the new Badehotel is going to focus on the relationship between the surroundings and the the building, with the aim to blend it into nature while being a continuation of the existing cement factory.

Due to uncertainty on license copyright, the figure is visible at this link:

https://www.shl.dk/dk/katuaq-cultural-centre/

Fig. 84: Nordic House, Greenland, SHL (1987)

Due to uncertainty on license copyright, the figure is visible at this link:

https://nordichouse.is/da/norraena-husider-lokad-yfir-hatidirnar-2/

Fig. 85: Nordic House, Iceland, Alvar Aalto (1968)

Case studies

The Energy Accademy, Arkitema (2017)

Introduction

The Energy Academy opened in 2007, where all the knowledge on sustainable energy, community power and sustainable development is accessible to the local community and the increased number of visitors and students. It is a meeting place in which conferences, workshops and courses are held for more than 500 visitors per year.

The Architectural firm in charge of the project was Arkitema, which collaborated with local craftsmen.

A Modern Reinterpretation of Viking Architecture

The shape and functional distribution of the building took inspiration from the Vikings' long-houses design (Fig. 86).

As the Vikings mainly built the structure of the long-houses in wood (usually oak), which supported the sloped roof with two rows of internal posts, the same structural system is used in the Academy, giving the idea of the traditional ship-like outline and interior open space (Fig. 89).

Great importance for the Vikings was the introduction of a fireplace in the middle of the house, considered as the main gathering and cooking place, and where heat was cumulated during the day. As the household could become extremely smoky, the Vikings used to have holes or vent cut into the roof for natural ventilation (Ahsan, 2021).

In the Academy, these elements are reinterpreted in a modern and sustainable way: two main chores with all the technical equipment and appliances are placed in the middle of the open space, working as heating storages during the day that is then released naturally through the openings in the roof and creating a chimney effect.

A Low Energy Building

The building consumes only 66 kWh/m2 annually and fulfils the goal of the island to have low energy buildings. An automation system is integrated in the design and opens the windows for the natural ventilation when the level of CO2 inside the building is too high.

Photovoltaic panels are integrated in the sloping roof, with an area of 100 m2 for the total 625m2 of the Academy (Fig. 87).

Rainwater is collected and re-used in the toilets, and renewable and natural materials such as newspaper and wooden fibre for walls and ceilings' insulation, and volcanic rocks for the foundation have been used. The building is elevated 70 cm above the ground level to avoid water infiltrations.

According to the heating passive strategies, the 2 main chores inside the building are made of concrete slab and stone mass, in order to accumulate the heating coming from both the technical equipment and the special glazing of windows that reflects heat and light into the space during the day (Fig. 88).

Concluding Remarks

As in the Energy Accademy, one of the objectives of the project's design will be the integration of passive strategies to reach the low energy building frame and demands. The design will as well investigate how to relate to the Vikings heritage and long-houses functional distribution.

Fig. 86: Outdoor View

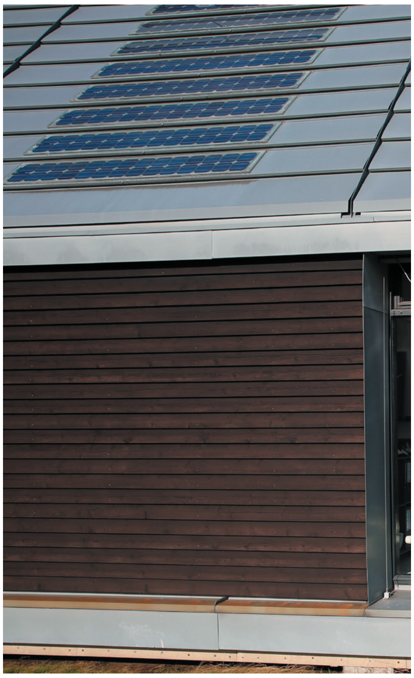


Fig. 87: Integrated Photovoltaic Panels

Fig. 88: Interior Thermal Mass Core

Fig. 89: Wood Structure

The Wadden Sea Centre, Dorte Mandrup (2017)

Introduction
A prime example of how to interpret and celebrate the building customs native to Denmark, or more specifically to the southern Jutland, is seen at the Wadden Sea Centre. Moreover, it is an example on how to blend in with the nature. The Wadden Sea Centre is designed by the Danish architect Dorte Mandrup.

The Wadden Sea Centre is located near the coast outside Ribe and is the cultural centre for the National Park of Wadden sea. It provides exhibitions, guided tours, and educational activities about the unique nature and migratory birdlife of the national park. (Dansk Arkitekturcenter, 2017)

Local Material Usage
In keeping with the local farmhouse typology and construction tradition, the roofs and majority of the facades are thatched, and the courtyard forms a barrier from the strong winds. The thatched roofing is reinterpreted to emphasize the tactility, robustness, and durability of the local materials, while also expressing a sculptural message. (Dorthe Mandrup A/S, 2016)

Concluding Remarks
As in The Wadden Sea Centre, the design of the Badehotel wants to engage with the local building traditions, blending in with the typologies and the landscape while analysing and possibly using the existing cement factory materials and tradition.

Due to uncertainty on license copyright, the figure is visible at this link:

https://www.ignant.com/2019/03/22/dorte-mandrups-sculptural-addition-to-the-wadden-sea/

Fig. 90: The Thatched Roof Detail

Due to uncertainty on license copyright, the figure is visible at this link:

https://www.ignant.com/2019/03/22/dorte-mandrups-sculptural-addition-to-the-wadden-sea/

Fig. 92: The Wood Gate

Due to uncertainty on license copyright, the figure is visible at this link:

https://www.pinterest.dk/pin/544443042451183414/

Fig. 91: Different Outdoor Materials and Textures

The Hotel Green Solution House, 3XN (2021)

Introduction

Hotel Green Solution House (Hotel GSH) is in the popular tourist destination of Rønne, on Bornholm. The Hotel will be the first commercial building in Denmark to provide a positive climate footprint. The design will consist of a total of 24 new rooms, a new conference room and a roof spa.

Upcycled Materials and Circular Economy

To achieve circular economy, all components are designed for reuse and disassembly. The upcycled waste products created from the off-cut construction is used for furniture and surfaces. The local granite is used as decoration while also regulating the temperature storing heat and cold naturally.

To achieve a carbon-negative building, the structure is made of cross-laminated timber with wood insulation and cladding, which can offset the CO2 emitted by the building over its lifespan. Renewable energy and passive design strategies are as well integrated in the design to help reduce its carbon footprint further, which include harvesting solar energy to heat the water, and natural ventilation to void the usage of mechanical systems.

Concluding Remarks

The design proposal will focus on the use of natural materials and passive renewable strategies to achieve a low energy building. The use of a timber construction and cladding is going to be investigated, for the possibility of limiting greatly the CO_2 emissions.

Due to uncertainty on license copyright, the figure is visible at this link:

https://inhabitat.com/3xn-unveils-denmarks-first-climate-positive-hotel-for-bornholm-island/hotel-green-solution-house-3xn-3/

Fig. 93: Outdoor View

Due to uncertainty on license copyright, the figure is visible at this link:

https://inhabitat.com/3xn-unveils-denmarks-first-climate-positive-hotel-for-bornholm-island/hotel-green-solution-house-3xn-3/

Fig. 94: The Roof Spa

Due to uncertainty on license copyright, the figure is visible at this link:

https://inhabitat.com/3xn-unveils-denmarks-first-climate-positive-hotel-for-bornholm-island/hotel-green-solution-house-3xn-3/

Fig. 95: The Wood Construction

Noma 2.0, BIG (2018)

Introduction

When designing a beach hotel, which is focused also on food experiences, it is crucial to investigate best practices, how world's best restaurants are created. This will give great understanding of functions and what are the best things that have worked out.

One of the best ways is to start looking at the best restaurants in the world. At the top of list in 2021 came restaurant Noma, located in Copenhagen, Denmark. The restaurant has been designed by world famous architectural firm BIG.

BIG has transformed an existing abandoned historical building in Copenhagen into the new site of famous restaurant Noma, which makes this case even more relevant to the project. The

architect firm have refurbished the old structure and created new additions, which is now Michelin-starred restaurant.

The building is ex-military warehouse called Søminedepotet, constructed in year 1917. The abandoned warehouse was covered in graffiti, but even though it had strict rules on preserving the historically significant site.

When creating restaurant Noma 2.0, the inspiration was taken from the traditional Nordic farm typology, the seater, which is a loose cluster of individual buildings, where different buildings are having different functions and are spread around landscape.

Functions and Materials

Each of the buildings are connected by glass covered paths, creating nature around as integral part of the culinary experiences.

The restaurant has an open floor plan, meaning that chefs and guest can always have visual contact. The building is constructed from local materials and construction techniques to emphasize site's heritage.

Each building has its own purpose, as in the traditional nordic farm settings. In this case, the main functions are:

- the main entrance with a big wardrobe;
- the main area with the final service kitchen, easily accessible from both the staff and the visitors. As it is an open space, it has an entire ceiling of ventilation;
- the main dining room, completely in oak and openable towards the outdoor garden;
- the private dining room, made in pine wood;
- the lounge area, with a central ireplace made of bricks;
- the preparation kitchen, staff areas, storage and Lab, which are placed in the existing renovated warehouse.

The restaurant also includes three greenhouses, which are placed on existing foundations, where there are gardens, test kitchen and bakery, responding to an urban ecology idea.
Noma is placed in a rural setting inside the city, which allows to grow and cultivate some of its own products.

Concluding Remarks

When designing a Badehotel which is focused on food experiences, it is crucial to investigate best practices, how world's best restaurants are created. This gives a great understanding of the interior functions needed, their best placement and materiality.
The idea of seasonal cuisine and ecological production of goods of the restaurant is going to be assessed, since it could fit with the ambitions of Samsø's culinary tourism.

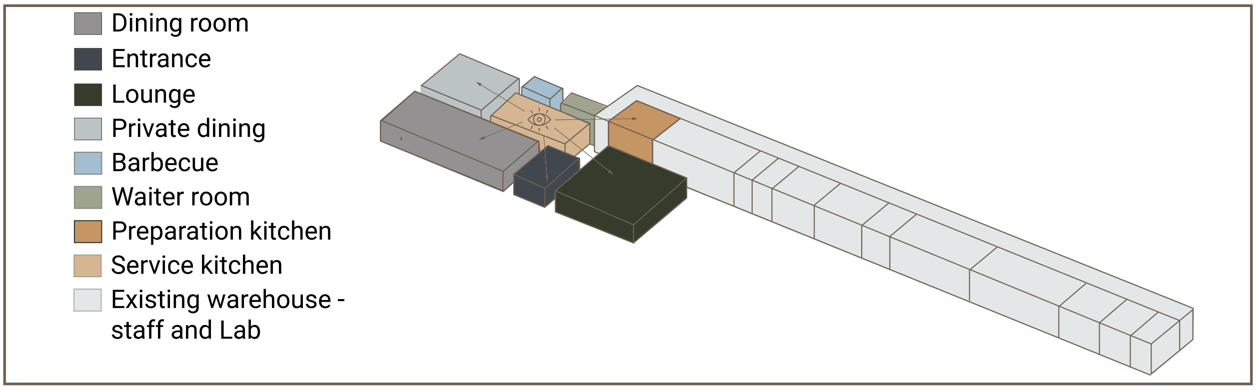


Fig. 96: The initial functional diagrams

Due to uncertainty on license copyright, the figure is visible at this link:

https://www.archdaily.com/902436/noma-big?ad_source=search&ad_medium=projects_tab

Due to uncertainty on license copyright, the figure is visible at this link:

https://www.archdaily.com/902436/noma-big?ad_source=search&ad_medium=projects_tab

Due to uncertainty on license copyright, the figure is visible at this link:

https://www.archdaily.com/902436/noma-big?ad_source=search&ad_medium=projects_tab

Fig. 97: The Existing Warehouse and its Restoration

Due to uncertainty on license copyright, the figure is visible at this link:

https://www.archdaily.com/902436/noma-big?ad_source=search&ad_medium=projects_tab

Fig. 98: The Open Service Kitchen

Due to uncertainty on license copyright, the figure is visible at this link:

https://www.archdaily.com/902436/noma-big?ad_source=search&ad_medium=projects_tab

Fig. 99: The Additional Greenhouses

Due to uncertainty on license copyright, the figure is visible at this link:

https://www.archdaily.com/902436/noma-big?ad_source=search&ad_medium=projects_tab

Fig. 100: The Brick Fireplace

Nest We Grow, Kengo Kuma Associates (2014)

Introduction

This project is the product of the collaboration between Kengo Kuma Associates and the College of Environmental Design UC Berkeley in response to an international competition.

Its main purpose was to design a building capable to engage the community together to produce, store prepare and enjoy local food in Hokkaido, Japan.

The project merges the heavy timber construction technique to the usage of rammed-earth walls and straw bale construction, combining different natural materials and textures.

Food Production and Sustainable Design Approach

The functional and passive strategies implementation program is decided according to the life cycle of the local foods production: from the growth to the harvesting, to the storage and cooking, until the composting phase which restarts the cycle.

The transparent polycarbonate cladding on facades and roof permits light to reach the plants for their growth, and to heat the space during colder month in order to extend the usability of the building for food production.

The walkway system permits to reach and harvest the produced vegetables, which appear as a floating forest above the middle gathering space on the ground floor, where the community can cook and enjoy the food both visually and physically around a fireplace.

The wall at the base of the building helps to block the northwest winter wind, and it's the placement for the composting bins and water tanks.

Sliding panels in the facades and roof openings permits air to flow through the structure and ventilate naturally the area, while permitting the surrounding landscape to become part of the interior space.

The funnel shape roof permits to collect water and the melted snow, which is then delivered to the water tanks and used to irrigate the plants.

Concluding Remarks

In the design of this project is possible to relate the building lifecycle to the food lifecycle. The structure becomes a place for gathering activities throughout the year, and therefore food, construction and society are combined in a symbiotic relationship and are experienced as one element.

In the design process of the Hotel, assessing the food production traditions, the soil features and the climate conditions will therefore be crucial in order to reach this unique and complete experience of nature, food and space.

Due to uncertainty on license copyright, the figure is visible at this link:

https://www.archdaily.com/592660/nest-we-grow-college-of-environmental-design-uc-berkeley-kengo-kuma-and-associates

Fig. 101: Outdoor View

Due to uncertainty on license copyright, the figure is visible at this link:

https://www.archdaily.com/592660/nest-we-grow-college-of-environmental-design-uc-berkeley-kengo-kuma-and-associates

Fig. 102: Facade Detail

Due to uncertainty on license copyright, the figure is visible at this link:

https://www.archdaily.com/592660/nest-we-grow-college-of-environmental-design-uc-berkeley-kengo-kuma-and-associates

Fig. 103: Sustainable Strategies Diagram

Due to uncertainty on license copyright, the figure is visible at this link:

https://www.archdaily.com/592660/nest-we-grow-college-of-environmental-design-uc-berkeley-kengo-kuma-and-associates

Fig. 104: Climate Analyses

Due to uncertainty on license copyright, the figure is visible at this link:

https://www.archdaily.com/592660/nest-we-grow-college-of-environmental-design-uc-berkeley-kengo-kuma-and-associates

Fig. 105: Goods Production Phases

Conclusion

Vision

The vision of the project is to have a regenerative and re-vitalizing approach, by using the existing building structure while grafting a new and engaging recreational function inside. This will be done by giving a new life to the existing materials and elements, preserving the ones with valuable features in relation to both the landscape and the community.

The new Hotel design will focus on the balance between private and public spaces, with the objective of becoming a new social and touristic landmark. Both visitors and locals will have the opportunity to gather and learn together about the island's traditions and local production, by introducing a communal kitchen and conference and public areas.

The interior design will re-interpret the local architectural traditions in a contemporary way, focusing on the usage of natural and recycled materials and on the integration of passive/ active strategies to reach a low energy building.

The Hotel will have around 20 private rooms, a Spa, a restaurant and communal kitchen and gathering areas.

Design Goals & Criterias

General

• Preserve the existing valuable parts of the cement factory:

- by adding insulation to the existing walls and structures of the building;

- by reusing or upcycling the existing building materials.

• Place the functions over the existing building foundation, maintaining the existing building shape.

• The building should not exceed the height of the existing building.

• The design should integrate the traditional building customs of the Nordic Architecture.

• The material choice should be based on LCA calculations:

- by having a total of Global warming potential close to 0 in order to be CO_2 neutral.

• Integrate active/passive strategies into the design:

- by implementing the use of renewable energy sources and passive solutions.

Outdoor Design

• Place gardens and greenhouses in relation to climate analyses and the food production cycle.

• The building must have one common, welcoming and recognizable entrance.

Interior Design

• Re-interpret the Viking's interior design of long-houses:

- by having and deciding the central core of the building, and placement of trusses;

- by designing an open floorplan with minimum hallways and circulation areas.

• Create meaningful spaces for interactions between visitors and locals.

- by designing outdoor and indoor functional spaces;

- by providing spaces with facilities that encourage the interactions;

- by offering facilities for local people, in form of a communal kitchen.

• The building should offer various kinds of SPA facilities.

Initial Room Program

Based on the previous Analyses, the table belows shows the different functions which have to be considered when designing the new culinary BadeHotel. This is going to be the point of departure on which the design process and the shaping of the building can start apon, keeping always in mind the number of users, the approximate m² and the hierarchy of the spaces listed below.

CULINARY SPACES	N.	N. PEOPLE	TOTAL (M2)
Dining room + Bar	1	40	110 + 30
Main Kitchen	1	10	50
Storage + freezers, coolers	1	2	20
Communal Kitchen	1	10	60
Changing room + toilets	2	5	15 + 15
Room for the staff	1	5	20
Laundry, cleaning	1	2	10
Technical room	\	\	\
Circulation area	\	\	\
GATHERING SPACE	N.	N. PEOPLE	TOTAL (M2)
Lobby + Lounge	1	20	80
Reception	1	1	5
Printer, storage room	1	2	10
Office and Staff area	1	1	20
Toilets	4	4	15
HC toilet	1	1	4
Wardrobe niche	1	2	10
SPA SPACE	N.	N. PEOPLE	TOTAL (M2)
Indoor pool	1	10	40
Sauna	2	4	15
Multi-functional area	1	2-4	20
Changing room + toilets	2	5	15+15
Technical rooms	\	\	\
GUEST ROOMS	N.	N. PEOPLE	TOTAL (M2)
Deluxe Suite	4	2	40
Classic	6	2 - 3	26
Standard	15	2	24
Special room	2	2 - 4	25
Common space	1	10	10
Laundry, cleaning	1	2	10
Circulation area	\	\	\
OUTDOOR ACTIVITIES	N.	N. PEOPLE	TOTAL (M2)
Outdoor pool	1	10	40
Extensions?	\	\	\
Badebro - Infinite bridge	1	\	\
INITIAL ROOM PROGRAM TOTAL			1390

Fig. 106: Initial Room Program Table

Initial Functional Diagram

The Initial Functional Diagram represents an approximate placement of the Room program's spaces. As a point of departure, all the functions are placed according to the existing footprint of the cement factory, in order to understand the possibility to preserve the building and place all the required spaces inside.

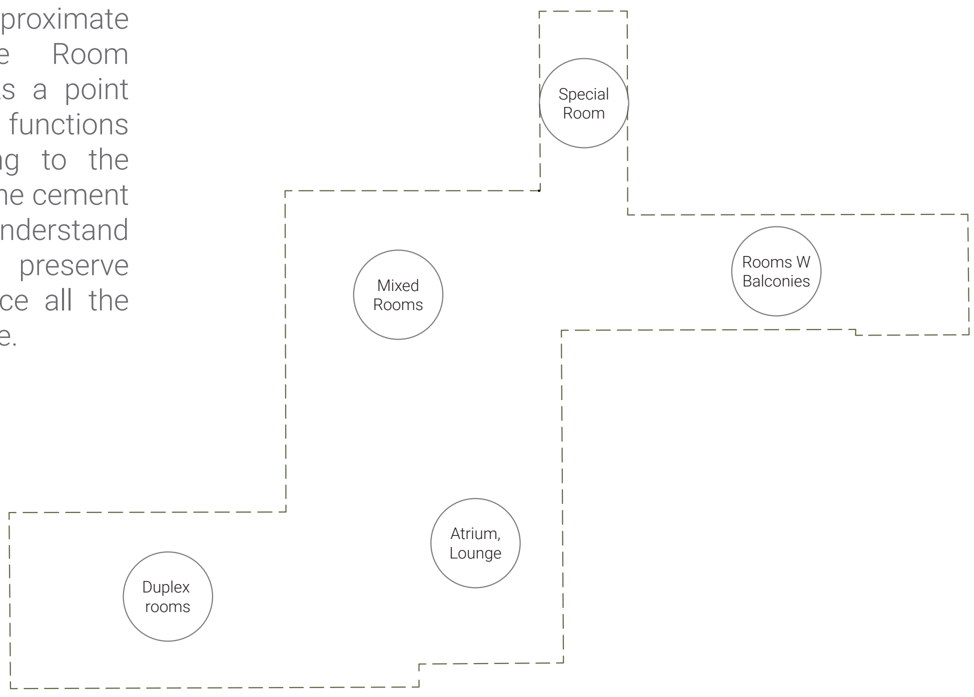


Fig. 108: First Floor, Initial Functional Diagram

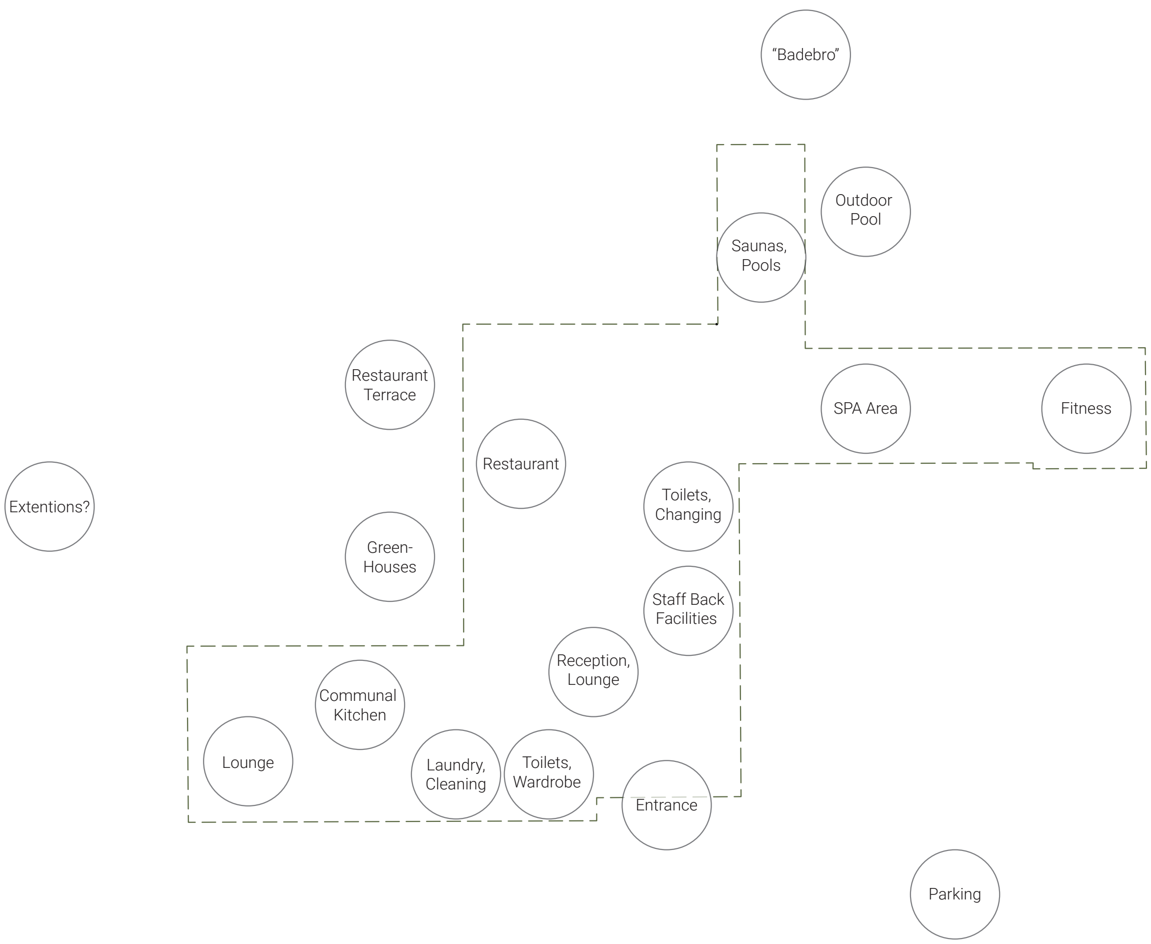


Fig. 107: Ground Floor, Initial Functional Diagram

Design Process

The Design Process chapter is a collection of all the studies and proposals for the new Badehotel.
The massing and site are conducted and different shapes have been studied.
The Midway critique is an important middlepoint stage where the design options are presented to collegues and guests in order to be critically analysed. The comments are collected in order to implement the design and arrive to a design solution.
Furthermore, the design details regarding the windows' placement, the introduction of mechanical systems are analysed with indoor envorinment and energy simulations, while analysis regarding the materials durability and $C0_2$ emissions are gained. The results are synthesised into a final design solution.

Massing Strategies

The View from the Seashore

The seashore in front of the site is connecting all the west coast and is a very popular walking path. For this reason, a massing analysis has been conducted in relation to the view from the shore.
Starting from the existing building (Fig. 109), different volumetric studies have been made in order to reach the square meters defined in the room program (p. 63).

As visible in the initial functional program (p. 62), it is necessary to add a floor on the existing building in order to keep its exact same footprint. This solution seemed to be the best option to preserve the building, but it results into a massive change to its view from the shore. The resulting building is a tall mass (Fig. 110) that breaks the longitudinal expression of the landscape that wanted to be preserved (p. 29).

The addition of a wing on the north side of the site (Fig. 111) is effective in order for this view to remain intact. As visible in Fig. 112, the 2 floors' addition wouldn't be perceived by the people walking on the shore, keeping the factory's original image untouched.

Another solution would be to add a volume on the south part of the site (Fig. 113). Even though this addition impacts the view from the shore, its longitudinal expression is merging with the landscape and the volume looks as a continuation of the existing massing (Fig. 114).

Concluding Remarks

The addition of new low longitudinal volumes would be the best solution in order to preserve the buildings' view from the seashore and emphasize the landscape expression.

Such volume addition fulfill the room program and fits well with the historical volumetric evolution of the existing building (p. 16).

Fig. 109: Axonometric view, existing

Fig. 110: View from the shore, option 1

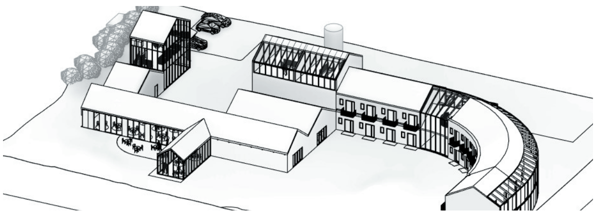


Fig. 111: Axonometric view, option 2

Fig. 112: View from the shore, option 2

Fig. 113: Axonometric view, option 3

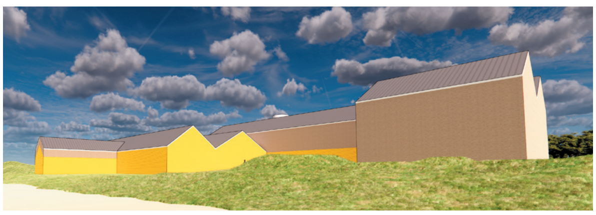


Fig. 114: View from the shore, option 3

Site Strategies

The Hierarchy of the site

The placement of the volumetric additions is now contextualized to the site properties.
The site is defined by two main boundaries: the sea on the west, and the main access road to the east. (Fig. 116)
The existing building shape does not provide a hierarchy of the outdoor spaces, which at the moment are used mainly as a storage for the produced concrete elements (Fig. 115).
Therefore, the addition of volumes on the north and south sides of the site permits the shaping of delimited outdoor areas (Fig. 116). Due to the previous existing climate conclusions (p. 33), outdoor activities can be placed on the east and west sides of the site.
The volumes can also act as as architectural shields from the neighbouring existing houses.
The northern wing relates to the inland, and frames a public courtyard inviting people to the building (Fig. 117).
On the contrary, the southern wing is directed towards the sea and the natural landscape, and frames a more private outdoor space.
The existing west appendix emphasizes two niches, where outdoor terraces can be placed to enjoy the summer breeze and the view to the sea.

Concluding Remarks

The double U shape building is ideal in the context to frame courtyards and terraces, providing the landscape of a clear spatial hierarchy and an understanding of its accessibility points.

Fig. 115: Concept for the Site

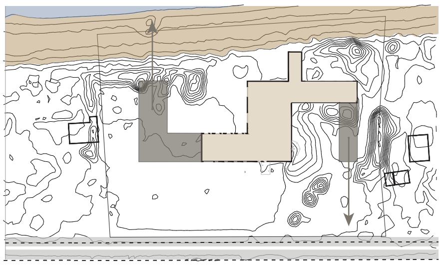


Fig. 116: Concept Diagram

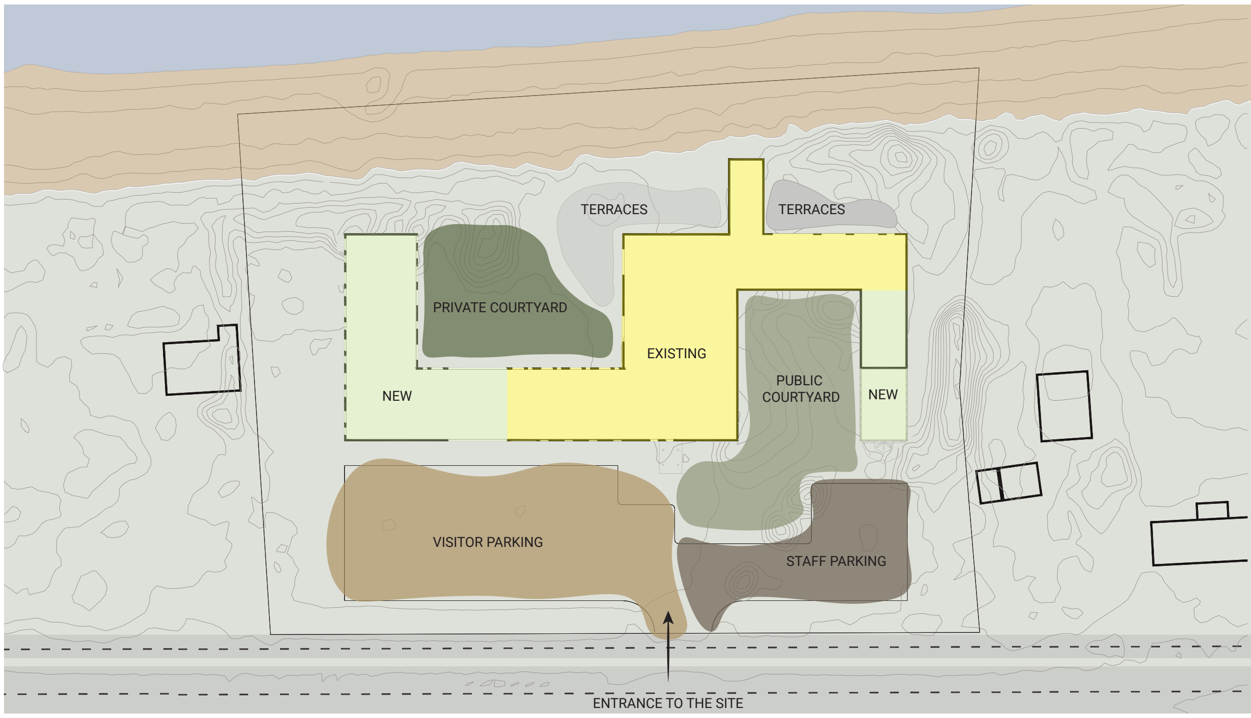


Fig. 117: Site strategies

Layout Strategies

The Functional Distribution

After having established the overall volumetric organization on the site, different functional layouts are suggested and analysed. This process takes its point of departure from the existing plan provided by the Municipality (Samsø Kommune, 1993).

