INTO THE WOODS A WOODEN VERTICAL VILLAGE

STUDIO MATTER SPACE STRUCTURE

Chalmers University of Technology
Department of Architecture and Civil Engineering

Examiner: Morten Lund
Supervisor: Jonas Carlson

Beata Karlsson
Gothenburg, Spring 2020

CHALMERS
UNIVERSITY OF TECHNOLOGY

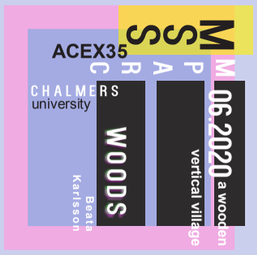
Into the Woods
A Vertical Wooden Village

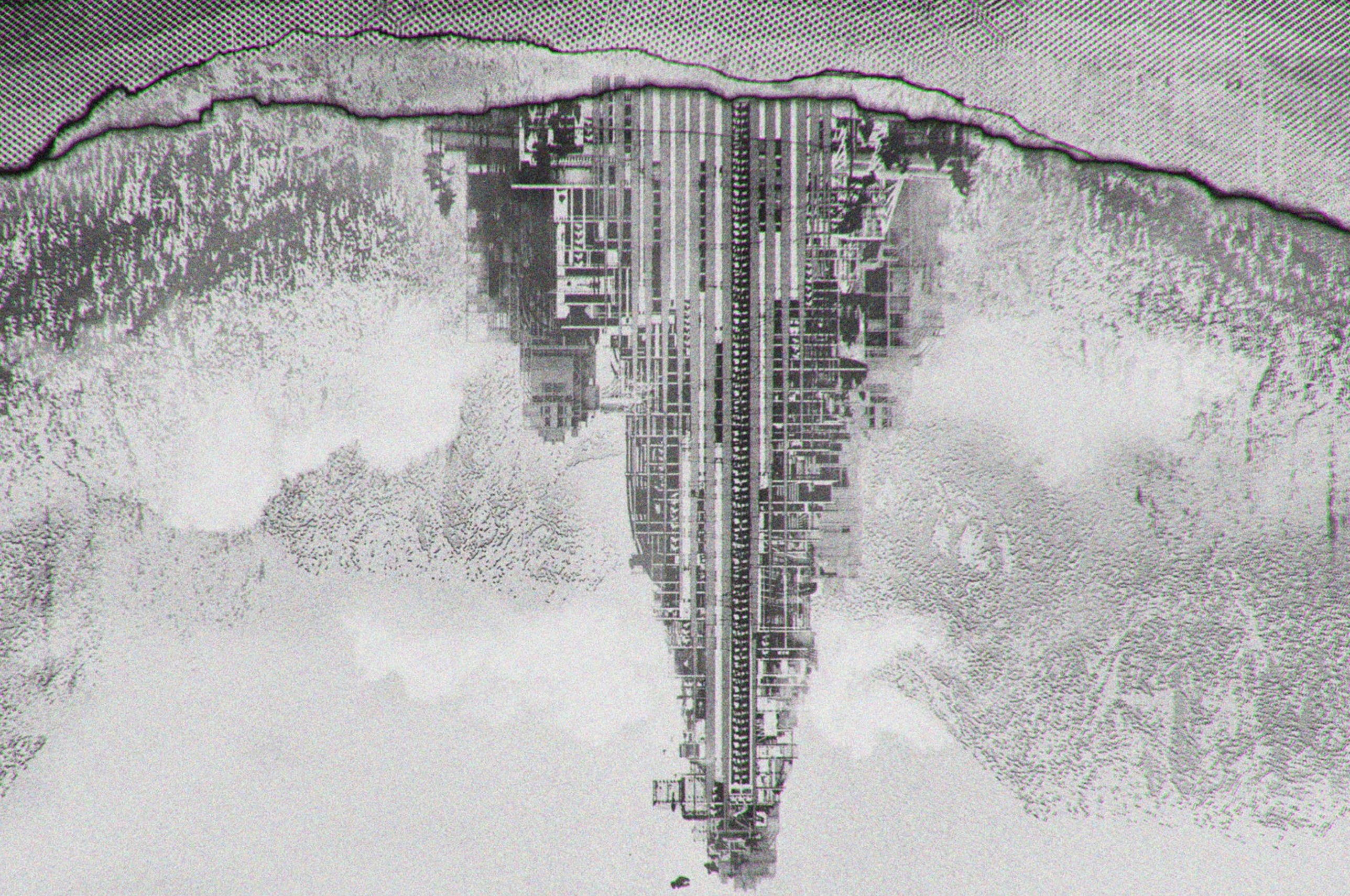
Chalmers University of Technology
Department of Architecture and Civil Engineering
Architecture and Urban Design
Studio Matter, Space, Structure

Gothenburg, Sweden 2020

Examiner: Morten Lund

Supervisor: Jonas Carlson


MSSS
ACEX35
CRAPP
CHALMERS
university
WOODS
Beata
Karlsson
vertical village
06.2020 a wooden



CONTENTS

“Architecture is what nature cannot make.
Architecture is something unnatural but not
something made up.”

Louis Kahn

STUDENT BACKGROUND

Beata Karlsson
Chalmers University of Technology
MPARC 2020
Matter, Space, Structure

Education

Chalmers University of Technology
Gothenburg, Sweden
2019 - 2020
Masters program in Architecture and Urban Design
- Matter Space Structure Thesis Project
- Matter Space Structure 3, *preparation and research for thesis project.*
- Reality Studio, *design, research, crowdsourcing and construction of playground and outdoor classroom for a school in an informal settlement area, Kisumu, Kenya.*

National University of Singapore
Singapore, Singapore
2017 - 2018
Department of Architecture, School of Design and Environment
- Smart & Synesthetic*, design of a concert hall in Singapore CBD, 18´*
- Structure-Tonics, *design of contemporary 3D-printed tropical high-rises, 17´*
Reading Visual Images
Department of Arts & Social Sciences
Chinese 1
Home
Visual Design

Chalmers University of Technology
Gothenburg, Sweden
2014 - 2017
Bachelor of Architecture

Malmö University
Malmö, Sweden
2013 - 2014
Architecture, Visualization & Communication

Employment

Powerhouse Company
Rotterdam, The Netherlands
2019 - 2020
Interior designer & Visual designer

Powerhouse Company
Rotterdam, The Netherlands
2018 - 2019
Internship in Architecture

Red Bull
Marketing
2014 - 2017

Acknowledgements
I acknowledge the help of the people who have been offering ideas, discussions and contributed comments for my work. I would like to offer my special thanks to my supervisor Jonas Carlson for his patience, guidance and useful critiques; I really appreciate the sharp and clear communication.

I would like to express my great appreciation to examiner Professor Morten Lund for constantly pushing me and encouraging me to make things with deeper understanding, to kill my darlings and take everything a step further than I thought was possible.

In addition a special thanks to Alexander Sehlström and Yutaka Goto for their valuable technical suggestions regarding wood and technical issues on this project. Thanks to Peter Lindblom and Tabita Nilsson, who helped me to develop prototypes.

Furthermore, a warm thanks to Powerhouse Company in Rotterdam for helping me grow as an architect, especially Gert Ververs and the visualization team, Rafael, Giovanni and Jugo, for sharing your skills and tricks of how to make quick and powerful visualizations.

Finally, I would like to give a deep thanks to my partner Pim, my family and friends for their great support and motivation; you are my true support columns.

Foreword

Choosing the path of this thesis was a challenge. After several years of studies and work in the field of architecture, both in Sweden, Singapore and the Netherlands, I found inspiration from a nearly limitless amount of sources. There were just so many scales, styles, theories and ideas to choose from.

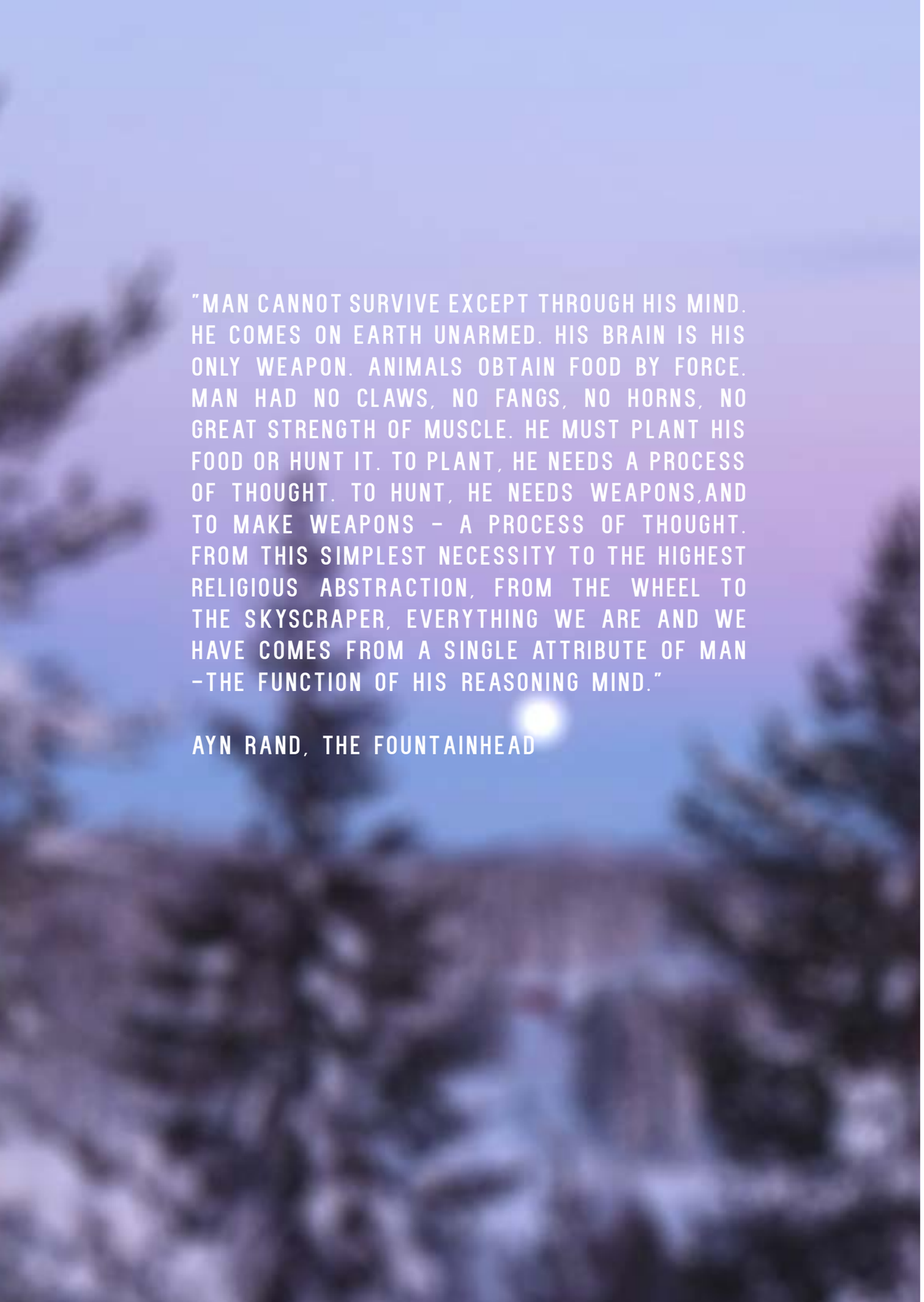
For this thesis I decided to try something new for me, which afterwards I felt was somewhat overwhelming. My goal was to combine what I've learned in Sweden with the knowledge and inspiration I gained while studying architecture in Singapore.

During the first year of my master I wanted to gain some more international experience and thus I went a year to Singapore to study. The Southeast Asian way of education and living was different from many things I'd learned in Sweden. The culture, climate, the amount of population amongst many other aspects were unlike what I'd experienced before. It made me realize there's not just one way to do it, it's about having an idea, exploring it and adapting it to different contexts and approaches.

Having a Swedish background, I decided to work with wood as the main material for the project. I also felt I had not worked enough with wood yet; my portfolio was just full of concrete and bricks. From my time in the city of Singapore, with its over 90 buildings of 150m+, I decided to focus on a skyscraper. The combination of wood and skyscraper is something that I think is relevant to the present time, since it connects elements of sustainability and dense living.

Therefore this projects combines my previous years of finding new impressions, plus the exploration of the unknown, while often being clueless to where it would end, - or well, now I know where it ends, because this is it. I'm not sure whether I feel for designing a high-rise building just by myself again however, having realised how puzzling it is. Yet, I felt for taking up this challenge and it gave me inspiration for the projects I will work on in the future.

I hope my thesis also provides you, my reader, with some inspiration, or, that it might also spark you to explore new paths yourself.



"MAN CANNOT SURVIVE EXCEPT THROUGH HIS MIND. HE COMES ON EARTH UNARMED. HIS BRAIN IS HIS ONLY WEAPON. ANIMALS OBTAIN FOOD BY FORCE. MAN HAD NO CLAWS, NO FANGS, NO HORNS, NO GREAT STRENGTH OF MUSCLE. HE MUST PLANT HIS FOOD OR HUNT IT. TO PLANT, HE NEEDS A PROCESS OF THOUGHT. TO HUNT, HE NEEDS WEAPONS,AND TO MAKE WEAPONS – A PROCESS OF THOUGHT. FROM THIS SIMPLEST NECESSITY TO THE HIGHEST RELIGIOUS ABSTRACTION, FROM THE WHEEL TO THE SKYSCRAPER, EVERYTHING WE ARE AND WE HAVE COMES FROM A SINGLE ATTRIBUTE OF MAN –THE FUNCTION OF HIS REASONING MIND."

