ANNET S. EXPETHIT & HOA NGUYEN

A RESEARCH AND VISITOR CENTRE OF CLIMATE CHANGE

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DEPARTMENT OF ARCHITECTURE, DESIGN & MEDIA TECHNOLOGY

MASTER THESIS 2020

ARCH. GROUP. 12

Bergen Research and Visitor Centre of Climate Change

Bergen Forskning av Besøk Senter

TITLE PAGE

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DEPARTMENT OF ARCHITECTURE, DESIGN & MEDIA TECHNOLOGY

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AD NYE VEJE

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MARIE FRIER HVEJSEL — PRIMARY SUPERVISOR
ASSOCIATE PROFESSOR, DEPARTMENT OF ARCHITECTURE, DESIGN & MEDIA TECHNLOGY
ASSOCIATE PROFESSOR, THE TECHNICAL FACULTY OF IT AND DESIGN
SECTION FOR ARCHITECTURE AND URBAN DESIGN
TECTONICS IN ARCHITECTURE (TiA)

DARIO PARIGI — SECONDARY SUPERVISOR
ASSOCIATE PROFESSOR, DEPARTMENT OF CIVIL ENGINEERING
ASSOCIATE PROFESSOR, THE FACULTY OF ENGINEERING AND SCIENCE
DIVISON FOR STRUCTURES, MATERIALS AND GEOTECHNICS
ADVANCED STRUCTURAL ENGINEERING RESEARCH GROUP

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ANNET SHERIN EXPETHIT. :AUTHOR
CAND. POLYT. STUD.

THI HOA NGUYEN :AUTHOR
CAND. POLYT. STUD.

TITLE PAGE
MB

ABSTRACT |.

SAMMENDRAG /'abstrakt/$_{(Dict)}$

RESEARCH AND VISITOR CENTRE OF CLIMATE CHANGE

60° 23' 50.049" N, 5° 21' 3.7008" E

FIG.01:OVERVIEW BERGEN AND ITS LANDSCAPE FROM THE MOUNTAIN OF FLØYEN

PRELIMINARY

This Thesis is compiled in the year of 2020, by Cand. Polyt. Students Annet Sherin Expethit and Hoa Nguyen at the Master Programme of Architecture and Design, Department of Architecture, Design & Media Technology at Aalborg University, Denmark. The topic of the Thesis transpired in the light of a mutual interest in Tectonics and the sensibility of Architecture, which we feed into a dialogue with the issue of our time; Climate Change and Sustainability.

ENGLISH

This Thesis outlines our take on Environmental Tectonic, manifested in a Research and Visitor Centre of Climate Change in the Nordic context of Bergen, Norway. Through an instrumental framework of theoretical and case studies and design explorations, the objective is positioning the complexities of Climate Change in the platform of Tectonics and its sensitivities. The integration of these fields attempts to address the role of Architecture in relation to man, climate and structure, and places a critical position on the contemporary approach in the Built Environment which increasingly isolates the man from the Architecture in the interest of energy efficiency. With the point of departure in the site, the Thesis centres the foci upon the city's transformation from Rain City to Climate City; a repercussion of man-made Climate Change, which implies issue of increasing Water, both from the sea and sky. Hence, the forces of the Water are allowed an authorship role in the making of the Architecture, both in its challenges and viability and evokes an interdisciplinary architectural agenda. In the landscape of North Sea in Bergen, the concept merges the element of Water and Architecture into a catalyst to mediate a confrontation of our consumerism culture. The Research and Visitor Centre of Climate Change aims to bridge and create interactions across students, scientists, researchers and society to create transparency between man and knowledge. Thus, it strives to unfold a collaborative platform for knowledge and learning that can inspire and influence us to rethink and alter the way we live, learn and acts. A platform that gathers a community and embeds a new narrative about Bergen as a front runner of Research and Sustainability.

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|| READING THIS THESIS

LESE \'le:se\(Dict)

THE STRUCTURE OF OUR THESIS

STRUCTURE OF CONTENTS

FIG.02: CHRONOLOGY

The Thesis is structured in the contents of Prologue,Methodology, Theory, Analysis, Concept, Design Development and Epilogue projecting a comprehensive picture upon our approach towards a new architectural typology of exploration, learning and research. Prologue and Methodology introduce our readers the scope and the instrumental methods and approaches. Theory presents the theoretical framework. Analysis and Design Development outline our analyses, in qualitative and quantitative manners, and how they set the ground for our design criteria, and thus inquiries and studies. Concept and Epilogue, outline our proposition of an Architecture of interdisciplinary character and our reflective thinking upon the result and the process towards it. The Thesis has a linear sequence of representation, however the process of designing has in experience been accessed as a parallel dimension with both overlaps and interweaves of research, analysis and sketching. Throughout the Thesis, subjects are elaborated and discussed by means of figures and texts.

Hence, a collection of photographs, diagrams, drawings and graphs are illustrated, giving a comprehensive figure of the complexity of the field, and yet, we do not shy away from equations to reinforce the understanding of the topic. Each chapter withholds a section of Notes which elaborates or expands a certain notion or topic in the text to broaden the understanding of the context, for instance, a short biography of significant theorists, architects or other interested parties. The Notes is signified in the respective text by a numeric notation(Note: A) and are cross-referred to the relevant pages. The Thesis is further supported by Appendix which withholds vital design decisions in further detail within simulations and calculations to emphasis the foundation of experiments. Additionally, QR-codes are respectively presented in the initial introduction of Bergen, refering to videos of the Site and allowing the reader to obtain an appreciation of context beyond the printed report, and later in the Design Development, leading the reader to an external link, in which early studies and sketches are presented.

ACKNOWLEDGEMENT .|||

ANERKJENNELSE /ˈɑnærçɛn:əlse/(Dict)

OUR GRATITUDE

This Thesis commences with an acknowledgement to our supervisors Marie Frier Hvejsel and Dario Parigi. With their respective fields of research and knowledge of Architecture and Tectonics, at Aalborg University, they have provide dedicated guidances and critiques that have been crucial for the direction, cohesion and substance in our Thesis. Marie's feedback has enforced critical and reflective thinking upon our methods and approaches in design. This imposed an attentive focus on the objective for each employed theories and actively employ them in studies and design decisions. Furthermore, they have motivated us to challenge ourselves and reach areas beyond our range of knowledge.

AALBORG UNIVERSITY

A special thank to James David William Holtom, GIS-adviser from Bergen Municipality, for responding to our request and providing the 3D model of Nordnes, Bergen, which is necessary for carrying out our analyses and modelling of our proposal of the Visitor and Research Centre. A sincere thank to Åge Vallestad, the City Architect of Bergen Municipality, for sharing and showing us the strategies for developing Bergen into the greenest city in Norway.

BERGEN MUNICIPALITY

Annet S. Expethit & Hoa Nguyen

AALBORG
MAY.2020

IV. FOREWORD

FORORD \'foru:r\(Dict)

WHY WE WRITE THIS THESIS

COPENHAGEN. 2019. 8.00 PM

We came across the theme of Climate Change, as we sat down to write our Thesis Synopsis in rainy Copenhagen in a November evening. We look outside the window and recalled, how the weather in November felt like, when we were kids, and how it is now. Though, thermal experience is subjectively conceived and memories are diffused, we did agreed that the year of 2019 is distinctly rainy and that Climate Change is upon us. In the soft lighted living room, we exchanged observations and thoughts on how, the Climate Change subject is discussed in homes, in politics, in business and in Architecture. And in recent years, we noticed an increase of series of sustainable initiatives and tendencies to reduce our emissions of Carbon Dioxide, CO_2, such as plant-based products in the food market, shared electric cars in the cities and upcycling of construction materials in Built Environment. However, our consumption is evidently the root to the crisis we are facing.(NASA. Climate Change) Further in the discussion, we frankly admitted to one another that the notion of *Sustainability* is not always in our consciousness when we consume in the everyday life, referring to the previous evening in which we energetically talked about travels, cultural and culinary experiences. We found ourselves in a state of euphoria within two seconds in the conversation without considering the repercussions of our desires. Silence replaced our voices in the living room as saying it out loud project in a way a confrontation with our consciences.

Today, our choices, actions and behaviour are in accordance to norms, they are figuratively static and embedded in us, even though we at a principle plan are aware that our choices are consequential for our planet Earth; why is that? Instinctively and based on our own thoughts, we conjectured, this is i.a. grounded in our conception of Climate Change as a distant threat and we are in a way emotional numb in spite of the experiences of extreme events of precipitation and heat wave.(NASA. Climate Change) Thus, shifting in behaviours is difficult, even though it depends on the individuals and it depends on the society, as a whole, to rethinking the way we live. Looking outside the window, the rain has increased its intensity and forced the constantly noisy traffic on roads to slow down, and swiftly the light of our phones caught our attention with its News notification with a forecast of the wretched weather as a result of Climate Change, and draw us outside the contemplative state of mind. With the phones in our hands, we came to a realisation that the issue of Climate Change is dominantly mediated to society through the platform of social media and News; the facts are provided to us, as no one seeks knowledge. Knowledge of Climate Change seems inaccessible and intangible for us, as we either do not know where to seek for it or we do not care, even though we all are stakeholders in our planet Earth. Here, we discussed if knowledge has to be displayed and mediated through another platform to stimulate people's emotions and awareness.

As we reflectively discuss this subject in the late evening with the aim of grasping a substantial theme for our Thesis, we questioning if our role as aspiring Architects / Engineers can confront people and ourselves, and inspire them and us to rethink the way we consume of Earth's resources? With these questions, we identified a driving force for our Thesis, and our emotions and motivations were set in motion:

"*No one can predict the future, however anyone can influence it. So, how can we inspire people to rethink the way we live and solve some of our biggest challenges* "

(Expethit and Nguyen, 2020)

The excitement took its turn and a frustration emerged in our bodies and minds, as we looked at one another and asked in which context; country, city, urban, rural, should our Thesis unfolds? Where do we start and how do we set the constraints? Without discussion, we opened our computers and started the search engine. Silence emerged again, as our focus and concentration are placed at the blue-lighted screens. The sounds of typing and clicking reflected our annoyed irritations and frustrations, and as minutes passed by, our body language and the intensified sighing in the room emanated a negative energy, affecting our moods, spirits and motivation.

At the verge of dropping the subject, we incidentally initiated a dialogue about the projects, we were involved with at our respective internships. Here, we found a common denominator; Bergen, at the east coast of Norway, which we found relevant and intriguing due to its landscape, its nature and its foci on the subject of social and environmental sustainability, as it experiences an increase of migration towards the already dense urban areas in the city, and an extensive increase of precipitation, as an environmental consequence of the Climate Change.(Iversen, 2018)

This Thesis is thus our view of how to engage Architecture to confront and narrative a message of our consumption, and how Architecture can unfold a collaborative platform for learning and exploration to bridge the alleged gap in the understanding of the scarcity of resources in relation to our actions and behaviour. The Thesis deals with this subject in a qualitative and experimental manner by means of discussion, reflective assessments and studies within the framework of interdisciplinary. The result of the Thesis might not make ends meet. However we believe it might raise dialogue, discussion or wondering of how we can reach out to societies and confront them; our planet Earth is drowning in our consumption.

FIG.03:
FLOODED CITY AS A RESULT OF CLIMATE CHANGE(Photo by Cristina Gottardi)

"No one can predict the future, however anyone can influence it. So, how can we inspire people to rethink the way we live and solve some of our biggest challenges"

(Expethit and Nguyen, 2020)

V. MOVITATION

MOTIVASJON \mutivaˈʃuːn\(Diet)

OUR THOUGHTS AND EXPECTATIONS

PRELIMINARY

This is a motivational note, outlining our thoughts and expectations of this Thesis. It takes a starting point in our critique upon the contemporary dynamics and mechanisms in the Built Environment and shifts into our interests in Tectonics. We must stress, the following is biased and narrated based on our observations and experiences. Hence, the opinions and statements are not objective or factual.

CRITIQUE UPON CONTEMPORARY ARCHITECTURE: WHERE IS THE SENSORY EXPERIENCE AND CONTEXTUAL RELATION?

In our conception of the contemporary Architecture throughout the years as students at Architecture and Design, a certain scepticism has gradually emerged. We distinguished a bias and tendency of generic discourse, as it is projected from a catalogue, which is presumably assessed and based on economy, return of interest and political calls. The scepticism is further enhanced in the fall of 2019, in which we enrolled Internships at architectural practices in Copenhagen. The experiences opened our eyes to how the art of Architecture is structured; oppressing the sensory and aesthetic attributes and distancing in regard to its context in the interests of economic profit. In the continuation of the understanding Architecture as it is today, we perceived a recurring discursive theme *Sustainability*, that has arisen as a response to the increasing crises of Climate Change. As cited in the introductive Foreword,(Ref. Foreword p. 12)' the notion is influential in relation to politics, to society and namely to the field of Architecture, which we find relevant and essential for our future. However, in our opinion, the pressing environmental and ecological challenges have altered a concentrated focus on measurable means such as Carbon Dioxide, CO_2, footprints and energy usage, manifested in the concepts on for instance Zero Energy Buildings and Passive House. The concepts fostered an increased implementation of technology and layers of constructions,(Hvejsel, 2018)' that challenge and confront the articulation of Architecture and our sensuous bodies.

DOES IT REFLECTS UPON OUR EDUCATION?

This discourse has changed the dynamics of roles in the Built Environment and called for holistic-based approaches of interdisciplinary, implying an increasing collaboration between engineers, architects and additional consultants.(Foged and Hvejsel, 2018) Hence, the role of the architect is diffuse. The discourse does not only apply in practice in the Built Environment, but it influences and marks the educational field as well. To illustrate; at our own education *Architecture and Design*, *Department of Architecture, Design and Media Technology*, the curriculum comprises of courses and projects that place a great emphasis on this issue of Climate Change(Aalborg Universjty, 2015 and Aalborg University, 2017) We are encouraged to learn and understand the notion of, for instance, the concept of Adaptive Architecture in order to create designs, which can accommodate and mitigate the effects of Climate Change. Furthermore, we are encouraged to embody the art of interdisciplinary; a cross -field of architecture and engineering to accomplish a holistic solution, which is manifested in the approach of Integrated Design Process.(Knudstrup, 2004) Though, we embrace and appreciate the potentials of interdisciplinary and find it vital for designing and creating viable architectural solutions, we do not concur with this approach in our position of practising Architecture, as we find it as unnuanced that compromise the reflective and philosophical aspects, as the quantitative measures are the decisive and dominating criteria.

THESIS IS OUR PLATFORM FOR EXPLORATION AND LEARNING

Our position upon the contemporary Architecture is partially the initiator for our common interest in the theme of Tectonics. We believe it withholds a range of potentials to create Architecture, that reintroduces an embrace of the perceptual aspect and of our bodily senses into the Built Environment, as it cultivates the interaction between technique and aesthetic in the creation of architectural articulation. (Frampton, Ed. Cava, 1995) ' (Hvejsel, 2019) Hence, the notion of Tectonics is a motivational factor for our Thesis. However, this does not necessarily serve us a viable solution or it might be an inappropriate approach in the reaction of the discourse today. With Tectonics as an overall topic and a common thread, we identify this Thesis as a platform for personal learning and exploration, as the notion is comprehensive and complex due to its embrace of a broad variety of interrelated aspects. Thus, this notion is studied and examined critically in the chapter of Theory. (Ref. Tectonics: A Critical And Theoretical Study p. 68) In continuation, with this Thesis we perceive a vast opportunity to develop our individual approaches; reformulate and cultivate them. We perceive an opening to gain academic returns, as an entity and as individuals, and to challenge and advance our competencies within literature, creative, critical and reflective thinking. Hence, the process of this Thesis is a learning process as well as regarding design.

0.1.0 LIST OF CONTENT
0.1.1 CONFRONTATION
0.1.2 INTRODUCTION
0.1.3 KNOWLEDGE AND COMMOM LANGUAGE
0.1.4 BERGEN

0.1.0 PROLOGUE

PROLOG \ pru'lo:g\ (Diet, n.d.)

CHAPTER CONTENT

The Prologue intends to outline the introductional aspects of the Thesis. It takes a starting point in a diagrammatic confrontation of our climatic challenges, that serves to position the thematic pivot point in this Thesis. Subsequently, the Introduction draws the scopes; The Problem, the Potential and the Platform, and aims to illustrate an overall picture for our readers. Inherently, it introduces the selected site Bergen, which is captured in a video sequence. Access to the video is through the following QR-code.

FIG.04: WATER (Photo by Photo by Silas Baison)

0.1.1 CONFRONTATION

KONFRONTASJON \kunfronta'ʃu:n\ (Dict, n.d.)
THE CLIMATE CHANGES AT GLOBAL SCALE

FIG.05:CARBON DIOXIDE, CO_2

PART PER MILLION (PPM) 413↑

DATA IS FROM NASA, GLOBAL CLIMATE CHANGE

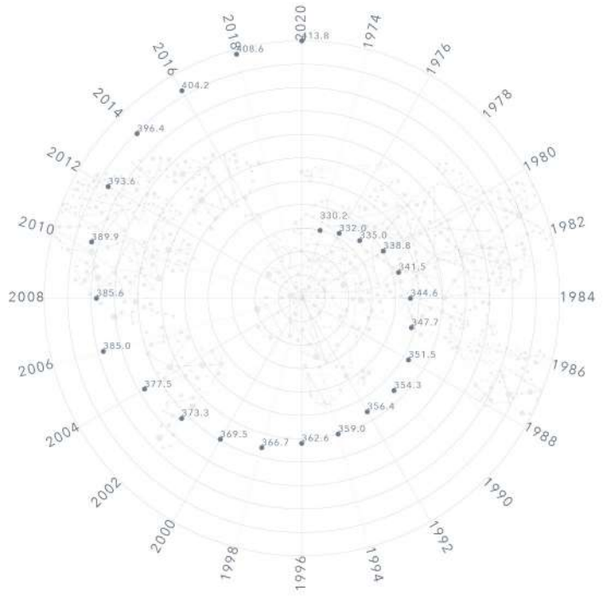


FIG.06: GLOBAL TEMPERATURE

SINCE 1880 0.98°C↑

DATA IS FROM NASA, GLOBAL CLIMATE CHANGE

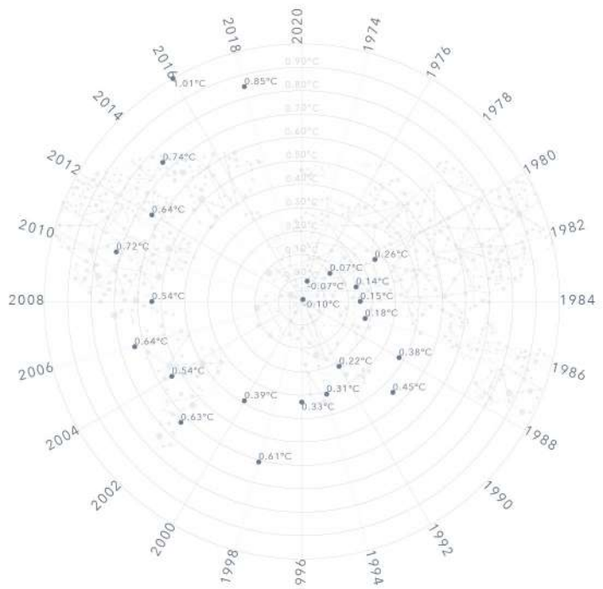


FIG.07:ICE SHEETS MASS

GREENLAND MASS VARIATION

↓281.0 GIGATONNES PER YEAR

ANTARCTICA MASS VARIATION

↓146.0 GIGATONNES PER YEAR

DATA IS FROM NASA, GLOBAL CLIMATE CHANGE, ICE MASS MEASUREMENT BY NASA'S GRACE SATELITES

FIG.08: SEA LEVEL [MM]

↑3.3 MILLIMETERS PER YEAR

DATA IS FROM NASA, GLOBAL CLIMATE CHANGE, NASA GOODARD SPACE FIGHT CENTER

FIG.09: THE CRUCIAL MAGNITUDE

QUETION WORDING:
Which of the following do you consider to be the most serious problem facing the world as a whole?

DATA IS FROM CLIMATE CHANGE REPORT 2011 BY EUROPEAN COMMISSION

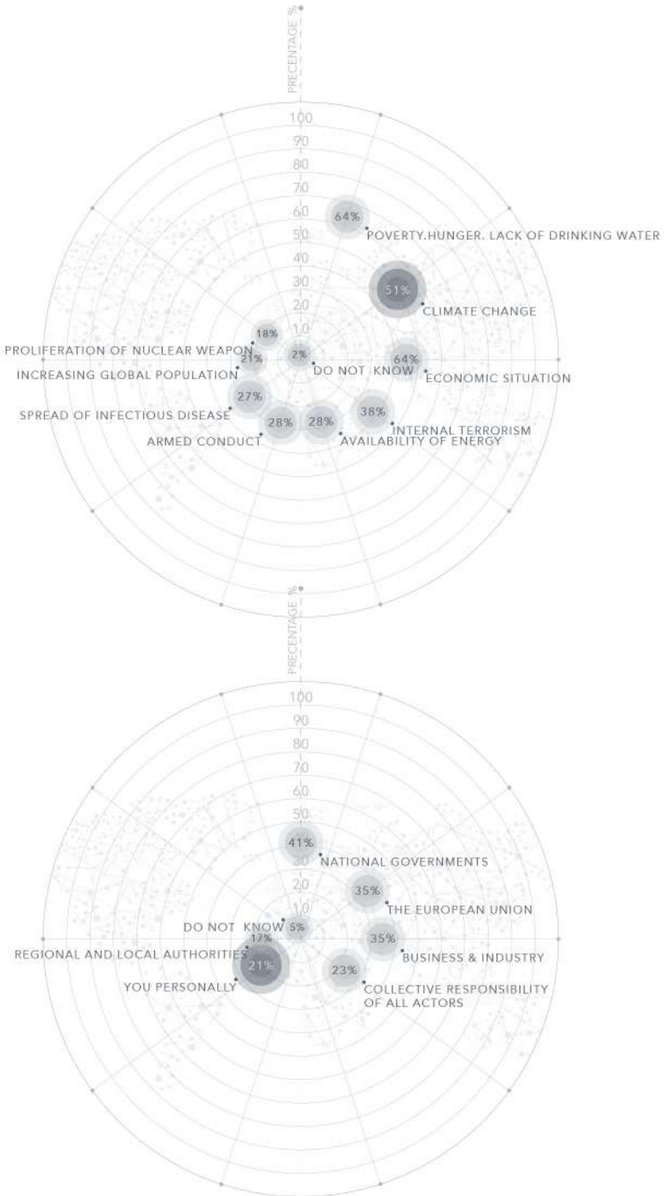


FIG.10: RESPONSIBILITY ON CLIMATE CHANGE

QUETION WORDING:
In your opinion, who within the EU is responsible for tacking Climate Change?

DATA IS FROM CLIMATE CHANGE REPORT 2011 BY EUROPEAN COMMISSION

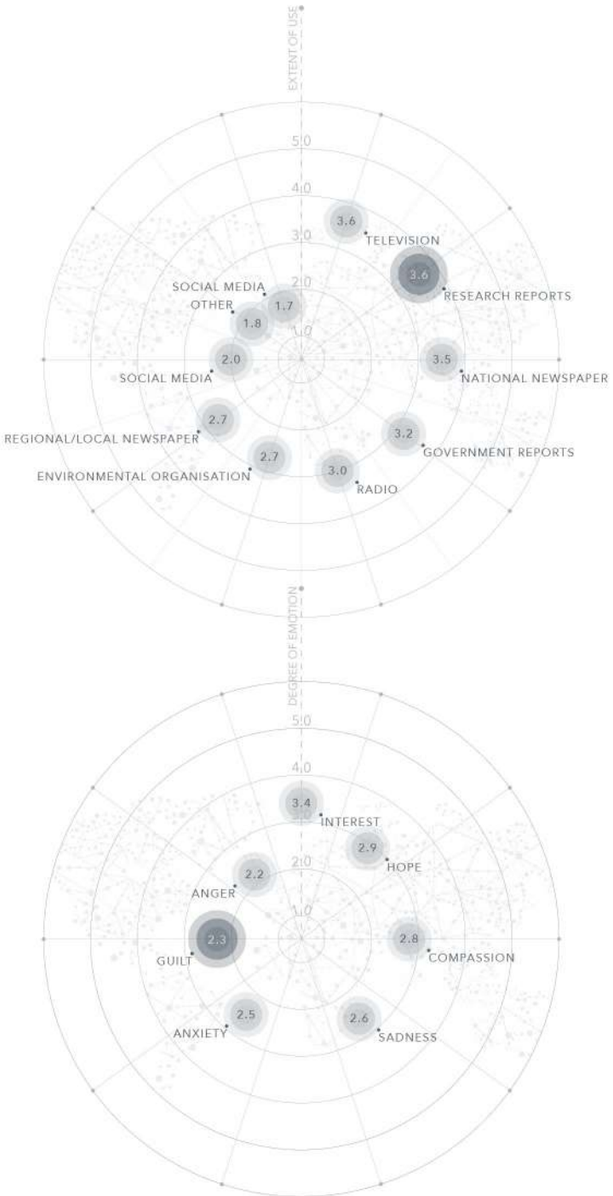


FIG.11:MEDIA USE CONCERNING INFORMATION ABOUT CLIMATE CHANGE

QUETION WORDING:
How important are the following sources to you when you seek information on Global Warmning or Climate Change?

DATA IS FROM NORWEGIAN CITIZEN PANEL DATA WAVE 2 MARCH 2014

FIG.12:EMOTIONAL REACTIONS TO CLIMATE CHANGE

QUETION WORDING:
With regards to Climate Change and everything you relate to it, how strongly do you experience the following emotions?

DATA IS FROM NORWEGIAN CITIZEN PANEL DATA WAVE 2 MARCH 2014

FIG.13: 1:10.000.000 MAP OF SCANDINAVIA

FIG.14: EMISSIONS OF CARBON DIOXIDE$_2$ BY OUR CONSUMPTION

FIG.15: APPLYING A NEW LAYER UPON THE EXISTING RESEARCH CENTRE

FIG.16: COMBINING RESEARCH AND LEARNING

INTRODUCTION 0.1.2

PRESENTASJON \presenta'ʃu:n\(Dict, n.d.)

THE SCOPE OF OUR PROJECT

Ref. Introduction
Index. Bjerknes Centre for Climate Research
Index. Bergen
Index. Water
Index. NORCE
Index. Nansen Environmental and Remote Sensing
Index. Institute of Marine Research
Index. University of Bergen

PRELIMINARY

The following introduces our readers the scope of the Thesis. The *Introduction* is distinguished in three complex of themes, which outline the point of departure for our Thesis. The first represents the problem; the issue of Climate Change and its consequences. The second denotes the potentials, and the third outlines the platform.

1. PROBLEM:
HUMAN-CAUSED CLIMATE CHANGE AND PEOPLE'S KNOWLEDGE OF IT

According to NASA, Climate Change is considered inevitable and the temperature of the globe continues to rise rapidly in the decades to come.(NASA. Global Climate Change, n.d.) Its forces and dynamic affects are consequential for man and nature. Hence, it has a far-reaching effects on us, human beings, and our ecosystems.(Ibid) There is scientific consensus, that Climate Changes are upon us and have already had consequential effects on our environment; shrinking ice sheet, accelerated sea level rise, intense events of heat waves and precipitation.(Ibid) Climate Changes are man-made, as it is evidently a result of human's industrial activities and thus usage of Earth's resources over the last 50 years, increasing the concentration of atmospheric Carbon Dioxide CO_2.(Ibid) In order to reduce the severity of Climate Change impacts, mitigation measures must take action in which the objective is to reduce the emission of CO_2.(European Environmental Agency, n.d.) Hence, it is essential to foster a change of lifestyle and behaviour, thus our CO_2 footprint. However, in spite of the repercussions of Climate Change, we continue our everyday life in the culture of consumerism, without resource-awareness, as the knowledge of Climate Change does not reach our threshold of comprehension.

2. POTENTIALS:
BJERKNES RESEARCH CENTRE FOR CLIMATE CHANGE IN BERGEN

With the existing Bjerknes Centre for Climate Research(Note: 0.1 p. 40) in Bergen, Norway, we conceive a potential and an opportunity for developing a platform to bridge a gap between the knowledge of Climate Change and us. Hence, an opportunity for creating a transparency between Research and Man with the aim of mediating and enhancing awareness and knowledge, and thus shift attitudes and behavioural intentions in our everyday life. In this way, we add a second layer to the function of Bjerknes Centre and redefine its role in Bergen. Bjerknes Centre for Climate Research is inherently a collaborative platform that involves other connections of research such as the University of Bergen(Note: 0.2 p. 40)', NORCE (Note:0.3 p. 40)', Nansen Environmental and Remote Sensing Centre(Note: 0.4 p. 40)' and Institute of Marine Research.(Note: 0.5 p. 40) (Bjerknes Centre for Climate Research, n.d.) In conjunction with this, we perceive a vast potential for creating a global Research Community by merging the collaborative environment of Bjerknes Centre with Bergen's ambition of being the greenest city in Norway. Such a configuration sets the framework for Bergen's as frontrunner for Research and Sustainability.

3. PLATFORM:
A RESEARCH AND VISITOR CENTRE OF CLIMATE CHANGE AT THE NORTH SEA

In the North Sea, at the edge of Nordnes, Bergen, the potentials are articulated and manifested in our proposition of an new distinct typology, which combines the cornerstone of knowledge with the notion of a learning landscape with experience and movement. Hence, a *Research and Visitor Centre of Climate Change* that can facilitate and build bridges and interactions across scientists, researchers, students and inhabitants of societies. A place that encourages and empowers learning, exploring, exchanging and sharing visions, ideas and knowledge with the objective of reaching our common goals.(Note: 0.2, p. 40) And a place, where we are allowed to raise critical and inquisitive questions in the understanding of our own impacts on the environment. With virtue in the placement in the North Sea, the *Research and Visitor Centre of Climate Change* can offer us, as static users and dynamic visitors, a vantage point from which to absorb the landscape of Water, which is a trademark for Bergen(Iversen, 2008) and in which the Thesis will take its starting point. Furthermore, it can have a mediating part, a catalyst, that confronts societies with our culture of consumerism and that narratives the possible prospect of our future, if we do not act on the threat.

-68°49'59.99" S -90°34'59.99" W

It is evidential that Climate Changes are man-made and the sequences of consequences are far-reaching. Despite the evidences and research, we as citizens do not respond upon it, as the communication of it is beyond or outside our vocabulary. Experiencing the consequences might initiate the radical changes.

FIG.17: ICE OF ANTARCTICA IS MELTING AS A CONSEQUENT OF OUR CO_2 EMISSIONS

(Photo by Cassie Matia on Unsplash)

KNOWLEDGE AND COMMON LANGUAGE

0.1.3

Ref. Knowledge and Common Language

VITEN OG FELLESSPRÅK \'vi:tən\ \'fel:es˙spro:k\ (Dict, n.d.)

THE ROLE OF MEDIATING

The following introduces the aspect of communication of the increasing challenges of Climate Change, and critially addresses the present and actual medias. Upon our discussion in the living room (Ref. Foreword p. 12)', regarding the topic of comprehension of Climate Change, we perceive a need to raise a critical dialogue in this Thesis to continue addressing the presumptuous issues of the platforms in which the knowledges of Climate Change are mediated. The ecological challenges seem continuously distant from the dimensions of our everyday lives, and consequently our understanding and shift of attitudes and behavioral intentions are suspended. (Taddicken et.al, 2018) This study also examines how Climate Change perception can be emphasised by means of Architectural experience.

PRELIMINARY

HOW IS THE ISSUE OF CLIMATE CHANGE MEDIATED?

While Climate Change has been singled out as one of the greatest pressing global challenges, we, as society, still tend to downplay its role and the risks it involves. (APS, n.d.) Nevertheless, its role is essential as it is consequential for our environment, and hence, concerns economic, ethical and political aspects. (Taddicken et.al, 2018) As accentuated previously, we may ask ourselves why we in spite of the emerging crises continue our culture of consumerism and lack of confrontation upon the act? Is it a consequence of the present communication methods or is it the attributes of Climate Change that make it hard and intangible to comprehend? Traditional media such as newspaper, television or radio have a long history in being the primary outlet for our way to obtain knowledge, however in the last decades the world has become more digitalised. (Ozkula, 2017) Our knowledge of recent events is communicated through medias that have become an ubiquitous phenomenon. (Ibid.) Nevertheless, it mediates the topic of Climate Change by countless activities and modes of communication; from new, research papers and debates to performance of art, poetry and products which strive to provide environmental benefits and let us reflect upon resource efficiency and social responsibility. (White et.al, 2019) Hence, the medias give evidence to the subject as a visible dimension, yet it still does not reach our thresholds of understanding in such a measure that we actually act upon it.

THE COMPREHENSION OF CLIMATE CHANGE

Scientists' have obtained the understanding of Climate Changes through a process of collective learning by field experiments, observations, and through improvements of theories, composition of models and methods to synthesise the complex field of knowledge. (Weber and Stern, 2011) However, the convergence between scientists' understanding and the general population is not perceptible; but why? Climate Changes as physical sensations might be challenging to comprehend due to its distant from our everyday concerns and its impacts that often seem global which makes it intangible. For instance, the main causes of Climate Changes is the emissions of Carbon Dioxide, CO_2, which are invisible, and hence, challenging to apprehend. (Ibid.) By the physiological factors the communication of Climate Change will be understood differently, and as complex the field is, the obtaining of knowledge can entail misconception for the individual grounded on the remote relation from personal experience. Accordingly, concerning the social factors we rely on others presumed to have greater understanding on the subject, and often seek towards intermediary sources, which reflect an indirect comprehension upon the notion. (Ibid.) Hence, the comprehension upon the subject can be difficult to engage with and thus intricate to respond to.

THE POWER OF PERSONAL EXPERIENCE

Our knowledge upon society, its feelings, thinking and doing in relation to Climate Changes become in that sense imperative to address in order to design an Architecture as a platform, which confronts societies with our consumerism and the challenging prospect of our future. Hence, we aim to oppose the absence of understanding by specifying knowledge procured by experience. With individual experiences, we aim to position an alternative way to learn and obtain knowledge, which has been evidenced from our everyday life; for instance by learning to ride a bike or learning a certain place's culture by visiting it, opposed to hearing or reading about it. Hence, with the outcomes of actions we enable an understanding upon a certain prospect. In continuation of the topic, several studies emphasise our ability to learn through experiences, and it can substantiate how one's personal experience is an effective approach to attain knowledge of the notion of Climate Change. (Ibid.) Our experience serves a basis for reflection (Ibid.) and by this accession we enable a way to reach our threshold of understanding and make man reflect upon Climate Change. Accordingly, this impact might shift one's behavioural intentions and encourage to take action.

FIG.18:1:8000 BERGEN

BERGEN 0.1.4

BERGEN \buh·gn\ (Dict, n.d.)

FROM RAIN CITY TO CLIMATE CITY

Index. Bergen
Index. Norway
Index. Water

OUR SITE VISIT

REGION	WESTERN NORWAY (Brejnhaj, 2020)
DISTRICT	HORDLAND (Brejnhaj, 2020))
CLIMATE	OCEANIC (Climate Travel, 2020)
ESTABLISHMENT	1070 (Brejnhaj, 2020)
AREA [KM²]	465 (Brejnhaj, 2020)
INHABITANTS	252.391 (Brejnhaj, 2020)

60°23'34.76"N, 5°19'26.94"E

FIG.19:BERGEN FROM PUDDEFJORDEN

The following descriptive note, about Bergen, takes a starting point in Norway in a global perspective, in which the perceived paradox is emphasised; Norway is on one hand a climate leader and on the other a giant oil industry, being dependent upon fossil fuel. Accordingly, the following will illuminate how Bergen is confronting the issues of Climate Changes, with the aim of positioning contextual circumstances for this Thesis. With the current challenges of increasing precipitation and sea-level rise (Iversen, 2010), the element of Water and the city of Bergen become an actual and perceptible notion in the light of Environmental act.

The country of Norway portrays a spectacular everchanging nature (Study in Norway, n.d.), that in the light of its nature phenomenon, its geographical and resources possessions is able to empower a range of environmental acts and considerations. (Statkraft, 2009) Among others, Norway is one of the leading countries in renewable energy with a strong dependency on the element of Water. (McKay, 2019) With more than 100 years of experience, 99% of the power production emerges from Hydropower, which makes Norway a distinctive example upon the act of Climate Change. (Statkraft, 2009) Hence, Water has a century of significance and is vital for the nation to function. In other environmental measures, Norway is projected as a global leader and front runner in climate action; for instance, it is the first country, worldwide, to constitute a Ministry of Climate and Environment (Environment, 2015), and it has an ambitious aim of a paradigm shift by 2050; Norway as a low Carbon Dioxide, CO_2, society by 90-95% reduction below the levels in 1990. (Climate Action Tracker. Norway., n.d.) However, the strategies are ambiguous and the initiatives are greatly undermined by the continuous expansion of oil drilling; (Sengupta, 2017) Norway is one of the world's biggest players in the fossil fuel industry. Thus, it becomes a noteworthy contradiction to the country's Environmental Policy. We conceive the paradox as an illustration of the complexities of the notion of Climate Change, and how it indeed reaches across various aspects and layers of society; economy, ethic and politics, which are also mentioned earlier in this Thesis. In continuation, it leaves us questioning our roles; if or how our Architecture can confront the paradox, and call the Norwegian society upon act?

PRELIMINARY

PARADOX OF NORWAY

DOMESTIC CO_2 EMISSION

↑7.50 TONS PER. CAPITA YEAR 1990

DOMESTIC CO_2 EMISSION W. REDUCTION

↓0.75 TONS PER. CAPITA YEAR 2050

Per. Capita indicates a measure of a quantity per person.

DATA IS FROM CLIMATE ACTION TRACKER

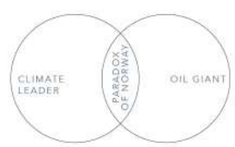


FIG.20:

60° 23' 50.0496" N, 5° 21' 3.7008" E

60° 23' 37.9932" N, 5° 19' 30.0792" E

60° 23' 48.3324" N, 5° 19' 25.392" E

FIG.21:

60° 23' 16.98" N, 5° 19' 54.696" E

60° 23' 54.7836" N, 5° 19' 5.8224" E

60° 23' 40.2828" N, 5° 19' 26.1372" E

FIG.22:

60° 23' 50.2044" N, 5° 18' 41.1048" E

60° 23' 48.3324" N, 5° 19' 25.392" E

60° 23' 30.8544" , N5° 18' 54.8532" E

FIG.23:

60° 23' 40.2828" N, 5° 19' 26.1372" E

60° 23' 48.3324" N, 5° 19' 25.392" E

60° 23' 54.4776" N, 5° 19' 11.3844" E

FIG.24:

60° 23' 49.5924" , N5° 19' 30.6948" E

60° 23' 25.1304" , N5° 19' 55.1064" E

60° 23' 30.8544" , N5° 18' 54.8532" E

FIG.25:

60° 23' 54.4776" N, 5° 19' 11.3844" E

60° 24' 3.0636" N, 5° 18' 8.5824" E

60° 24' 4.4352" N, 5° 18' 4.3344" E

FIG.26:

60° 23' 35.8152" N, 5° 19' 28.2252" E

60° 23' 17.4192" N, 5° 19' 44.0616" E

60° 23' 26.7324" N, 5° 19' 7.9068" E

FIG.27:

60° 24' 1.1916" N, 5° 18' 7.1136" E

60° 23' 58.8264" N, 5° 18' 11.6712" E

60° 24' 1.1916" N, 5° 18' 7.1136" E

FROM RAIN CITY TO CLIMATE CITY

FIG.28:Transformation of Bergen

(Iversen, 2008)

From comprehending Norway from a global perspective, the following introduces our location Bergen at a regional plan, outlining its identity and characteristics. With its position at the west coast of Norway, Bergen constitutes, worldwide, a part of the longest national coastline, spanning from Egersund in the south and to the polar circle at north.(Visit Norway, 2020) (Ref. Maps of Scandinavia p. 24) Hence, on the basis of the location, in close proximity to the North Sea, Bergen perceives itself being based on Water concurrently with its identification as a maritime city regarding the various naval activities and its history of trade and seafare.(Iversen, 2010) Our motivation for Bergen as a location for our Thesis is, among other factors, grounded in the city's many years of research and development of becoming a frontrunner in its transformation alongside the notion of global Climate Changes. Bergen is one of Europe's most rainy cities, defined as the Rain City(Bremer et.al., 2020) due to its situation in close juxtaposition to the sea and the landscape of oblique mountains, which implies a great vulnerability and exposure to large quantities of precipitation.(Iversen, 2008)(Ref. Analysis: Microclimate p. 100) However, incidences in recent years, Bergen's vulnerability has increased regarding Climate Changes and its consequences such as flooding, temperature rises and extreme weather conditions. By the pre-existing challenges of precipitation, the rainwater and sea-level rise become the main indicators for Bergen, which menace the city including its cultural heritage and identity.(Iversen, 2008) This metamorphosis has modified Bergen's identity, known as the Rain City, to the Climate City.(Bremer et.al., 2020) Hence, the element of Water encompasses the city's identity for better or for worse, and leaves us questioning how Bergen, as a Climate City, intervenes with Water in the approach of securing a green future? (Iversen, 2008)

THE STATE OF ART: BERGENS CURRENT STRATEGIES

THINK GLOBALLY, ACT LOCALLY

The confrontation of environmental matters, in Bergen, is approached through a series of initiatives, specifically with the facing challenges of dealing with Water both from the sea and the sky.(Iversen, 2010) In the response to the notion of Climate Changes a range of projects, particularly with an emphasis on the element of Water(Ibid)' have been planned and initiated, for instance, regarding wastewater, surface water man.agement and other international projects on flooding.(Iversen, 2008) Indeed, the mentioned initiatives revolve around the notion of Water and aim to approach the environmental issues with a local manner. Hence, the objective is to utilise Water as a resource that should rather enhance the city than harm it.(Ibid.) Upon the view of ongoing acts and research, the Municipality of Bergen emphasis the principle of *Think Globally, Act Locally*(Ibid.) with the aim to operate with global goals of reduction the Carbon Dioxide, CO2, emission into our atmosphere.(Sustainable Innovation Forum 2015, Climate Action, n.d.). Furthermore, an imperative strategy lies within knowledge, and the importance to raise a transparent bridge between education, research and people on the act of Climate Change. Hence, the existing Bjerknes Centre for Climate Change and the Built Environment are working collaboratively to support the common goal. Additionally, initiatives in raising awareness of the environmental issues for the younger generation are cultivated by a series of platforms and programs at the involved institutions.(Iversen, 2008)) These initiatives and approaches to promote awareness and learning are of substantial relevance and strengthen our own objective of creating a synthesis in the field of knowledge, research and learning in the framework of the element of Water and its pre-existing significance of the city; energy, health and recreational activities.

BERGEN'S BUILT ENVIRONMENT

FIG.29: Architectural Strategies by Bergen Municipality.(Bergen Bystyre, 2019)

In line with the previous mentioned projects, the Municipality of Bergen has outlined how Architecture and its impact on the human beings is significant.(Iversen, 2008) The architectural aim for Bergen is procured through a range of strategies, establishing a fundamental platform towards an inclusive, distinctive and climatic city. The strategies encompasses four categories; Aesthetic, Characteristic, Inclusive and Green.(Bergen Bystyre, 2019) These instrumental means operate within the field of transforming Bergen into a denser city within a synthesis of architectural value and environmental consciousness in relation to its existing distinctive townscape. The operating factors concern variable aspects, for instance, regarding the measure of prioritising interactive and social spaces for people. Furthermore, the strategy of such as Aesthetic can be reached in the creation of recreational areas stimulating the senses, or by the transparent coherence between interior and exterior scenic surroundings. Hence, the mutual destination towards a sustainable and green future is topical and of great significance in a societal aspect of the city. (Iversen, 2008) Hence, the accession towards an environmental act is based upon the physical boundaries and the spatial experiences:

"*The visible parts of architecture are shape, aesthetic, materials and symbols. This become attached to the profession in relation to how the built and urban space appear. Meanwhile, Architecture likewise concerns its impact. Good architecture inspires and is identity-forming, it provides solicitude and creates enthusiasm. Our physical settings shapes us as human beings and society*" (Bergen Bystyre, 2019 p. 4)

SYNTHESIS; CAN BERGEN'S STRATEGIES SUBSTANTIATE OUR PROJECT?

The introduction to Norway, and specifically Bergen, projects an intricate and complex situation; Norway as an entity continuously endorses the oil industry, while Bergen, as a cog in a vast machine, is suffering under it. Simultaneously, scientific inquiries and work of Climate Change are based in Bergen, aiming to be a leading frontrunner of Climate Change research. As stated in the Introduction,(Ref. Introduction p. 27)' we conceive the scientific unfoldings and the collaborative initiatives in Bergen as a substantial aspect for our project, which is strengthened in the light of this elaborated read upon Bergen. Namely, the Bergen's focus on the element of Water, which also resonates with our impressions and later elaborated upon in the Analysis, is crucial for our project. Furthermore, the pre-existing initiatives and arrangements in the promotion of Climate Change awareness are in alignment with our own perceive potentials, in which we strive to advance and enhance the transparency between research and man; knowledge and learning through our Architecture. Figuratively, Bergen already has all the threads and we are the ones to make an attempt, tidying a knot by placing an architectural layer upon it. To address and make a note in regard to the architectural aims by the Municipality of Bergen, we do not notice a distinctive strategy and approach. However, it is noteworthy to mark, that the chronology of the scheme; the notions of Aesthetic, Characteristic and Inclusive are presumably prioritised in comparison to the notion Green. Thus, the strategy does also amplifies the significances of social and aesthetic aspects, which resonate relatively with our point of view.(Ref. Motivation p. 16)

The immediate impression of Bergen is the element of Water. It is present in the body of the sea and dominates the micro-atmosphere approximately 200 rainy days per year.(Weather Atlas, n.d.) It is all around us, embracing and surrounding us at the moment we approach Bergen, and it the decisive factor for how we experience the urban spaces; the streets, its surfaces, its life and its atmosphere, and how all of it is in interplay with the fluidity of Water. Hence, we perceive a vast potential in Water, physically and figuratively, and allow it to possess an authorship role in our creation of Architecture. In response to this, forthcoming design studies and exploration will be fostered, which can substantiate to establish the city of Bergen as a gathering point or platform of exploring and learning, and not to mention to confront the man upon our consumption and its impact on the environment.

FIG.30: WATER AS AN AUTHOR OF THE ARCHITECTURE(Photo by Silas Baison)

Index. NORCE
Index. Nansen Environmental and Remote Sensing
Index. Institute of Marine Research
Index. University of Bergen
Index. Bjerkes Centre for Climate Research

NOTES

NOTE \'nu:te\(Dict)
TO PROVIDE CONTEXT

INTRODUCTION

Bjerknes Centre for Climate Research 0.1

The Bjerknes Centre for Climate Research was founded in 2000. It engages more than 200 scientists from 39 countries and is on the largest units for Climate Change research in Europe. The overall aim of Bjerknes Centre for Climate Change is to understand and quantify the climate system for the benefit of society. In 2003-2012, Bjerknes Centre for Climate Research was labelled a National Centre of Excellence (CoE). (Bjerknes. UIB, 2016)

University of Bergen. UiB 0.2

The University of Bergen,UiB, is an European University with approximately 16.000 students and 300 employees. UiB is both an educational and a research unit, which involves a series of different disciplines and fields, structured in 7 faculties and 90 departments. UiB is a part of a global network of students and scientist, and perceive itself as a dynamic network for meeting and interacting, also with other communities. (University of Bergen, n.d.)

NORCE 0.3

NORCE is one of Norway's largest independent Research Institutes. It has 1000 employees from around the world. NORCE provides innovation and research in Energy, Health Care, Climate, the Environment, Technology and Society. It is based in Bergen, however it has a strong presence in other locations such as Alta, Tromsø, Bardu, Bodø, Haugesund, Randaberg, Stavanger, Kristiansand, Grimstad and Oslo.(NORCE Research, n.d.)

Nansen Environmental and Remote Sensing Centre. NERSC 0.4

Nansen Environmental and Remote Sensing Centre, NERSC, was founded in 1986 and is an independent non-profit Research Foundation. It conducts environmental and climate research, and generate an interdisciplinary across scientific expertise in Earth system, environmental and climate research, satellite, remote sensing, modelling and data assimilation. NERSC is affiliated with the University of Bergen, UiB. (NERSC, n.d.)

Institute of Marine Research. IMR 0.5

The Institute of Marine Research, IMR, is Norway's largest centre of marine science. It has approximately 750 employees. Their objective is to provide advice to Norwegian authorities on aquaculture and the ecosystems of Barents Sea, the Norwegian Sea, the North Sea and the Norwegian coastal zone. Hence, their main activities are research, advisory work and monitoring. The IMR has its base in Bergen, however, they are also present in Tromsø, Matre , Austevoll and flødevigen.(Institute of Marine Research, n.d.)

UN 17 Sustainable Development Goals 0.6

UN 17 Sustainable Development Goals (SDGs) are shared aims for peace and prosperity for people and planet. The SDGs initiate an urgent call for action in an international partnership. The SDGs involves environmental, societal and social sustainability.(Sustainable Development Goals, Knowledge Platform, n.d) The 17 SDGs can be explored at their website: https://sustainabledevelopment.un.org/?menu=1300

MB

0.2.0 LIST OF CONTENT
0.2.1 APPROACH
0.2.2 CONJECTURE/ANALYSIS

0.2.0 METHODLOGY

METODE \me'tu:de\ (Dict, n.d)

CHAPTER CONTENT

The Methodology elaborates on the approach and methodologies, applied in this Thesis. It includes The Integrated Design Process(Knudstrup, 2004) to illustrate an instrumental map for our process in this Thesis, and it outlines the Method of design generator, Conjecture/Analysis(Dark, 1979). The objective is to outline and explain, how we are carrying out our studies and collecting the outcomes.

FIG.31: WATER (Photo by Silas Baison)

0.2.1 APPROACH

Index. Christian Norberg-Schulz
Index. Mary-Ann Knudstrup
Index. Integrated Design Process
Index. Peter Zumthor

FRAMGANGSMÅTE \ˈframgaŋksmoːtə\ (Dict)

OUR POSITION AND PROMINENCES

OBJECTIVE

The objective of the following elaborates on our prominences, positions and approaches concerning the scope of the Thesis. It addresses and articulates a framework of which the dissertation operates within. The elaboration places a focus upon our position on the advanced approach of interdisciplinary and its role, which outlines our critical point of view on studies, analysis and selection of sources. This is grounded in the vision of denoting nuanced understandings and grasping the potentials and consequences.

ARCHITECTURE:
A MULTIDISCLINARY ENDEAVOUR

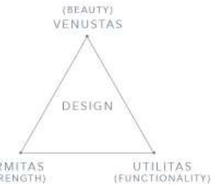


FIG.32: Example on Vitruvius' essential work: The Vitruvian Triangle (Vitruvius, 1914)

With the view to approach our Architecture to meet the man-made Climate Changes and confront our culture of consumerism, we aim to elucidate our position and practice within the Thesis. The descriptive note upon Bergen give potential to build on our platform of the proposition of a new typology creating a transparency between knowledge and learning which encourages us to explore, share visions, and raise question and understanding upon our impacts on the environment. On that note our Architecture addresses the notion of Catalyst Architecture (Kiib & Marling, 2015) described by Hans Kiib and Gitte Marling (Note: 0.1 p. 50) which comprise Architecture as a mediating role in the development for our society. The conception emphasises the ability to impact the framework of our lives and it further has the ability to frame a certain function that provides us aesthetic and sensuous experiences. Hence, we perceive our Architecture as a catalyst of the element of Water, which can confront our consumerism and impact on environment. In this context, it is important to understand the multifaceted substance of Architecture; Architecture evokes a multidisciplinary endeavour, in which one experiences a series of contradictory aspects among; rationality, our logos (Your Dictionary, n.d.) and emotion, our pathos (Your Dictionary, n.d.) and architectural intention against viable realisation. Thus, a series of dimensions concerns aesthetic assessment with a focus on phenomenological values, while other aspects are placed in the quantifiable and empirical realm. However, the contradictories, the integration and the unification of architectural qualitative and quantitative features is to a certain degree essential in order to create Architecture that is appreciative for its surrounding. This is rooted at the beginning of the interdisciplinary of Architecture and Engineering, which is emphasised in the work of the Roman architect Marcus Vitruvius Pollio (Vitruvius, 1914) (Note: 0.2 p. 50) However, in our point of view, integration of Architecture and Engineering does not necessarily entail an equilibrium of the respective fields. It depends on the narrative of the Architecture, the sensory perceptions of it and contextual conditions, which likewise is outlined by the architectural theorist Christian Norberg-Schulz: (Note: 0.3 p. 50) According to Norberg-Schulz, there is not a pre-appointed approach nor methodology in Architecture, as the architectural quality is not a universal measure; it is derived and rooted from the specific context, referring to the notion Genius Loci; the Spirit of Place. (Kjeldens, et al., 2012)

THE INTEGRATED DESIGN PROCESS:
AN INSTRUMENTAL MAP

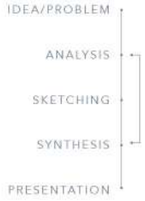


FIG.33: The Integrated Design Process
(Knudstrup, 2004)

In the field of Architecture and Engineering, we question ourselves how we can access the Thesis within its substance of complexity; It is embedded in the education of Architecture and Design, Aalborg University, to place the framework of design within the method of Integrated Design Process, developed by Mary-Ann Knudstrup (Note: 0.4 p. 50) which aims to integrate the architectural and engineering aspects through five phases; Problem/Idea, Analysis, Sketching, Synthesis, Presentation. (Knudstrup, 2004) However, we do not distinguish it as a methodology, which is experienced in previous projects, rather an instrumental map (Ref: IDP as an instrumental map, p. 46) to navigate a design process, as it does not ensure either aesthetic nor sustainable solution. Hence, the principle of the Integrated Design Process is understood as a platform to structure and control the vast series of parameters, architecturally and technically, that are considered necessary and vital for an architectural design.