The interior functions are divided following the longitudinal expression of the building (Fig. 118). The core of the building is where the concrete is mixed (Blandmaskine), and heavy machineries and products are stored (Fig. 119). The “Kontor” rooms are the offices, while the “lager” spaces are mainly used as a storage.

As a general input to the new design distribution, building a basement is not recommended, due to the problematic resistance of the soil (p. 24). Therefore, all the public functions are placed on the ground floor, in order to be easily accessible from both the local community and the Hotel's guests.

The Hall and Spa in in the main Core

From an accessibility point of view, the main hall should connect all the functions of the hotel (Fig 120). Therefore, the main core should be the space dedicated to the main hall.

As one of the main focuses of the project is to create spaces for the culinary experience (p. 65), here the restaurant area is predominant and has its own wing and the best view towards the sea (Fig. 121). On the contrary, the Spa area is minimized to the limit in order for all the public areas to be accessible on the ground level.

This clear division gives the opportunity to the restaurant guests (both locals and visitors) to enjoy the experience without being in direct relation to the Hotel more chaotic flows.

Although very functional from an accessible point of view, this interior distribution would not relate to the original longitudinal organization of spaces (Fig. 118), where the main core is now splitted, breaking the interior trusses spread.

Thus, the first distribution concept is limiting the spatial feeling of openness of the garage and Fabrikshal.

The Restaurant in the main Core

The second functional option relates to the longitudinal placement of the existing plan.

The main concept is based on the re-interpretation of the factory's different spaces, from the concrete production to the new food production.

The main core of the fabric is the active area associated to the concrete production and therefore becomes the new Hotel's restaurant area where the food is produced (Fig. 122).

The storages wings of the fabric are instead the quiet areas where the concrete is stored, and become the new Hotel's areas for sleep and relax.

The main entrance is kept where the original one is (Fig. 123), and therefore the only original and untouched volume through history (p. 16) becomes the Hotel hall.

The Spa is here placed on the right wing of the Hotel, and has to be accessed from the outdoor public courtyard.

Although its discconection from the main hall, this displacement gives the opportunity to distinguish two main experiences for the guests: one related to the Spa, the other one related to gastronomy.

Concluding Remarks

Although the first distribution provides an easier accessibility to all the functions of the project, the second one is more related to the existing factory's qualities and therefore to the authors main design goal (p. 63).

The intrinsic space functionality is here transformed and declined from a concrete production perspective, to the food production and leisure one. The restaurant area becomes the functional and volumetric focal point of the project.

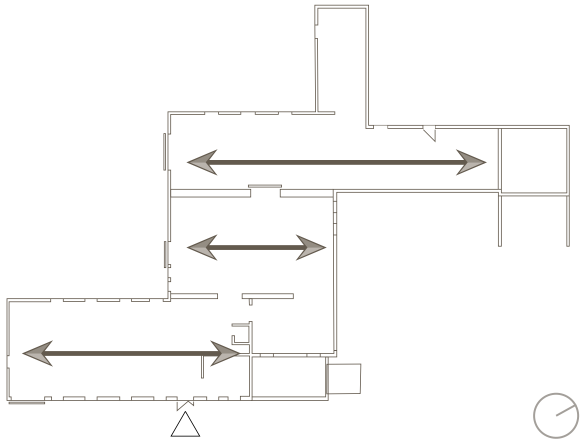


Fig. 118: Garage interior picture

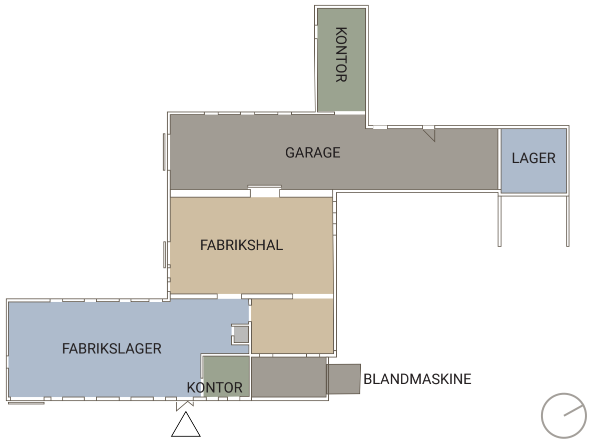


Fig. 119: Existing functional diagram

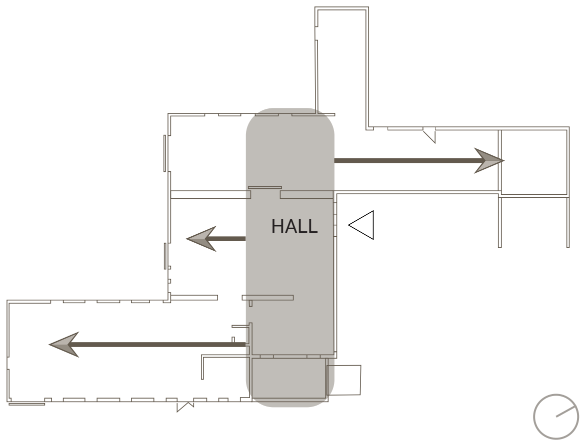


Fig. 120: Concept, first distribution option

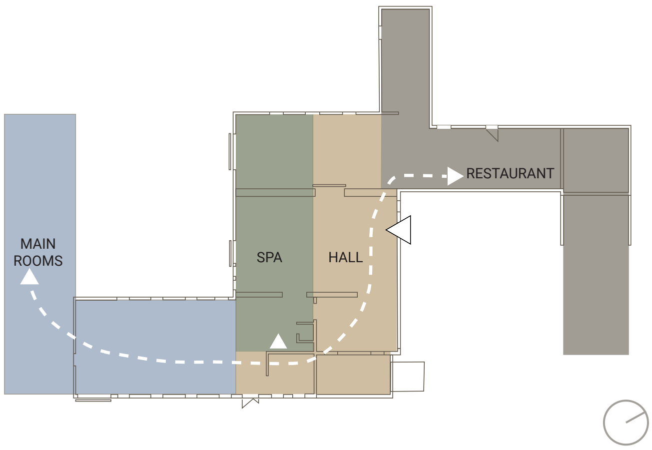


Fig. 121: First distribution option

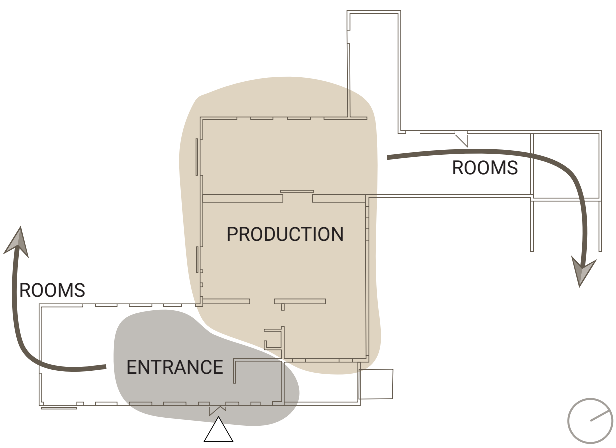


Fig. 122: Concept, second distribution option

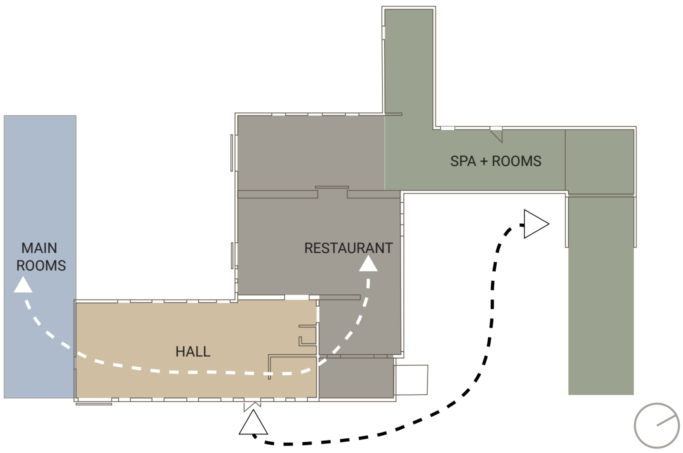


Fig. 123: Second distribution option

Shape Strategies

The Linear Shape

Introduction

This chapter focuses on the collection of studies and proposals for the overall shape of the new Hotel. At this point of the process, both the functional options previously analysed (p. 70) are taken into consideration. Both 2D drawings and 3D visualizations are created in order to have a better understanding of the spatial qualities and features of the new Badehotel.

A Linear Approach

This first concept is mainly based on the landscape's longitudinal expression and the building's history of addition (pp. 16, 29).
The footprint of the existing building is preserved, and a new floor is added to the fabric for the new Hotel's rooms (Fig. 125). Two new wings are added to the existing (p. 69), both of them following the direction of the existing buildings' roofs (Fig. 124).

The double height rooms in front of the existing Silo pop out from the general shape of the building, enforcing the divergent character of this part of the building throughout history (Fig. 125).
All the public functions are placed on the ground floor and detailed according to the previous analysis (p. 71). A glazed hall works as a filter between the existing main volume and the new Badehotel's rooms (Fig. 126).

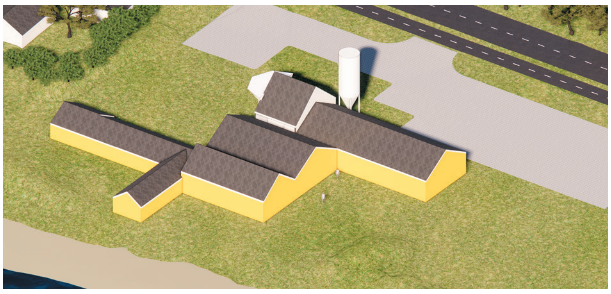


Fig. 124: SW axonometry view, Existing Factory

Fig. 125: SW axonometry view, Linear Shape Proposal

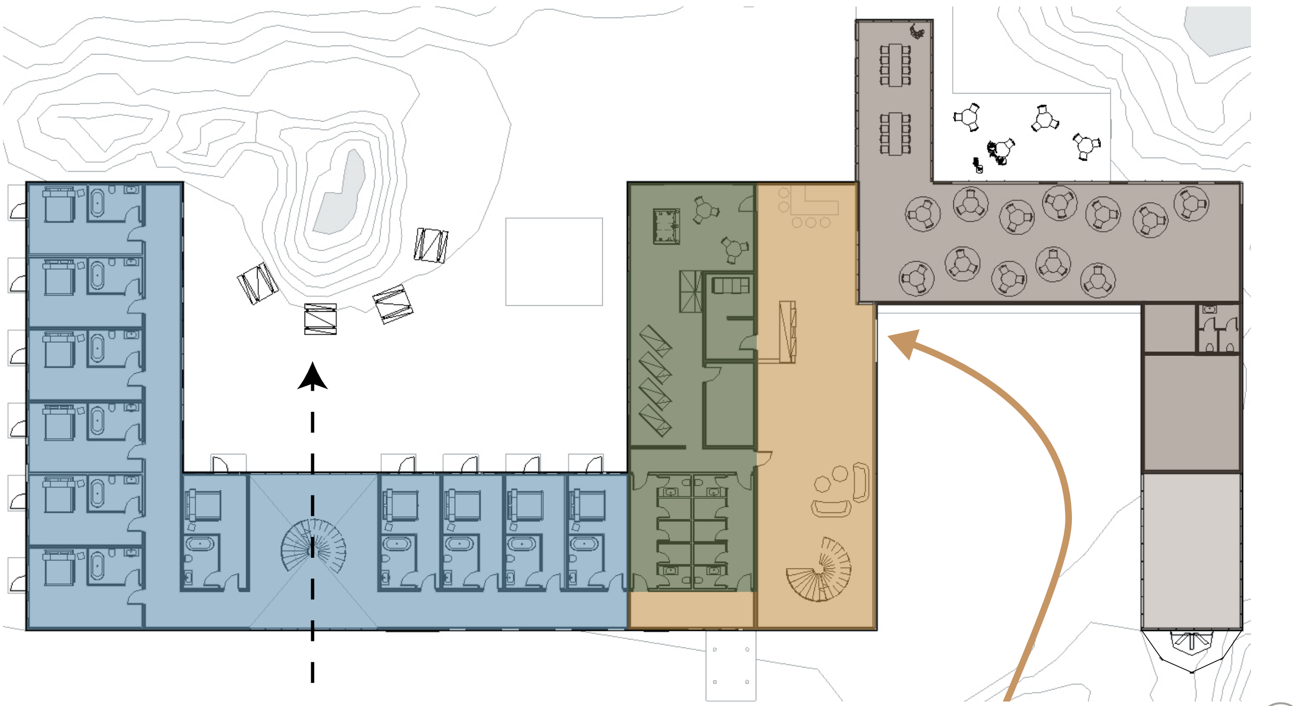


Fig. 126: Plan distribution, ground floor

The Restaurant

In this solution, the restaurant is placed on the right wing of the building (Fig. 126). Therefore, it is easily accessed from the outdoor courtyard and main hall by both the Hotel guests and local visitors. The interior of the main dining room combines concrete and wood elements. The wooden trusses of the existing fabric are preserved or, if in critical conditions, are replaced with new ones using the recycled wood. To keep the identity of the original cement fabric, concrete is used for both walls and floor finishing (Fig. 127). Hence, wood and concrete combine harmoniously while preserving the industrial essence of the existing building (p. 48). Moreover, the transversal existing appendix of the building is kept for special dining events.
Its relation to the sea and the natural landscape is emphasized by a fully glazed envelope. Its transparency allows people to feel more connected with nature and enjoy the sunset (Fig. 128).

Concluding Remarks

This solution's main "limitation" is that the Spa and main hall areas are not following the longitudinal expression of the existing fabric. Therefore, a new solution where all the spaces are equally combined must be analysed. Moreover, the historical continuity of the existing cement factory's main volume (p.) would be here disrupted (Fig. 125). The 3D interior explorations below show the intent of keeping the existing wooden trusses and the aim of provide transparency towards the sea.

Fig. 127: Main Dining Room

Fig. 128: Special Dining Room

The Curved Shape

A Re-interpretation of the Vikings' Architecture

Samsø is considered an important touristic stop in Denmark for the Vikings' archeological remains (pp. 12, 20).
In order to relate to the Viking's architectural identity and particularly to their settlement fortifications (p. 50), the traditional circular geometric shape is introduced in the design of the new Badehotel rooms wing (Fig. 130). The new parts of the building are also clearly distinguished from the linear expression of the existing factory, emphasizing the contrast between old and new.
This important separation is enforced by a glass and wood space, which acts as a filter with the old building while connecting the two new floors of the Hotel's rooms (Fig. 131).

The Spa

The existing appendix of the building (Fig. 129) seems the perfect placement of the main pool, especially for its deep relation to the sea.The volume is glazed and openable during summer, and the pool can therefore merge completely with nature. Here guests can enjoy the sunset both during summer and winter, feeling the deep connection between the outdoor cold water of the sea and the warm water of the interior pool (Fig. 133). The Spa volume is completed with 5 duplex rooms, which are mainly designed for the guests interested on an experience more oriented to relaxation and leisure (Fig. 130). In this way, the Hotel will address the different users' needs (p. 38).

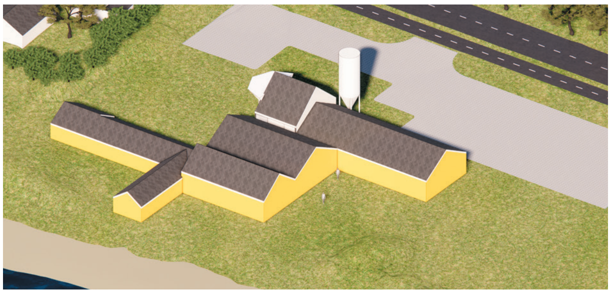


Fig. 129: SW axonometry view, existing

Fig. 130: SW axonometry view

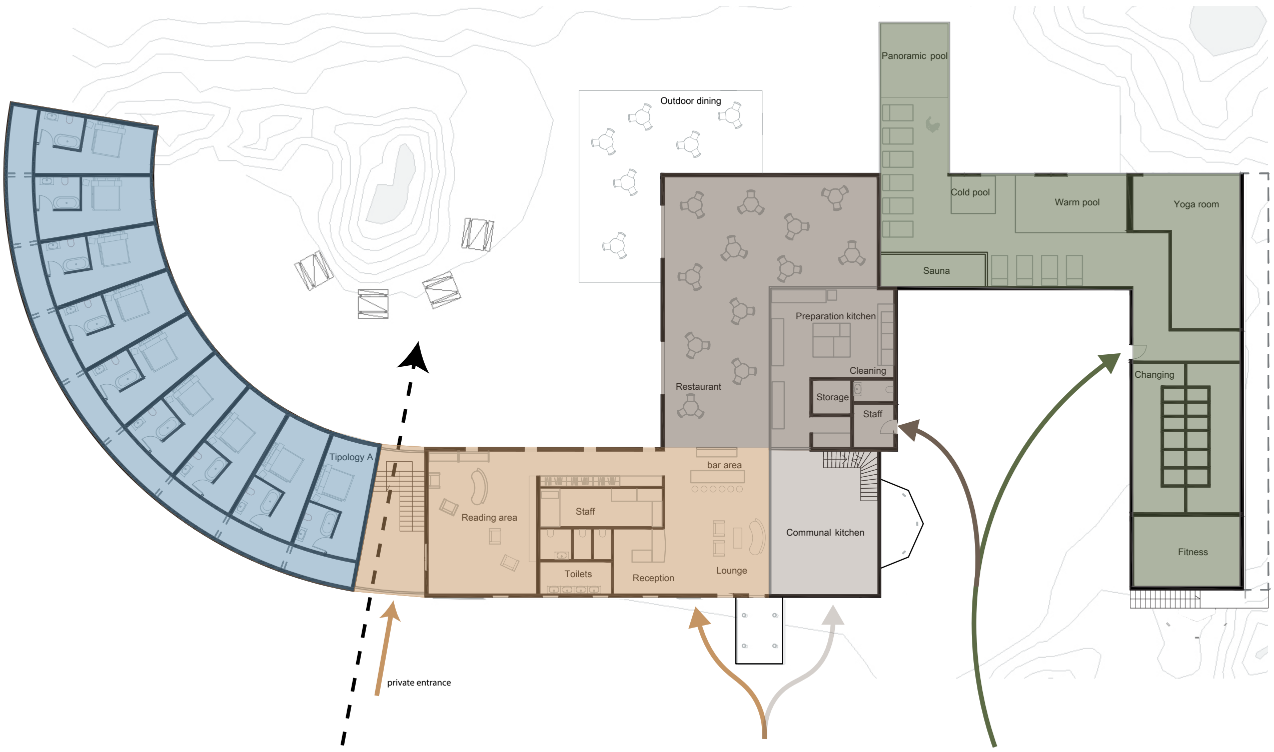


Fig. 131: Plan distribution, ground floor

The Communal Kitchen

The driven concept of the design is the functional transformation from the original production of cement to the new production of food. Therefore, the main core of the building is now occupied by spaces dedicated to the culinary experience (Fig. 132).
In the existing building, the main focal point is where the concrete mixer and silo are placed, and therefore the volumetric expression of this space differs from the rest of the building (Fig. 129). As the new Hotel's thematic focus is the culinary experience, this specific space's function is re-vitalized (p. 48) and becomes the space for the communal kitchen.

The space is designed as a greenhouse, where vegetables are farmed and harvested and then directly cooked and tasted in the common kitchen both by locals and visitors (Fig. 132). The existing concrete mixer and the Silo could be used to store soil and water, to enforce the passage from an industrial production to an agricultural and culinary production.

Concluding Remarks

The interior functional placement of this solution is using the previous main production spaces in a new way, and therefore is considered to be the one to develop in the design.

Fig. 132: Communal Kitchen

Fig. 133: Spa's main pool

The Midway Critique

Introduction

On the 4th of April, we had the opportunity to show our design proposals to our collegues, an external guest (Lars Juel Thiis, Partner CUBO Arkitekter), our main supervisor (Luis Santos), and to Tenna Doktor Olsen Tvedebrink (Professor, AAU).

The Outcomes from the Meeting

While the site strategies (p. 71) were well accepted, the main critical points have been found in the curved shape geometry and the height of the Hotel rooms' new wing (Fig. 134 - 135).

As Professor Tvedebrink comes from Samsø, her opinion has been particularly fruitful to have an insight of the importancy of the fabric in the collective imaginarium and the culture of the site. In her perspective as a local, The curved shape and scale of the project are too radical for the context.

Therefore, they have all agreed that in order to keep the identity of the site, it is important that the original fabric and specifically the entry volume remain untouched.

To achieve this, the height of the building should be lowered and should blend with the longitudinal expression of both the existing factory and the landscape.

Concluding Remarks

Both the general site strategies and the placement of the restaurant in the middle of the building have been considered as successful choices, therefore the process will now focus on the southern wing of the building. The number of rooms from the initial room program (p. 65) is slightly reduced to 18, giving the possibility to reduce the volumetric expression of the new rooms' wings within the program range.

Fig. 134: Linear Shape Concept, South Facade

Fig. 135: Curved Shape Proposal, South Facade

The Detached Shape

Placement and Orientation

After the Midway critiques' outputs, the design strategies for the southern wing of the building have changed. The idea of designing the Hotel's new rooms as detached houses proved to be coherent as well with the Municipality local plan (p. 19, *KortSamsoe*), where the areas for summerhouses and small detached houses are the only one that can be planned in close proximity to the seashore.

Different studies have been made in order to understand the best placement and architectural features of the detached rooms.
The main design aspects used in these studies were the orientation, the sloping roof expression, and the connection between the existing and the new units (Fig. 136 - 139).

The latter topic has been highly investigated, trying to find lines, modules and rules in the existing fabric plan to use for the placement and dimensioning of the detached units (Fig. 140 - 141).

Concluding Remarks

The new detached rooms are placed and dimensioned following the guidelines on which the existing building plan is based on (Fig. 140). Hence, the units re-interprate the existing, and blend into the landscape thanks to their minimized dimensions and heights. Further investigations will inform the design about the spatial quality and perception of the new wing.

Fig. 136: Axonometric view, detached units

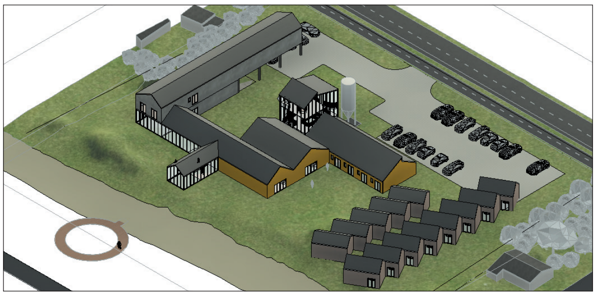


Fig. 137: View from the shore, 30 degree units

Fig. 138: Axonometric view, units under one roof

Fig. 139: View from the shore, displaced units

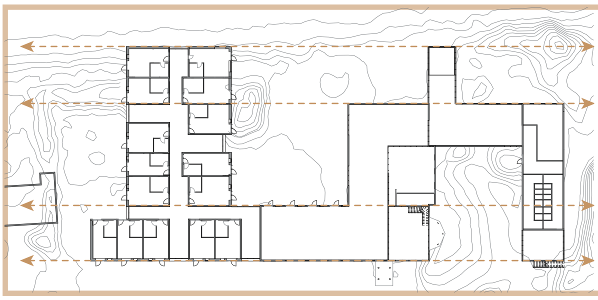


Fig. 140: Concept, detached rooms placement

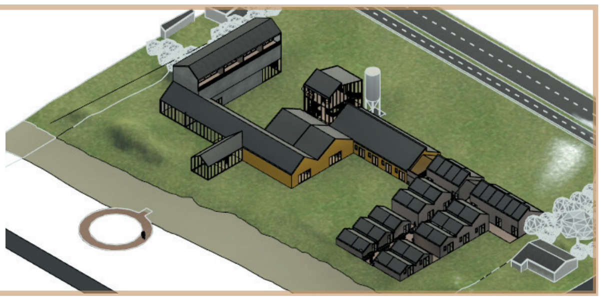


Fig. 141: View from the shore, final option

Compact or Detached Shape?

As the rooms' distribution of the detached shape is decided (p. 79, Fig. 141), the accessibility and features of their connection were taken into account. From a comfort point of view, the ideal solution would be to connect the detached room with a covered hallway (Fig. 142). This design strategy would limit the wall sections of those facing the hallway (useful in regards to LCA and material considerations), while protecting the guests from the wind and rain extreme conditions during winter.

However, a transparent covered hallway would require a great quantity of glass and steel. According to the Construction Material Pyramid *(materialepyramiden)* which lists materials according to their CO_2, glass is classified as one of the most impact materials. Moreover, its high weight, fragility and need of maintainance made the authors realise that the benefits would be less than the disadvantages.

Concluding Remarks

As previously mentioned, guests coming to a BadeHotel are usually interested in feeling at one with nature (p. 30).
Hence, the final solution is a detached shape, where the connecting path between the detached rooms is completely open.
In order for the hallway to be more dynamic, the adjacent rooms are displaced (Fig. 143 -145).

Fig. 142: Covered hallway, compact concept

Fig. 144: Linear facades, detached concept

Fig. 143: Open hallway, detached concept

Fig. 145: Dispaced facades, detached concept

The Sloping Roof

The new detached rooms' roof is following the orientation and lines of the existing building.
Each room is considered as an indipendent typo and therefore has its own sloping roof.
The closer the unit is to the shore, the lower its height.
If at the beginning both the wall and slope of the roof were decreasing (Fig. 146), more tests made it clear that the same result could be achieved only decreasing the slope of the roof (Fig. 147). This solution would prevent the rooms closer to the seashore to have too low ceilings, compromising the interior space of the room.

Concluding Remarks

The roofs of the new detached rooms become a re-interpretation of the existing building's roof.
In order to blend the detached units into the natural landscape, the roofs' slope is decreasing towards the sea.
In order to make the concept work both aesthetically and functionally, the height of the walls is fixed, while the roof slope is decreasing the more the rooms get closer to the seashore.
As previously mentioned, the distribution of the rooms and the roof shape follows the features of the existing building (p. 77, Fig.140)

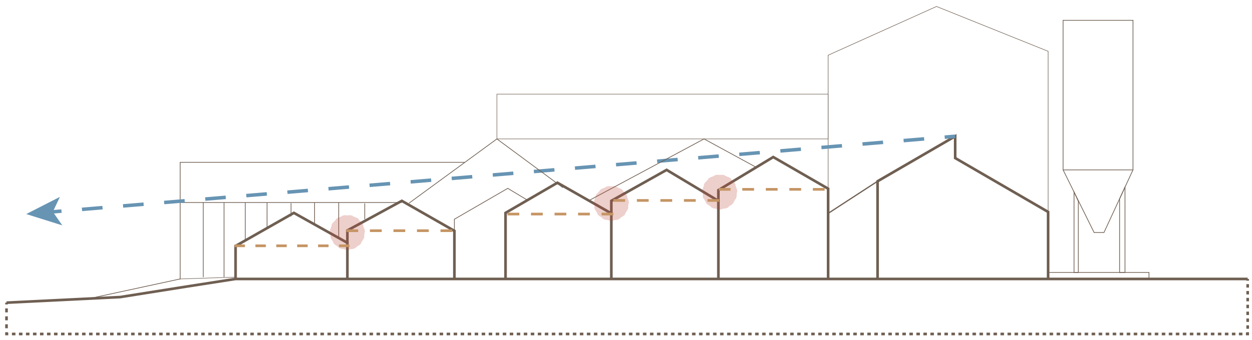


Fig. 146: Detached Rooms Nodes, South Facade

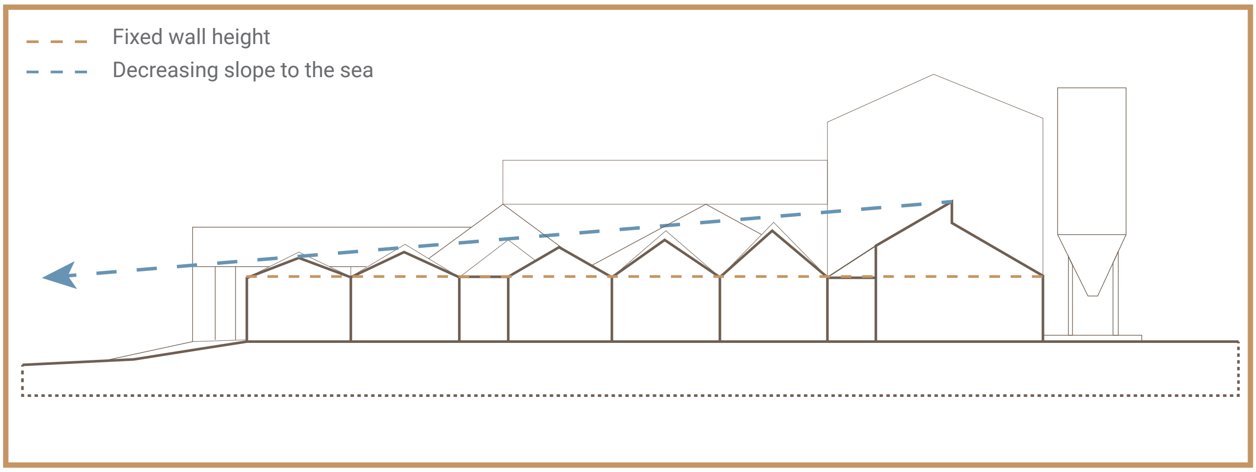


Fig. 147: Decreasing the roof's slope, South Facade

Synthesis

Life Cycle Assessment Analyses (LCA)

Introduction
Life Cycle Assessment (LCA) evaluates the energy requirements and emissions produced by a material during its production phase, use phase, operational phase and demolition and disposal or recycling phase. In this design process over LCA, a software tool LCAByg, developed by the Danish Building Research Institute, have been used.
Several investigations have been tested out in LCAbyg, for each building element. This gives a determined emission of the building elements in order to understand which materials would be the most sustainable to use.