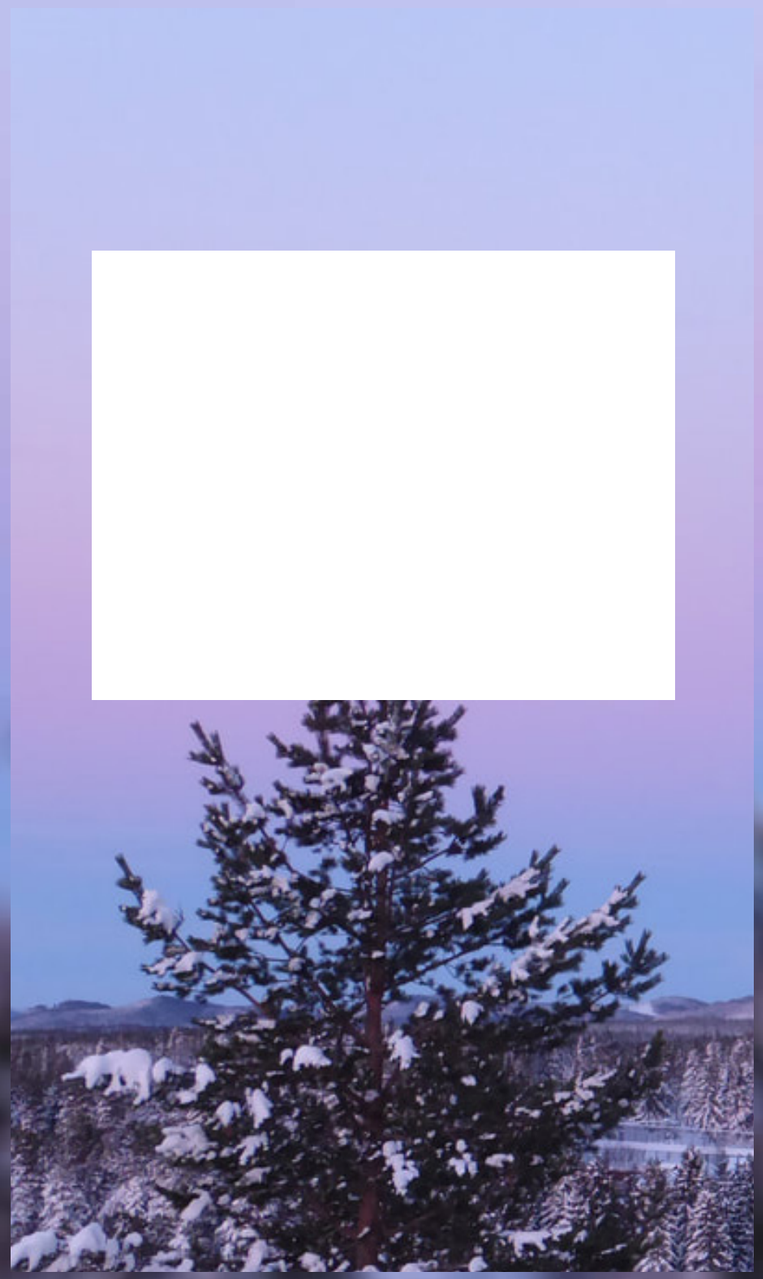
AYN RAND, THE FOUNTAINHEAD

ABSTRACT

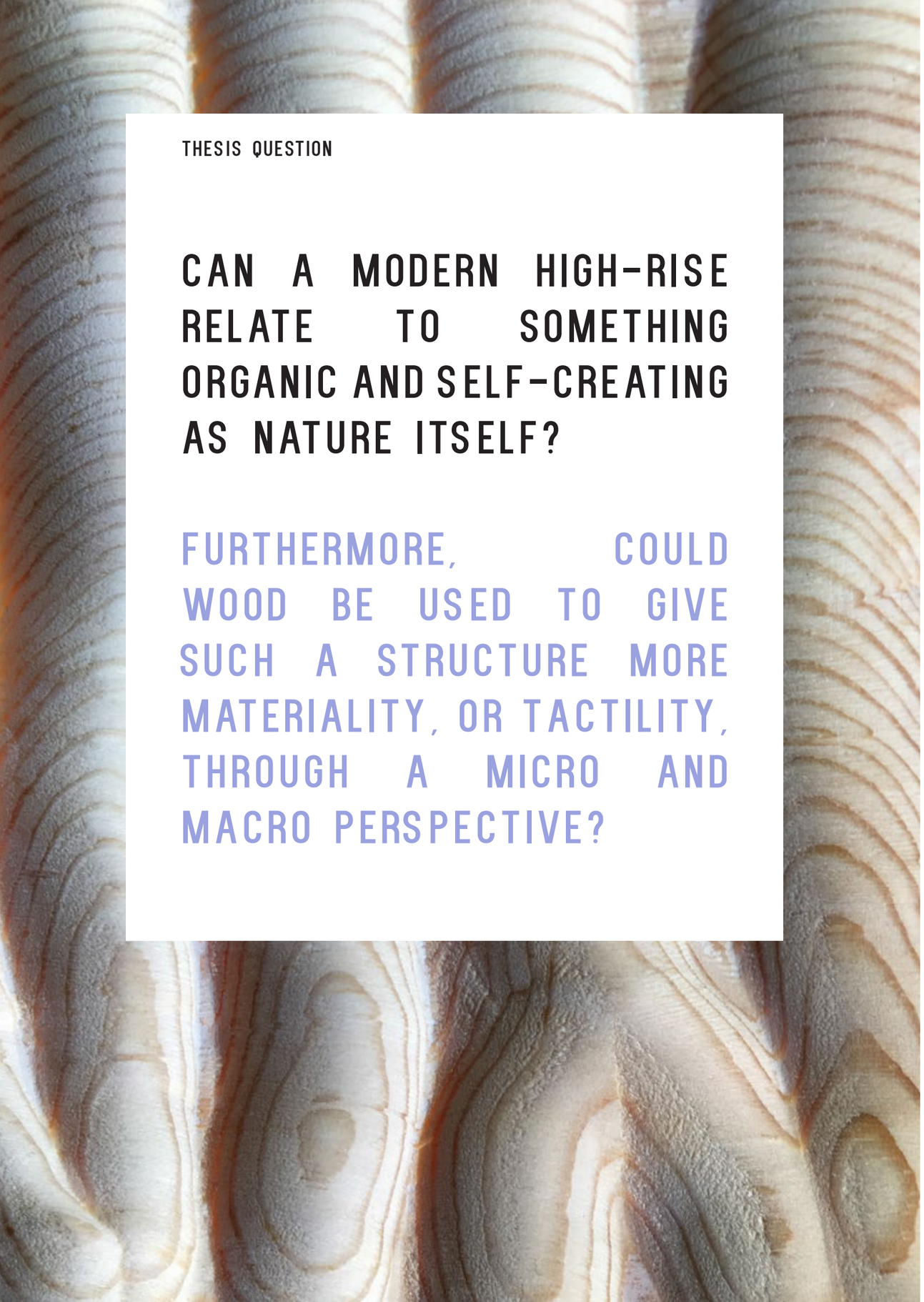
The modern manmade high-rise seems to be unrelated to the organic and self-creating essence of nature. Moreover, in contemporary structures engineered wood is often only used for its sustainable qualities, but can a wooden system be implemented in such a way to highlight that it affects our senses? The goal of the exploratory project is to redefine these notions. It investigates whether a modern high-rise can relate to nature. Next to that it investigates how a loadbearing structural system of engineered wood can be used to give such a structure more materiality and tactility.

To answer these questions the modern wooden high-rise was researched from a holistic perspective using micro and macro scales. The design transformation of the proposal went through a bottom-up process with an interplay of digital tools, drawings, material investigations, structural research and visualizations. Designing such a mega structure in a future setting is a complex undertaking; therefore the focus only lies on the development of the wooden structural system and in showing the possibilities of giving a high-rise a detailed level of materiality and tactility. Topics regarding urban planning, transport, sustainability and other social or economic issues are observed but do not form part of the design proposal, considering the exploration is in the matter, structure and its relation to the surrounding nature.

The result shows that perhaps a modern high-rise can indeed relate to nature, by rethinking the ordinary concept of a skyscraper. Building vast does not necessarily mean the structure becomes unrelated to nature, or more specifically the woods. Additionally, adapting the framework and concept of the building to the surrounding landscape, like an ordinary village, could relate it to nature. The implementation of a wooden loadbearing structural system can be adopted to give a high-rise more materiality and tactility. Engineered wood in high-rises could be used in such a way to give it sensorial qualities. Lastly, the result also forms a celebration of wood, its character and spirit by being the main ingredient of a loadbearing and ornamental structural program for a high-rise.



DEFINITIONS & DELIMITATIONS



THESIS QUESTION

CAN A MODERN HIGH-RISE RELATE TO SOMETHING ORGANIC AND SELF-CREATING AS NATURE ITSELF?

FURTHERMORE, COULD WOOD BE USED TO GIVE SUCH A STRUCTURE MORE MATERIALITY, OR TACTILITY, THROUGH A MICRO AND MACRO PERSPECTIVE?

DISCOURSE

High-rises are challenging structures; the taller and larger they get, the more complex they become. Among others, there is a whole system of infrastructure and stress analysis, which is way too complex and vast for even trying or putting effort into in solving through a master thesis' project. Similarly, issues regarding urban planning, economic, social, sustainability and transport affairs are beyond the scope of this thesis. Those topics will be addressed and discussed in this document, but it is important to emphasize that these topics and the questions which they could raise will not be answered by the design proposal.

What this project aims, is to create an optimistic conversation about the future use of wood and new building technologies, especially in tall structures. The last few years there has been an increase in the dialogue and development of tall wooden structures, and the project can be linked to this progress. That is why this thesis looks at the following questions:

Can a modern high-rise relate to something organic and self-creating as nature itself? Furthermore, could wood be used to give such a structure more materiality, or tactility, through a micro and macro perspective?

The project strives to give a response to these questions. The design proposal celebrates wood, highlights the materiality and possibilities of modern tall wooden structures in terms of dimensions combined with nature, by analyzing parts of the structure in different scales, from micro to macro perspectives. By connecting the proposed structure to a natural, forestlike setting, it also aims to show that a modern high-rise and nature do not have to form a juxtaposition.

However, the high-rise considered as a typology is nothing new and tall structures have been built for centuries; temples, towers, antennas and pyramids can be found all over the world. Such structures placed in a natural setting are not a new interpretation, neither is building tall structures from wood. This design investigation will not lift a discussion about the typology of a high-rise, neither will it discuss whether or not the modern high-rise is a structure humanity should strive for.

Instead, the high-rise is seen as a given. This project is rather a critique of the lack of materiality in modern high-rises, especially the current wooden ones, and how wood can be implemented to give more materiality to such structures. Currently, engineered wood such as glulam and cross-laminated timber (CLT), is not being used for its intrinsic material qualities. Instead, it is often simply being used to replace concrete in a sustainable way. Modern

"IF THE SKYSCRAPER WERE NOTHING MORE THAN EQUAL SPACES SLICED UP VERTICALLY (AS UNIVERSAL SPACES), IT WOULD BE TOTALLY BORING."

- AKIRA SUZUKI

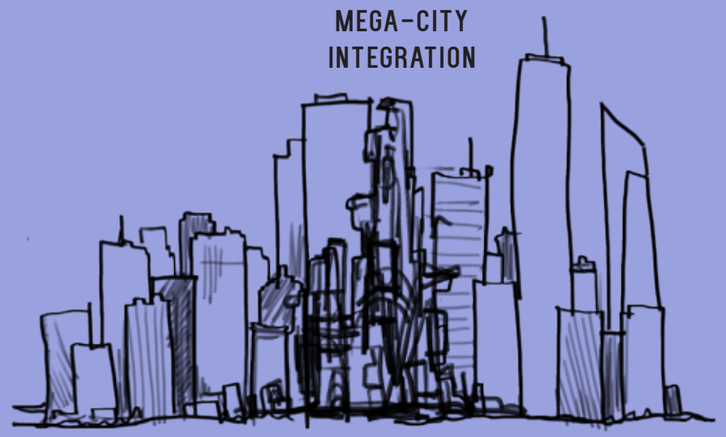
- VOLUME + LANDSCAPE STUDY

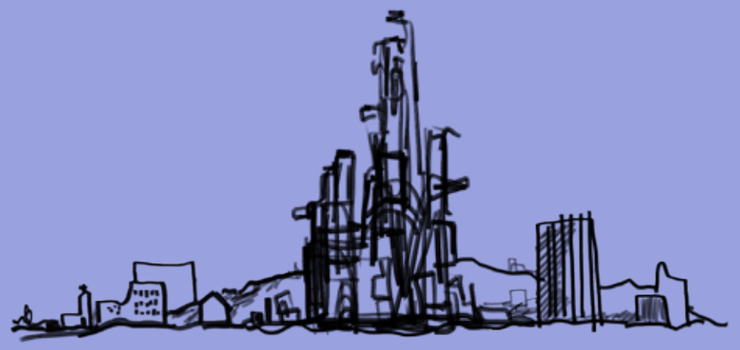
high-rises are somewhat “sustainable”, conversely ”green washed”, but overall they currently lack materiality and tactility. The current height record for a wooden high-rise is held by the Mjøsa Tower in Norway. The structure, around 80 meters tall, which although constructed majorly from CLT and glulam, offers little wooden materiality and tactility of the structural sustem.

Despite that the project does not focus on the following issues, these are just hard to neglect. The future will, reasonably, be dominated by global challenges, such as climate change and increasing populations. A new era of more sustainable construction could help to reduce the huge impact on our climate caused, and being caused, by concrete constructions all over the globe. Focusing on materiality, in addition to sustainability, by combining the inventiveness of man and the power of machine, is the basic premise of the proposal.

As stated before, the wooden high-rise is not a new invention. However, with the technologies of today and tomorrow we have the possibilities of improving the high-rises to new heights, both literally and figuratively. The research centre at ETH Zurich for example is already building small wooden constructions solely made by robotics. The future might bring forward small programmed robots that can put together elements and climb along the structure, which could make the construction process go faster than if it would have been done by mere manpower. This could offer possibilities to challenge the traditional high-rise typology-style.

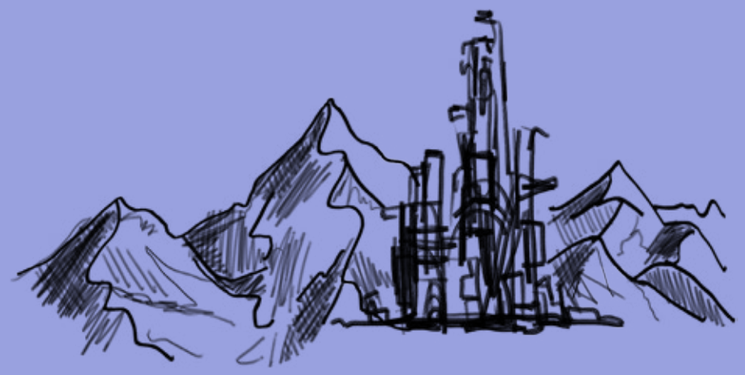
In conclusion, this thesis tries to find an answer to the question whether the skyscraper can relate to nature and whether engineered wood can be used to give such a structure materiality and tactility. Other topics it might raise could form interesting discussions on a range of related topics. These discussions however do not materialise the core of what this thesis is about.





NATURE
JUXTAPOSITION

- Highlights unique qualities by putting dissimilar things side by side

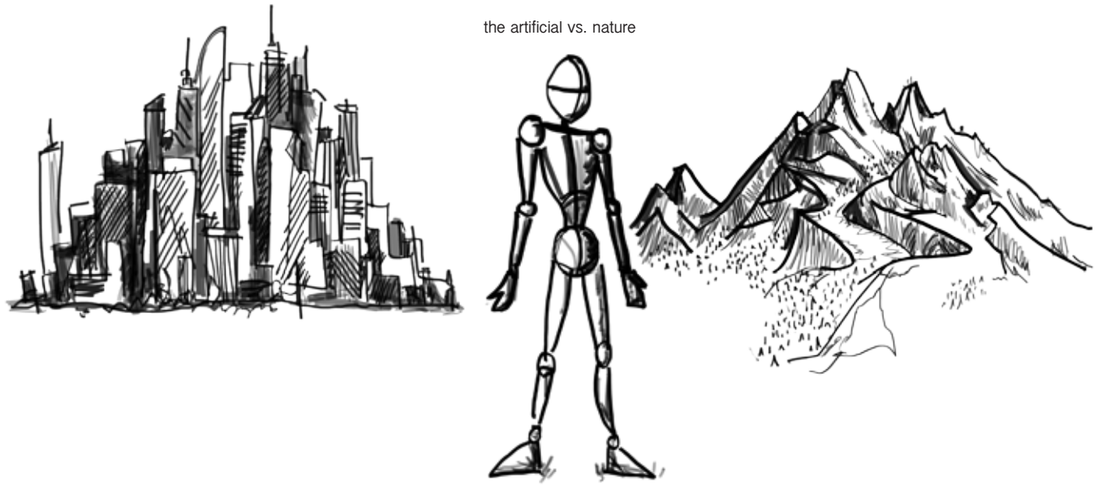


JUXTAPOSITION

Combining a high-rise with nature means that two different forces meet and that they will obviously affect each other. The high-rise as a landmass can be seen as a sign of wealth, comfort and power, at the same time as a tall structure or simply a sign of human endeavour to the sky (Yeang 1996:8). The typology itself also opens up a conversation about contemporary utopian communities, which will be discussed further down in the project. This design proposal might be seen as a way of rethinking the idea of the high-rise, by placing it in nature in a tabula rasa condition. But as mentioned before, tall structures in natural settings already exist, whether they are successful or useful is another topic altogether.