LEARNING FROM THE PAST

Design Processes concern a series of branches that reach scientific research, critical and creative thinking in an iterative approach. (Knudstrup, 2004) Nevertheless, it allows one to reflect and discuss upon design decisions which addresses environmental, social or contextual conditions and allow on to make a substantiated assessment and narratives that address different situations. However, of own experiences in previous projects, this endeavour of assessment is not inherently employed in our Design Process, which designate that a series of decision-makings are regularly rushed without substantial or evidential reasoning. To elaborate, design decisions were often based relatively solely on quantifiable and measured parameters, or without any viable arguments regard to the overall social, cultural and architectural aims. Consequently, this custom often ensued in compromising the architectural and aesthetic qualities without considerations to the experience. However, we must stress that the technical aspect is still vital for a viable and valuable result and should not be neglected. Hence, within a critical framework we eagerly vision to place an accentuated emphasis upon the approach and process of decisions-making with the objective of understanding the decisions and assessments we are making, and thus its potentials and consequences. Accordingly, we see a necessity to stress the approach of the Thesis by critically ask and question our decisions; in which coherence did the decision emerge, and what drives it, what are the constrains for the design, and what are the consequential aspects; socially, architecturally, aesthetically or technically? Shall our logos (Your Dictionary) or pathos (Your Dictionary) decide? Peter Zumthor (Note: 0.5 p. 50) articulates such a situation in *Thinking Architecture* and emphasise the significance of a critical assessment and its confrontation with our pathos:

The feelings, preferences, longings, and desires that emerged and demand to be given a form must be controlled by critical powers of reasoning, but it is our feelings that tell us whether abstract consideration really ring true" (Zumthor,2005, p.21)

TOOLS AND SOURCES

In the threshold of a critical point of view, an emphasis is placed on a critical attitude towards our application and employment of tools in studies and analyses; are we using analogue or digital utilities, and what are the potentials and consequences of it? Analogue tools, such as sketching, allows us to create and design at a relatively abstract plan. Digital utilises, such as 3D modelling, enforce a certainty in details and criteria. Hence, it is vital to understand the analytic aim of the study in order to select the appropriate tool and exploit its attributes. We do also aim to implement a critical approach regard our reads upon sources and its content, as sources can be biased, politically, ideologically or personally, which imply its statements and claims are not necessarily theoretical and empirical based, nor objective. Sources are also linked to its time of origin, which is vital for understanding for putting the subject into perspective and support our argumentation.

FIG.34:INTEGRATED DESIGN PROCESS
AS AN INSTRUMENTAL MAP

ARCHITECTURE :A
TECTONICS :T

INSTRUMENTAL MAP

OUR FRAMEWORK

TECTONICS

INTEGRATED DESIGN PROCESS

IDEA/PROBLEM
ANALYSIS
SKETCHING
SYNTHESIS
PRESENTATION

CONJECTURE

PROBLEM STATEMENT
ANALYSIS
EXPLORATIVE SKETCHING
SYNTHESIS
DESIGN

THEORETICAL BASE
CONCEPT DEVELOPMENT
RECAPITULATION

ANALYTICAL BASE

T A

T	A
WATER	DETAILING
GESTURE AND PRINCIPLE	STRUCTURE
EXPERIENCED ARCHITECTURE	SUSTAINABLE SOLUTIONS
TRANSPARENCY: BETWEEN MAN AND RESEARCH	RELATION TO CONTEXT
TRAMSPARENCY THROUGH MATREIALS	COMMUNITY
TRANSPARENCY THROUGH SPATIAL ORGANISATION	PRESENTATION
SUBSTANTIATE RESEARCH BY CONTEXT	REFLECTION
IMPACT PEOPLE'S BEHAVIOUR BY LEARNING	
IMPACT PEOPLE'S BY TRANSPARENCY	
SENSUAL IMPACT	
NARRATIVE OF SPACE	

T	A
TRANSPARENCY: BETWEEN MAN AND RESEARCH	WATER HARVESTING
WATER TO ACTIVATE SENSES	WATER TREATMENT
CONSTRUCTION	FORM
STRUCTURE	VOLUME
GESTURE	FUNCTIONALITY
SENSUALITY	INDOOR ENVIRONMENT
CATALYST	CO_2 FOOTPRINT
KINAETHETIC IMPACT	ECONOMY
ENVIRONEMENTAL AWARENESS	MATERIALS
	LOGICAL ARGUMENTATION
	VERIFICATION
	EXPLORATION

T	A
MATERIALITY	MOTIVATION
TACTILITY	APPROACH
SENSUALITY	CLIMATE CHANGE
RESSOURCES AT SITE	WATER
	BERGEN
USER	ENVIRONMENTAL ARCHITECTURE
UNIT PROGRAM	ENVIRONMENTAL TECTONICS
GESTURE AND PRINCIPLES	ATMOSPHERIC ARCHITECTURE
	CONJECTURE/ ANALYSIS
	GESTURE AND PRINCIPLE
	SECTION OF SITE
	MAPPING
	MICROCLIMATE
	SERIAL VISION
	URBAN TOMOGRAPHY
	CASE STUDIES
	UNIT PROGRAM
	FUNCTION DIAGRAM
	VISION

0.2.2 CONJECTURE/ANALYSIS

Index. Conjecture//Analysis
Index. Gesture and Principles
Index. Karl Popper

GJETNING/ANALYSE /kənˈdʒektʃə(r)/, /əˈnæləsɪs/(Dic)
A METHOD OF DESIGN GENERATOR

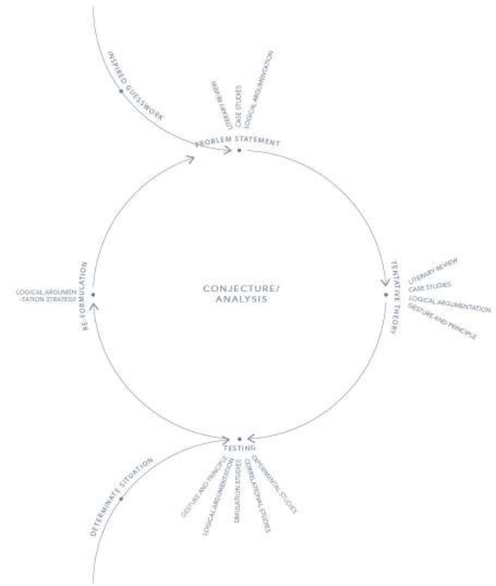


FIG.35:CONJECTURE/ANALYSIS
(Foged,2015)

The following demonstrates the methodology Conjecture/Analysis(Darke, 1979) and its accession to research design. From a scientific and humanistic attitude, the methodology endeavour to address the objectives of an architectural theoretical framework, by applied methods and models, which attempt to authenticate the conjectures and the design studies.(Foged, 2015) By the introduction of Gesture and Principle(Hvejsel, 2018) we aim to substantiate the notion by Architectural experience. Hence,the methodology is designated for the Thesis to potentially permit an adequate way to support both the broad objective of the project and the specificity of each design study in an architectural research agenda.

Methodology as an approach joints specific epistemological and ontological presumption to applicable research methods, which reconciles philosophical concepts with useful research techniques(Creswell, 2003). In other words, a methodical accession will in the light of knowledge and objective reality be a critical evaluation upon reliability and validity of the research. Hence, several propositions for methodologies has been developed by theoreticians presumably in order to provide methods to guide, structure and direct a certain design development. Accordingly, our motivation for the Thesis is rooted in exploiting a method of which can support the fundamental principle of working and structuring the design in the interdisciplinary field of Architecture and Engineering. In the light of this, the dissertation will be structured on the basis of the designated methodology of Conjecture/Analysis, which attempt design in a systematic, explorative and goal-oriented inquiry based on conjectures.(Foged, 2015) By theoretical propositions and research analysis, the methodology will entail an accession to explorative design thinking by the foci of the Thesis and access the design development in a critical interdisciplinary intellect.

The methodology of Conjecture/Analysis derives from a scientific conduct in philosophy explained by the German philosopher Karl Popper(Note: 0.1 p. 51) and his view upon the scientific approach to design. In contradistinction to the rational Synthesis/Analysis paradigm(Foged, 2015), that implicates inquiry prerequisite by statements of facts, the Conjecture/Analysis revolve around systematic inquiry commenced by problem statement, by proposing a conjecture or inspired guesswork conducted by empirical analysis.(Bamford, 2002) Hence, the methodology addresses the framework of design founded on conjectures and emphasises a cyclical process rooted into a larger process of theory, testing, reformulation, verification, falsification and phenomena creation in a non-linear probe.(Foged, 2015) Another important matter is the Primary Generators, which is the concept or a collection of associated concepts that generates an accession into a problem in the initial process of design.(Trebilcock, 2009) It will reduce the amount of potential solutions and assist the further design, where the significance lies within our awareness of the generating forces, of which will be accessed by critical evaluation and the exploration of the certain conjectures. The Popperian formulation, elaborated on by Isak Worre Foged,(Note: 0.2 p. 51) (Foged, 2015) determine conjecture as the hypothesis statement, which is portraying the problem statement. Hence, the formulation is delineating a rational framing where tentative theory is implicated; Literary reviews, case studies and logical argumentation create the basis. It is thereby of great importance to address the tentative theories as a fundamental for the design development; for instance, we aim to conduct case studies as a method for architectural research by the understanding of Gesture and Principle,(Hvejsel, 2018) which can substantiate the interdisciplinary field of Architecture and Engineering.

In the position of the interdisciplinary field, our interest in Tectonics becomes crucial in the assessment to our Architecture and the interaction between aesthetic and technique. Hence, in the notion of tentative theory, case studies and critical evaluation we aim to stress the conception of Gesture and Principle(Ibid.) addressed by Marie Frier Hvejsel,(Note:0.3 p. 51) to vigorously validate and test the hypothesis statement, in relation to multiple tec hnical and environmental aspects, upon the obliging studies. The notion of Gesture and Principle grasp the essence of a approach to Tectonics, which addresses the human proportion and sensuous position; Gesture delineates the experienced architecture, while Principle is the state of art which put the Gesture into realisation.(Hvejsel, 2018) In the light of these terminologies, our understanding of the expressions becomes a comprehensive accession to how to address architectural eminence and the capability to impose a bodily incident which can foster a sense of perception related to the human scale. Hence, we aim to exploit this conception as method to authenticate the Tentative Theories and presumably be able to address the foci upon the element of Water as a principle to impose gestures.

While the research is contemplated as a network of knowledge and methods, the phase of testing is aimed to be stretched by an inquiry which both addresses the qualitative and quantitative aspects. By the means of verification/falsification of the conjectures, the Thesis aims to address the explorative studies by both physical and digital measures of for instance hand sketching, physical and digital models and simulations. However, in the verification/falsification new problems will occur and provide new insight and supplementary studies. This process might reveal unexpected phenomena that will otherwise be intangible.(Foged, 2015) In that notion, we aim to encourage an experimental framework of the Thesis being embedded in the cyclical process of theory, testing, reformulation, verification, falsification and phenomena creation. In relation to the foci of this Thesis, the element of Water becomes a potential primary generator which can drive the design. This focus raises intriguing questions upon how the element can empower knowledge and learning and potentially persuade Gestures to impact our behavior? Hence, this primary generator can assist towards a distillation of the emerging conjectures and the problem statement.

NOTES

NOTE \'nu:te\(Dict)
TO PROVIDE CONTEXT

APPROACH

Hans Skaarup Kibb & Gitte Marling 0.1

Hans Skaarup Kibb, Emeritus Associate Professor (Aalborg Universitet, VBN)[1] and Gitte Marling, Professor, are in connection with the Deparment of Architecture, Design and Media Technology the authors to Catalyst Architecture that assembles a series of conducted research and case studies. The objective is to unable understandings of the role of Architecture in the development of a democratic city and learning city (Kibb and Marling, 2015)

Marcus Vitruvius Pollio 0.2

Marcus Vitruvius Pollio was a Roman Architect and Engineer. In the distinct De *Architectura*, Vitruvius combined history of ancient Architecture and Engineering with his own experiences and position on the subjects.(Cartwright, 2015) Vitruvius outlined essential elements, when designing Architecture; Firmitas (Strength), Utilias (Functionality) and Venustas (Beauty)(British Library, n.d.)[2]; notions that are still significance in the field of Architecture today.

Christian Norberg-Schulz 0.3

Christian Norberg-Schulz was a Norwegian Architect and a professor at *Arkitekthøgskolen* in Oslo, Norway. In his work, Norberg-Schulz outlines the significance of the conception of Phenomenology, which is also a starting point for his notion Genius Loci; The Spirit of Place.(Orig. Sommer, n.d.) The notion places an emphasis upon the contextual condition, when designing Architecture(Norberg-Schulz, 1980)

Peter Zumthor 0.4

Peter Zumthor is an architect from Basel, Switzerland. Zumthor started his career as a cabinet maker, and established his architectural practice in 1979. Through his architecture, his sensuous attention to materiality and place, Zumthor is considered as one of the most extraordinary architects in 21st century and has received a series of Awards, among others, the Pritzker Architecture Prize. Zumthor's work withhold experiential qualitites and embrace the cultural and technology of contemporares(Archdaily, 2019) In the book *Thinking Architecture*, comprised of a series of essays, published in Birkhauser 1998, Zumthor elaborates upon his architectural philosophy and allow readers a glimpse into his mind.(The Pritzker Architecture Prize, n.d.)

Mary-Ann Knudstrup 0.5

Mary-Ann Knudstrup is a Danish architect, professor and head of the Research group for Sustainable Architecture at the Department of Architecture, Design and Media Technology. Furthermore, she has a history of emphasising the field of Architecture and Planning by being one of the founding partners of the education *Architecture and Design* at *Aalborg University*. As an accession to Problem-Based Learning, Knudstrup developed the notion of the *Integrated Design Process* which encompasses a structure and strategy to handle the multifaceted process of architecture and engineering. (Knudstrup, 2004) Apart from that, Knudstrup has done research in the subjects of sustainability and well-being (Aalborg Universitet, n.d.)

CONJECTURE/ANALYSIS

Karl Popper 0.1

Karl Popper is generally stated as one of the greatest philosophers of science of the twentieth century. Additionally, he was states as a social and political philosopher of valuable stature and an academic and social commentator. His remarkable features lie within the scope of his intellectual influence. Popper is in particular noted for his favour of empirical falsification in opposition of the classical inductivist views on the scientific method. Hence, his approach to theory is based upon the argument on empirical sciences which can never be proven but falsified constituting the notion of experiments. (Stanford Encyclopaedia, 2018)

Isak Worre Foged 0.2

Isak Worre Foged is a Danish architect/engineer and associate professor at the Department of Architecture, Design and Media Technology. His work emphasises tectonics in architecture, environmental architecture and computational architecture. In relation to his academic field he is founding partner in the architectural studio AREA, that explores the notion of Environmental Tectonics, based upon his PhD thesis: Environmental Tectonics: Matter Based Architectural Computation in 2015 and Constructing and Construing Environmental Sensations from 2016. (Foged & Hvejsel, 2018)

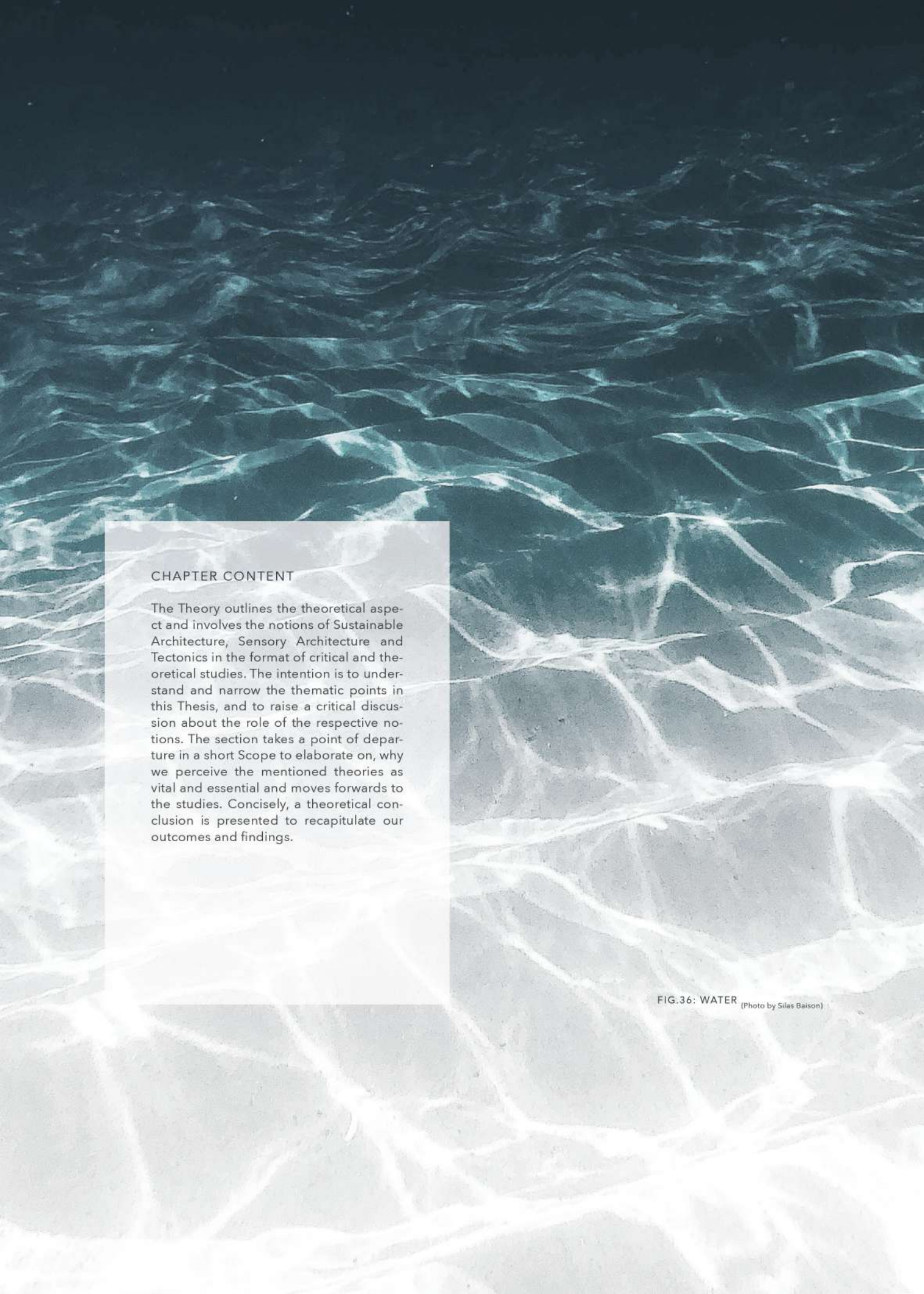
Marie Frier Hvejsel 0.3

Marie Frier Hvejsel is a Danish architect/engineer and associate professor at the Department of Architecture, Design and Media Technology. Additionally, she co-heads TiA Research Group for Tectonics in Architecture. Hvejsel holds a PhD in domestic architectural quality and prefab technology whereas the publications of hers juxtaposes critical reflection upon theory and design method in the field of Architecture in an everyday practice. Her PhD *INTERIORITY* examples everyday practice through the specific interest in furniture scale as an accession to tectonic thinking in architecture. Other publications as *Circular Tectonics? A critical discussion of how the architectural discipline can drive ecological continuity* addresses the framework of Tectonics in reference to an ecological architectural practice. (Foged & Hvejsel, 2018)

0.3.0 LIST OF CONTENT
0.3.1 PRELIMINARY
0.3.2 SUSTAINABLE ARCHITECTURE
0.3.3 SENSORY ARCHITECTURE
0.3.4 TECTONICS
0.3.5 THEORETICAL SYNTHESIS

0.3.0 THEORY

TEORI \teu'ri:\ (Dict, n.d.)



CHAPTER CONTENT

The Theory outlines the theoretical aspect and involves the notions of Sustainable Architecture, Sensory Architecture and Tectonics in the format of critical and theoretical studies. The intention is to understand and narrow the thematic points in this Thesis, and to raise a critical discussion about the role of the respective notions. The section takes a point of departure in a short Scope to elaborate on, why we perceive the mentioned theories as vital and essential and moves forwards to the studies. Concisely, a theoretical conclusion is presented to recapitulate our outcomes and findings.

FIG.36: WATER (Photo by Silas Baison)

Index. Sustainable Architecture
Index. Sensory Architecture
Index. Tectonics

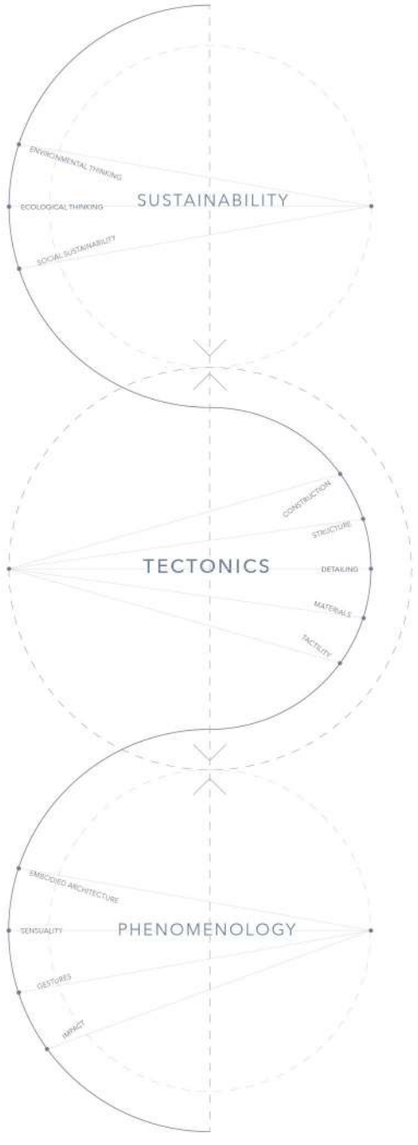


FIG.37: TECTONICS AS A METHOD TOWARDS ENVIRONMENTAL AND SENSORY ARCHITECTURE

PRELIMINARY

The motivational note Motivation (Ref. Motivation p. 16) and introductive Prologue (Ref. Chapter:Prologue p. 18-39) project the initial settings for the Thesis' theoretical framework; Sustainable Architecture, Sensory Architecture and Tectonics. This Preliminary read introducesthe theoretical and critical studies of the respective individual and interconnected notions towards meeting the objectives of the Thesis. Across the three fields, Tectonics is a vital attribute in bridging the aspects, and hence the interconnecting constituent to our Architecture.

WHY SUSTAINABLE ARCHITECTURE: HOW DO GRASP THE SUBJECT?

The notion of Sustainable Architecture is essential and relevant in light of the increasing Climate Change challenges. The Built Environment, as a great contributor to Carbon Dioxide, CO_2, emissions into our atmosphere (Ramboll, 2019), it is positioned as a crucial player in the environmental act. We aim to approach and grasp this notion with a critical assessment. Hence, the study strives to illuminate the role of Sustainability in the current Built Environment and how it influences the technology and, thus the creating of Architecture. Hence, it aims to elaborate upon the potentials and pitfalls of Sustainable Architecture.

WHY SENSORY ARCHITECTURE: HOW DO WE GRASP THE SUBJECT?

The notion of Sensory Architecture is vital, as we perceive an increasing universal approach and a vast negligence of the contextual and sensory aspects in the contemporary discourse of Architecture. Hence, the connection to the specific site and the tactile experience of space; smelling, touching and hearing (Pallasmaa, 2012) are neglected as a repercussion of the measurable oriented Built Environment. The study strives to elaborate on the attributes of contextual and sensuous Architecture, and includes a discussion of the notion's potentials and pitfalls.

WHY TECTONICS: HOW DO WE GRASP THE SUBJECT?

The notion of Tectonics is as initially stated vital, as it withholds the potentials to address the crisis of Climate Change, without oppressing the aesthetic, cultural and sensory aspects. (Beim & Hvejsel, 2019) It takes a starting point in the specific site and addresses the sustainable aspect with its focus on material compatibility, which is culturally interrelated with the locally available technology, and it addresses the sensory aspect, as its tangible measures such as constructional expression can reveal a narrative of space. (Kenneth Frampton, 1995) Thus, Tectonics is the linkage between Sustainable Architecture and Sensory Architecture.

0.3.2 SUSTAINABLE ARCHITECTURE

BÆREKRAFT \'bæ:rekraft\(Dict, n.d.)

A CRITICAL AND THEORETICAL STUDY

Index. Sustainable Architecture
Index. LEED
Index. BREEAM
Index. DGNB
Index. COP21

PRELIMINARY

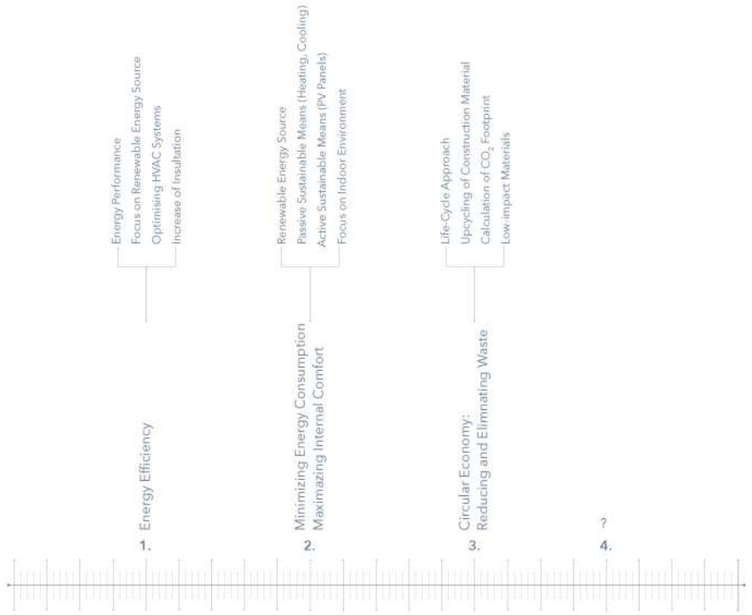
This study explores the inherent complexities of the notion of Sustainability, and the objective is to enable an elaborated understanding of it in relation to Architecture, and also its significance and relevance to our society. It takes a starting point in a broad perspective in the cultural and political aspects and boils it down to its role in Built Environment. Here, the study introduces the concept of Circular Thinking and proceeds to a case study of Upcycled Studios by Lendager Group(Note: 0.1 p. 78)' that manifests an ecological approach in addressing the issues of Climate Change.

2°C: IT'S INFLUENCE ON SOCIETY AND POLITICS

The 2°C references the Paris Climate Agreement from COP21.2015 (Sustainable Innovation Forum 2015, Climate Action, n.d.)

With the status quo of the crisis of Climate Change and the situation of resource scarcity, men are facing one of the immense challenges of its time. In the future to come, the issues will intensify its effect on society, its cultural, political and economic evolving, the urban and rural land development, and consequently the field of Architecture.(Bundgaard et al., 2015)Though this study focuses on Sustainability in the Built Environment, we are declined to take a starting point in addressing the impact of Sustainability in relation to other aspects to broaden our perspectives within this field. After all, the combat against Climate Change has to take a point of departure in our actions and behaviours, which all are associated with our conception of the notion. Subjectively, we conceive the notion of Sustainability as intricate and multifaceted, connected to a range of aspects with interdependencies, which implies that the notion reaches across disciplines of different fields. An immediate observation of its impact upon culture reveals a series of tendencies, in which environmental awareness is cultivated in our culture of consumerism. For instance, our clothing is aiming to be based on recycled and sustainable sources and changing its course towards a fashion of circular and climate awareness.(Note: 0.2 p. 78)Our transportation takes a shift from gasoline to electric(Note: 0.2 p. 78)' giving us a Carbon Dioxide CO_2-neutral mobility. Our food is looking for options and alternatives in nature.(Note: 0.2 p. 78)

The initiatives are innovative, however, they are integrating into our society with such a gradual and relaxed manner that the impacts are partial and limited, and they are still foreign for certain target groups. Politically, the issues of Climate Change has called for global collaboration across the hemisphere. This is for instance manifested in the Paris Climate Agreement, COP21 in November 2015, that collaborative aims to hold the increasing average temperature of the Earth below 2°C in hopes of preventing irreversible and damaging climatic patterns.(Sustainable Innovation Forum 2015, Climate Action, n.d.) Furthermore, upon observation of the political and societal landscape, there is a rising population of individuals that make a passionate stand in addressing the crisis of Climate Change, apart from NGO (Non-Governmental Organisation) such as Green Peace,(Note: 0.3 p. 78)' Recently the Swedish activist Greta Thunberg (Note: 0.4 p. 78) that advocates and calls for momentous actions against Climate Change. The call for action and awareness is clear and highlight the responsibility of human and its descendants.(Conte, 2018) Thus, the notion of Sustainability is an essential feature in any discourses.



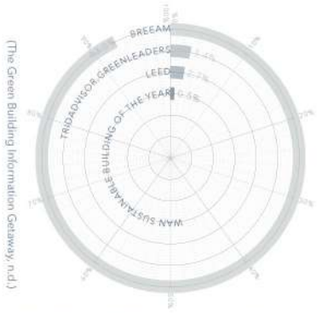


FIG.38: NORWAY [407 ACTIVITIES]

FIG.39: DENMARK

FIG.40: CHRONOLOGY OF SUSTAINABILITY IN THE BUILT ENVIRONMENT (Conte, 2018 and Rambøll, 2019)

2°C: IT'S INFLUENCE ON ARCHITECTURE

In the field of Architecture, the notion of Sustainability is constantly evolving in line with the development and advancement of technologies and strategies. For instance, the challenges have altered the conception of Sustainability from the far-reaching understanding, singularly dealing with the Energy Efficiency of buildings,(Rambøll, 2019) to an advanced and matured understanding, in which environmental and economic aspects, through the life cycle of Architecture, are in focus. Thus, the issues of Climate Change call for an amplified focus on resource efficiency and ecological principles which aim to eliminate waste; introducing the concept of Circular Economy into the Built Environment.(Jensen et al., 2018) The notion of this is described and discussed later in the study. In the continuation of Sustainability's significance in the Built Environment, upon observation, we notice an increasing bias of environmental assessment methods, using certification standards, for instance, DGNB, LEED and BREEM.(Note: 0.5 p. 78) as a means for measuring the Architecture's sustainable performances.(Conte, 2018) The respective schemes have individual areas of focus. Some operate within a relatively narrow scope for instance cost-efficiency, and others have a holistic approach and embrace a comprehensive series of focus criteria.(Rambøll, 2019) The objective is to provide recognition at an international plan by quantifying the environmental attributes of Architecture.(Ibid) Here. we place a great critique upon this bias in the Built Environment, as we are not convinced certification of Architecture can on a one-to-one basis impose improvement of the environment in which we live, work and socialise, despite its contribution to our physical comfort and relieving the pressure upon the natural environment. The following quote exemplifies our critique:

"*In relation to health and well-being, indoor air quality, lighting and thermal comfort are rated by the respondents at the most important well-being and health-related factors […] However, environmental certification standards such as DGNB, LEED and BREEAM can help address issues such as air quality, by dictating requirements to building materials with low levels of chemical substances*"(Rambøll, 2019, p.3)

The notion of our well-being is associated with a calculated assessment. This distinct focus on *physical well-being* over-rules the *psychological well-being,* which involves the emotive, sensuous stimulations and social affiliation and connections.(Diener, 2000) In summary, a stamp of gold or any nuance of the metal scheme does not equal Architecture that promotes well-being, however, it undermines the inherent the cultural value of Architecture.

Index. Lendager Group
Index. Upcycled Studios

Project: Upcycled Studios
Architect: Lendager Group
Engineer: $MOE_{A/S}$
Building Owner: $NREP_{A/S}$, $Arkitektgruppen_{A/S}$
Year: 2015-2018
Location: Ørestad South, Copenhagen, DK

FIG.41: CASE STUDY
UPCYCLED STUDIOS
(Photos by Rasmus Hjortshoj,
COAST, Collective Architecture Studio)

FIG.42: CASE STUDY
UPCYCLED STUDIO
(Photos by Rasmus Hjortshoj,
COAST, Collective Architecture Studio)

ABOUT THE PROJECT

In the crossroad of increasing demand for workspace and housing, concurrently with the urban areas are expanding, and the vision of a significant reduction of Carbon Dioxide CO_2, Upcycled Studios combines the functions of workspace and housing. It designed in the approach of Circular Economy to address the issues of resource scarcity and inconceivable waste accumulation. This is reflected in the degree of flexibility and the Life-Cycle-Approach, applied in the construction. For instance, the concrete elements are comprised of upcycling of 1400 tons concrete from the expansion of Metro in Copenhagen, reducing the emission of CO_2. Another characteristic is the upcycled glass from abandoned buildings, which implying a save of 96% CO_2 compared to virgin production of glass. Thus, the design used low-impact materials to reduce waste and pollution.

(Lendager, 2019)

CIRCULAR THINKING IS BECOMING MAINSTREAM

With the continuous consumption and material scarcity, the concept of Circular Economy is in an acceleration into the Built Environment, creating a paradigm of Circularity and changing the narrative of Sustainability.(Jensen et al., 2018) The concept places paramount emphasis on the ecological approach in Architecture in the search of harmony with our environment and nature. Pioneers within this field, have perceived a vast potential in conceiving construction waste as a resource; materials such as plastic, metal, concrete, wood and glass can be recirculated and configure into a new material with a new function, thus increasing its value.(Lendager, 2019) Hence, the principles of Non-toxic quality, Conserve, Reuse, Recycle/Renew and Disassembly in construction are the cornerstones in Circular Thinking.(Conte, 2018)Thus, the concept contributes to saving means and resources, and at the same time diminishing emissions of Carbon Dioxide CO_2 and pollutions to sustain and strengthen our biological basis for continued existence on this Earth.(Ibid) In continuation, we notice the means of industrial waste is interesting and relevant in the understanding of a Sustainable future, as waste is our own finding. Waste did not exist in the time before our technological leap, and with the introduction of circularity into the Built Environment, waste may be a temporary issue.(Lendager, 2019)

UPCYCLED STUDIOS AS CASE STUDY

Circular Thinking is for instance manifested in the Upcycled Studios by Lendager Group, who outlines its approach as a sustainable holistic, which balances the aspects of the economy and social perspective.(Lendager, 2019) We are aware that the scope of Upcycled Studios is quite far from our Thesis, however, we conceive this project as essential in the understanding of ecological approach in the Built Environment. Hence, the analysis places a focus upon the utilisation of recycled resources in construction. In the lens of solely Sustainability, we position the project as a potential pioneer for Circular based design. The concept is evidently designed with prosperity in mind, as it strives to regenerate the way we live and work, and the reduction of Carbon Dioxide CO_2 footprint into our atmosphere is the generator for design decisions; a driving force for the concept.(Ibid) However, we conceive the force as a key contributor to the generic design, stated in the motivational note(Ref. Motivation p. 16)', which is prevailing in the image of our cities. The move towards a future of assembly and disassembly Architecture fosters further a constrained and strict standard that distances itself further from the specific context and the locally available materials.(Bundgaard et al., 2015) Hence, it enhances the complex issues of contemporary Architecture instead of solving it. Looking retrospectively to the 1950s and 1960s after World War II, where the discourse of Universal Architecture in Europe (Note: 0.6 p. 78) were accused of neglecting the contextual, historical and intimate aspect(Lund, 2001)'. Hence, we must have a critical point of view upon the ecological approach. In continuation in the analytic point of view, the concept of Upcycled Studios does address some of our environmental and societal challenges, however, we wonder if the combination and composition of materials are pivotal for our experience of space or it is pivotal for completion of Circularity? The Circular Thinking affects the architectural approaches and design disciplines, as it calls for advanced and holistic interdisciplinary across the field of architecture, engineer and economy (Beim, Hvejsel, 2019) The increasing quantification of architectural quality has its pitfalls and can underrepresent the human and all its senses, and the cultural aspect.(Ibid) Thus, this study raises causes for further studies of the notion of Phenomenology to understand how our senses are enhanced in architectural cohesion.

SYNTHESIS

Point of Departure:
Preservation and protection of our natural environment

Objective:
Sustainable environmental Architecture

Means:
Ecological approach in construction activities

To synthesise, the study of the notion of Sustainability gave a nuanced insight into its mechanism and its branches that reach across disciplines; Environment, Economy and Society(Conte, 2018)', which we yet try to grasp. Sustainability in Built Environment emerged as a means to manage Architecture responsibly to ensure the well-being and healthiness of inhabitants and simultaneously take the environment into consideration, by saving its resources and reduce its pollution.(Ibid) Thus, the notion of Circular Thinking has relevance in our Thesis, as it addresses how ecological approaches can be applied in construction, thus Architecture, in the action against Climate Change. It forces us to confront, to rethink and reimagine the ways materials and resources are applied and used at a local and global perspective. However, we must also raise critical discussion of this notion, as it is interconnected with other aspect, as cited introductory in this paragraph. It has raised a dialogue of the relationship between human's conception of the Ecological Thinking and the technology of our time. Ecological Thinking strives to recover our environment, which is emerged in the human-centred vision of life on Earth.(Lendager, 2019) We created a degraded situation through our consumption(Ibid)', and we are in the process of remedying it through technology. This corresponds favourably to taking responsibility through the faith in the advancement of technology and escaping from revising human's behaviours and their culture of consumption. This resonates with our problem statement(Ref. Problem Statement p. 121)', as we believe that a sustainable future does not only concern the way we build, but in the way we consume as well. This raised another topic for discussion, as our consumption is rooted and associated with welfare, well-being, liberty; a certain standard of living in the context of Western society, which challenges the absolute changeover of people's mindset.

0.3.3 SENSORY ARCHITECTURE

SANSELIG ARKITEKTUR \sansəli arkitekˈtʉːr\ (Dict, n.d.)

A CRITICAL AND THEORETICAL STUDY

Index. Sensory Architecture
Index. Christian Norberg-Schulz
Index. Genius Loci
Index. Juhani Pallasmaa
Index. Peter Zumthor
Index. Phenomenology
Index. Martin Heidegger
Index. Critical Regionalism
Index. Kenneth Frampton

PRELIMINARY

In the response to the pitfalls of contemporary Sustainable Architecture, which is explored in the previous study (Ref. Sustainable Architecture: A Critical And Theoretical Study p. 56), the notion of Phenomenology is investigated, as it, in an architectural cohesion, concerns our sensuous experience and perception of a space. An aspect that we perceive as essential for our Architecture. The study takes a starting point in the theory of Genius Loci by Christian Norberg-Schulz (Note: 0.1 p. 79) and Multisensory Architecture by Juhani Pallasmaa (Note: 0.2 p. 79) and Atmospheric Architecture by Peter Zumthor (Note: 0.3 p. 79), including a case study of The Thermal Vals, by the latter. We will not repeat the theory's whole, however, we rather point out the aspects, which illuminate our focus. Concisely, the study synthesises the branches of Phenomenology in relation to our Thesis.

CHRISTIAN NORBERG-SCHULZ

Genius Loci:

The notion of Genius Loci derives from a Latin and means The Genius of the Place, referring to the Deity or Spirit. (Oxford Reference, n.d.) The ancients defined it as: that opposite man has to come to terms with, to be able to dwell.
(Norberg-Schulz, 1980)

The philosophical position of Phenomenology is approached and articulated differently. (Lund, 2001) Hence, the mentioned theories in this study vary from one another and yet have parallels in certain areas. The Norwegian architect Christian Norberg-Schulz, whose work is elaborated upon the philosophy of Martin Heidegger (Note: 0.4 p. 79) (Norberg-Schulz, 1980), has revived the notion of Genius Loci; the Spirit of Place and placed a paramount focus on the essence of a place; a place is a space that has a distinct character. Norberg-Schulz argues that a place and its phenomena, thus its concrete objects and its condition of topographic and climate character foster distinctive Architecture that emerges in a symbiotic relationship with its surroundings. In the following quote illustrated an elaborated view upon Norberg-Schulz's perception of a place: "*A concrete term for environment is place. It is common usage to say that acts and occurrence takes place. In fact it is meaningless to imagine any happening without reference to a locality. Place is evidently an integral part of existence. What, then do we mean with the word "place"? Obviously, we mean something more than abstract location. We mean a totality made up of concrete things having material substance, shape, texture and colour. Together these thing determine an "environmental character", which is the essence of place. In general a place is given as such a character or "atmosphere"*" (Norberg-Schulz, 1980, pp. 6-8)

Critical Regionalism (Frampton, 1981):

01. Architecture is not an isolated object, however it is an continuation of the contextual condition.
02. Architecture emphasises the notion of Tectonics instead of scenography.
03. Architecture is the response to the specific condition of the site it is placed. Such as sunlight, topography and microclimate.
04. Architecture embrace the tactile experience of a space and not only the visual aspect.
05. Architecture can merge the cultural and universal influences.

Norberg-Schulz does not only place significance upon the objects, but upon the qualitative aspect as well. He argues that we identify and orientate ourselves with a certain place; a certain environment in which life occurs, referring to notions of accommodation, arrival, gathering, interaction and meeting. (Norberg-Schulz, 1980) Hence, he perceives a place as a *total phenomenon.* (Norberg-Schulz, 1980, p.7) Furthermore, Norberg-Schulz adds an existential dimension to his theory, which will be discussed later in this study. He dives into the everyday experiences and points out our actions are different, which consequently require different environments. Hence, he ascribes an everyday-life dimension in his theory, which we appreciate.

The position of Norberg-Schulz's theory can be conceived as a critique upon the movement of a universal Architecture and its modernist dogmas, that biased the Architecture in Europe after World War II, which is mentioned in the study of Sustainable Architecture as well. (Ref. Sustainable Architecture: A Critical And Theoretical Study p. 56) Furthermore, in the theory of Genius Loci, there are parallels to Kenneth Frampton's (Note: 0.5 p. 79) position on the notion Critical Regionalism (Note: 0.6 p. 79) in which seek an Architecture rooted in the modern tradition, but tied to local, geographical and cultural context.

In continuation of phenomenological perception of space, Finnish architect Juhani Pallasmaa introduces the notion of multisensory of one's body into Architecture as an opposition to the approach of contemporary Architecture. (Pallasmaa, 2012) Pallasmaa claims that the discourse of today suppresses our other Aristotelian senses such as smell, hearing, taste and touch in favour of our vision. (Ibid.) Thus vision is conceived as a dominant and decisive sense in the creation of space. Vision is omni-directional, and our cognitive minds investigate and reflect upon the objects, which we visually observe, however, it distances the man from the objects. (Ibid.) Accordingly to Pallasmaa, Architecture that enhances life has to address all the senses simultaneously. (Ibid) In his theory, he points out the significance of the tactile sense for our experience and understanding of a space, which is expressed in the following quote: "*All the senses, including vision, are extensions of the tactile sense; the senses are specialisations of skin tissue, and all sensory experience are modes of touching, and thus related to tactility*" (Pallasmaa, 2012, p.12) Hence, he states that the quality of a space does not only concerns visual quality, but it involves a complex multi-sensory synthesis of factors that grasp an overall atmosphere, ambiance, mood or feeling of a space. (Pallasmaa, 2014) Tactility offers information upon proximately to our bodies, signalling intimacy, affection or closeness that enable us to connect with the surrounding. In other words, the senses can indicate distance, relatively. For instance, the senses of vision, smelling and hearing can describe the characteristics of a place from a certain far distance, however, touch and taste can only occur at a near distance. (Gehl, 2010) Furthermore, the tactile sense embodies other aspects beyond the Aristotelian senses such as sensations of orientation, continuity, duration, gravity, balance, scale, stability and illumination to assist us in the understanding and experiences of space. (Pallasmaa, 2014) This is synthesised into our capacity to grasp and capture environmental entities and atmosphere peripherally and unconsciously. Thus, atmospheric characteristics of a place, space and setting are grasped before the conscious observation of compositions and details.

JUHANI PALLASMAA AND TACTILITY

Tactility

Tactility relates to our capability of being touched or felt. It is the responsiveness to simulation of the sense of touch (Merriam-Webster, n.d.)

In line with Norberg-Schulz and Pallasmaa's position, Swiss architect Peter Zumthor emphasises that the aesthetic of Architecture is expressed through its sensory. (Zumthor, 2006) Zumthor has a distinct focus on the notion of Atmosphere, which Pallasmaa also mentioned in his position, and elaborates that atmospheric aspect grasps the embodied, emotive and immediate essence of one's experience of space; "*I enter a building, see a room, and - on the fraction of a second - have this feeling about it*" (Ibid, p. 13) In his writings, he describes the essential elements in the creation of architectural atmosphere. For instance, he enhances the significance of the compatibility of material, in which properties, processing and combination of it foster a range of possibilities to articulate a space; the presence of certain material in an interplay with for example light can darken or illuminate the space. (Ibid) In close relation to the compatibility of material, the criteria of sounds of a space are significance as well. The acoustic properties of a material in space can articulate the characteristics of the interiority and insinuate us to speak clearly and loud, or quietly and whispery. (Ibid) The sounds of certain spaces are embodied in our memories; we can for instance instantly identify the sound of a railway terminal or sound of a swimming pool. Furthermore, Zumthor points out that atmosphere emerges between Architecture and the surroundings, its climatic and topographic conditions, (Ibid) which resonate well with Norberg-Schulz's point of view.

ZUMTHOR'S THINKING OF ARCHITECTURE

Atmospheric Attributes (Zumthor, 2006)

01. The Body of Architecture
02. Material Compatibility
03. The Sound of Space
04. The Temperature of Space
05. Surrounding Objects
06. Between Composure and Seduction
07. Tension Between Interior and Exterior
08. Levels of Intimacy
09. The Light on Things

Project: Thermal Bath Vals
Architect: Peter Zumthor
Year: 1996
Location: Graubunden, Switzerland

FIG.43:THE THERMAL BATH VALS
(Photo tby Travor Patt)

FIG.44:THE THERMAL BATH VALS
(Photo by anonphotography.com)

ABOUT THE PROJECT

The Thermal Vals is situated in Switzerland and facilitates a spa and hotel. It is built upon a thermal spring in Graubunden Canton. The concept was creating a form of cave structure, which combines with the vision of sensory experience. Zumthor takes a starting point in the natural surrounding. Thus, the building is embedded in the hillside, mimicking the Swiss landscape with a grass-topped roof, and making an extension of the landscape. It integrates a cultural influence, as the structure consists of locally quarried Valser Quarzite stones, which is in a layering composition, creating multi-nuanced stripes. The Thermal Vals offers outdoor and indoor baths, ranging from 10 C to 42 C, which enable a variety of different thermal experiences.(ArchDaily, n.d.)

PETER ZUMTHOR'S THERMAL BATH VALS AS A CASE STUDY

In the coherence of our foci upon Water and with the exploration of the notion of Phenomenology, we perceive the Thermal Bath Vals by Peter Zumthor as an ideal architectural project for a case study. The following analysis is based on a combination of information on the project, provided in literature and other sources, and upon our own knowledge of characteristics and performance of materials. The Thermal Bath Vals is respectful to its surroundings and integrates its characteristics into the internal aesthetic. It offers us, perceivers, an atmosphere of a natural bath in the mountain of Switzerland. Thus, the Thermal Bath Vals takes a starting point in its site and combines stones and water in the creation of an environment, which offers sensory experiences of cold and hot, light and shadow, open and enclose, and materiality.(Archdaily, n.d.) In continuation of the analysis, we conjecture, it embraces the sense of sound, addressing our audial aspect, by employing the appropriate materials; the reflective acoustic attribute of the Valser Quarzite stones enforce the sounds of Water, which converges when the dynamic fluidity of the Water is in collision with the stones' solid matter. Furthermore, the Vals embraces the notion of thermoception; the sensation and perception of temperature of external environment.(Britannia, n.d.) The thermal condition of Water in interaction with the thermal condition of the air, forms saturated steam (vapour) in the air, inducing an atmosphere of thermal experience. We believe, it also illustrates the mythical atmosphere that is associated with bath, referring back to the Roman baths.(Fazio et al., 2014) Furthermore, Zumthor utilises lights, natural and artificial, to emphasis and illuminate joints and corners. The case study illustrates the significance of material compatibility in the creation of sensuous Architecture; how combinations of materials, materiality (surface) and properties such as acoustic and thermal can address our other senses and provide us information about the characteristics and the scale of space; we cannot only see it, but we can also hear and feel it. Concisely, it illustrates how contemporary technology in combination with the contextual conditions can offer an authentic experience; enabling us to connect with the environment.

SYNTHESIS OF SENSORY ARCHITECTURE

This study reveals an intriguing connection between the theories of Christian Norberg-Schulz, Juhani Pallasmaa and Peter Zumthor. In our point of view, their cultivation and passion for the sensuous aspect in Architecture are grounded in the vision of Architecture that is a dialogue with its site; its contextual conditions, and perhaps mediates a meaning towards its society. Hence, escape the pitfall of generic and universal Architecture. Here, we perceive a parallel to the discourse of Critical Regionalism by Kenneth Frampton, substantiating our approach and focus upon Tectonics, which is elaborated in the following study. (Ref. Tectonics: A Critical And Theoretical Study p. 68) The explored notion of Phenomenology is imperative in elucidating our conception and understanding of place, space and setting, and for our endeavour towards sensory Architecture. It provides us a vocabulary and initiates criteria or constraints for our analyses and design development; which inquiries or questions are necessary to investigate and integrate the sensory aspect into our design of the Research and Visitor Centre?

Index. Teshima Art Museum

FIG.45:TESHIMA ART MUSEUM

(Photo by Hoa Nguyen)

With Phenomenology's avocation for particular regard to context and its specific circumstances(Norberg-Schulz), we perceive potential in exploiting the contextual conditions of the North Sea, approximately to Nordnes, to create Architecture that is in synergy with the element of Water. In light of this specific study, we place a phenomenological approach in the analyses of Bergen, its landscape(Ref. Analysis: Serial Vision p. 93)(Ref. Analysis: Genius Loci p. 97) and add additional attention in the analyses of climatic characteristics.(Ref. Analysis: Microclimate p. 100) with the objective of exploring its potentials and drawbacks and possibly involve them in our design. The focus on the notion of multisensory(Pallasmaa), raises an attentive attitude in our thinking of place and space in regard to our bodies. It initiates ideas and forces for exploration and investigation of, how Water in architectural cohesion is not only a means for visual pleasure, but if it has potentials in creating atmosphere, addressing our other senses.(Ref. Foci: Water p. 85) Hence in addressing our emotions, that draws a new association between the emerged feeling and immediate grasp to the Architecture in our memories. Thus, besides the sense of vision, thermoception, touch and hearing are of imperative interest to be explored in this Thesis. Our read on Zumthor's position initiates an interest in how material and its properties can articulate certain characteristics of a space such as acoustically, visually and thermally. This is for instance explored in the case study. Furthermore, it also draws connections to the topic of technology of our time, which, we perceive, has great relevance to both Sustainability and Tectonics. Though the notion of Sensory Architecture is imperative for our framework, we must also place a critical view and draw its pitfalls to enable a nuanced understanding. As, Phenomenology is a philosophical position(Lund, 2001), it involves the ontological conception of Existence(Norberg-Schulz, 1980), which in our point of view is abstract and intersubjective. Norberg-Schulz places, for instance, a focus on the synergy between existence and architectural form, inducing poetic or psychic implications of Architecture; meaning that Architecture represents a means to give us an existential foothold in this world.(Ibid). Such an abstract position is intangible and does not impose any answers in the creation of space. Hence, we mentioned in the preliminary introduction of this study, that we strive to extract the tangible aspects for analytical intentions. The read upon Pallasmaa's position does also raise a discussion. According to Pallasmaa, life-enhancing Architecture addresses all our senses simultaneously, however, we questioning if the quality of the specific singular space, that are able to do such, is of low or high. As we discussed this, we had a hard time remembering or associating back to a certain architecture or space that addressed all of our senses. Architecture that approximately comes close to these notions is the Teshima Art Museum, Naoshima, Japan. Thus, the concept of Sensory Architecture is intriguing and significant for our experiences of a place, space and setting, however, it is subjective and we cannot conclude or evaluate upon it. Furthermore, the notion does not entail Architecture that takes ecological, economic or social aspects into considerations, which also are essential in this Thesis. Hence, Phenomenology, as an isolated approach, cannot initiate and induce concrete answers to our endeavour towards Architecture that responds to the issues of our time.

0.3.4 TECTONICS

TEKTONIKK \ tɛk'tɒn.ɪk\ (Dict, n.d.)

A CRITICAL AND THEORETICAL STUDY

Index. Tectonics
Index. Kenneth Frampton
Index. Peter Zumthor
Index. Gottfried Semper
Index. Marco Frascari

PRELIMINARY

The objective of this study is to enable a nuanced understanding of the notion of Tectonics and its vital position in Architecture; as an instrumental approach upon structural forces and the expression of material assemblies by the poetics of construction. (Frampton, 1995) The study takes a point of departure in the theoretical foundation of Tectonics and later includes selected positions by Gottfried Semper (Note: 0.1 p. 80), Kenneth Frampton (Note: 0.2 p. 80) and Marco Frascari. (Note: 0.3 p. 80) Again, we will not repeat the theories' whole, however, we aim to focus on the aspects that are relevant for our Thesis, Subsequently, it outlines a case study of Steilneset Memorial by Peter Zumthor, exemplifying the notion of Tectonics and discussing its potentials and pitfalls.

SIGNIFICANCE OF TECTONICS

The notion of Tectonics in Architecture is a multifaceted scope, encompassing multiple influential factors, as it does not only concern constructions, but likewise, it favourably can affect the environment and the human mind and body. (Hvejsel, 2018) The definition has, however, evolved in time and the understanding of the notion has supplementary become vital in its prospective of establishing a viable and sustainable approach in its assessment to construction. (Beim & Hvejsel, 2019) The emerging environmental and ecological challenges, as designated in the previous study (Ref. Sustainable Architecture: A Critical And Theoretical Study p. 56), call for contemplation upon how we in the field of Architecture and Engineering can embellish the Built Environment. Our motivation for the critical study upon Tectonics, thus, aims to position not merely its ability to impose an architectural value of space, but likewise a rethinking of the notion in relation to environmental circumstances. Hence, the notions of Circular Tectonics (Beim & Hvejsel, 2019) is investigated later in this study to examine its potentials for application towards an environmental architectural agenda.

THEORETICAL FOUNDATION

THE MOUND/THE EARTHWORK 0.1

HEARTH 0.2

ROOF 0.3

ENCLOSURE 0.4

FIG.46: GOTTFRIED SEMPER

In light of the need for Tectonics in contemporary Architecture, we take a starting point in the etymological and theoretical foundation to fully understand its meaning and force, fully. In an architectural agenda, the origin of the word *tectonic* derives from the Greek term *tekton* that signifies the virtuosity of a carpenter or builder. (Frampton, 1995) However, Tectonics has various meanings, likewise within the field of Architecture itself. The subject has extensively been argued throughout history and with a variety of explanations to follow. For instance, the understanding of Tectonics was, accordingly to the German architect and theorist Gottfried Semper, a division of four coherent practices. (Semper, 1989) Semper stresses the notions of vernacular building cultures and craft traditions by deconstructing Architecture of a primitive Hut into the elements of *The Mound/Earthwork, Hearth, Roof* and *Enclosure*. (Ibid.) Hence, Semper introduces to contextuality in relation to how the foundation encounters and obtains the building, and how the man-made unite with site and nature.