Windows
A comparison have been tested out in LCAbyg between an aluminum framed window with 3-layered glazing and aluminum/wood framed window with 3-layered glazing. A window with wood frames only have not been included in this investigation, especially because the site itself is placed near the seashore, which climate would damage the wooden frames. As shown in Fig. 148, the total Global Warming Potential value (GWP) is lower with an aluminum/Wood window, rather than with an aluminum window. Moreover, the latter has a higher GWP value in the production stage (A1-3). On the other hand, the aluminum/wood window has a higher GWP in the Waste processing stage (C3). However, the replacement stage (B4) is the same for both of them, since the joints need to be replaced after 25 years.

Insulations
The U-value has been set on a constant of 0,1 W/(m²K), but the thickness of the insulation will vary according to what type of insulation it is. Fig.149 shows that the insulation with the lowest GWP is the straw type, but the thickness of it would be around 480 mm. Whereas the wood fibre insulation would have the highest GWP impact in the waste processing stage (C3). Moreover, the thickness of the wood fibre insulation would be lower (375mm).

Walls
The U-value has been set on a constant of 0,119 W/(m²K). With this u-value the walls convey to the Building Regulation. *(Bygningsreglementet)*
The insulation used in these investigations is the wood fibre type, which explains the high GWP value in the Waste processing stage (C3). The investigation has been done for concrete, timber, zink and reed. These materials have been investigated especially because they suit the site's context and the existing building being a cement factory back in the days.
Fig.150 shows that the wall with the least GWP impact is the reed wall and after that, it is the timber wall.

Roofs
The u-value has been set to a constant of 0,089 W/(m²K), according to the new building standard regulation (heated to a minimum 15 °C). The insulation for these investigations is the wood fibre type, exept for the Roof type 2, where the insulation is mineral wool.
In the Fig.151, it can be seen that the Roof type 2 is has a higher GWP impact, whereas the slate roof has the lowest. The Roof type 1, the Fibre Cement Roof, the Zink Roof and the Slate Roof have the same construction layers, but the outer roof finishing is different.

Terrain Decks
The U-value is set to 0,080 W/(m²K). From the fig.152, the terrain deck with timber finishing has the highest GWP impact, and since it has not wood fibre insulation as insulation apart from EPS insulation, there is a high value on the waste processing stage as well (C3).

Concluding Remarks
In these LCA investigations on LCAbyg, a standard value of 10% has been set on the construction-installation process (A5). Besides this, in the transport stage, one part of the distance will be by both lorry and then by container ship.The LCA investigation has given a good understanding of the stages in the life cycle assessment for materials. Working on LCA at the same time with energy calculations has been crucial in order to make decisions.

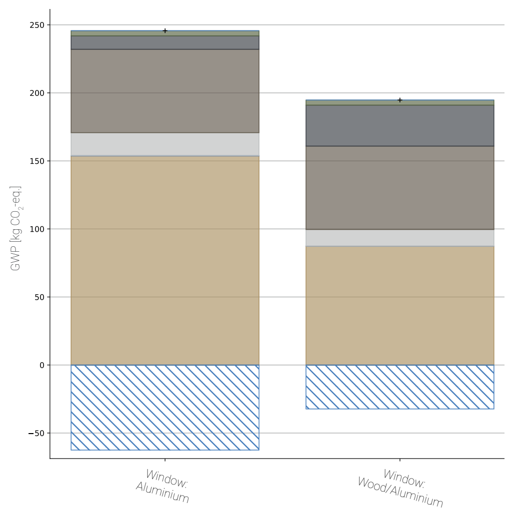


Fig. 148: Window analysis

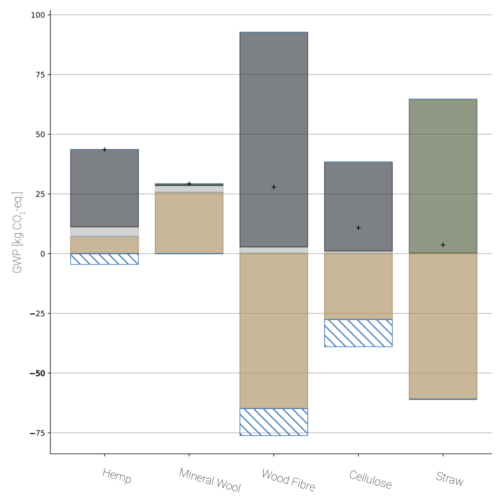


Fig. 149: Insulation analysis

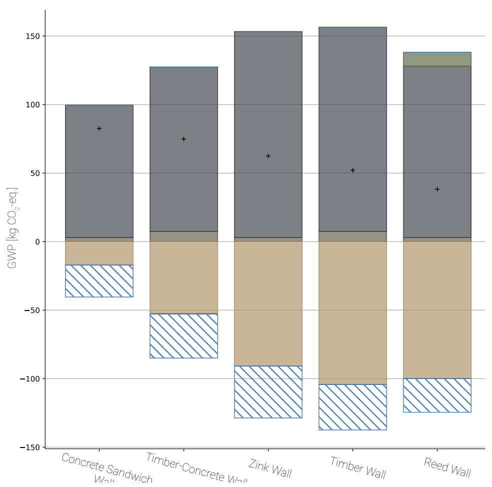


Fig. 150: Wall analysis

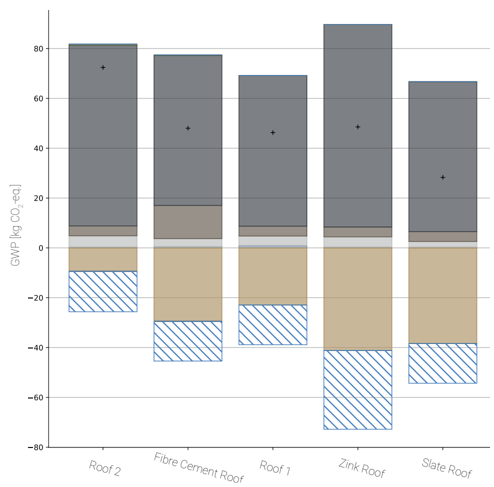


Fig. 151: Roof analysis

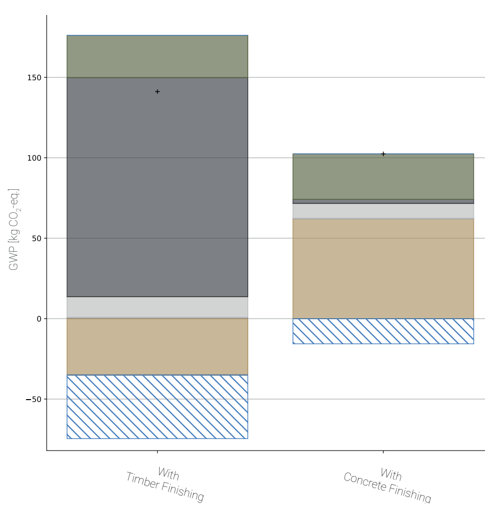
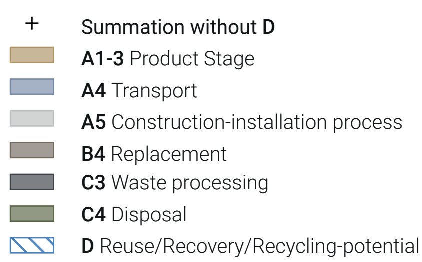


Fig. 152: Deck analysis



Energy and Indoor Comfort

Construction Type Building Performance

While creating integrated design it is important to pay attention on how different components would influence the building performance.
While investigating LCA analyses, it is possible to see how much CO_2 a building would consume in its construction and life-time period materialwise. However, it might happen that the best used elements according to the LCA would require greater energy consumption.
Hence, the whole CO_2 consumption would be greater and would not provide best indoor comfort for users.
Therefore, energy simulations were conducted simultaneously with the LCA analyses.

As the existing building would be renovated by adding extra insulation and internal cladding, there was a great attention in investigating the newly created buildings.
Figure 153 shows building parts, where energy and comfort analyses were performed on.

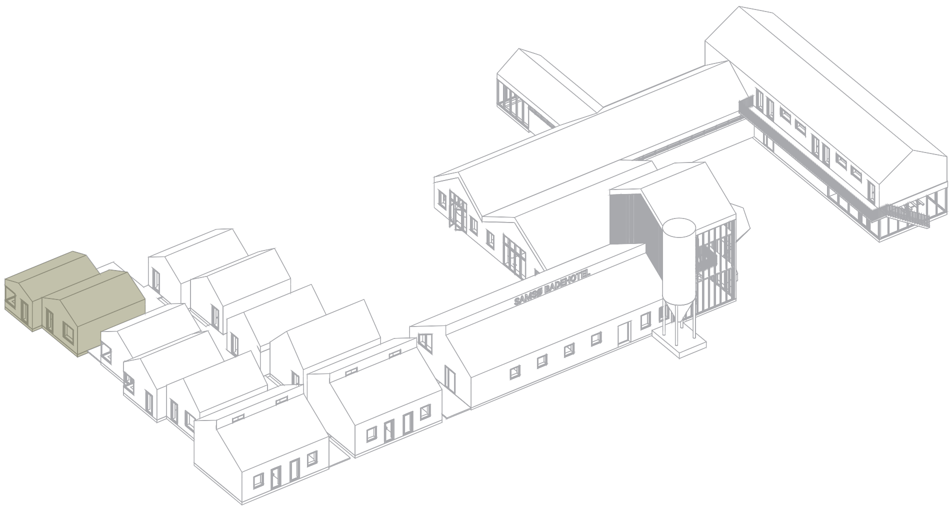


Fig. 153: Analysed building parts - detached units

BSim Analyses

Building energy and comfort analyses were performed using BSim.
To best highlight how different construction techniques influence the upper mentioned factors, temperatures inside the building and total energy usages have been investigated.
In this analyses the main envelope constructions - externall walls, roof, and terrain deck - have been investigated.

In the example shown in Figure 149, concrete sandwich walls and timber construction walls were compared, as these are the construction elements with largest areas, and therefore they would influence building performance the most.

From Figure 154, it is possible to conclude that concrete walls are keeping the heat much better comparing to timber construction walls. Therefore in this case the temperatures inside the building are more consistent through out the year, and improving indoor comfort.

When comparing energy usages, it is possible to see that more energy is used for heating using concrete walls. This is due to fact that the material density is larger.
On the contrary, energy usage for ventilation while using concrete lements is greatly reduced. This is also due to fact, that it takes more time to heat up the thermal mass.

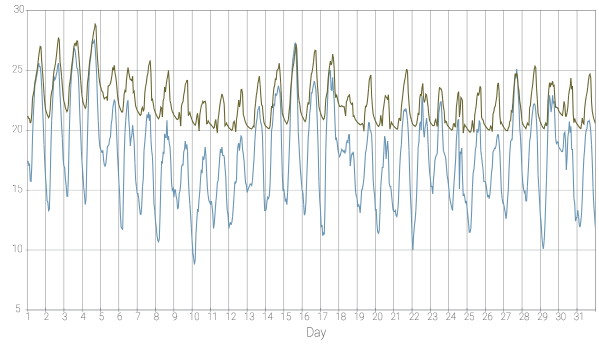
Concrete Sandwich Walls

Month	Sum/Mean
qHeating	**13.3 kWh**
qInfiltration	-72.2 kWh
qVenting	-110.9 kWh
qSunRad	1292.5 kWh
qPeople	438.0 kWh
qTransmission	**-1532.0 kWh**
qVentilation	**-19.1 kWh**
Hours > 21 °C	2126.0
Hours > 27 °C	**12.0**
Hours > 28 °C	3.0
FloorHeat	8.9 kWh

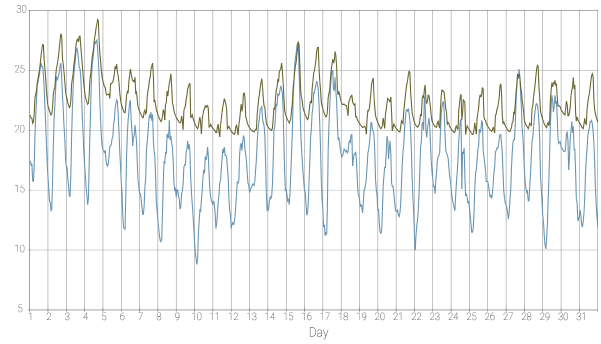
Timber Construction Walls

Month	Sum/Mean
qHeating	**12.8 kWh**
qInfiltration	-72.8 kWh
qVenting	-110.7 kWh
qSunRad	1292.5 kWh
qPeople	438.0 kWh
qTransmission	**-1477.8 kWh**
qVentilation	**-72.1 kWh**
Hours > 21	2127.0
Hours > 27	**24.0**
Hours > 28	4.0
FloorHeat	8.5 kWh

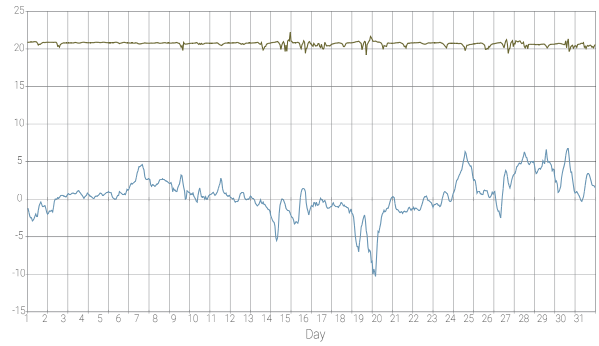
July



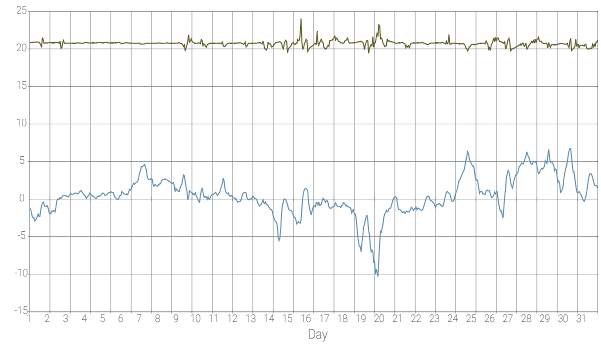
July



February



February



Inside Temperature°C
Outside Temperature°C

Fig. 154: Comparison between concrete sandwich elements and timber wall elements

LCA Combined with Energy Simulations

By investigating LCA and energy simulations simultaneously, it is possible to design a building in the most sustainable way. The most sustainable wall construction when only looking at LCA resulted to be the timber construction one. On the contrary, using concrete sandwich elements as walls allows to reduce the energy consumption, therefore also CO_2 levels are reduced.

Those investigations helped to chose the right construction techniques and allowed some flexibility in the design. Therefore, for the envelope there will be used both the timber construction and concrete sandwich element walls.
The double height building looking towards the inland will be built in concrete elements, while the detached units looking toward more natural environment will be using timber walls.

Daylight

Introduction
Sufficient daylight is important for the users well being, however too much sunlight can make users feel uncomfortable.
The sun's angle in Nordic context is changing drastically, and therefore daylight simulations were done, in order to highlight problematic areas of the building, and further develop the project for best daylight conditions.
The building's placement itself, where the best view is towards the west, creates problems with the direct sunlight in the evening.
The analyses further helps to investigate how design should be developed, in order to achieve enough daylight in the different building parts at different times of the day, taking into consideration their usage.

Detached Units
In the Hotel rooms people are expected to be located mostly in the morning and later in the evening, when they return back from various day activities that Samsø is offering. Therefore, there have been looked at those specific time frames.

From the analyses it can be concluded that the most problematic element is the evening sun from 17:00 to 23:00. The most western units are getting uncomfortable direct evening sun, therefore light illumination is exceeding 3000 lux, which is described as overilluminating. This creates discomfort for the hotel users.
In Figure 155, the darker blue areas are the ones where the sunlight is not excessive (<3000 lux) and the yellow ones are areas with excessive sunlight.

As the view for the project is very important, visitors will have the possibility to close light curtains, to avoid direct sunlight and create more calm environment, or leave them open, to enjoy the amazing view to the beach.

Restaurant
the restaurant is a place that offers great views and great food. Therefore, it is crucial to avoid uncomfortable daylight conditions which could compromise the experience.

As the restaurant is placed on the building's western side, it is receiving a lot of daylight in the evening hours. The brighter yellow spots on the Figure 156 are showcasing problematic areas, where illuminance is exceeding 3000 lux for over 40% in timeframe from the expected restaurants usage time from 08:00 to 22:00.

In order to provide better comfort for guests, solar shading must be added, while still providing the amazing views. The views and importance of the existing building's apearance are fundamental, and therefore the usage of internal solar shading has been chosen, which can be regulated manually and automatically (Fig. 158).

Kitchen
The kitchen is located in the niche, where the only possibility for daylight are northern windows. The placement of them is limited, due to different installations and functions.
The most problematic area is the centre of the kitchen, where room does not provide sufficient daylight for working properly in the space.
In the figure 157, the bluish spots are showcasing areas where the illuminance is not reaching 300 lux of the kitchen's expected working hours.
In order to provide the staff with the best daylight conditions in the kitchen area, a skylight or solar chimney should be designed. To provide the building with higher architectural value, the skylight have been chosen to let diffused daylight into the darker kitchen areas.

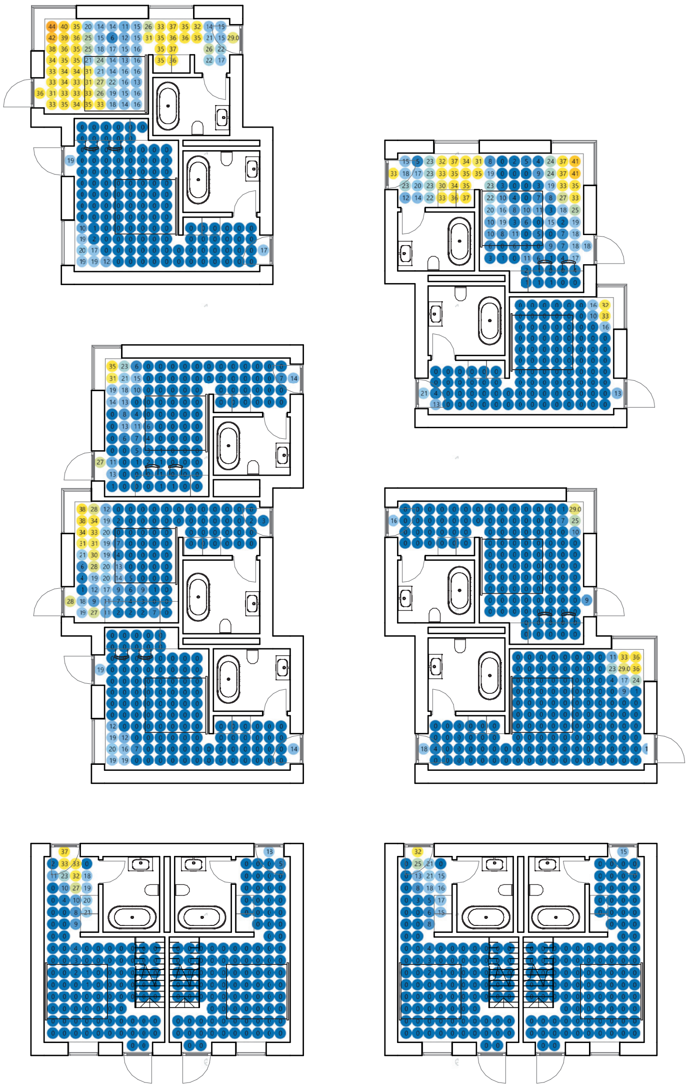


Fig. 155: Excessive daylight May to September (17:00-23.00)

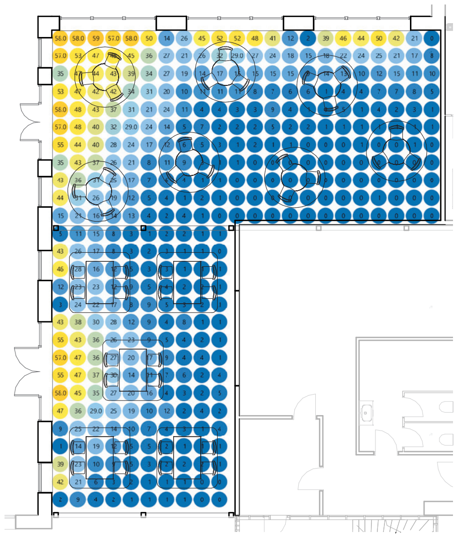


Fig. 156: Excessive daylight (08:00-22.00)

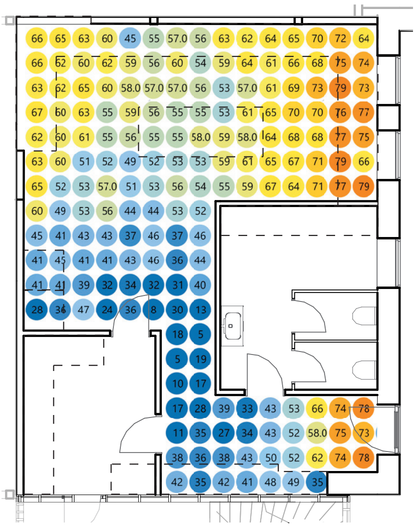


Fig. 157: Daylight availability (08:00-20.00)

Fig. 158: Solar shading

Presentation

The Presentation chapter presents the final drawings and renderings for a deep understanding of the new culinary Badehotel.
It includes site plans and strategies, plans, facades, sections and 3D visualizations to show the materiality and interior atmospheres on which the authors focused on. To have an overview of the technical aspects of the project, the chapter also includes the indoor environment simulations of the Hotel and restaurant area, the energy and LCA calculations and detailing drawings.

In the end, reflections and conclusions are summed up, where there are given considerations regarding the most challenging aspects of the project, and further investigations that could be done.

Samsø culinary Badehotel

Site Strategy

Samsø Culinary Badehotel is a Master thesis proposal for the re-vitalization of the existing cement factory in Havvenej 131.
The objective of the project is to preserve, while extending, the existing factory's footprint and volumetric features, and regenerating its functionality from an industrial production to a food production and leasure oriented one.

The new Hotel will consist of 18 rooms, a two dining room restaurant, a Spa and a greenhouse with communal kitchen.
The design is focusing on both human and environmental well-being, providing spaces for both visitors and locals, while using mostly natural and local produced materials to renovate the building.

The main actions performed on the existing building are the up-cycling of the existing materials, the replacement of the damaged roofs, and the addition of new volumes.
The latter follows the historical volumetric evolution of the factory, which has changed from a detached shape to a compact one throughout the years (Appendix 1).

The new wings define two courtyards, one opens to the sea - the visitor courtyard - and the other to the inland - the public community courtyard (Fig. 159 - 163).

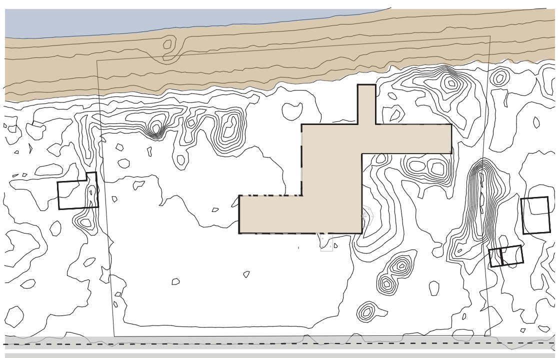


Fig. 159: The Existing Cement Factory

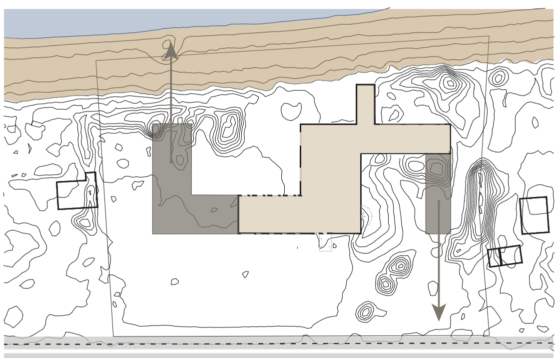


Fig. 160: Volumetric Additions

Fig. 161: Main entrance, New Culinary Badehotel

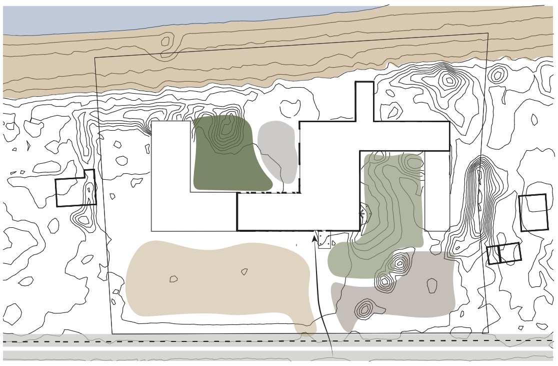


Fig. 162: Courtyards and Parking areas

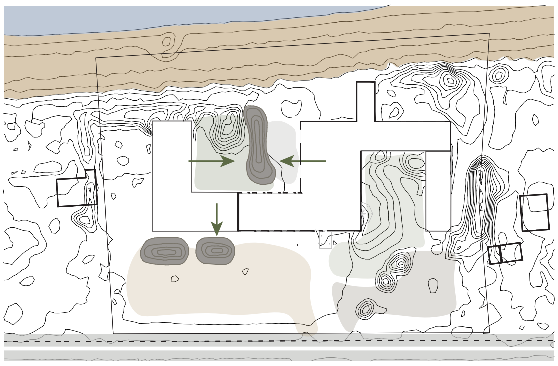


Fig. 163: Addition of dunes to protect views

Site Plan

The new Badehotel is placed in Havvejen 131. The site is a very strategic under a touristic point of view, due to its central location in the island and its proximity to important landmarks (e.g. Kanahavekanalen, Fig. 24).

The project site is defined by two main boundaries: the sea on the west, and the main access road to the east.

The new additional volumes create a double U shape building, which frames the outdoor space into courtyards while shielding the existing fabric from the neighbouring houses.

The outdoor space towards the inland invites people to the building, where both the existing Silo and concrete mixer are preserved and restored.
On the contrary, the outdoor space towards the sea frames a more natural courtyard, where different aromatic plants grow.
Here, a terrace is placed for people in the restaurant to fully enjoy the landscape while experiencing the culinary products of the island.