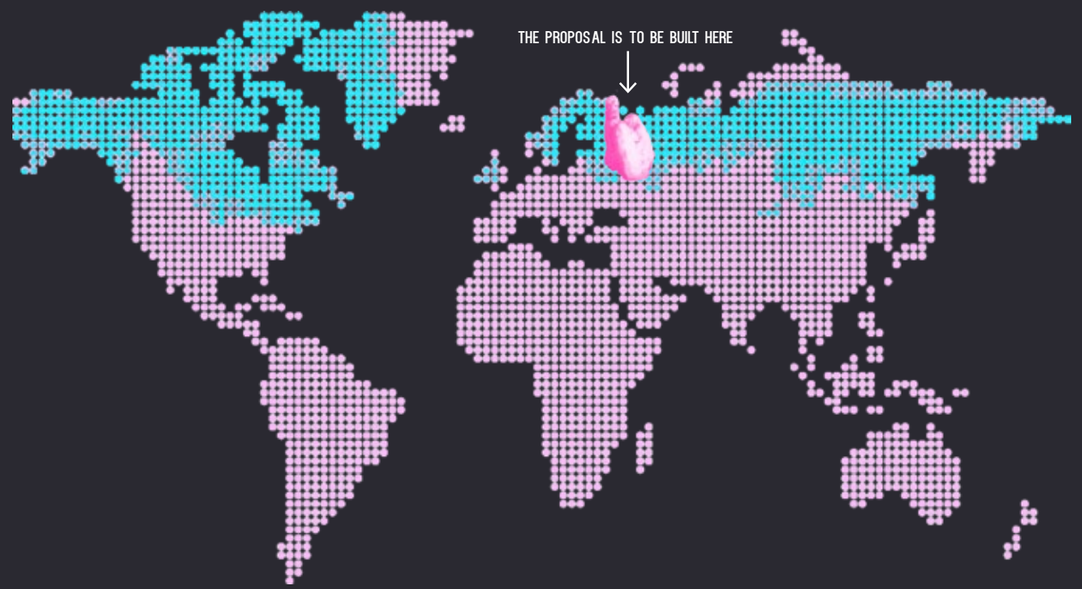
"The Skyscraper is a potent symbol of power and domination. The higher we build the more power we appear to command. Overcoming the most fundamental of all forces, gravity, this is nowhere more graphically demonstrated than in the space rocket, and even that is a skyscraper whilst still on earth."
- Professor Bryan Lawson, the University of Sheffield School of Architecture

However, the self-creating and organic growth elements of nature have inspired the design proposal, for example by not going for a high-rise with four similar facades. Since the landscape shows variety, the building should also communicate and develop in different ways due to the surrounding nature and weather exposure.



the artificial vs. nature

city < human > nature



BOREAL FORESTS ON EARTH

The high-rise should be made of locally sourced material in a boreal area through a sustainable process, designed around achieving 100% reforestation. *Increasing use of wood as a building material, with new methods on how to grow and harvest responsibly, is essential to maintain the balance of nature on our planet.*

If the wood is treated with respect, in return, its appearance and properties give materiality, character and tacility to the façade and interior: pure, organic and imperfect.

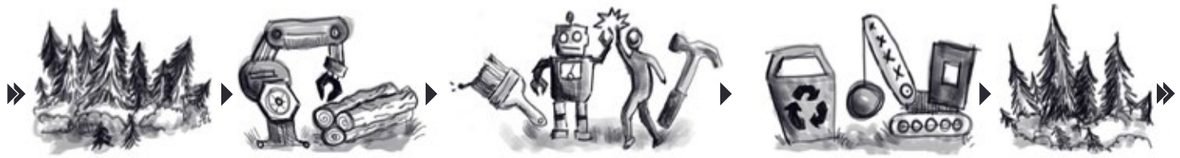
MATERIALITY, WOOD & STRUCTURE

Wood & structure

A structure of this size consists of billions of elements, it is a technical junction that cannot be developed in a elaborated holistic perspective for a thesis project, and thus the design proposal centres on the structures' loadbearing system, primarily the column structure. A hierarchical system has been developed based on dividing pillars into different classes based on their ability to handle stress, and its size in diameter.

The understanding of the relationship between junctions in a wooden structure is what makes it interesting and is something that has to be shown in the design. Developing junctions and joints in the design specifies the uniqueness of the wooden structure and by doing so a closer level of detailing is possible. Instead of placing façade elements on covering the structure, the structure is visible and its junctions become the ornament of the vertical village.

A Lifecycle Perspective of the megastructure

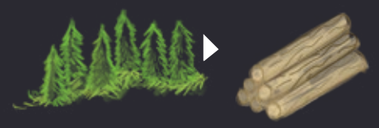


Resource / Extraction >> Design / Manufacturing >> Occupancy / Development / Maintenance >> Teardown / Recycling >> Reforestation / Restoration

An efficient way of making this easier, reducing costs and leftover materials of the construction process is to use modern digital tools while calculating and manufacturing. Moreover, for developing this kind of vast structural wooden system a great interdisciplinary collaboration between architect, engineer and contractor is necessary.

The loadbearing structure consists of engineered wood, assuming that in the future we can make CLT and glulam on site, using the same technologies in use today for tall concrete structures and applying the same ideas to tall structures of engineered wood. However it might be questionable why someone would like to build a wooden structure when it takes up so much space, only for a loadbearing system. The major reason is basically the great sustainable properties of the wood. A huge structure also stores vast amounts of CO2. The sustainable benefits could be boosted with this argument.

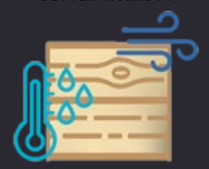
WOOD IS SUSTAINABLE AND A RENEWABLE RESOURCE



WOOD IS STRONG AND COMPARED TO CONCRETE IT IS VERY LIGHT

WOOD IS HEALTHY FOR DWELLERS

WOOD IMPROVES THE AIR QUALITY AND GIVES BETTER HUMIDTY



"PEOPLE WHO NEVER KNEW EACH OTHER BUT WHO HAD THE SAME LOVE AND CARE FOR THE WOOD THEY USED, KNOWING IT WOULD LIVE FOR GENERATIONS. THIS FOR ME IS ANOTHER FORM OF MINIMALISM. MINIMUM USE OF MATERIALS FOR MAXIMUM OF RESULTS."

– AXEL VERVOORDT
(Miki & Vervoordt 7:2011)

Materiality

First of all, giving materiality to a building can sound like a vague notion, because what is even meant by ambiguous concepts such as materiality and tactility? We all have the ability to see or feel materiality in different things. Beauty, yet another opaque term but one which also has a certain meaning to us all, can be found in a simple matter like an aging piece of fibrous wood or a rough stone. In this thesis the description of materiality is a way of describing, defining and valuing the beauty in non-perfection and the organic and natural. By giving the engineered materials a materiality that expresses these qualities, machine-made matter can be designed to recreate a natural tactility and look on the outside. A material with local origins gives the whole building a spirit, history and calmness and at the same time, as makes it sustainable by using local production.

When everything around us is getting too high-tech and machine made, tactility will make things more interesting, to feel a soul and craft in something, or know where the materials are coming from, the history behind an element gives a higher value (Miki & Vervoordt 9-10:2011).

Perhaps we can find a feeling of wellbeing in pure materials that creates an interruption from the plastic and hectic world of today. Nor can we just rely on using and create new materials that we cannot reuse; we must use and consume what we already have and find a harmony between the new and the old. In the future we will have to deal with the overconsumption we are creating today, to find value in the mass-produced products of the 00's. There is no room for throwing away "the ugly" anymore, we have to live and deal with it. Thereby it is vital to be creative and make something of what we already have, the construction industry needs to produce buildings with more recycled and renewable materials. It is an art to find value in "worthless" or "ugly" matters, but it is also in this way we can find historic and spiritual materiality.

A strong materiality does not necessary asks for overworked decoration; patina of age, bare boards and imperfections can give sense of spirituality and beauty in itself (Miki & Vervoordt 39:2011).

Noble, organic yet primitive materials with unexpected mistakes are most likely fundamental for a natural tactility. Presumably the most interesting materiality we can find in buildings comes from years of aging and external influences. Wood is clearly a natural material that can withstand wear and tear for centuries, if properly treated. In modern architecture, specifically large-scale buildings, it seems there is a lack of materiality. The main reason probably lies in the demanding time and effort it takes to work with it; which means it is not generating enough money compared to other materials. Developers are simply not interested in the tactile values of the material. In some projects however, engineered wood has started to replace concrete; but mainly due to the reasons of sustainability. Very rarely the reason to use wood in such projects is because of the materiality and tactility of engineered wood.

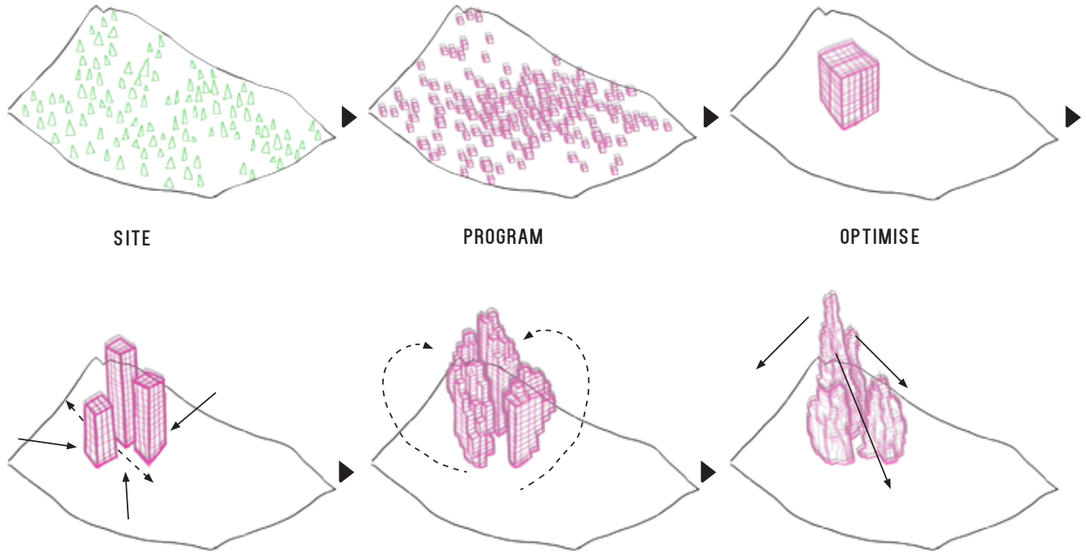
"A BUILDING HAS AT LEAST TWO LIVES – THE ONE IMAGINED BY ITS MAKER AND THE LIFE IT LIVES AFTERWARD – AND THEY ARE NEVER THE SAME."

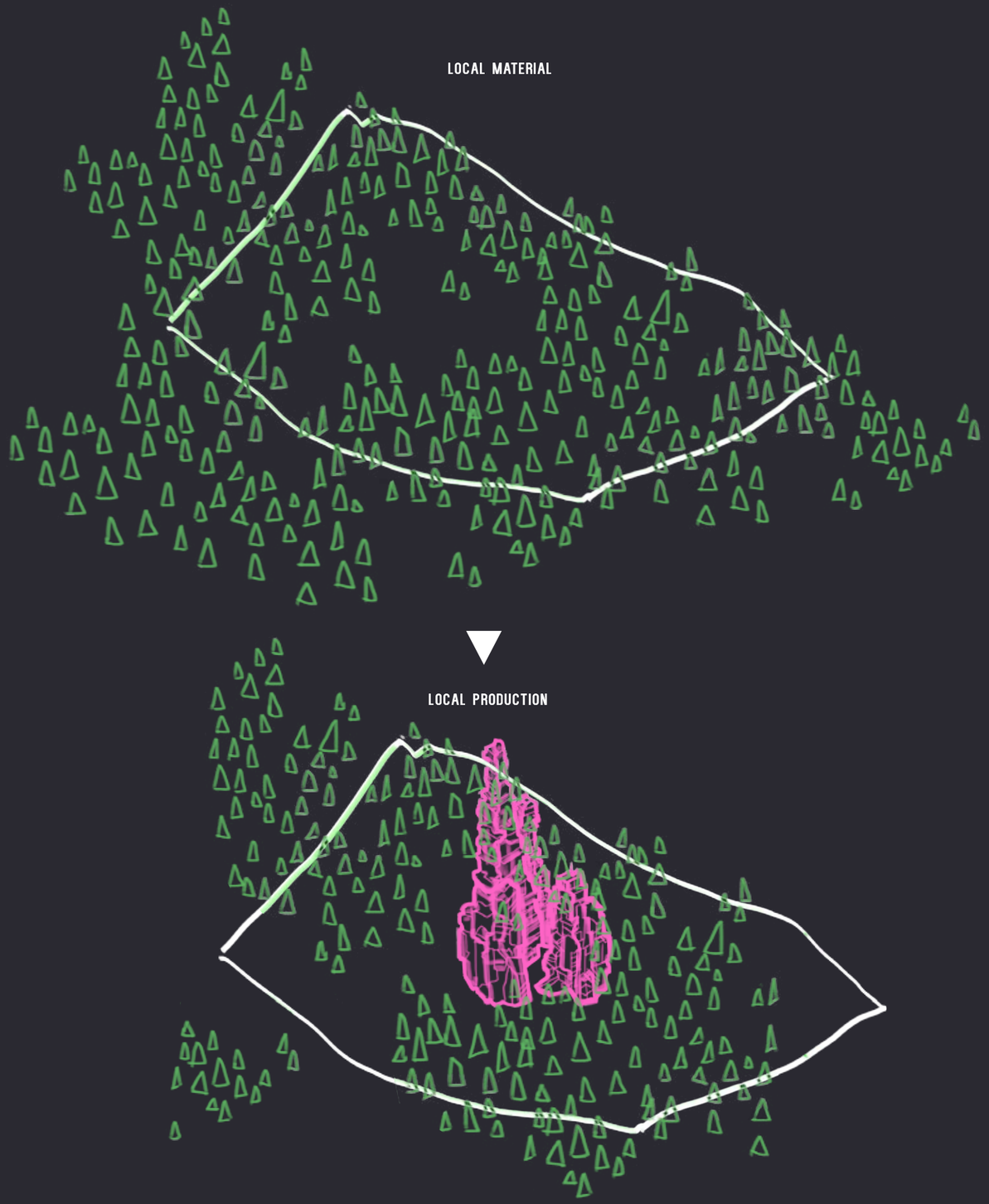
– REM KOOLHAAS

FUNCTION

A vertical village in a way is an option of optimizing a regular horizontal village. An important aspect of why this kind of building cannot easily be built in a city however is because it presumably just would be too expensive. Building mainly in wood, this kind of stepped mega structure requires a lot of space. A wooden structure needs more space than a comparable one of concrete, due to its density and loadbearing properties. It will probably prove too difficult to persuade urban developers to build a structure that takes up more space when each square meter aims to be marketable; that would somehow be regarded as a waste of "valuable space".

Instead, by placing this structure in the natural setting of a forest it spatially covers a smaller area of land than a village with the same properties would do. From an economic perspective that simply means that building higher allows for more people and cash flow made from the specific site (Yeang 1996:14). Most importantly, building vertically suggests possibilities for other spatial qualities and activities. It certainly contributes to a more dense cohesion and urban ambience compared to a regular village with a similar same amount of inhabitants.





WOOD & ENGINEERING

Nowadays, properly constructed wood could have a similar strength as steel due to new technologies in wood engineering. Due to its lightweight and good bearing capacity wood is getting used more frequently in modern tall structures as well as in bridges. It is not the material elements of wood that might limit it being used for building large wooden structures; instead difficulties could arise in the construction and maintenance. Still, when wood is used properly it resists stress and moisture from external influences. Nonetheless wood it is a smooth, durable and strong material capable for use in construction.

The combination of glue and wood has been developed into an engineering distributed material, next to that of just pure cut timber. This modern innovation could be compared with steel and reinforced concrete (Erikson 2007:99). Cross-laminated timber (CLT), is an engineered timber product that is having the sustainable credentials of wood, with the quality of concrete and steel. The use of CLT has risen dramatically the past five years. For CLT, the conditioned timber is stacked into lamellas placed at a 90 degree angle to the layer beneath. The layers are pressed and glued together using non-toxic adhesive, which creates high strength wooden panels. The only limit of the size for these CLT panes is the size of the machine that creates it; the largest ones produced so far are up to 22 meters tall.