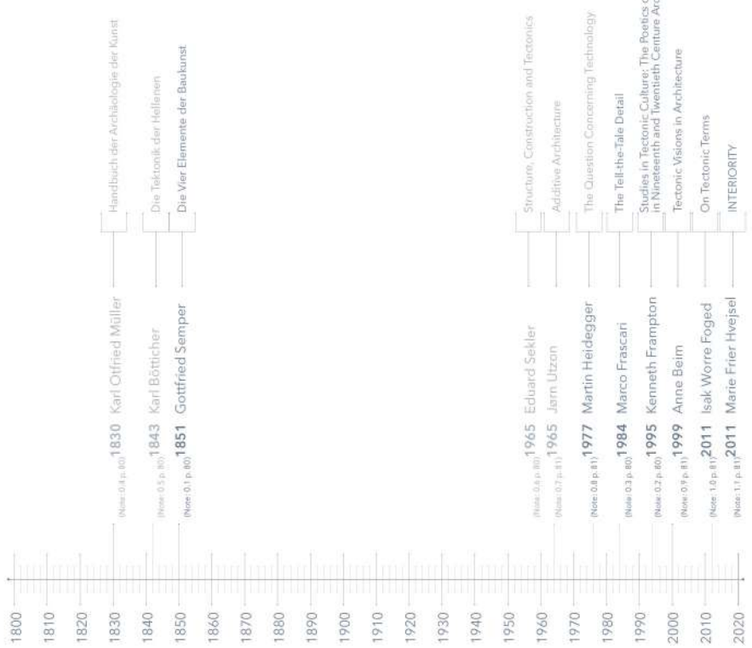


FIG.47: THEORETICAL MAP OF TECTONICS

However, eventually, the four elements synthesised into two intelligible categories articulating the *Mound* and *Heath* as the mass and topography, entitled as the *Stereotomic*, while the *Enclosing* space and its lightweight *Roof* denote the *Tectonics*. (Schwartz, 2017) To Semper, and later Kenneth Frampton, (Frampton, 1995) these two aspects enunciate the quality of architecture by the interplay of the converging elements and their extensive focus upon how materials are assembled to prompt their appearance in space. Additionally, his positions on the understanding of joining is described by other theorist as: "*Semper's emphasis on the joint implies that fundamental syntactical transition may be expressed as one passes from the stereotomic base to the tectonic frame, and that such transitions constitute the very essence of architecture.*" (Read, 2000, p.28) Hence, we perceive Semper's study as both rational and poetic approach to the notion, by the interlinking of the mass and framework to reveal its narrative of space in relation to its contextual position.

FROM SEMPER TO FRAMPTON

Frampton's position on Tectonics is built upon the founding idea of Semper, by collating contemporary construction practices with poetic accession and historical aspects. His point of view is influenced by technique, execution and conditions of context. (Frampton, 2015) Thus, the understanding of the term assembly a composition of elements which define a space that becomes an integrated part of our accession to Architecture. Marco Frascari discusses with a similar mindset, but with foci on the art of joining and how assembling can reveal a narrative through the creation of the visual and tactile sensuous experience of gesture, independent of scale. (Frascari, 1984) Hence, Frascari positioned the articulation of joining as the central aspect of Tectonic quality. However, while Frampton emphasises the importance of structural integration in detailing, (Frampton, 1995) this appeared less important to Frascari. Hence, with reference to Frascari, we understand Tectonics as a collection of architectural details that portray the whole, and similarly manifests the ambiance of space.

ANALYSIS

Project: Steilneset Memorial

Architect: Peter Zumthor and Louise Bourgeois

Building Owner: Varanger Museum$_{A/S}$, Vardø Municipality and Norwegian Public Road Admin.

Year: 2011

Location: Vardø, Troms og Finnmark, Norway

FIG.48: CASE STUDY
STEILNESET MEMORIAL

(Photo by Astrid Westvang, 2011)

ABOUT THE PROJECT

The Steilneset Memorial serves an example of Tectonics in Architecture. By the conception of a series of elements which form the buildings structure, the building addresses a contextualised approach. The design portrays a logical construction by the limited materials used and their form of structure. The wooden frame structure and the silk fabric creates a coherent dependency upon each other and show the trace of forces in relation to the surrounding terrain. Both form and material play a vital significance for space due to the pavilion's transparency and in its revealing. Hence, in its reading it reveals an expressive comprehension of the transformation between the lightweight structure and the embracing space.

(ArchDaily, 2012)

FIG.49: CASE STUDY
STEILNESET MEMORIAL

(Photo by Astrid Westvang, 2011)

STEILNESET MEMORIAL AS CASE STUDY

The Steilneset Memorial by Peter Zumthor and Louise Bourgeois(Note: 1,2 p. 81) emphasise the understanding of Tectonic practice in regard of form, material and context. (ArchDaily, 2012) Hence, we conceive the Steilneset Memorial applicable and relevant due to its essential parameters of forming an environmental thinking in Tectonics. The analysis of the project places a focus upon the terminologies and the history of Tectonics, to emphasises the notion as a way to address Sustainability and its role within the framework of Tectonics. Steilneset Memorial pictures a simple construction encompassing a series of wood elements or frames that arrange the span, the landings and the final structural expression, and hence the enclosing space. The formation of the structure expands three-dimensionally from a single element gesturing an endless continuance of the assemblage, and thus a wide-ranging ability in the process of generating formations. The lightweight compression structure and the tensile enclosing fabric membrane create an intriguing contrast, and at the same time, they are interrelated to one another. The exterior frames rely upon the membrane for lateral bracing along the longitudinal axis of the whole composition, and the enclosing membrane requires the exterior frames for horisontal and vertical support. Furthermore, the membrane generates an environmental contextualisation by its transparency compounding into the surroundings. Hence, the assessment to environmental notion becomes intelligible by the surroundings as the Stereotomic encountered by the Tectonic construction. Following, we can discuss the art of joining in the revealing of the building and the appealing to details as being scaleless. In that sense, every assemblies becomes a detail which further emphasises the quality of the architecture in its way to address contextual measures: for instance, by how the structure touches the ground or how the materials respond to its surroundings. Hence, the analysis addresses how the environment can permits for authorship by Tectonics in Architecture.

SYNTHESIS

This study of Tectonics gives evidence to vital potentials of the notion in the role of construction as a poetic approach to space. Furthermore, it similarly reveals Tectonics as a measure, subjecting to the contextual conditions, for instance, as outlined by Semper and the Primitive Hut. The latter draws parallels to aspects in the study of Sensory Architecture(Ref. Sensory Architecture: A Critical And Theoretical Study p. 62) in which Christian Norberg-Schulz and Peter Zumthor outline the importance of a dialogue between the Architecture and the specific site. With this, we notice distinctly the interrelationship between the notions of Sensory Architecture and Tectonics, which indeed embrace the contextual aspect. In continuation, Tectonics synthesises the contextual aspect with culture, through the employment and exploitation of local materials. Circling back to parallels to Sensory Architecture, we have already, emphasised how property and compatibility of materials have a vital role in addressing our senses through architectural spatiality, which is a vital aspect in Tectonics as well. For instance, how careful consideration of concrete and its surface can be exploited in Architecture, aesthetically, structurally and acoustically. Hence, the concrete does not only articulate the contemporary technology, but it substantiates the load-bearing system, reflects the light and frames a certain reverberation time, addressing our embodied experiences of stability, gravity, duration, illumination and sound.

Speaking of material and contemporary technology, we perceive essentials and noteworthy connections between Sustainable Architecture and Tectonics as well. With a sustainable approach, how can a critical application of material resources available at the site or their assembly substantiate the increasing need for resource efficency? This aspect is specifically investigated by Anne Beim and Marie Frier, who feed the notion of Tectonics into the Circular Thinking, fostering the notion Circular Tectonics(Beim & Hvejsel, 2019) The notions of Circularity, which is elaborated on in the study of Sustainable Architecture(Ref. Sustainable Architecture: A Critical And Theoretical Study p. 56)' is accelerating into the contemporary Built Environment and entails an approach to Architecture which concerns design, construction practices and the built's adaptability to various uses in a long-term prospect. This is elaborated on in the following statement: *(buildings are) parts tied together as a whole in a broader context of natural and cultural systems. This understanding feeds a new ethical dimension into tectonic practice that recognizes the correlation between the materials used, the ecosystems they form a part of and the resources we share as common members of the global community*" (Beim, 2015 p.12) According to Beim and Frier, the synthesis of Tectonics and Circular Thinking foster a viable architectural thinking, which equally emphasises the notion of social and sensory aspects. Hence, this study of Tectonics gave a broad insight into the multifaceted understanding of the notion. It reveals a series of potentials for our approach towards an Environmental Tectonics, and substantiates our conception of Tectonics as a means to tie the Sensory and Sustainable aspects, as it aims to address both poetics of space concurrently with the ecological approaches. However, we must further access this notion from a critical point of view as this Tectonic approach involves the complexity of aspects that might impose a risk of failure.

0.3.5 THEORETICAL SYNTHESIS

TEORETISK SYNTESE /teu're:tisk//syn'te:se/ (Diet, n.d.)

A VIEW UPON THE THEORIES

PRELIMINARY

The following will recapitulate the comprehension of the previously accentuated theoretical findings and further reconcile the contemplated aspects with the aim to expand our vocabulary and accession to the subsequent analysis and design development. A theoretical map will support the essential outcomes and relationship between the field of Sustainable Architecture, Sensory Architecture and Tectonics, which aims to articulate our position within the complex matters in relation to Nordnes and the element of Water.

THE INTERDISCIPLINARY FIELD OF ARCHITECTURE

SUSTAINABLE ARCHITECTURE

TECTONICS

SENSORY ARCHITECTURE

FIG.50:Tectonics as a method towards Sustainable and Sensory Architecture

In the meticulous study of the interdisciplinary field of Architecture concerning Sustainable Architecture, Sensory Architecture and Tectonics we aim to position a theoretical platform of knowledge fields which enables a critical way to access the following design development. By the theoretical studies and appreciation, we further permit an accession to the point of departure of the Thesis addressing the problem of human-caused Climate Change without oppressing the sensuous experience, by introducing the notion of Tectonics. While Sustainable Architecture constantly is evolving, addressing the notion isolated has its pitfalls as the increasing quantification of architectural quality can diminish the human and its senses and cause generic outcomes. (Ref. Sustainable Architecture: A Critical And Theoretical Study p. 56) Hence, we stress to address Sensory Architecture which escapes this pitfall of generic solutions, however attending the notion solely will not consider ecological, economic and social aspects and cannot initiate or induce concrete solutions concerning Architecture that counters the challenges of our time. (Ref. Sensory Architecture: A Critical And Theoretical Study p. 62) Tectonics aims to address these pitfalls as it acknowledges Architecture to be situated within construction as an ecological manner of the used materials or resources available in context and further it positions a way to reveal experience of space through material assemblance or by allowing the environment of authorship of Architecture. (Ref. Tectonics: A Critical And Theoretical Study p. 68) Hence as mapped, the inclusion of the three fields, rather than solely focusing on one measure, provides a strengthen and developed comprehension upon the potentials across each field.

ARCHITECTURE AND CONTEXT

Key points:

01. Addressing climate characteristics
02. Addressing context characteristics
03. Relation between man and environment

In the aim of moving towards an environmentally Sustainable Architecture, we aim to stress Architecture in synergy with the contextual conditions of Nordnes, specifically by the element of Water and its intangible dimension. Accordingly, the studies reveal a way to access the environmental circumstances by both the cultivation for sensuous experience and Tectonics as a contextual instrumentality grounded in the conception of Architecture. The map clarifies how the interdisciplinary field come to realisation by the positioned theories; As previously accentuated the theory of Sensory Architecture reveals an understanding upon place, space and setting, which can be approached correspondingly to site by its climate characteristics or its undulating landscape in juxtaposition to Water. (Ref. Sensory Architecture: A Critical And Theoretical Study p. 62) With a similar mindset Tectonics reveal how we can unite man-made with site and nature as articulated by the notion of Environmental Tectonics and how Architecture can construct environments for human which increase the comprehension upon a given context and its circumstances. (Ref. Tectonics: A Critical And Theoretical Study p. 68) On that note, we place an understanding upon how to associate our Architecture with the environment at hand by adding attention on environmental or climate characteristics at site and emphasise it through ecological construction means and its revealing of space e.g. through the way the Tectonic encounters the Stereotomic. Hence, we perceive a range of potentials for our design studies to address Nordnes and its both contextual and climatic relationship to Water.

THE NARRATIVE

Key points:

01. Thinking space in regards of mind and body
02. Multisensory to address emotions
03. Reveal a narrative through details

With the Thesis' point of departure in Water as a mean to confront society with our culture of consumerism (Ref. Introduction p. 27) we aim to position a way to create Architecture that can mediate meaning and confront man to take a stand on the environmental challenges in Nordnes. As previously accentuated, we as human obtain a way to learn and attain knowledge by individual experience, (Ref. Knowledge and Common Language p. 29) which we perceive as a potential to address by thinking of place and space in regard to our mind and bodies. (Ref. Sensory Architecture: A Critical And Theoretical Study p. 62) With reference to Juhani Pallasmaa and multisensory we see a possibility to procure Climate Challenges in Nordnes by understanding Water in an Architectural framework of not only visual pleasure, but similarly the other senses and perhaps address our emotions. This embracing of Water will, with reference to Marco Frascari, further be supported by the art of joining, which accentuate how details can reveal a narrative through the creation of visual and tactile sensuous experience independent of scale (Ref. Tectonics: A Critical And Theoretical Study p. 68) Hence, through Tectonics we aim to address experience of space which can articulate Water e.g. by openings to frame Water visually or acoustically in the audio of rainfall towards a material surface. Accordingly, in addressing our emotions through our senses, we can draw a new association between the emerged feeling and the immediate grasp to the Architecture in our memories, and thus, support the spatial narrative and the human perception of it.

MATERIALS AND RESSOURCES

Key points:

01. Reuse, Recycle/Renew and Disassembly
02. Thinking in a long-term prospect
03. Technology of our time

This further draw correlation to materials, resources and the technology of our time which by the notion of Circular Economy introduces a way to approach the narrative of Sustainability. (Ref. Sustainable Architecture: A Critical And Theoretical Study p. 56) By the notion we enable a way to apprehend materials by the terms of Reuse, Recycle/Renew and Disassembly, which forces us to rethink ways materials and resources are utilised. In a Tectonic cohesion it further relates to the understanding of a maximum utilisation in regards of construction and materials which by Circular Thinking potentially permits a way to rethink our Architecture in its adaptability to various use in a long-term prospect. In relation to the element of Water this could e.g. be addressed by the Research and Visitor centre of Climate Change, concurrently with the increase of Water at site, could turn into a water reservoir or a water tower. Following the notion of Circular Thinking addresses how contemporary technology can remedy upon man-made Climate Challenges of our time e.g. by mechanisms which make the built respond to the changing environment. In keeping with our aim to create Architecture that confront society upon our consumerism, this corresponds to take responsibility through the advancement of technology which hence, reflects our problem statement of this Thesis. (Ref. Problem Statement p. 121) Thus, by these measures we position a way to address our platform of a Research and Visitor Centre of Climate Change, that potentially can figure as an Architectural catalyst that through the built encounters an Ecological awareness.

FIG.51: MAP OF THE THEORETICAL CONNECTIONS

NOTES

NOTE \'nu:te\(Dict, n.d.)

TO PROVIDE CONTEXT

SUSTAINABLE ARCHITECTURE

Lendager Group 0.1

Lendager Group is a Danish architectural company, who promotes Circular Economy in cities, buildings and companies, across it's three branches Lendager ARC, Lendager UP. and Lendager TCW. Lendager ARC is the architectural department and aims to become the leading sustainable office in Denmark. Lendager UP provides upcycled materials and was started on account of a demand for locally produced upcycled products. Lendager TCW deals with organisational strategies of Circular Economy. Cross-disciplinary is rooted in their approach and is carried out with a foundation in holistic Sustainability. They strive to balance the aspects of social, environment and economy, and conceive themselves as significant contributor in creating a future of economic and Sustainable growth (Lendager Group, n.d.)

Sustainable Bias 0.2

The tendencies towards a Sustainable future is for instance reflected in strategies and products from various companies and retailers. In the category of fashion, clothing chain such as H&M(H&M Group, n.d.) is promoting clothing, produced upon recycled or Sustainable fabrics and their organisational strategies are also Sustainable bias. In the category of vehicles, , companies for instance Tesla(Tesla Impact Report, 2018)' is specialising in electric cars. Furthermore, buses for public transportation are transiting into electric engine as well. In the category of food, company such as Naturli'(Naturli' Environment, n.d.) delivers only product that are plant-based. Thus, it promote a way to reduce the emission of Carbon Dioxide CO_2 through the food human consume.

Greenpeace 0.3

Greenpeace is a NGO (Non-Governmental Environmental Organisation) who advocates and calls for a more sustainable and greener future, and protection of the Earth's fauna. Greenpeace was founded in 1971 and is operating worldwide and has 26 offices in 55 countries. According to Greenpeace, they take non-violent and creative action to promote and pave the way towards a more peaceful and sustainable world. They raise awareness and place focal points in the areas of Climate & Energy, Nature & Food, Democracy & Europe and Pollution. Furthermore, they operate at a political plan and confront the governments that systematic threaten the environment. (Greenpeace, n.d.) Though, their actions have been critised, as their documentations upon the climatic impact from certain activites have not been sustantiated fully.

Greta Thunberg 0.4

Greta Thunberg is a 17-years-old climate activist from Stockholm, Sweden. At the age of 15, she initiated the her protest in front of the Swedish Parliament Building and stated that she will continues the protest until the Swedish Government met the Carbon Emission Target agreed at COP21 in Paris 2015. Subsequently, she draw global attention with her speech at the UN Climate Conference in September 2019, in which she accused the contemporary political landscape for devastating our climate and planet, living the future generation an unbeatable battle against Climate Change. She has lead a series of strikes and has inspired millions of people around the world to protest and demand action on Climate Change. (BBC, 2020)

DGNB, LEED, BREEAM 0.5

DGNB (Green Building Council Denmark)(DGNB, n.d.)' LEED (Leadership in Energy and Environmental Design)(LEED Rating System, n.d.) and BREEAM (Building Research Establishment Environmental Assessment) (BREAAM, n.d.) are certification systems, based in different countries. In Denmark, all are known among architectural practices and is utilised, depending on the stakeholders in the building project and the scale of it. The certification systems aims to support Architecture towards a more sustainable future. Hence it rates Architecture regard to the environmental, economic, technical and social aspects, and if feasible, the building is either DGNB, LEED or BREEAM certified, which add a sustainable value.

Discourse: Universal Architecture 0.6

Universal Architecture emerged after World War II and aimed to enhance the industrialisation further within the Built Environment on account of the increasing demand of housing. Hence, it strived to redefine the process of constructing a building; manufacturing the components for assembly to replace the long process at construction site. The approach was compared to the process of manufacturing of cars. Some Architects from the time were convince, the generic system creates a framework in which environment for social interaction and well-being well emerge. However, throughout 1950's and 1960's critiques arose, which pointed out the concept of System Architecture lacks the human and historical aspect. (Lund, 2001)

Index. BREEAM
Index. LEED
Index. DGNB

SENSORY ARCHITECTURE

Christian Norberg-Schulz was a Norwegian architect, historian and a professor at *Arkitekthøgskolen* in Oslo, Norway. He studied Architecture at the Polytechnic of Zurich in 1949 and continued at Harvard University and at the Norwegian Institutet in Rome. Norberg-Schulz was initially inspired by Sigfried Gidion, Walter Gropius and Mies Van der Rohe, and practised the notion of Universal Architecture.'(Architects, Architecture, Architectuul, n.d.) Later, in his work, which is inspired by the work of Martin Heidegger(Note: 0.4)' Norberg-Schulz outlines the significance of the conception of Phenomenology, which is also a starting point for the revived notion of Genius Loci; The Spirit of Place.'(Danskkunst Historiker Forening, n.d.)

Christian Norberg-Schulz (1926-2000) 0.1

Juhani Pallasmaa is a Finnish architect. He is universally known through his interest and theory in the notion of Phenomenology, which is manifested in the publication *The Eyes of The Skin, Architecture and the Senses*. The 1st edition was published in 1995. Here, he stressed the significance of experiencing Architecture through our senses, which he states is neglected by architectural practitioners in the contemporary Architecture. (Architects, Architecture, Architectuul, n.d.) Pallasmaa is perceived as a distinguished architect and architectural thinkers. His positions include: Rector of the Institute of Industrial Art, Director of the Museum of Finnish Architecture, Professor and Dean of the Faculty of Architecture.'(Pallasmaa, 2012)

Juhani Pallasmaa (1936 -) 0.2

Peter Zumthor is an architect from Basel, Switzerland. Zumthor started his career as a cabinet maker, and established his architectural practice in 1979. Through his architecture, his sensuous attention to materiality and place, Zumthor is considered as one of the most extraordinary architects in 21st century and has received a series of Awards, among others, the Pritzker Architecture Prize. Zumthor's work withhold experiential qualitites and embrace the cultural and technology of contemporares.(Archdaily, 2019) In the book *Thinking Architecture*, comprised of a series of essays, published in Birkhauser 1998, Zumthor elaborates upon his architectural philosophy and allow readers a glimpse into his mind.'(The Pritzker Architecture Prize, n.d.)

Peter Zumthor (1943 -) 0.3

Martin Heidegger was a German philosopher who addresses architectural philosophy and the effect of architecture in relation to humans. In his work Questions Concerning Technology he emphasises the notion of technology and how to use it as an instrument in society. He enables an understanding upon technology relating to the term techné which enables the comprehension of revealing, and hence the poetics of space. This work is eminent and is a platform for various of following influential architectural theorists such as Christian Norberg-Schulz and Kenneth Frampton. (Foged & Hvejsel, 2018) Hence, Heidegger is known for his contribution to the notions of Phenomenology and the existential dimension.'(Norberg-Schulz, 1980)

Martin Heidegger 0.4

The British architectural theorist and professor at Columbia University, Kenneth Frampton is of great influence in architectural culture and history. His writing on twentieth-century architecture and role in the progress of Tectonic culture has achieved him great influence and prominence in architecture. He is among others noted for his work in *Studies in Tectonic Culture. The Poetics of Construction in Nineteenth and Twentieth Century Architecture* that encompasses writing that trace the history of concurrent form as an evolving poetic of structure and construction. His international standing is founded upon his theories on Critical Regionalism, that emphasises architecture encountering the idea of sense of belonging and identity. (Foged & Hvejsel, 2018)

Kenneth Frampton 0.5

In his writing in 1980 Critical Regionalism, Towards a Critical Regionalism: Six Points for an Architecture of Resistence, Kenneth Frampton outlines the modern culture and Architecture are moving towards a state that is universally conditoned and exhaustively optimised by the technologies. Furthermore, he points out that the universal architectural approaches and practices are driven by iconic symbols of our modern culture; the skyscraper. Frampton's response upon, which he believe is an issue of great mesure, is Critical Regionalism that he describes as *"mediating the impact of universal civilization with elements derived indirectly from the peculiarities or a particular place"* (Frampton, 1980)

Critical Regionalism by Kenneth Frampton 0.6

Index. Christian Norberg-Schulz
Index. Juhani Pallamsaa
Index. Peter Zumthor
Index. Martin Heidegger
Index. Kenneth Frampton
Index. Critical Regionalism

Gottfried Semper 0.1

The German architect and theorist Gottfried Semper became one of the most influential architects in the nineteenth century. From his first essays on Greek polychromy in 1834 to his final lectures about the origin of architecture in 1869 he endeavoured to comprehensive theory in architecture elaborating on the changing nature of architectural form. His appearance is certainly in relation to his work about the origins of architecture elaborated on in his book *The Four Elements of Architecture* from 1851. His ideas did both applause and oppose and proved a vast influence in the development of modern theory (Foged & Hvejsel, 2018).

Kenneth Frampton 0.2

The British architectural theorist and professor at Columbia University, Kenneth Frampton is of great influence in architectural culture and history. His writing on twentieth-century architecture and role in the progress of Tectonic culture has achieved him great influence and prominence in architecture. He is among others noted for his work in *Studies in Tectonic Culture. The Poetics of Construction in Nineteenth and Twentieth Century Architecture* that encompasses writing that trace the history of concurrent form as an evolving poetic of structure and construction. His international standing is founded upon his theories on Critical regionalism, that emphasises architecture encountering the idea of sense of belonging and identity. (Foged & Hvejsel, 2018)

Marco Frascari 0.3

The Italian architect and architectural theorist Marco Frascari have among other architects exemplified the notion of tectonic through his theoretical work. The concept of Tectonics is described by the concepts of construction and construing, which according to Frascari has to be presented in meaningful architecture. In his work in *Tell-The-Tale Detail* Frascari emphasis the dimension of detail and how the mental construing and the actual construction lies within the art of joining. Hence, a certain narrative and revealing of tectonic can be distinguished in the detail and its mean. (Foged & Hvejsel, 2018)

Karl Otfried Müller 0.4

The German professor and scholar of classical Greek etymology is in an Architectural framework known for his work *Handbuch der Archäologie der Kunst*, where he by Kenneth Frampton is positioned as one of the earliest in addressing the notion of Tectonics by the referring to *tektonische* as a series of art forms of for instance dwellings or places for men to meet, but likewise other activities.(Frampton, 1995) Hence, he indirectly bound the notion in relation to architecture together with other activities connected to the Greek etymology of the term *tekton*.(Foged, 2015)

Karl Gottlieb Wilhelm Bötticher 0.5

The German archaeologist specialised in Architecture Karl Bötticher is well known for the conception of Kernform and Kunstform from Die Tektonik der Hellenen, which reintroduces the Greek etymology of Tectonics. The principles describe the coreform (Kernform) and the artform (Kunstform) as a way to define the construct in relation to artform to define the object of Architecture. Following, the work positions the notion Tectonics as an application to architectural research by approaching Tectonics in Architecture as a concept which compose all the element of a building together to be complete. (Foged & Hvejsel, 2018)

Eduard Franz Sekler 0.6

The Austrian architect, architectural historian and professor Eduard Sekler was known for the paper *Structure, Construction, Tectonics*. On the notion of Karl Bötticher and Gottfried Semper he formed a repositioning of Tectonics through architectural eminence. Sekler distinguish tectonics as an approach to transform structure and construction into architectural spatial experience. In his 50 years as a professor of Architecture at the Harvard Graduate School of Design he made essential determination to address architectural history in which Tectonics was visible as a focal element. (Foged & Hvejsel, 2018)

Index. Gottfried Semper
Index. Kenneth Frampton
Index. Marco Frascari

Jørn Utzon 0.7

The Danish architects Jørn Utzon has throughout is known for his ideal design systems which can figure for prefabricated building components. In his approach of Additive Architecture, he examined how to transform prefabricated components into artistic means of construction. One of the most thorough examples was The Espansiva building system reflecting upon the understanding of construction unit as an essential factor for Architectural design. The notion of repetition refers to economic thinking in the means of construction, and thus addresses the notion of Tectonics trough a Sustainable lens.

(Beim, 2004)

Martin Heidegger 0.8

Martin Heidegger was a German philosopher who addresses architectural philosophy and the effect of architecture in relation to humans. In his work Questions Concerning Technology he emphasises the notion of technology and how to use it as an instrument in society. He enables an understanding upon technology relating to the term techné which enables the comprehension of revealing, and hence the poetics of space. This work is eminent and is a platform for various of following influential architectural theorists such as Christian Norberg-Schulz and Kenneth Frampton. (Foged & Hvejsel, 2018)

Anne Beim 0.9

Anne Beim is a Danish architectural professor and head of Centre for Industrialised Architecture at The Royal Danish Academy of Fine Arts, School of Architecture in Copenhagen. She has been author and co-author for publications particular regarding the notion of Tectonics in relation to challenging areas of architectural practice. Among other publications she is co-author on *Towards an Ecology of Tectonics. The Need for Rethinking Construction in Architecture* which emphasises the call for an act for the emerging challenges of climate changes. (Beim, 2014)

Isak Worre Foged 1.0

Isak Worre Foged is a Danish architect/engineer and associate professor at the Department of Architecture, Design and Media Technology. His work emphasises tectonics in architecture, environmental architecture and computational architecture. In relation to his academic field he is founding partner in the architectural studio AREA, that explores the notion of Environmental Tectonics, based upon his PhD thesis: Environmental Tectonics: Matter Based Architectural Computation in 2015 and Constructing and Construing Environmental Sensations from 2016. (Foged & Hvejsel, 2018)

Marie Frier Hvejsel 1.1

Marie Frier Hvejsel is a Danish architect/engineer and associate professor at the Department of Architecture, Design and Media Technology. Additionally, she co-heads TiA Research Group for Tectonics in Architecture. Hvejsel holds a PhD in domestic architectural quality and prefab technology. Her PhD *INTERIORITY* examples everyday practice through the specific interest in furniture scale as an accession to tectonic thinking in architecture. Other publications as *Circular Tectonics? A critical discussion of how the architectural discipline can drive ecological continuity* addresses the framework of Tectonics in reference to an ecological architectural practice. (Foged & Hvejsel, 2018)

Louise Bourgeois 1.2

The French American artist Louise Bourgeois is one of the most influential figures in art history in the 20th century. Bourgeois obtained her first studio in 1980 in New York, where she worked on numerous of projects for instance the Cells which is currently exhibited at Louisiana in Copenhagen, Denmark. She is among other works well-known for her large exaggerated spider sculptures, which has designated her the name Spiderwoman.(Louisiana, n.d.) Additionally, Bourgeois has together with Peter Zumthor designed one of two parts of the Steilneset Memorial in Norway.(ArchDaily, 2012)

Index. Martin Heidegger
Index. Anne Beim
Index. Marie Frier Hvejsel

0.4.0 LIST OF CONTENT
0.4.1 FOCI: WATER
0.4.2 SERIAL VISION
0.4.3 GENIUS LOCI
0.4.4 MICROCLIMATE
0.4.5 MAPPING
0.4.6 WATER TIDES
0.4.7 TARGET GROUP
0.4.8 UNIT PROGRAM
0.4.9 ANALYTICAL CONCLUSION
0.4.10 PROBLEM STATEMENT
0.4.11 VISION

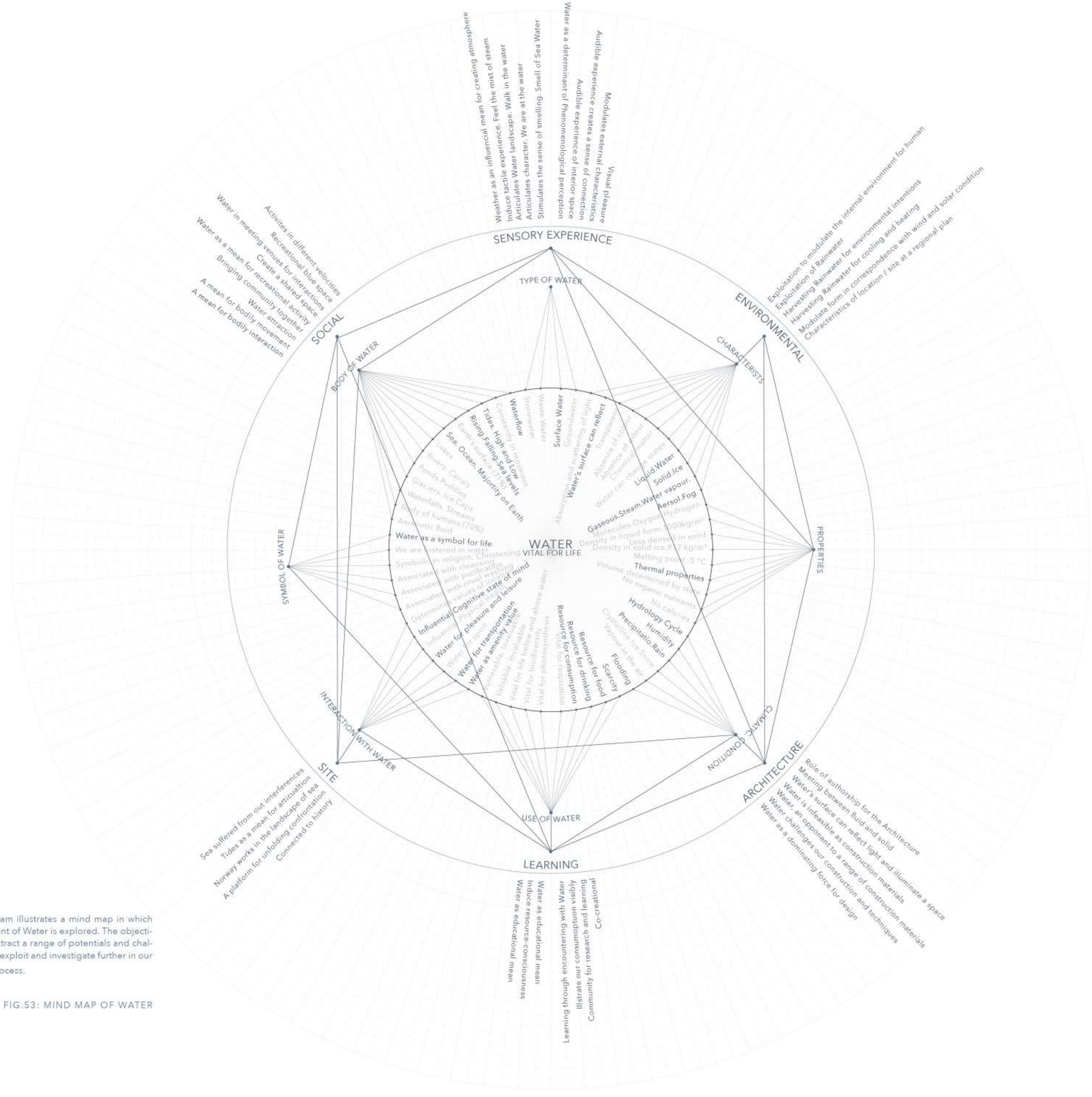
0.4.0 ANALYSIS

ANALYSE \ɑnɑˈlʏːse\ (Dict, n.d)

CHAPTER CONTENT

The Analysis introduces the analytical site studies, such as measurable environmental and climatic conditions of Nordnes, Bergen, cartographic analysis, araised from a transformational approach, and visual-orientated analysis, which derives from a phenomenological approach. Moreover, it includes an analysis of groups of users. The site analyses are presented in Microclimate, Mapping (Corner, 1999) Serial Vision(Cullen, 1971) and Genius Loci. The objective is to provide our readers and ourselves with a contextual understanding of the framework of the tangible and phenomenological aspects. The user analysis is presented in Target Groups, and aims to provide an overall understanding of the user spectrum, which creates a basis for the program.

FIG.52:WATER(Photo by Silas Baison)



The diagram illustrates a mind map in which the element of Water is explored. The objective is to extract a range of potentials and challenges to exploit and investigate further in our design process.

FIG.53: MIND MAP OF WATER

FOCI:WATER 0.4.1

FOCUS \ˈfu:kəs\(Dict) :VANN \ˈvɑn\(Dict)
AN AREA OF FOCUS

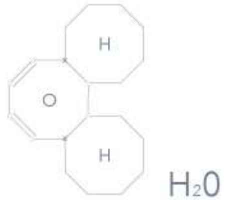
Index, Water

PRELIMINARY

The following outlines our focus upon Water, which is based on our observations and research of Bergen. Our inquiry takes a starting point in the Mind Map in which we map the various aspects of Water and synthesised them into a series of groups. The elaboration explores the versatility of the element Water and places an emphasis on the potentials and challenges of Water and is illustrative supported by a mind map. This study does not gives us an answer or definite solution to, how Water can be employed in our project, however, it initiates a setting of constraints and framework of which aspects of Water, we in fact can operate with.

WATER AND ITS VERSATILITY

As mapped, Water is a matter of versatility, and its value and meaning are conceived differently, depending on the coherence or context it is presented in. Although, us human beings have made a shift to land, our connection to Water remains significant as ever, as it is fundamentally vital for life and its organisms. Water is constantly in movement and has its own cycle; the Hydrologic Cycle, in which it alternatively appears in different states and shapes, depending on the conditions. It emerges as vapour (gaseous state) in the atmosphere and condensed into the structure of liquid in the nature of rain. (Encyclopaedia Britannica, , 2020) Moreover, it is essential for our society, as it is a vital media for transportation and resource for our consumerism. Hence, we perceive it as a invulnerable and vulnerable measure, which we can dominate and vice versa. We exploit it, filter it and contaminate it. In continuation of enhaning the versatility of Water, it is also significant for our cognitive minds, as it can be associated with memory or identity. Its presence can evokes the sentiments of calmness, transquility and well-beings. Furthermore, it can have a recreational purpose, a gathering element for social activity and interactions.



Water is a matter of chemicals elements; Hydrogens [H] and Oxygen [O] that transform into H_2O. It figures in the states of solid, liquid and gas(Zumdahl, 2020)

A SYNTHEIS OF WATER AND ARCHITECTURE

Essentially, in relation to our Thesis,the focus on Water raises intriguing questions, discussions and dialogues about the intersection of Water and Architecture? Here, we perceive a range of potentials and challenges that set the framework for our studies in design and perception, as its fluid and dynamic nature have a decisive influence. In the light of our approach(Ref. Approach p. 85) and hence the call for interdisciplinary, we place an emphasis on the Water in relation to technique, sensory and aethestics, which is highlighted in the map. Relatively to technique, the properties of Water, can for instance have a potential role in regulating the thermal experience within a space with, and thus enhancing a sustainable strategy with the principle of cooling with natural forces. In contractory, Water is crucially challenging for construction and is hostile with a variaty of construction materials. Relatively to sensory, Water and its characteristics can stimulate our bodily senses, as we are able to touch, see, hear and taste it. Aesthetically, for instance can Water in its fluidity integrates in the spatial experience and with its transparency filter light and create fluctuaing reflections. The mentioned are purely immediate ideas and thoughts, and thus this study calls for elaborated explorations and studies in the Design Process.

FIG.54:

FIG.55:

FIG.56:

FIG.57:

FIG.58:

FIG.59:

FIG.60:

FIG.61:

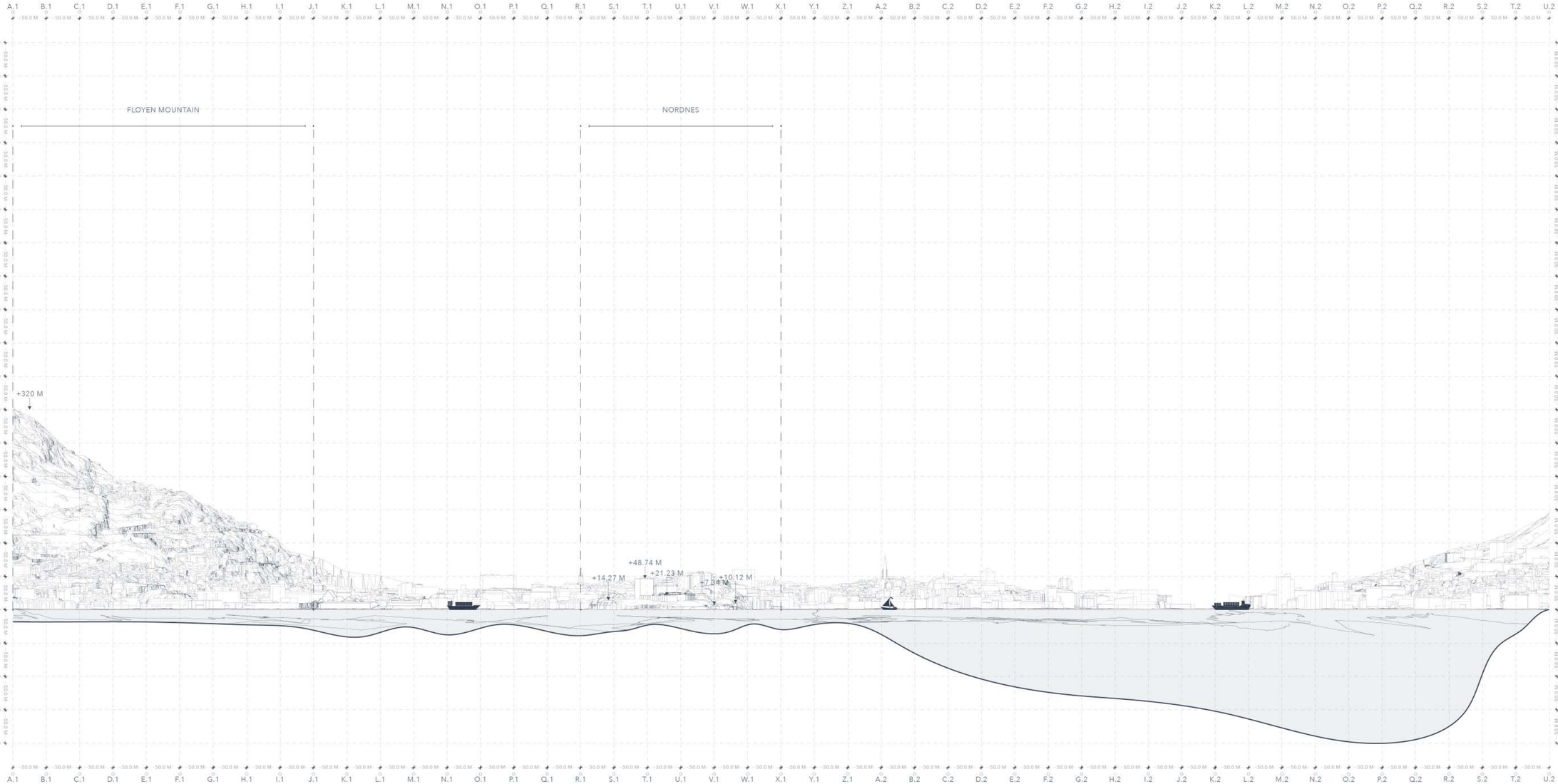
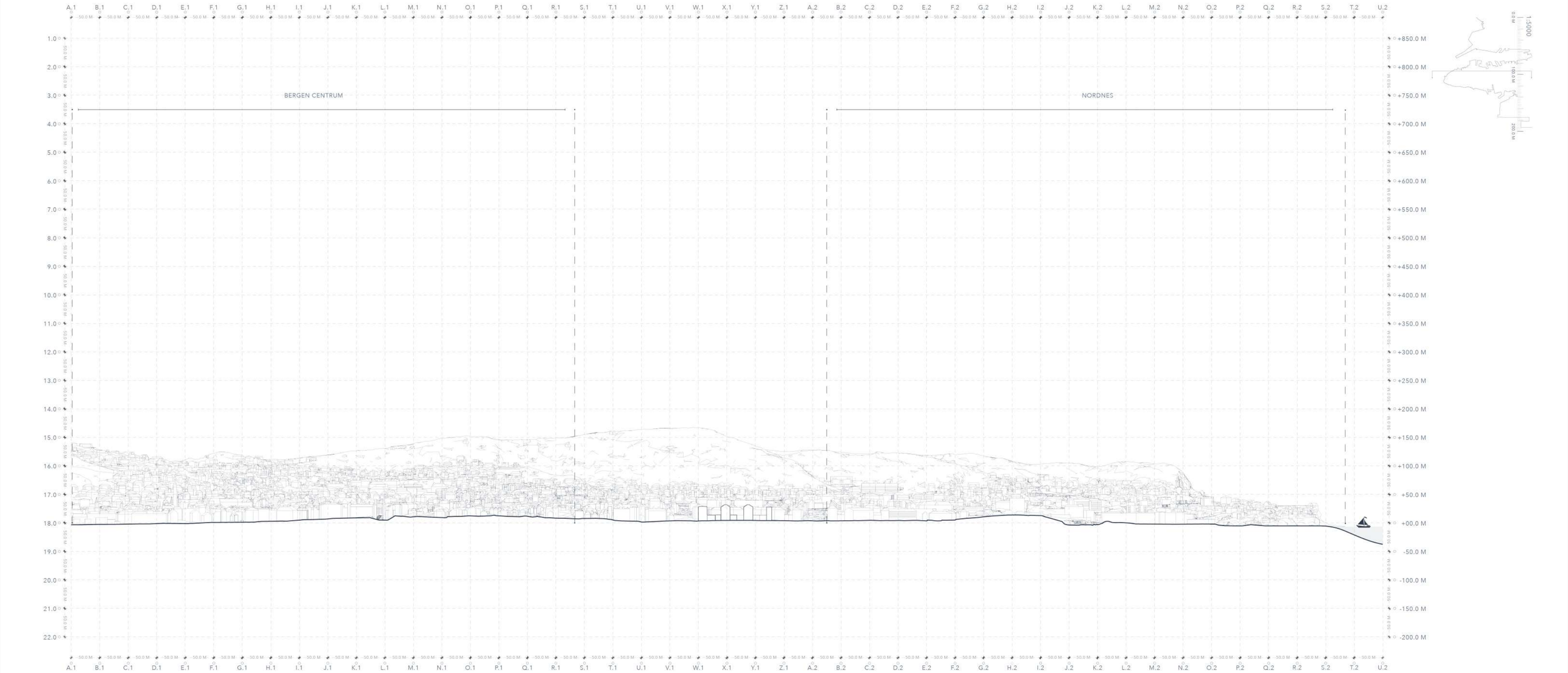


FIG.62: 1:5000 SECTION OF BERGEN


BERGEN CENTRUM
NORDNES
1:5000
50.0 M
100.0 M
200.0 M
+850.0 M
+800.0 M
+750.0 M
+700.0 M
+650.0 M
+600.0 M
+550.0 M
+500.0 M
+450.0 M
+400.0 M
+350.0 M
+300.0 M
+250.0 M
+200.0 M
+150.0 M
+100.0 M
+50.0 M
+00.0 M
-50.0 M
-100.0 M
-150.0 M
-200.0 M

SERIAL VISION 0.4.2

SERIEL VISJON/ˈseːriel/ /viˈʃuːn/ (Diet, n.d.)

GORDON CULLEN: A PHENOMENOLOGICAL APPROACH

Index, Serial Vision
Index, Gordon Cullen

FIG.63: ROUTE FOR SERIAL VISION

Serial Vision enables a comprehension upon the phenomenological perception of townscape revealed through the visual registration of space.(Cullen, 1971) Hence, we aim to grab the essense of Site by the understanding upon scale, materiality and tactility through the sequence of space and thus, the gestures and atmospere it reveals. In addition, the analysis can clarify hidden potentialts which can be utilised in our approach to Architecture through our kinaesthethic sympathy and experience.

PRELIMINARY

Location: Nordnes Park
Date: February 8th 2020
Time: 10.00 A.M

SERIAL VISION

Serial Vision is an approach developed by the architect and urban designer Gordon Cullen,(Note: 0.1 p.X) which aims to support and substantiate the notion of kinaesthetic experience by the means of a series of visual impressions of townscape. This approach to townscape exemplifies the complexity of senses and how Man can perceive a certain space through its scale, focal points, materiality, movement and contrasts in the scene of the city.(Ibid.) These elements positions both phycological and bodily experiences which accentuate the experience of sphere or space. In addition, the comprehension of the Site is crucial as it can reveal potentials of townscape.

SEQUENCE OF SPACE

The kinaesthetic experience of space portray a nature setting remote from the pulsating town life in the centre of Bergen. The route preliminary presents an open field grasping the essense of the undulating landscape scenery in an interplay with the dense city structure and the slightly waving water noticeable in the distance. Moving along the undulating streets the atmospheric content encounter a spatial transition towards recreation grounds comprehending nature value through the Nordnes Park. In addition, the sequence of space towards Site gesture a descending movement with every step or passing corner leaving the observer inquisitive upon the fourthcoming experience by the interaction between one's body and the landscape. By the tactile sense in vegetation, the vertical space defined by trees, and sound of wind passing trough the branches, the stimulating sense of touch, vision and auditory are empowered. The ascending lane of trees impacts the experience of space and is conveying a vertical perception that brings another scale and direction, which might gesture one to face the sky and hence enter an additional sequence or impression of townscape. The pathways leading to alternately open and narrow spaces, and finally leading onto the revealing of water keep the spark of a viewer alive. Hence, the sequences greatly reveals the value of incident(Ibid.) by the positions which entraps the eye in the multiple patterns revealed. The descending passage towards the water is revealing the terminus by the transition from vertical and undulating sphere to a constrasting open field encircled by water. This sequence creates a sense of closure leaving one with the view upon the hilly mountains, the everchanging sky and the dynamic roar of the waves.

THE FINDINGS

The contrasting impressions of Nordnes Park and the revealing of water brings variable spatial experiences; In relation to the embodied experience the transition towards our Site enables gestures in the descending movement through the nature value of landscape and water. Hence, these aspects act as a medium procuring movement, liveliness and narrates the dynamic sequence between body and place. Through the descending movement of earthwork, one is gestured or navigated through the uneven terrain creating a contant correlation between Man and Nature. This movement can with reference to Cullen be understood as an abstraction of the act of descending, encompassing the unknown while the act above level states the subject of exposure or exhilaration.(Cullen, 1971) With this understanding we positions a way to address our motivation and create a parallel between Man and Knowledge as a abstraction of the landscape, which can unite through the transparency of water. Hence, we encounter a way to emphasise our Architecture in the notion of movement dynamics.

FIG.64:PRELIMNARY SEQUENCES

FIG.66:NORDNES PARK

FIG.67:MOVING TOWARDS WATER

FIG.65:THE REVEILING OF WATER

FIG.68:WATER AND LANDSCAPE

Landscape

Standing at the crossroad of land and sea, we are in a way in the intersection of city and the world. The city is dense, energetic, and it accumulates politics, power, trade, interation, pleasure and agitation.

FIG.69:VIEW FROM THE EDGE OF NORDNES

The analysis is an empathetic reading. It is descriptive and narrative, and introduces our readers personal perceptions and experiences of the site, Nordnes, Bergen. Nordnes is a landscape branch, which is visibly approached once you arrived Bergen. The terminologies, described in this analysis, derived from our studies of the notion of Sensory Architecture.(Ref. Sensory Architecture: A Critical And Theoretical Study p. 62)

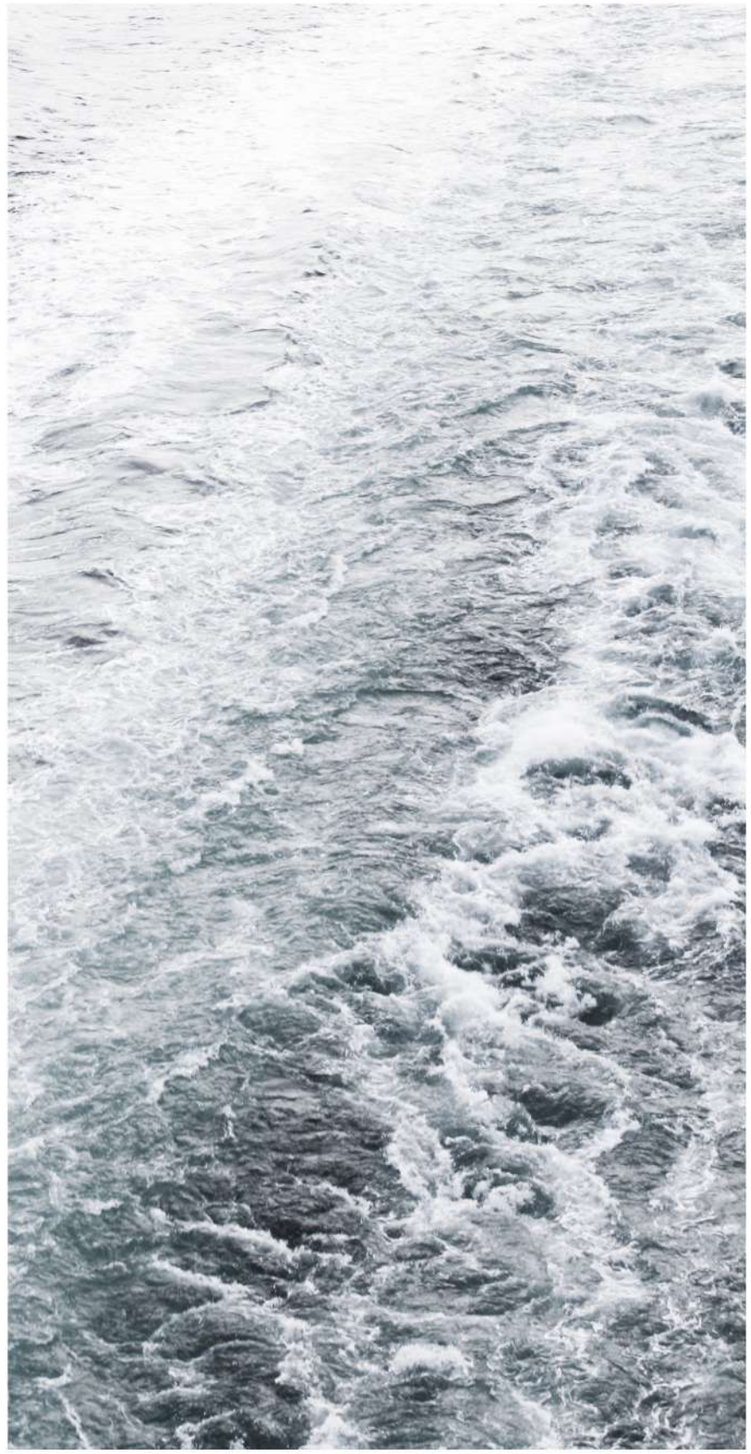
PRILIMINARY

Location: Nordnes Park
Date: February 8th 2020
Time: 10.00 A.M

OUR PHENOMENOLOGICAL EXPERIENCES

As we approach the edge of, what we learnt to know, Nordnes Park, we could see the direct intersection of land and water; the matter of solid in collision with the matter of fluid. A collision which evokes a particular sound, which we from far away already could register with the sense of hearing. Now, the infinite and open North Sea is in front of us, and as we are standing on the soft soil with the clear and sunlit sky above us, observing, we feel small and insignificant within seconds; the world is infinitely bigger than us, and yet we have the power and ability to pollute it. The wind intensified its velocity, imposing rising amplitudes in the water waves and unfolding its fierce forces. We feel its pressure upon our skin, and it slightly pushed us towards the cold stainless steel, which the protective railing is constructed of. Leaning against it and looking once again at the landscape in front of us, the gateway to Bergen is in the horizon, indicated by the prominent Bergen bridge which connects the mainland to the island of Askøy. The scattered islands, composed of formations of rocks, create a dynamic landscape in the sea and draw an enclosing or perhaps a protective gesture around Bergen. The formations of rocks appear raw and harsh, yet touched. Architectural bricks in shape of large and small scale buildings emerge in correspondence with the geological conditions, thus the topography of the landscape. Vegetation, and its inherent natural shades of green, create a pleasant contrast to the grey formations of rocks. Looking further along the coastlines of the scattered islands, our technologies are significantly present in the images. Our ships for transportation, houses for working and living, equipment for constructing. Everything is constantly in movement, or rather in circulation, for the sake for our consumerism.

Thus, the landscape of the North Sea narrates a history, which implies that we, human beings have always lived and worked in close connection in landscape. It is interfered by us; we interact within it, upon it and beside it. At the moment, we converge it, it becomes a cultural landscape, and sometimes the landscape and its nature suffers from our actions, apropos our foci upon Climate Changes. Our contemplative views were all of a sudden interrupted with the emergence of droplets of water from the immediate clouded sky. A heavy rain was upon us and the wind has again intensified its forces. With rapid movements of our bodies, we seek shelter underneath the mushroom body of the trees, dominating the green area that border towards the edge of Nordnes. Observing the scenario of rain dominating the sphere, the atmosphere has changed its character radically. We realised that within one hour, we experienced a series of weather phenomena; sunlight, cloudy, wind and rain. In continuation, the everchanging weather in Bergen implies a fluctuation of light. At one moment, we experienced a clear and bright day, illuminating the water, and within minutes, the characters change as clouds emerge in sky, hinder the sunlight, and induce a gloomy luminosity into the sphere. Hence, the weather and the site have an interdependence relationship, in which the weather has a significant power to create and change the experience of the site and its atmosphere. Our biased narrative of the site is obviously not conclusive, however it enable a figurative and descriptive understanding of Genius Loci of the site, in which water and the weather play a vital role for one's experience.