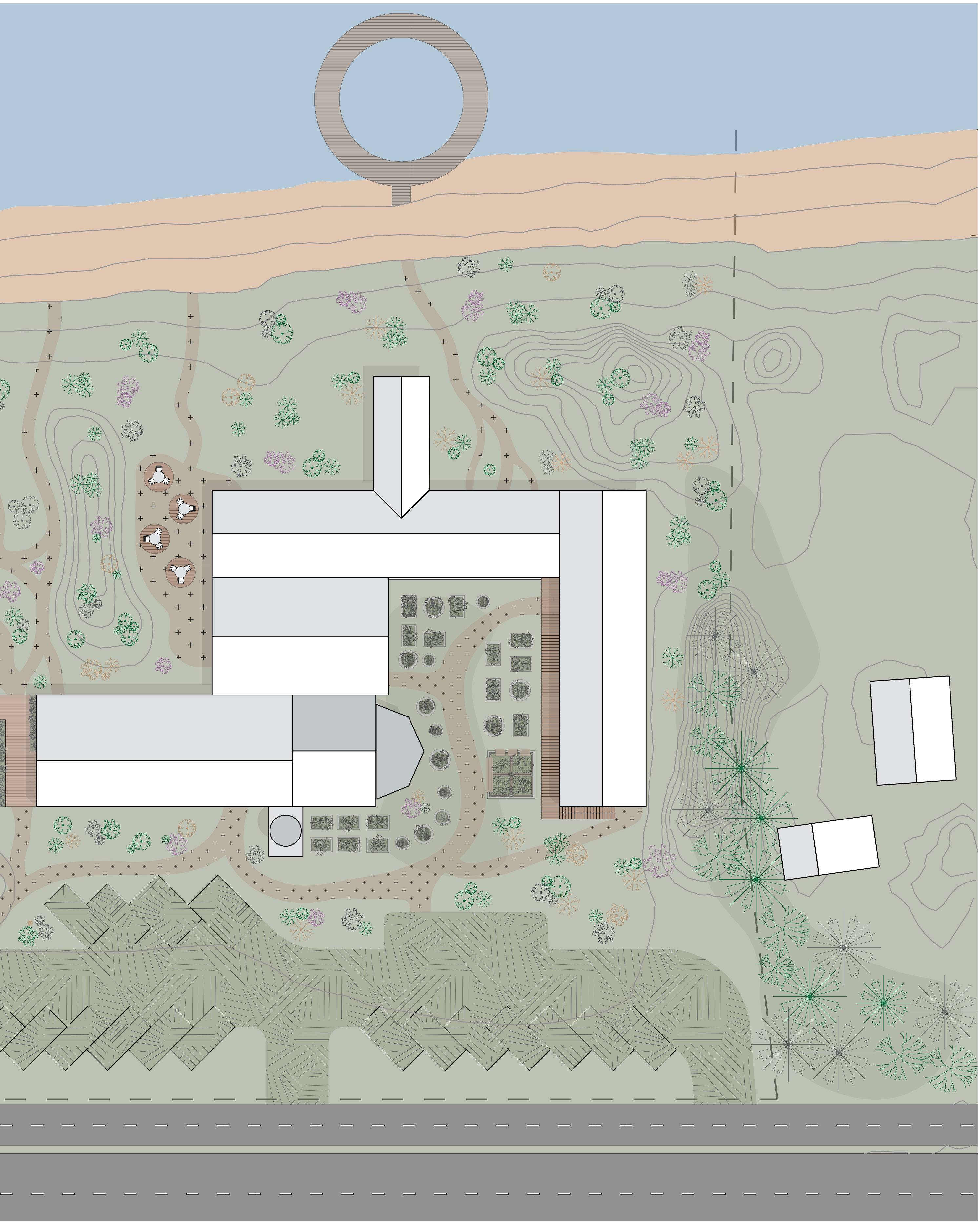
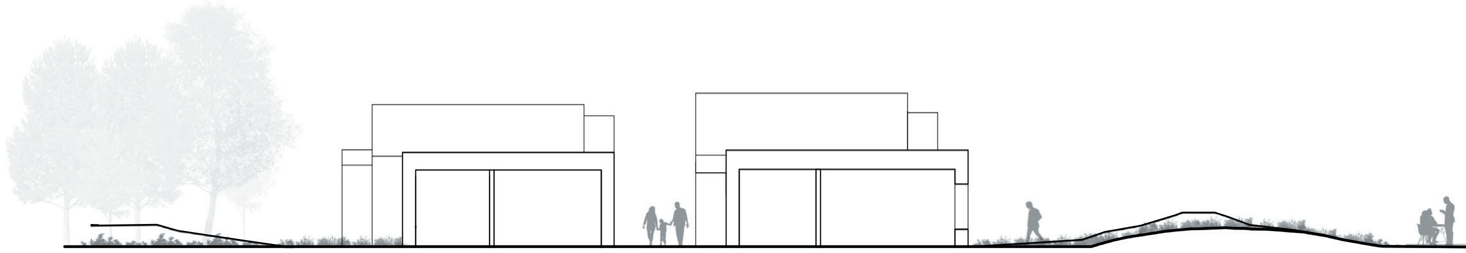


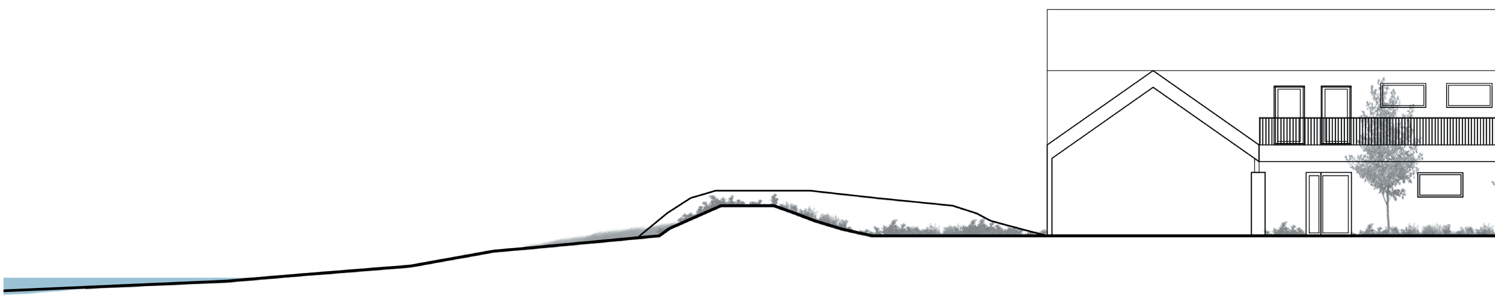
Fig. 164: Site Plan, 1:400

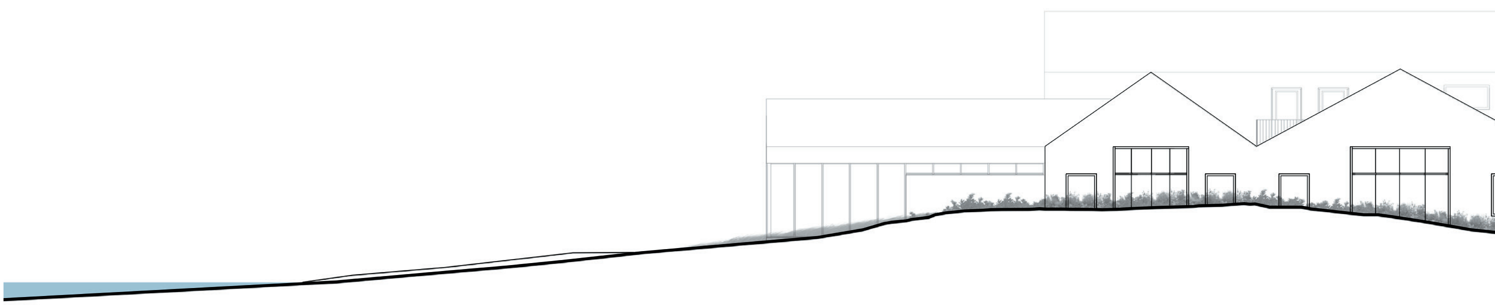
Site Sections

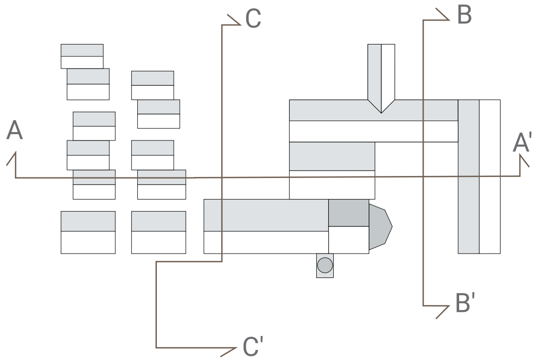
The original building' volumes are higher on the east while they get lower when approaching the seashore and nature. This approach is also used in the new volumes on the south, where the sloping roofs' angle decrease the more they get closer to the sea. This solution permits the new addition to blend better with its surroundings, following the longitudinal expression of both the landscape and the existing building. On the contrary, the east facade is higher, to make the building visible from the road and becoming a filter between the sea on the west and the road on the east.

The soil composition must be considered when building close to the shore.
The project site's soil is a mixture of sand and marine clay, with a high moisture content, and therefore it is considered to be highly unstable Therefore a pile foundation with concrete deck is the best option in order to stabilize the terrain, while keeping the same ground level between the existing volumes and the new ones.









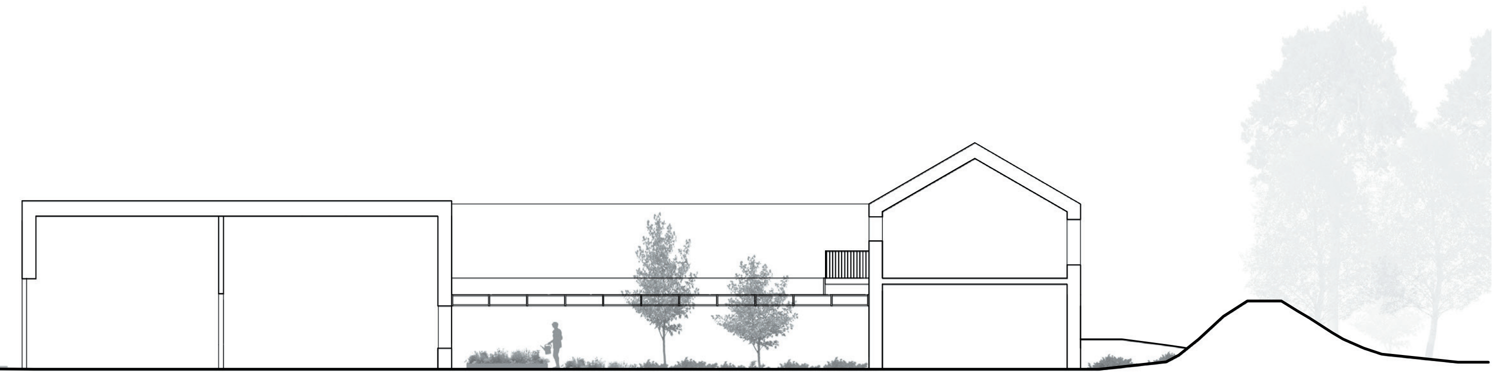


Fig. 167: Section AA', 1:250

Fig. 165: Section BB', 1:250

Fig. 166: Section CC', 1:250

Building Strategy

The main actions on the existing cement factory are the addition of two new volumes on the northern and southern side of the site, restoration of the existing Cement Factory's walls (Fig. 169).
All the volumes are therefore preserved, and the existing small appendix towards the sea acts as a wind shield for the designed courtyards (Fig. 168)

The main entrance of the existing cement factory keeps its function for the new Culinary Badehotel, where both locals and the Hotel's guests can enter the building (Fig. 170).
From this entrance all the necessary areas are easily accessed. The Silo acts as a filter between the main existing factory's volume and the communal kitchen.

The Spa area, the northern private rooms and the kitchen are all accessed from the courtyard towards the main road. (Fig. 172)

The mechanical systems are integrated in the design, providing a technical room in the main building for the lounge and reception areas, one in the kitchen for the culinary experience spaces, and one in the Spa for the northern wing volumes (Fig. 171).
The mechanical systems are also integrated in the detached rooms and placed in the gap in between every unit, above bathrooms (Fig. 172).

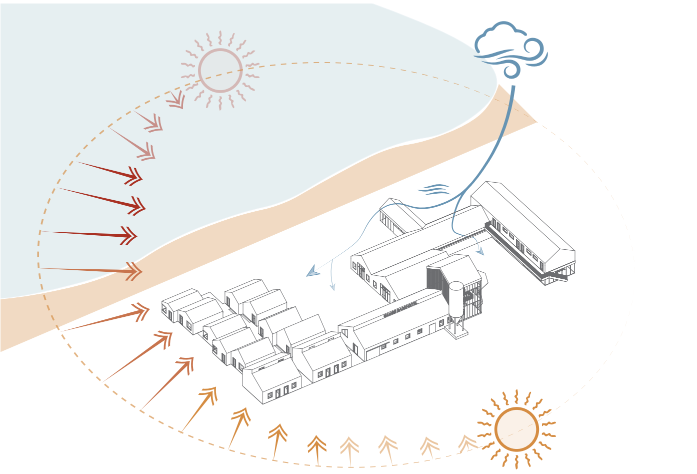


Fig. 168: Climatic conditions diagram

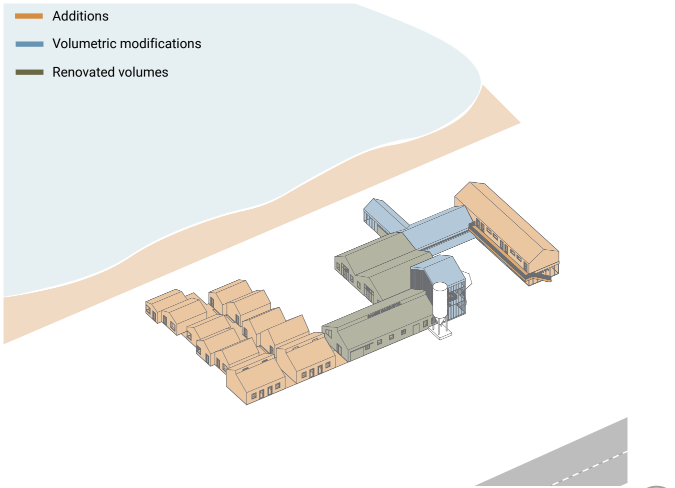


Fig. 169: Volumetric modifications diagram

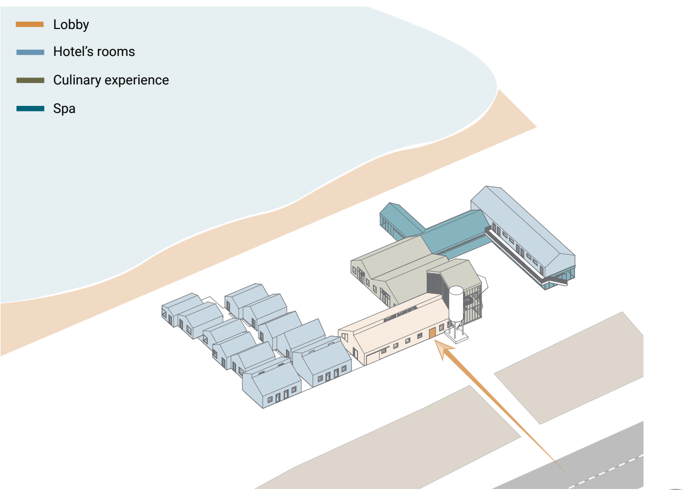


Fig. 170: Functional diagram

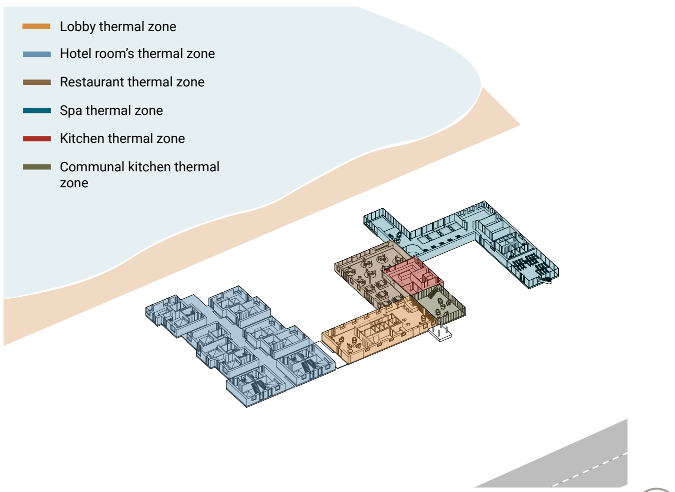


Fig. 171: Thermal zoning diagram

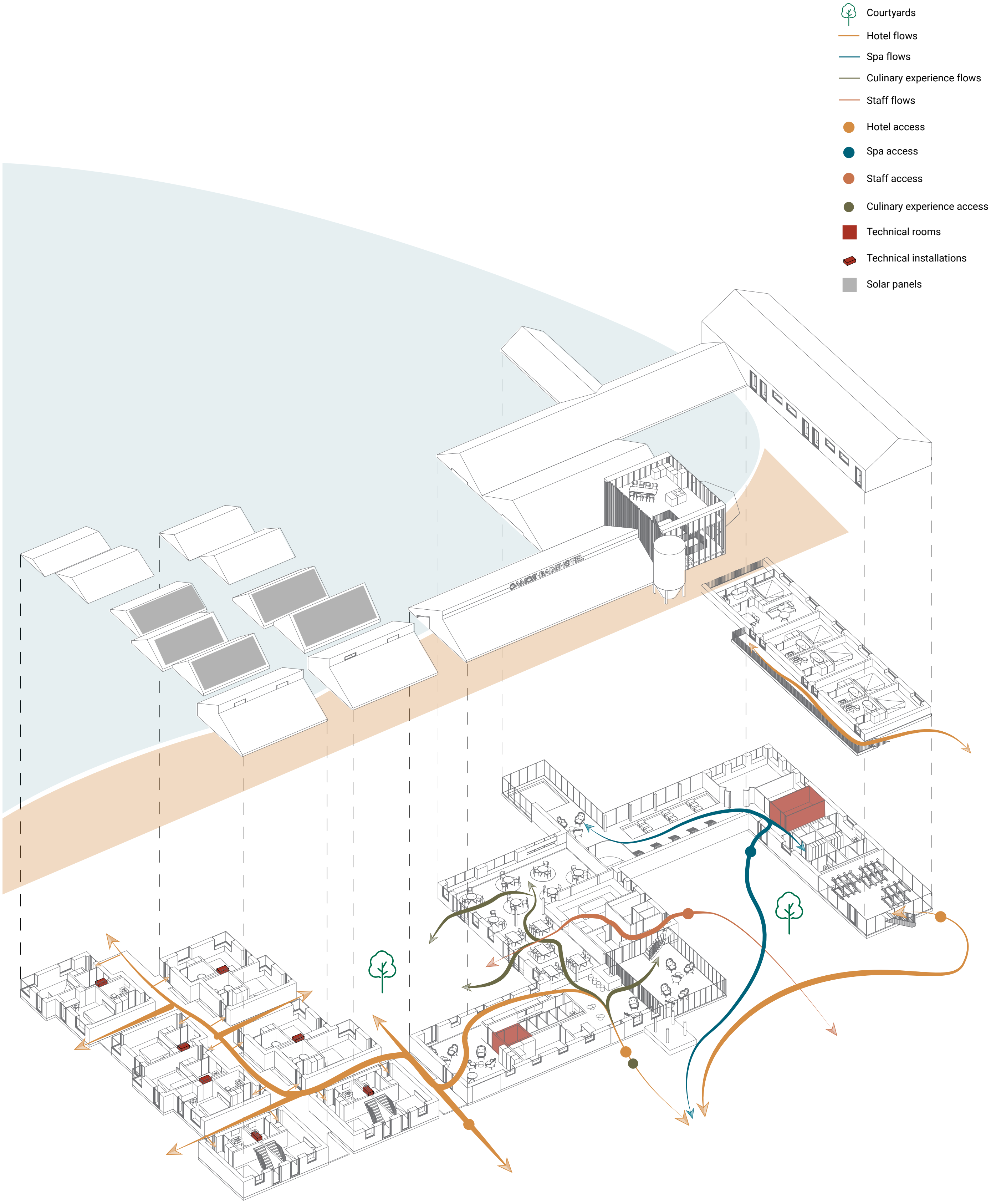
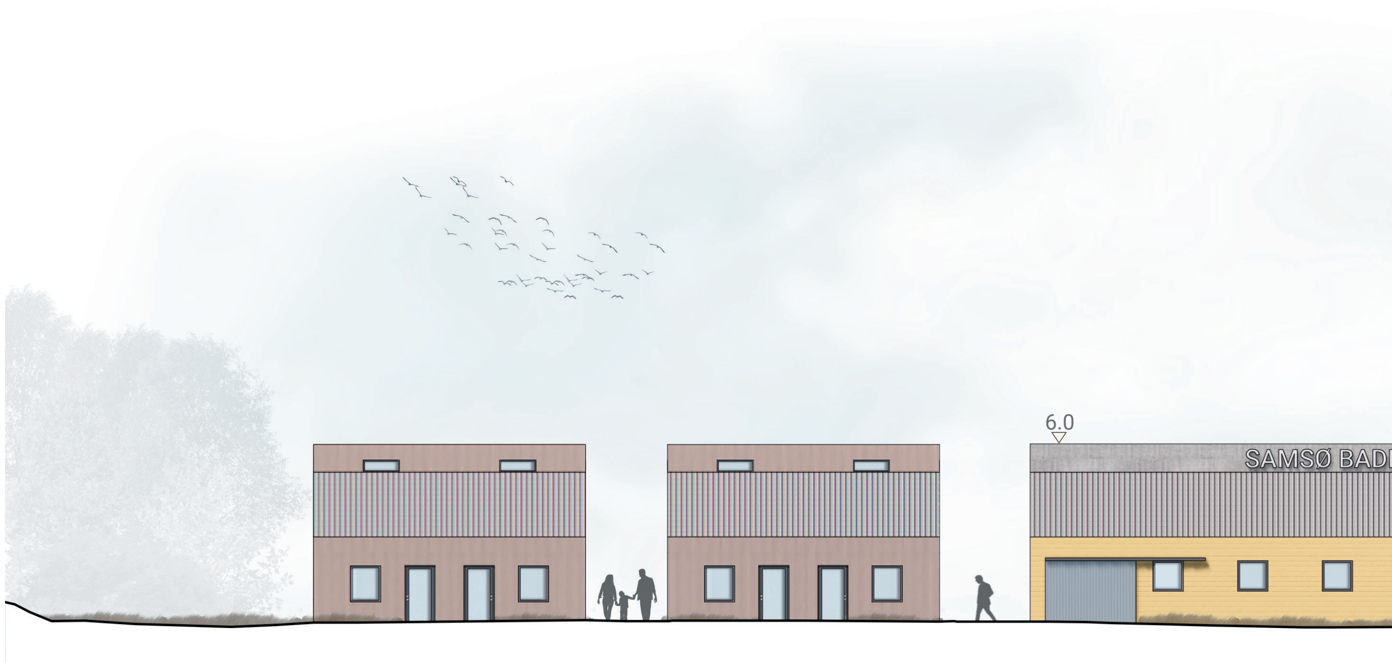
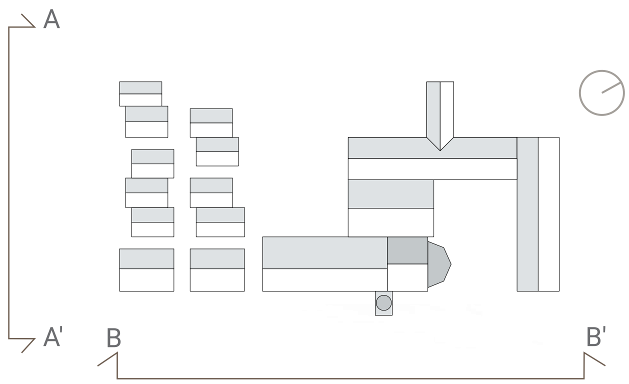


Fig. 172: Exploded view

Elevations

The facades of the existing main building are preserved, and the yellow bricks are restored in order to keep the identity and autencity of the existing cement factory. The new detached private rooms have a timber cladding, in order to blend into the natural landscape. On the contrary, the northern private rooms have a concrete finish due to their close relation to the existing concrete mixer and old production areas.
The Spa is completely transparent towards the sea, to emphasise the relationship between the indoor warm pools and the outdoor cold sea.
Hence, different texture and perceptions are integrated together, providing guests with different experiences.





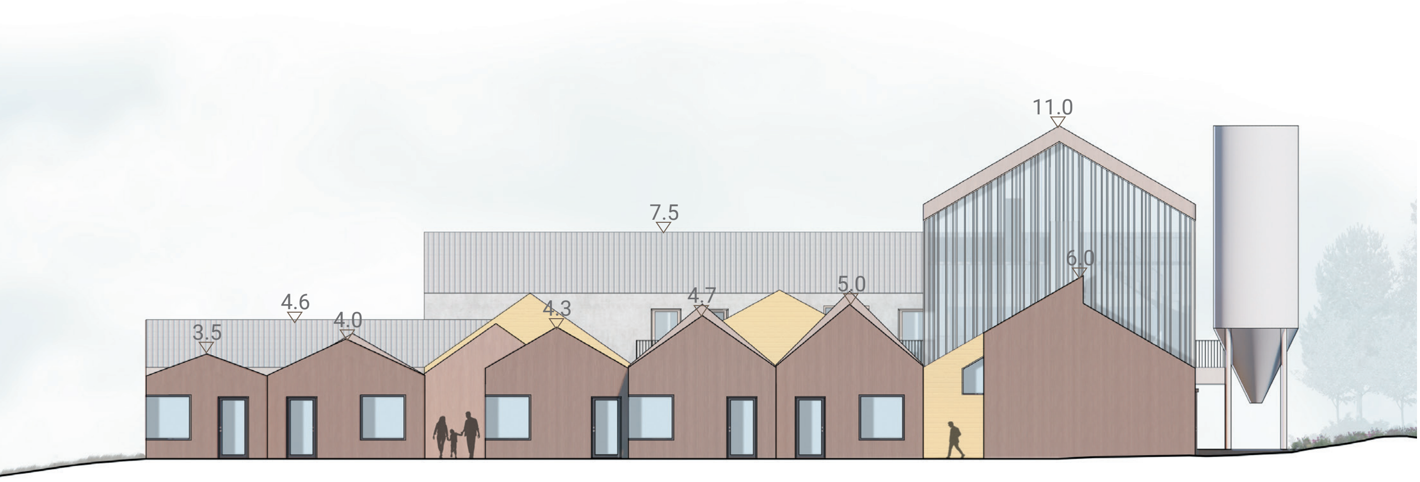
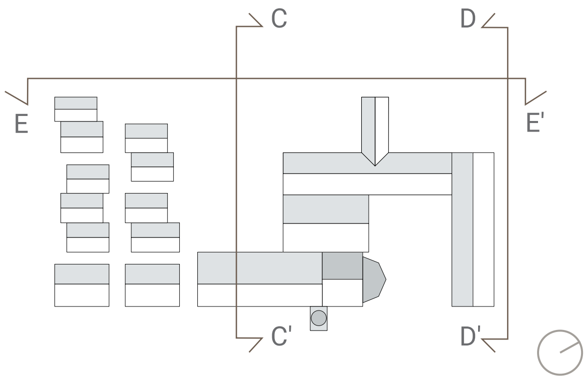
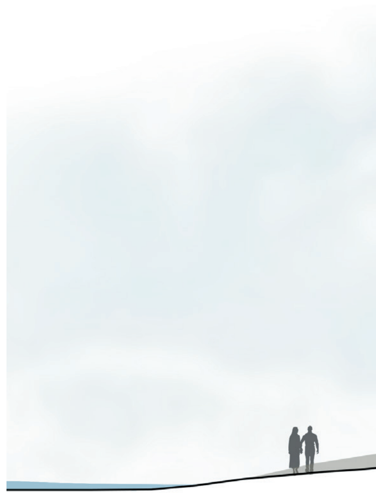


Fig. 173: South Facade, 1:250 AA'

Fig. 174: East Facade, 1:250 BB'


C
D
E
E'
C'
D'



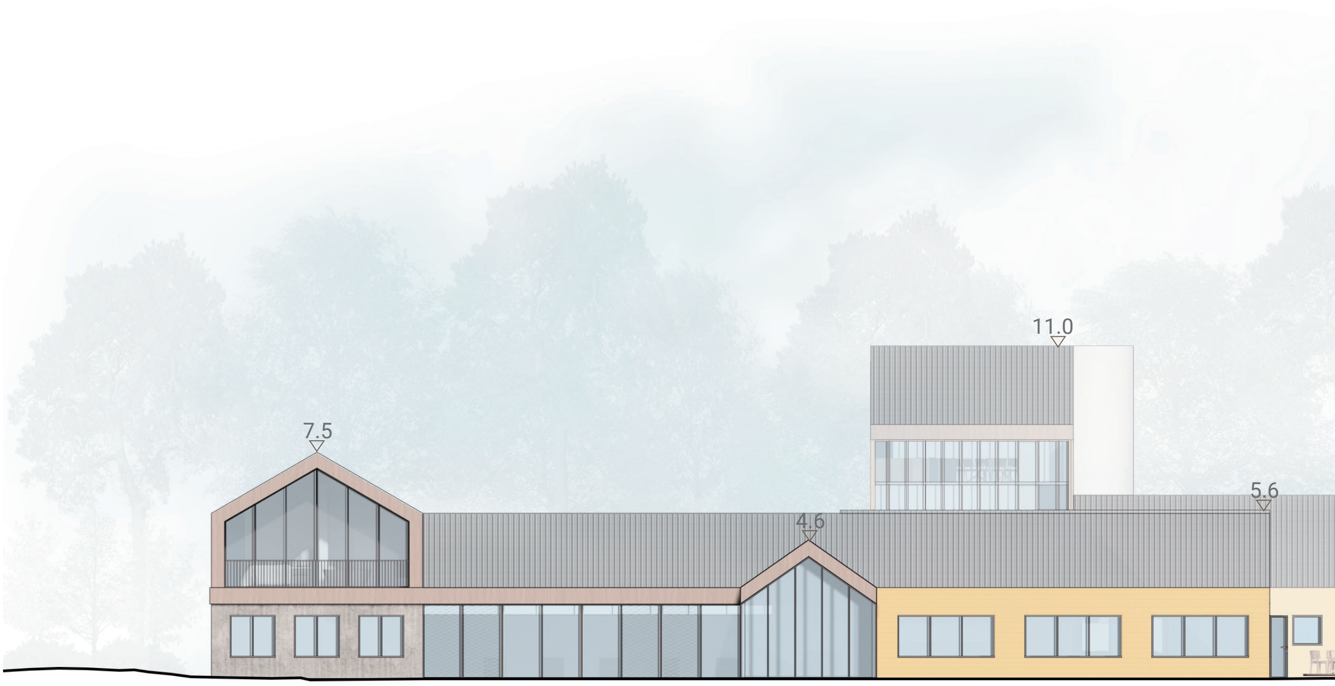

11.0
7.5
4.6
5.6

Fig. 175: South Facade, 1:250 CC'

Fig. 176: North Facade, 1:250 DD'

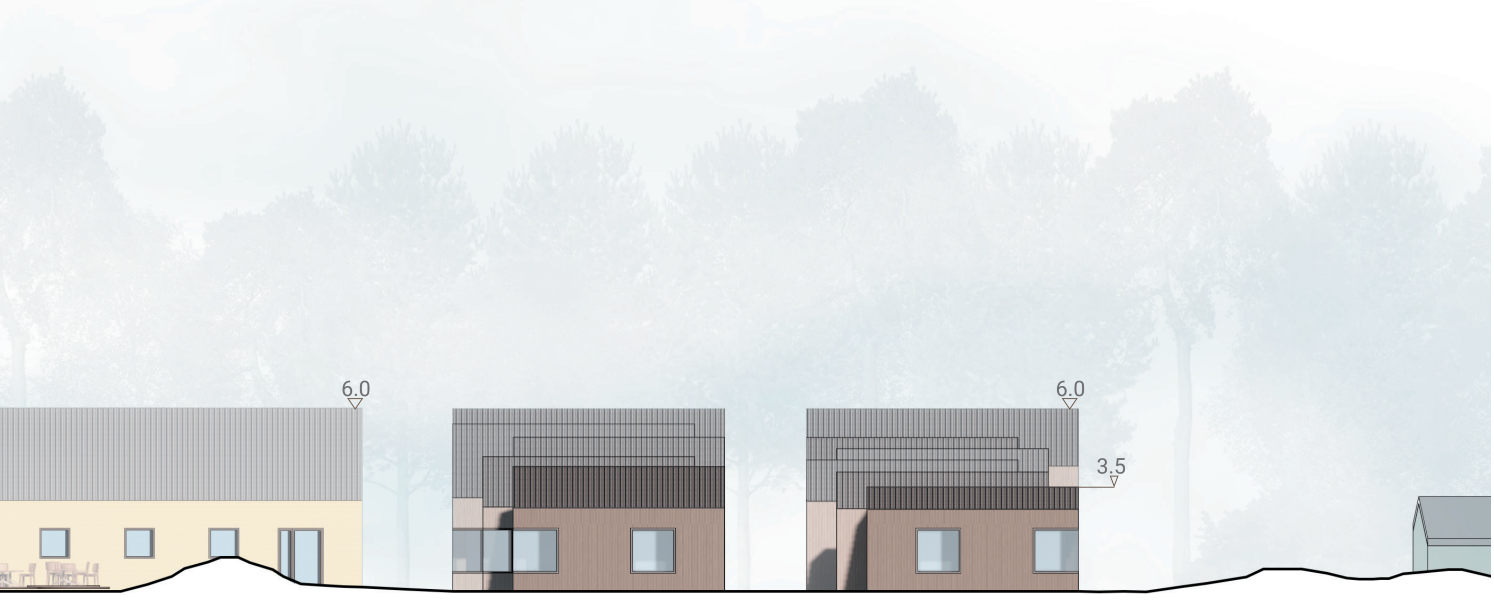


Fig. 177: West Facade, 1:250 EE'

The View from the Shore

The cement factory is placed in closed proximity to the seashore, which is very popular for hikes since it connects all the west coast of the island. In the community's perception, the building is mostly perceived from this view.