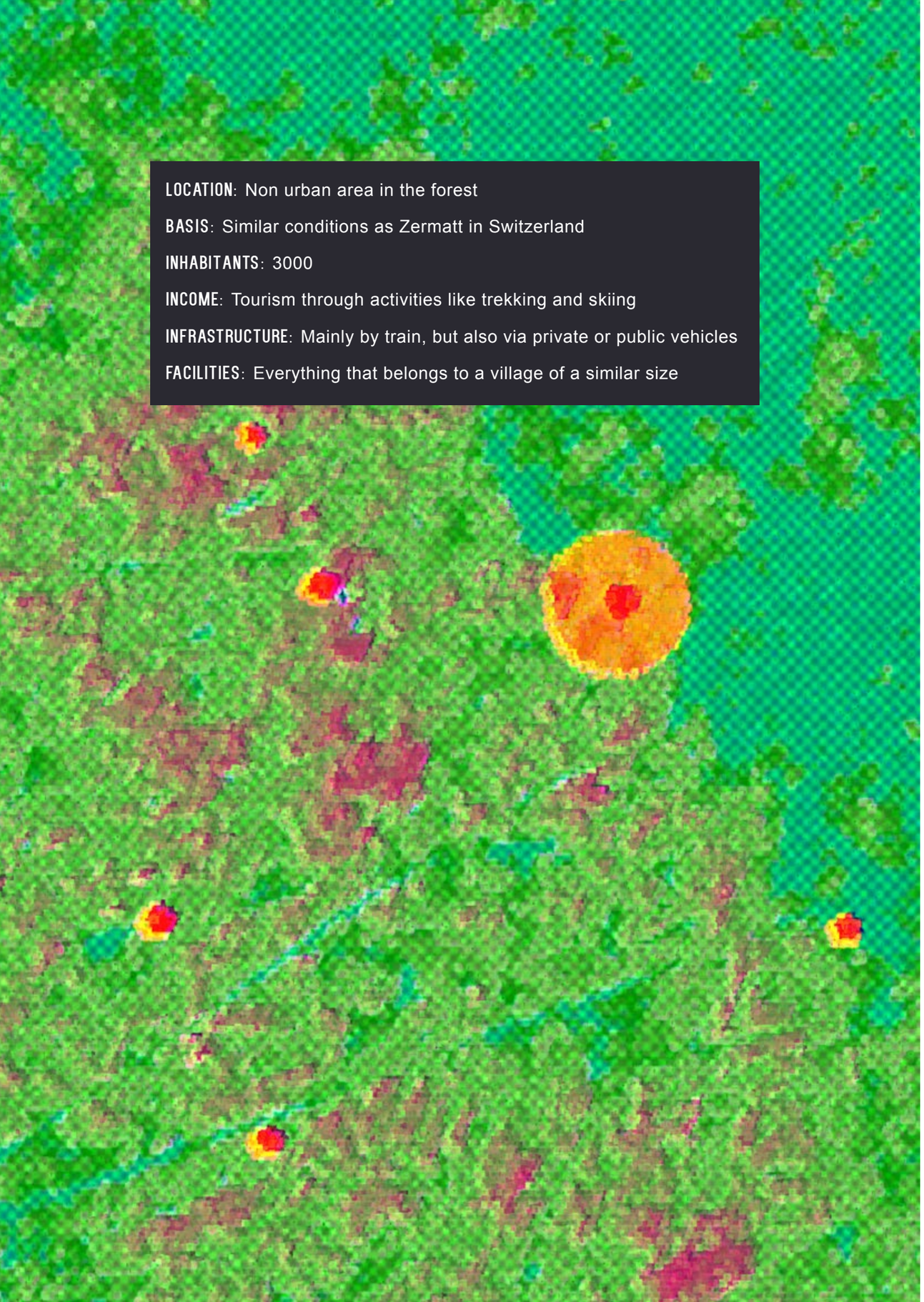
The development of wooden buildings has not evolved that much because old building statutes and regulations have set rules. After several city fires in Sweden, wood was no longer popular to build with and these prejudices and regulations have drastically affected and slowed down the development of wood building for many years. The relevance of the restrictions has also not been discussed in recent years and urban fires in Sweden have not taken place for 100 years. Furthermore, the design of large or tall houses has been completely dominated by concrete frames in Sweden since the 30's.

In comparison to regular wood, the engineered wood remains structurally stable during a fire, unlike unprotected steel subjected to such high temperatures. In contrast to timber, fabricated wood can handle fire exposure since the outer layer chars form a shelter around the core, which makes it not lose its loadbearing capacity. Depending on engineering formation and the protection of the surface, fabricated wood can resist from burning down. Still fire repellent treatment on the facade is important on tall wooden structures. Burning facades can be more difficult to save and do more damage, as shown by the fire of the Grenfell tower in the United Kingdom in 2017. On the other hand, it is most common in the case of a fire that the loose interior is set on fire, therefore the risk of fire is the same as in a concrete building when a fire starts from the interior.

La Sagrada Família
Stone construction
172 m

The Vertical Village
Wood construction
190 m

La Tour Eiffel
Iron construction
300 m



Already, engineered wood is showing engineering capabilities similar to that of other building materials such as steel (The Institution of Structural Engineers *2019)*. Still, challenges remain in the production and maintenance of such wood. Also, current (fire) regulations and perceptions of wood as a building material form somewhat of a threshold to a wider application. However, engineered wood remains structurally stable during a fire when given a fire repellent treatment, making it useful as a building material (The Institution of Structural Engineers *2019)*.

URBAN CONTEXT & INFRASTRUCTURE

Location

Even though the proposal is not an urban planning project, it still is important to highlight the unique possibilities that the wooden vertical village creates. By placing the mega-structure in nature new qualities appear, a juxtaposition forms and suddenly the high-rise gives characteristics from nature to the manmade inner atmosphere.

Since the high-rise and nature are intertwined, the structure needs a program that responses to its connection with nature. Today, unfortunately, many mixuse high-rises get typical floor plans, basically similar copies stacked vertically. This design proposal highlights the possibilities of creating a vertical village, using the program, functions and diversity of a village. This of course makes the development of a high-rise even more complex and expensive. Contrariwise the design proposal features the interesting possibilities this brings forward, especially while focusing on the connection to the surrounding nature, which creates completely unique circumstances for the atmospheric conditions. It aspires to show that a comfortable modern urban setting with brutal powerful nature as a neighbour is indeed possible.

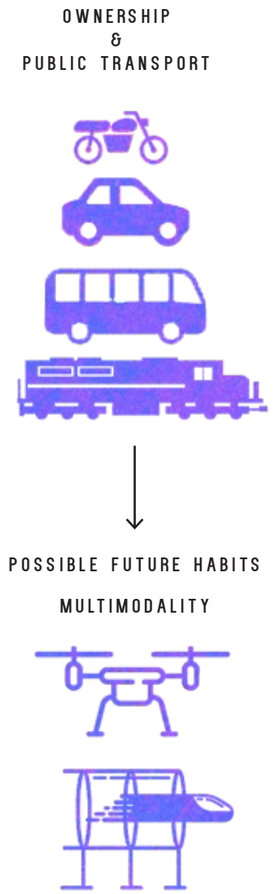
Urban planning wise, high-rises close to nature are nothing unique or strange, Manhattan is adapted to Central park, Hong Kong and Cape town are adapted to the surrounding natural reservoirs. Urban life close to nature is nothing novel in that sense. Additionally, this design project is not about a city, it is a proposal of a vertical village hosting around 3000 inhabitants. In order to ensure that the discussion on this design project is not about urban planning and urban problems, the framework is based on the conditions of an alpine village. The proposal is given a similar plan, even though it is vertical compared to a typical village, which is horizontal. The framework and assumptions for the regulations are to have roughly the same starting point as the village of Zermatt in Switzerland; in terms of population, tourism, infrastructure, supply and communication. Albeit a difference between the wooden vertical village and Zermatt lies in the second one having a higher fluctuation in the seasonal amount of tourists.

The vertical village in the woods can be a destination with a range of facilities. A mix of hotels, dwellings, offices, restaurants, schools, cinemas, shops and more, maintains a dynamic and public realm throughout day and night. The assumption furthermore is that people live here throughout the whole year and that a major source of income is tourism, especially coming from hiking and skiing. Residents and visitors are to be able to work and live within a densely planned area where all amenities are within walking distance. Everything that belongs to a regular village will also belong in this mix-use proposal: people will have fights, commit crimes and vandalize just as everywhere, and this cannot be completely avoided through a design. People will often follow their own paths, thereby a mix-use structure also presents a balance of energy with different uses and activities of areas at different times.

Transport

Based on the framework, the proposal assumes that most communication with the surrounding area will be via high-speed train and regular transport by car or bus. No research has been done in this area, but the design proposal assumes that there is both a road and a train connection directly to the structure. Probably there will be faster and easier means of transport in the future. When such inventions become commonplace, our buildings and cities will surely need to adapt. It is yet unknown however in which way this development will go. Due to its futuristic setting, the design of the building assumes for example that some new form of air transport will become possible in the future. That is why the high-rise contains stepped terraces which can be used as landing platforms. Easy access to the structure through public and private transport connections also means that there will be more visitors and the need for parking is reduced.

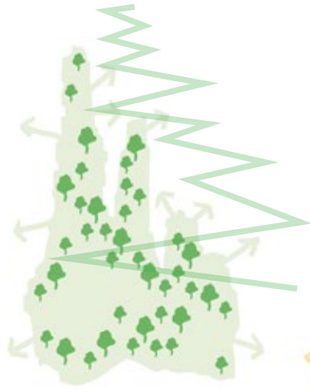
With all these connections to the surrounding area, living in nature does not have to be as isolated as it might sound. Nonetheless, in which way the wooden vertical village connects and communicates with the adjoining areas, and the complex urban planning challenges involved, are not focussed on by this proposal.



"STUDY NATURE, LOVE NATURE, STAY CLOSE TO NATURE. IT WILL NEVER FAIL YOU."

– FRANK LLOYD WRIGHT

VISIONS



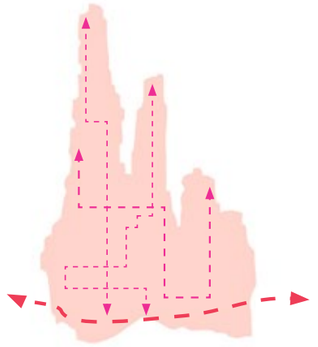
TERRACES WITH CONNECTED WALKING TRAILS

DESTINATION

INVENTED BY MODERN TECHNOLOGIES

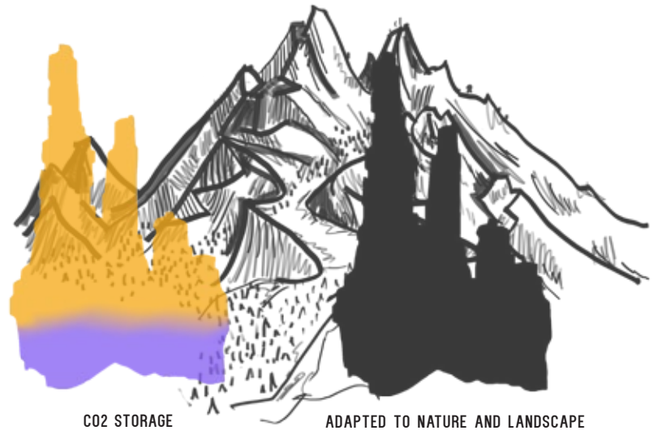
MIX-USE

ORGANIC WOODEN STRUCTURE



INTEGRATED COMMUNICATION & TRANSPORT

ACTIVITIES: STROLLING / TREKKING TRAILS



CO2 STORAGE

ADAPTED TO NATURE AND LANDSCAPE

RELATED THEMES

Building vast requires economy, meaning that copious of other factors are involved and everything is no longer about architecture (Koolhaas, Mau & Sigler 510:1997).

A huge building project automatically becomes a political, economic and urban interaction. This chapter reviews the practical parameters of the project, how the thesis questions can be put in a whole discussion about the building development of today and tomorrow. Important to highlight here is that this section on related themes assists in helping to get a deeper understanding of the topic, but does not forms a part of the design proposal.

Sustainability

Using more and more wood might seem confusing since it was reported in July 2019 that every minute an area the size of a football pitch is cleared in the rainforest of the Amazons alone (Shukman:2019). Therefore, the production of wood must be controlled and done responsibly; otherwise areas will keep deforesting at alarming rates.

On the other hand, wood requires relatively little material to be processed and residual material can be used to replace fossil fuels. The wooden products can also be reused and eventually replace fossil fuels by becoming energy. A growing forest binds carbon dioxide and wooden building even give a perennial delay of carbon dioxide emissions to the atmosphere. This makes it far more ecologic than concrete, metal and plastic; a distinct advantage for big projects and urban areas.

The choice of material for a structure consequently becomes important in sustainable constructions since it effects and impacts the life cycle of the structure. Thanks to the sustainable managed, carbon-capturing and fire-retardant properties, wood and timber are clearly the best construction elements to use (Jodido 2011:6). In the end, an unbeatable fact and reason to use wood is that it practically is the only renewable and widely available construction material we have access to.

Forest industry

Building in wood is not novel. The majority of all residential buildings in the US for example are made of wood. Also in Europe more contemporary large long-term wooden structures are being built every day.

Even though it is associated with antique woodland huts, innovations in the timber industry are making the forest easier to use. The forest is providing more functions and gives a global desire for this brilliant source (Jodido 2011:6). Furthermore, modern smart wooden buildings require less energy today, and with new machines and robots the process for production can also provide for low energy consumption with high perfection (Erikson 2007:66-67). New machines and robots will make it possible to create new systems and details, also to calculate and help against error during construction, thereby speeding up the building process as well.

Economy and urban future

The macroeconomic free market strategies set the foundation of the globalisation of today and with that a shift of climate, power, urbanisation and innovation (Schätz 2017). According to PwC, a global construction output of $15 trillion is expected by 2025, with rising markets in India, China and the USA, mainly in fast growing urban agglomerations. With this continuous expansion and growth, some cities might reach a looming point of efficacy.

People might just like to be surrounded by other people; cities are simply a hyper efficient system that is the result of the combinatory forces of great infrastructure and density (Schätz 2017). As the city population grows, so does our need for more resources.

For the first time in history, more than half of the population of the world lives in cities and urban areas, caused by the process of urbanization and the rise in global population growth. This continuous increase has had a great impact on urban habitats, natural environments, technological development and industrial expansion. Analysing these changes, we can think about what kind of cities we can expect to develop in the future and what their characteristics might be.

The growth of cities gives abundant opportunities, Hong Kong for example is working well from an infrastructure perspective, but according to a report by the International Centre for Urban Design and Mental Health the effect of high density on psychological health is negative (Centre for Urban Design and Mental Health, 2017). The promise of possibilities, wealth and jobs makes it attractive to live in dense cities, but also easy to neglect what the lack of space, light or nature does to our health.

Density

The city offers jobs and dreams, but counters that with expensive housing. Overpriced rents, poor paid jobs, cheap services and products also work as engines for the economy. A city is always a great mix of people and business, but it might grow too fast, uncontrolledly, be overpopulated and create places without any control and rules. At some point all cities seem to hit a threshold, beyond which at least parts of the city turn into unhealthy places to live in, which are too dense and and full of constant traffic jams.

This could possibly also apply to this thesis proposal of a high-rise in nature. Building with the sky as the limit could make the construction become overcrowded or very dense, similar to the example of the former walled city in Kowloon, Hong Kong, or for instance, the Nakagin Capsule Tower in Tokyo, Japan. The proposal of living in the woods could form a tight-knit community, but with a risk of becoming extremely dense or paradoxically even abandoned.