Water

Water is significant in the experience of the atmosphere of Nordnes. The movement of the Water is constant and forceful, creating waves. In synergy with wind, the sounds of Water emerge. Our cognitive minds have absorbed its characteristic, its sounds and appearence, and store them in our memories. Hence, within micro-second upon looking at Water or listen to it, we can associate it with the city of Bergen.

FIG.70:MOVEMENT OF WATER

Clouds in the Sky

The sky is of paramount importance of the experience of Nordnes. The everchanging formations of clouds in the sky allows or hinder the rays of light. This imposes a fluctuation of luminous and overcast skies, thus the mood and ambiance of the site.

FIG.71:THE FORMATION OF CLOUDS

0.4.4 MICROCLIMATE

MIKROKLIMA /mikrukli:ma/ (Dict, n.d.)

ENVIRONMENTAL CONDITIONS

OBJECTIVE

The following outlines the environmental conditions of Nordnes, Bergen, concerning parameters and measures such as precipitation, mean temperature of sea water, mean temperature, duration of daylight hours and sunshine hours, and wind. We conceive Microclimate crucial in the framework of *Environmental Tectonics,* in which the tangle, tactile materiality and resources should resonate with the Ecological Thinking and the context, they are situated in. It is equivalently essential in the notion of sensory Architecture in which the body of a human acts a the source of information, which are activated through the force of nature. With a starting point in our foci upon Water, the analyses place a distinct attention towards the measure of precipitation that paradoxically is positioned as a critical environmental challenge and an identity-creating mean for Bergen. Furthermore, the analyses aim to unable understandings of the environmental invulnerabilities and vulnerabilities, and hence the potentials and critical areas, of the context. And it might reveal a series of potentials in the forming of approaches and strategies, regarding to indoor environment.

RAINFALL

The analysis illustrates that Bergen experiences a vast amount of precipitation, which is also one of its characteristic.(Iversen, 2008) Throughout a year, Bergen is exposed to approximately 202 rainfall days.(Weather Atlas, n.d.) Thus, the analysis reveals a critical point in the context, which our Research and Visitor Centre shall address and raises a question, if we in a way can harvest the rainwater and exploit it with a recreational and environmental purposes. Additional to the climatic aspect, this analysis can insinuate the cultural custom and behaviour among the inhabitants of Bergen.

LOCAL MAX.

22.0 DAYS (OCTOBER, BERGEN, NORWAY)
17.7 DAYS (NOVEMBER, AALBORG, DENMARK)

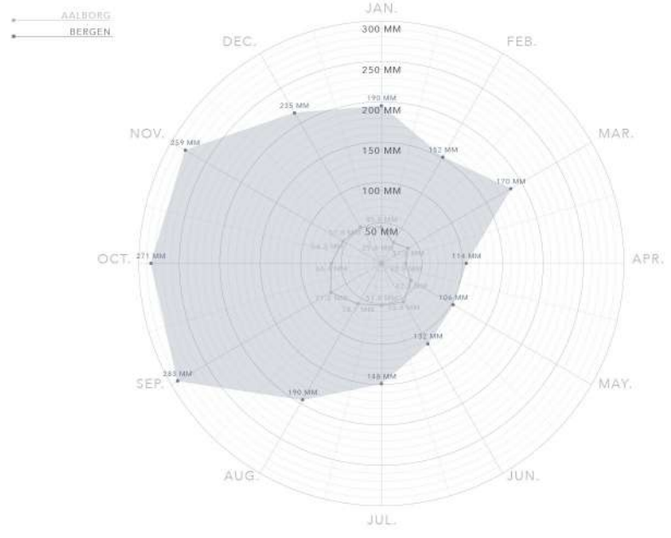
LOCAL MIN.

11.0 DAYS (OCTOBER, BERGEN, NORWAY)
11.1 DAYS (NOVEMBER, AALBORG, DENMARK)

FIG.72: AVERAGE RAINFALL DAYS

(Weather Atlas, n.d.)

Data is from Weather Atlas



The analysis illustrates the measurable dimension of the rainfall, and aims to enable us and the readers an understanding of the magnitude of the issues. It particularly places the issues of precipitation into perspective, as it compares the status quo in Bergen with the situation in Aalborg. Notably, the amount of precipitation in Bergen is 4 times greater compared to Aalborg, simultaneously, the number of days (Ref: FIG.68) of rainfall are relatively close.

LOCAL MAX.

283.00 MM (SEPTEMBER, BERGEN, NORWAY)
71.3 MM (SEPTEMBER, AALBORG, DENMARK)

LOCAL MIN.

106.00 MM (MAY, BERGEN, NORWAY)
29.6 MM (FEBRUAR, AALBORG, DENMARK)

FIG.73: AVERAGE RAINFALL

(Weather Atlas, n.d.)

Data is from Weather Atlas

TEMPERATURES [°C]

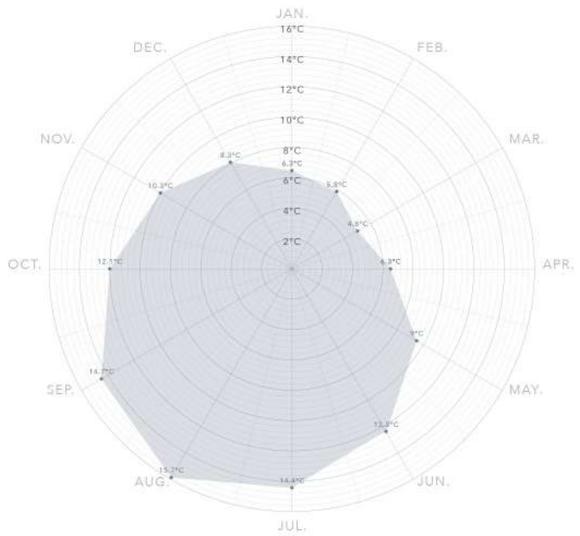
The analysis outlines the mean temperature [°C] of the sea water in Bergen. It is included, as we conceive it as essential in the framework of understanding the consequences of Climate Change. Among other aspects, the rising sea temperature affects marine species and oceanic ecosystem. (IUCN, n.d.) Furthermore, the analysis is valuable if a certain principle of exploiting its thermal properties for indoor environmental purposes.

LOCAL MAX.
15.7 °C (AUGUST, BERGEN, NORWAY)

LOCAL MIN.
4.8 °C (MARCH, BERGEN, NORWAY)

FIG.74: MEAN SEA TEMPERATURE [°C]

(Weather Atlas, n.d.)



Data is from Weather Atlas

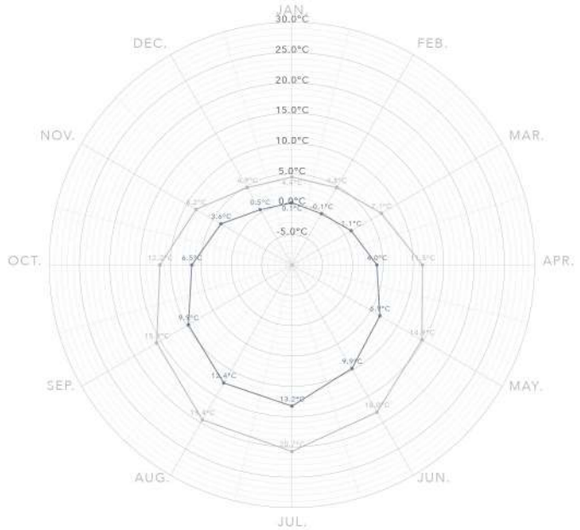
Despite its position in the Northern latitudes, the temperatures and, thus, the climate in Bergen is considered moderate and mild. The analysis illustrates the mean temperature [°C], affiliated with its highest and lowest vertices. However, it is important to mention that the data are illustrating a static state,which is misleading in coherence with other contextual parameters. As Bergen is proximity to the North Sea, the weather is constantly changing and unstable; rain and sun can appear alternately with in a brief amount of time.

LOCAL MAX.
20.7 °C (JULY, BERGEN, NORWAY)

LOCAL MIN.
-0.1 °C (FEBRUAR, BERGEN, NORWAY)

FIG.75: MEAN TEMPERATURE [°C]

Weather Atlas, n.d.)



Data is from Weather Atlas

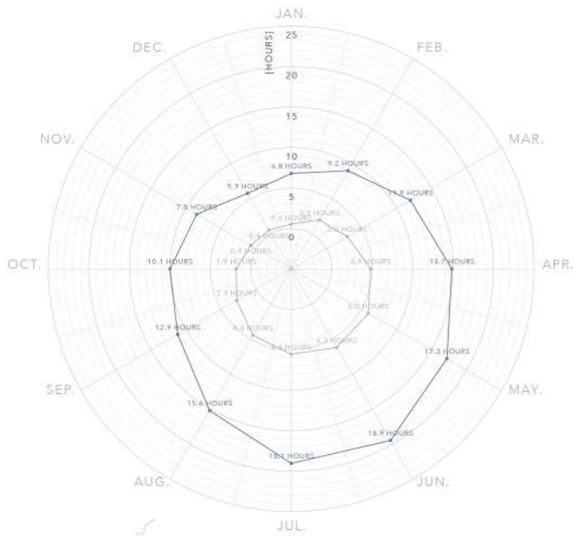
DURATION AND WIND [HRS]

The analysis illustrate the yearly average Daylight Hours and Sunshine Hours, which we perceive as a vital climatic characterisation of a location. The durations of Daylight and Sunshine are associated with psychological and health impact on human's well-beings. Situated in the Northern latitudes, Bergen has a relatively low annual value of Daylight Hours and Sunshine Hours. Thus, this criteria can affect the Architecture and its programmatic organisation in order to exploit the natural light as optimal as possible.

LOCAL MAX.
18.9 HRS (DAYLIGHT)/(JUNE, BERGEN, NORWAY)
6.3 HRS (SUNSHINE)/(JUNE, AALBORG, DENMARK)

LOCAL MIN.
5.9 HRS (DAYLIGHT)/(DECEMEBER, BERGEN, NORWAY)
0.4 HRS (DAYLIGHT)/(NOVEMBER, AALBORG, DENMARK)

FIG.76: AVERAGE DAYLIGHT/SUNSHINE HOURS (Weather Atlas, n.d.)



Data is from Weather Atlas

The analysis illustrates the yearly condition of wind direction and magnitude. Though, Bergen is shielded from North, North-east and East, as it is surrounded by various mountains such as Floyen and Ulriken (Sustain Europe). The implication of the force of wind can incorporate in environmental strategies such as natural ventilation.

PERIOD.
01.JAN.(01.00 AM) - 31.DEC.(12.00 AM)

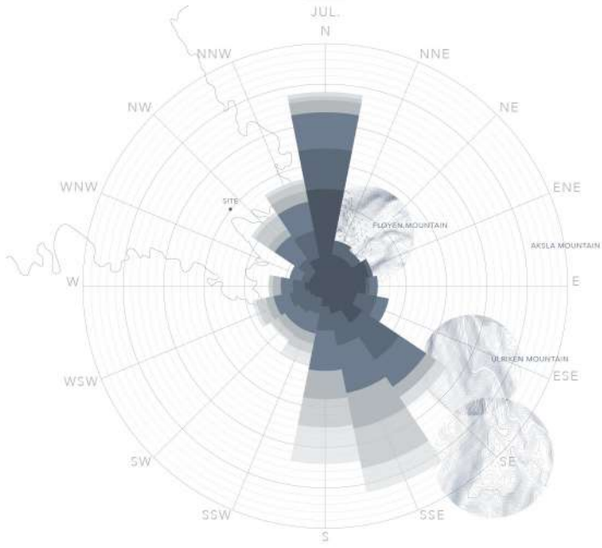
HOURS OF CALM CONDITION
363 HRS (4.14% OF THE TIME)

LOCAL MAX.
13.86 M/S (N. BERGEN, NORWAY)

LOCAL MIN.
1.52 M/S (WNW. BERGEN, NORWAY)

FIG.77: WIND CONDITION [M/S]

(EnergyPlus, n.d.)



Hourly Data is EnergyPlus Weather Data

0.4.5 MAPPING

KARTLEGGE/'kɑtleg:e/ (Diet, n.d.)

JAMES CORNER: A TRANSFORMATIONAL APPROACH

Index. Mapping
Index. James Corner

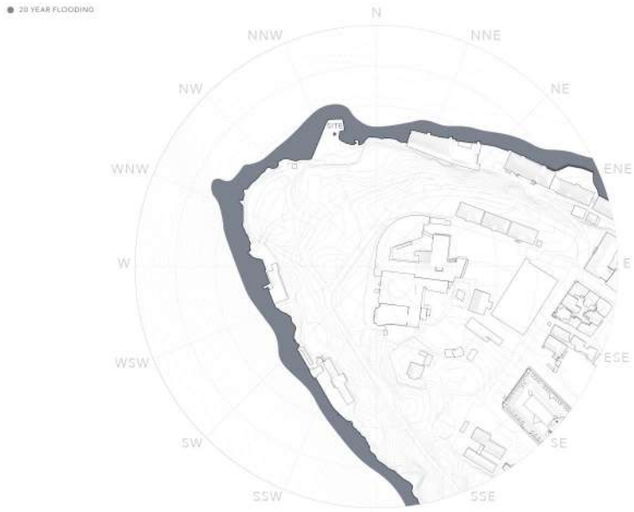
OBJECTIVE

The following outlines the state of art of Nordnes, Bergen regarding its circumstances and measures which enables a fundamental understanding of the Site positioned in relation to its surrounding context. With the foci upon the element of Water and the framework of Environmental Architecture, we conceive the certain study significant in extracting essential findings to substantiate our Architecture and its involvement by the Analysis method, The Agency of Mapping.(Corner, 1999)

THE AGENCY OF MAPPING

James Corner Note: 0.1

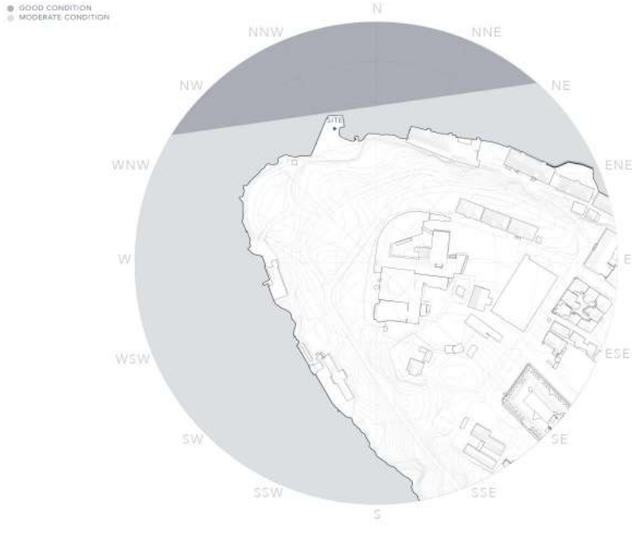
The Agency of Mapping developed by James Corner (Note: 0.1 p. 104) exemplifies an accession to establish a fundamental basis of the Site and its cohesion to potential elements in the proximity. The study aims to comprehend an understanding upon the contextual conditions and prospective transformation, and the certain qualities or challenges it might involve. The analysis method shed light on elements and objects bridged with the surrounding context in order to reveal hidden complexities.(Ibid.) The Extractions will handle the extracted findings, while Plotting entails the creative attitude by relating the extracted findings in a new contextual means.(Ibid.) Hence, with a focus of extracting necessary findings, the analysis enables a cartographic approach to Nordnes' circumstances. With a great focus upon the element of Water the analysis will clarify an overview of the essential notions and measures such as flooding, water condition, functions, infrastructure, vegetation and topography. These elements will potentially reveal the environmental critical or potential areas which can unfold strategies or use of contextual findings.



Data is from Weather Atlas

The analysis of the flooding indicates a twenty-year venue and how the site will be exposed to sea level rise due to storm surges. With the Site being exposed to water from three points, it will greatly be vulnerable to flooding. This certain study enables an understanding upon the prospect incidences regarding the element of Water and its significant role for the city. Hence, the notion of Water needs to be addressed in order take caution upon its risks by land and perhaps be an element that enables a transparency between environmental challenges and man.

FIG.79: FLOODING



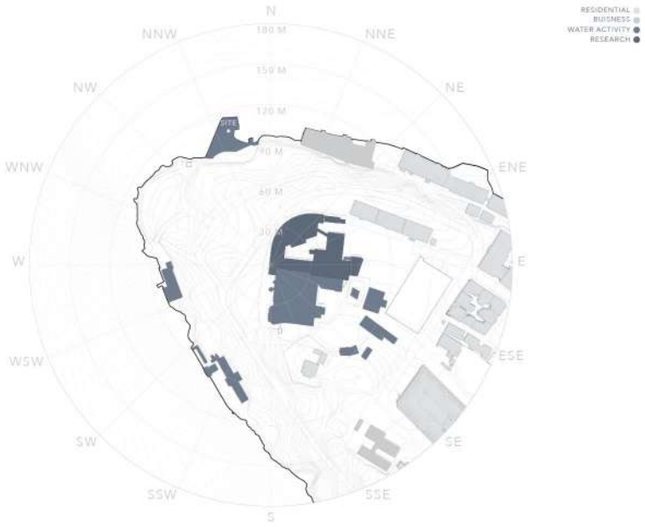
Data is from Weather Atlas

In the notion of Water it is essential to address the state the water quality in the nearest context. The current position of the seawater indicates both good and moderate conditions for the coastal waters. The water in the proximity indicates a reasonable situation, though, with a lower quality of water in the imminence by land. These conditions are common in Bergen's quality of water. (Weather Atlas, n.d.) Hence, in the possibility to utilise the water as an architectural element positions a significance in the awareness of the certain state of art.

FIG.78: WATER CONDITION

FUNCTIONS AND INFRASTRUCTURE

The analysis of the functions emphasises the varies trades in the area of Nordnes. The visible structures access a diverse townscape including residential, business, research and activities with reference to the notion of water. The functions reveal our site in great connection to the Norwegian Institute of Marine Research and varies water activities, for instance Bergen Aquarium Centre and baths. Hence, the element of Water is noticeable at site and gives the opportunity to further support our Architecture. In addition, the Research Centre could potentially be a substantiate our approach to Architecture in the aim to bridge research, knowledge and the individual.



Data is from Site registration

FIG.81: FUNCTIONS

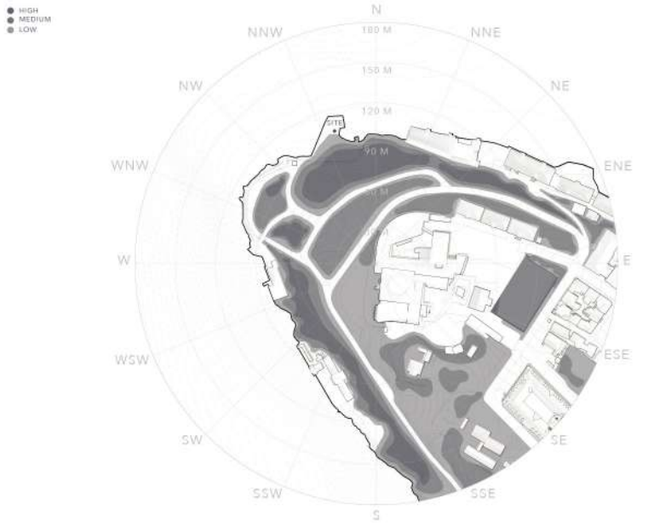
The infrastructure is largely defined by the movement of the topography. The site is placed in great connection with the curved routes characterising the path to the site and adjacent to shipping services. The Mapping exemplifies a hierarchy of the roads, displaying primary, secondary and tertiary practices and type of mobility. Hence, it clarifies an understanding upon the accessibility to Site; The soft road users have access to the Site from shore, while ships and boats can access it by water. In addition, this indicates a main entrance for essentially soft road users from south. The certain analysis can by example be utilised in the way to encounter or gesture the visitor of the building.

Data is from Site registration

FIG.80: INFRASTRUCTURE

VEGETATION AND TOPOGRAPHY

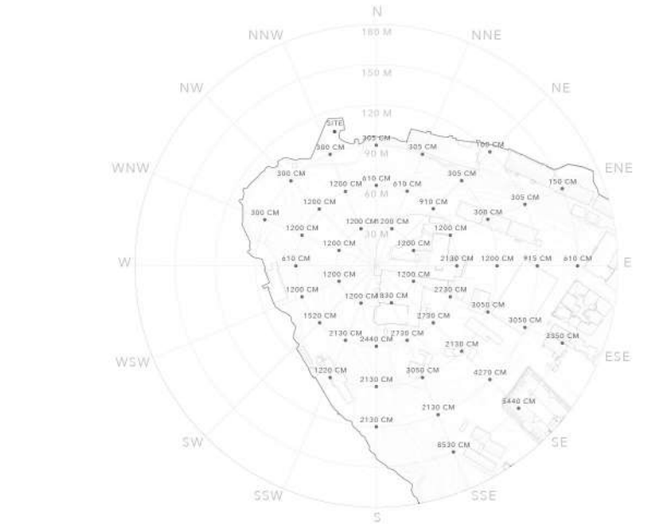
The analysis of the vegetation indicates the sites position within a green context located in relation to the park, Nordnes Parken. Vegetation is a dominating factor which emerges from the landscape and its formations. The density of the vegetation is positioned in dense groups and becomes more scattered towards the city at south. Despite the site's central placement, it appears hidden in more natural surroundings with distance from the dynamic city. Hence, it enables space and a natural state of art along the paths. The Mapping of the vegetation can contribute to the green narrative or encountering of the prospect design and substantiate our environmental approach to architecture.



Data is from Site registration

FIG.83:VEGETATION

The Mapping of the topography reveals a clear cohesion between the undulating landscape and the paths towards the Site. This nature positions as a magnitude which creates a dynamic natural appearance in townscape. In addition, in the specific context it aims to transition the individual from urban town structure towards the nature from south to north. The topography can be an essential measure as it is a natural element, which mirrors a great part of the identity of not only Bergen but Norway in general. Hence, it can potentially be an element which in relation to Water can reflect potentials of the city and, thus, make the following design site specific.



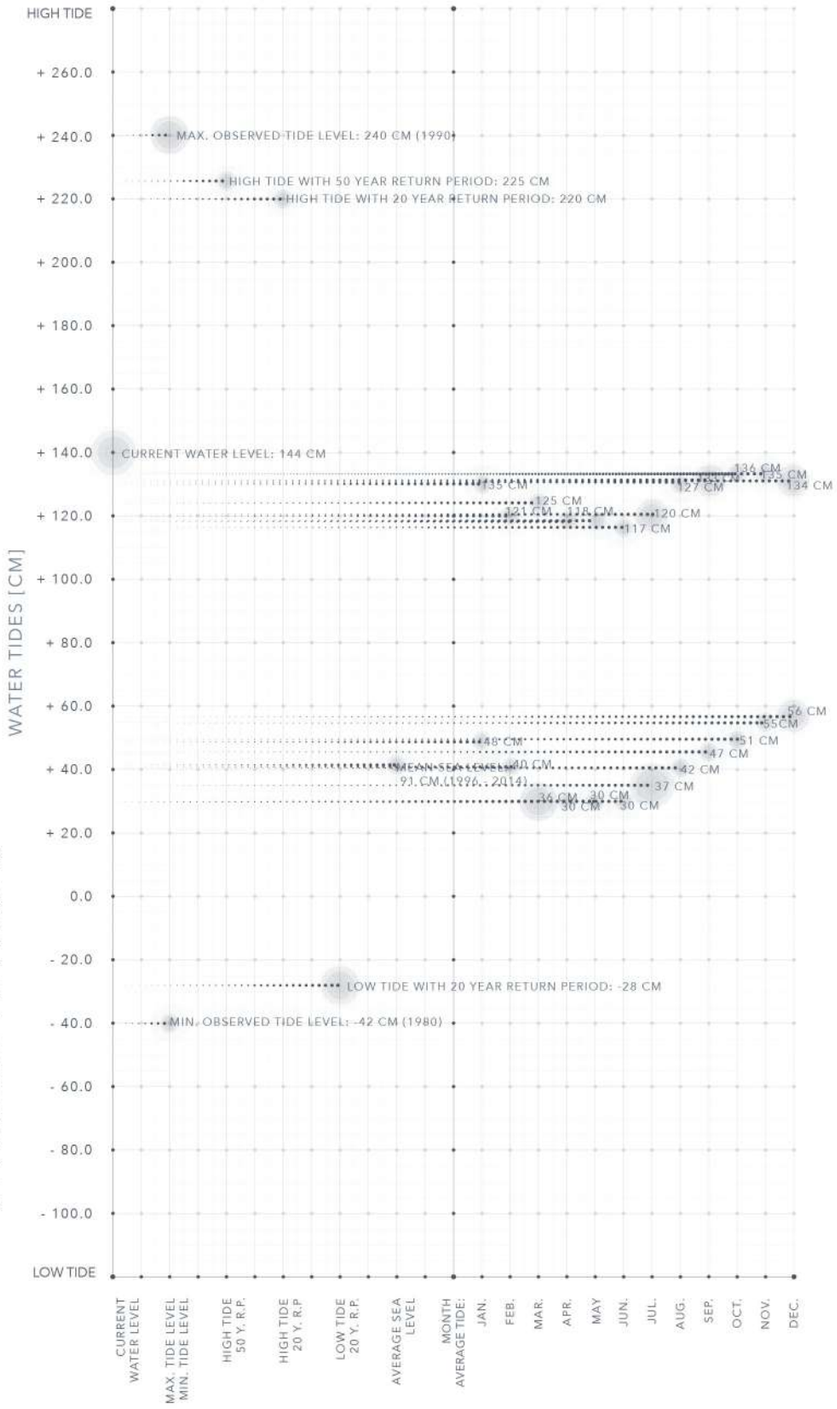
Data is from Topographic Map

FIG.82: TOPOGRAPHY

0.4.6 WATER TIDES & SEA LEVEL CHANGE

TIDEVANN OG HAVFLATE ENDRING /'ti:devan/ /ha:vfla:te/ /'endriŋ/ (Diet, n.d.)

PRESENT AND PROSPECTIVE WATER CONDITIONS



The analysis of the water tides illustrates the correlation between the different vertical datums for Bergen. Throughout a year, the average High tide and Low tide values varies greatly in comparison to the current water level at 144 cm.(Kartverket, 2020) While the average values in 2020 are within the range of 30 cm to 136 cm (Ref: Appendix: Water Tides p. x), the prospective values for a return period of 20 years shows a much broader range from -28 cm to 220 cm. Thus, the analysis reveals a pivotal aspect, which raises intriguing questions that need to be addresses for our Research and Visitor Centre; Can we utilise the water tides as a way to both learn and experience the water level challenges of our time? Additional to the climatic aspect perhaps the moving water can be captured and utilised for energy.

FIG.84:WATER TIDES

The analysis of the sea level change determine three different scenarios of future sea-level change until year 2100. It exemplifies three different greenhouse gas emission scenarios describing how the sea level will occur depending on the case for low emission, reduced emission and high emission.(Kartverket, 2020) The Solid lines show the projected average sea level change, while the colored are exemplify the range. The scenarios indicates how the high emission scenario will be faced if we don't act upon the climate challenges of our time. Hence, we aim to utilise this study to see how we can meet the future projections of low or reduced emission by acknowledging the man-made problems through our Architecture, as a catalyst to mediate and exchange knowledge.

FIG.85: SEA LEVEL CHANGE

TARGET GROUPS 0.4.7

BRUKER/ˈbrʉːkər/ (Diet, n.d.)

THE STATIC AND DYMANIC USERS

Index. NORCE
Index. Nansen Environmental and Remote Sensing
Index. Institute of Marine Research
Index. University of Bergen
Index. Bjerkes Centre for Climate Research

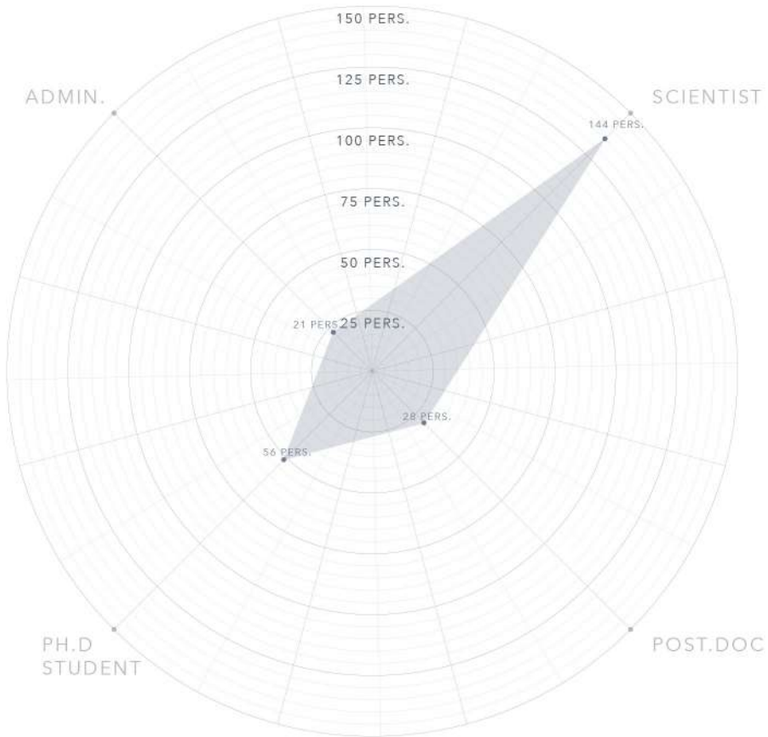


FIG.86:CURRENT USERS OF BJERKNES CENTRE OF CLIMATE RESEARCH' Data is from Bjerknes UiB

The following study aims to construct an understanding upon the target groups of the Research and Visitor Centre differed by the segments of Static and Dynamic Users. By the Static Users, we place an emphasis on the potential of the pre-existing platform of Climate-related actors in Bergen, Norway, while the dynamic users concern the external operators whom both comprise scientific or educational users but likewise the common society. Hence, by unifying Static and Dynamic target groups we accentuate the platform of the Thesis to build bridges across scientist, researchers, students and society.

We conceive a distinctive opportunity for building on the platform of knowledge, by the point of departure in Bergen and the pre-existing Scientific Research and Education present at Bjerknes Centre for Climate Research.(Bjerknes Centre for Climate Research, n.d.) Hence, among others the Static Users comprises a collaborative platform of organisations encompassing the *University of Bergen, NORCE, Nansen Environmental and Remote Sensing Centre,* and *the Institute of Marine Research*,(Ref: Introduction, p. x) which makes Bjerknes Centre one of the largest Climate Research units in Europe.(Bjerknes Centre for Climate Research, n.d.) By the interactions across scientists, postdocs and Ph.D. students from the respective associations and further numerous of recruited international scientists, Bjerknes Centre becomes a key contributor of first-rate knowledge on Climate Change to the policy makers, industry and general public. Hence, which we aim to further accentuate through our Architecture. The multidisciplinary work between the target groups has enhanced the level of Climate Research addressing various agendas of individual study or co-working and making climate models or forecast future scenarios. The main work is represented through five laboratories; EARTHLAB, FARLAB, Sclerochronology lab, TElab and ICOS(Ibid.). However, we aim to add a second layer to these aspects by involving an exhibition team to put the Knowledge and Research dimension on display and encourage to learn by exploring, sharing ideas and to emphasise our Architecture as a catalyst to mediate the challenges of our time.

Hence, with the functions of the existing Bjerknes Centre for Climate Research as a core, presenting a Research and Knowledge dimension, a learning aspect is placed upon it, inherently inducing additional users to the program; the Dynamic Users.(Ref. Analysis: Static and Dynamic Users, p. 113) Such users are perceived as external stakeholders of the future Research and Visitor Centre, and the introduction of them into the realm of Scientific Research raise transparency between research and man, and can evoke humans' inherent inquisitive nature for exploring and learning. The Dynamic Users can have various agendas when visiting the future Research and Visitor Centre; spontaneous or planned pleasure, study or co-working, which indicate the degree of versatility of the functions. The target groups of Dynamic Users oppose the usual usage and duration of a typical place for working, as they can interact with its functions at different times of a day. As a result, they influence the flexibility and spatiality of space. In continuation, they raise the activity levels and add a dynamic dimension for the atmosphere, that emerge between the objects and subjects within a space.

PRELIMINARY

THE STATIC USER

- 0.1 EARTHLAB - Earth Surface Sediment Laboratory (Note: 0.6, p. 127)
- 0.2 FARLAB – Facility for advanced isotopic research and monitoring of weather, climate, and biogeochemical cycling (Note: 0.7, p. 127)
- 0.3 Sclerochronology Lab (Note: 0.8, p. 127)
- 0.4 TElab – Uni Research Trace Element Lab (Note: 0.9, p. 127)
- 0.4 ICOS - The Chemical Oceanography Laboratory (Note: 1.0, p. 127)

FIG.87: LIST OF LABATORIES
(Bjerknes Centre for Climate Research, n.d.)

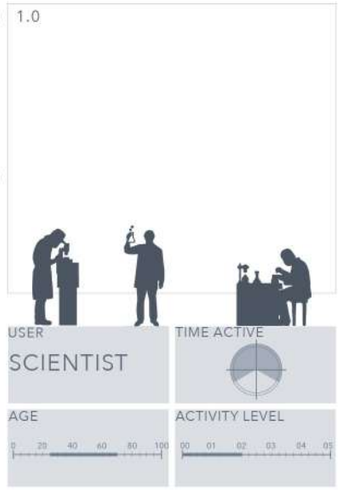
DYNAMIC USERS

1.0 Scientists comprise the operators of the four organisations which are engaged in the laboratories addressing the issues of Climate Changes. Their purpose is to gain climate understanding, make climate models and future scenarios of climate incidences. The work of the Scientists is vital for putting knowledge on display for society.

2.0 The Post.docs support the research of the Scientists and comprise likewise the operation within the five laboratories. Their work is further involved with the Ph.D Students as lectors or supervisors, with the aim to mediate knowledge within the research field. Hence, they need facilities of focus area, library and teaching areas.

(Bjerknes Centre for Climate Research, 2016)

ACITIVITY LEVEL
00. SLEEPING
01. SITTING
02. STANDING
03. WALKING
04. RUNNING
05. MANUAL WORK

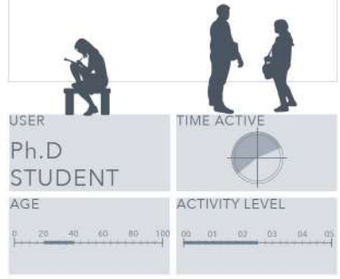


3.0 Ph.D. Students are involved in the Research School on Changing Climates in Coupled System (CHESS), with the purpose of examining in-depth knowledge upon Climate issues in the inter-disciplinary field of coupled Earth System. Their work involve focus areas, library and lecture rooms to support their studies. (CHESS, n.d.)

4.0 The exhibition team is accountable for the gallery and plays a vital role in mediating the knowledge and scientific work to society. The team works in association with Scientists and Post.docs to create exhibitions with the purpose of knowledge sharing, learning and exploring. Their work is both general management and physical arrangement of the displays.

(Museums Victoria, n.d.)

ACITIVITY LEVEL
00. SLEEPING
01. SITTING
02. STANDING
03. WALKING
04. RUNNING
05. MANUAL WORK



5.0 The Kitchen staff encompass the engine of the Climate Kitchen and are, for instance, the Executive Chef, which works on the front line in the area of Eatery. Their work needs a production kitchen to facilitate the many users of the building.

(Collier, 2018)

6.0 The administration involves the work of general office management and the Climate Data Centre, which manages the data of both internal and external projects of the Scientists and Post.docs. Their work needs a common office structure to facilitate the employees.

(The BCCR Partners, n.d.)

ACITIVITY LEVEL
00. SLEEPING
01. SITTING
02. STANDING
03. WALKING
04. RUNNING
05. MANUAL WORK

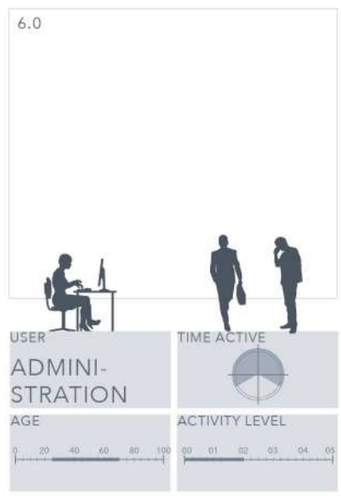
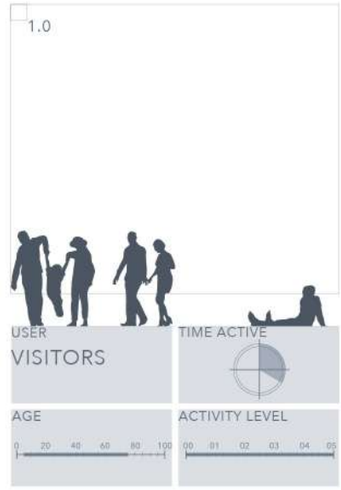


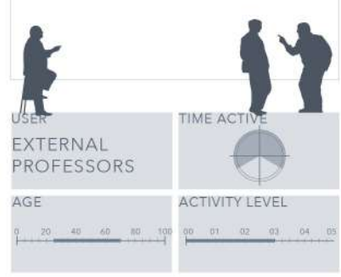
FIG.88: STATIC USERS

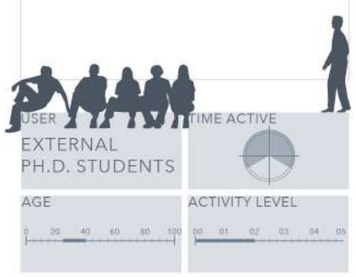


1.0 Visitors, local, regional and international, experience the Research and Visitor Centre of Climate in their time of leisure. The purpose of their visit is pleasure and social activity. However, the inherent functions of the Centre initiate a motivation for exploration and learning.

2.0 External Researchers are associated research employees from the affiliated organisations such as NORCE and Marine Institute that also are located in other cities in Norway. The principle of co-working across various organisations and branch intiate a need for additional in the laboratories and focus area. Moreover a community space that allow them longer stay.

ACITIVITY LEVEL
00. SLEEPING
01. SITTING
02. STANDING
03. WALKING
04. RUNNING
05. MANUAL WORK

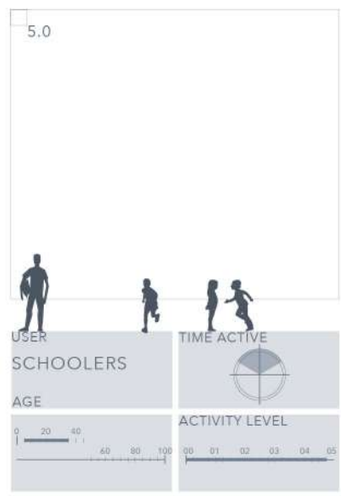


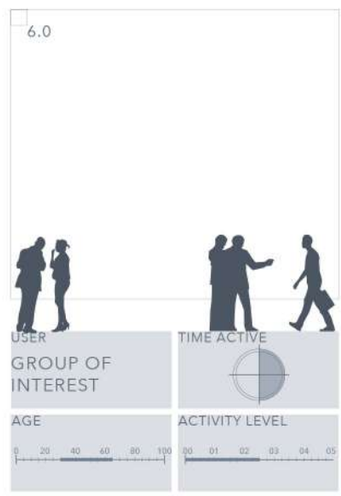


3.0 External Professors are mainly from the University of Bergen (UiB). Their responsibilites for lectures and supervisions indicates needs for proper working space for preperation, and perhaps space for initiate social and professional relation to the static professors and researchers of the Centre.

4.0 External Ph.d Students are affiliated with the community of Chess (Note: 1.1, p. 127) which is a platform that allows the students to communicate and share experience and knowledge. This community initiate a physical space for meeting and social interaction; for enhancement of co-working and sharing of knowledge.

ACITIVITY LEVEL
00. SLEEPING
01. SITTING
02. STANDING
03. WALKING
04. RUNNING
05. MANUAL WORK





5.0 The nature of the Research and Visitor Centre of Climate Change, that houses knowledge, invites schoolers at different level for exploration and learning. This initiate a co-working relationsi with the local schools and institues; to nurture and learn the next generation the facing challenges.

6.0 Groups of interest derive from the envisionment of Research and Visitor Centre of Climate Change becoming an international gathering point for Climate Change research. It is assummed that the future Climate Change conferences, for instance COP-conference, to be held in Bergen, calling relevant politicians and NGOs (organisations).

ACITIVITY LEVEL
00. SLEEPING
01. SITTING
02. STANDING
03. WALKING
04. RUNNING
05. MANUAL WORK

FIG.89: DYNAMIC USERS

0.4.8 UNIT PROGRAM

ROM PROGRAM /ˈrɔm proˈgram/ (Diet, n.d.)

THE PROGRAM OF OUR ARCHITECTURE

		AREA	UNIT	NOTES	DAYLIGHT	AIR FLOW	WATER
GALLERY OVERWHELMING EMPOWERING INFORMATIVE	(Ref. Utzon Center) EXHIBITION	300 M²	3		3%	7 l/s/pers.	WATER IS PRESENT
	EXHIBITION	200 M²	1		3%	7 l/s/pers.	
	EXHIBITION	150 M²	1		3%	7 l/s/pers.	
	OUTDOOR EXHIBITION	10 M²	1	ON PLATFORM		7 l/s/pers.	CLOSE CONNECTION TO WATER
	OUTDOOR EXHIBITION	15 M²	1	ON PLATFORM		7 l/s/pers.	
	GALLERY WORKSHOP	75 M²	1		3%	20 l/s	
	(Ref. Utzon Center) SHOP	75 M²	1		3%	7 l/s/pers.	
KNOWLEDGE MOTIVATIONAL	LABORATORY	150 M²	5	WITHHOLD EQUIPMENT	3%	20 l/s	
	LIBRARY+READING AREA	375 M²	1	PUBLIC	3%	7 l/s/pers.	
	SCIENTIST AREA	525 M²	1	FREE SEATING	3%	7 l/s/pers.	
	PH.D AREA	150 M²	1	FREE SEATING	3%	7 l/s/pers.	
EDUCATION INSPIRATIONAL	AUDITORIUM	150 M²	1		3%	7 l/s/pers.	
	LECTURE ROOM	150 M²	1		3%	7 l/s/pers.	
	TEACHING LABORATORY	150 M²	1		3%	20 l/s	
	MAKERSPACE	150 M²	1		3%	7 l/s/pers.	
	GROUP ROOM AREA			A PART OF LIBRARY AREA	3%		
MILIEU COMMUNITY	COMMUNITY SPACE	150 M²	3		3%	7 l/s/pers.	
	COMMON KITCHEN	150 M²	1		3%	20 l/s	
	STUDIOS	12 M²	8		3%	7 l/s/pers.	
	SHARED SPACE	200 M²	1		3%	7 l/s/pers.	
EATERY INTERACTIONS	RESTAURANT, CLIMATE SNACK	275 M²	1		3%	7 l/s/pers.	CLOSE CONNECTION TO WATER
	PRODUCTION KITCHEN	200 M²	1		3%	20 l/s	
	FLOATING AQUACULTURE	125 M²	1	FLOATING PLATFORM			CONNECT WITH THE SEA WATER
	FLOATING FARMNING	37 M²	1	FLOATING PLATFORM			
FORMAL INVITING	MAIN PATH	575 M²	1				CLOSE CONNECTION TO WATER
	FOYER + RECEPTION	75 M²	1		3%	7 l/s/pers.	
	ADMINISTRATION	150 M²	1		3%	7 l/s/pers.	
ADDITIONAL PRACTICAL	HALLWAY	75 M²					
	STAIRS	50 M²	1				
	LAVATORY	3 M²	32			10 l/s	REUSE OF HARVESTED RAINWATR CONNECT WITH THE SEA WATER
	DEPOT	25 M²	5				
	DEPOT FOR WATER TANK						
	FLOATING WETLAND						
	TOTAL	5400 M²					

Air Flow Rates is from DS/EN 15251

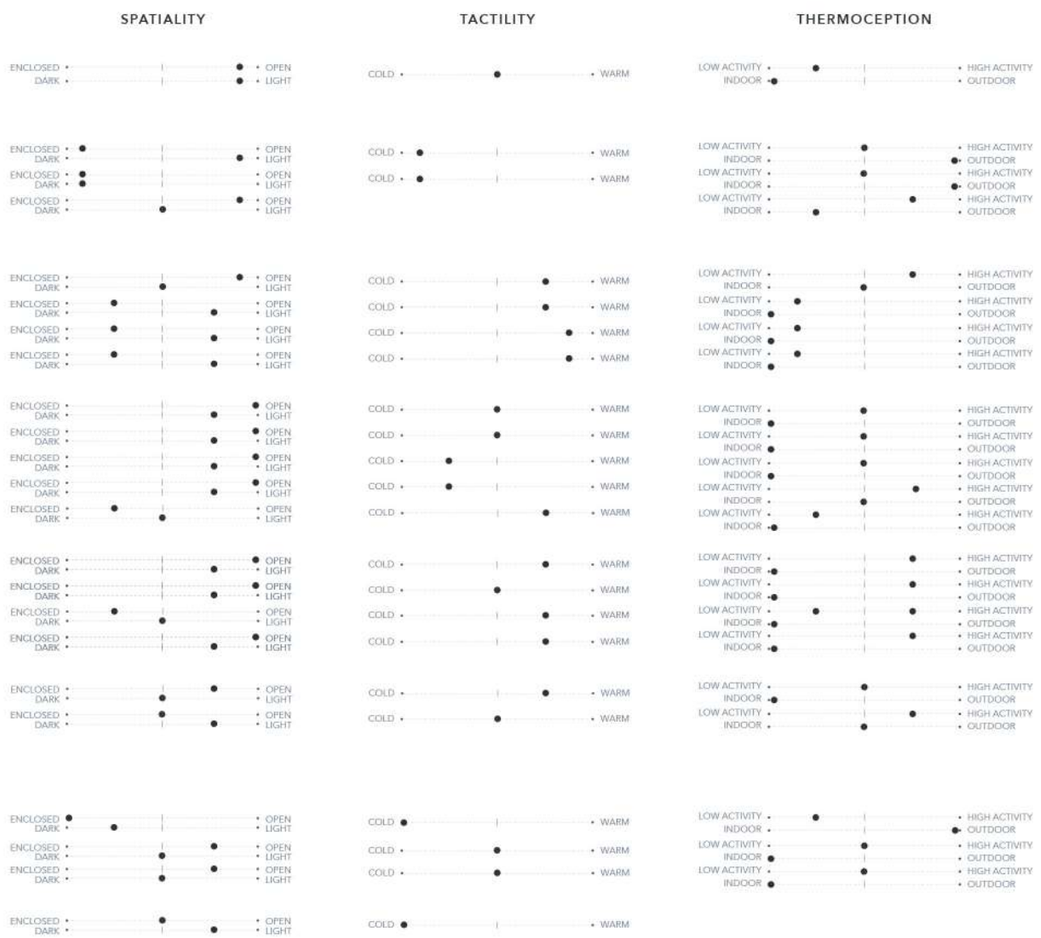


FIG.90:DIAGRAM OF STATIC USERS

FIG.91:DIAGRAM OF DYNAMIC USERS

ANALYTICAL CONCLUSION 0.4.9

ROM PROGRAM /ˈrɑm proˌgram/ (Dict, n.d.)

A REFLECTIVE VIEW UPON OUR ANALYSES

FIG.92:WATER IN THE NORTH SEA

PRELIMINARY

With an aim of synthesizing the studies and analyses in this chapter, the following tries to translate the accumulated knowledge into an architectural context, and leading towards a holistic vision for our project, and, thus, a range of design criteria.

THE AGENCY OF WATER

With a holistic point of view of our analyses of Bergen, and specifically the site, Nordnes, Water is evidently an essential element, which is mentioned earlier. It is a significant indicator for Bergen's identity and, at the same time, it is the root to the environmental issue; Water from the sea and the sky. Our explorative analysis of Water (Ref. Foci: Water p. 85) resonates incidentally well with our framework of Tectonics as a linkage between Sensory Architecture and Sustainable Architecture. We perceive Water as an influential creator of the atmosphere and ambiance in a conceivable interplay with material and structure, and addresses our senses, visually, acoutically acoutically and thermally. Additionally, we find it feasible to employ Water in passive and active strategies in the threshold of Sustainability, which will be elaborated on later in the Thesis.

THE AGENCY OF WEATHER

In continuation of the analyses of Nordnes, with the Phenomenological approach (Ref. Analysis: Genius Loci p. 97) and underpinned by the quantitative registration of the Microclimate (Ref. Analysis: Microclimate p. 100), we have distinguished a notable role of the Weather, being everchanging, and climate and time-specific, in the identification with space. By feeding the notion of Weather into the context of Architecture, the building of the Research and Visitor Centre ties itself to the specific site, and raises potentials and drawbacks. The potentials lie in how the experience of Architecture can be constructed by the environment; how natural phenomena can be translated into a determinant factor for the visual, audible, thermal and olfactory read of place and time. For instance, the intersection of droplets of rain with the surface of the sea allows the perceiver to identify he or herself of being close to North Sea in Bergen. The drawback lies in practical matters, that are essential for the building's utility aspect. For instance, the limited Nordic light indicates an urge for optimal exploitation of daylight, and the windy coast calls for weather resistance materials.

TIDES AND CONFRONTATION

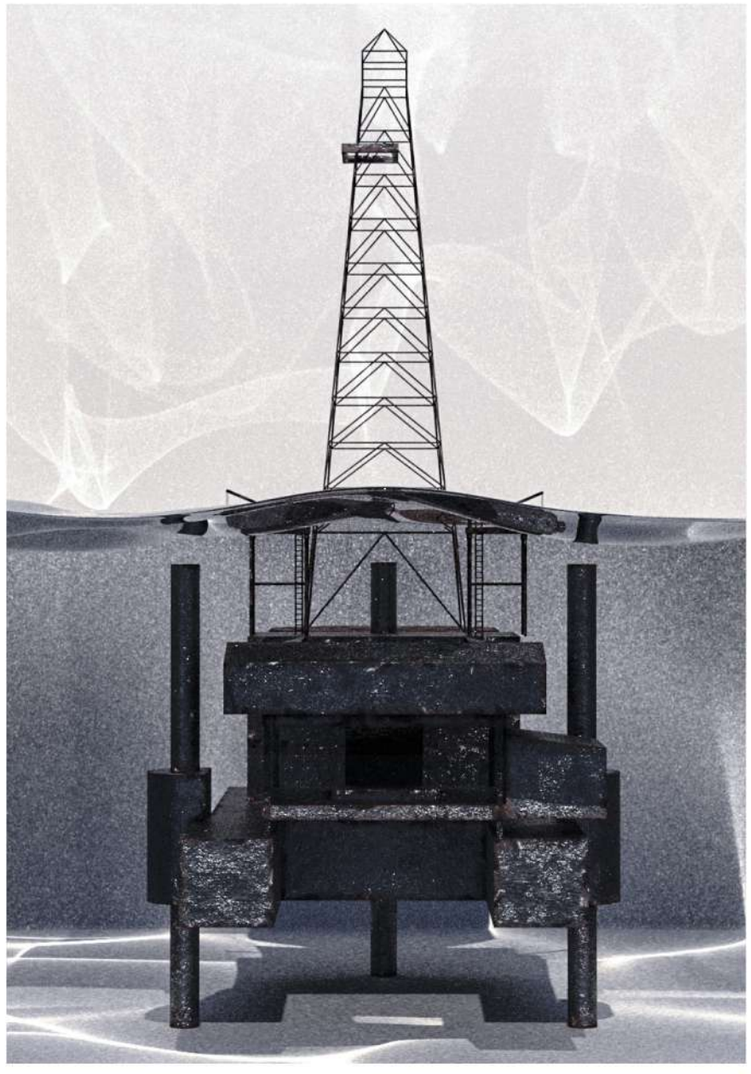
Apropos of particular regard to the location, that incidentally resonates well with the Norberg-Schulz's and Frampton's architectural point of view, our registration of Water tides in Bergen unfolds or reveals another potential of Water. Here, the phenomena of the sea allows an inherent confrontation of our environmental challenges to the perceiver, if it is present in the experience of space. Hence, we place a mediating and authorship role upon the tides in our design. The study of Bergen reveals an advocation for Sustainability, culturally and academically. The latter is manifested in the existing Bjerknes Centre for Climate Research and, here, we perceive an opportunity for developing a collaborative platform for research, exploration, learning and knowledge on display by transforming it into a hybrid typology; a Research and Visitor Centre of Climate Change, which reaches across groups of diverse demographics and background.

PROBLEM STATEMENT 0.4.10

PROBLEM FORMULERING \pruˈbleːm formɐˈleːrɪŋ\(Dict)

PRELIMINARY

The following introduces our readers the a statement of problem, which is fostered by the analyses in this chapter. The subsequent studies and eventually the final architectural design aim to answer.



The environment is drowning as a result of our consumption of Earth's resources. The oil rig represents the source to our usage that has among others led to declining Arctic Sea Ice, Ocean Acidification, Sea Level rise and extreme events of Precipitation.(NASA, Global Climate Change, n.d.) We are literally drowning in consumer culture.

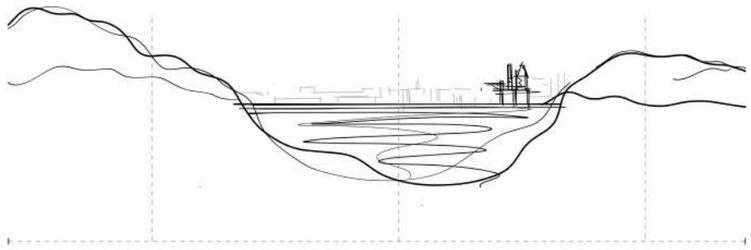
FIG.93:A NARRATIVE

"Can we employ Water as an agent of Tectonic Architecture that confronts our society with the issues of Climate Change and thus inspire a shift of behavioural consumption? And how can we create a new typology as a common platform to empower exploration and learning for a green future?"

VISION 0.4.11

VISJON/viˈʃuːn/ (Dict, n.d.)

OUR VISION OF RESEARCH AND VISITOR CENTRE



Perceiving the North Sea and landscape of Bergen, we conceive an abstraction of the gap between Research and Man. The landscape represents Research; shielded and hidden from external environment, and the exposed Water represents the Man, whose emotion and action are driven by its visual orientation.

FIG.94:PRIMARY GENERATOR

WHAT DO WE ENVISION WITH OUR ARCHITECTURE?

In our vision of this Thesis, we endeavour to revitalise the existing Bjerknes Centre for Climate Research and transform it into a platform of knowledge and learning; a Research and Visitor Centre of Climate Change as a catalyst that responses to our environmental challenges and has a mediating role in confronting and developing the society of Bergen towards a sustainable future. The platform aims to offer functions for focus, research and learning, and forums for dialogues and discussions. Thus creating transparency between research and man, and repositioning the framework of the way we work, learn and interact.

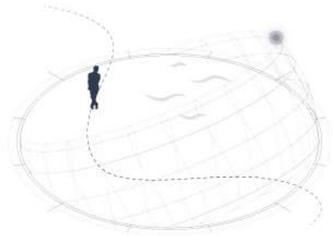
With the location in the North Sea, at the edge of Nordnes, Bergen, we envision the Research and Visitor Centre of Climate Change to engage in a relationship with the context and its climatic and environmental attributes, particularly, the element of Water and its inherent phenomena. Hence, the climatic and geographical conditions aim to play a significant role in the creation of diverse sensory experience and atmosphere. In continuation, by placing Architecture in the Water, we mean to narrate the uncomfortable truth of how our consumption consequently results in cities are drowning.