The aim of the project is to keep the originality, autencity and identity of the existing factory preserved from this particular view point, so that people walking on the shore are able to recognized the building and the new additions to it.

The new volumes blend into the landscape thanks to their longitudinal expression, and relate to the existing factory's sloping roofs and orientation.

Aromatic herbs such as sea rosemarin and lavander, but also other indigenuous flowers which tipically spread on the island's inland are introduced on the site. These remark the landscape longitudinal division between sea, sand and soil.
The woodchip paving remarks the accessible paths to reach the detached rooms and restaurant.

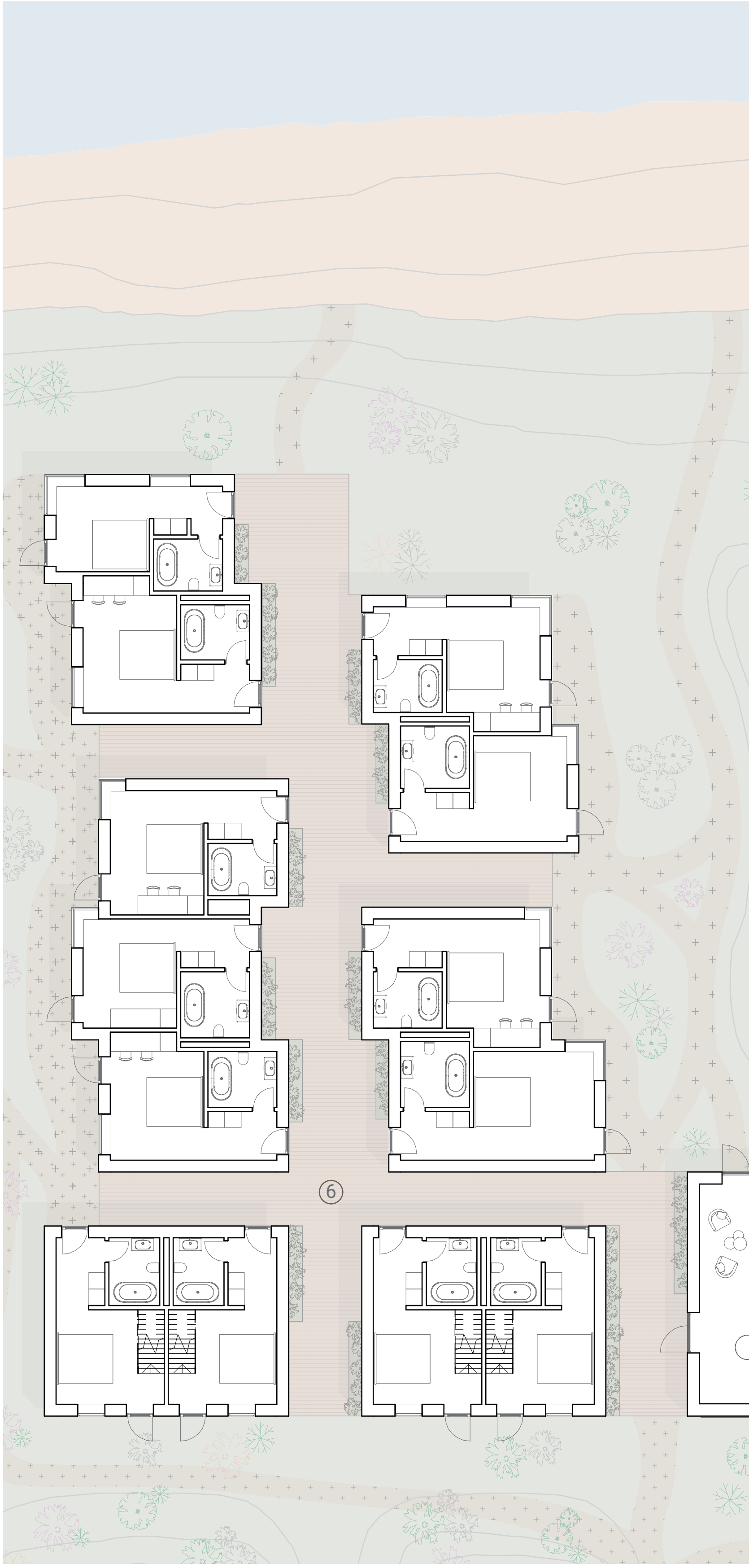
Fig. 178: View from the Shore

Ground Floor Plan

The main entrance to the new Culinary Badehotel corresponds to the existing entrance to the cement factory, which is emphasized by the presence of the existing Silo.
When entering, the guests are welcomed in the main lobby with the reception. From the lobby, they have an overview of the restaurant dining rooms and the very transparent communal kitchen. The main core of the building is transformed from the concrete production space to the culinary experience space.
The reading room mediates the busier nature of the lobby and the quietness of the private detached rooms.
The outdoor courtyard on the east is the point of access for the kitchen staff and for the guests interested into the Spa experience.
The production character of this courtyard is enforced by the renovated concrete mixer, and the re-use of concrete elements for the growth of aromatic plants and vegetables. Here, the "cement industry" is fully re-converted into the *Food Industry*.

Due to the popularity of cycling tourism and to the very central placement of the Hotel on the island, a bike sharing and renting point is placed in proximity to the road access.

Hence, spaces for different activities and experiences are combined and easily accessed by both the local community and visitors.



1. Entrance and main Louge
2. Dining Area
3. Kitchen
4. Communal Kitchen
5. Reading room
6. Detached Private rooms
7. Spa area
8. Bike parking and Renting point
9. Multi-functional room
10. Storage room
11. Mechanical room
12. Changing room
13. Staff room
14. Mechanical room

Fig. 179: Ground floor plan, 1:250

The Restaurant

Samsø has a great tradition and interest into food production, and therefore the new Badehotel main focus is the culinary experience.
The main core of the existing building is re-vitalized by transforming the concrete production areas into gastronomic spaces.

The interior design is mainly oriented to the renovation of the existing wood trusses, and the reconversion of the original garage gates. The relationship to nature is emphasized by longitudinal windows that frame the sea, while the new glazed gates permit the passage to the outdoor courtyard and terrace.
Especially during summer, the courtyard becomes alive with aromas and plants.

The industrial features of the original cement factory are reproposed in the combination between the concrete flooring, the wood trusses and the repurposed garage door.

As the ceiling finish, upcycled timber trusses are used.

Fig. 180: Main Dining Room

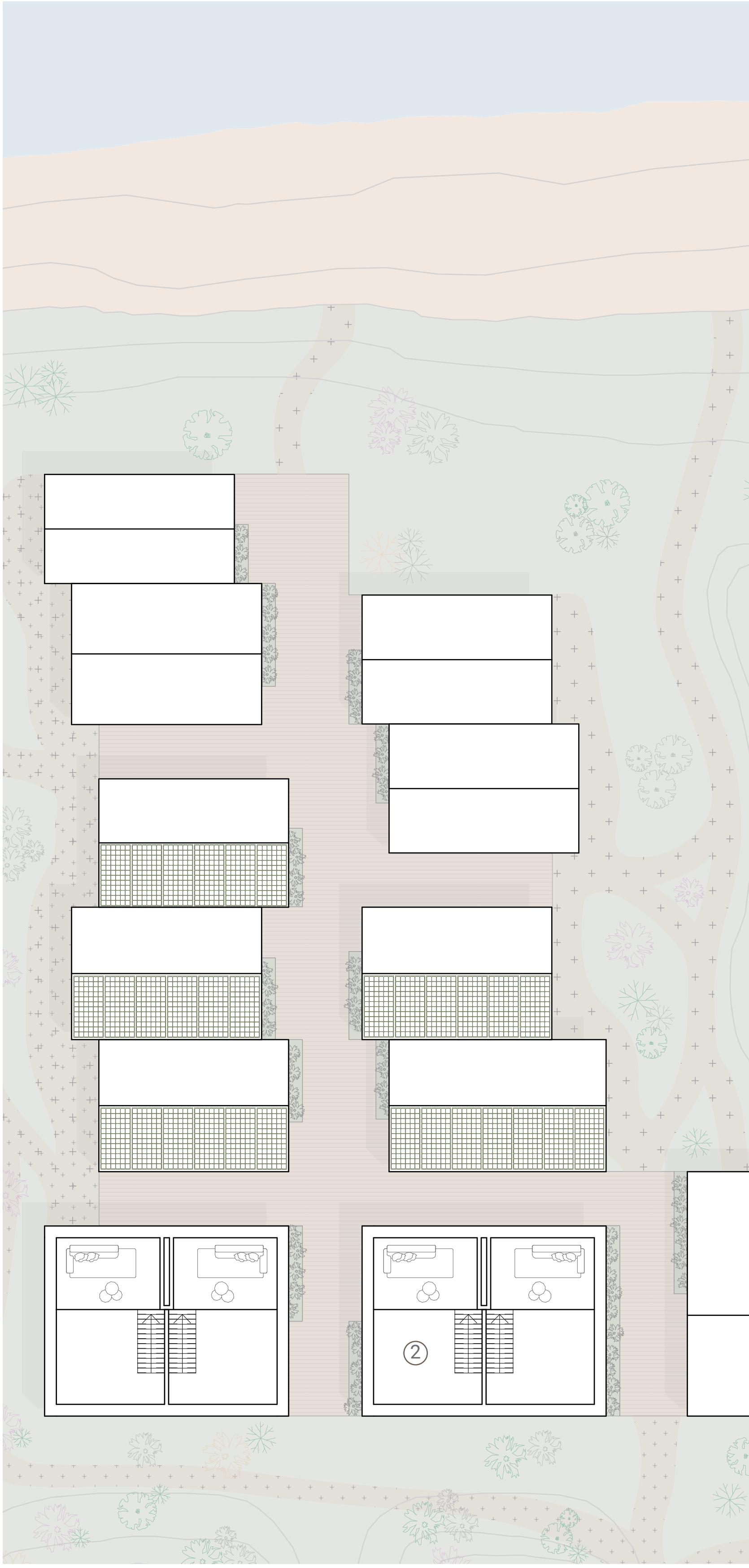
First Floor Plan

The detached rooms' height decreases towards the sea, in order to blend into the landscape and follow the existing building's longitudinal expression.

On the contrary the northest wing of the building is facing the inland. Together with the communal kitchen, they relate to the higher existing volumes of the Silo and the concrete mixer.
Therefore, the northest wing has a first floor, where five rooms are placed in relation to the Spa experience.
Although higher, the volume is not changing the overall view of the building from the seashore.

The rooms are accessed by external staircase and the aesthetic expression relates to the cement mixer and its element production by using concrete sandwich elements.

Therefore, the two opposite rooms' wings are differentiated and their materiality reinforces their relationship either to the sea and natural surroundings or to the inland concrete production.



1. Communal Kitchen
2. Duplex, Second Floor
3. Private Rooms
4. Royal Suite

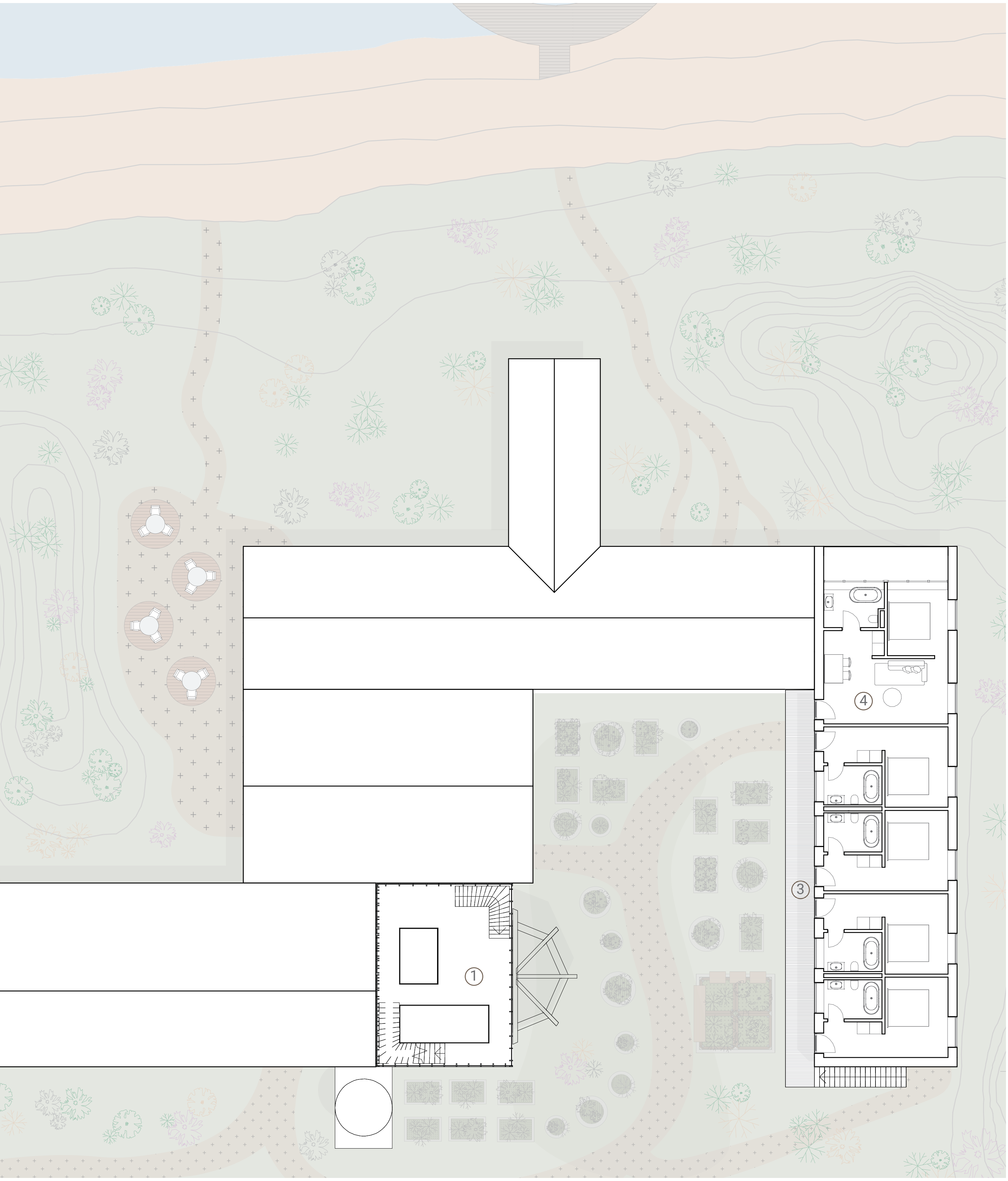


Fig. 181: First Floor Plan, 1:250

The Spa

The new Culinary Badehotel provides both visitors and the local community with the benefits of a Spa area. This would be the first Spa on the island, highlighting the building's great contribution to the many leisuring activities on the island.

The Spa wants to be in direct connection to the sea and the landscape, which is emphasized by continuous flow between the transversal existing volume of the factory and the introduction of a "Badebro" into the sea.

The existing brick envelope is transformed, both by the renovation of the existing and the introduction of glazed curtain walls, in order for guests to fully experience the outdoor nature.

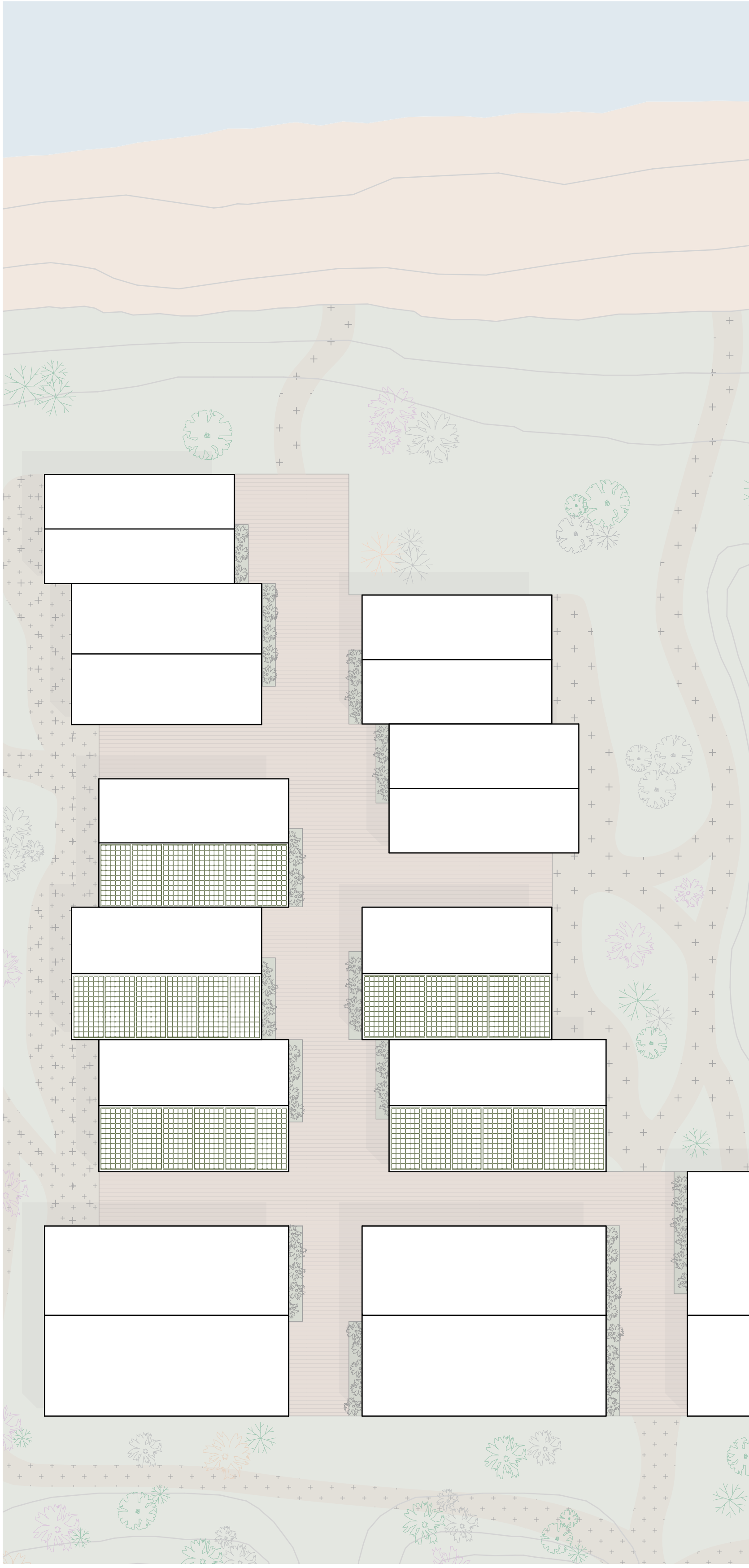
Two pools are designed, one of which is thoguht as a warm pool, where people can perceive the thermal gap between the warm indoor water and the cold outdoor water of the sea. Both of the pools are flushed to the landscape and the sea, and the curtain walls provide the opportunity to open towards nature during summer time. Hence, outdoor and indoor merge together, making the guest feel at one with nature.

Fig. 182: Spa, Main Pool

Second Floor Plan

The concrete mixer volume is the main focal point of the cement factory. Its height and volumetric expression has always differed from the rest of the building.
Therefore, the space is re-converted into a communal kitchen, as main focal point of the new culinary Badehotel.

The communal kitchen is the only volume of three floors, which height pops out from the overall building.
The volume is designed as a greenhouse. Here, both locals and visitors can fully experience the food production from the harvesting to the tasting phase.
The top floors of the greenhouse are infact dedicated to the plantation of local vegetables and aromas, which are then collected and transformed into gastronomic dishes.
The guests can be part of the preparation process, where they are assisted by a trained staff. In the end, they can all be gathered on the ground floor's dining space.



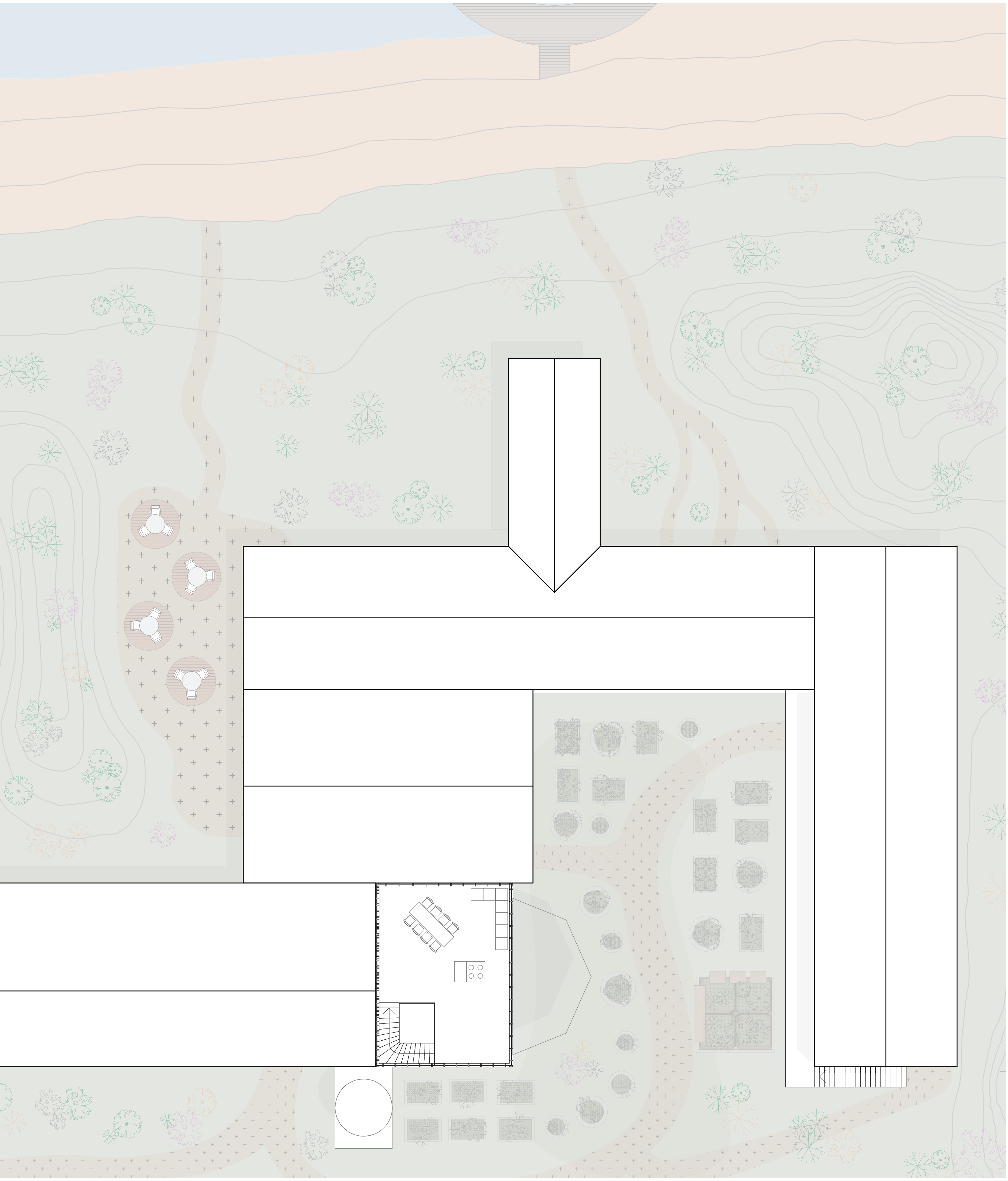
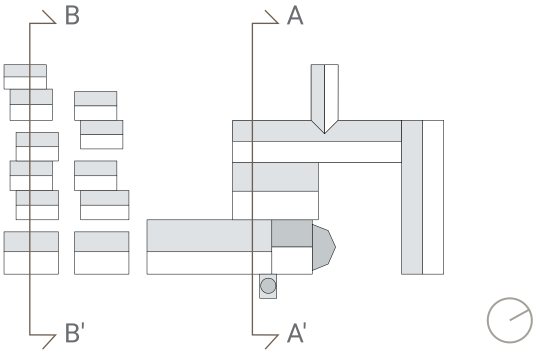
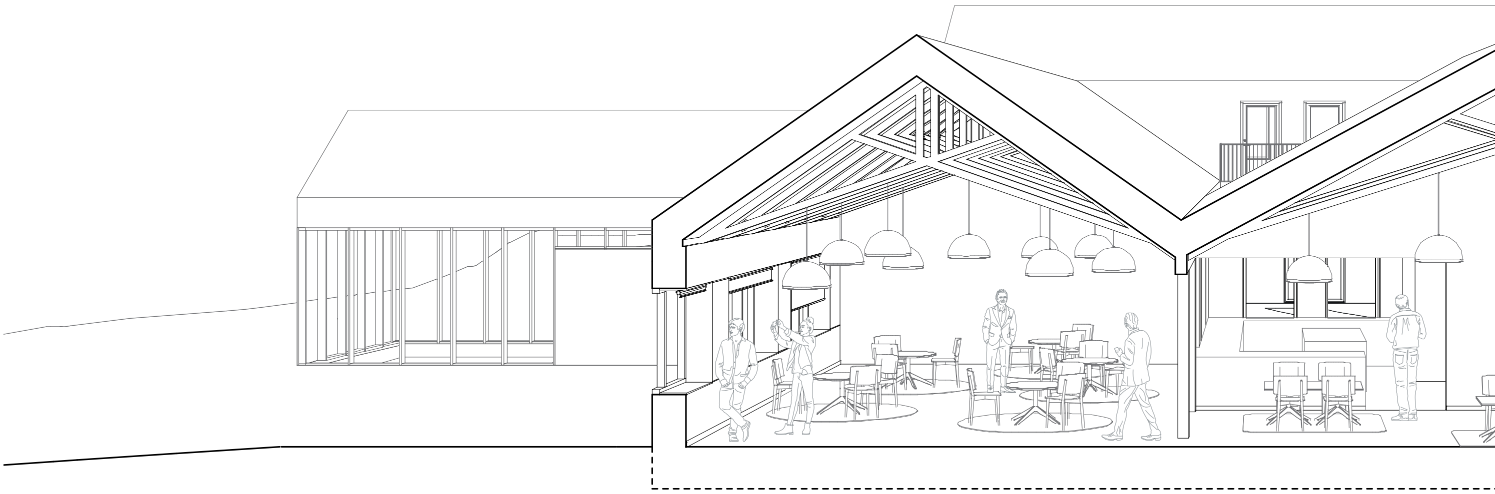
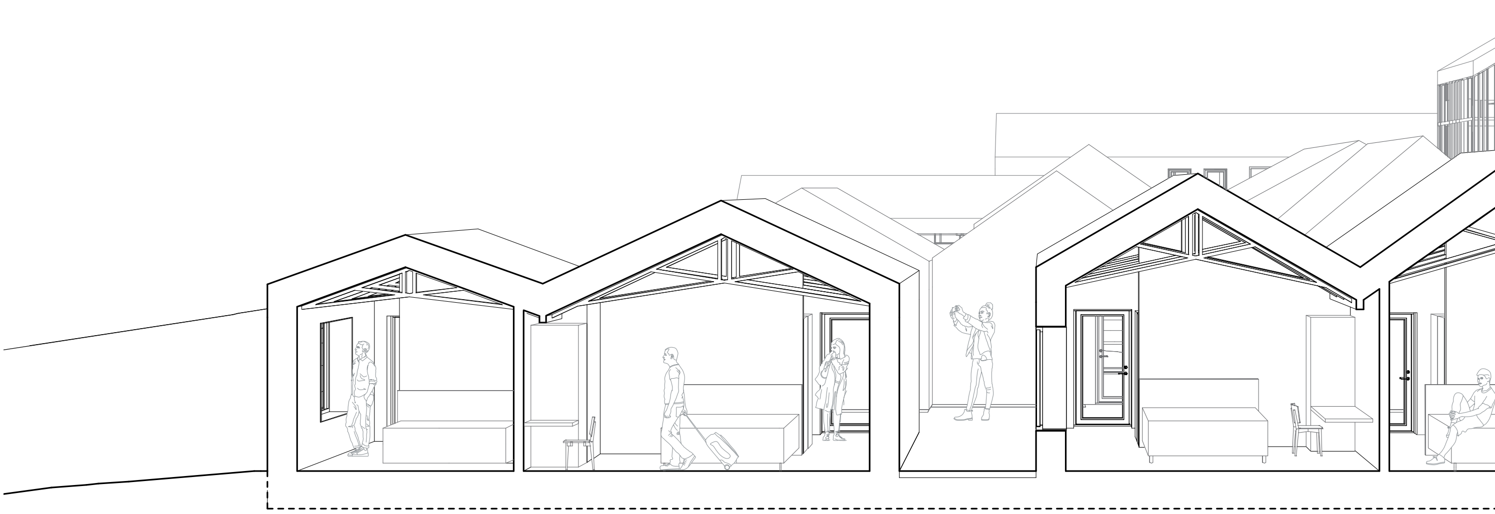