A village needs sufficient supplies and infrastructure just like a city, this has not been developed in the design proposal but it still is important to point it out. Yet, this proposal could contain all the features that a village, or smaller community needs, but once the construction has reached its building capacity, the building could still become overcrowded. Perhaps the vertical village proposal could be expanded more horizontally, or it could frankly become the dramatic death of the building making life not worth living there.

However, to be or to live in one specific location might not be that important in the future due to globalisation, combined with new technologies and improved infrastructure, making the delivery of products and services faster and easier. Regardless of personal finances, living in a healthy manner may become more important and this will make it less attractive to live in the centre of a city since the same opportunities nowadays offered by city living will also exist elsewhere. This growth of globalization can possibly create a shift, where the city is not that attractive and promising anymore.

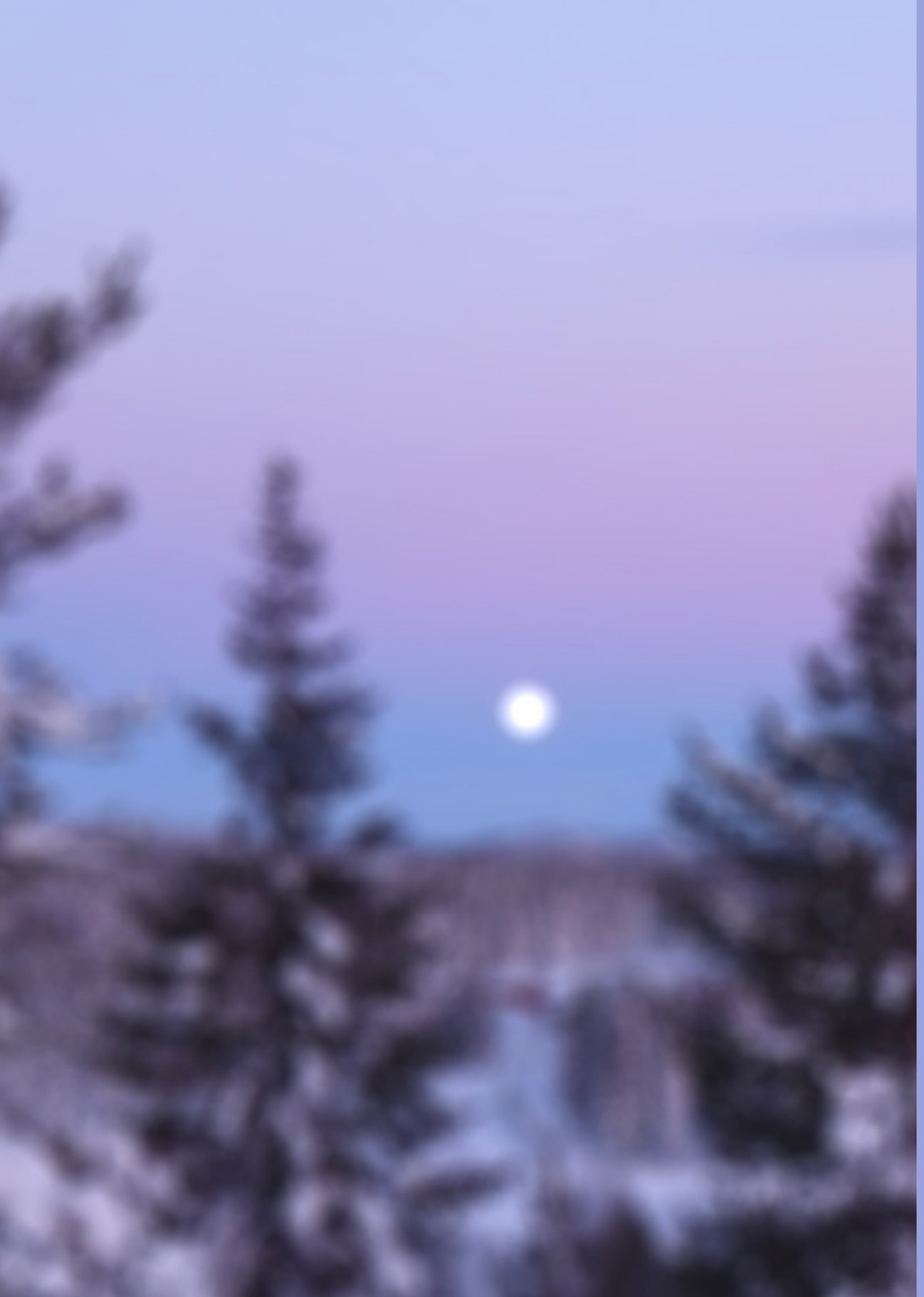
The former walled city, in the Kowloon area of Hong Kong, is an example of what can happen when a place becomes overcrowded: laws and regulations cannot be followed, the amount of informal settlements grows and the most vulnerable people become the most defenceless. The walled city basically was a vertical slum area born in the city centre of Hong Kong. Due to the density the air quality was bad, it was always full of noise and also full of safety issues. But at the same time it was also a very well working community with services such as private owned shops and healthcare (Wall Street Journal, 2014). When the municipal government tore down the area huge protests arose. The dwellers were attached to the place; their business and home were all located in this dense building structure (九龍城寨 - Kowloon walled city Hong Kong, 2015).

Utopia

Eventually, this is how many cities look like today: an immense urbanisation combining wealthy areas next to poor areas, and still more walled cities seem to be growing around the world, from China to Kenya. Again, the city gives some hope for a better future for everyone, but the lack of space creates dwellings beyond pleasantness and quality, turning dreams into nightmares.

To deal with these issues, there has been a multitude of examples of unsuccessful utopian architecture projects throughout history. Most attempts to create the absolute community have failed dramatically. It might be important to point out that this design proposal does not aim to create a story of a “greenwashed” utopian village in harmony with nature and people. Nor does the proposal attempt to stand to be beautiful; rather the aesthetic interest should lie in the tactile encounter of nature and mankind, while at the same time showing the exposed obliquity of the supporting structure. Related is a quote by Dutch architect Rem Koolhaas: “Talk about beauty and you get boring answers, but talk about ugliness and things get interesting.”(Spiegel, 2006), the discussions on the walled city of Kowloon might be as curious as those on the visionary arachnology Arcosanti in Arizona by Paolo Soleri.

There are many interesting aspects of discussing such experimental social theories and results. This thesis project might lead to opening discussions on utopian architecture. Yet, such matters are far too complex and broad to be tackled in this thesis proposal, and thus it does not tries to do so.

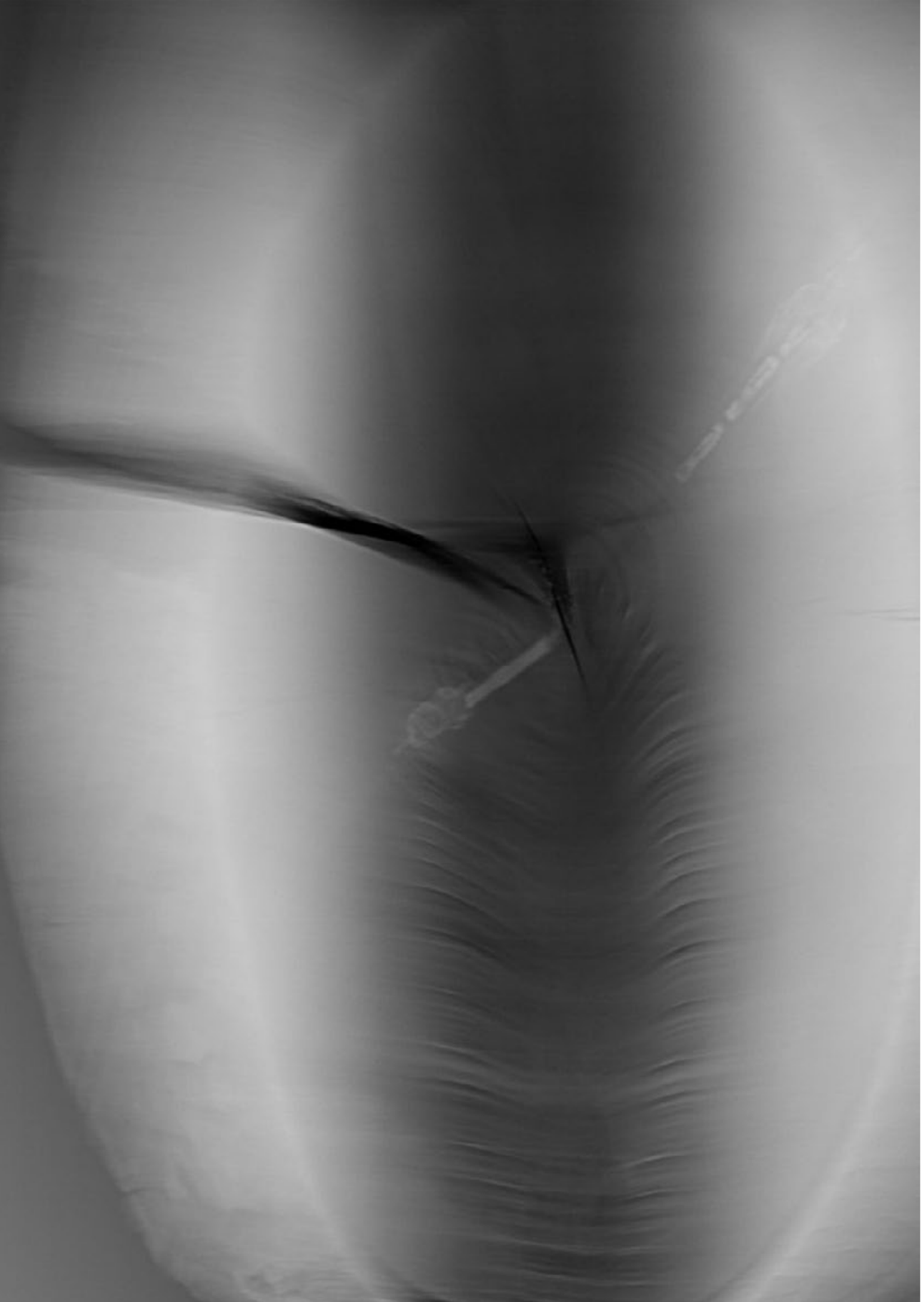


ANALYSIS & INVESTIGATIONS

XS – XL

MICRO & MACRO PERSPECTIVES

XS ,S,M,L,XL



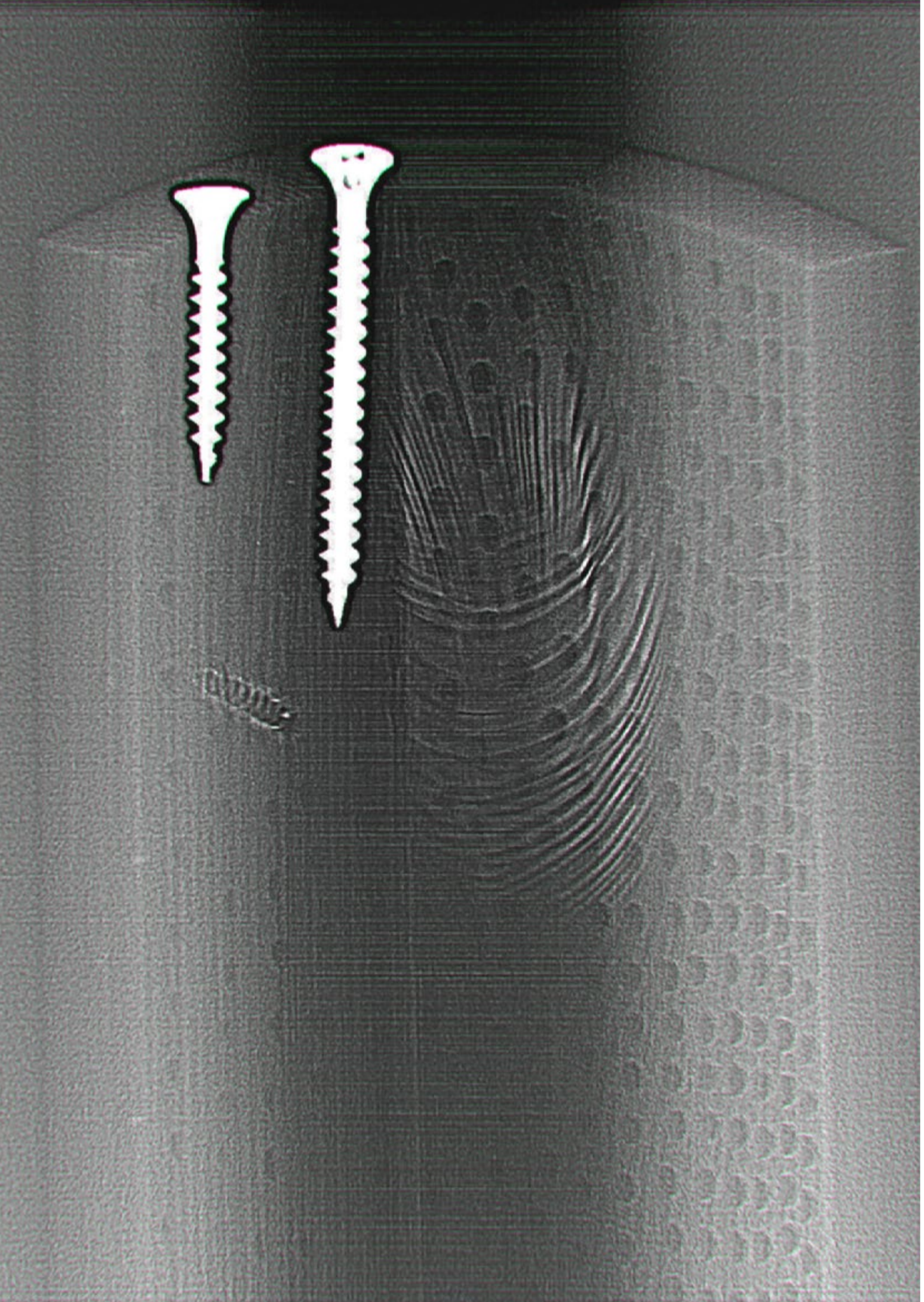
SCALE STUDY: 2:1 ***MICRO PERSPECTIVE***

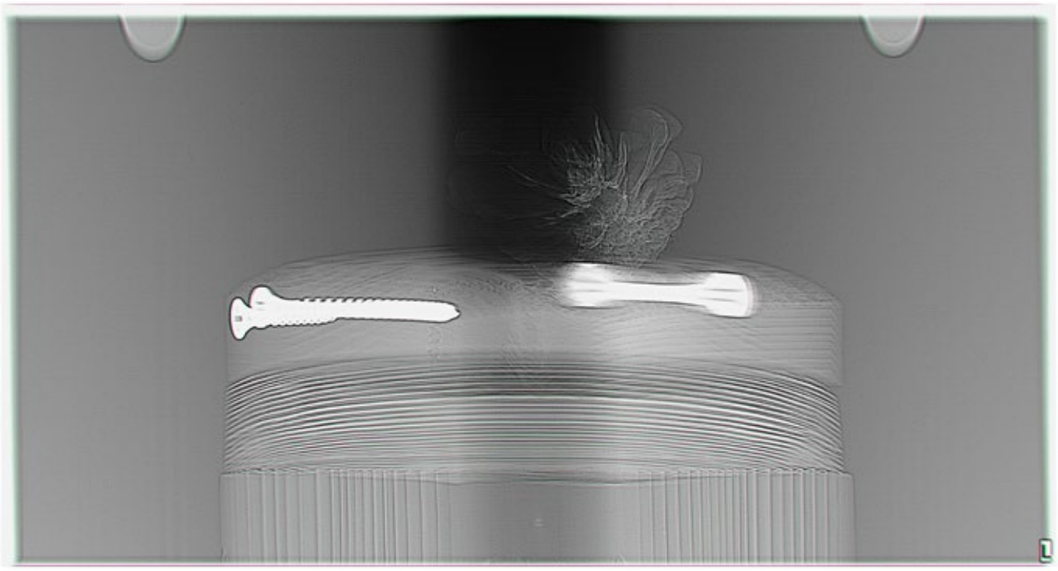
MATTER: Pine wood

X-RAY: ***Above,*** a part of a big branch. ***Left,*** a log with inner crack, due to an outgrowing branch with inner resin.