The Research and Visitor Centre of Climate Change shall manifest a sensory journey by tactile, thermal, and vision means, which will be underpinned by our approach of Tectonics as a linkage between Sustainable Architecture and Sensory Architecture, as it embraces the interplay between the constructive, the structural, the architectural, and the functionaL aspect. Thus, the Tectonic character in this Thesis will be emphasised in form of combined aesthetic and technical design of the overall architectural composition, the interior space, the detailing, the materials and lighting properties.

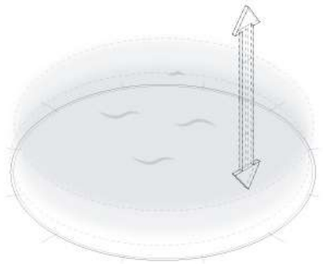
0.4.12 GENERATORS

GENERATOR / gene'ra:tur/ (Diet, n.d.)

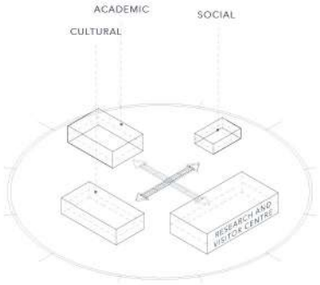
THE DRIVING DESIGN FORCES



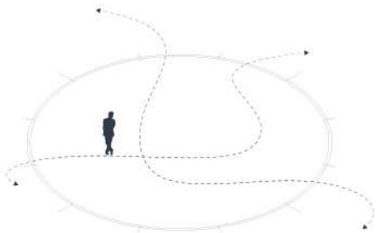
WATER AND WEATHER TO DETERMINE ATMOSPHERIC EXPERIENCE OF SPACE



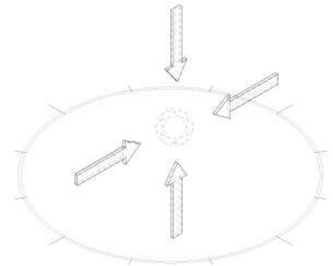
THE EVERCHANGING WATER TIDES IS AN INTEGRATED PART OF THE SPATIAL EXPERIENCE



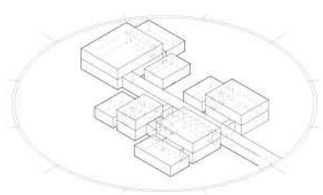
FUNCTION SHOULD EMBRACE SOCIAL CULTURAL AND ACADEMIC ACTIVITIES



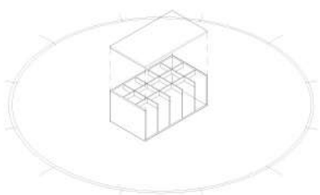
THE PROGRAM SHOULD EMBRACE A DYNAMIC FLOW



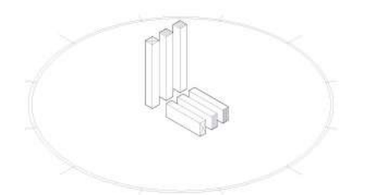
A GATHERING POINT FOR THE RESEARCH COMMUNITY



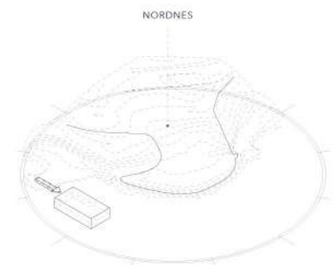
FUNCTIONS DIVIDED INTO DISTINCTIVE VOLUMES



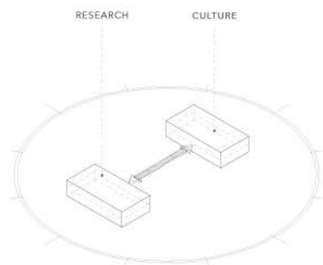
THE STRUCTURAL SYSTEM SHOULD UNDERPIN A CLEAR SEQUENCE OF SPACE



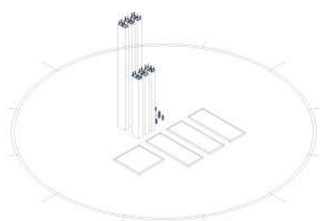
THE MATERIAL AND ITS PROPERTIES SHOULD UNDERPIN THE PRESENCE OF WATER



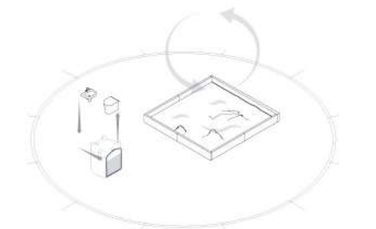
ARCHITECTURE APPROACHED AS CONTINUATION OF NORDNES



A CLEAR LINKAGE BETWEEN RESEARCH AND CULTURE FUNCTIONS



THE STRUCTURAL SYSTEM SHOULD CONSIST OF MODULAR ELEMENTS AND BE DESIGNED FOR DISASSEMBLY



WATER AS A SUSTAINABLE MEAN FOR PASSIVE AND ACTIVE STRATEGIES

FIG.95:BERGEN

NOTES

NOTE \'nu:te\(Dict)

TO PROVIDE CONTEXT

Index. Earthlab

Index. FARLAB

Index. Schlerochronology Lab

Index. TELAB

Index. ICOS

Index. CHESS

Index. Bjerknes Centre Data Lab

SERIAL VISION

Gordon Cullen (1914 -1994) 0.1

Gordon Cullen is a British architect, planner and urban theorist, who has contributed to the understanding of space through his theories and research. He was a key member of architects, historians and poets who enabled the architectural shape and opinion in post-war Britain.(Cruickshank, 1994) Probably the most important achievement of his work is with reference to the Townscape movement, where Cullen wrote Townscape based upon his seminal studies and projects. Today the work is distinguished as The Concise Townscape. However, his position as an influential planning consultant was first out into practice by 1983.(University of Westminster, n.d.)

MAPPING

James Corner (1961-) 0.2

James Corner is an American landscape architect, Emeritus Professor and founder of the James Corner Field Operations which emphasises Architecture and Urbanism in various scale. He has devoted the past 30 years to work within this field both by developed projects, teaching, public speaking and writings. Some of his significant projects includes the High Line, New York City; Freshkills Park and Shelby Farms in Staten Island. (Weitzman School of Design - University of Pennsylvania, n.d.) His work has been acknowledged through numerous prizes including the Cooper Hewitt National Design Award and through his body of writing on landscape architecture and urbanism. (James Corner Field Operations, n.d.)

USER

Bjerknes Centre for Climate Research 0.1

The Bjerknes Centre for Climate Research was founded in 2000. It engages more than 200 scientists from 39 countries and is on the largest units for Climate Change research in Europe. The overall aim of Bjerknes Centre for Climate Change is to understand and quantify the climate system for the benefit of society. In 2003-2012, Bjerknes Centre for Climate Research was labelled a National Centre of Excellence (CoE). (Bjerknes. UIB, 2016)

University of Bergen. UiB 0.2

The University of Bergen,UiB, is an European University with approximately 16.000 students and 300 employees. UiB is both an educational and a research unit, which involves a series of different disciplines and fields, structured in 7 faculties and 90 departments. UiB is a part of a global network of students and scientist, and perceive itself as a dynamic network for meeting and interacting, also with other communities. (University of Bergen, n.d.)

NORCE 0.3

NORCE is one of Norway's largest independent Research Institutes. It has 1000 employees from around the world. NORCE provides innovation and research in Energy, Health Care, Climate, the Environment, Technology and Society. It is based in Bergen, however it has a strong presence in other locations such as Alta, Tromsø, Bardu, Bodø, Haugesund, Randaberg, Stavanger, Kristiansand, Grimstad and Oslo.(NORCE Research, n.d.)

Nansen Environmental and Remote Sensing Centre. NERSC 0.4

Nansen Environmental and Remote Sensing Centre, NERSC, was founded in 1986 and is an independent non-profit Research Foundation. It conducts environmental and climate research, and generate an interdisciplinary across scientific expertise in Earth system, environmental and climate research, satellite, remote sensing, modelling and data assimilation. NERSC is affiliated with the University of Bergen, UiB. (NERSC, n.d.)

Institute of Marine Research. IMR 0.5

The Institute of Marine Research, IMR, is Norway's largest centre of marine science. It has approximately 750 employees. Their objective is to provide advice to Norwegian authorities on aquaculture and the ecosystems of Barents Sea, the Norwegian Sea, the North Sea and the Norwegian coastal zone. Hence, their main activities are research, advisory work and monitoring. The IMR has its base in Bergen, however, they are also present in Tromsø, Matre , Austevoll and flødevigen.(Institute of Marine Research, n.d.)

EARTHLAB 0.6

EARTHLAB is short for Earth Surface Sediment Laboratory, which is one of the five laboratories present at the Bjerknes Centre for Climate Research. The laboratory has four fields involving the work with Sediments, Cronology, Magnetism and Field. The researchers associated with the laboratory operate with various of equipment of for instance scanners, x-rays or seismic and sediment coring equipment to support their research. On a daily basis four people including a project-leader, co-leader, a laboratory manager and a Ph.D. student work at EARTHLAB. (Bjerknes Centre for Climate Research, 2016)

FARLAB 0.7

FARLAB is short for Facility for advanced isotopic research and monitoring of weather, climate, and biogeochemical cycling. The work at the laboratory is to understand Earth Systems by analysing for instance weather, atmospheric water, seawater and others.(UIB, n.d.) Their work involves research both in laboratories but likewise field measurements, which involves the ability to transport the equipment by ship or aircraft. On a daily basis three people, including a projectcoordinator and partners work within the field of the laboratory.(Bjerknes Centre for Climate Research, 2016)

Sclerochronology Lab 0.8

The Uni Research Sclerochronology laboratories main task is to work with bivalve Sclerochronology, in other words, biodiversity. The laboratory encompasses smaller equipment of for instance grinder polisher, microscopes, Buhler low and high speed saws and others. The daily operation is executed by one researcher. (Bjerknes Centre for Climate Research, 2016)

TELAB 0.9

The TELAB is the Uni Research Trace Element Laboratory which primary work concerns the state of art of the accurate estimate of constructed ocean temperatures. The work requires a variation of equipment which on a daily basis is operated by five people including researchers, a scientific responsible worker and partners. The laboratory is open for students and other guests. (Bjerknes Centre for Climate Research, 2016)

ICOS 1.0

ICOS is short for marine Integrated Carbon Observation System and describes the Chemical Oceanographic Laboratory which concern the activities related to quantifying air-sea carbon flux and water mass movement and dynamics. The laboratory is attended by two researchers, who works with various of equipment which periodically is taken to sea to do field measurement called the "round-the-clock" onboard analysis. (Bjerknes Centre for Climate Research, 2016)

CHESS 1.1

CHESS is a Research School on Changing Climates in Coupled Earth Systems with the objective of creating a Research-training environment for Ph.D. students within the subject of Climate fields. The candidates are from The University of Bergen, and are closely affiliated with the Bjerknes Centre and the on-going research. However, other external members of the Research School are from different Universities in Norway. (CHESS, n.d.)

Bjerknes Climate Data Centre 1.2

Bjerknes Climate Data Centre is afiliated with the Bjerknes Centre for Climate Research in the work of managing data services for both internal and external projects. The Data Centre has collaborations with various of international data and archives, where the daily operation is executed by five members including a leader, Data Managers and a Software Architect. (The BCCR Partners, n.d.)

MB

0.5.0 LIST OF CONTENT
0.5.1 CONCEPT
0.5.2 THE STRUCTURAL SYSTEM
0.5.3 STRATEGIES
0.5.4 DESIGN FOR DISASSEMBLY

0.5.0 CONCEPT

KONSEPT \kun'sept\ (Dict, n.d)

CHAPTER CONTENT

The Concept presents our proposal for a Research and Visitor Centre of Climate Change. The presentation consists of figures and descriptive text and aims to narrate and illustrate the different characters and atmospheres of the Centre. Furthermore, it includes technical measures such as Structural System, Indoor Environment and Sustainable Strategies. The chapter aims to project an overall picture of the potential qualities of our proposal.

FIG.96: WATER (Photo by Silas Baison)

FIG.97: APPROACHING THE ARCHITECTURE

CONCEPT 0.5.1

KONSEPT /kun´sept/(Dict, n.d.)

PRESENTATION OF OUR DESIGN

FIG.98:
APPROACHING THE ARCHITECTURE

Located in the sensitive landscape of North Sea, the Research and Visitor Centre of Climate Change emerges from the Water and offers visitors, students and researchers a vantage point from which to absorb the distinctive scenery and atmosphere. The Research and Visitor Centre narrates a story of Bergen's rooted research and scientific discoveries and invite people to explore, learn and understand the environmental challenges of our future. Furthermore, it strengthens Bergen as a gathering point for Climate Research at a regional and global scale.

The concept of the Research and Visitor Centre is created in unity with the contextual conditions, namely the element of Water, and its composition is manifested as a drowning city in the North Sea. From the dense landscape sceenary of Bergen the journey takes a starting point at the tip of Nordnes as a continuation of the existing descending landscape, and lead us closer to the Water. With the abstraction of the volumes as houses and transition spaces as streets, the functions, which are manifested as individuals, forms a cohesive sequence of space between the Water.

In the dynamic interplay between the Research and Visitor Centre and the Water, the element becomes an essential agent for Sustainable means and for the diverse sensory experiences regarding the tactile, thermal and visual aspect. The Two-Way Beam Grid becomes the structure, that in shape and materiality unite the Sustainable and Senseous aspects by radiating a simplicity which express and exploits the contextual environment and its ever-changing weather conditions.

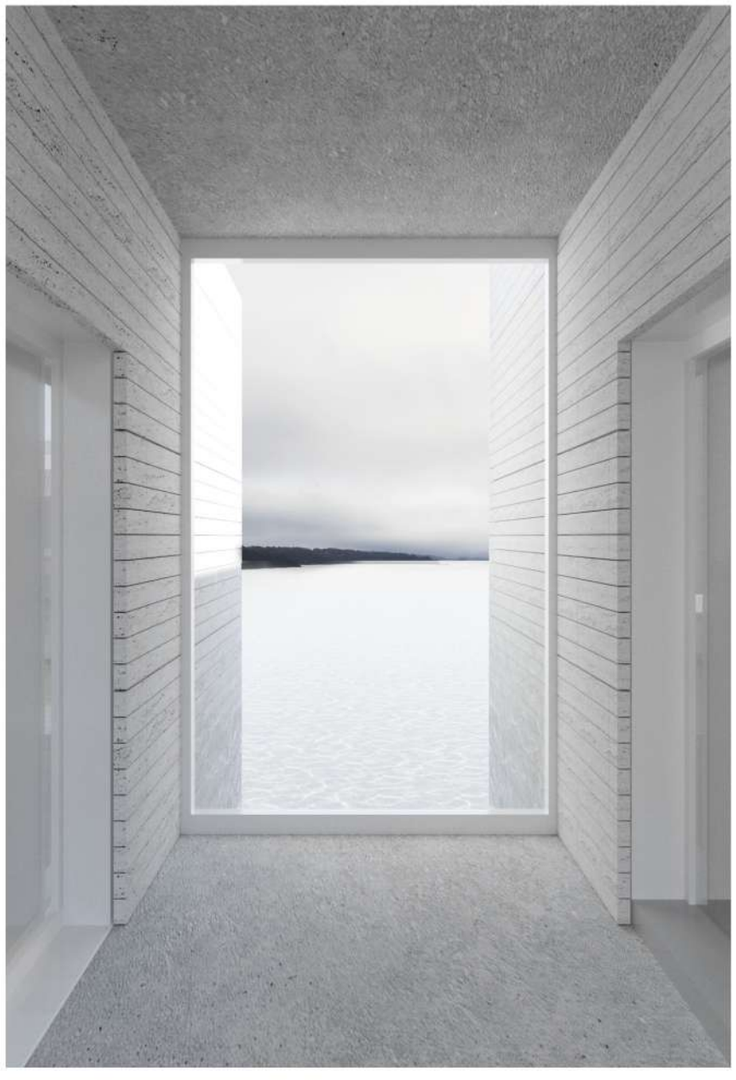
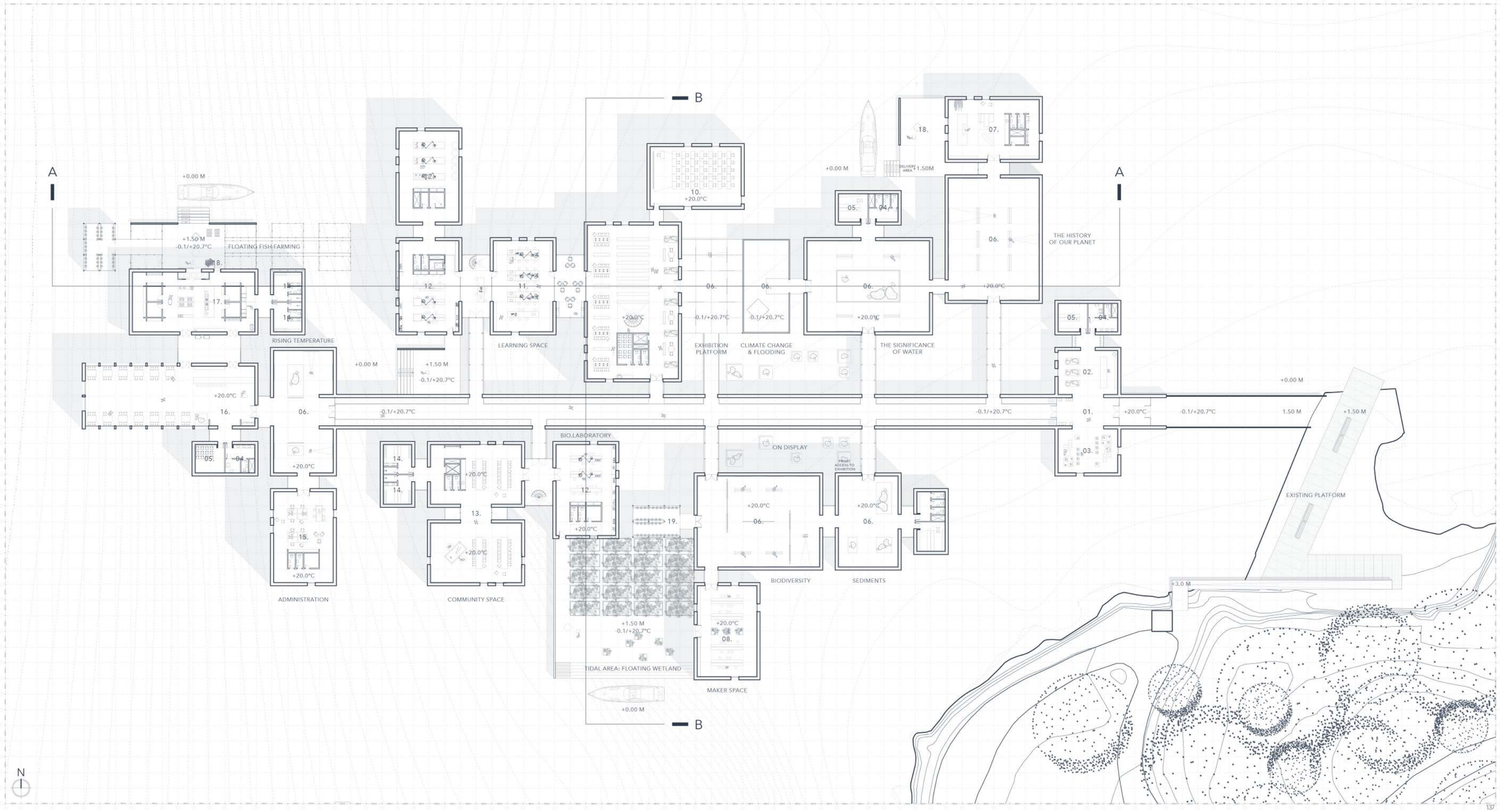


FIG.99: OBSERVING THE PRESENCE OF WATER FROM THE TRANSITION SPACE

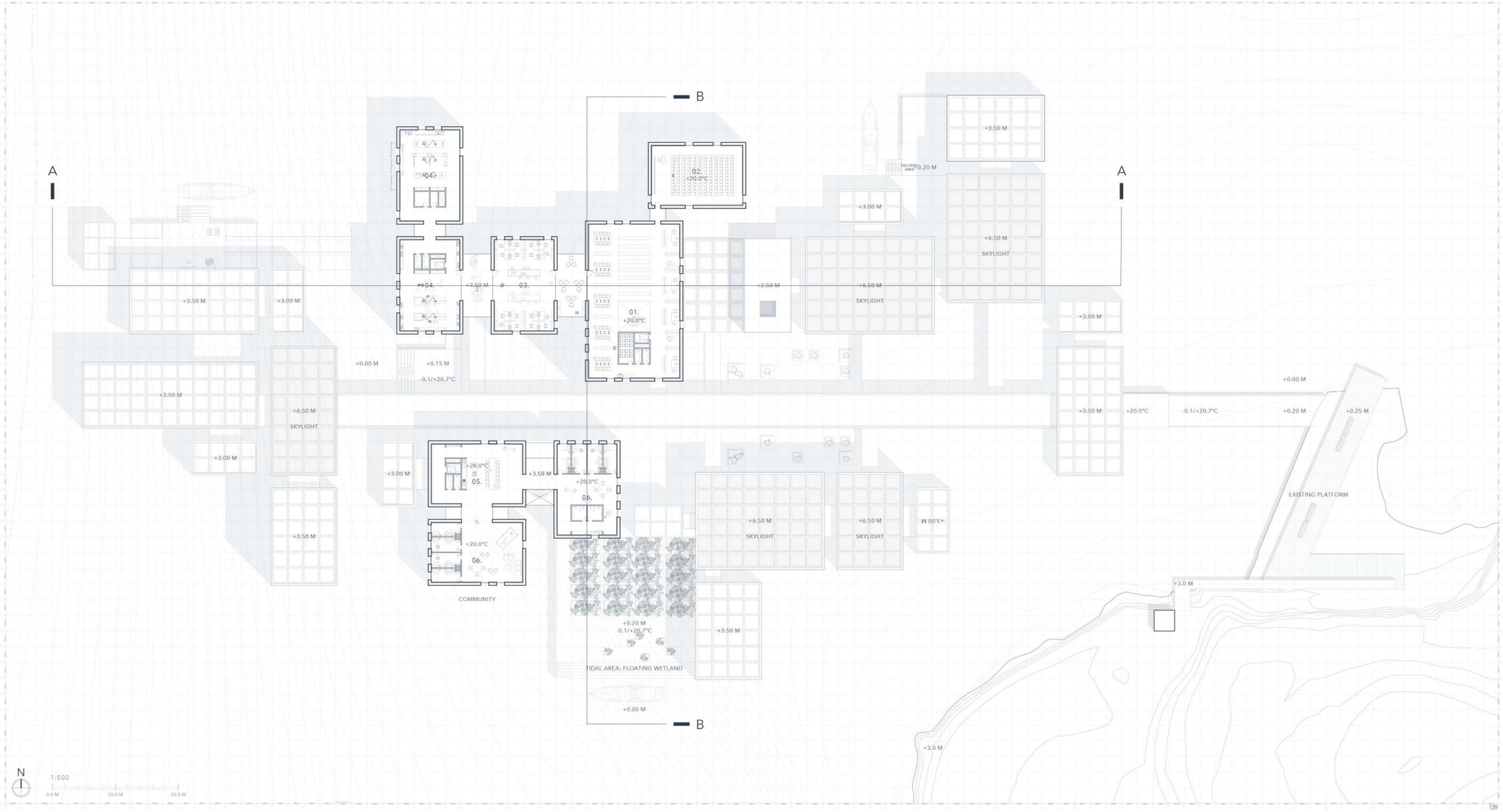
FIG.100: LIME STONE CLADDING

FIG.101: PLAN 00



01. ENTRANCE
02. RECEPTION
03. SHOP
04. LAVATORY
05. DEPOT
06. GALLERY
07. GALLERY WORKSHOP
08. MAKER SPACE
09. LIBRARY + READING AREA
10. LECTURE ROOM
11. LABORATORY
12. TEACHING LABORATORY
13. COMMUNITY SPACE
14. DRESSING ROOM
15. ADMINISTRATION
16. EATERY
17. PRODUCTION KITCHEN
18. OUTDOOR PLATFORM

FIG.102: PLAN 01



01. LIBRARY + GROUP ROOM AREA
02. AUDITORIUM
03. PHD. AREA
04. LABORATORY
05. COMMUNITY KITCHEN
06. STUDIOS

FIG.103: PLAN 03

01. LIBRARY + GROUP ROOM AREA
02. AUDITORIUM
03. PHD. AREA
04. LABORATORY
05. COMMUNITY KITCHEN
06. STUDIOS

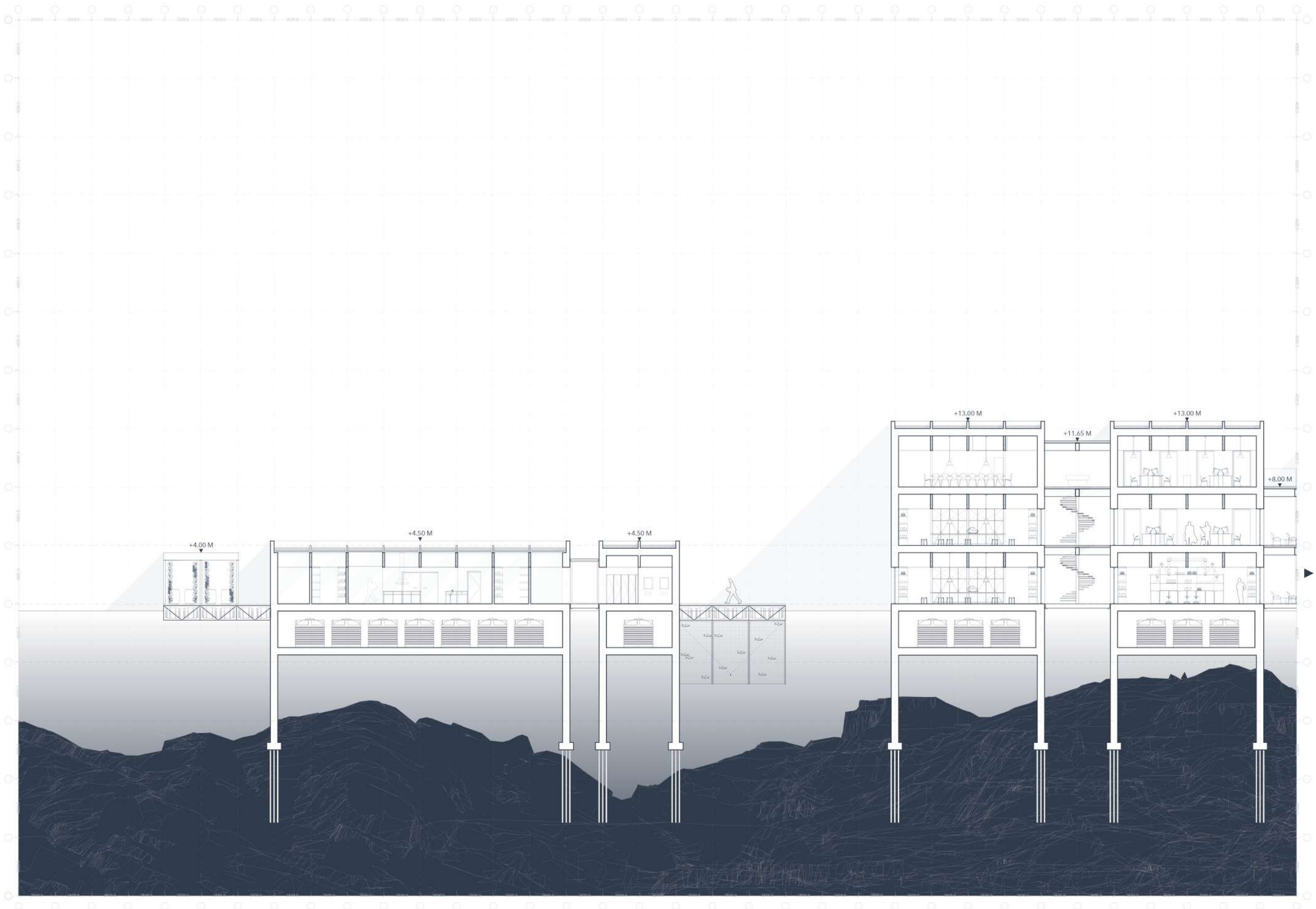


FIG.104: SECTION A-A

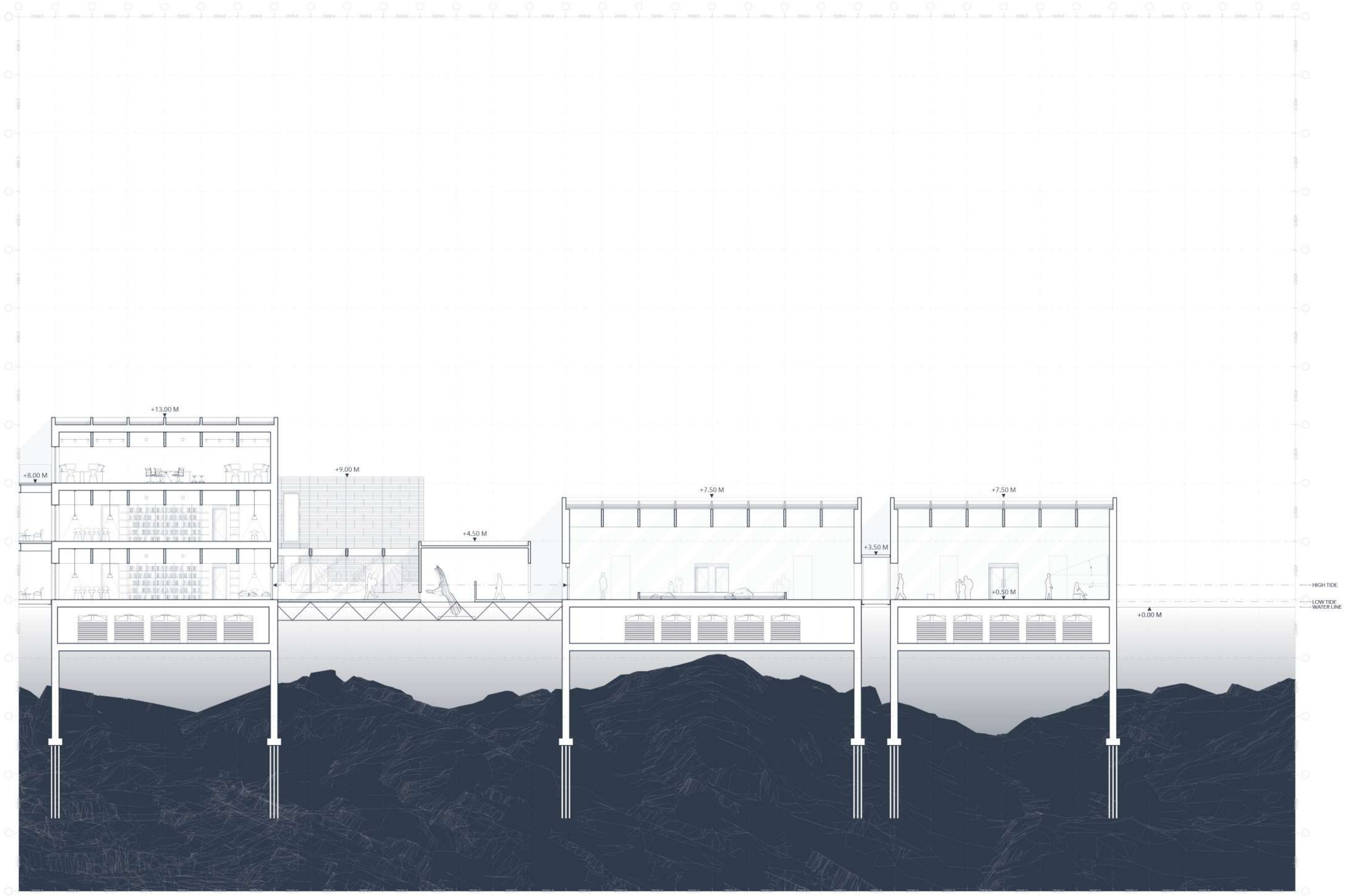


FIG.105: SECTION A-A

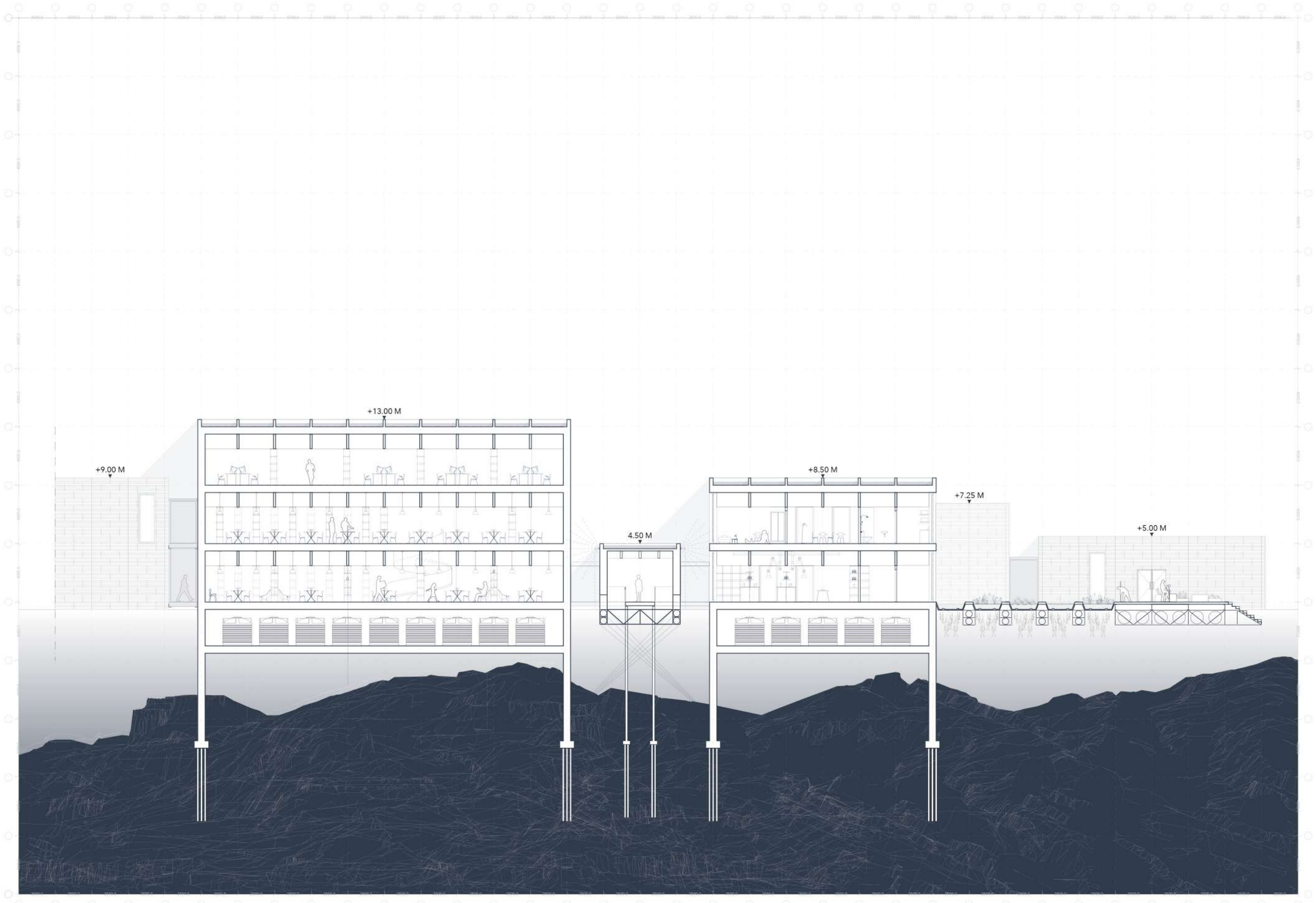
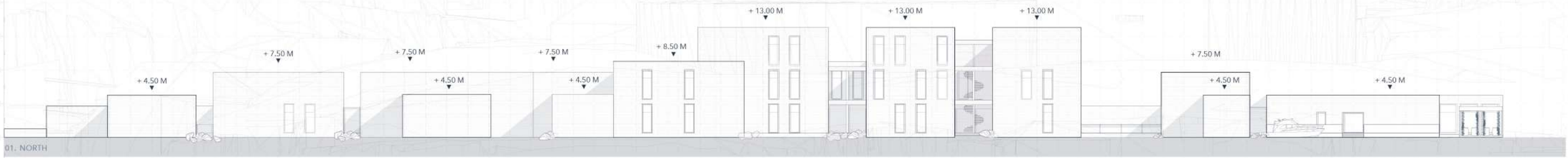
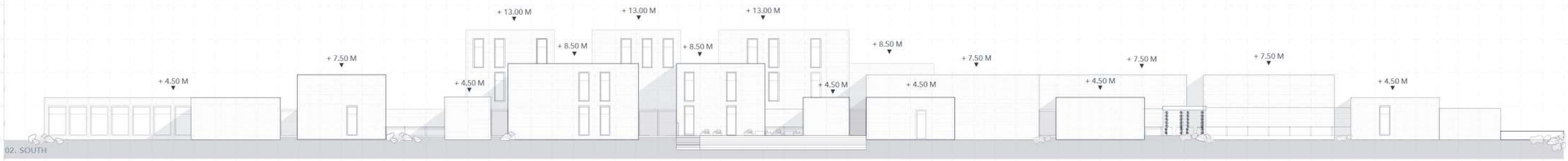


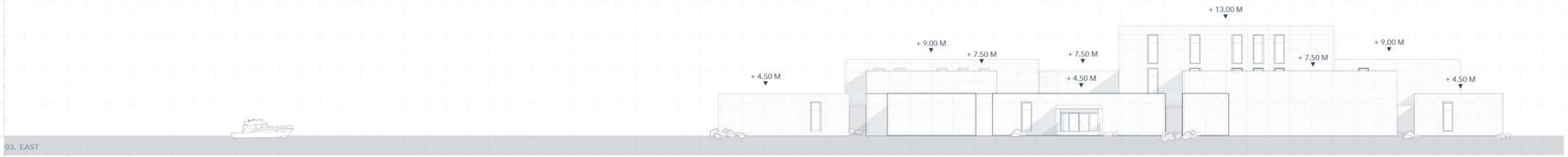
FIG.106: SECTION B-B



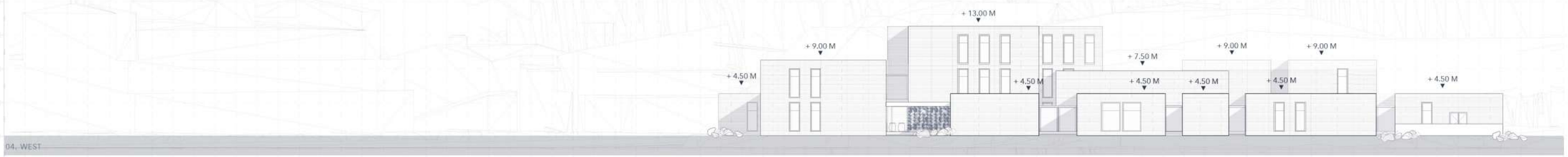
01. NORTH



02. SOUTH



03. EAST



04. WEST

1:500

0.0 M 10.0 M 20.0 M

0.5.2 SPATIAL EXPERIENCE

ROMLIG OPPLEVELSE / `rumli // op:le:velse /(Diet, n.d.)

THE DIVERSE SPATIALITY

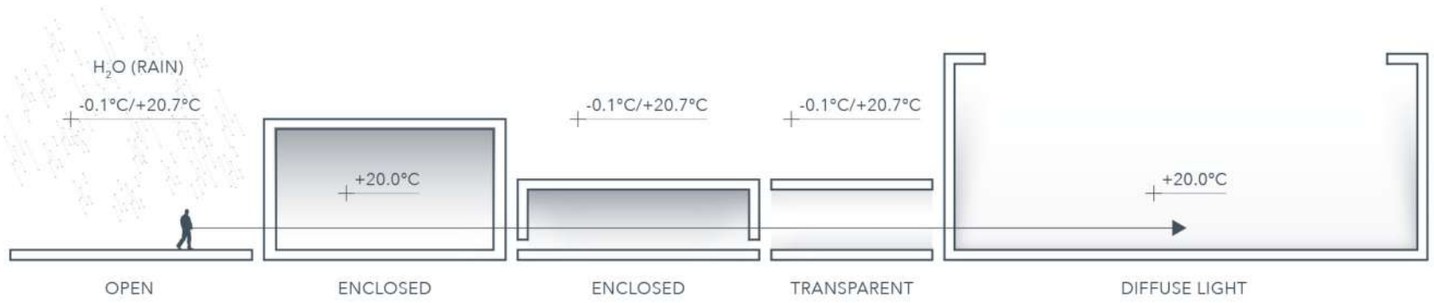


FIG.107: SPATIAL EXPERIENCE FOR DYNAMIC USERS

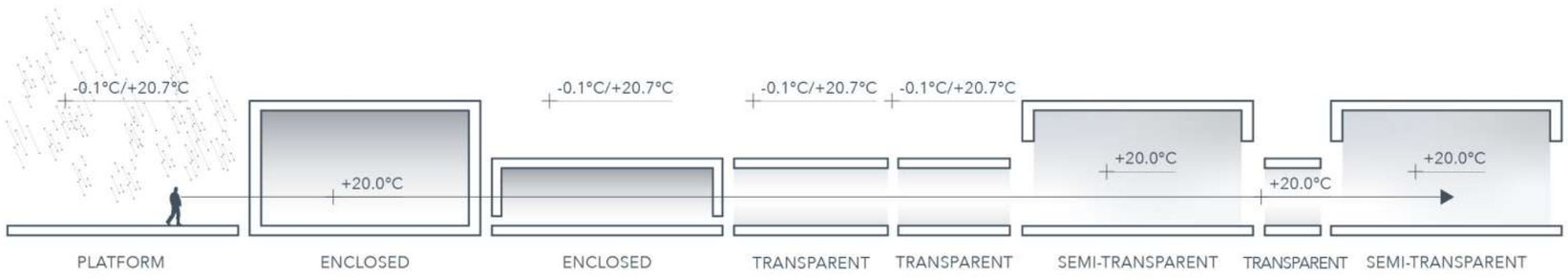
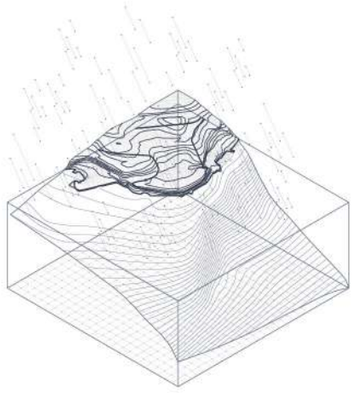


FIG.108: SPATIAL EXPERIENCE FOR STATIC USERS

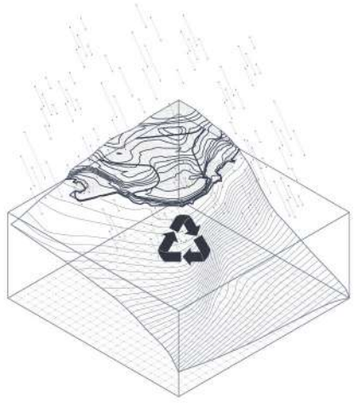
0.5.3 TRANSLATION

FORVANDLING / for'vandlin /(Dist. n.d.)

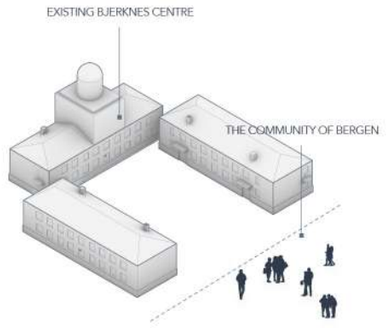
FROM BERGEN TO OUR ARCHITECTURE



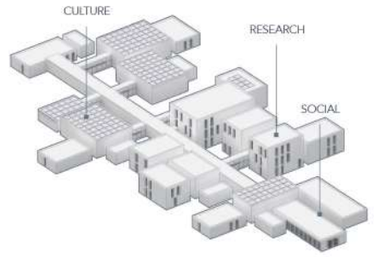
1.0. WATER AS AN ISSUE FROM THE SEA AND SKY



1.1. REUSE OF WATER FROM THE SEA AND SKY

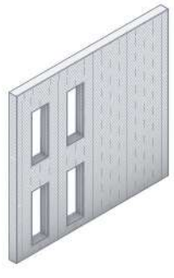


3.0. RESEARCH AT THE EXISTING BJERKNES CENTRE IS INVISIBLE TO MAN



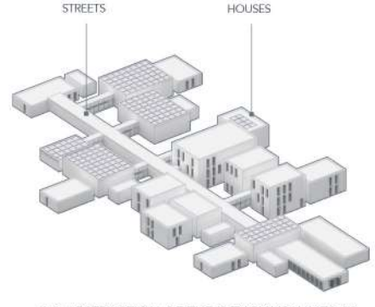
3.1. TRANSPARENCY BETWEEN RESEARCH AND MAN BY RESEARCH, SOCIAL AND CULTURE FUNCTIONS

FIG.109: PRINCIPLES 2.0. THE VERTICAL FACADE EXPRESSION REPRESENTED IN BERGEN



2.1. THE VERTICAL FACADE EXPRESSION TRANSLATED INTO THE RESEARCH AND VISITOR CENTRE

4.0. THE DENSE CITY STRUCTURE OF BERGEN



4.1. ABSTRACTION OF THE CITY BY VOLUMES AS HOUSES AND TRANSITION SPACES AS STREETS

FIG.110: A PLACE FOR ABSORBING KNOWLEDGE

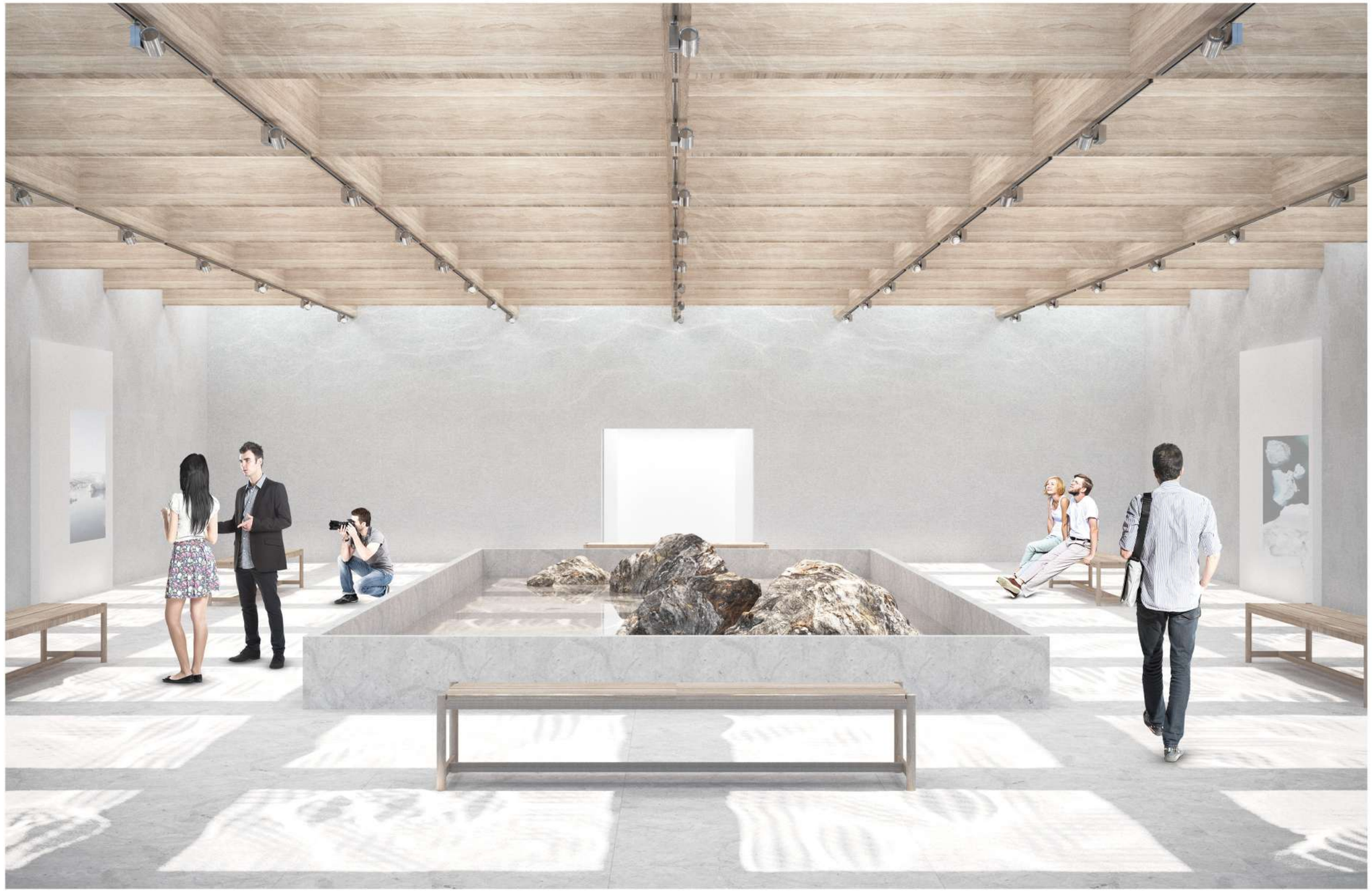


FIG.111:
GALLERY AREA WITH A CHARACTERISTIC PRESENCE OF WATER

0.5.4 THE VERSATILITY OF BEAM GRID

ANVENDELSE AV BEAM GRID /ˈanvenːəlse//ˈɑːv// beem // grid // (Diet, n.d.)

HOW WE UTILISE BEAM GRID

FIG.112:
BEAM GRID TO REFLECT WATET

FIG.113:
BEAM GRID TO UNDERPIN ACOUSTICAL CONDITION

FIG.114:
BEAM GRID AS A FURNITURE

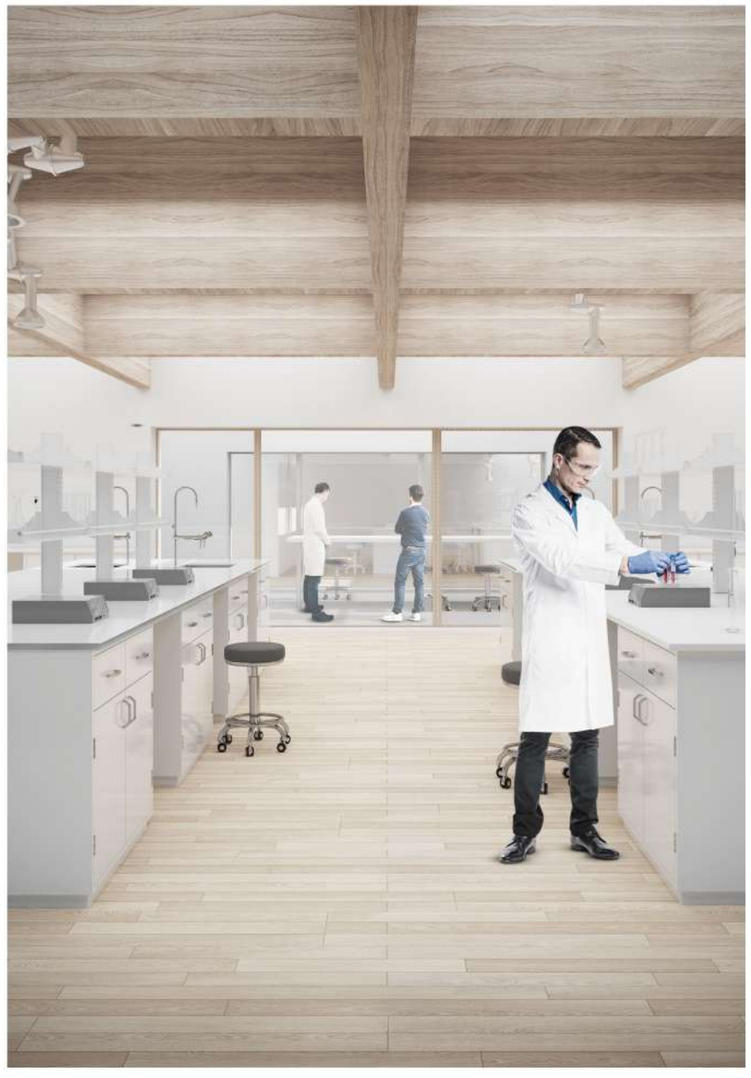
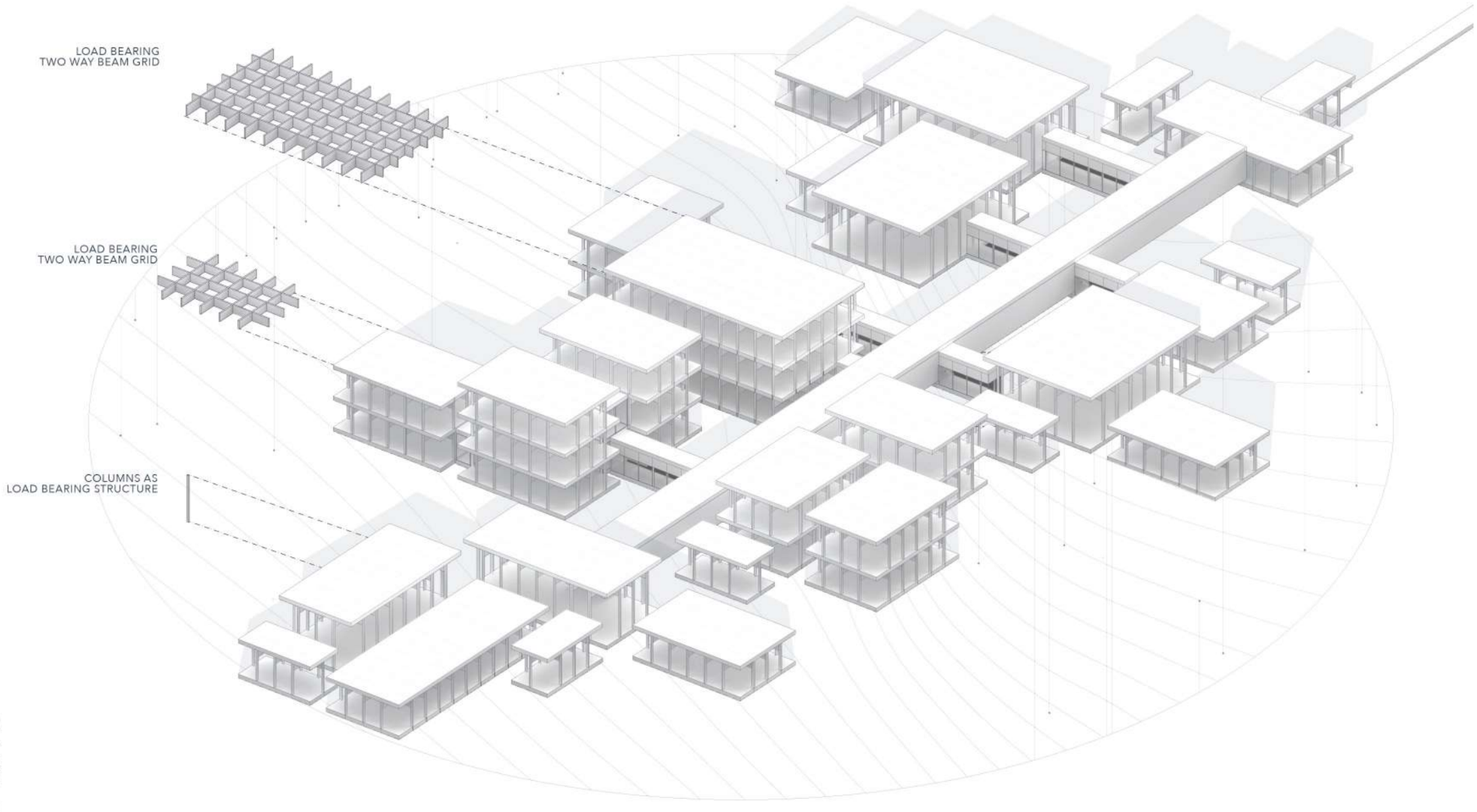


FIG.115: LABORATORY

0.5.5 THE STRUCTURAL SYSTEM

STRUKTURELL SYSTEM /strʉktʉ'rel/ /sy'stɛm/ (Diet. n.d.)