Fig. 183: Second Floor Plan, 1:250

Sections







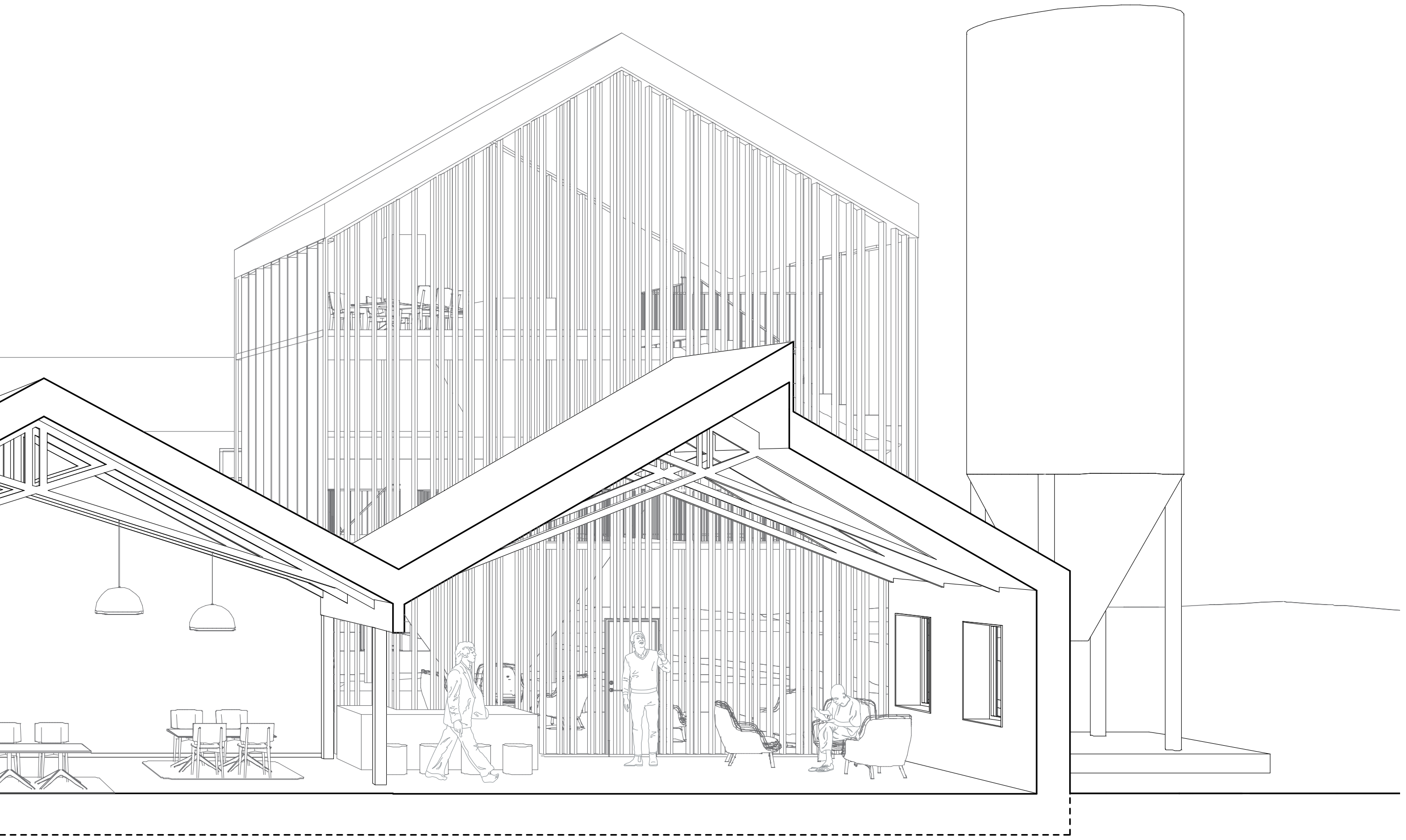


Fig. 184: Section AA', 1:100

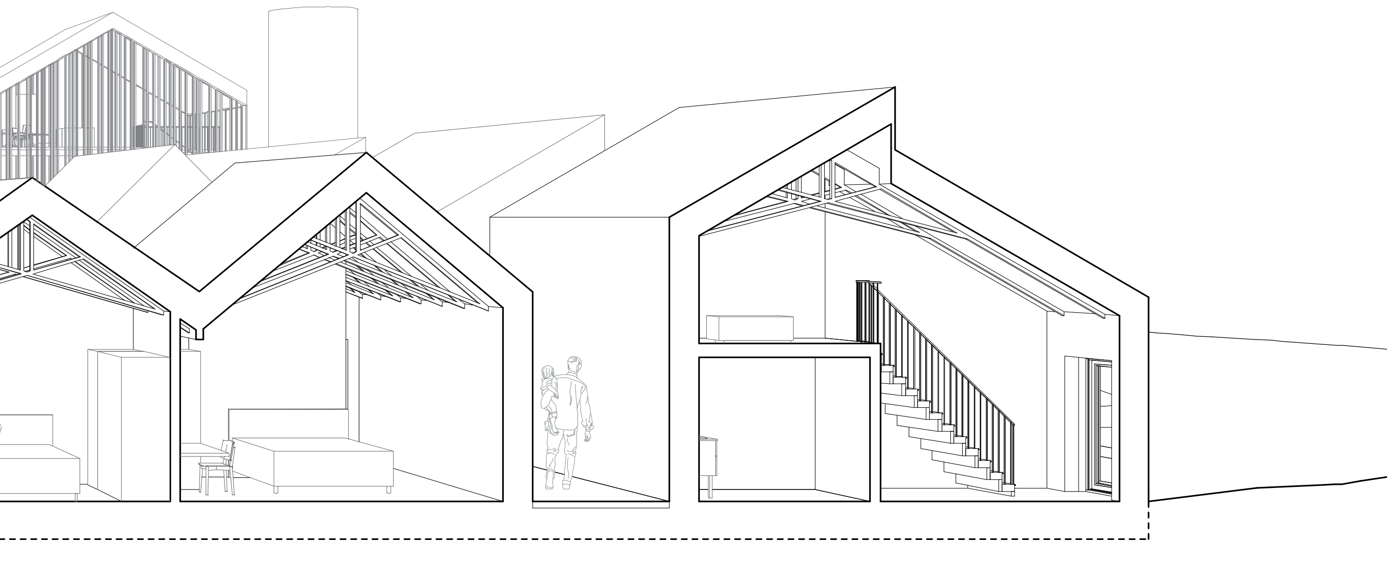


Fig. 185: Section BB', 1:100

The Hotel Rooms

The Detached Rooms

The new Badehotel has 13 detached rooms. Although independent, the units are combined and connected through an outdoor space, where guests are fully exposed to the surrounding natural environment (Fig. 179). All the rooms have a private toilet, while the bigger ones also have a working space. The window niche frames the landscape, and allows the guests to seat and enjoy the view. Both the wood trusses relate the design to the existing building.

The most eastern rooms are duplex, where the roof's height is used to place a bed loft. This typology is especially designed for families of three to four members.

The Spa Rooms

On the northern side of the site, 5 rooms are designed in relation to the Spa experience. These rooms are accessed by the outdoor courtyard, in close relationship to the existing concrete mixer and Silo. As for the detached typology, these rooms are all provided of a private toilet. The room at the end of the wing is a special typology for its relationship to the sea. It is the "royal suite" of the Hotel, with a private balcony directly facing the sea. Both the toilet and the main bedroom have a curtain wall, giving their guests the unique experience of opening the whole facade during summer.

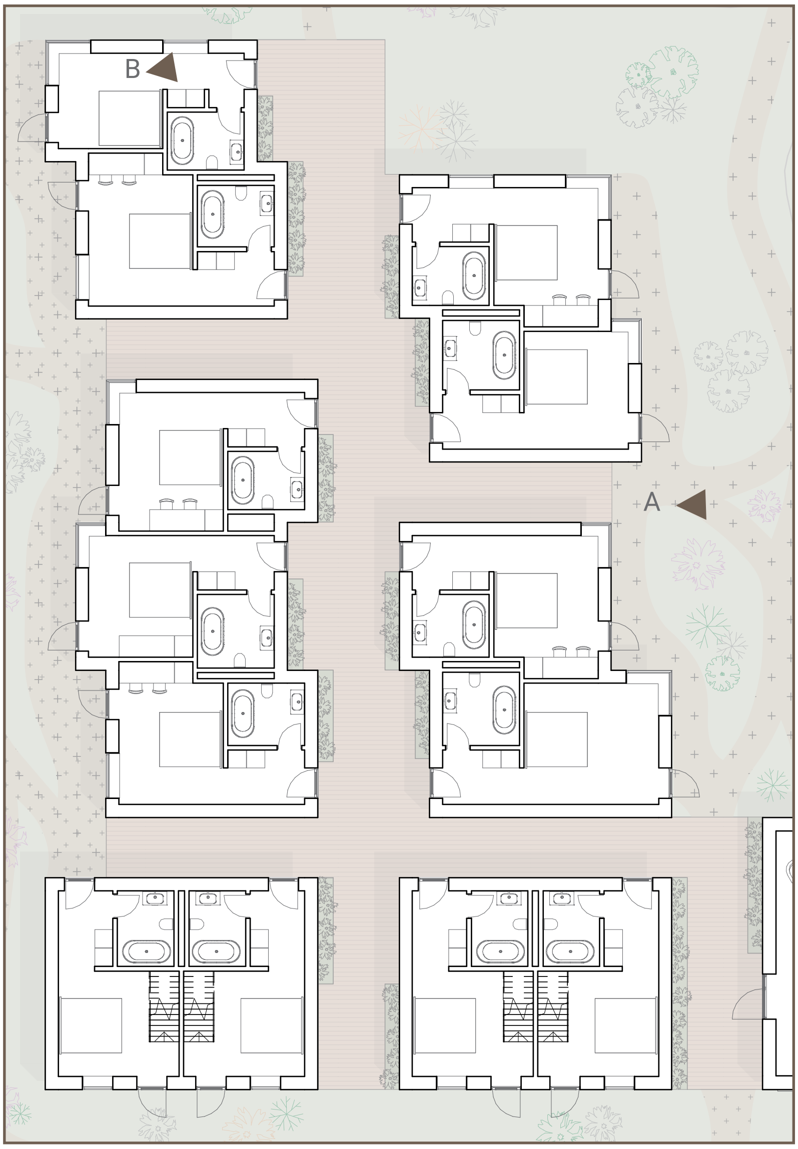
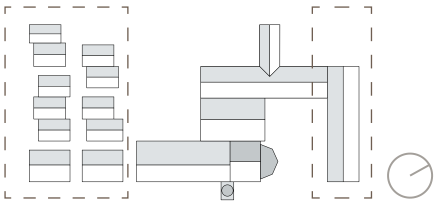


Fig. 187: The Detached Rooms



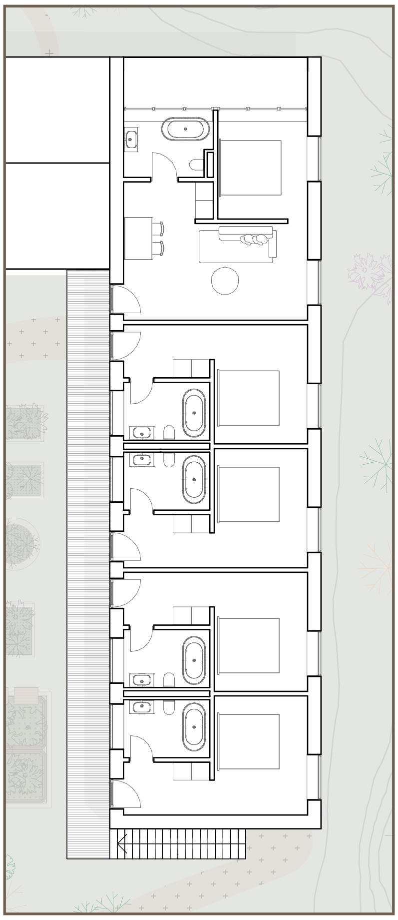


Fig. 186: The Spa Rooms

Fig. 188: Detached Rooms Courtyard, view A

Fig. 189: Interior Room, view B

The Culinary Experience

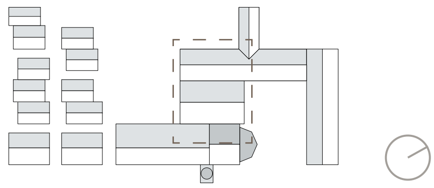
The Dining Room

The dining room is placed where the garage and main hall of the existing cement factory was.
The space is characterized by the existing wood trusses, which have been renovated and kept as they were. The space can host around 40 people between Hotel guests and local visitors. Moreover, the renovated gates open to an outdoor terrace, where guests can dine while enjoying the natural surroundings (Fig. 192).
The outdoor courtyard is a dynamic space and changes completely according to the seasons. Here the staff takes care of the plantation of different aromatic herbs and flowers which can be used in the dishes. Hence, the culinary world combine to nature, merging one to the other.

The Kitchen

In order to provide the Hotel of a great variety of gastronomic dishes, a well equiped kitchen is designed. This space becomes the very heart of the production core, and it is accessible both from the dining room and the outdoor courtyard.

The latter is also opened towards the dining room, in order for both the Chef and the guests to have an overview of each other (Fig. 193)
Moreover, the kitchen is provided of a staff area and storage room towards the north, so that the products can easily be carried in and out of the kitchen.



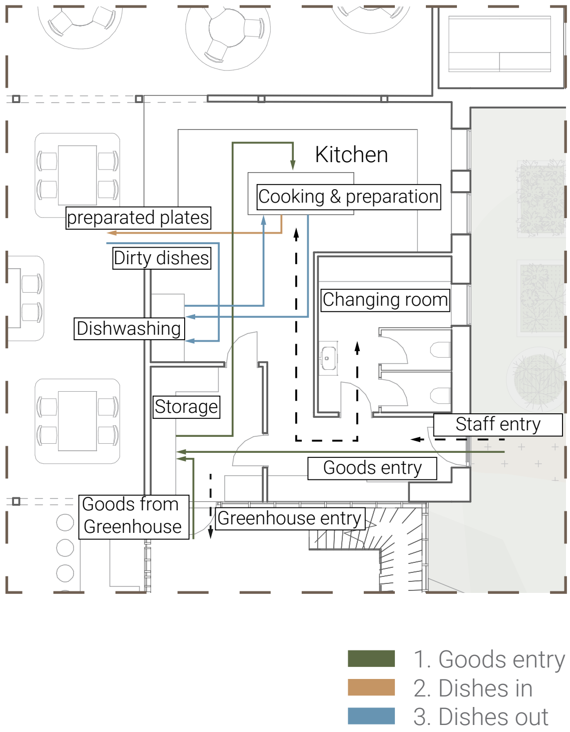


Fig. 190: Plan of the Restaurant Area

Fig. 191: Kitchen circulation

Fig. 192: The Outdoor Dining Terrace, view A

Fig. 193: The Kitchen and Main Dining Room, view B

The Renovation of the Existing Building

Introduction

The aesthetical identity of the existing cement factory is recognized by the existing yellow bricks and roof's shape. Therefore, these elements have been re-used and renovated to breath a new life into the existing structure while keeping the image of the building intact.
A very small percentage of the existing walls have been demolished, the majority of which are in the appendix volume and the right wing of the existing building. Nevertheless, their footprint is still kept as a mark of history.
The roof's slope is kept identical as the pre-existence volumes, however the height and structure are slightly changed to meet indoor spatial and environmental standards, and achieve volumetric and compositional coherence.
The height variations are highlighted by the use of glass and curtain walls.

Upcycling the Existing Materials

The exterior yellow bricks can be reused or upcycled, according to the conditions of the material. The same procedures are taken into account for the existing wood trusses, which material can be reused in the making of furniture and elements in the new detached rooms.
Both the wall and roof existing sections are then retrofitted with the required amount of insulation and the new wood load bearing structure.


Glued Laminated Timber


Brick Walls


Upcycled Timber


Timber Floor

Fig. 194: Diagram Plan

Life Cycle Assessment (LCA)

Global Warming Potential Output (GWP)
From the understanding of Life Cycle Assessment, an aim for a low Global Warming Potential has been highly prioritized.

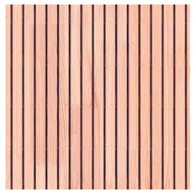
One of the project's goal is to achieve a low carbon emission building, meaning that the GWP value of the total construction should be the closest to 0.0 $kgCO_2\text{-eq}/m^2$ per year.

From the tool LCAbyg, the new Culinary Badehotel will have a total GWP value on 4,54 $kgCO_2\text{-eq}/m^2$ per year.
The building contains aluminum/wood-framed windows, terrain decks with concrete finishing and timber finish and walls of timber walls, concrete sandwich walls and renovated brick walls.
The insulation for this building is wood fibre insulation, that partly will be upcycled from the existing timber trusses.

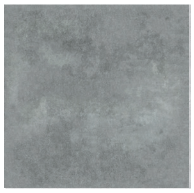

Concrete Floor

Gypsum Board


Dark Grey Aluminium


Timber Facade


Roof Tiles


Concrete Walls

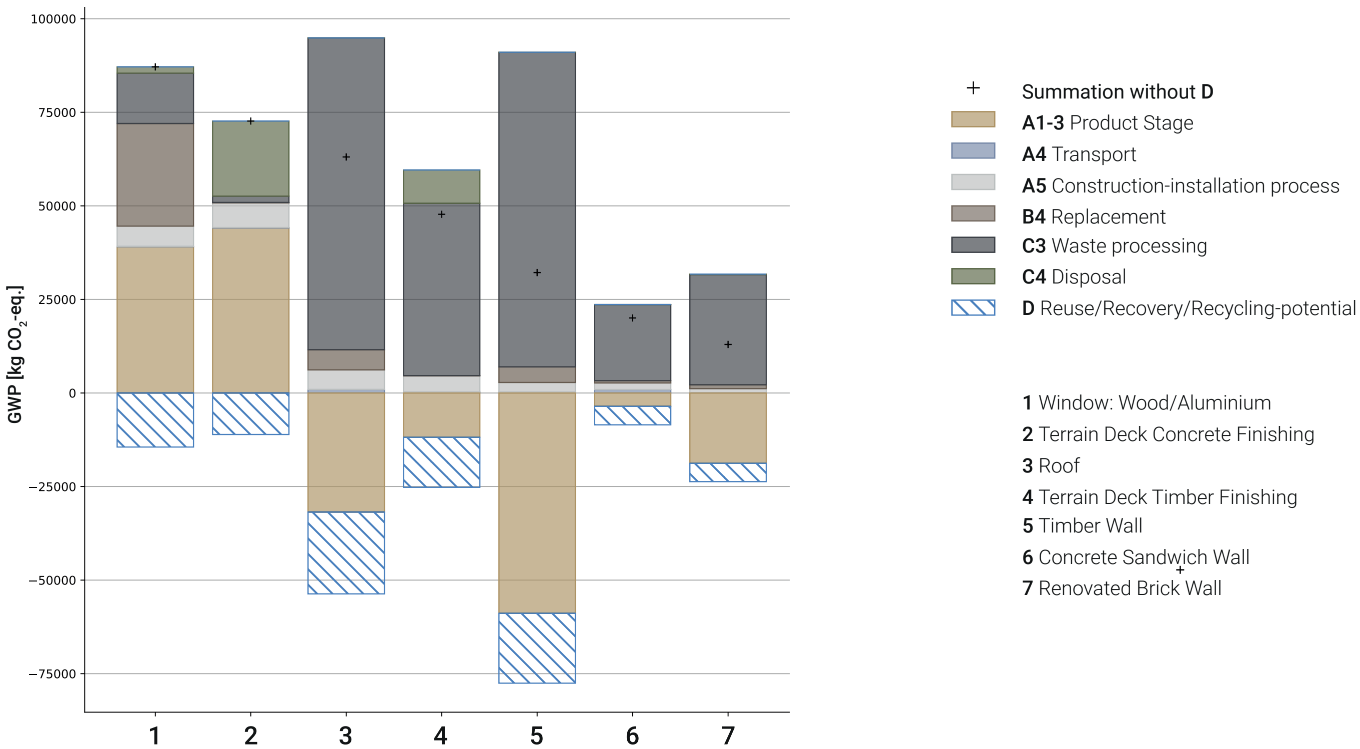


Fig. 195: GWP calculation of the all building

The Accumulated Output

The diagram shown in Fig.196 sums all the impacts together year by year for the considered period. The referenence study period span from 0 to 50 years. The yellow line shows the impact from the energy consumption, where it starts from 0 and grows a little steeper during the first years. This is because, as we have chosen a scenario for energy supply which projects the development of Danish energy production towards renewable energy in the future. This is visible in this figure, since the impact of the same amount of energy is only slowly growing in the coming years. The blue line shows the impact of the materials, and every raise indicates that there will be a replacement of the materials that year.

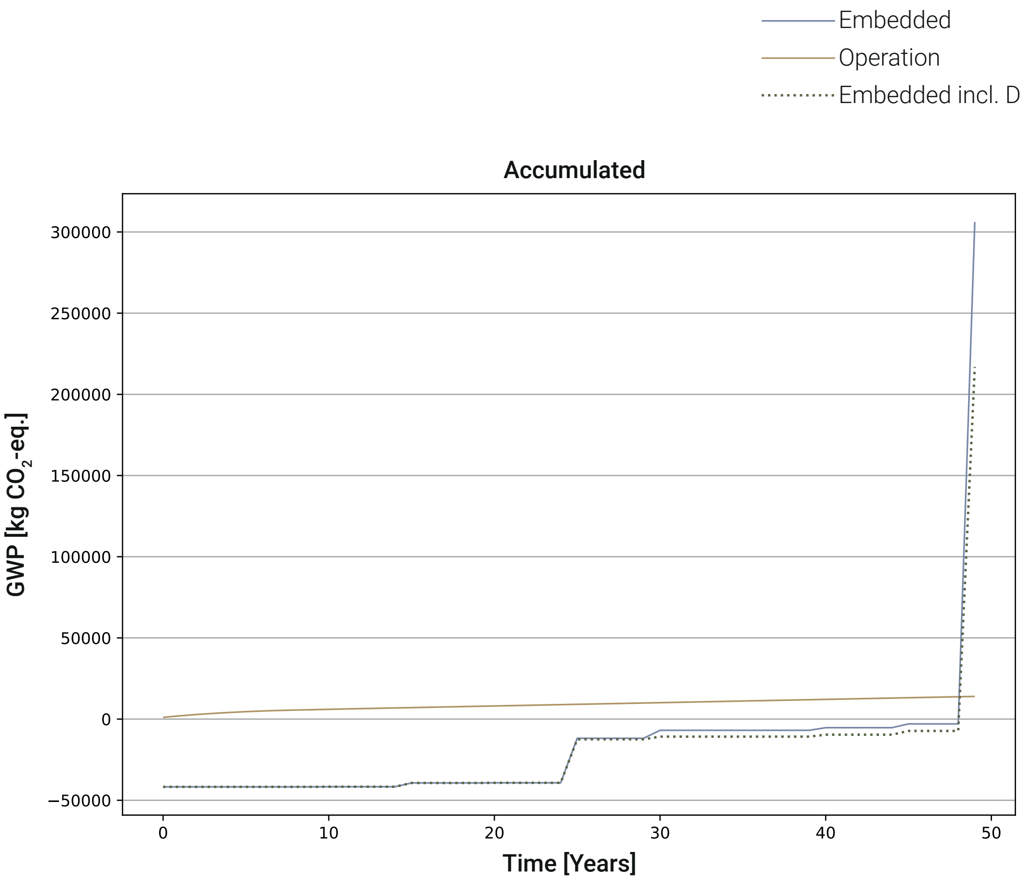


Fig. 196: Accumulated results of the all building

Total Energy Consumption

Be18 Outputs

The building meets required energy frame, according to building regulations for buildings with diverse use, consisting of hotel, restaurant and spa as main building parts. The Samsø Badehotel is reaching low energy frame, combining passive and active strategies. The total energy frame is 25.7 kWh/m^2 per year. This energy frame is reached by using supplement, as whole building is not in use 24 hours a day.
The building is provided with heat and hot water by using electricity and a heat pump. The buildings excessive heat is explainable with large glazed areas of greenhouse. Even being problematic area, it provides building with very sufficient natural ventilation, both in summertime and wintertime.
Photovoltaics of 75 m^2 on the eastern roofs of detached units are lowering electricity consumption as a sustainable active startegy.

Energy Frame Low Energy	
Total energy frame	37.2 kWh/m² per year
Total energy requirement	25.7 kWh/m² per year
Net requirement	
Room heating	17.5 kWh/m² per year
Domestic hot water	5.3 kWh/m² per year
Cooling	0.0 kWh/m² per year
Heat loss from installations	
Room heating	0.0 kWh/m² per year
Domestic hot water	0.0 kWh/m² per year
Output from special sources	
Solar cells	15.3 kWh/m² per year
Heat pump	14.6 kWh/m² per year
Contribution to energy requirement	
Heat	0.0 kWh/m² per year
El. for operation of building	4.2 kWh/m² per year
Excessive in rooms	17.7 kWh/m² per year

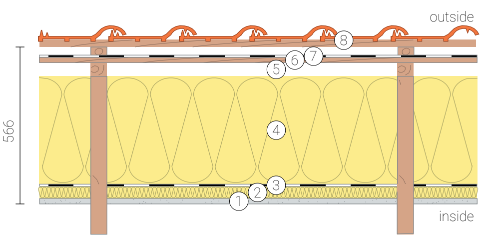
Fig. 197: Total energy frame

Detailing

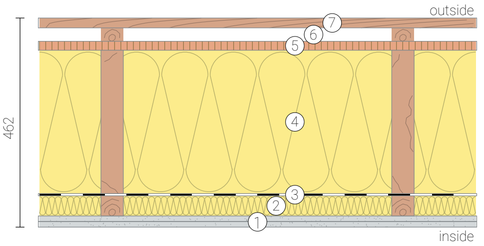
Samsø Culinary Badehotel consists of three different building construction techniques have been used. The detached units on the South are consisting of timber construction walls, timber roof covered by tiles and concrete terrain deck with wooden finishes. The renovated building is left with existing, but renovated external walls, where insulation is placed on interior side. The roof is fully renovated, and terrain deck is insulated from the bottom, to live up with the building regulation requirements for energy frame. The newly created double height extension is consisting of concrete sandwich elements.

The choice of envelope materials are highly supported by LCA and energy analyses, in order to leave the least impact on the environment, and provide comfortable indoor climate. Not only analyses are taken into consideration, but also architectural vision of the project and user comfort.

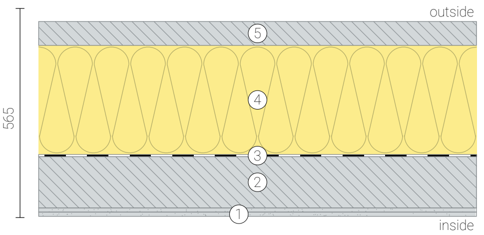
In this part, there are showcased main constructions used, as well as how materials are connected in detailed semi-sections for different buildings of the project. Also, proposal of timber frame for duplex units have been showcased (Figure 202)



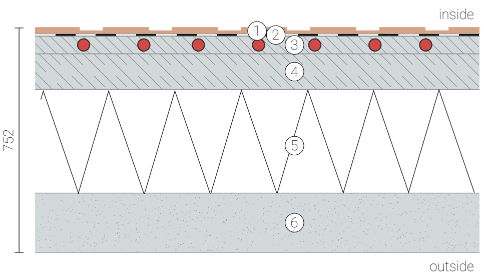
Roof
1 - Ceiling finish
2 - Insulation 45mm (λ-0,034 W/mK)
3 - Vapour barrier
4 - Wood fiber insulation 400mm (λ-0,038 W/mK)
5 - Ventilation gap 50mm
6 - Plywood 21mm
7 - Roofing felt
8 - Tiles with build-up



Timber Wall
1 - 2x plasterboard 25mm
2 - Insulation 45mm (λ-0,034 W/mK)
3 - Vapour barrier
4 - Wood fiber insulation 320mm (λ-0,038 W/mK)
5 - Wind barrier (OSB) 22mm
6 - Ventilation gap 30mm
7 - Timber cladding



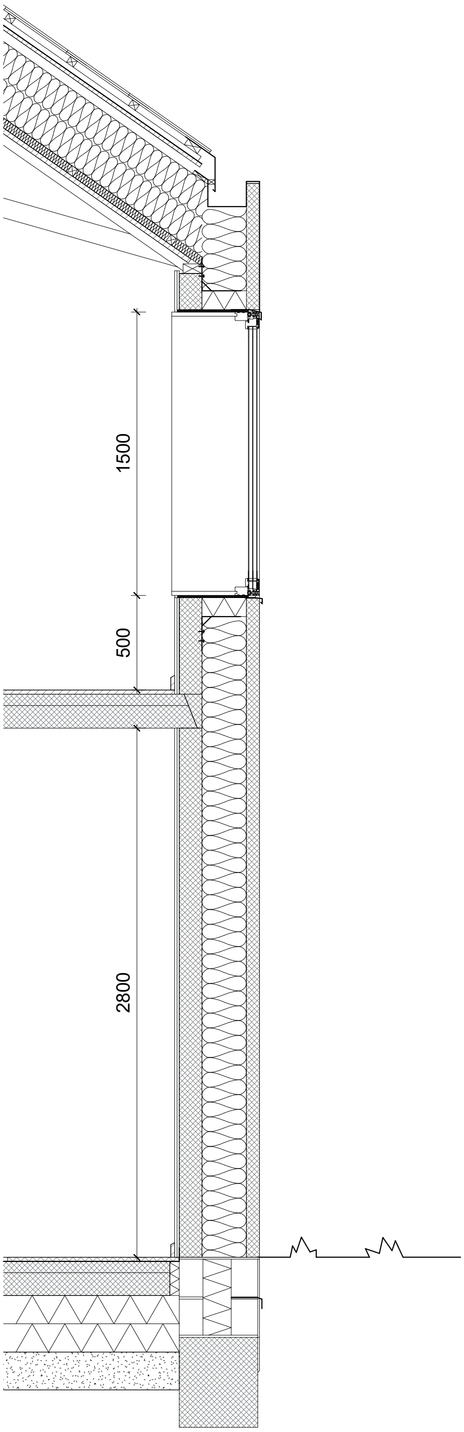
Concrete Sandwich Wall
1 - 2x plasterboard 25mm
2 - Cocrete bearing wall 120mm
3 - Vapour barrier
4 - Wood fiber insulation 320mm (λ-0,038 W/mK)
5 - Concrete outer layer 70mm

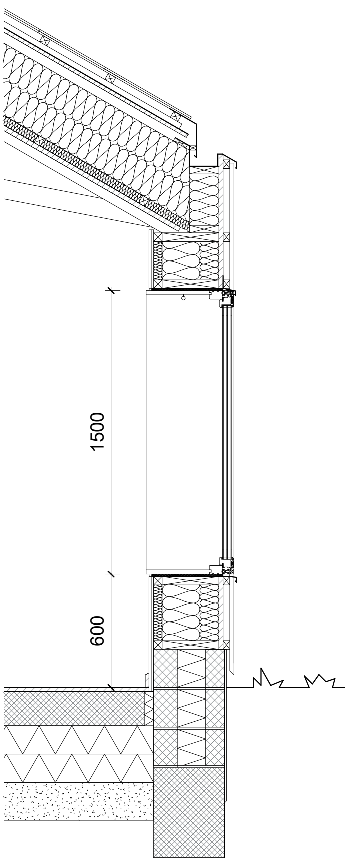


Terrain Deck
1 - Floor finishes (tiles, wood or concrete)
2 - Vapor barrier (+ foam underlay for wood flooring)
3 - Screed layerwith floor heating 60mm
4 - Structural floor 120mm
5 - Polystyren (λ-0,038 W/mK)
6 - Lightweight Expanded Clay Aggregate

Fig. 198: Detailing of elements

Fig. 202: Example of timber frame for duplex rooms





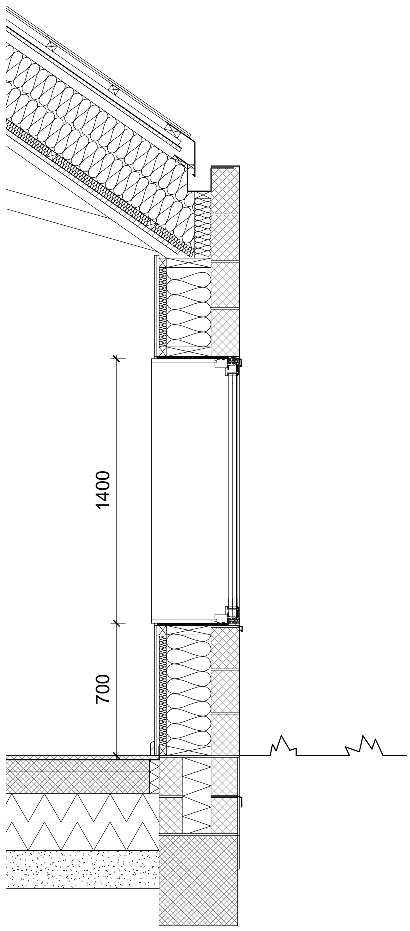


Fig. 199: Double height concrete building

Fig. 200: Detached units

Fig. 201: Restaurant

Building Performance

Indoor Climate

It is at high importance, that hotel guests feel comfortable in their rooms. Due to large glazed windows and doors, large overheating and heat losses may be problematic. Therefore, hotel units are provided with efficient hybrid ventilation, where mechanical ventilation is in use in the colder months of the year. The natural ventilation can be adjusted by visitors wishes, by using tilt/turn terrace doors.
Because of possible overheating, there have been looked at indoor temperatures, to investigate ventilation aggregator efficiently enough for comfortable indoor environment.