ANALYSIS: - THE BEAUTY OF IRREGULARITIES

The organic growth becomes even more obvious under the surface, containing an inner fibre system grown for many years. The material is still “alive” after cutting it down, resin might leak out and cracks might occur still hundred years after construction. These organic irregularities and self-developing properties inside the wood makes it interesting to analyse, every branch has it own organic shape and fibre direction, as unique as a human fingerprint.





SCALE STUDY: 2:1 ***MICRO PERSPECTIVE***

MATTER: Pine wood with screws and holes

X-RAY: ***Above,*** wooden pieces in different directions with screws and a pinecone on top. ***Left***, a piece of wood with screws, screwholes and a branch.

ANALYSIS: - THE BEAUTY OF IRREGULARITIES

The X-ray study presents the material in an honest and pure way, whereas there is no sameness or nothing to hide. No paint or sanding machines can hide those organic years of growing and external influences; it remains inside the wood, visible but not touchable. This analysis would be dull if done on concrete, stone or plastic.

XS,S,M,L,XL

SCALE STUDY: 1:1 MICRO PERSPECTIVE

MATTER: Pine wood in 50 different ways

SMELL AND TACTILITY: The fantastic thing with wood is its ability to affect the senses with texture and smell depending on how it is treated.

ANALYSIS: THE POSSIBILITIES

Exposing and treating the matter in different ways might affect characters and emotions. By simply treating the surface even the engineered machine-made wood becomes tactile. The loadbearing system can be celebrated for its materiality as well as sustainability. Texture and spirit of wood changes due to the extremes, it becomes almost sculptural, yet imperfect, the essentials are in the properties of the matter, whether the result is about beauty or opposite.

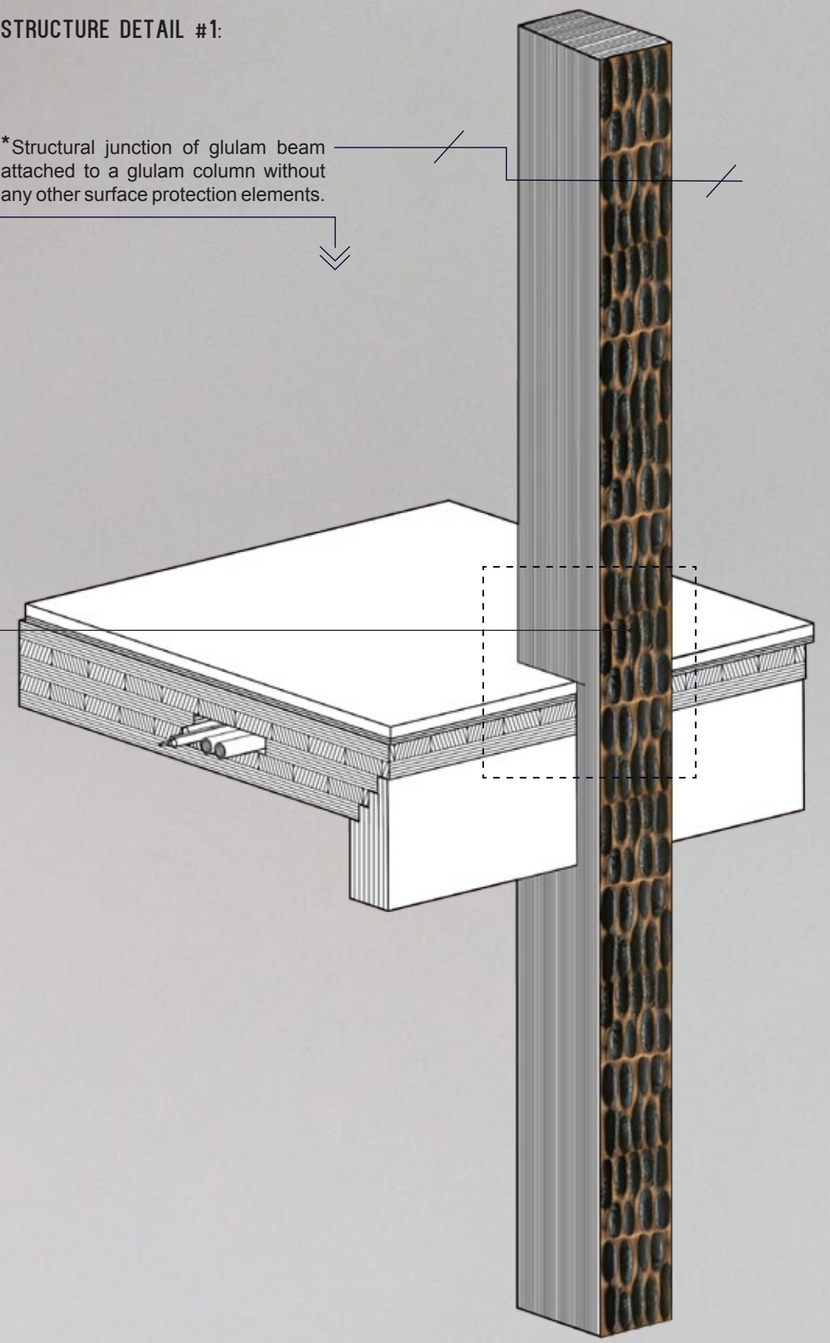
TOUCH ME AND SMELL ME!

XS,S,S/M,L,XL

DETAIL DRAWINGS

STRUCTURE DETAIL #1:

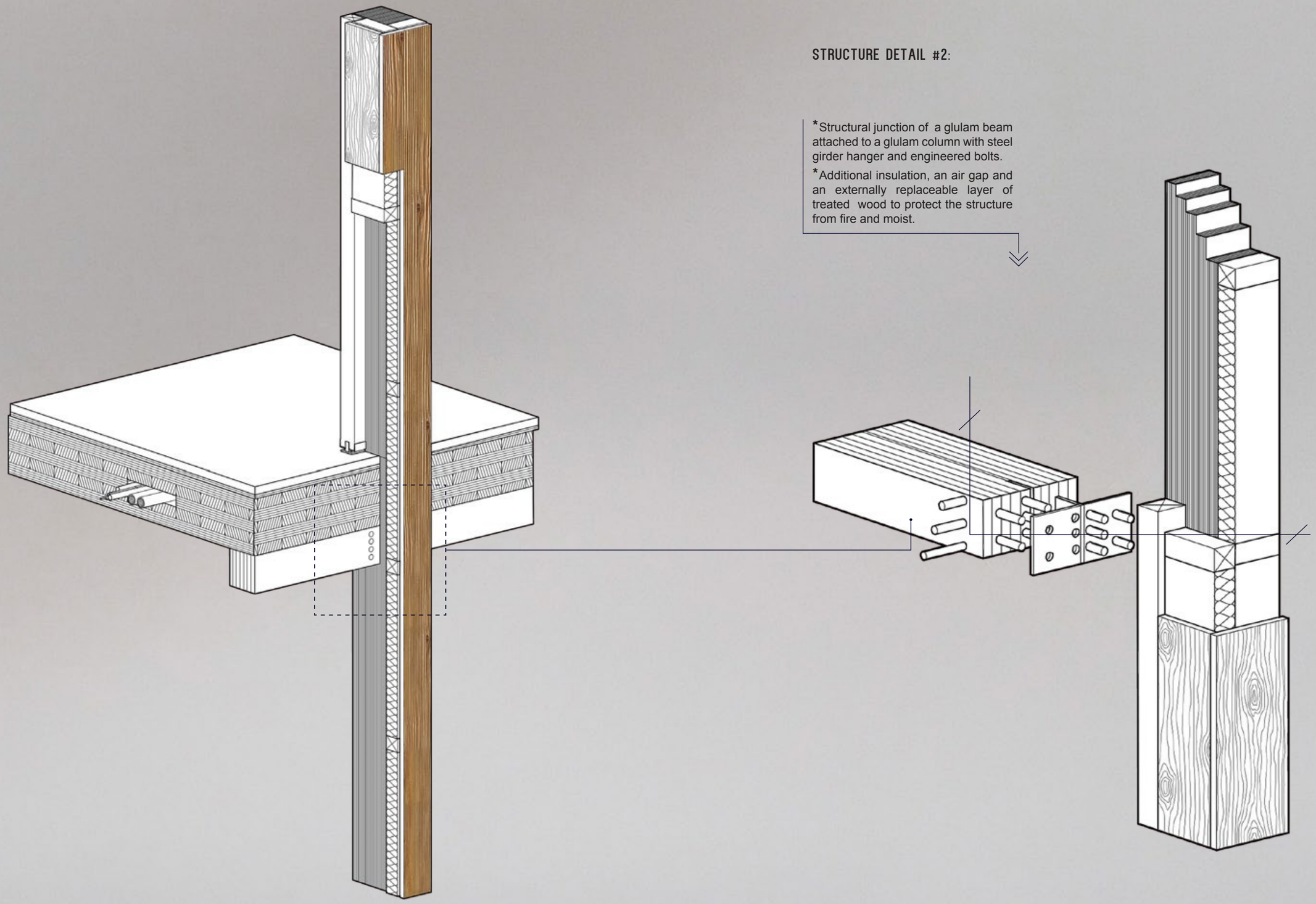
*Structural junction of glulam beam attached to a glulam column without any other surface protection elements.



STRUCTURE DETAIL #2:

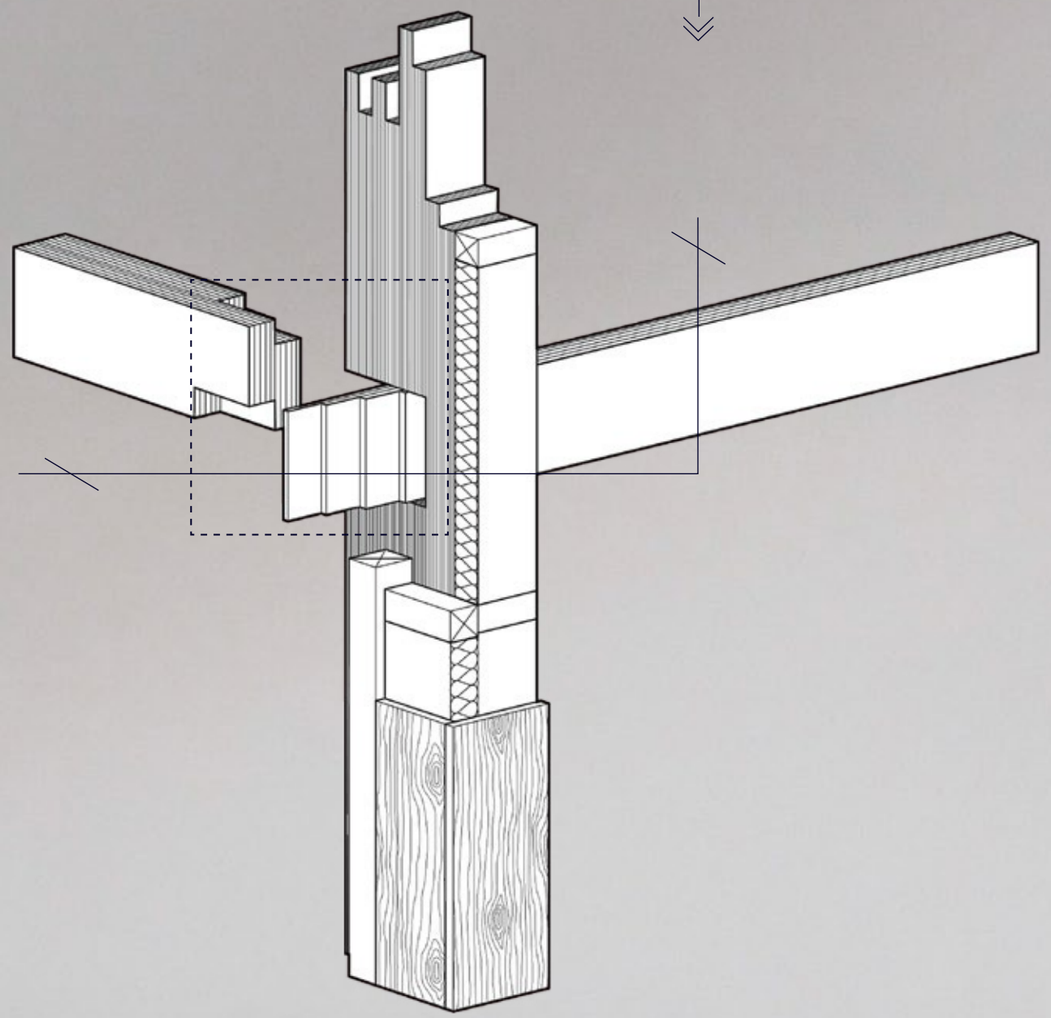
*Structural junction of a glulam beam attached to a glulam column with steel girder hanger and engineered bolts.

*Additional insulation, an air gap and an externally replaceable layer of treated wood to protect the structure from fire and moist.



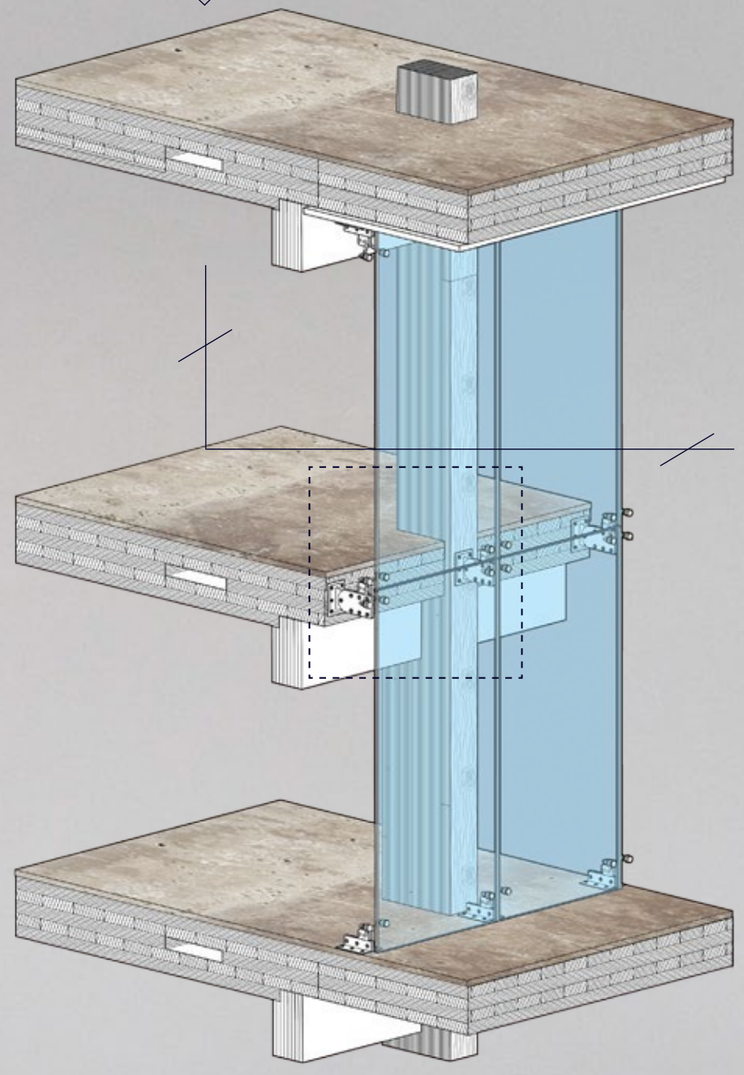
STRUCTURE DETAIL #3:

*If assuming that we in the future can make engineered wood on site with new technologies, then the beams can directly be incorporated within the columns by combining glulam and CLT.