THE FORCE OF OUR DESIGN



The diagram gives an overview of the Structural System and the present compressive actions of the wooden Two-way Beam Grid. The structure is determined with reference to material efficiency for each volume with the aim to address Cicurlar Thinking and minimise the material use.

FIG.116:THE STRUCTURAL SYSTEM OF OUR DESIGN

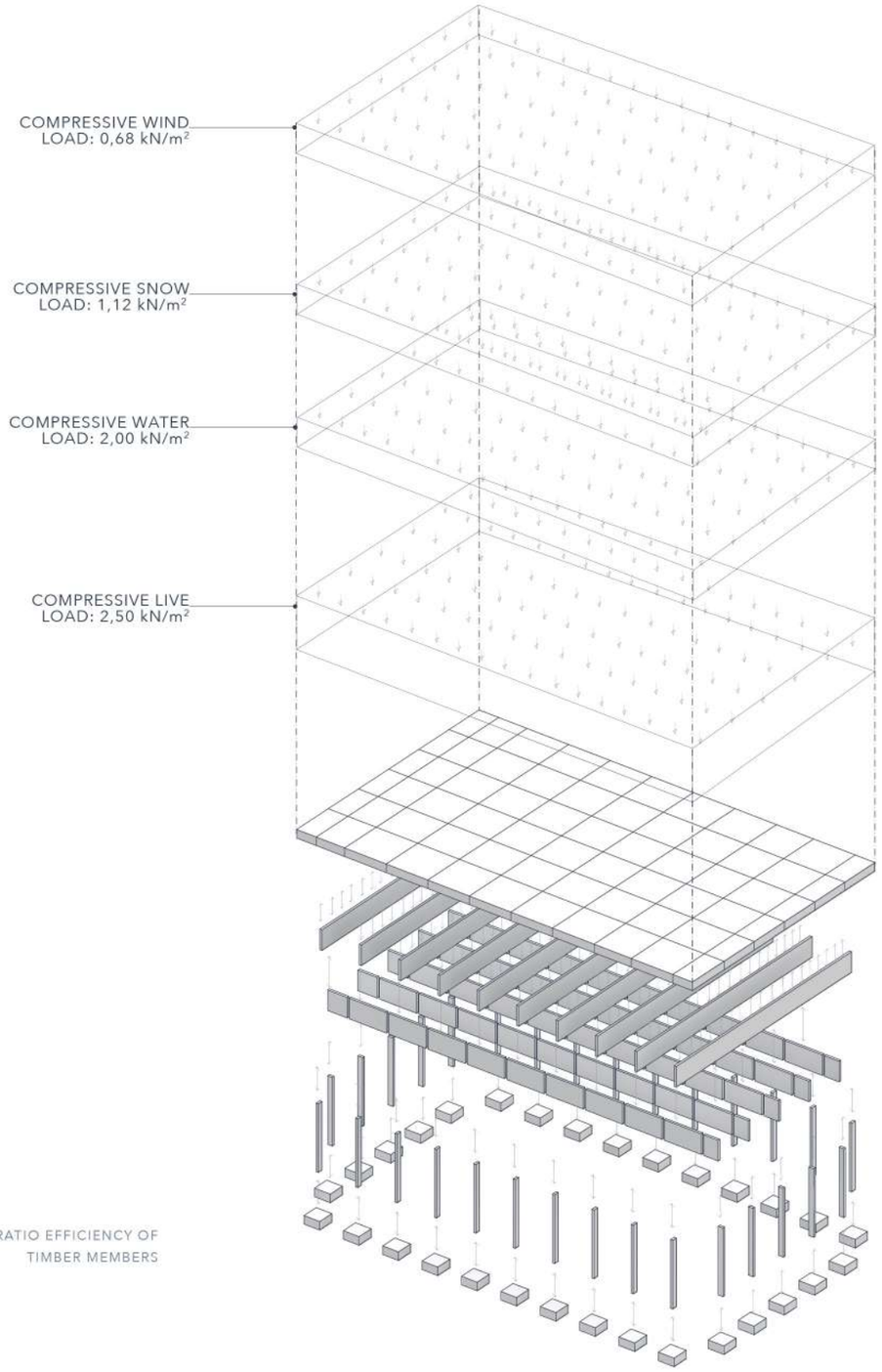
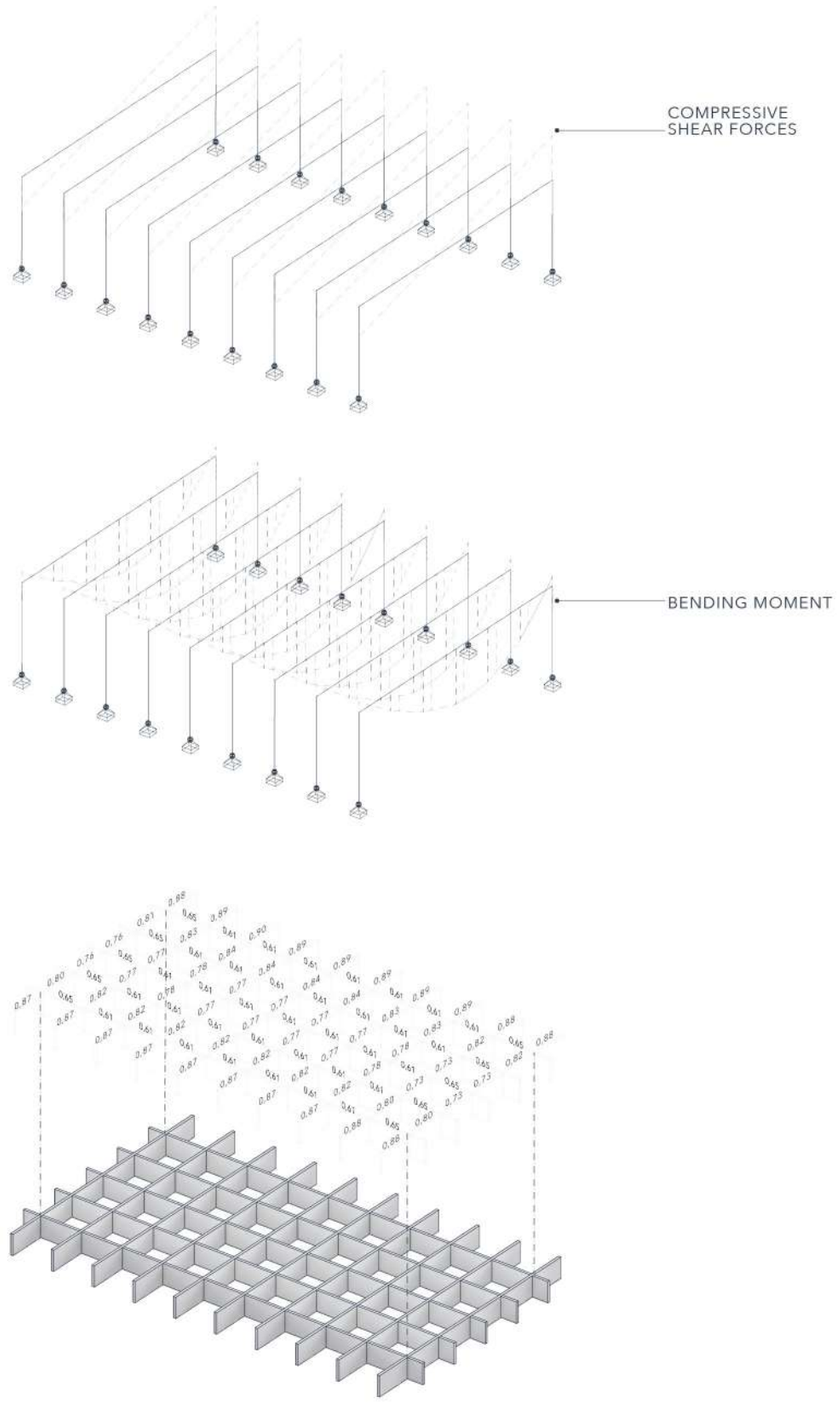


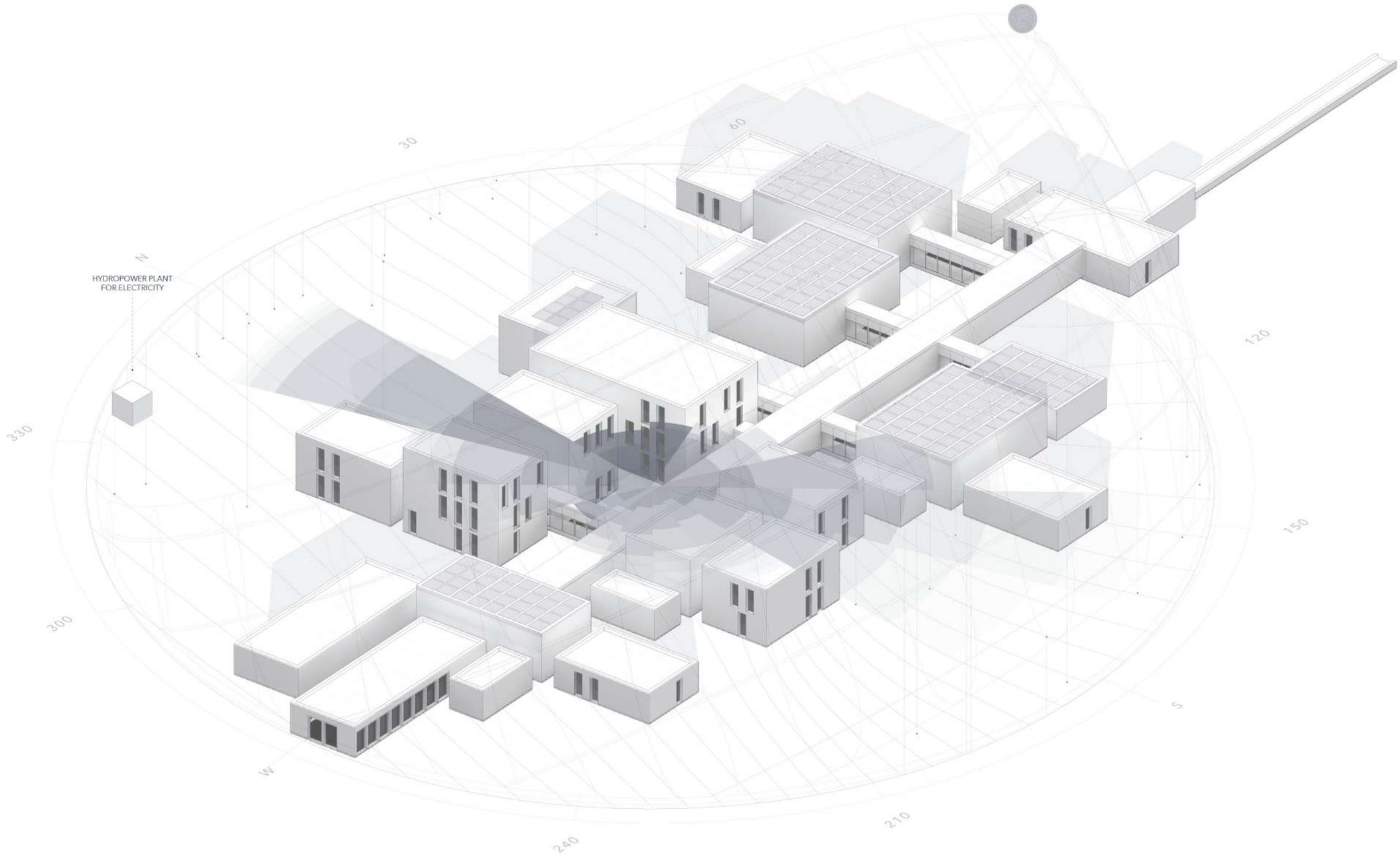
FIG.117:THE RATIO EFFICIENCY OF TIMBER MEMBERS



0.5.6 STRATEGIES

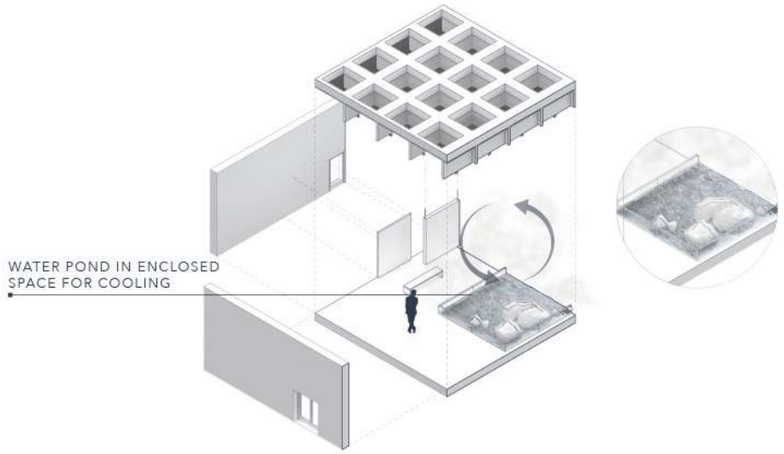
STRATEGI /strate'ji:/ (Dist, n.d.)

STRATEGIES TO IMPROVE THE INDOOR ENVIRONMENT



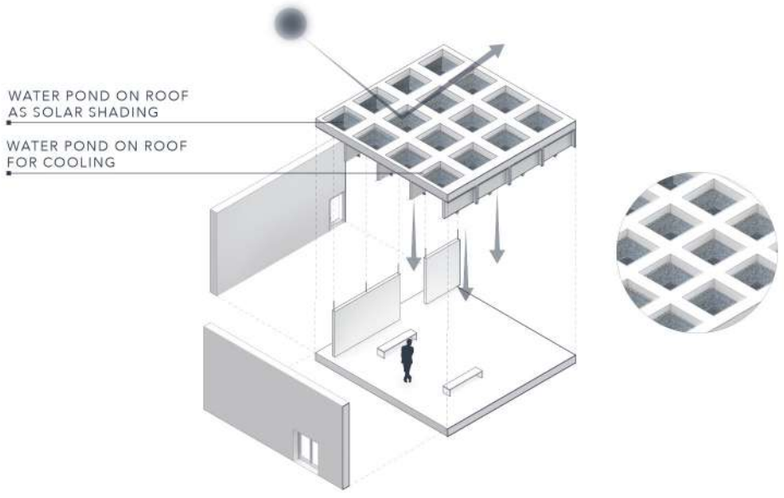
WATER POND FOR COOLING

The water pond within an enclosed space will lower the indoor air temperature by evaporation along with cross-ventilation through openings in the facade. The water ponds are positioned in the gallery spaces and the restaurant which have a greater amount of windows.(NZEB, n.d.)



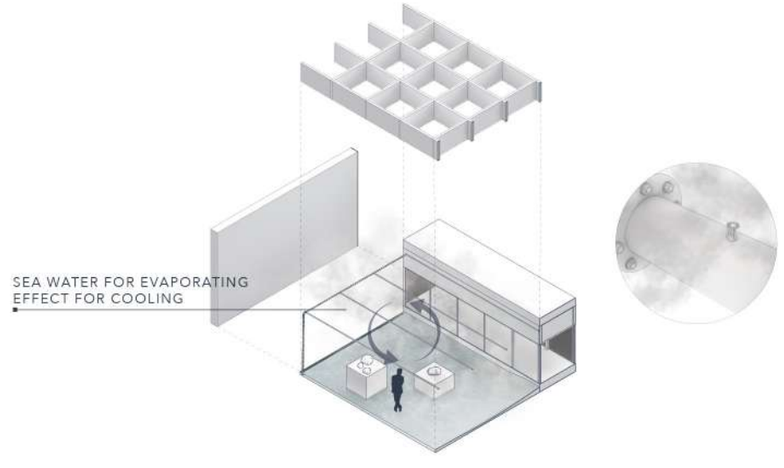
ROOF POND FOR COOLING

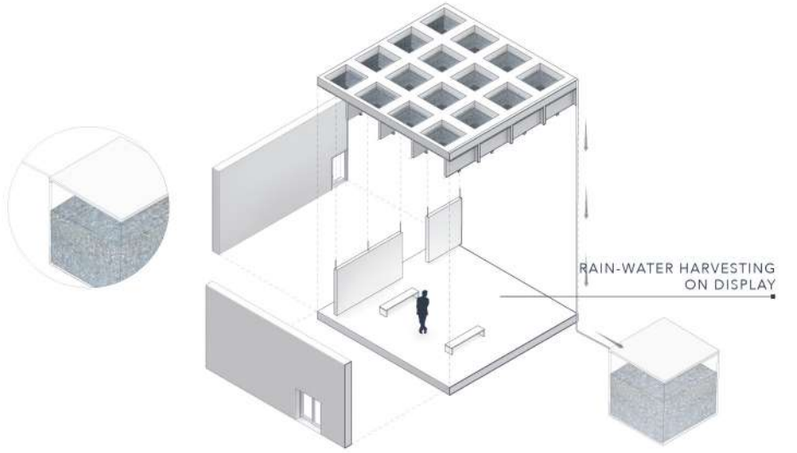
The Two-Way Beam Grid allows for collecting rainwater and provide roof ponds, which will minimise the heating effect from solar radiation and function as cooling storage. The passive strategy allows for a greater amount of windows in the roof.(NZEB, n.d.)



EVAPORATIVE COOLING

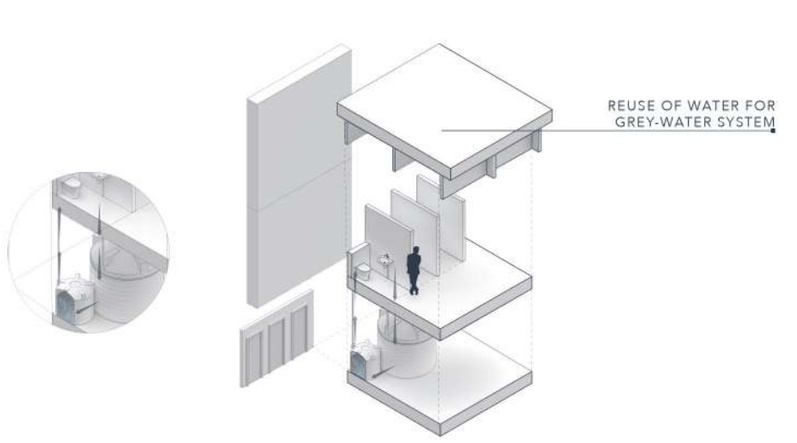
With the placement at the North Sea, there is a great potential in utilising the seawater as a strategy for cooling. The building will by water spray nozzles cool down the building through the process of absorbing heat from the air and lower the temperature. (NZEB, n.d.)





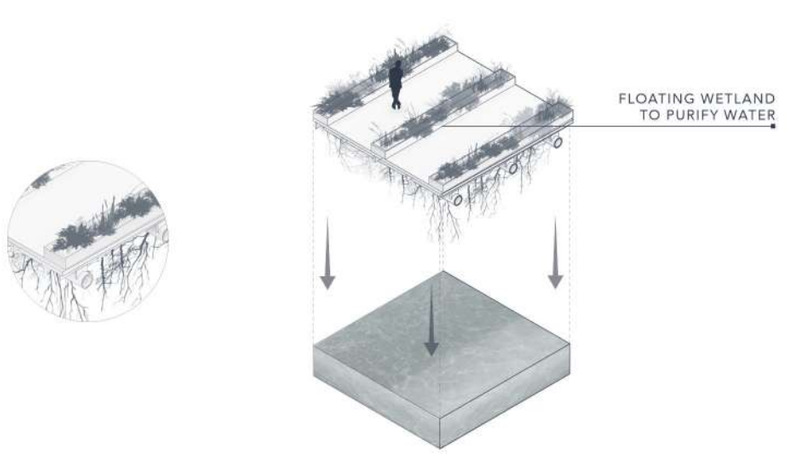
Rainwater Harvesting

Rainwater Harvesting collects the rain into a Management system for later use. Harvesting Rainwater reduces the over-exploiting drinkwater resources. Furthermore it reduces the stress on the sewers and prevent them from being overflooded.(Gervand.dk)



Grey Water System and Bio-gas System

Grey Water is used Water from sinks, and showers and can be resued for lower value purposes. Reusing of Grey Water reduces the stress on the sewer or septic system. The Biogas-system can generate green-based energy and can support the electricity consumption. (Sustainable Earth Technologies, n.d.)



Floating Wetland

Floating Wetland can create ideal habitat for birds on surface and aquatic creatures underwater. Thus, it increases the local biodiversy. The roots underwater filter out pollutants from wastewater and other industrial contaminants, and increase the Water quality.(IISD, n.d.)

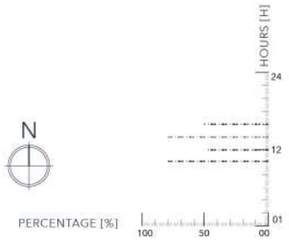
0.5.7 INDOOR ENVIRONMENT

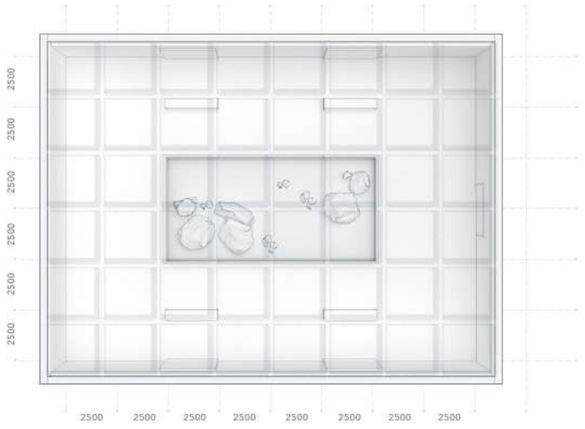
INDRE KLIMA /ˈindre// kliːmə/ (Dict, n.d.)

A HEALTHY ATMOSPHERE

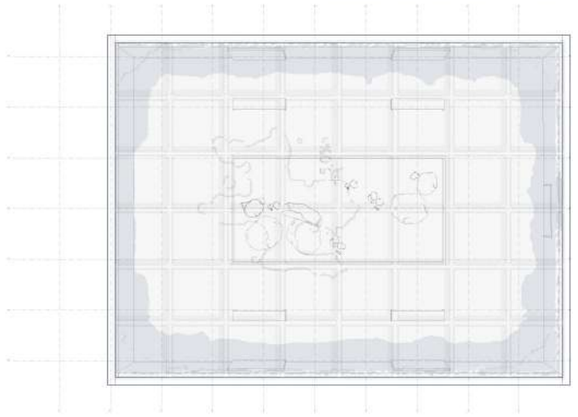
DAYPROFILE - THE USE OF THE BUILDING

EXPLORATIVE SPACE - GALLERY



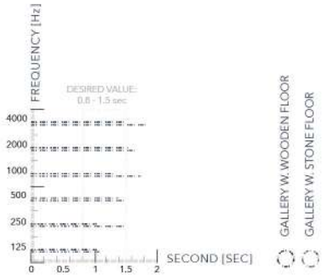


AVERAGE DAYLIGHT FACTOR: 3.8%

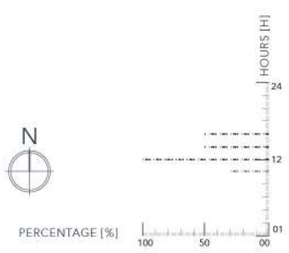


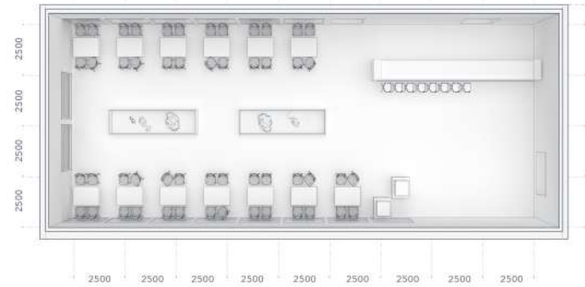
ACOUSTICAL PERFORMANCE OF SPACE

REVERBERATION TIME (T30)

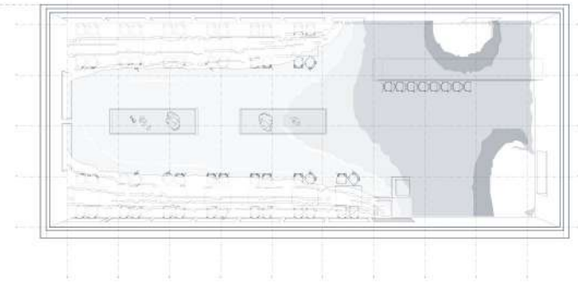


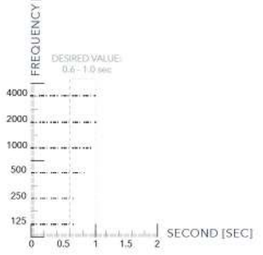
SOCIAL SPACE - RESTAURANT



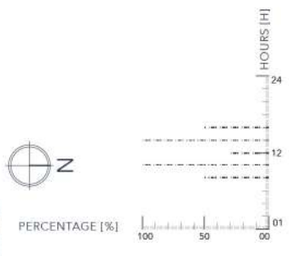


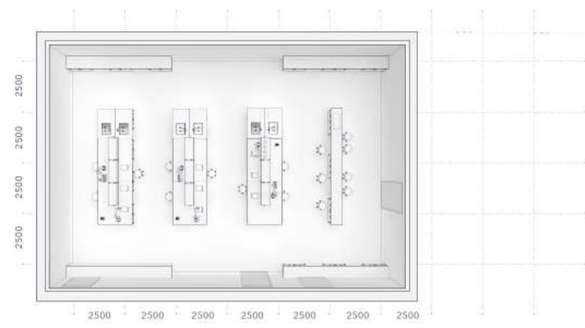
AVERAGE DAYLIGHT FACTOR: 5,4%



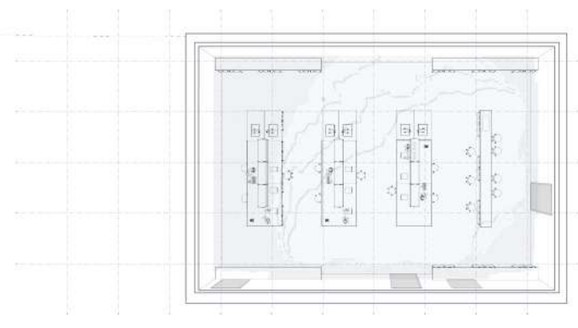


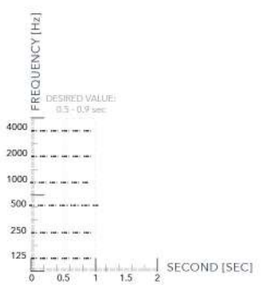
WORK SPACE - LABORATORY





AVERAGE DAYLIGHT FACTOR: 5,7%



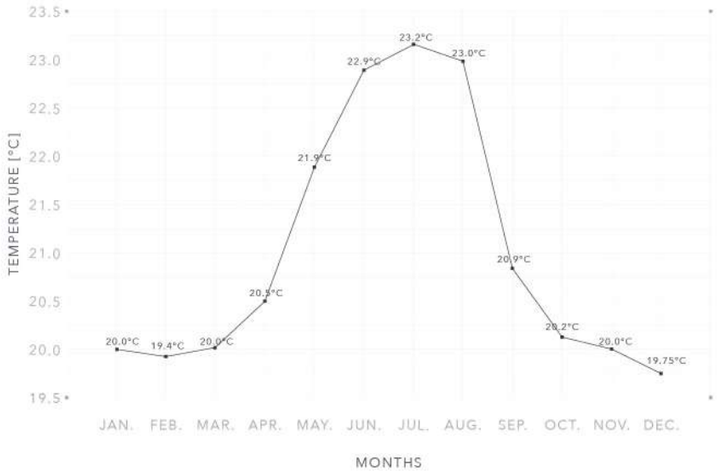


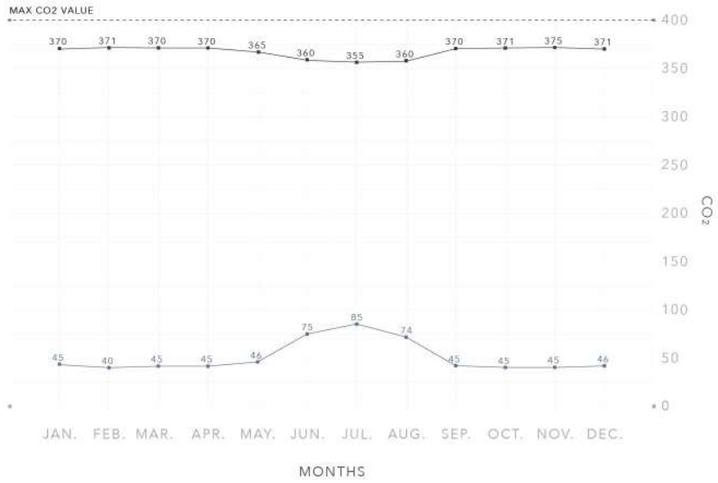
GALLERY

MONTH AVERAGE TEMP. [°C]
21,7°

HOURS > 27°
[MAX: 25 H] 25

HOURS > 26°
[MAX: 100 H] 75





GALLERY

MONTH AVERAGE CO_2 LEVEL [PPM]
414.6

CO_2 [PPM]

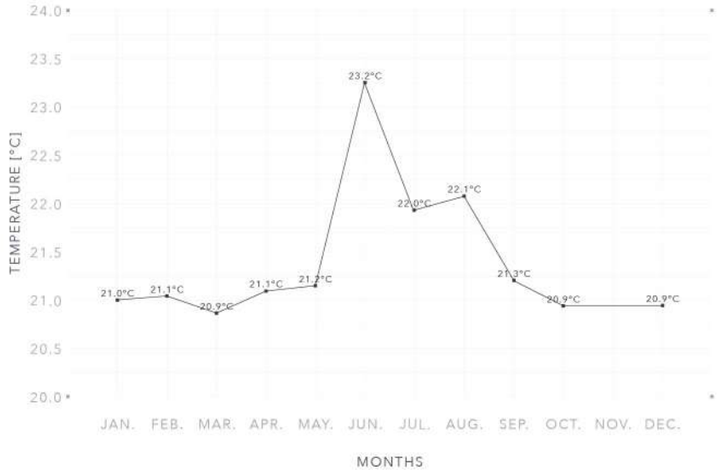
AIR CHANGE [100 $\cdot H^{-1}$]

RESTAURANT

MONTH AVERAGE TEMP. [°C]
21,5°

HOURS > 27°
[MAX: 25 H] 16

HOURS > 26°
[MAX: 100 H] 87



RESTAURANT

MONTH AVERAGE CO_2 LEVEL [PPM]
491.9

CO_2 [PPM]

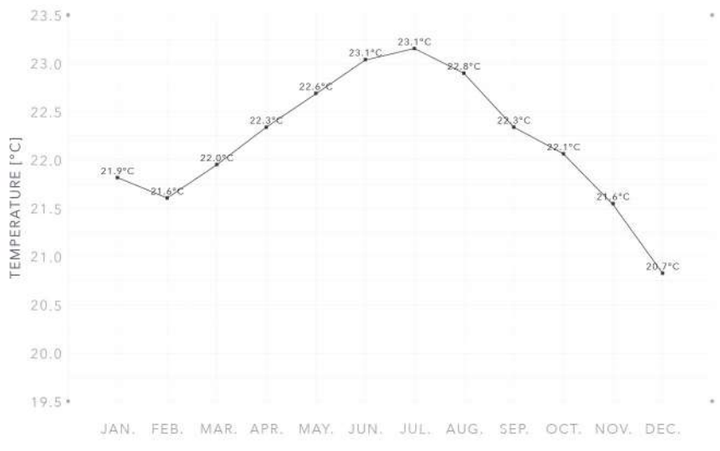
AIR CHANGE [100 $\cdot H^{-1}$]

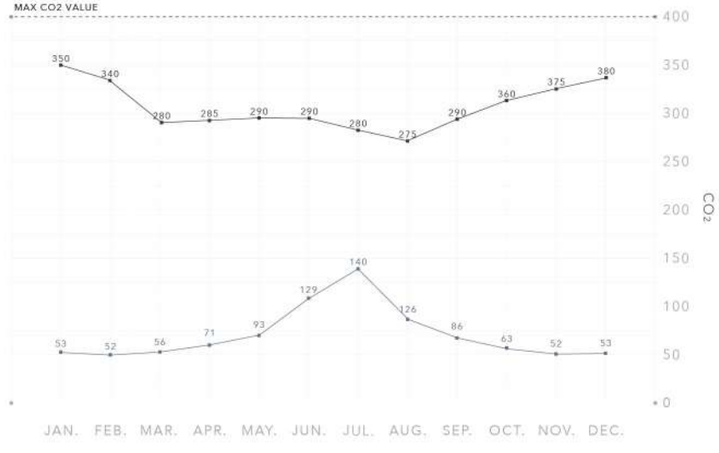
LABORATORY

MONTH AVERAGE TEMP. [°C]
22,2°

HOURS > 27°
[MAX: 25 H] 7

HOURS > 26°
[MAX: 100 H] 47





LABORATORY

MONTH AVERAGE CO_2 LEVEL [PPM]
385.8

CO_2 [PPM]

AIR CHANGE [100 $\cdot H^{-1}$]

FIG.118: EATERY

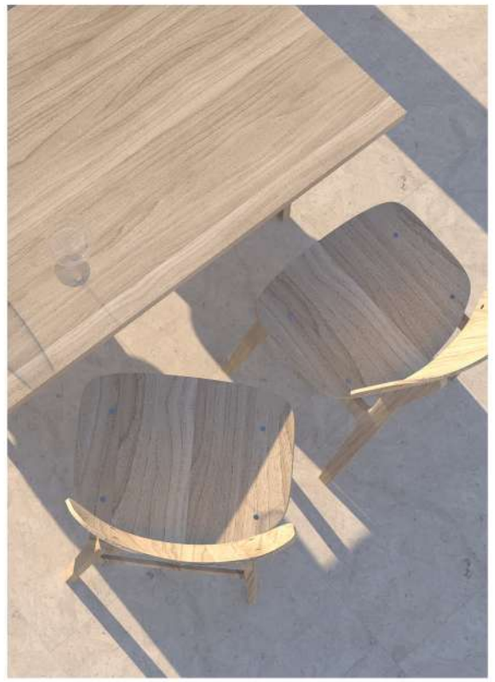
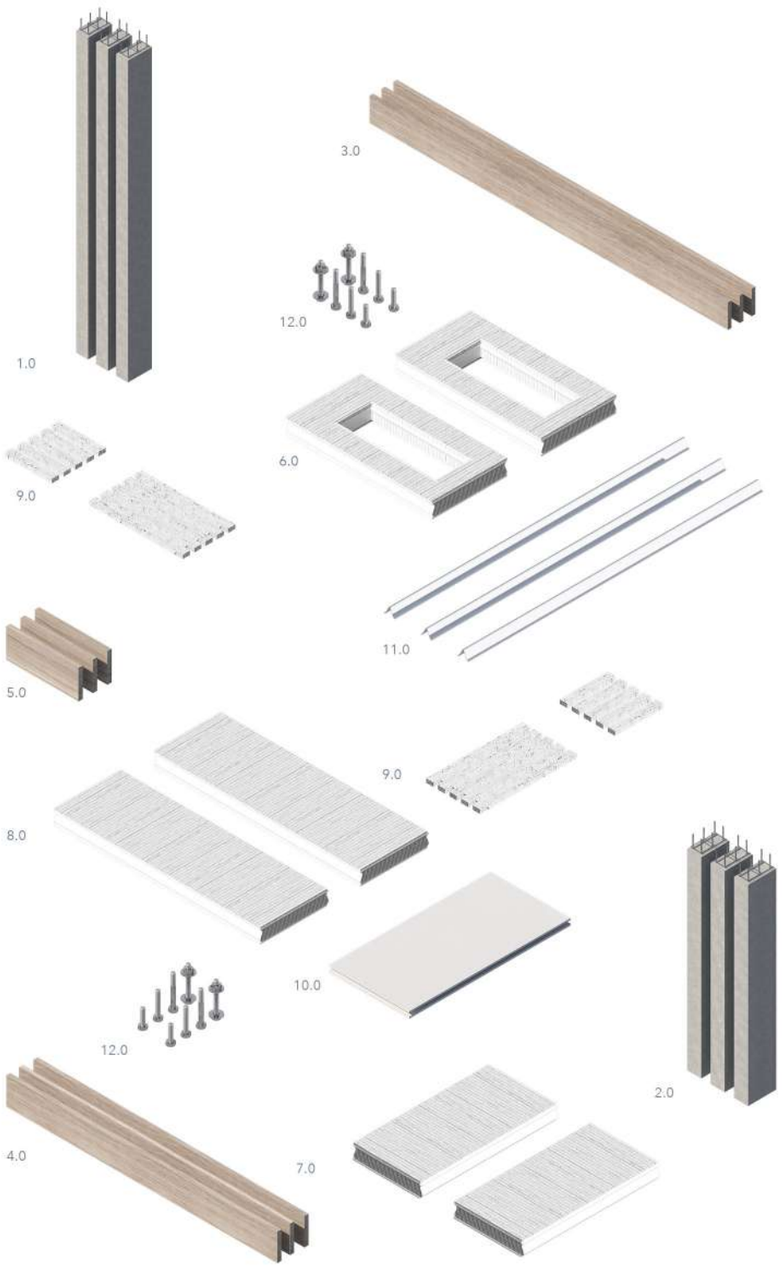


FIG.119: EATERY

0.5.8 DESIGN FOR DISASSEMBLY

DESIGN FOR DEMONTERING /de'sain/ / 'demon'te:rin/ (Diet, n.d.)

RESEARCH AND VISITOR CENTRE IS CIRCULAR



1.0 CONCRETE COLUMN 6.7 M
2.0 CONCRETE COLUMN 4.0 M
3.0 GLUE-LAMINATED BEAM 15.0 M
4.0 GLUE-LAMINATED BEAM 10.0 M
5.0 GLUE-LAMINATED BEAM 2.5 M
6.0 WALL UNIT WITH WINDOW 4.0 M
7.0 WALL UNIT 4.0 M
8.0 WALL UNIT 6.7 M
9.0 LIME STONE
10.0 GYPSUM
11.0 MECHANICAL STEEL JOINT
12.0 BOLTS AND NUTS

FIG.120: UNITS FOR DISASSEMBLY

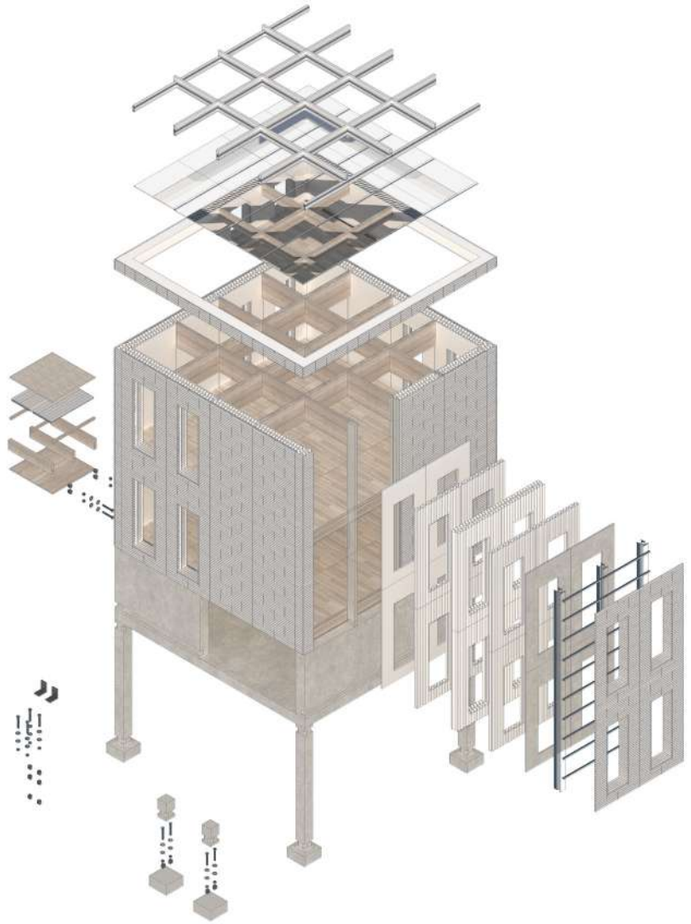


FIG.121: DISASSEMBLY PRINCIPLE

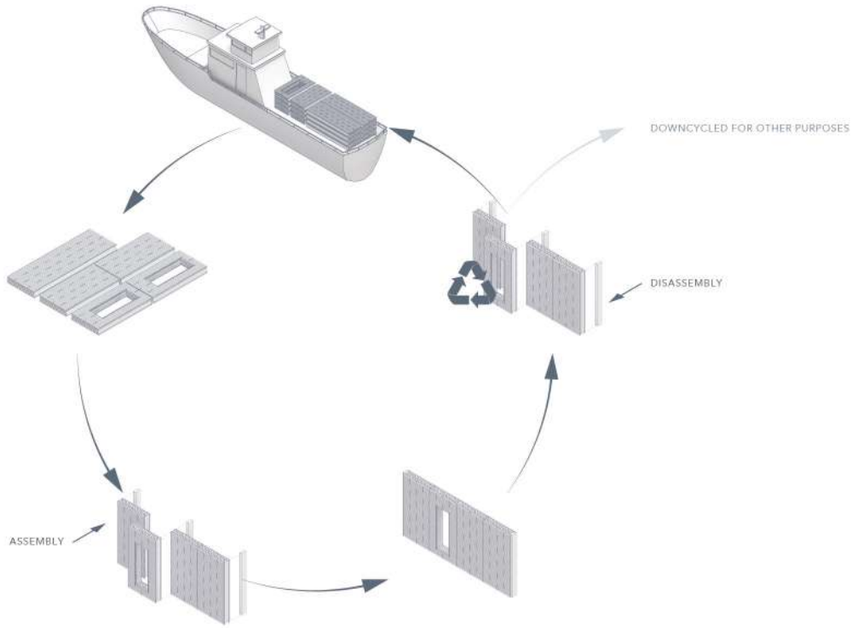


FIG.122:LCA OF WALL UNIT

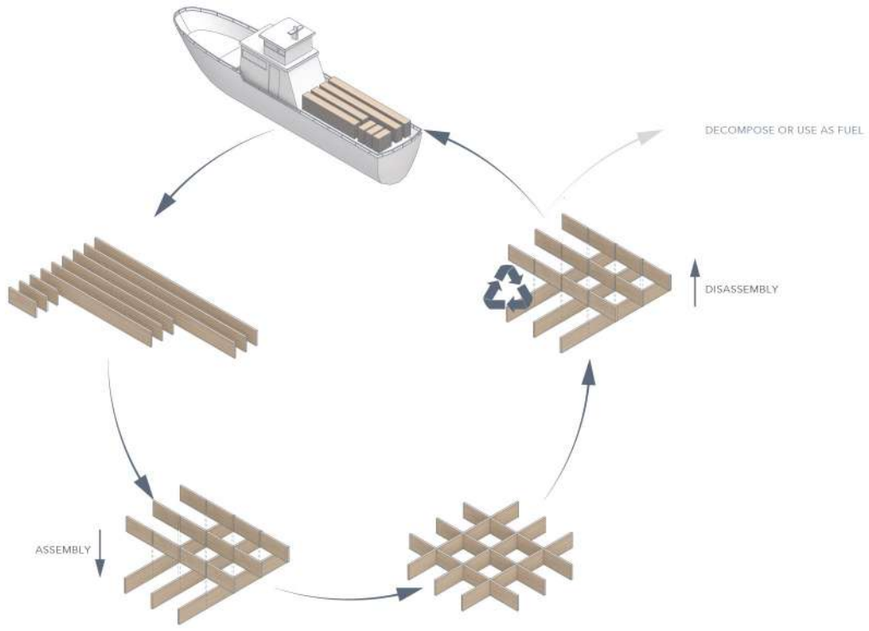


FIG.123:LCA OF BEAM GRID

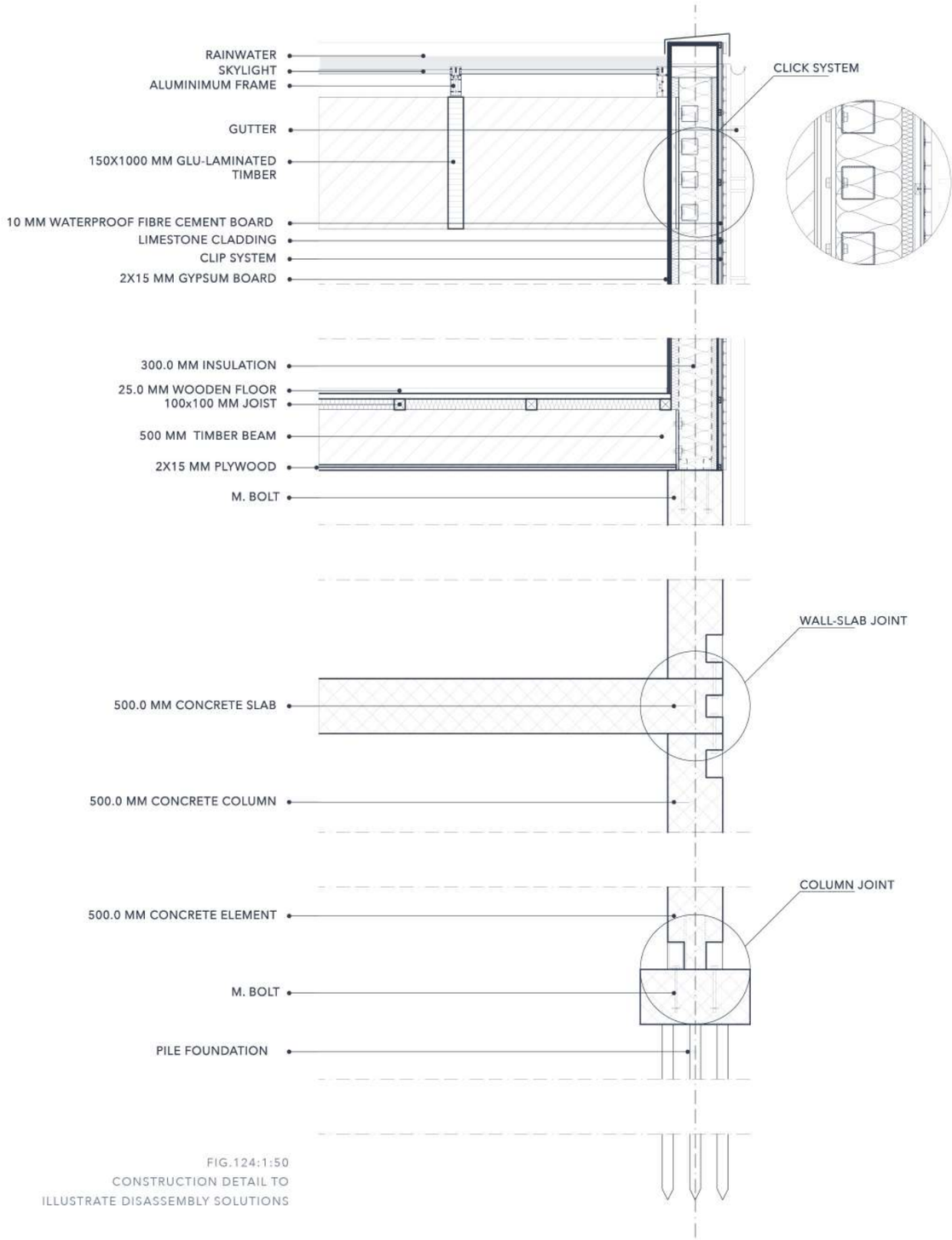
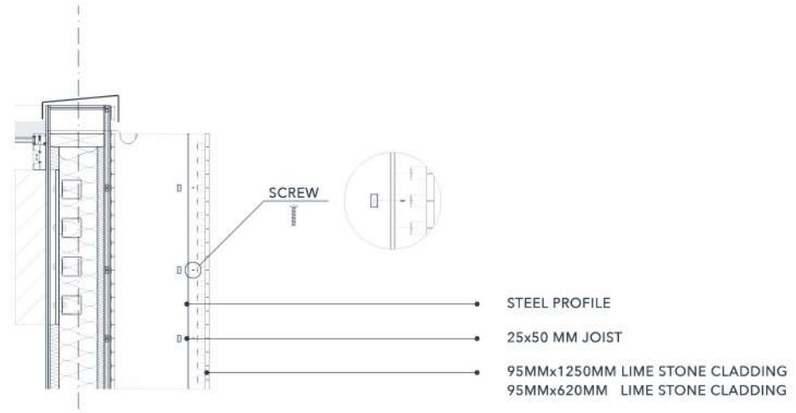
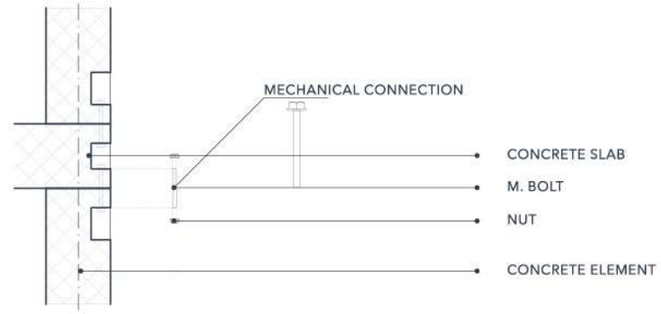


FIG.124:1:50
CONSTRUCTION DETAIL TO
ILLUSTRATE DISASSEMBLY SOLUTIONS

CLICK SYSTEM



WALL-SLAB JOINT



COLUMN JOINT

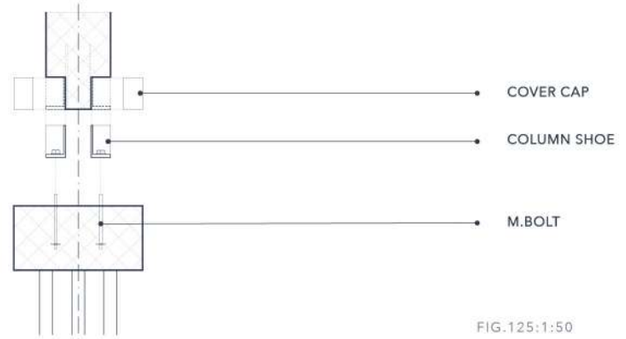


FIG.125:1:50
CONSTRUCTION DETAIL TO
ILLUSTRATE DISASSEMBLY SOLUTIONS

0.6.0 DESIGN DEVELOPMENT

ANALYSE \ɑnɑˈlʏːse\ (Dict, n.d)

CHAPTER CONTENT

The Design Development consists of underlying inquiries and studies. Our studies are carried out accordingly to the method Conjecture/Analyse and are presented in such a manner that our readers can understand the process from the initial Conjecture to the final design decision. The objective is to project our process towards the final design and enhance the parameters that influence our design. The presented studies in this chapter are selected. Preliminary studies from the early process can be assessed through the following QR-code.