Also the restaurant is providing perfect indoor comfort. In the restaurant, at high importance were indoor temperatures and CO_2 levels. The analyses were made, assuming that at the same time there will be located 25 people.
The restaurant alone, provided problematic indoor climate, but as it is open towards the entrance with cooler temperatures, it allowed to use air mixing between the zones, providing even better ventilation and fresh air change.

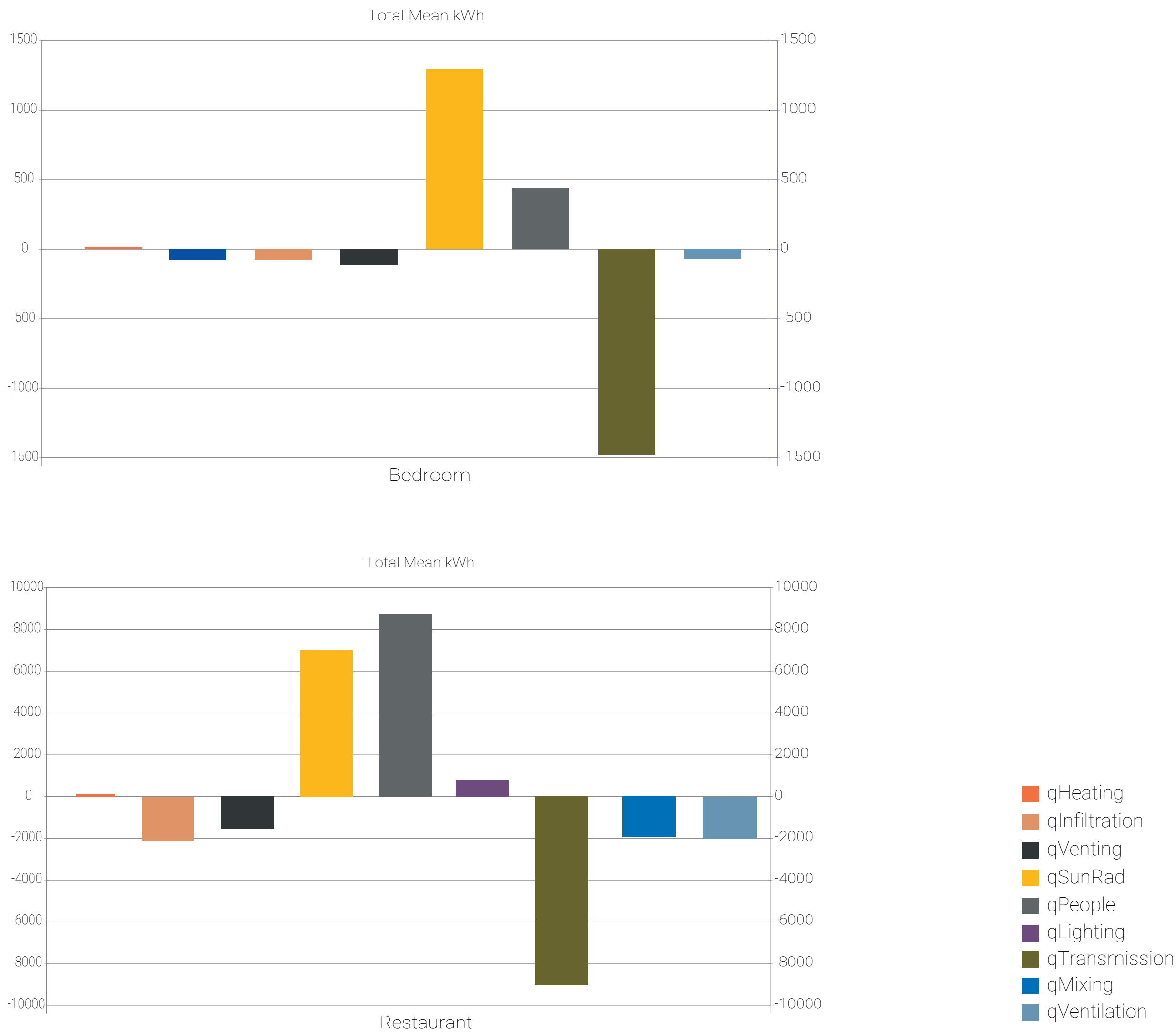


Fig. 203: Energy consumtion

Daylight

Detached hotel units are providing ideal daylight conditions inside the rooms, both in the morning and evening.
The large glazed windows are accomadating sufficient daylight in the morning time, where simple tasks can be performed, even reading visitor's favourite book and relax (Figure 205).
The light curtains provided in each of the hotel units allow to enjoy ones privacy in bedrooms, as well as block direct light in the evening, while still mantaining ideal sunlight conditions to reach through them (Figure 206).
By using see through shading devices in the restaurant, it is possible to reduce excessive daylight, while still providing very good daylight availability and views towards the shore, so guest could enjoy the culinarry experiences without compromises (Figure 204).
Providing skylight in the kitchen area, allows staff to enjoy ideal natural daylight conditions all day through (Figure 207).

By paying close attention to natural daylight, it not only provides comfortable indoor environment, but also allows to reduce energy consumed while using artificial lighting devices.

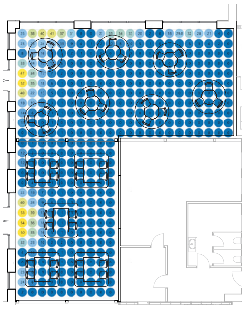


Fig. 204: Excessive daylight, 17:00-23:00 (Restaurant)

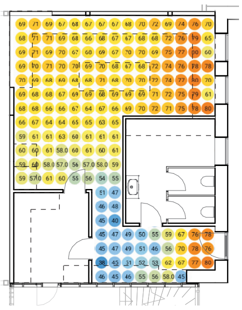


Fig. 207: Daylight Availability, 08:00-20:00 (Kitchen)

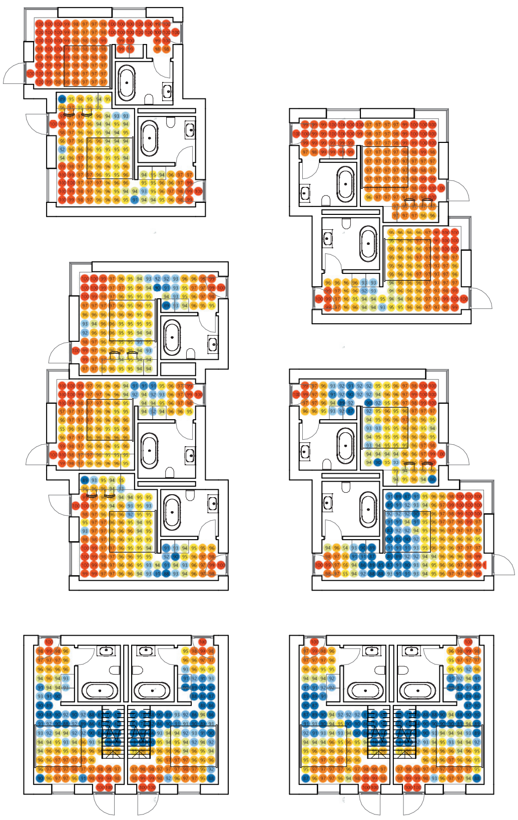


Fig. 205: Daylight availability 07:00-10:00 (Hotel)

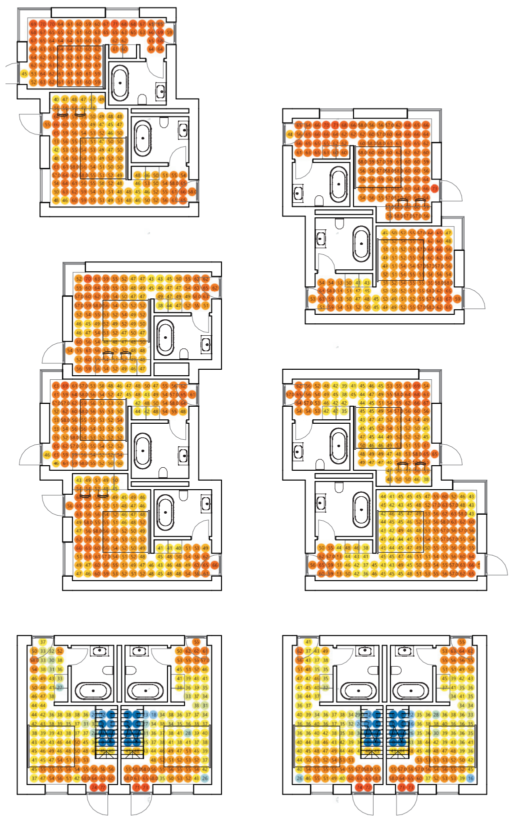


Fig. 206: Daylight availability, 17:00-23:00 (Hotel)

Conclusion

The new Culinary Badehotel project aims for the re-vitalization and regeneration of the existing cement factory on the scenic island of Samsø.

Taking the existing competition brief as a departure point, the project's objective is to enforce the aesthetical and functional identity of the factory and translate it into a culinary Hotel.

The design focuses on the transformation of spaces from the concrete production to the food production, where the kitchens become the focal point.
The strategic central location of the building permits to the new Hotel to become a landmark of Samsø for both tourists and locals.
The main actions on the existing is the renovation and reuse of the existing materials and the addition of new volumes to accomodate some of the new program requirements, while following the historical evolution of the factory's organic growth.
The new volumes blend into the landscape thanks to their longitudinal low expression.
The additions follow the planimetric lines and roof orientation of the existing building, becoming at one with it. The industrial character of the cement factory is enforced by the coniugation between a wood trusses structure and concrete flooring, and also by renovating the existing Silo and Concrete mixer to maintain history of the place.

The result is a building in which all layers of history are distinguished and at the same time are blending together with the landscape.
Here, locals and visitors can explore the popular culinary traditions of the island together, from the harvesting to the tasting of local products. They can as well relax in the first island's Spa, feeling at one with the sea and the outdoor narture.

Reflections

The most challenging aspect of the project was understanding the best designing approach to use with the existing structure.
Indeed, the list of methods and literatures regarding the restoration of modern and industrial buildings is very vast, due to the topic's acquired importance especially in recent times.

The lack of documentation regarding the existing construction's state made it difficult to understand in depth the restorative intervention to make, especially in regards to the foundation and floor typology. This prevented the authors to be critical regarding the actual economical and structural benefits in restoring the building instead of demolishing it.
For the project to be realistically approachable, a construction evalutation should be made beforehand.
Another important aspect are the limitations of the Municipality plan. As briefly stated in the Analysis chapter, the project should be approved by both local and national authorities in order to be effectively operable.

Therefore, an investigation on the real intentions of the client and the Municipality to actually gain the permission to build from the National authorities should be made.

From a design point of view, the main limitations have been found in achieving a number of rooms which could respect the site's longitudinal expression but that could also be realistic in order for the Hotel to be economically functional. There could be investigated the possibility to extend the hotel to a proximity site, and restore the existing building for the culinary and leisure experiences only.

In general, the lack of time prevented the design to focus more on the Spa area, both from a design and energy consumption point of view. Although the main focus of the Hotel has always been the culinary experience, the authors akwkoledge that the introduction of a Spa into a project would need a deep focus on the required mechanical systems for it to be realistically operable and comfortable. The same applies to the energy consumptions and indoor comfort analyses of the greenhouse.

Moreover, the project could be more refined, if more materials would have been investigated apart from the LCAByg’s library, in order to see whether that would have changed the Global Warming Potential to be lower than what is now.

Literature List

A day in the life of a chef (no date) Le cordon bleu. Available at: https://www.cordonbleu.edu/news/a-day-in-the-life-of-a-chef/en#:~:text=Head%20culinary%20chefs%20will%20spend,speeds%20and%20assist%20with%20cooking.

Adventure Cycling Association (no date) 'Bicycle Tourism 101'. Available at: https://www.adventurecycling.org/advocacy/building-bike-tourism/bicycle-tourism-101/.

Ahsan, S. (2021) An overview of Architecture In The Viking Age, Rethinking The Future. Available at: https://www.re-thinkingthefuture.com/architectural-community/a5886-an-overview-of-architecture-in-the-viking-age/.

Arkitektur Center, D. (2017) Vadehavscentret i Ribe, Dansk Arkitektur Center. Available at: https://dac.dk/viden/arkitektur/vadehavscentret-ribe/.

Arkitektur Center, D. (no date) Vikingetid, Dansk Arkitektur Center. Available at: https://dac.dk/viden/artikler/vikingetid/.

Bliv receptionist (no date) Hotel og Restaurant skolen. Available at: https://hrs.dk/bliv-elev/erhvervsuddannelser/receptionist.

Böhme, G. and Thibaud, J.-P. (1998) The Aesthetics of Atmospheres. Routledge.

Brandi, C. (1963) Teoria del Restauro. Torino: Giulio Einaudi Editore.

Breuer, D. (2007) The Planning Act in Denmark, 813. Available at: https://naturstyrelsen.dk/media/nst/Attachments/planlovenpengelsk2007.pdf (Accessed: 10 February 2022).

'Building regulation 2020' (no date). Available at: https://bygningsreglementet.dk/Historisk/BR18_Version1/Ovrige-bestemmelser/25/Krav/473_484.

Business Region Aarhus (no date) 'Samsø Municipality in Eastjutland's Millioncity'. Available at: https://businessregionaarhus.dk/media/39142/frekvens-samsoe-kommune.pdf.

climatestotravel (no date) climatestotravel. Available at: https://www.climatestotravel.com/climate/denmark/samsø.

COST Association (2017) Sustainability, Restorative to Regenerative. RESTORE Working Group One, p. 120. Available at: www.eurestore.eu.

Cullen, G. (1971) 'Casebook: Serial Vision', in In The Concise Townscape. 2nd edition. London: Architectural Press, pp. 17–96. Available at: https://www.researchgate.net/figure/Cullen-Serial-Vision-the-opening-page-of-the-Casebook-section-of-Townscape-1961_fig7_323973559 (Accessed: 1 February 2022).

De Luminae (no date) 'Weather Data - General Description'. Available at: https://deluminaelab.com/docs/dl-light/en/weather.html.

DinGeo (no date) 'Havvejen 131, 8305 Samsø'. Available at: https://www.dingeo.dk/adresse/8305-samsø/havvejen-131/.

Douet, J. (2015) Industrial Heritage Re-tooled: The TICCIH Guide to Industrial Heritage Conservation. Left Coast Press Inc. Available at: https://books.google.it/books?hl=it&lr=&id=6WaTDAAAQBAJ&oi=fnd&pg=PA6&dq=industrial+heritage&ots=HatqsOep1E&sig=UwZdHAuUAuT1Tqywe1fsuHt8ZyY&redir_esc=y#v=onepage&q=industrial%20heritage&f=false (Accessed: 16 February 2022).

E+N Architectural Firm (2007) E+N, E+N. Available at: http://eplusn.dk/restaureringsfilosofi (Accessed: 15 February 2022).

emu-redaktionen (2021) 'Kevin Lynch´s kategorier til analyse af byrum'. Available at: https://emu.dk/stx/design-og-arkitektur/design-og-arkitekturhistorie/kevin-lynchs-kategorier-til-analyse-af-byrum (Accessed: 16 February 2022).

Gedeon, G. (2017) Coastal Construction: Designing the Foundation. Ced engineering, pp. 10–47. Available at: https://www.cedengineering.com/userfiles/Coastal%20Construction%20-%20Designing%20the%20Foundation%20R1.pdf.

Guide to Sustainable Building Certifications (2018). Realdania. Available at: https://issuu.com/realdania.dk/docs/guide-to-sustainable-building-certi.

How Many Hours Does A Chef Work? (no date) Culinary Lab. Available at: https://culinarylabschool.com/how-many-hours-does-a-chef-work/#:~:text=As%20a%20guide%2C%20the%20standard,pretty%20much%20the%20industry%20standard.

International charter for the conservation and restoration of monuments and sites (The Venice Charter, 1964) (1964). International council of monuments and sites.

International Living Future Institute (2022) About the LBC Red List, Living Future Institute. Available at: https://living-future.org/declare/declare-about/red-list/ (Accessed: 15 February 2022).

Jantzen, J., Kristensen, M. and Christensen, T.H. (2018) 'Sociotechnical transition to smart energy: The case of Samsø 1997-2030', Elsevier Ltd. [Preprint]. Available at: https://www.sciencedirect.com/science/article/pii/S0360544218314713 (Accessed: 1 February 2022).

Jastrup, M. and Drique, M. (2012) Sustainia Sector Guide to Buildings. Sustainia, p. 106. Available at: https://issuu.com/sustainia/docs/buildings_sector_guide.

Jorgensen, C. and Pedersen, M. (2014) Industrial Heritage in Denmark: Landscape, Environments & Historical Archaeology. Available at: https://books.google.it/books?hl=it&lr=&id=A56fDwAAQBAJ&oi=fnd&pg=PP1&dq=Caspar+-Jørgensen+%26+Morten+Pedersen+(eds.),+Industrial+Heritage+in+Denmark:+Landscapes,+Environments+and+Historical+Archaeology+(Aarhus:+Kultur+Styrelsen+%26+Aarhus+University+-Press,+2015)&ots=UY-_QwIh5R&sig=yxDnI3EYR5NixFWaJVC1Z66Dn7c&redir_esc=y#v=onepage&q&f=false (Accessed: 15 February 2022).

Kjeldsen, K. (2012) New Nordic : arkitektur & identitet.

Klimatilpasning (no date) 'Seawater level - Rising water level'. Available at: https://www.klimatilpasning.dk/sektorer/kyst/havvandstand/.

Knudstrup, M.-A. (2004) 'Integrated Design Process in Problem-Based Learning', The Aalborg PBL Model : Progress, Diversity and Challenges [Preprint]. Available at: https://vbn.aau.dk/ws/portalfiles/portal/16081935/IDP_in_PBL_2004_Mary-Ann_Knustrup_Ny_pdf_fil.pdf (Accessed: 1 February 2022).

Kulturstyrelsen (2012) 'EGNSBYGGESKIK PÅ LANDET FØR 1930'. Available at: https://slks.dk/fileadmin/user_upload/SLKS/Omraader/Kulturarv/Bygningsfredning/Gode_raad_om_vedligeholdelse/1.1_Egnsbyggeskik_paa_landet_foer_1930.pdf (Accessed: 15 February 2022).

Łabuz, T. arkadiusz et al. (2018) 'COASTAL DUNES OF THE BALTIC SEA SHORES: A REVIEW', QUAESTIONES GEOGRAPHICAE [Preprint]. Available at: https://sciendo.com/pdf/10.2478/quageo-2018-0005 (Accessed: 22 February 2022).

Liddell, H., Gilbert, J. and Halliday, S. (2010) 'The Domestic Chemical Cocktail', in. 5th Warwick Healthy Housing Conference, Edinburgh: Gaia Group. Available at: http://www.gaiagroup.org/assets/pdf/publications/The%20Domestic%20Chemical%20Cocktail.pdf (Accessed: 17 February 2022).

Lynch, K. (1960) The Image of the City. MIT Press.

Mandrup A/S, D. (2016) The Wadden Sea Centre, Denmark, Dorte Mandrup. Available at: https://www.dortemandrup.dk/work/wadden-sea-centre-denmark.

Marto, A. and Al-Bared, M.A. (2017) 'A review on the geotechnical and engineering characteristics of marine clay and the modern methods of improvements', Malaysian Journal of fundamental and applied sciences, 13. Available at: https://www.researchgate.net/publication/322064399_A_review_on_the_geotechnical_and_engineering_characteristics_of_marine_clay_and_the_modern_methods_of_improvements.

Miljø- og Fødevareministeriet (2019) Naturbeskyttelsesloven, 240. Available at: https://www.retsinformation.dk/eli/lta/2019/240.

National Museum, D. (no date) What were Viking homes like?, National Museum of Denmark - a collection of museums all over the country. Available at: https://en.natmus.dk/historical-knowledge/denmark/prehistoric-period-until-1050-ad/the-viking-age/the-people/viking-homes/.

Nielsen, L. (2013) Personas - User Focused Design. (Human - Computer Interaction Series). Available at: https://link.springer.com/book/10.1007/978-1-4471-4084-9.

Norberg-Schulz, C. (1996) Nightlands : Nordic building. Cambridge, Mass. : The MIT Press.

Postiglione, G. and Henschel, M. (no date) nineteen thirties nordic architecture.

Ringgård Christiansen, J. (no date) 'The unusual weather we are experiencing now may become the normal of the future'. Available at: https://vejr.tv2.dk/2020-02-22-det-usaedvanlige-vejr-vi-oplever-nu-kan-blive-fremtidens-normal.

Roua, V. (2016) Architecture In The Viking Age: Urban Planning, Emporia, And Strongholds, The Dockyards. Available at: https://www.thedockyards.com/architecture-viking-age-urban-planning-emporia-strongholds/.

Salomonsen, M. and Grølsted, E. (2020) 'Traditioner og fortællinger i Samsø Kommune', Trap Denmarks redaktion, 1 February. Available at: https://trap.lex.dk/Traditioner_og_fortællinger_i_Samsø_Kommune (Accessed: 16 February 2022).

Salvo, S. (2016) Restaurare il Novecento. Macerata: Quodlibet.

Samsø Badehotel (no date) Samsø Badehotel. Available at: https://samsoebadehotel.dk/vaerelsestyper/.

Sander, L., Fruergaard, M. and Pejrup, M. (2015) 'Coastal landforms and the Holocene evolution of the Island of Samsø, Denmark', Journal of Maps [Preprint]. Available at: https://www.researchgate.net/publication/272816771_Coastal_landforms_and_the_Holocene_evolution_of_the_Island_of_Samso_Denmark (Accessed: 28 February 2022).

Soltani, S. and Kirci, N. (2016) 'Phenomenology and Space in Architecture: Experience, Sensationand Meaning', International Journal of Architectural Engineering Technology, 2019, 6.

Thomas Hoffmann (no date) 'Sea Level Rise in Denmark'. Available at: https://videnskab.dk/naturvidenskab/danske-forskere-havet-vil-stige-mere-end-fns-klimapanel-regner-med.

Trap Danmark redaktion (2020) 'Byggeskik på landet i Samsø Kommune'. Available at: https://trap.lex.dk/Byggeskik_p%C3%A5_landet_i_Sams%C3%B8_Kommune (Accessed: 15 February 2022).

Uddannelsesguiden (2022) Receptionist, UddannelsesGuiden. Available at: https://www.ug.dk/uddannelser/erhvervsuddannelser/foedevarerjordbrugogoplevelser/receptionist.

Viking Houses (2010) Viking Denmark. Available at: http://www.vikingdenmark.com/viking-houses-architecture-inside-layout.html.

Visit Denmark (no date) 'Record Holiday Season in 2021'. Available at: https://www.visitdenmark.dk/corporate/om-os/nyheder/rekord-skuldersaeson-i-2021.

Visit Samsø (no date) Visit Samsø. Available at: https://www.visitsamsoe.dk/en/ (Accessed: 1 February 2022).

What is a Chef's Work Schedule? (no date) ecpi University. Available at: https://www.ecpi.edu/blog/what-is-a-chefs-schedule.

Zumthor, P. (2006) 'Atmospheres', in Atmospheres. Birkhäuser Architecture.

Zumthor, P. (2010) Thinking Architecture. 3rd edition. Birkhauser Verlag AG.

Figure List

Figure 2 (no date) Visit Samsø. Available at: https://www.visitsamsoe.dk/en/inspiration/issehoved-2/.

Figure 3 (no date) Visit Samsø. Available at: https://www.visitsamsoe.dk/en/inspiration/a-rolling-landscape-of-hill-and-dale/.

Figure 4 (no date) Visit Samsø. Available at: https://www.visitsamsoe.dk/en/inspiration/maarup-oesterstrand/.

Figure 5 (no date) Visit Samsø. Available at: https://www.visitsamsoe.dk/en/inspiration-paa-samsoe/the-taste-of-samsoe/.

Figure 6 (no date) Visit Samsø. Available at: https://www.visitsamsoe.dk/en/inspiration-paa-samsoe/the-taste-of-samsoe/samsoes-best-open-faced-potatosandwich/.

Figure 18 (1948). Available at: http://www5.kb.dk/danmarksetfraluften/images/luftfo/2011/maj/luftfoto/object312550/.

Figure 19 (1992) Samsø Kommune.

Figure 21 (2022) The existing Factory, 2022. Available at: https://skraafoto.kortforsyningen.dk/oblivisionjsoff/index.aspx?project=Denmark&lon=10.2027929&lat=56.1277927.

Figure 25 (no date) Visit Samsø. Available at: https://www.visitsamsoe.dk/inspiration/langoere-kirke/.

Figure 26 (no date) Samsoemuseum. Available at: https://www.samsoemuseum.dk/kultur-i-landskabet/brundby-stubmoelle/.

Figure 46 (no date) Tv2 Østjylland. Available at: https://www.tv2ostjylland.dk/samfund/lasse-villave-112-ar-gammel-fabrik-om-til-hotel-en-beslutning-afgor-det-hele.

Figure 65 (no date) The Badehotel Outdoor View. Available at: https://samsoebadehotel.dk/galleri/.

Figure 66 (no date) The Barn House Suite Typology. Available at: https://samsoebadehotel.dk/vaerelsestyper/barn-house-suites/.

Figure 67 (no date) The Classic Room Typology. Available at: https://samsoebadehotel.dk/vaerelsestyper/.

Figure 68 (no date) The Luxury Tent Typology. Available at: https://samsoebadehotel.dk/vaerelsestyper/.

Figure 69 (no date). RESTORE Working Group One, pp. 2017–2021. Available at: www.eurestore.eu.

Figure 73 (no date). RESTORE Working Group One, pp. 2017–2021. Available at: www.eurestore.eu.

Figure 74 (no date). RESTORE Working Group One, pp. 2017–2021. Available at: www.eurestore.eu.

Figure 75 (2007) E+N. Available at: http://eplusn.dk/restaureringsfilosofi.

Figure 76 (no date). RESTORE Working Group One, pp. 2017–2021. Available at: www.eurestore.eu.

Figure 78 (no date) The Dockyards. Available at: http://medieval.mrugala.net/Architecture/Danemark,_Slagelse,_Trelleborg/.

Figure 79 (no date) Viking Denmark. Available at: http://www.vikingdenmark.com/viking-houses-architecture-inside-layout.html.

Figure 80 (no date) Elgaard Archtiecture. Available at: https://elgaardarchitecture.com/en/project/the-kings-hall-at-lejre-land-of-legends/?fbclid=IwAR2OAnyOR_QYrD0UKtumXME0bMgwpsXZbo9TDUAkcLPsEVsljePELfNwgxc.

Figure 84 (no date) SHL. Available at: https://www.shl.dk/dk/katuaq-cultural-centre/.

Figure 85 (no date) Nordens Hus. Available at: https://nordichouse.is/da/norraena-husid-er-lokadyfir-hatidirnar-2/.

Figure 90 (no date) Ignant. Available at: https://www.ignant.com/2019/03/22/dorte-mandrups-sculptural-addition-to-the-wadden-sea/.

Figure 91 (no date) Pinterest. Available at: https://www.pinterest.dk/pin/544443042451183414/.

Figure 92 (no date) Ignant. Available at: https://www.ignant.com/2019/03/22/dorte-mandrups-sculptural-addition-to-the-wadden-sea/.

Figure 93 (no date) Inhabitat. Available at: https://inhabitat.com/3xn-unveils-denmarks-first-climate-positive-hotel-for-bornholm-island/hotel-green-solution-house-3xn-3/.

Figure 94 (no date) Inhabitat. Available at: https://inhabitat.com/3xn-unveils-denmarks-first-climate-positive-hotel-for-bornholm-island/hotel-green-solution-house-3xn-3/.

Figure 95 (no date) Inhabitat. Available at: https://inhabitat.com/3xn-unveils-denmarks-first-climate-positive-hotel-for-bornholm-island/hotel-green-solution-house-3xn-3/.

Figure 97 (no date) Archdaily. Available at: https://www.archdaily.com/902436/noma-big?ad_source=search&ad_medium=projects_tab.

Figure 99 (no date) Archdaily. Available at: https://www.archdaily.com/902436/noma-big?ad_source=search&ad_medium=projects_tab.

Figure 100 (no date) Archdaily. Available at: https://www.archdaily.com/902436/noma-big?ad_source=search&ad_medium=projects_tab.

Figure 101 (no date) Archdaily. Available at: https://www.archdaily.com/592660/nest-we-grow-college-of-environmental-design-uc-berkeley-kengo-kuma-and-associates.

Figure 102 (no date) Archdaily. Available at: https://www.archdaily.com/592660/nest-we-grow-college-of-environmental-design-uc-berkeley-kengo-kuma-and-associates.