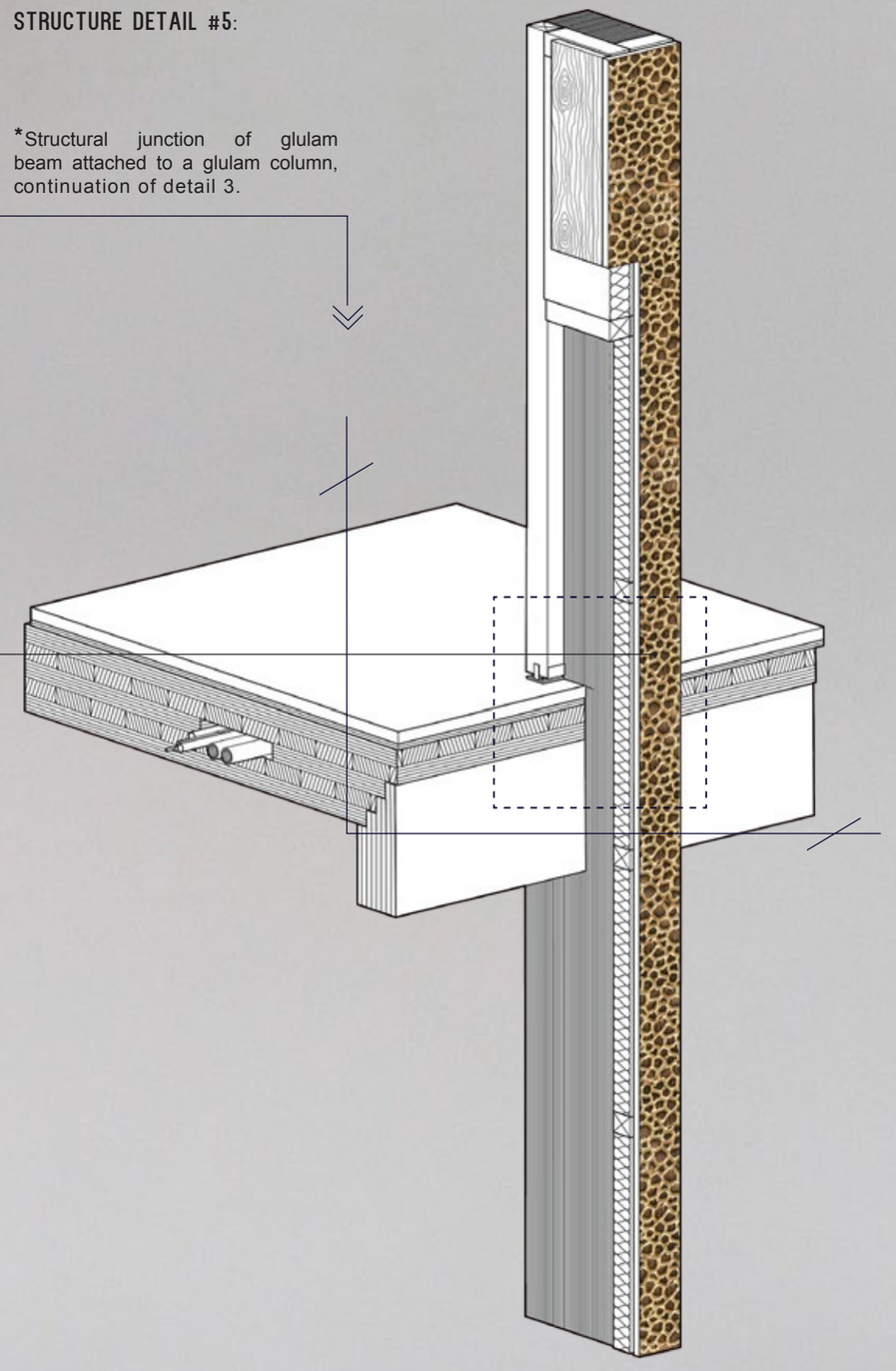
STRUCTURE DETAIL #4:

*Windows can be placed outside the structure to protect against external impacts. By covering the floor with concrete or rammed earth, the structure can be more heavy and silent as well. Together, it protects against moisture and fire.



STRUCTURE DETAIL #5:

*Structural junction of glulam beam attached to a glulam column, continuation of detail 3.