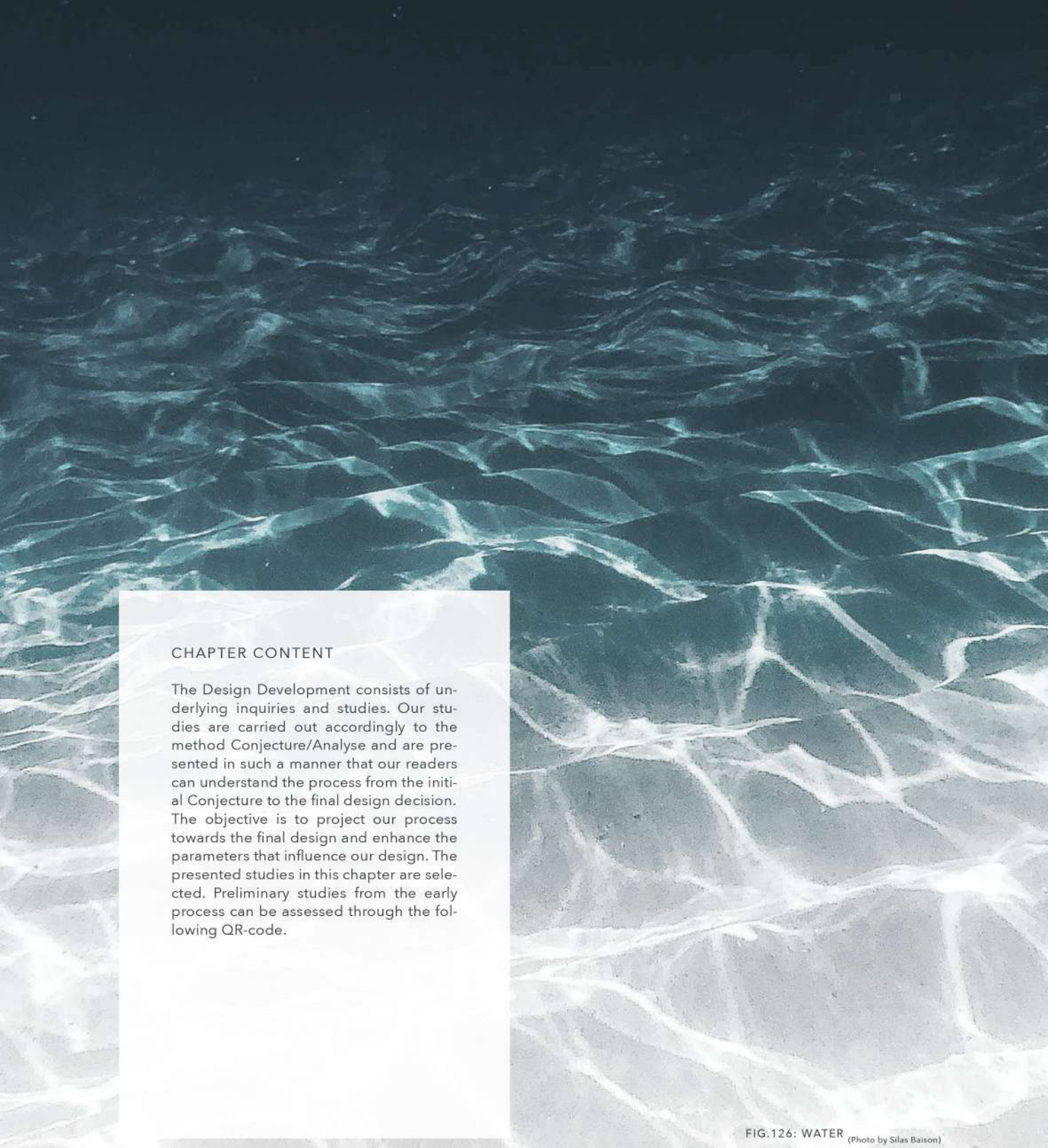
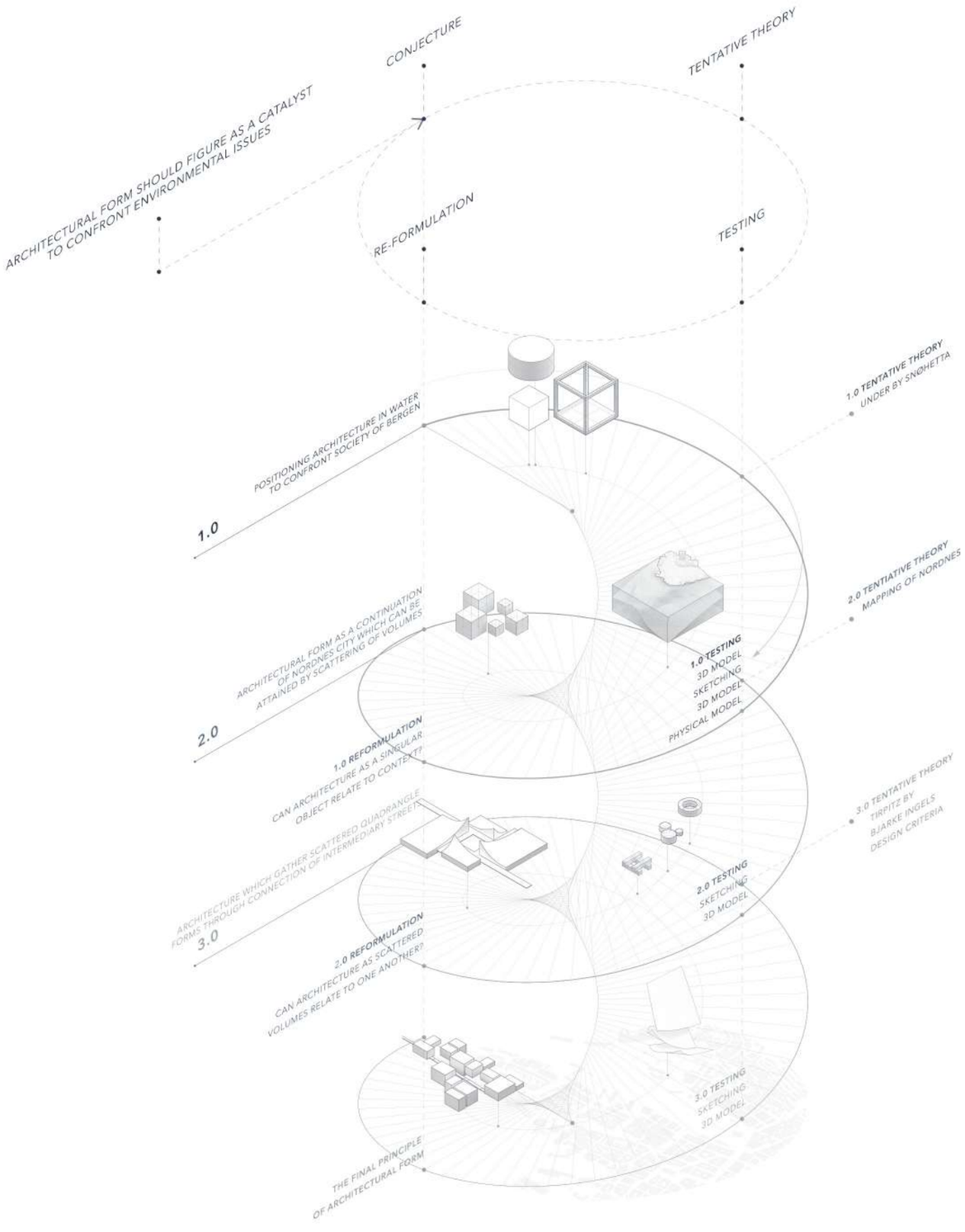


FIG.126: WATER (Photo by Silas Baison)



STUDY OF FORM 0.6.1

ARKITEKTONISK FORM /ɑrkitek'tu:nisk//'form/ (Dict, n.d.)

WHAT GENERATES OUR ARCHITECTURAL FORM

PRELIMINARY

The following introduces to the preliminary studies of the Design Development addressing Architectural Form and Concept based on the method Conjecture/Analysis. With the point of departure in our vision and our endavour to build on the platform of knowledge and learning in regards of man-made Climate Change, we envision our Architecture to have a mediating role to confront and enlighten the society of Bergen towards a shift of behaviour and sustainable future. In conjunction with this, it is desirable to employ the Architectural Form as a narrative of how the man-made or our culture of consumerism is entailing climatic challenges which is drowning our cities. This thinking fosters the following Generator:

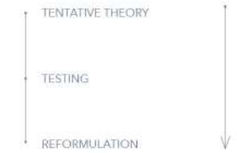
GENERATOR/GESTURE: ARCHITECTURAL FORM AS A CATALYST; A DROWNING CITY

The Architectural Form should figure as a catalyst to confront the environmental issues facing our everyday life.

In order to design an Architectural Form that confront our environmental issues, we **conjecture:**

0.1 CONJECTURE/PRINCIPLE

Positioning Architecture in the water to confront the society of Bergen.

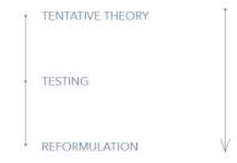


With the point of departure in simple three-dimensional forms we enable an understanding upon the characteristic outline of a concept and its interplay with context. By the preceding studies of Bergen (Ref: Analysis) and with reference to the Snøhetta-designed Underwater restaurant "Under" (Snøhetta, n.d.) as theoretical reference, it became apparant that the Architectural Form in its regularity as singular object appears foreign by the visual contrast to the circumjacent context. Accordingly, it constituted grounds for exploring Form as a continuation of Nordnes, and thus potentialy induce a favourable relation between foam and its field.

In order to design an Architectural Form, which relates to the Site and its appearance, we **conjecture:**

0.2 CONJECTURE/PRINCIPLE

Architecture as a continuation of Nordnes relates to the city which can be attained by scattering of volumes

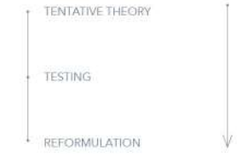


This Conjecture initiates an analysis of how the Architectural Form can be an extension of Nordnes by scattering of volumes as a conception of the pattern of a city. While the study exemplify the scattering of various of shapes it is noticeable how the pure and rational shape of the square, or the rectangle as a variation of the square, remains a highly recognisable form in conjuction with the city of Nordnes. However, the scattered volumes needs an organisation to relate its spaces to one another and hence create a logical composition in forthcoming Design Development.

In order to design an Architectural Form, which in its organisation relates to one another, we **conjecture**:

0.3 CONJECTURE/PRINCIPLE

Architecture which serves to gather and organise scattering of quadrangle forms through the connection of intermediary streets



This certain Conjecture impose an analysis of how the scattered volumes can be related to one another and appear as an unity. With a reference to our design criteria and Tirpitz by Bjarke Ingels (BIG, n.d.) the imposition of linear sequences of repetitive streets creates an organisation of volumes grouped along a main street. Hence, the Architectural Form emphasise the conception of the city creating a relationship that rely on the intermediary streets. However, since the volumes indicates the concept that gives the unity to the whole, the significance of space must be articulated by the study of spatial compositions and the structure to reveal it.

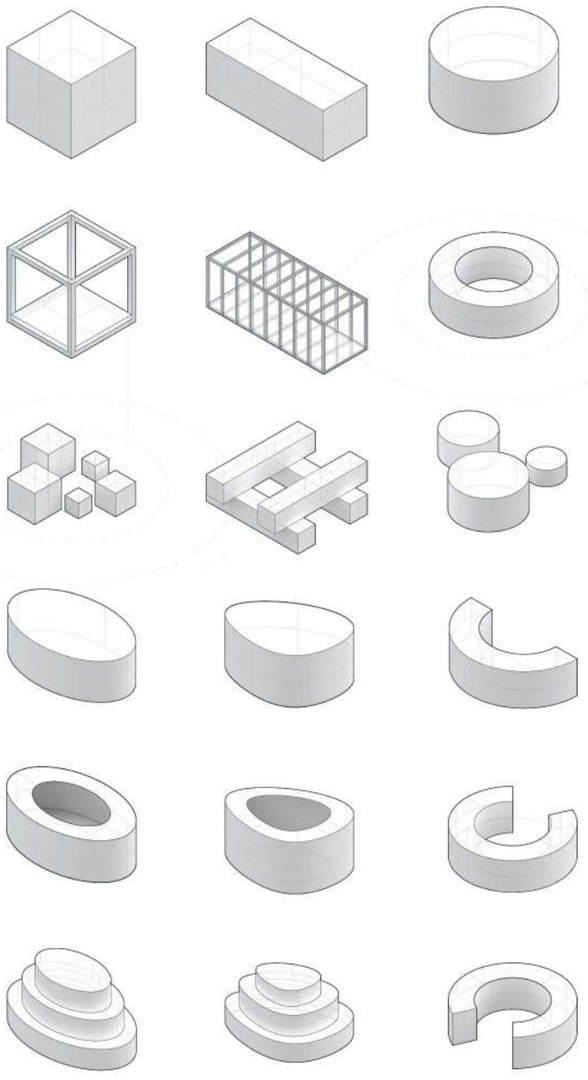
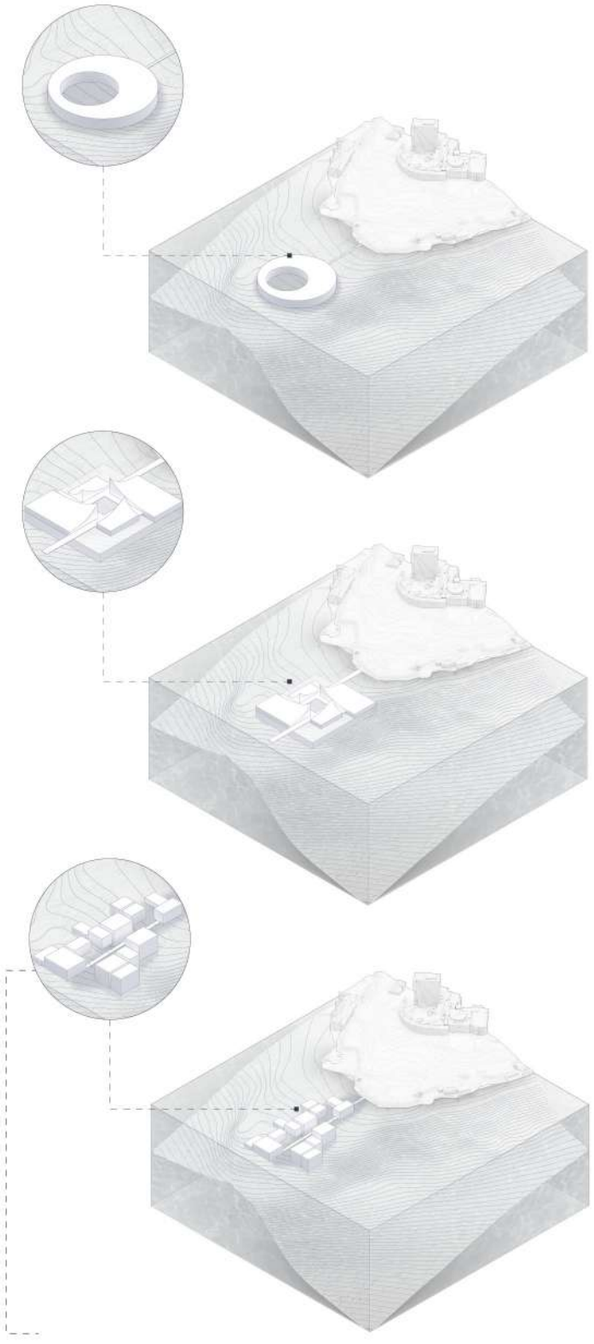


FIG.127:STUDY OF FORM



CONCEPT 1.0
THE CENTRALISED CIRCLE

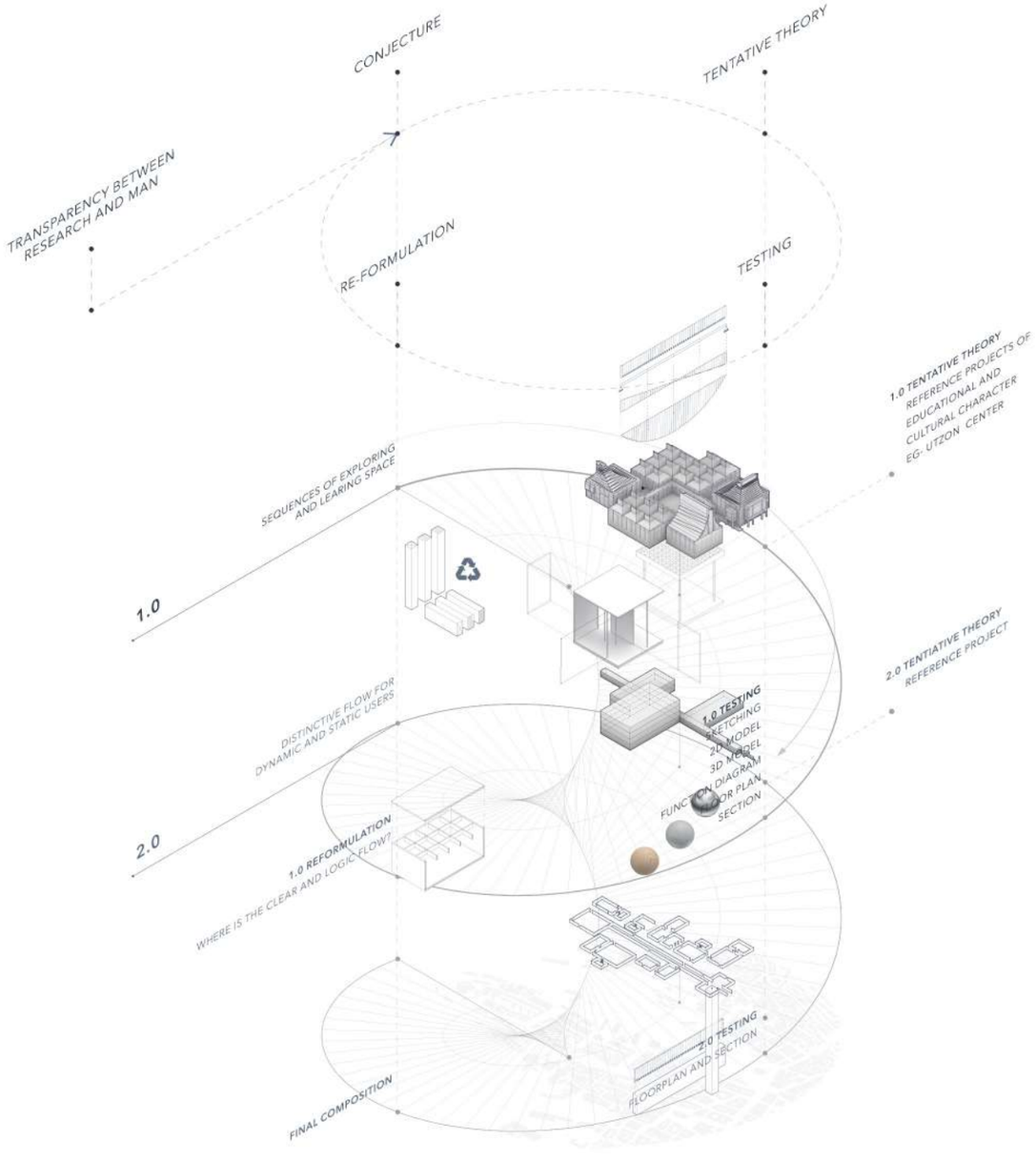
The concept aims to mediate how our consumption of Earth's resources and behaviour consequentially result in flooding of our homes. The architecture is articulated in the landscape of Water by the rising and falling tides, which induce that the conception of it depends on the specific microclimate and time of the day. Its circular shape gestures movement and is framing the element of the Water.

CONCEPT 2.0
THE MOUNTAIN

Inspired by Bergen's landscape of mountains and water, this concept shapes a distinct roof structure as an abstraction of it. The concept consists of four volumes, perceived as individual elements above the water surface, but it is conceived as en entity below water. The composition frames a courtyard that will be flooded twice a day, according to the water tides, and manifest the issue of how our landscape is drowning as a consequence of our consumerism culture.

CONCEPT 3.0
THE DROWNING CITY

The concept creates a unity with the contextual conditions, namely the element of Water, by its scattering of volumes and connection of intermediary streets, mediating a drowning city in the North Sea. The descending movement of the volumes is an extension of Nordnes' landscape which emphasise an interplay with both the city and the water according to the water tides. Hence, by the composition of Architectural Form, the society of Bergen will be confronted with our consuming culture.



COMPOSITION 0.6.2

KOMPOSISJON /kompusiˈʃuːn/ (Diet, n.d.)

WHAT GENERATES OUR CONFIGURATION OF FUNCTIONS

PRELIMINARY

This analysis takes a starting point in the foregoing study and illustrates our process of the creating of composition and organisation. With an aim of creating a house of dual functions; Research, Educational and Cultural, we position the organisation of functions as vital for the creation of joint spaces in which diverse groups, that are differentiated and disconnected today, can have the opportunity to interact and learn from one another. This thinking fosters the following Generator/Gesture:

GENERATOR/GESTURE: TRANSPARENCY BETWEEN RESEARCH AND MAN

The composition of function can create and enhance the transparency between Research and Man

In order to create and enhance the transparency, we **conjecture:**

0.1 CONJECTURE/PRINCIPLE

The architectural composition should be displined by a sequence of connected exploring and learning spaces.

TENTATIVE THEORY
TESTING
REFORMULATION

The conjecture initiates a range of secondary case studies of Architecture of respectively Research, Educational and Cultural character with the objective of obtaining an understanding of functional and logical organisation. However, in testing, we experienced issues and obstacles as an appealing composition of functions does not inherently leads to a logical flow of the building. This issue imposes a need for reconfiguration of functions in which flow is significantly considered. This induces another conjecture.

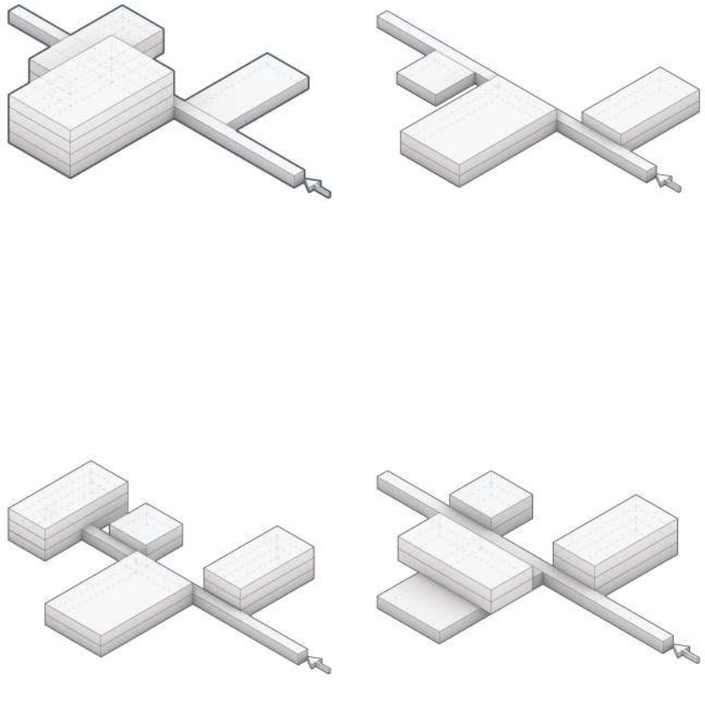
In order to create a logical flow for our users, we **conjecture:**

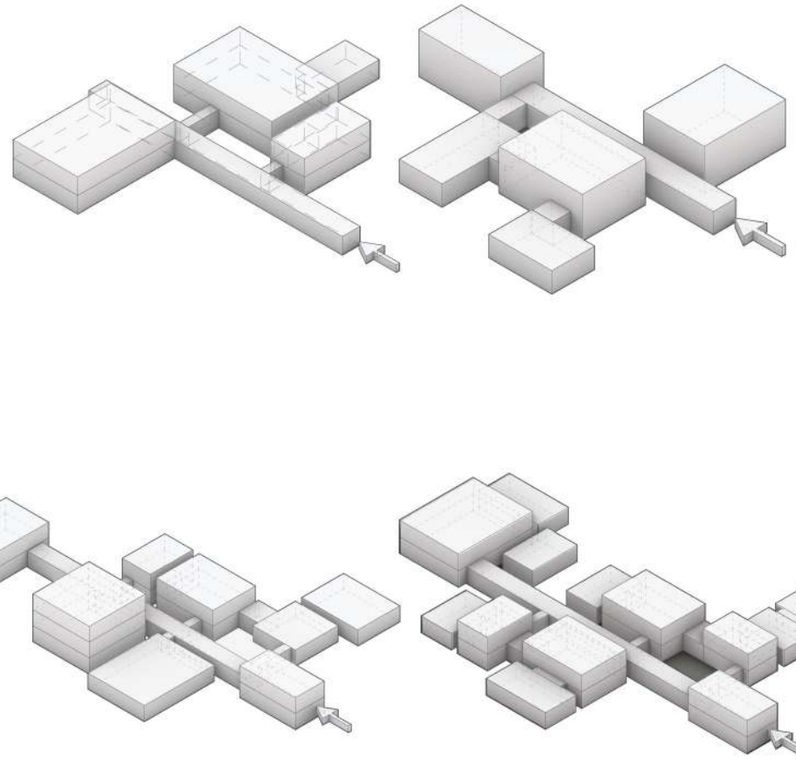
0.2 CONJECTURE/PRINCIPLE

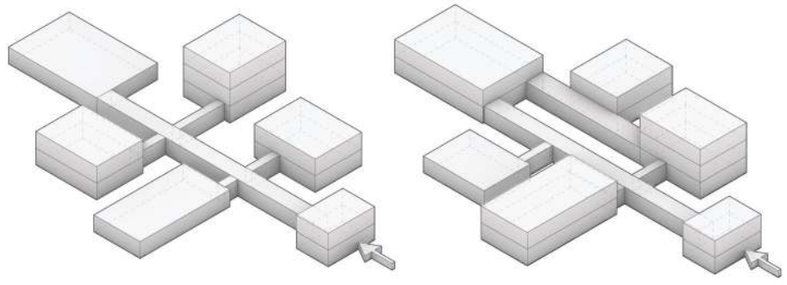
Distinctive flows for respectively the dynamic and static users gesture a higher quality of the building's usability.

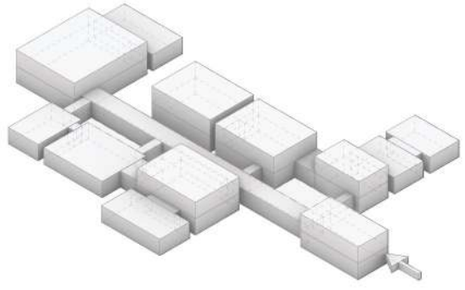
TENTATIVE THEORY
TESTING
FINAL COMPOSITION

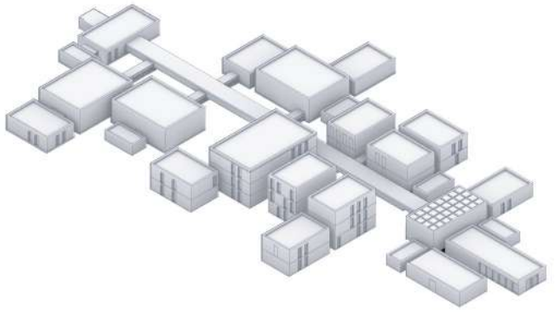
The conjecture calls for a concentrated focus upon the creating of floor-plan and initated an extensive series of floor-plan iterations. The progrss strives to achieve a plan that enable our readers an understanding of spaces in which Research and Men met.

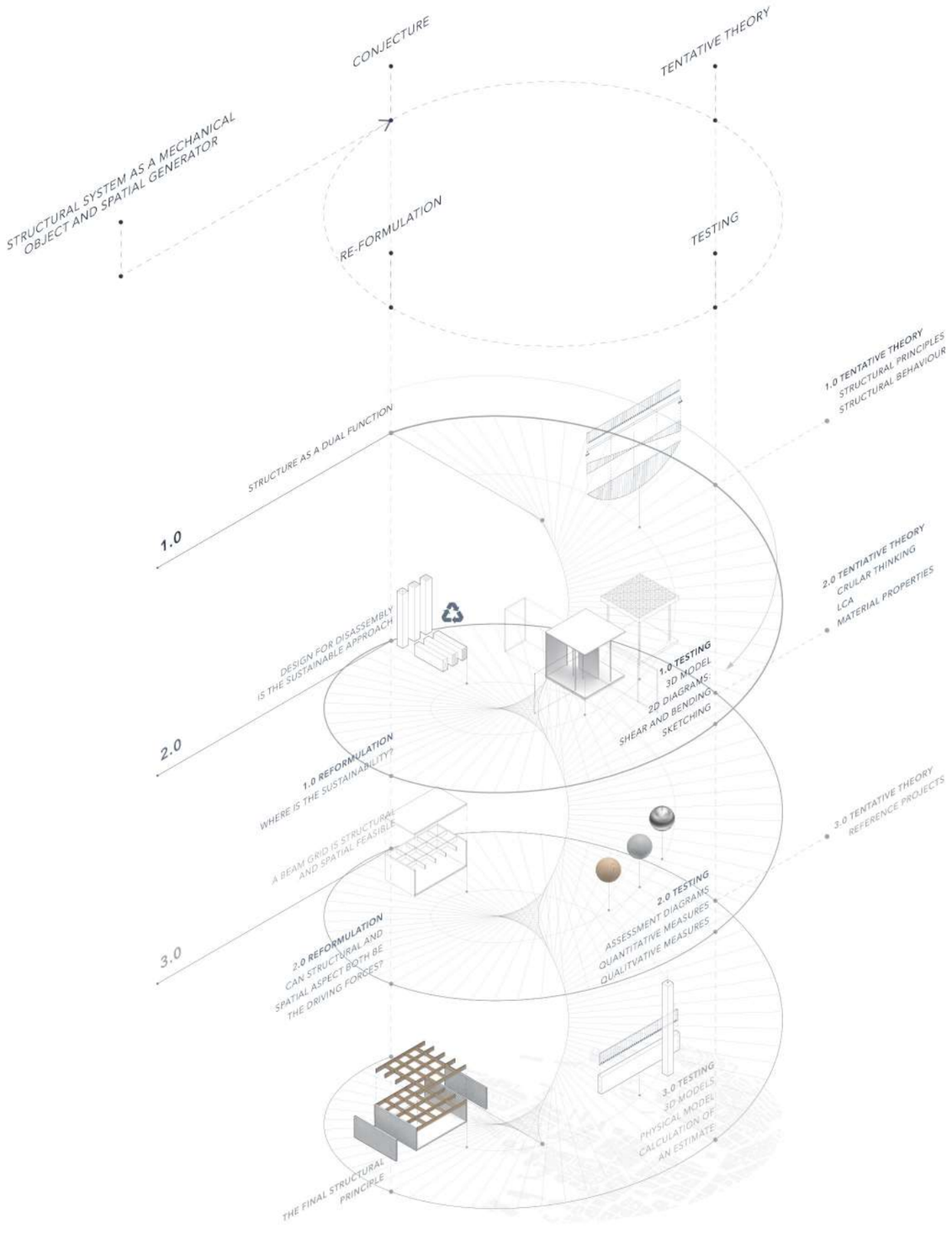












STRUCTURE 0.6.3

STRUKTURELL SYSTEM /strʊktʉ'rel//sy'ste:m/ (Diet, n.d.)

WHAT GENERATES OUR STRUCTURAL SYSTEM

PRELIMINARY

The following introduces our readers studies of the structural aspect. The framework of Tectonics, as linkage between the notion of Sensory Architecture and Sustainable Architecture, initiates a call for a structural system, which embraces humans' conception of space, visually, and thermally, through the way, the structure is articulated and through the performance of the materials, and simultaneously addressing the accelerating Circular Thinking. (Jesen et. al, 2018) This approach and aim fosters the initiating Generator for our design process of the structure.

GENERATOR/GESTURE: STRUCTURAL SYSTEM AS A MECHANICAL OBJECT AND SPATIAL GENERATOR

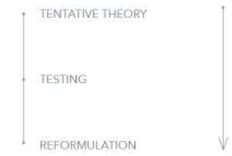
The Structure should be designed as an articulated object, which holistically addresses the actions, conditioned by the contextual environment, and plays an instrumental role for the creation of architectural space without neglecting the Circular Thinking.

In order to design a Structure that addresses the prevailing actions, while it is a generator for spatiality, we conjecture:

0.1 CONJECTURE/PRINCIPLE

The Structure can embrace a dual function; spatial and mechanical.

With an analysis of a range of structures,that have inherent capacities to address the serie of loads that the context imposes and can employ a variety of construction materials, it became apparent that the majority withhold potentials for clear articulation in space and encompas space-defining elements. However, in terms of our criteria, in which we strive to create a clear adjacency, a selection of principles are investigated in subsequent study, that also includes the role of materials. This subject induces the notion of Sustainability and induce an additional conjecture.

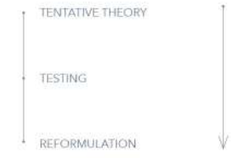


In order to design a structural system, which considers the aspect of Circularity, thus Sustainability, we conjecture:

0.2 CONJECTURE/PRINCIPLE

A modular system allows Design for Disassembly (DfD), which in fact is regarded as having the highest value in terms of Circularity

This Conjecture impose an analysis of how the principles can be translated into a modular system and initiates an analysis of construction materials. Namely Wood, Concrete and Steel in relation to Sustainability, as material, its properties and the technology, we employ in conjunction with it, are determining for the degree of Reusability. The analysis includes quantitative measures such as Carbon Dioxide CO_2 footprint, however, the overall assessment and, thus, the final material for our structure must take its articulation in space and its potential for interplay with Water into consideration.

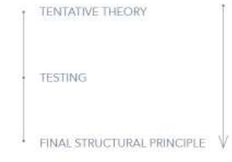


In order to design a multifaceted structural system, which has an adequate structural capacity and equivalently considers the tactile aspect, we conjecture:

0.3 CONJECTURE/PRINCIPLE

A Beam Grid structure of Wood has structural capacity and can emphasise the presence of Water, visually and and, thus, induce a characteristic ambiance in the interior space.

This Conjecture initiates a quantitative and qualitative analyses of the system of Beam Grid. Besides, calculation of estimate, we place a focus on materials, its articulation and the potential combinations of them and synthetise with the previous studies of the structural aspect. Aiming to reach a holistic structural solution without surpressing us, as perceiver and receiver, we take a final call for Beam Grid in timber.



0.6.4 STRUCTURAL PRINCIPLES

Index. Structural Principles

STRUKTURELL PRINSIPP /strʉktʉ'rel//prin'sip/ (Dict, n.d.)

A STUDY OF LOAD-BEARING AND STABILIZING SYSTEM

ITERATION 1.0
THE CATENARY

MATERIAL VERSATILITY ● ● ●

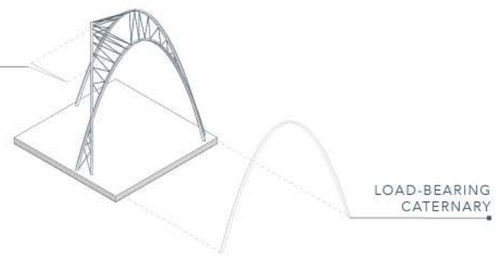
RESISTANCE FOR COMPRESSIVE FORCES ● ● ●

RESISTANCE FOR TENSILE FORCES ● ○ ○

LONG SPAN STRUCTURE ● ● ●

LOW MED. HIGH

FEASIBILITY



ITERATION 2.0
THE WALL AND COLUMN

MATERIAL VERSATILITY ● ● ●

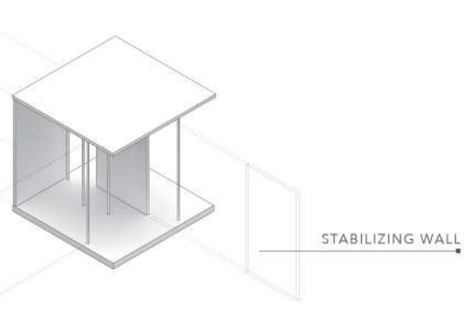
RESISTANCE FOR COMPRESSIVE FORCES ● ● ●

RESISTANCE FOR TENSILE FORCES ● ● ○

LONG SPAN STRUCTURE ● ● ○

LOW MED. HIGH

FEASIBILITY



ITERATION 3.0
THE COLUMN AND BEAM

MATERIAL VERSATILITY ● ● ●

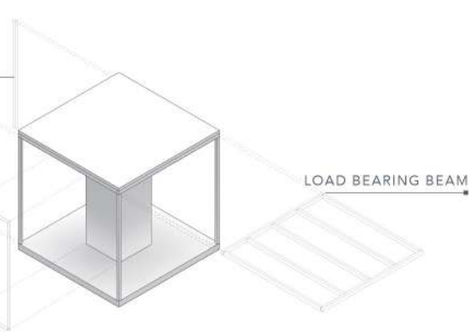
RESISTANCE FOR COMPRESSIVE FORCES ● ● ○

RESISTANCE FOR TENSILE FORCES ● ● ○

LONG SPAN STRUCTURE ● ● ○

LOW MED. HIGH

FEASIBILITY



ITERATION 4.0
THE FRAME

MATERIAL VERSATILITY ● ● ○

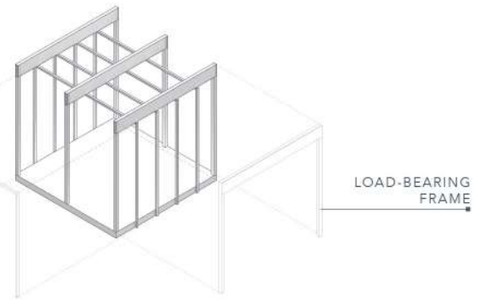
RESISTANCE FOR COMPRESSIVE FORCES ● ● ○

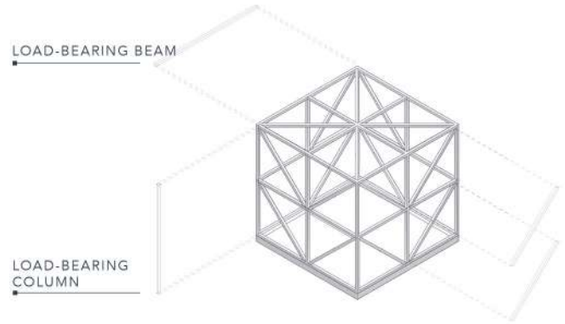
RESISTANCE FOR TENSILE FORCES ● ● ○

LONG SPAN STRUCTURE ● ● ○

LOW MED. HIGH

FEASIBILITY





ITERATION 5.0
THE TRUSS

MATERIAL VERSATILITY ● ● ○

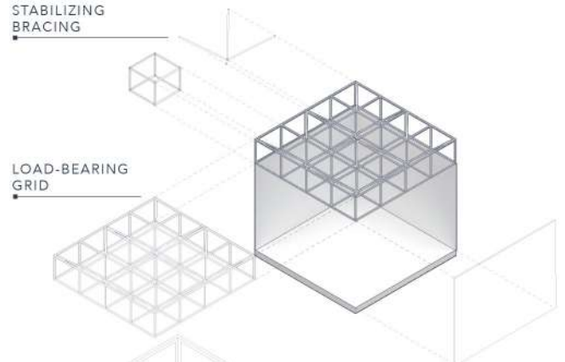
RESISTANCE FOR COMPRESSIVE FORCES ● ● ●

RESISTANCE FOR TENSILE FORCES ● ● ●

LONG SPAN STRUCTURE ● ● ○

LOW MED. HIGH

FEASIBILITY



ITERATION 6.0
THE SPACE TRUSS

MATERIAL VERSATILITY ● ● ○

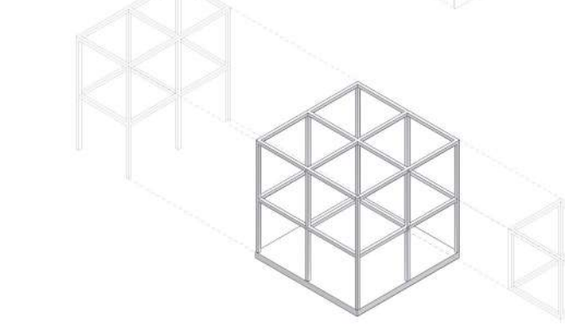
RESISTANCE FOR COMPRESSIVE FORCES ● ● ○

RESISTANCE FOR TENSILE FORCES ● ● ○

LONG SPAN STRUCTURE ● ● ○

LOW MED. HIGH

FEASIBILITY



ITERATION 7.0
THE GRID

MATERIAL VERSATILITY ● ● ○

RESISTANCE FOR COMPRESSIVE FORCES ● ● ●

RESISTANCE FOR TENSILE FORCES ● ● ●

LONG SPAN STRUCTURE ● ● ●

LOW MED. HIGH

FEASIBILITY

ITERATION 8.0
THE TWO-WAY BEAM GRID

MATERIAL VERSATILITY ● ● ○

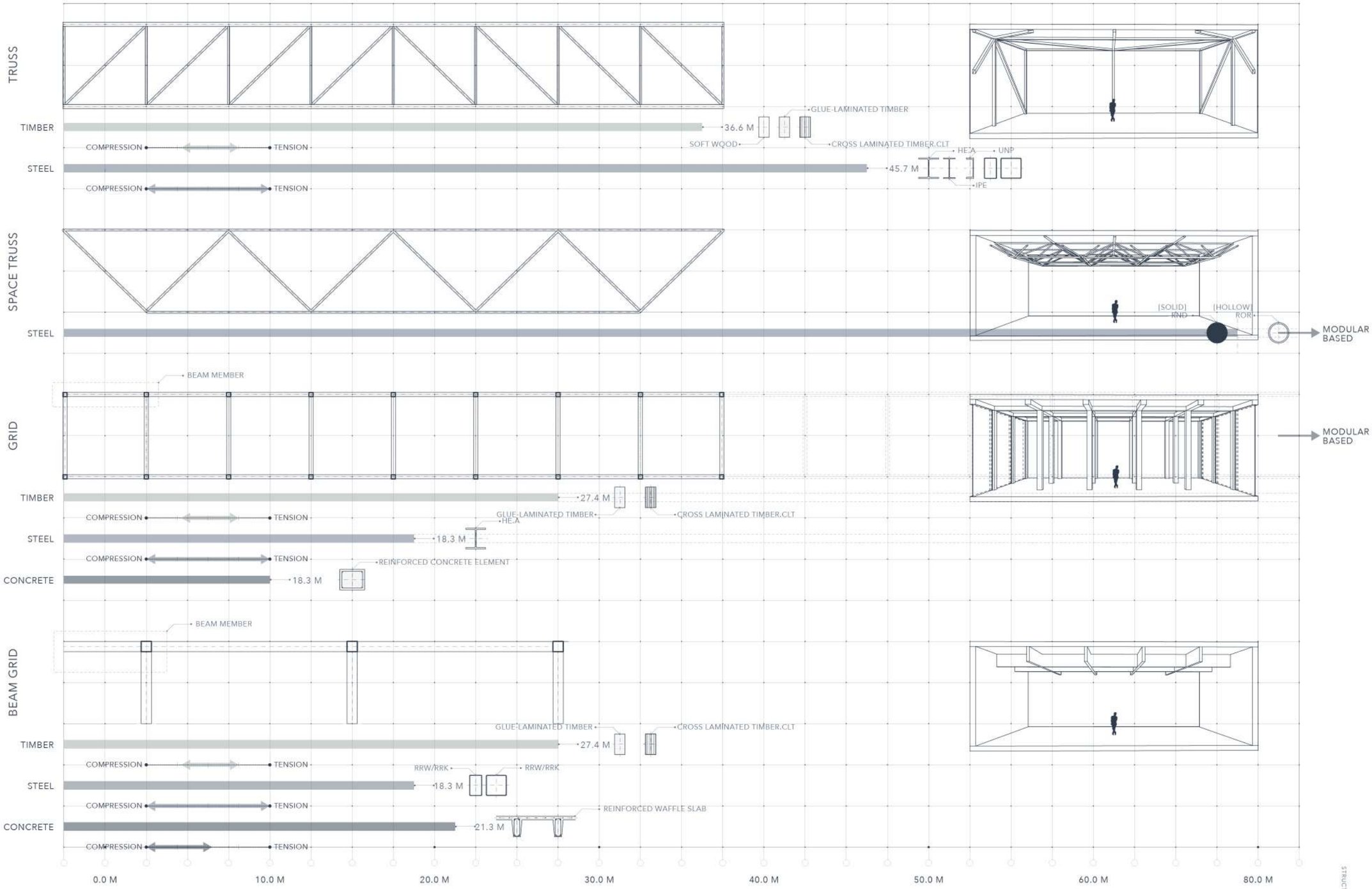
RESISTANCE FOR COMPRESSIVE FORCES ● ● ●

RESISTANCE FOR TENSILE FORCES ● ● ●

LONG SPAN STRUCTURE ● ● ●

LOW MED. HIGH

FEASIBILITY



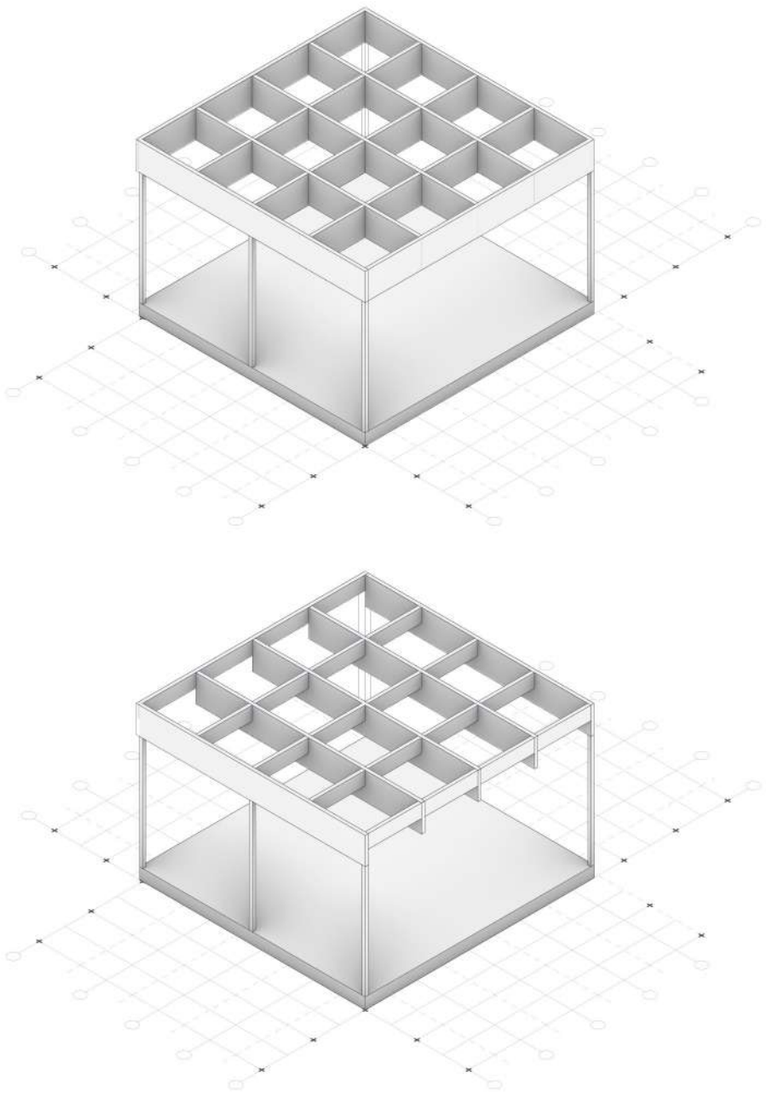
The aforementioned studies gave cause for investigating the principles in regards to materials and its entailment in a Sustainable prospect. Thus, the certain study places an emphasis upon the Structures and their capacity within the construction materials Wood, Concrete and Steel. By the certain study we see a potential in the Two Way Beam Grid and its advantages for being effective for medium spans and heavy lateral loads. Furthermore, it reveals a clear experience of space sequences by the minimum of structure in place. This further support the aspect of Circular Thinking with less constraints within a space creating an increased flexibility, that comply with the possibility of reusing the building or modular structural system for other purposes. Finally, we contemplate a vast potential of the Structure in interplay with the presence of Water, which we aim explore for the prospective studies.

FIG.128: STUDY OF STRUCTURAL SPAN AND MATERIAL CAPACITY

0.6.5 STRUCTURAL ANALYSIS

STRUKTURELL ANALYSE/strʉktʉ'rel//ɑnɑ'lʏːse/(Dict, n.d.)

A STUDY OF THE TWO-WAY BEAM GRID



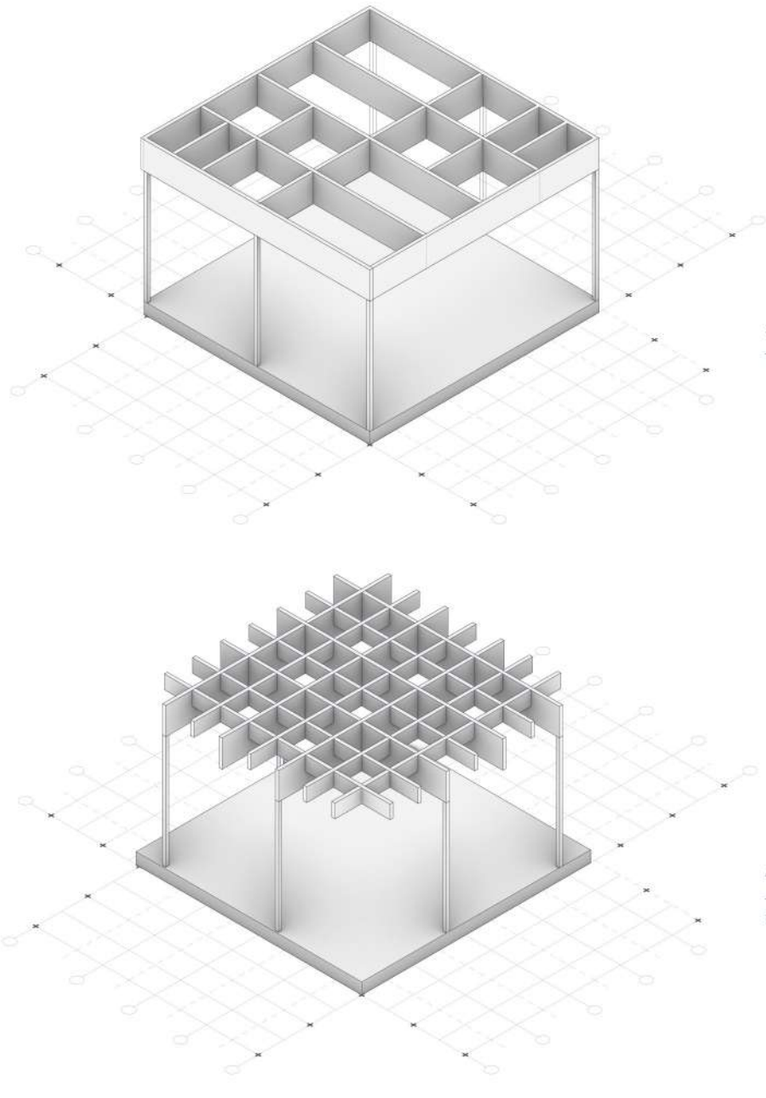
1.0

THE REGULAR TWO-WAY BEAM GRID

2.0

THE REGULAR TWO-WAY BEAM GRID WITH DIFFERENT CROSS-SECTION

FIG.129:ITERATIONS OF THE TWO-WAY BEAM GRID



3.0

THE IRREGULAR TWO-WAY BEAM GRID

4.0

THE REGULAR TWO-WAY BEAM GRID WITH DIFFERENT CROSS-SECTION

0.6.6 MATERIAL

MATERIAL/materi'a:le/(Dict, n.d.)

A STUDY OF MATERIALS' IMPACT ON OUR ENVIRONMENT

IMPACT AND POTENTIAL

This analysis places a focus upon the construction materials Soft Wood, Glue-laminated Wood, Concrete and Steel, with the aim to determine its Global Warming Potential, End of life Potential and the lifespan and vulnerability for Water of each generic material. The materials impact on environment is crucial to address in order to synthesize a sustainable approach and initiative to the structural aspects. Hence, we aim to enhance our understanding upon the environmental impact of our design decisions in regards of structural purposes by considering the materials on an equal footing and eventually assist the choice of structural system.

GLOBAL WARMING POTENTIAL (GWP)

In the context of Material or Product Lifecycles, Global Warming Potential describes the global warming impact from various of gases in a specific period, which we have utilised to examine the material solely. Specifically, it measures the emission in relative to Carbon dioxide, CO_2. A higher value is equivalent to a bigger impact, while a negative value indicated a positive potential. (Environmental Protection Agency, 2017)

END OF LIFE POTENTIAL (EOL)

End of Life Potential is, in the context of Material or Product Lifecycles, describing the final stages of existence. The notion concerns disposing of material or the possibility of reusability and the involving CO_2 impact.

(Mengarelli et.al., 2016)

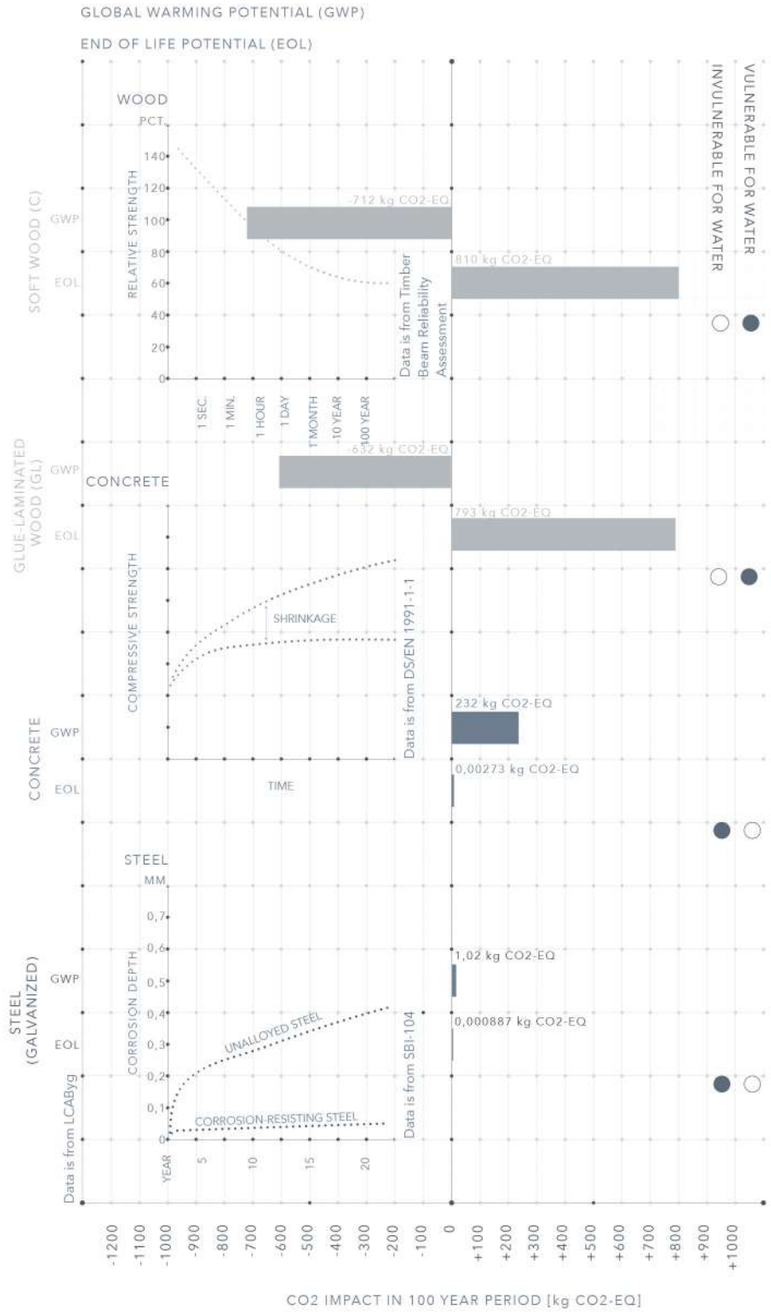
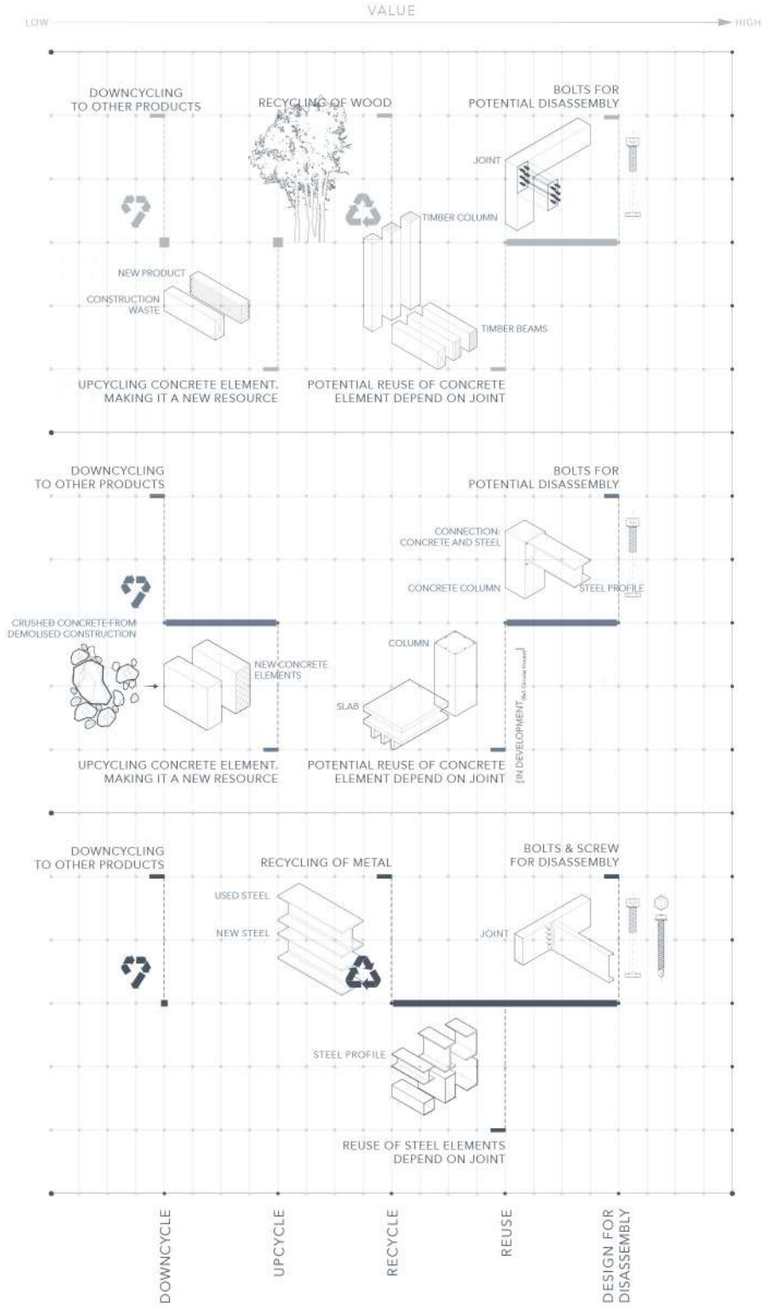


FIG.130: ASSESSMENT OF MATERIALS POTENTIAL AND IMPACT



REUSABILITY

This analysis places an exclusively focus on Reusability in regard to the structural aspect. Thus, the generic materials Wood, Concrete and Steel are assessed solely on the basis of their respective potentials for Disassembly, Reuse, Recycle, Upcycle and Downcycle in relation to structural purposes for the future, even though, we are aware that the mentioned materials hold a range of additional potentials for upcycling products for other purposes. The objective of the analysis is to obtain an understanding of the materials' advantages and disadvantages in the framework of Circular Thinking and providing information for the overall assessment of the material and, hence, the eventual choice of structural system.