Figure 103 (no date) Archdaily. Available at: https://www.archdaily.com/592660/nest-we-grow-college-of-environmental-design-uc-berkeley-kengo-kuma-and-associates.

Figure 104 (no date) Archdaily. Available at: https://www.archdaily.com/592660/nest-we-grow-college-of-environmental-design-uc-berkeley-kengo-kuma-and-associates.

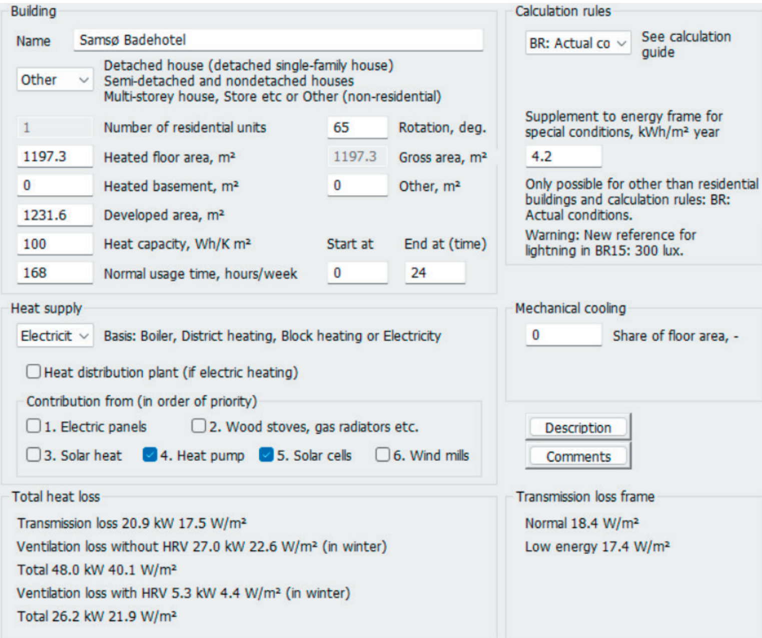
Figure 105 (no date) Archdaily. Available at: https://www.archdaily.com/592660/nest-we-grow-college-of-environmental-design-uc-berkeley-kengo-kuma-and-associates.

Figure 157 (no date) Phifer. Available at: https://www.phifer.com/product/sheerweave-performance-2390-2410-2500/.

Appendix

Appendix 2

Be18 calculations



Building

Name: Samsø Badehotel

Other — Detached house (detached single-family house) / Semi-detached and nondetached houses / Multi-storey house, Store etc or Other (non-residential)

1	Number of residential units	65	Rotation, deg.
1197.3	Heated floor area, m²	1197.3	Gross area, m²
0	Heated basement, m²	0	Other, m²
1231.6	Developed area, m²		
100	Heat capacity, Wh/K m²	Start at	End at (time)
168	Normal usage time, hours/week	0	24

Calculation rules

BR: Actual co — See calculation guide

Supplement to energy frame for special conditions, kWh/m² year: 4.2

Only possible for other than residential buildings and calculation rules: BR: Actual conditions.

Warning: New reference for lightning in BR15: 300 lux.

Heat supply

Electricit — Basis: Boiler, District heating, Block heating or Electricity

☐ Heat distribution plant (if electric heating)

Contribution from (in order of priority)

☐ 1. Electric panels ☐ 2. Wood stoves, gas radiators etc.

☐ 3. Solar heat ☑ 4. Heat pump ☑ 5. Solar cells ☐ 6. Wind mills

Mechanical cooling

0 Share of floor area, -

Description

Comments

Total heat loss

Transmission loss 20.9 kW 17.5 W/m²

Ventilation loss without HRV 27.0 kW 22.6 W/m² (in winter)

Total 48.0 kW 40.1 W/m²

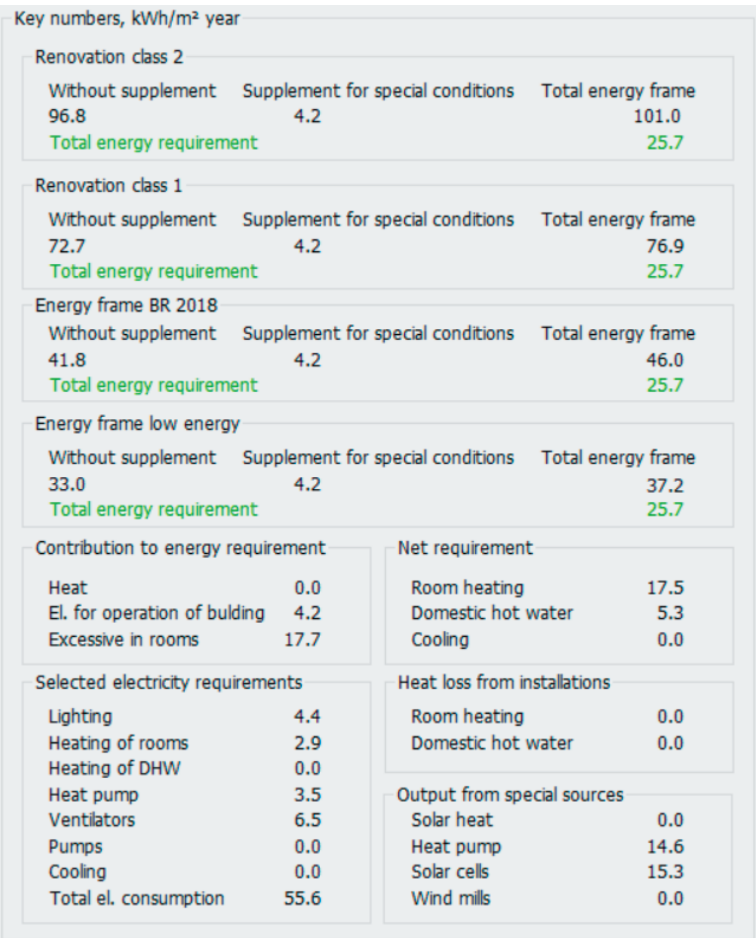
Ventilation loss with HRV 5.3 kW 4.4 W/m² (in winter)

Total 26.2 kW 21.9 W/m²

Transmission loss frame

Normal 18.4 W/m²

Low energy 17.4 W/m²



Key numbers, kWh/m² year

Renovation class 2

Without supplement	Supplement for special conditions	Total energy frame
96.8	4.2	101.0
Total energy requirement		25.7

Renovation class 1

Without supplement	Supplement for special conditions	Total energy frame
72.7	4.2	76.9
Total energy requirement		25.7

Energy frame BR 2018

Without supplement	Supplement for special conditions	Total energy frame
41.8	4.2	46.0
Total energy requirement		25.7

Energy frame low energy

Without supplement	Supplement for special conditions	Total energy frame
33.0	4.2	37.2
Total energy requirement		25.7

Contribution to energy requirement

Heat	0.0
El. for operation of bulding	4.2
Excessive in rooms	17.7

Net requirement

Room heating	17.5
Domestic hot water	5.3
Cooling	0.0

Selected electricity requirements

Lighting	4.4
Heating of rooms	2.9
Heating of DHW	0.0
Heat pump	3.5
Ventilators	6.5
Pumps	0.0
Cooling	0.0
Total el. consumption	55.6

Heat loss from installations

Room heating	0.0
Domestic hot water	0.0

Output from special sources

Solar heat	0.0
Heat pump	14.6
Solar cells	15.3
Wind mills	0.0

Fig. 212: Be18 Input and Output

BSim model and results

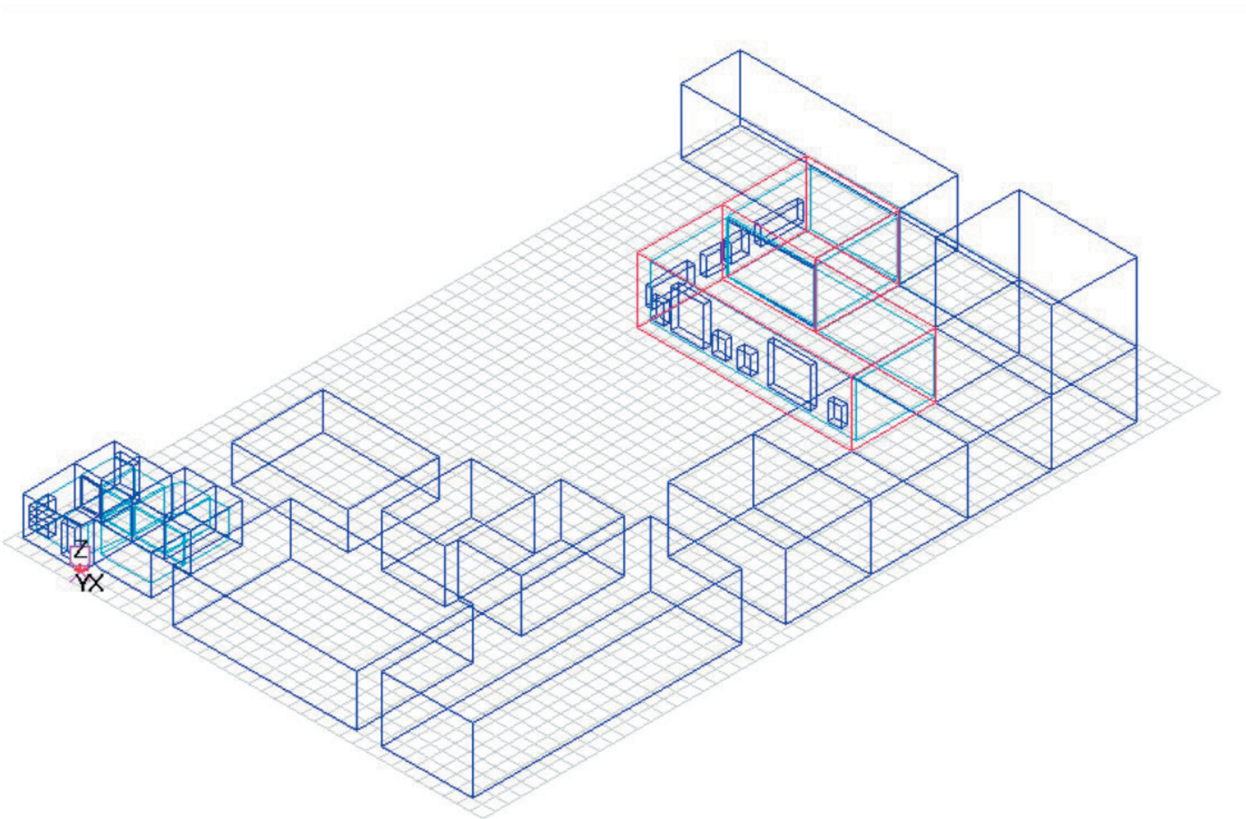


Fig. 213: BSim Model

2010 | Month | Hours | Restaurant

Restaurant	Sum/Mean	1 (31 days)	2 (28 days)	3 (31 days)	4 (30 days)	5 (31 days)	6 (30 days)	7 (31 days)	8 (31 days)	9 (30 days)	10 (31 days)	11 (30 days)	12 (31 days)
qHeating	257,52	64,62	33,05	5,51	0,01	25,96	5,65	0,00	0,00	2,71	0,00	34,97	85,05
qCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qInfiltration	-2564,08	0,00	0,00	0,00	0,00	-733,36	-527,97	-368,65	-407,50	-526,60	0,00	0,00	0,00
qVenting	-1629,24	0,00	0,00	0,00	0,00	-303,57	-312,24	-413,68	-325,88	-273,86	0,00	0,00	0,00
qSunRad	6971,58	155,73	311,86	647,84	801,27	903,08	846,68	884,06	852,44	741,00	494,86	211,93	120,82
qPeople	8760,00	744,00	672,00	744,00	720,00	744,00	720,00	744,00	744,00	720,00	744,00	720,00	744,00
qEquipmen	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qLighting	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qTransmiss	-9619,39	-1019,81	-982,45	-1199,18	-1159,79	-484,52	-501,48	-492,97	-518,47	-429,90	-924,43	-887,12	-1019,27
qMixing	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qVentilation	-2172,71	55,45	-34,42	-198,02	-361,25	-151,10	-229,12	-352,14	-344,29	-233,13	-314,31	-79,78	69,41
Sum	3,69	0,00	0,04	0,15	0,24	0,49	1,51	0,62	0,31	0,21	0,12	0,00	-0,00
tOutdoor me	8,1	0,7	0,4	-0,7	7,1	11,5	14,2	17,8	17,9	14,5	9,8	3,4	0,7
tOp mean(?	22,8	20,5	20,9	22,0	25,4	22,3	23,2	25,5	25,3	23,0	24,1	21,1	20,4
AirChange(/	0,8	0,3	0,3	0,3	0,3	1,4	1,5	1,9	1,7	1,4	0,3	0,3	0,3
Rel. Moistur	52,9	61,2	58,4	50,1	42,8	42,8	50,1	50,4	49,2	50,5	55,4	61,2	63,1
Co2(ppm)	1234,5	1700,4	1694,7	1687,6	1681,5	610,0	604,5	581,4	592,3	606,9	1675,1	1685,1	1693,9
PAQ(-)	0,1	0,2	0,2	0,2	0,1	0,4	0,2	-0,0	0,0	0,2	-0,0	0,1	0,2
Hours > 21	5955	157	248	501	699	434	566	744	744	661	722	331	148
Hours > 26	1074	0	0	15	285	62	95	257	233	21	106	0	0
Hours > 27	605	0	0	0	181	28	42	163	132	8	51	0	0
Hours < 19	0	0	0	0	0	0	0	0	0	0	0	0	0
FanPow	773,38	65,68	59,33	65,68	63,57	65,68	63,57	65,68	65,68	63,57	65,68	63,57	65,68
HtRec	4904,55	768,29	685,85	782,55	412,75	263,32	142,47	43,60	36,20	108,06	300,56	594,45	766,45
ClRec	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
HtCoil	617,33	175,02	103,43	24,03	0,43	38,05	10,50	0,00	0,00	2,86	0,04	80,17	182,80
ClCoil	-379,36	0,00	0,00	0,00	-1,41	-18,43	-53,48	-145,09	-132,71	-28,24	0,00	0,00	0,00
Humidif	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FloorHeat	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FloorCool	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentHeatPu	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentHeatPu	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

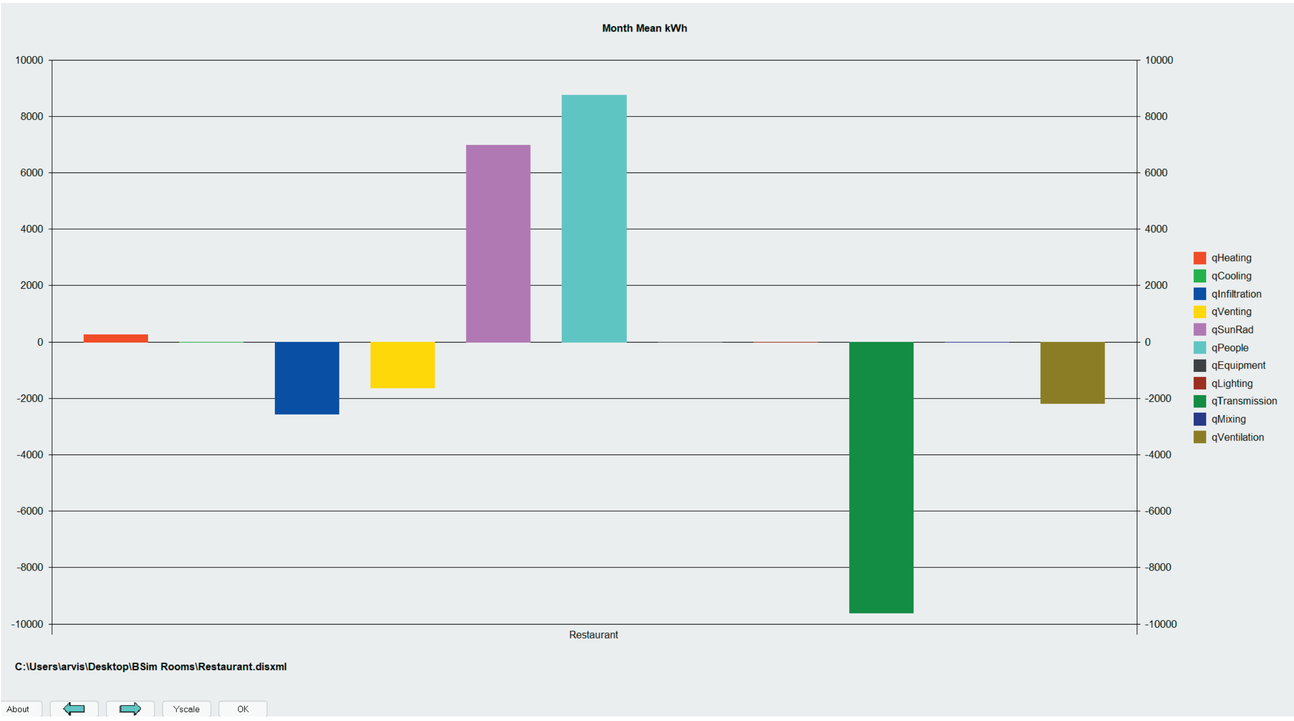


Fig. 214: BSim simulation, adding solar shading for large windows

2010 | Month | Hours | Restaurant

Restaurant	Sum/Mean	1 (31 days)	2 (28 days)	3 (31 days)	4 (30 days)	5 (31 days)	6 (30 days)	7 (31 days)	8 (31 days)	9 (30 days)	10 (31 days)	11 (30 days)	12 (31 days)
qHeating	287,45	84,23	41,83	3,48	0,01	5,99	0,40	0,00	0,00	0,20	0,00	44,94	106,37
qCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qInfiltration	-2583,85	0,00	0,00	0,00	0,00	-669,38	-516,34	-433,05	-460,53	-504,56	0,00	0,00	0,00
qVenting	-1985,65	0,00	0,00	0,00	0,00	-422,12	-378,44	-412,26	-387,32	-385,51	0,00	0,00	0,00
qSunRad	9010,93	198,68	402,84	853,83	1043,02	1165,77	1073,27	1119,47	1107,03	971,96	654,37	271,03	149,66
qPeople	8760,00	744,00	672,00	744,00	720,00	744,00	720,00	744,00	744,00	720,00	744,00	720,00	744,00
qEquipmen	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qLighting	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qTransmiss	-11097,30	-1082,05	-1063,54	-1353,59	-1353,02	-608,69	-641,72	-689,44	-683,55	-544,90	-1050,80	-949,13	-1076,87
qMixing	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qVentilation	-2387,24	55,15	-53,08	-247,55	-409,72	-215,00	-255,39	-327,99	-319,28	-256,94	-347,43	-86,84	76,84
Sum	4,33	0,00	0,05	0,17	0,28	0,57	1,78	0,72	0,36	0,25	0,14	0,00	-0,00
tOutdoor me	8,1	0,7	0,4	-0,7	7,1	11,5	14,2	17,8	17,9	14,5	9,8	3,4	0,7
tOp mean(?	23,6	20,5	21,1	22,8	26,6	23,3	24,4	27,3	26,9	24,0	24,8	21,3	20,4
AirChange(/	0,7	0,3	0,3	0,3	0,3	1,3	1,3	1,4	1,4	1,3	0,3	0,3	0,3
Rel. Moistur	50,7	61,0	57,3	47,0	39,7	40,8	47,1	46,3	45,2	47,7	52,7	60,5	63,1
Co2(ppm)	1241,1	1700,2	1693,5	1683,5	1675,8	623,8	621,0	615,4	612,5	617,9	1671,3	1684,3	1693,9
PAQ(-)	0,1	0,2	0,2	0,2	0,1	0,3	0,1	-0,1	-0,0	0,2	-0,0	0,1	0,1
Hours > 21	6261	140	275	598	706	503	637	744	744	695	729	350	140
Hours > 27	1441	0	1	40	321	106	143	353	319	48	110	0	0
Hours > 28	928	0	0	18	227	69	80	239	208	19	68	0	0
Hours < 19	0	0	0	0	0	0	0	0	0	0	0	0	0
FanPow	773,38	65,68	59,33	65,68	63,57	65,68	63,57	65,68	65,68	63,57	65,68	63,57	65,68
HtRec	4881,76	769,18	683,46	779,32	412,69	249,72	137,48	43,60	36,20	107,42	300,15	593,81	768,74
ClRec	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
HtCoil	568,15	175,93	95,12	12,41	0,21	14,26	0,52	0,00	0,00	0,61	0,00	80,11	188,99
ClCoil	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Humidif	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FloorHeat	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FloorCool	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentHeatPu	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentHeatPu	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

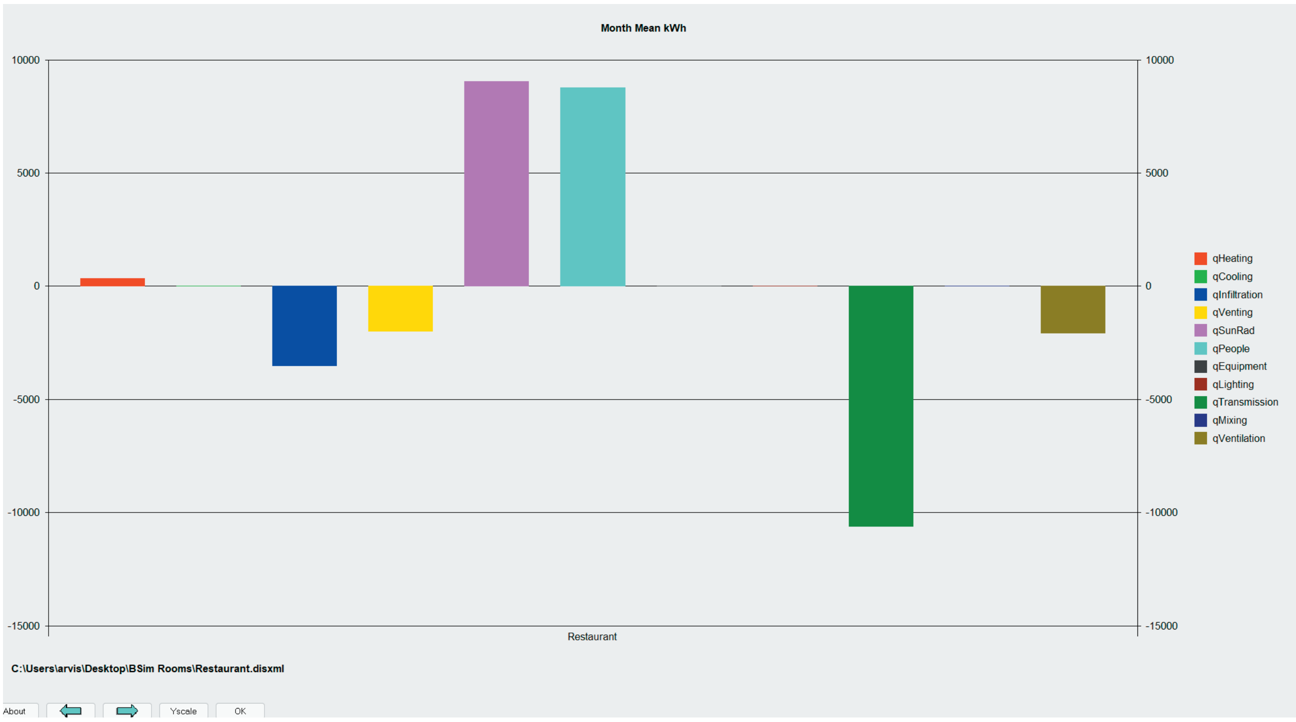


Fig. 215: BSim simulation, adjusting mullions for openings

2010 | Month | Hours | Restaurant

Restaurant	Sum/Mean	1 (31 days)	2 (28 days)	3 (31 days)	4 (30 days)	5 (31 days)	6 (30 days)	7 (31 days)	8 (31 days)	9 (30 days)	10 (31 days)	11 (30 days)	12 (31 days)
qHeating	2139,26	636,32	345,14	59,01	8,37	0,00	0,00	0,00	0,00	0,00	0,99	395,03	694,40
qCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qInfiltration	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qVenting	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qSunRad	11672,32	253,05	514,40	1095,59	1350,87	1524,84	1409,48	1467,87	1436,07	1248,92	834,94	346,05	190,26
qPeople	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qEquipmen	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qLighting	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qTransmiss	-13810,85	-889,37	-859,54	-1154,56	-1359,17	-1524,73	-1409,34	-1467,66	-1435,98	-1248,86	-835,91	-741,08	-884,66
qMixing	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
qVentilation	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Sum	0,74	0,00	0,00	0,04	0,07	0,11	0,14	0,20	0,09	0,06	0,02	0,00	0,00
tOutdoor me	8,1	0,7	0,4	-0,7	7,1	11,5	14,2	17,8	17,9	14,5	9,8	3,4	0,7
tOp mean(?	26,9	20,1	20,6	22,6	27,7	31,8	32,4	35,3	34,9	31,6	25,0	20,3	20,0
AirChange(/	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Rel. Moistur	35,6	49,1	48,2	43,4	32,6	26,0	24,8	20,9	21,3	25,6	37,7	48,8	49,2
Co2(ppm)	350,0	350,0	350,0	350,0	350,0	350,0	350,0	350,0	350,0	350,0	350,0	350,0	350,0
PAQ(-)	0,2	0,4	0,4	0,3	0,1	-0,0	-0,0	-0,1	-0,1	0,0	0,2	0,4	0,4
Hours > 21	5834	36	128	510	681	744	720	744	744	720	711	81	15
Hours > 27	4167	0	1	47	459	638	688	744	744	697	149	0	0
Hours > 28	3810	0	0	26	382	551	629	744	744	651	83	0	0
Hours < 19	0	0	0	0	0	0	0	0	0	0	0	0	0
FanPow	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
HtRec	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
ClRec	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
HtCoil	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
ClCoil	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Humidif	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FloorHeat	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
FloorCool	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentHeatPu	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentHeatPu	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
CentCooling	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

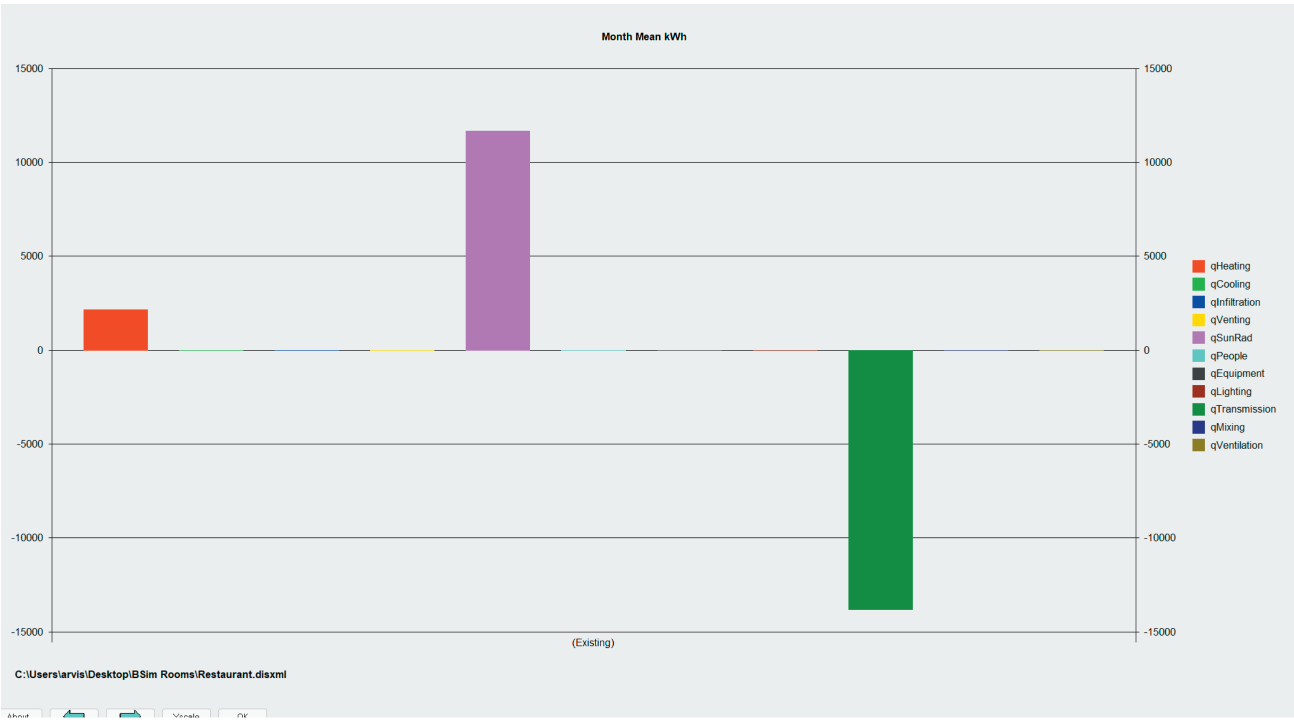


Fig. 216: Raw data and BSim using only heating as starting point

LCA results

2 Miljøprofil

Tabellen viser de vigtigste nøgletal fra projektet. Nøgletallene er fordelt på de 9 indikatorer som LCAbyg understøtter, samt fordelt for de enkelte livscyklusfaser der udgør bygningens miljøprofil. Miljøprofilen er givet for den totale udledning samt pr. kvadratmeter etageareal pr. år, hvilket gør resultaterne sammenlignelige med andre projekter, forudsat at disse er angivet med samme enhed.
Af nederstående tabel findes den mest anvendte indikator, GWP. De resterende 8 fra LCAbyg findes på næste side.

	GWP **Pr. referenceenhed** **[$kgCO_2$-eq/m^2 pr. år]**	**GWP** **Total** **[$kgCO_2$-eq]**
Sum projekt	4.54	320133.46
Sum materialer (A1-3, A4, A5, B4, C3-4)	4.75	334648.6
Produkt (A1-3)	-0.59	-41733.48
Transport til byggeplads (A4)	0.04	2560.76
- Transport (byggevarer)	0.04	2560.76
- Transport (jord, byggeaffald, oplagring mv.)	0.0	0.0
Opførelse / montering (A5)	0.37	25918.96
- El i byggeproces	0.0	0.0
- Fjernvarme i byggeproces	0.0	0.0
- Brændstof i byggeproces	0.0	0.0
- Transport på byggepladsen	0.0	0.0
- Spild	0.37	25918.96
Udskiftninger (B4)	0.55	38765.5
Energiforbrug til drift (B6)	0.2	13964.59
- El til drift	0.23	13964.59
- Varme tl drift	0.0	0.0
Endt levetid (C3-4)	4.39	309136.85

Fig. 217: LCA results, final report