Design For Disassembly (DfD)

The approach of DfD is a cornerstone of the Circular Thinking, as it feeds* components into closed cycle, in which the material can be re-sued, reassembled and recycled to new components or products of equivalent, higher or lower quality.(Lendager, 2018)

Reuse

Use the material or component again, directly or without changing it. The origin value remains the same.(Lendager, 2018)

Recycling

Recover material while keeping its origin purpose or value. For instance, recycling of steel members from demolished project into new elements.(Ibid)

Upcycling

Recover or reuse a waste material by making it into a new resource. For instance, waste concrete crushed into and shaped into new concrete elements.(Ibid)

Downcycle

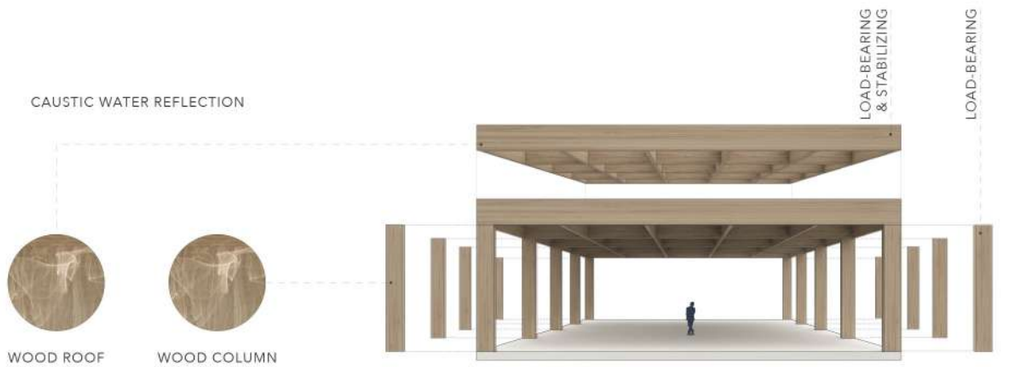
To recover or reuse a waste material by making it into a new resource, however, with a lower value than original.(Ibid)

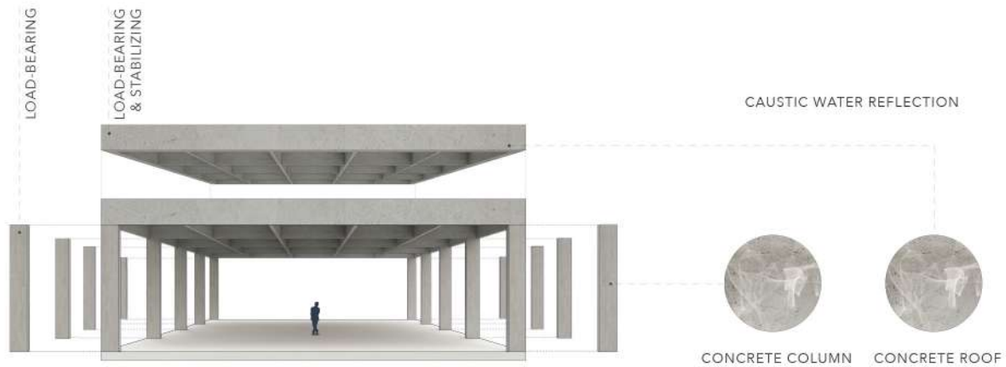
FIG.131: ASSESSMENT OF MATERIALS' POTENTIALS FOR REUSABILITY

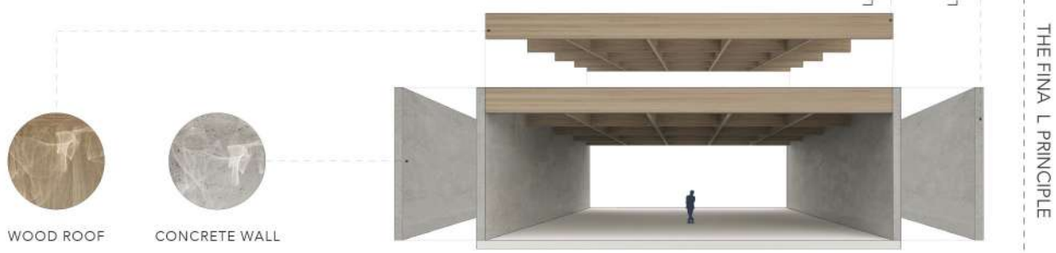
0.6.7 THE TWO-WAY BEAM GRID

TO SIDE BJELKE GITTER /'tu://'si:de// bjelke// 'gitər/ (Dict, n.d.)

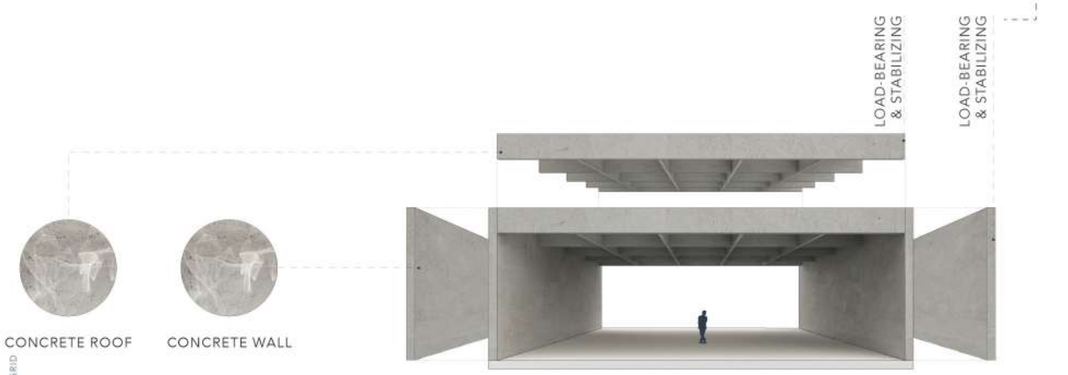
A STUDY OF THE TWO-WAY BEAM GRID AND MATERIALS

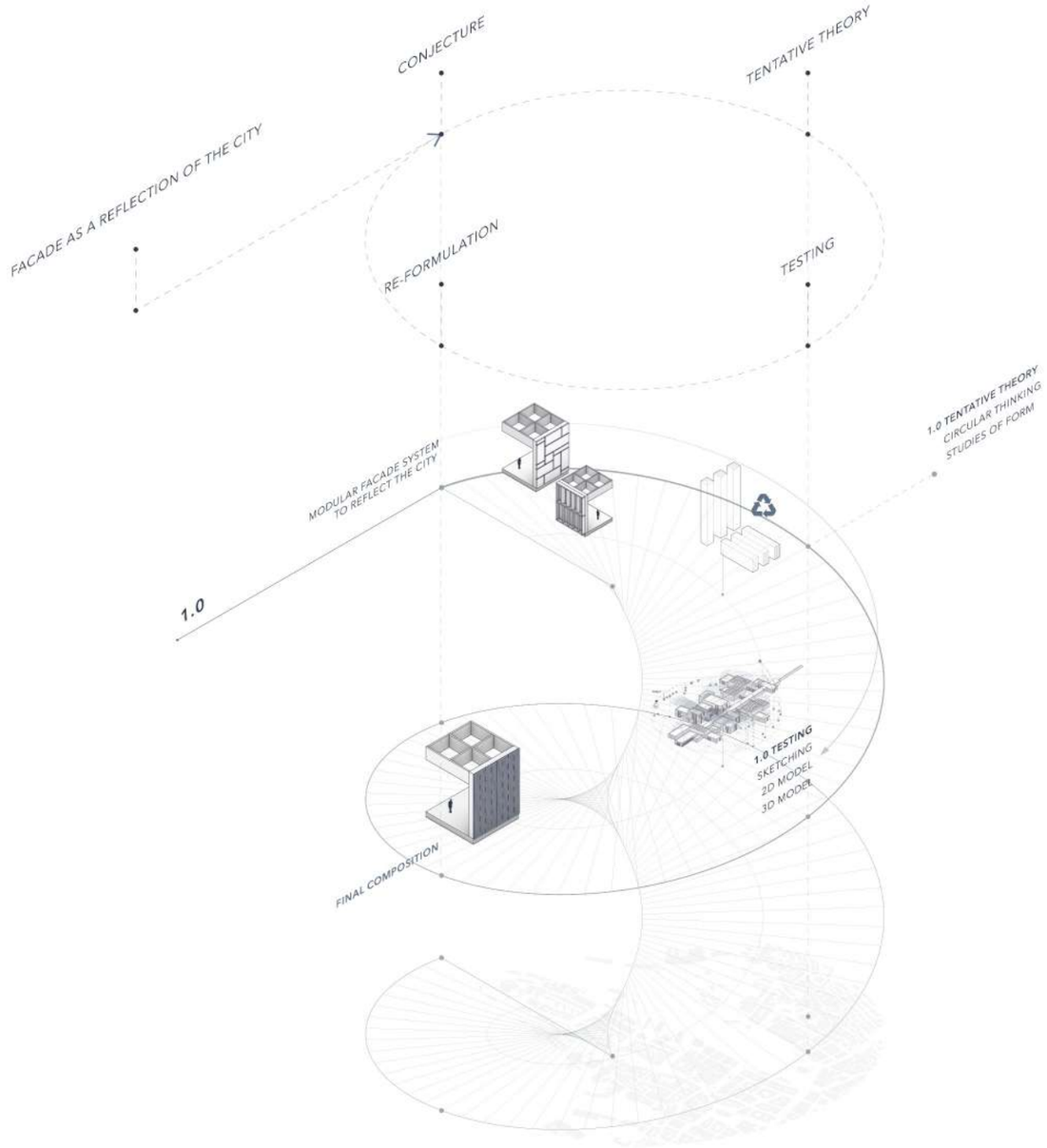






THE FINAL PRINCIPLE





FACADE 0.6.8

FASADE /fa'sa:de/ (Diet, n.d.)

WHAT GENERATES OUR FACADE

The following introduces to studies of the architectural facade which is of great significance giving the first visual impression of the building. In the framework of the previously accentuated studies, the testing of the facade system takes a starting point in addressing a Sustainable approach without neglecting its relation to the context at hand. Hence, the studies aim to emphasise the visual pattern of the Nordnes to further support the narrative of the drowning city, as covered earlier. This approach aims to foster the following Generator of the forthcoming studies:

PRELIMINARY

The Architectural Facade should be designed as an articulated object, as a reflection of the city of Nordnes and simultaneously address the notion of Circular Thinking.

GENERATOR/GESTURE:
ARCHITECTURAL FACADE AS A REFLECTION OF THE CITY

To design an Architectural Facade that reflects the city of Nordnes without neglecting the Circular Thinking, we conjecture:

The Architectural Facade forms a modular system, that mirrors the pattern of the city.

0.1 CONJECTURE/PRINCIPLE

With the analysis of a variation of Facade iterations and their respective attitude towards sustainable means, it became apparent how the majority of the iterations has potential for addressing the notion of Circular Thinking and modularity by the repetitive design solutions. However, in terms of addressing the city of Nordnes and the perceptible facade patterns of horizontal cladding typology and vertical window glazing, gave potential to further studies of the modular panel system. Following a subsequent study was made to include the exploration of patterns by the system of scale, dimension, composition and modular thinking. Hence, aiming to reach a solution within the aspect of modularity we take a final call for the panels of a simple, standardised cladding system of which both consider the notion of Circular Thinking and mirrors the pattern of the city.

- TENTATIVE THEORY
- TESTING
- REFORMULATION

0.6.9 FACADE PRINCIPLES

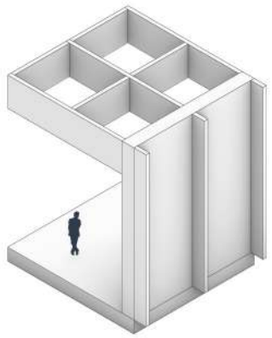
FASADE PRINSIPP /fə'sɑːde//prin'sip/ (Dict, n.d.)

A STUDY OF FACADES AND MODULARITY

ITERATION 1.0
VERTICAL LARGE SPACED ELEMENTS

CONTINUATION OF NORDNES ● ○ ○
DESIGN FOR DISASSEMBLY ● ○ ○
OPTIMIZING THERMAL ENVIRONMENT ● ● ○

LOW MED. HIGH

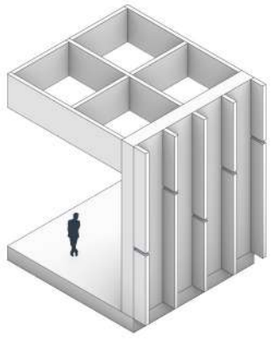


WOOD CONCRETE STEEL

ITERATION 2.0
VERTICAL SPLITTED ELEMENTS

CONTINUATION OF NORDNES ● ○ ○
DESIGN FOR DISASSEMBLY ○ ○ ○
OPTIMIZING THERMAL ENVIRONMENT ● ● ○

LOW MED. HIGH

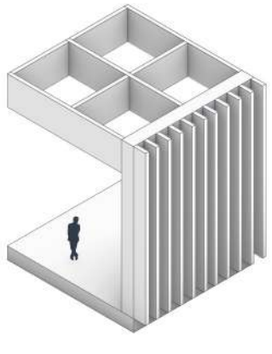


WOOD CONCRETE STEEL

ITERATION 3.0
VERTICAL ELEMENTS

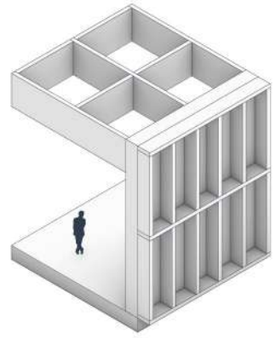
CONTINUATION OF NORDNES ● ○ ○
DESIGN FOR DISASSEMBLY ● ○ ○
OPTIMIZING THERMAL ENVIRONMENT ● ● ●

LOW MED. HIGH



WOOD CONCRETE STEEL

FIG.132: A STUDY OF FACADES

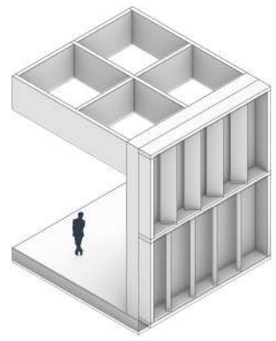


WOOD CONCRETE STEEL

ITERATION 4.0
FRAMES

CONTINUATION OF NORDNES ○ ○ ○
DESIGN FOR DISASSEMBLY ● ● ○
OPTIMIZING THERMAL ENVIRONMENT ● ● ○

LOW MED. HIGH

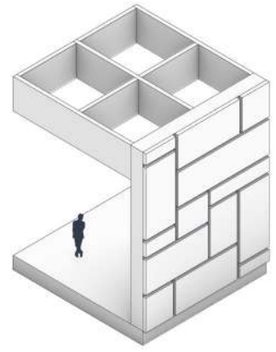


WOOD CONCRETE STEEL

ITERATION 5.0
ANGLED FRAMES

CONTINUATION OF NORDNES ○ ○ ○
DESIGN FOR DISASSEMBLY ● ○ ○
OPTIMIZING THERMAL ENVIRONMENT ● ● ●

LOW MED. HIGH

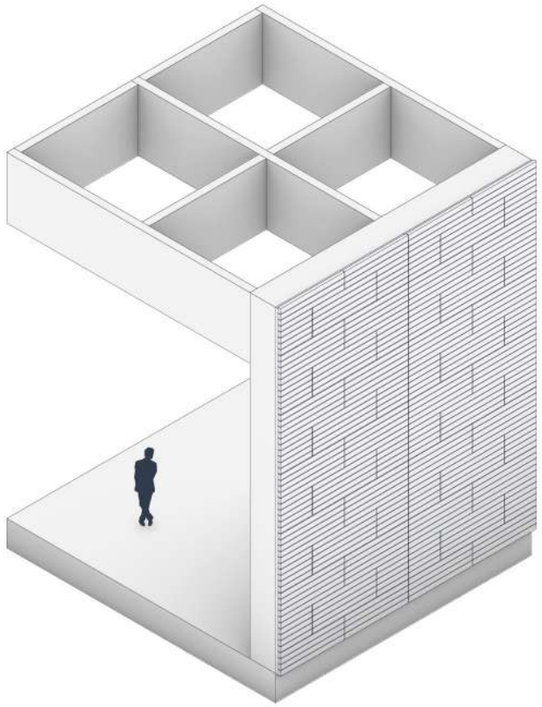


WOOD CONCRETE STONE

ITERATIO 6.0
THE PANEL SYSTEM

CONTINUATION OF NORDNES ● ● ●
DESIGN FOR DISASSEMBLY ● ● ●
OPTIMZING THERMAL ENVIRONMENT ● ● ○

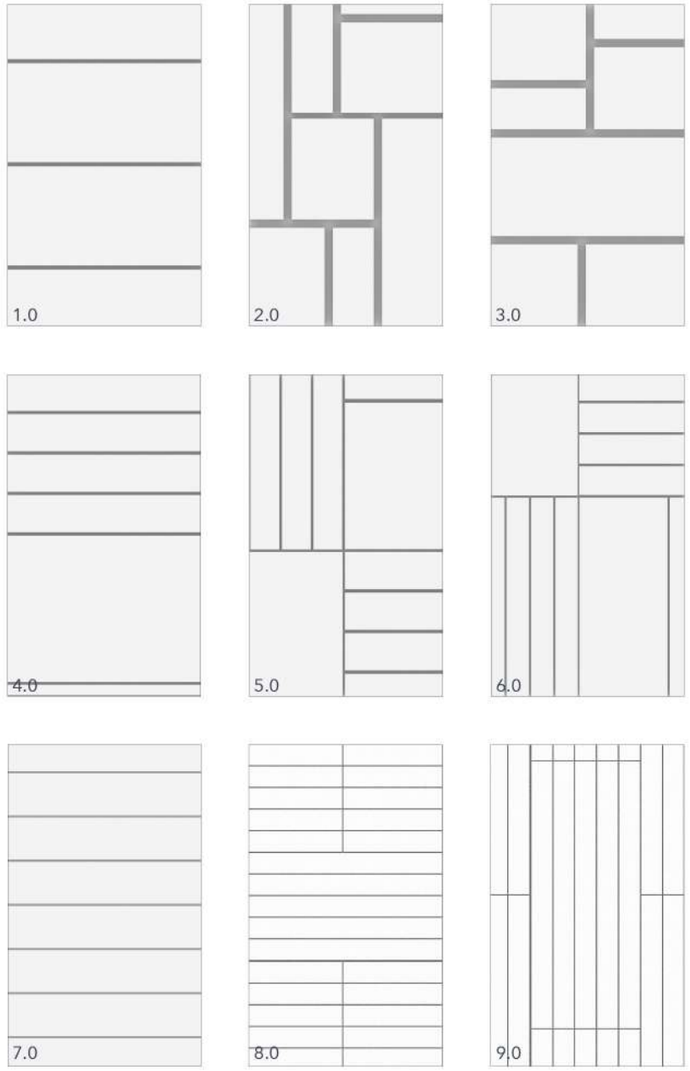
LOW MED. HIGH



FACADE PATTERNS

The study of the facade gives the possibility to examine varies of patterns and the architectural expression of it in relation to the concept of modularity. The studies illustrate the principle of a cladding system explored by different element dimensions, space gap and composition. The linear displaced elements create a simple way to address a simple system with standard element sizes, which we see great potential in the notion of Disassembly and modularity.

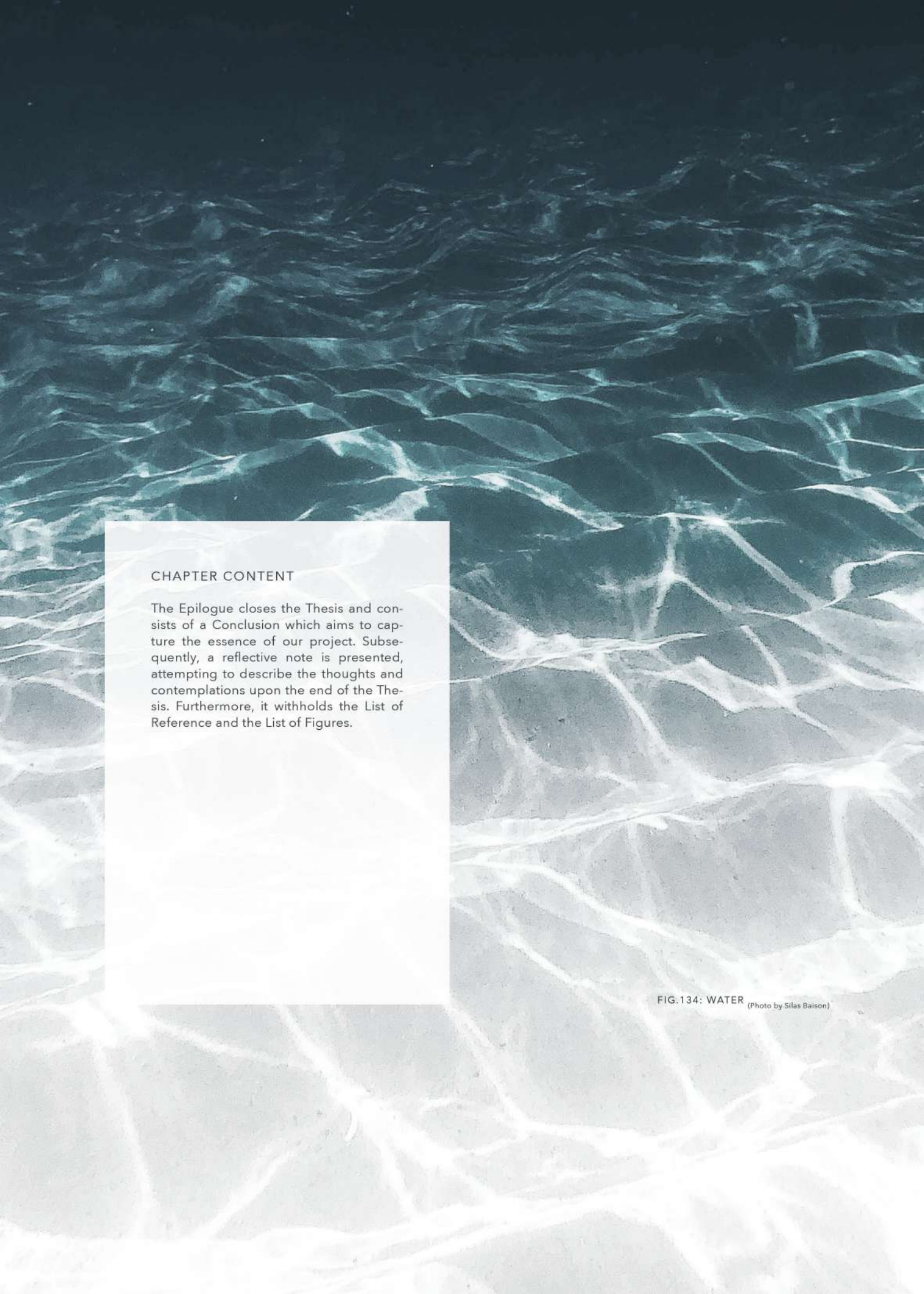
FIG.133:STUDY OF FACADE PATTERNS



0.4.0 LIST OF CONTENT
0.4.1 MICROCLIMATE. ENVIRONMENTAL CONDITION
0.4.2 MACROCLIMATE. ENVIRONMENTAL CONDITION

0.7.0 EPILOGUE

KONSEPT \kun'sept\ (Dict, n.d)



CHAPTER CONTENT

The Epilogue closes the Thesis and consists of a Conclusion which aims to capture the essence of our project. Subsequently, a reflective note is presented, attempting to describe the thoughts and contemplations upon the end of the Thesis. Furthermore, it withholds the List of Reference and the List of Figures.

FIG.134: WATER (Photo by Silas Baison)

CONCLUSION

konklusjon / kɒŋkluˈʃuːn/ (Dict, n.d.)

A RESEARCH AND VISITOR CENTRE OF CLIMATE CHANGE

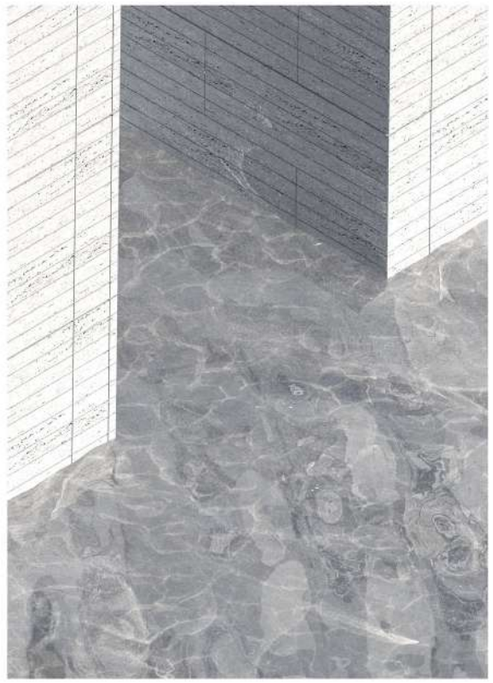


FIG.135: INTERSECTION OF SOLID AND FLUID

The Research and Visitor Centre of Climate Change manifests the design of a new Architectural typology as a catalyst that strives to confront and respond to our culture of consumerism and the environmental challenges it involves as a consequence of our behaviour. With the placement at the North Sea in Bergen, the Architecture approach the narrative of the drowning city as a consequence of our consumption and hence, convey the society with the climatic and environmental attributes which both challenges present and prospective everyday live. In the mediating role of our Architecture, the functions given to the building reflect the synergy between man and research and attempt to create a platform for focus, learning, dialogues and discussions by placing an emphasis on the research field, explorative and social spaces. Hence, through the Architecture, the society of Bergen will perceive a first-hand experience of the challenges.

ARCHITECTURE AS A CATALYST

Working within the context of Bergen in Norway and its identity as a Climate City gave the potential to work with Water as a significant element of this Thesis. However, the element has both poised its challenges and privileges architecturally, which has involved a great amount of research of the phenomena and its characteristics. By the significant emphasis on the element, the Architecture strives to push the boundaries of how we build by re-thinking Architecture towards beneficial sustainable solutions without suppressing the sensory experience of space. In that sense, it is visible how the Architecture employs Water through strategies such as water ponds for cooling the building but at the same time underpin the presence of water and sensory ability.

THE SIGNIFICANCE OF WATER

Tectonics and the structural system becomes in that sense the linkage between the Sustainable approach and Sensory Architecture, which is perceptible through the design of the Two-way Beam Grid which captures and frames the element of Water both from the sky while the columns frames the water tides from the sea. Another aspect is how the structure addresses the notion of Circular Thinking in its flexibility and adaptability. This sympathetic approach is further mirrored in the Architecture through both formal and aesthetic choices through the approach of disassembly and reusability, that gives the privilege of another purpose or further extension of the building in a prospective cohesion.

WATER AS AN AGENT OF TECTONICS

0.7.2 REFLECTION

REFLEKSJON / reflek'ʃu:n/ (Dies, n.d.)

A REFLECTION UPON OUR PROJECT, PROCESS AND EXPECTATION

AALBORG. MAY. 2020.

This reflective read takes a starting point in the approach and process of the Thesis., and moved forward to how world's pandamic situation has affected our way of working.

THE APPROACH AND PROCESS

This Thesis illustrates the significance of site visit; experiences the location and absorbs its culture, its qualities and its potentials. The interdependence relationship between the location, its condition and the concept is evident in our project; without our visit to Bergen, the ideas, the approaches, and thus the final Architecture will unfold differently. The approach of Tectonics as a linkage between Sensory and Sustainable Architecture, is experienced as intricate and complex, compared to what it appears on paper. The synthesis between the notions has been a difficult challenge in several studies, though we were aware of the Tectonic driving force for our Thesis. The complexity of the respective notions embedded a comparative approach, however, we had a hard time figuring out which positions and aspects, we supposed to prioritise to achieve our vision. These critical points in our process can have a significant say for our design. However, it is difficult to point out specific pitfalls at the end of the process, but we are aware that a clear and specific set of constraints can narrow the spectrum of the respective notion and thus enable us to focus on the essential aspects. This leads us to a reflection and discussion of the disputes and challenges in the undertaking of an Architectural Thesis in the threshold of interdisciplinary of Architecture and Engineering, which is addressing the complex range of factors in depth and reach a holistic balance between them. Relatively early in the process, we perceive elaborative explorations and studies of the complex series of factors as too ambitious and unrealistic in the timeframe of one semester. Hence, we deliberately create a hierarchy and point out the parameters, which we perceive as vital and important for the Thesis, to be explored and developed. Throughout the Thesis, we tried to reach decisions or solutions that architecturally felt right for our concept, simultaneously, we tried to underpin them with achievable principles. At times we positioned ourselves in deep water and uncertainties, as we leaped notions, which is outside our threshold of knowledge and vocabulary. For instance, the Circular Economy, which is not an inherent configuration in our curriculum.

This Thesis is based on informed decisions in conjunction with theory and analysis, and is biased by personal perceptions. Our proposal for a Research and Visitor Centre of Climate Change aims to challenge the notion of Architecture as a catalyst that not only accommodates the functional needs but narrates a message to our society; that we are drowning. Nevertheless the vision or intention, we cannot one-to-one conclude that Architecture can carry out a task of such a character. However, we are confident that our Architecture can evoke a range of thoughts and feelings. It can either evoke our emotions, catch people's attention and encourage to learn and explore, or it can appear provocative. Nonetheless, it will initiate and raise a discussion, and if our conception is spot on, it will raise discussions of how we are moving forward to a greener future. The concept does also initiate a discussion of our way of living in the future, as the inevitable rising sea level will force us to confront and deal with the issue of Water, and as we observe the current Climate situation, this future may be closer than we anticipate. Thus, is Circular Tectonics and floating Architecture a new normal?

THE CONSEQUENCE OF CORONA

It is undeniable that the current event of the pandemic Corona had a predominantly impact on our process and in our way of working, and we do admit that it initially took a toll on us. Our culture of working consists of discussions, dialogues, and sketching simultaneously. The situation called for a radical change in communication, which leads to a series of miscommunications and misunderstandings and stalls the efficiency of our work. Eventually, we found a way around it and made it work. However, we feel it is vital to include the Corona situation in our reflection, as it forced us to seek alternative means in the process of creative thinking; analog approaches and methods such as sketching and scale models are replaced with digital agents, which might have a significant impact on the design decisions. The situation has raised awareness of the significance of the analog approach, as we, for instance, experienced a distorted sense of scale when we interact within the parameter of 3D modeling. In continuation, we wonder if our creativity was unfolded differently, and thus, the design, if our platform and forum for display and discussion were not taken from us. In continuation of the Corona situation, we want to reflect briefly upon Team-work. We have always perceived Team-work as an inherent part of reflective thinking. However, particularly this semester, it has played a vital role in writing and creating this Thesis. The absence of physical presence, dialogues and discussion can create distance, and consequently, the Thesis can appear incohesive. Thus, we reach a renewed appreciation of functional Team-work, in which respect and trust are essential. To synthesise, this Thesis has indeed challenged us and pushed the boundaries in the way we perceive and approach Architecture. It reaches unfamiliar and unknown territories and the process has fluctuated from frustrations and uncertainties to excitements. However, we conceive it as a platform in which we had the space to explore and learn; a platform in which we were allowed to cultivate our passion.

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Photos courtesy by Jeremy Bishop ()Accessed 2020.05.01 at: https://unsplash.com/photos/7KLUhedmR2c) **FIGURE 05**

Photos courtesy by Silas Baison (Accessed 2020.05.15, at https://unsplash.com/photos/f4bfvVXKZP8) **FIGURE 31**

Photos courtesy by Rasmus Hjortshøj , COAST, Collective Architecture **FIGURE 42-43**

Photos courtesy by Trevorpatt (Accessed 2020.05.15, at https://www.flickr.com/photos/trevorpatt/14644513330 **FIGURE 44**

Photos courtesy by anonphotography.com (Accessed 2020.05.15, at https://www.flickr.com/photos/anonphotography/6379415385) **FIGURE 45**

Camus, F., n.d. *Saint Benedict Chapel / Peter Zumthor*. [photograph] Accessed 10th February, 2020, Available at: https://www.archute.com/saint-benedict-chapel/ **FIGURE 45**

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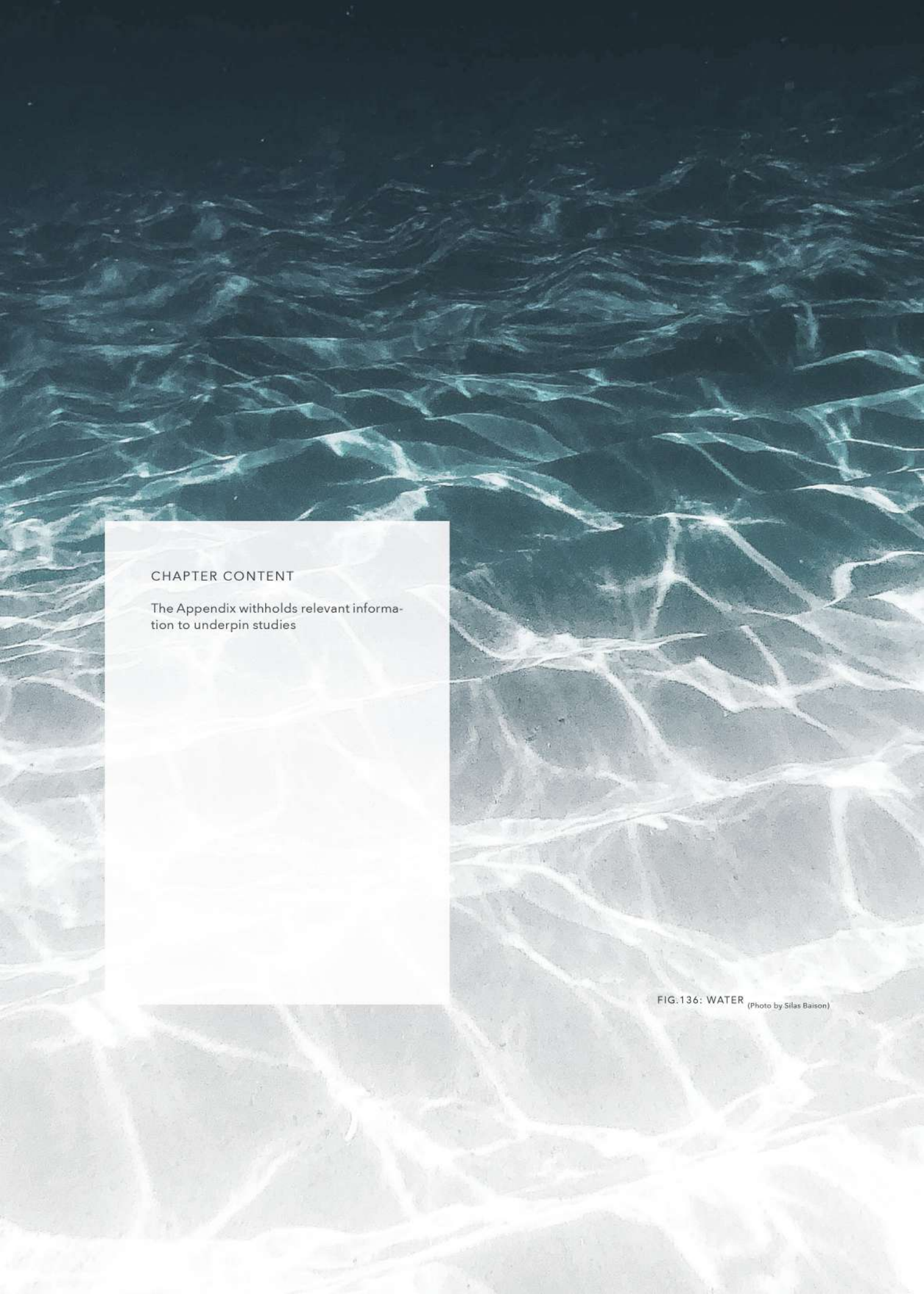
0.8.0 APPENDIX

BILAG \'bi:la:g\ (Dict, n.d)



CHAPTER CONTENT

The Appendix withholds relevant information to underpin studies

FIG.136: WATER (Photo by Silas Baison)

0.8.1 WATER TIDES

TIDEVANN /'ti:devan/ (Diet, n.d.)

TIMEBASED LEVELS FOR HIGH TIDE AND LOW TIDE

	WEEK	TIME		WATER TIDES	
		LOW TIDE	HIGH TIDE	LOW TIDE [cm]	HIGH TIDE [cm]
JANUARY	1	08.18-12.27	14.50-06.20	66-78	131-141
	2	12.27-18.06	06.20-11.55	73-32	126-162
	3	06.15-11.52	12.39-18.14	38-66	137-163
	4	13.11-18.06	06.57-11.53	64-36	131-155
FEBRUARY	5	06.10-09.50	12.29-16.29	43-69	154-125
	6	11.03-17.09	17.25-10.55	73-25	121-157
	7	06.02-17.52	11.38-15.38	18-47	164-144
	8	11.18-17.13	17.44-10.58	61-31	125-148
MARCH	9	17.44-08.18	11.32-14.53	29-51	150-128
	10	09.00-16.06	15.40-09.49	58-23	112-145
	11	16.50-08.34	10.34-15.14	4-43	165-137
	12	09.32-16.14	16.11-9.59	30-58	110-136
APRIL	13	16-46-07.17	10.34-13.46	23-35	131-144
	14	07.51-14.55	14.26-08.34	27-58	108-129
	15	15.42-07.27	09.25-14.03	0-22	140-160
	16	08.15-15.05	14.49-8.49	32-52	105-122
MAY	17	15.41-06.25	09.29-14.47	21-29	128-139
	18	06.58-13.31	13.26-18.35	29-48	109-127
	19	18.08-06.27	08.04-12.56	3-22	128-154
	20	07.13-13.38	13.45-07.09	20-47	106-133
JUNE	21	14.23-17.23	08.06-11.51	23-37	116-134
	22	06.09-11.51	12.31-18.07	23-37	115-131
	23	12.58-17.50	06.27-11.53	13-30	122-145
	24	06.16-11.41	12.41-17.54	16-47	106-138
	25	06.07-10.53	12.42-16.51	27-46	111-133
	26	11.34-10.12	17.28-10.12	22-32	123-135
	27	123-140	26-34	11.19-16.53	17.37-10.54
JULY	28	115-140	22-45	17.35-09.37	11.41-16.01
	29	110-130	36-53	10.30-15.54	16.51-09.52
	30	136-146	17-31	16.35-08.48	10.36-15.15
AUGUST	31	123-136	33-47	13.10-15.59	16.09-09.58
	32	129-143	25-39	16.42-08.05	10.45-14.34
	33	114-125	46-63	08.40-14.50	15.13-08.43
	34	135-159	13-43	15.36-07.36	09.33-14.02
SEPTEMBER	35	124-145	28-62	08.22-15.05	14.50-09.03
	36	139-150	32-47	15.49-06.22	09.51-13.21
	37	119-139	42-72	07.22-13.29	13.53-18.17
	38	130-170	15-60	14.29-06.28	08.21-12.51
OCTOBER	39	124-161	23-74	07.10-14.01	13.37-07.54
	40	136-156	40-42	14.50-18.05	08.53-12.16
	41	125-151	41-81	06.20-11.15	12.46-17.39
	42	125-175	27-76	13.00-17.37	06.38-11.42
NOVEMBER	43	131-165	30-81	18.19-12.27	12.46-18.22
	44	130-158	45-75	13.34-17.11	07.31-11.17
	45	132-158	46-78	18.11-09.10	11.46-15.15
	46	132-173	33-81	10.43-16.36	17.08-10.36
DECEMBER	47	136-173	31-80	17.20-10.09	11.20-16.25
	48	134-153	52-82	11.35-16.17	17.38-10.19
	49	143-157	48-66	16.50-08.22	10.50-14.40
	50	140-160	44-71	08.58-15.33	15.36-09.30
	51	146-167	36-66	16.22-08.27	10.17-14.56
	52	129-140	61-77	09.20-15.17	15.48-09.14
	53	144-155	44-56	15.56-17.47	09.52-11.38

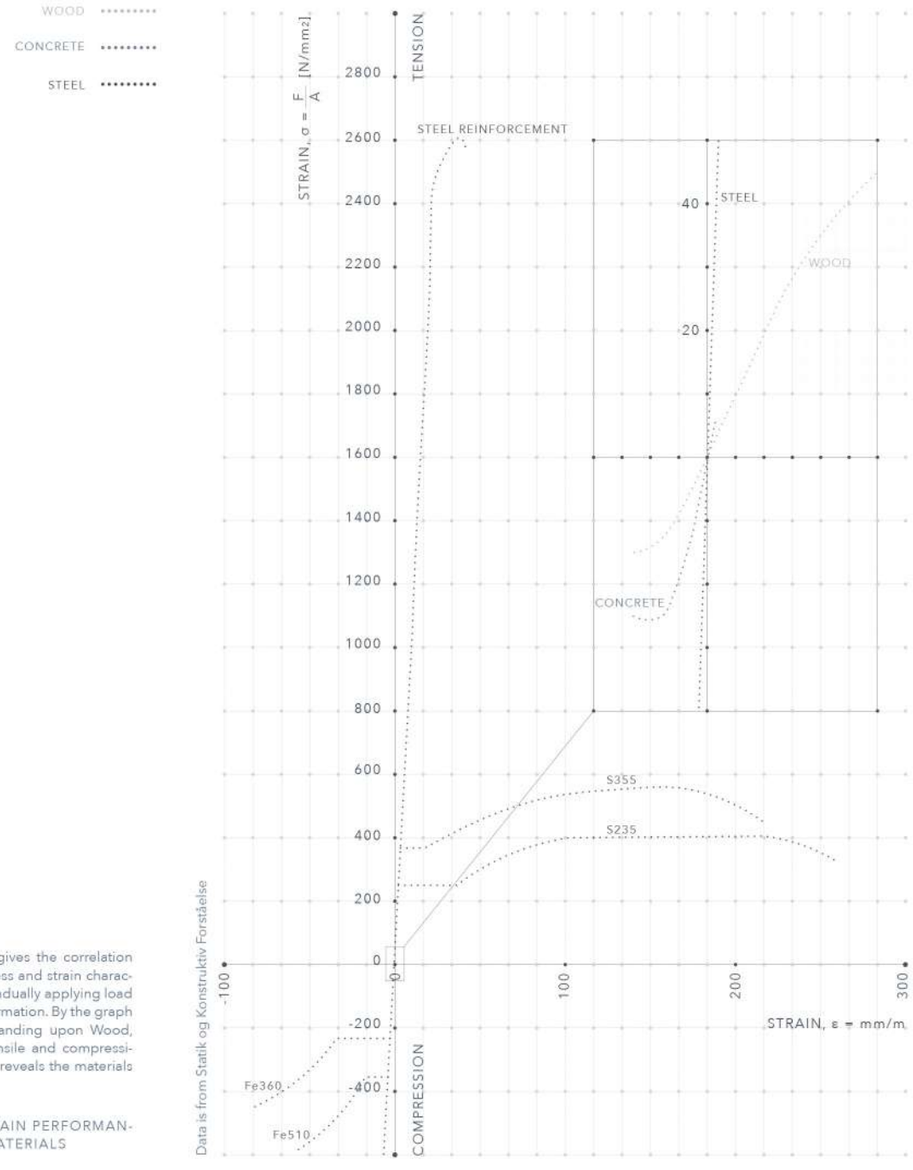
FIG.137:WEEKLY BASED WATER TIDES

(Kartverket, 2020)

0.8.2 PERFORMANCE DIAGRAM

ARBEJDKURVE /'ɑrbæid'kʉrve/ (Dict, n.d.)

STRESS-STRAIN DIAGRAM FOR WOOD, CONCRETE AND STEEL



The stress-strain curve gives the correlation between a materials stress and strain characteristics by the test of gradually applying load and measuring the deformation. By the graph we enables an understanding upon Wood, Concrete and Steels tensile and compressive strength, and hence, reveals the materials properties. (Gammel, 2010)

FIG.138: STRESS-STRAIN PERFORMANCE DIAGRAM FOR MATERIALS

0.8.3 ACTIONS ON STRUCTURES

Calculation of Snow load is conducted in accordance with Eurocode: EN1991 (EC1) + Danish NA (National Annexes)(Dansk Standard, 2nd Edition, 2007 + Dansk Standard, 3rd, 2015)

IMPOSED LOAD: SNOW

Snow is defined as a variable actions Q_k in Eurocode. The load act vertically on the structure.

Formula [kN/m²] $S=\mu_i \cdot C_e \cdot C_t \cdot S_k$

Calculation:
*0.8·0.8·1.0·1.75 kN/m² =**1.12 kN/m²***

Symbols		**Values**	
Snow Shape Coefficient	μ_i	0.8 [Angle of Roof: 0°≤α≤30°]	[Table 5.2 Eurocode 1, p. 52]
Exposure Coefficient	C_e	$0.8_{Cal.\ 01}$	
Thermal Coefficient	C_t	1.0	
Characteristic Value of Snow Load on the ground	S_k	1.75 kN/ m²	[Figure C.10. Eurocode 1, p. 52]

CAL. 01: THE EXPOSURE COFFICIENT

The Exposure Coefficient C_e depends on topography of the location and the scale of the construction.

Formula $C_e=C_{Top} \cdot C_s$

Calculation
*0.8·1.0=**0.8***

Symbols		**Values:**	
Factor for Topography	C_{Top}	0.8 [Windswept]	[Table 5.1.a Eurocode 1, p. 51]
Factor for Scale of Construction	C_s	1.0 [l_2≤10h]	[Table 5.0.b Eurocode 1, p. 52]

IMPOSED LOAD: RAIN

The Rain Load is calculated as an additional action on structures based on knowledge of Bergen and its challenges with rainfall days and the design of a rooftop water catchment. The calculation will be examined based on Water's density and the damming height.

Formula $R=\rho \cdot h$

Calculation:
*10 kN/m³ · 0.2 m = **2 kN/m²***

Symbols		**Values**	
Density	ρ	9.81 kN/ m³ [Water Density] (10 kN/ m³ is the generally used approximation)	[Practical Engineering Geology, p. 232]
Damming height	h	0.2 m	[Estimation from 21st Century Museum of Contemporary Art by SANAA]

According to EUROCODE 1, the Wind load is presented by a set of pressures/forces whoses effects are equivalent to the extreme effect of the Wind. Wind is defined as a variable/instantaneous load and is based on the calculation of velocity of Wind V_m. The velocity V_m is determined from the basis Wind velocity V_b, which depends on the climate and height variation of the Wind, determined from the terrain roughness and orography.

IMPOSED LOAD: WIND

Calculation of Wind Load is conducted in accordance with Eurocode: EN1991 (EC1) + Danish NA (National Annexes)(Dansk Standard, 2nd Edition, 2007 + Dansk Standard, 3rd, 2015)

CAL. 01: BASIC WIND VELOCITY

Calculation 01
$V_b=0.8 \cdot 1.0 \cdot 27\ m/s=$***21.6 m/s***

Formula [4.1]
$V_b=C_{dir} \cdot C_{season} \cdot V_{b,0}$

Symbols		
V_b		Basic Wind Velocity
27 m/s	$V_{b,0}$	Fundamental Value of Basic Wind Velocity [According to Eurocode 1, p. 75]
0.8	C_{dir}	Directional Factor (Note 1.0) [Table 1a. DKNA. Eurocode 1, p. 75]
1.0	C_{sea}	Season Factor (Note 2.0) [Table 1b. DKNA. Eurocode 1, p. 75]

Note

1.0 The Directional Factor for various directions can be found in NA (National Annex). The recommended value 1.0

2.0 The Season Factor for various directions can be found in NA (National Annex). The recommended value 1.0

According to EUROCODE 1, the mean Wind Velocity v_m at a height z above the terrain correponds to its roughness and orography, and to the basic Wind velocity v_b

CAL. 02: MEAN WIND VELOCITY

Calculation 02
$v_m(z)=1.05 \cdot 1.0 \cdot 21.6\ m/s=$***22.68 m/s***

Formula:
$v_m(z)=c_r(z) \cdot c_o(z) \cdot v_b$

Values		**Symbols**	
	v_m	Mean Wind Velocity	
(Cal.02.1) 1.05	$c_r(z)$	The Roughness Factor (Cal.02.1)	[Chapter 4.3.2. Eurocode 1, p. ~~76~~]
1.0	$c_o(z)$	The Orography Factor	[According to Eurocode 1, p. 76]
21.6 m/s	v_b	Basic Wind Velocity	

CAL. 02.1: THE ROUGHNESS FACTOR

Calculation 02.1
$c_r(z)=0.16 \cdot ln\left(\frac{5.0\ m}{0.01\ m}\right)=$***1.05***

Formula:
$c_r(z)=k_r(z) \cdot ln\left(\frac{Z}{Z_0}\right)$
When $Z_{min} \leq Z \leq Z_{max}$

$c_r(z)=c_r(Z_{min})$
When $Z<Z_{min}$

Values		**Symbols**	
(Cal.02.2) 0.16	k_r	Terrain Factor (Cal.02.2)	[Formula 4.4. Eurocode 1, p. 76]
5.0 m	Z	The Reference Height [m]	
0.01 m	Z_0	The Roughness Length: a Terrain Parameter [m]	[Table 4.1. Category I. Eurocode 1, p. 77]
1.0 m	Z_{min}	The Minimum Height [m]	[Table 4.1. Category I. Eurocode 1, p. 77]
200.0 m	Z_{max}	Defined by Eurocode	[According to Eurocode 1, p. 76]

CAL. 02.2: TERRAIN FACTOR

Formula: **Calculation 02.2**

$$k_r = 0.19 \cdot \ln\left(\frac{Z_0}{Z_{0,II}}\right)^{0.07} \qquad k_r = 0.19 \cdot \ln\left(\frac{0.01\ \text{m}}{0.05\ \text{m}}\right)^{0.07} = 0.16$$

Symbols **Values**

The Roughness Length: a Terrain Parameter [m]	Z_0 0.01 m	[Table 4.1. Category I. Eurocode 1, p. 77]
Defined by Eurocode	Z_{II} 0.05 m	[Table 4.1. Category II. Eurocode 1, p. 77]

CAL. 03: TURBULENCE INTENSITY

Formula: **Calculation**

$$I_v(Z) = \frac{\sigma_v}{v_m(Z)} = \frac{k_I}{c_o(Z)\cdot\ln\left(\frac{Z}{Z_0}\right)} \qquad I_v(Z) = \frac{1.0}{1.0\cdot\ln\left(\frac{5.0\ m}{0.01m}\right)} = \frac{\sigma_v}{v_m(Z)} = 0.16$$

[Formula 4.7. Eurocode 1, p. 80]

When $Z_{min} \le Z \le Z_{max}$

$$I_v(Z) = I_v(Z_{min})$$

[Formula 4.7. Eurocode 1, p. 80]

When $Z < Z_{min}$

Symbols

The Orography Factor	c_o 1.0	[According to Eurocode 1, p. 76]
The Turbulence Factor	k_I 1.0	[According to Eurocode 1, p. 80]
The Reference Height [m]	Z 5.0 m	
Minimum Height: a Terrain Parameter [m]	Z_0 0.01 m	[Table 4.1. Eurocode 1, p. 77]

CAL. 04: PEAK VELOCITY PRESSURE

Formula: **Calculation**

$$q_p(Z_e) = [1+7\cdot I_v(Z)]\cdot\frac{1}{2}\cdot\rho\cdot v_m^2(Z) = c_e(Z)\cdot q_b \qquad q_p(Z_e) = [1+7\cdot 0.16]\cdot\frac{1}{2}\cdot 1.25\ \text{kg/m}^3\cdot(22.68\ \text{m/s})^2(z) = \mathbf{681.557}\ \frac{kg}{m\cdot s^2} \approx 0.68\ \frac{kN}{m^2}$$ (Note 2.0)

Symbols

The Turbulence Intensity	$I_v(Z)$ 0.16
Note 1.0 Air Density	ρ 1.25 kg/m³
Mean Wind Velocity	v_m 22.68 m/s
The Exposure Factor	$c_e(z)$
Basis Velocity Pressure	q_b

Note 1.0

According to EUROCODE, the value of ρ is 1.25 kg/m³

Note 2.0

1 kN = 1000 kg·m/s². Thus in the conversion of unit the value is in kN/m²

$$q_e(Z) = 681.557\ \frac{kg}{m\cdot s^2}\cdot\frac{1\ kN}{1000\ \frac{kg\cdot m}{s^2}} = 0.68\ \frac{kN}{m^2}$$

CAL. 04: WIND PRESSURE ON SURFACE

Formula: **Calculation**

$$[\text{kN/m}^2]\ W_e = q_p(Z_e)\cdot c_{pe} \qquad W_e = 0.68\ \text{kN/m}^2\cdot c_{pe} = \text{kN/m}^2$$

[Formula 4.8, Eurocode 1, p. 81

Symbols

Wind Pressure on Surfaces	W_e	
The Peak Velocity Pressure	$q_p(Z_e)$ 0.68 kN/m²	
The Reference Height for External Pressure	(Z_e) 5.0 m	
The Pressure Coefficient for the External Pressure	C_e	

The Pressure Coefficient depends on geometry of the building and its structure of roof. Hence, the value of Coefficient varies depending the zone of the building.

[Table 7.2, Eurocode 1, p. 104