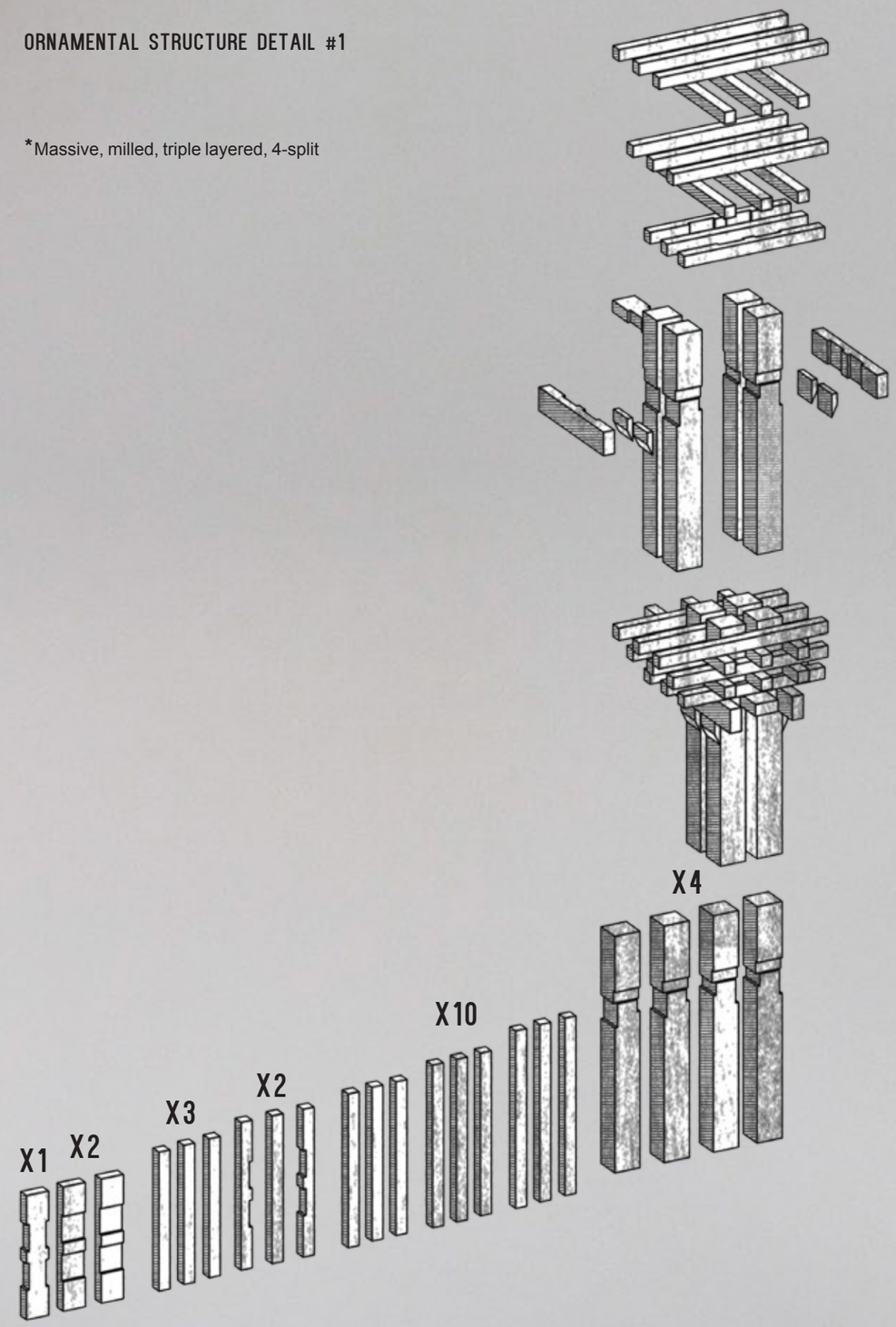


STRUCTURAL
JOINTS

XS,S,M,L,XL

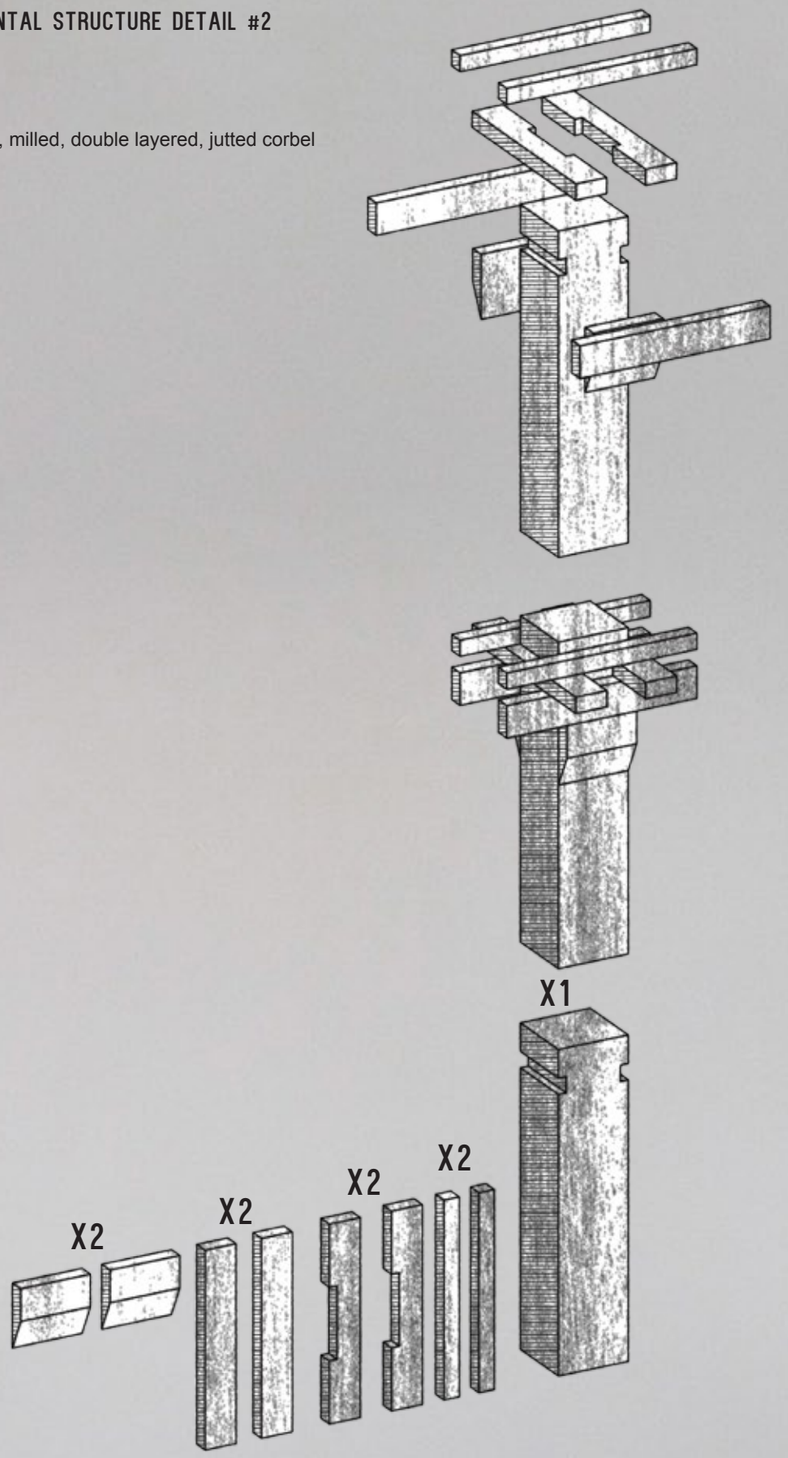
ORNAMENTAL STRUCTURE DETAIL #1

*Massive, milled, triple layered, 4-split



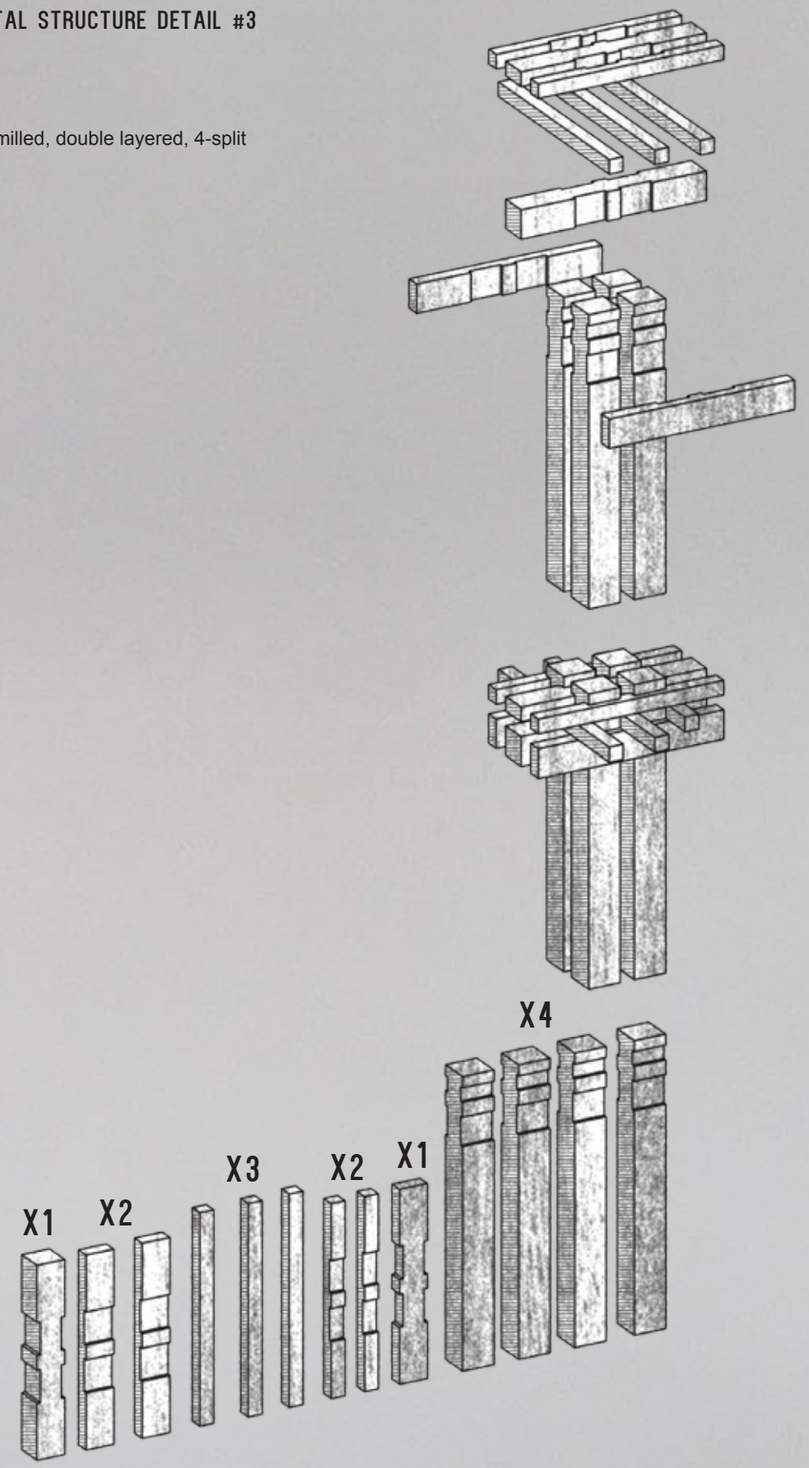
ORNAMENTAL STRUCTURE DETAIL #2

*Massive, milled, double layered, jutted corbel



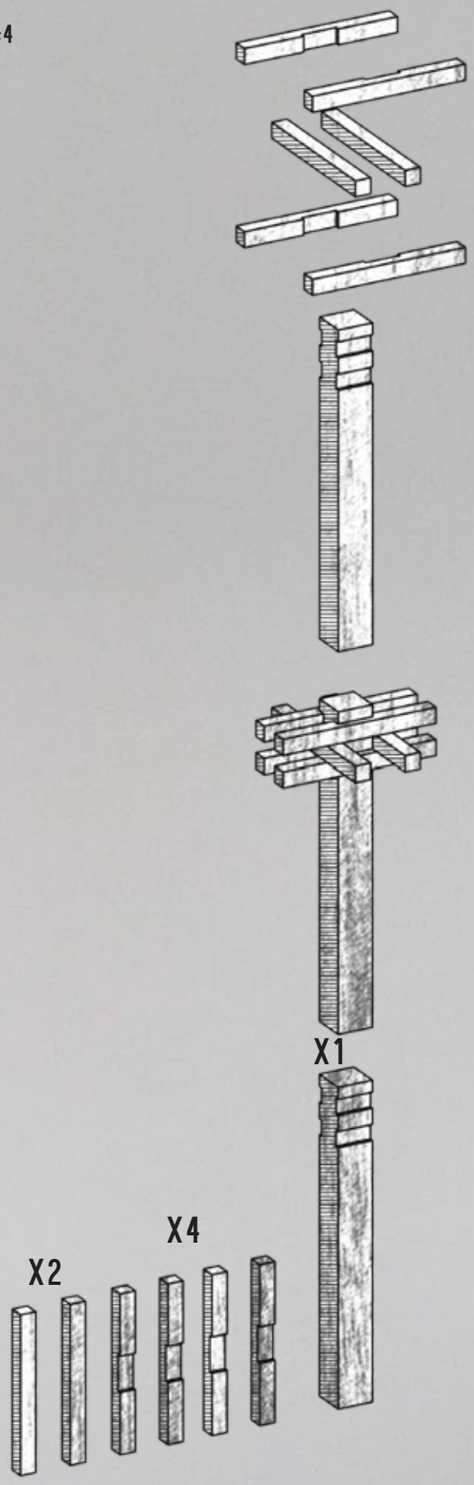
ORNAMENTAL STRUCTURE DETAIL #3

*Massive, milled, double layered, 4-split



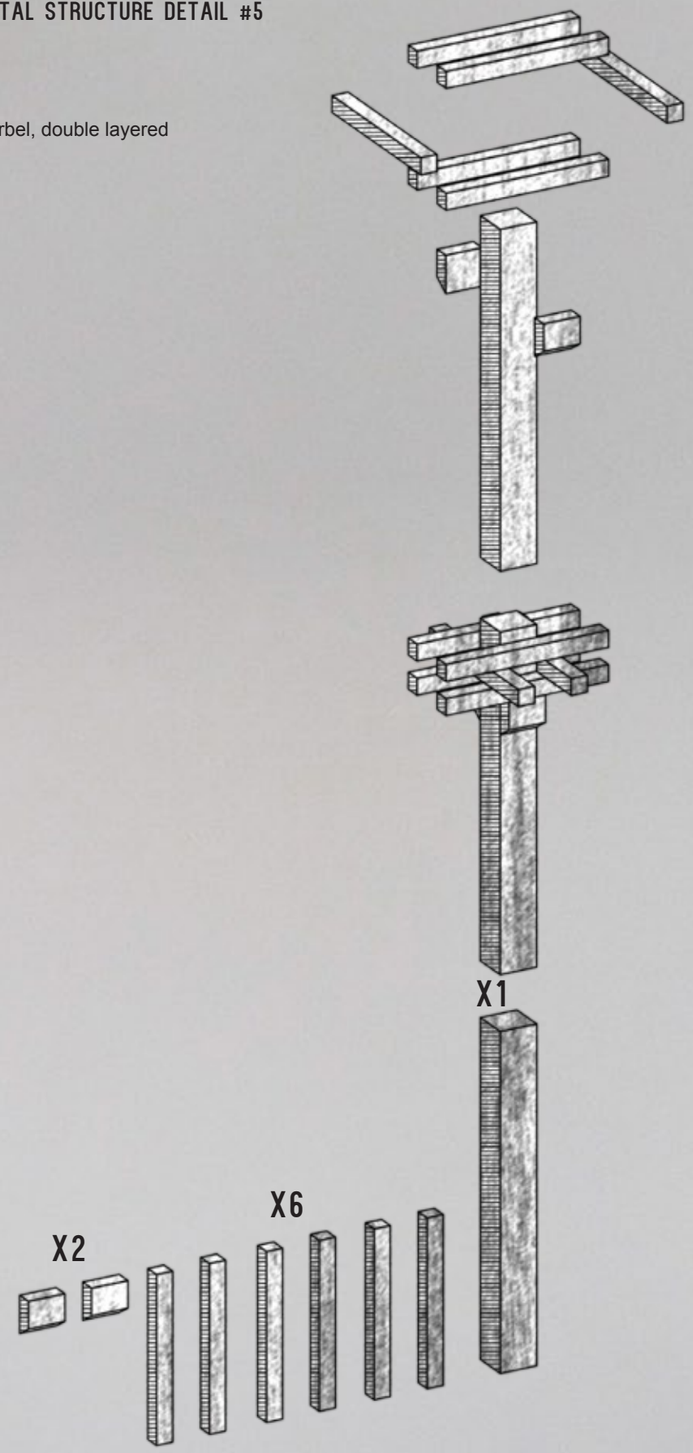
ORNAMENTAL STRUCTURE DETAIL #4

*Milled, double layered



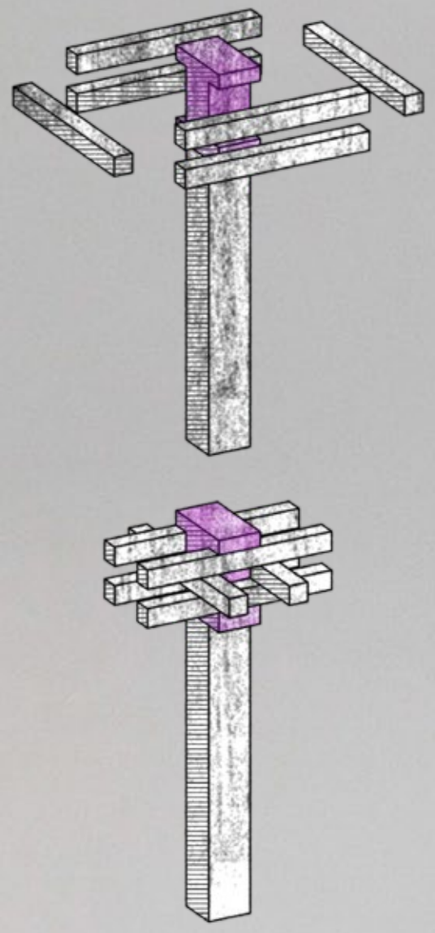
ORNAMENTAL STRUCTURE DETAIL #5

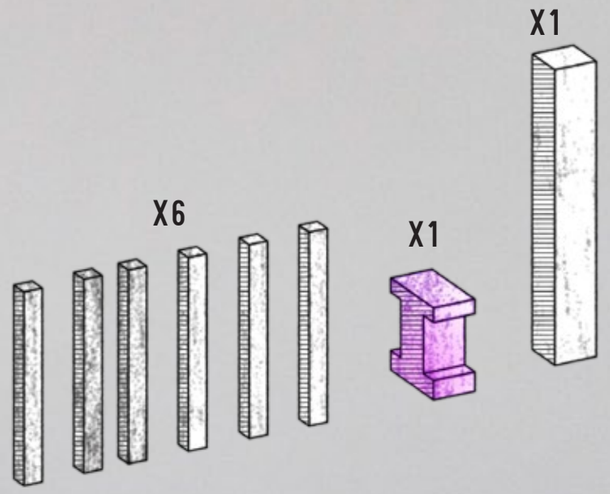
*Jutted corbel, double layered



ORNAMENTAL STRUCTURE DETAIL #6

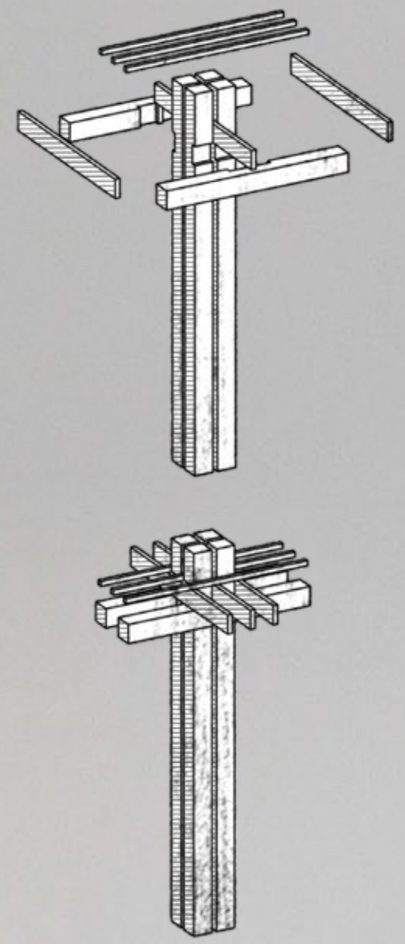
*Concrete junction, double layered

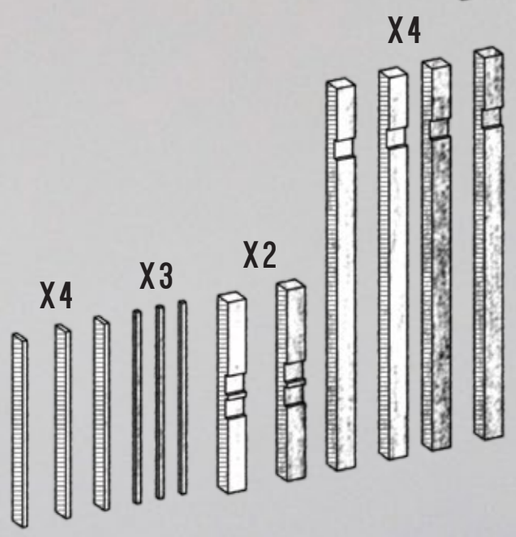




ORNAMENTAL STRUCTURE DETAIL #7

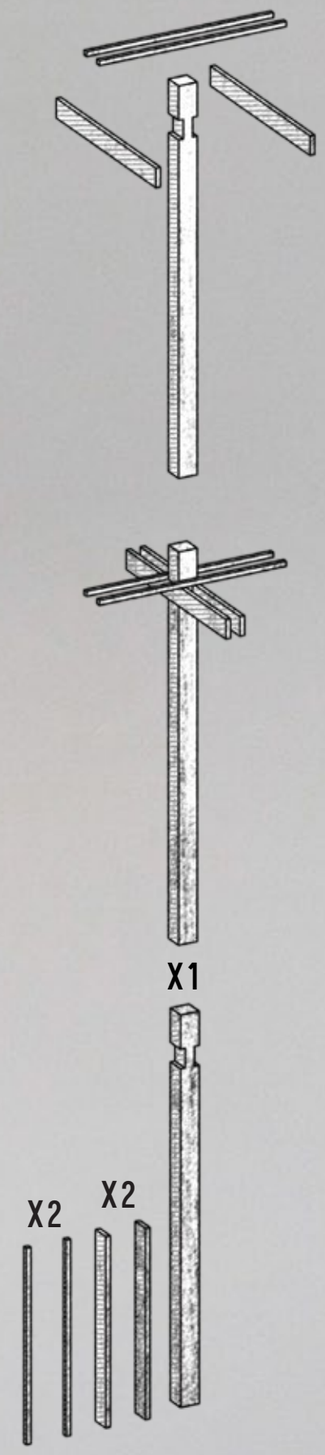
*Slim, milled, 4-split

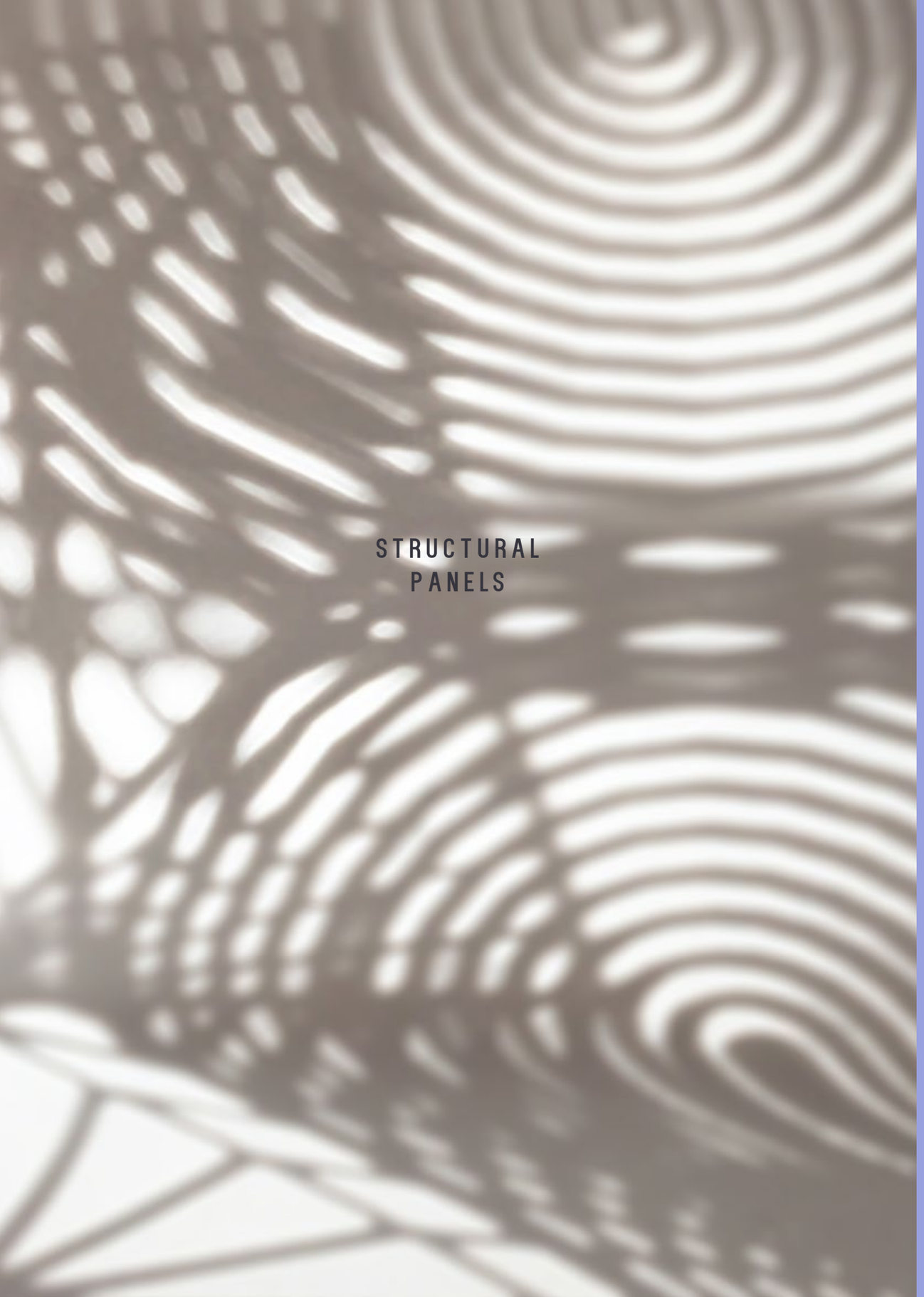




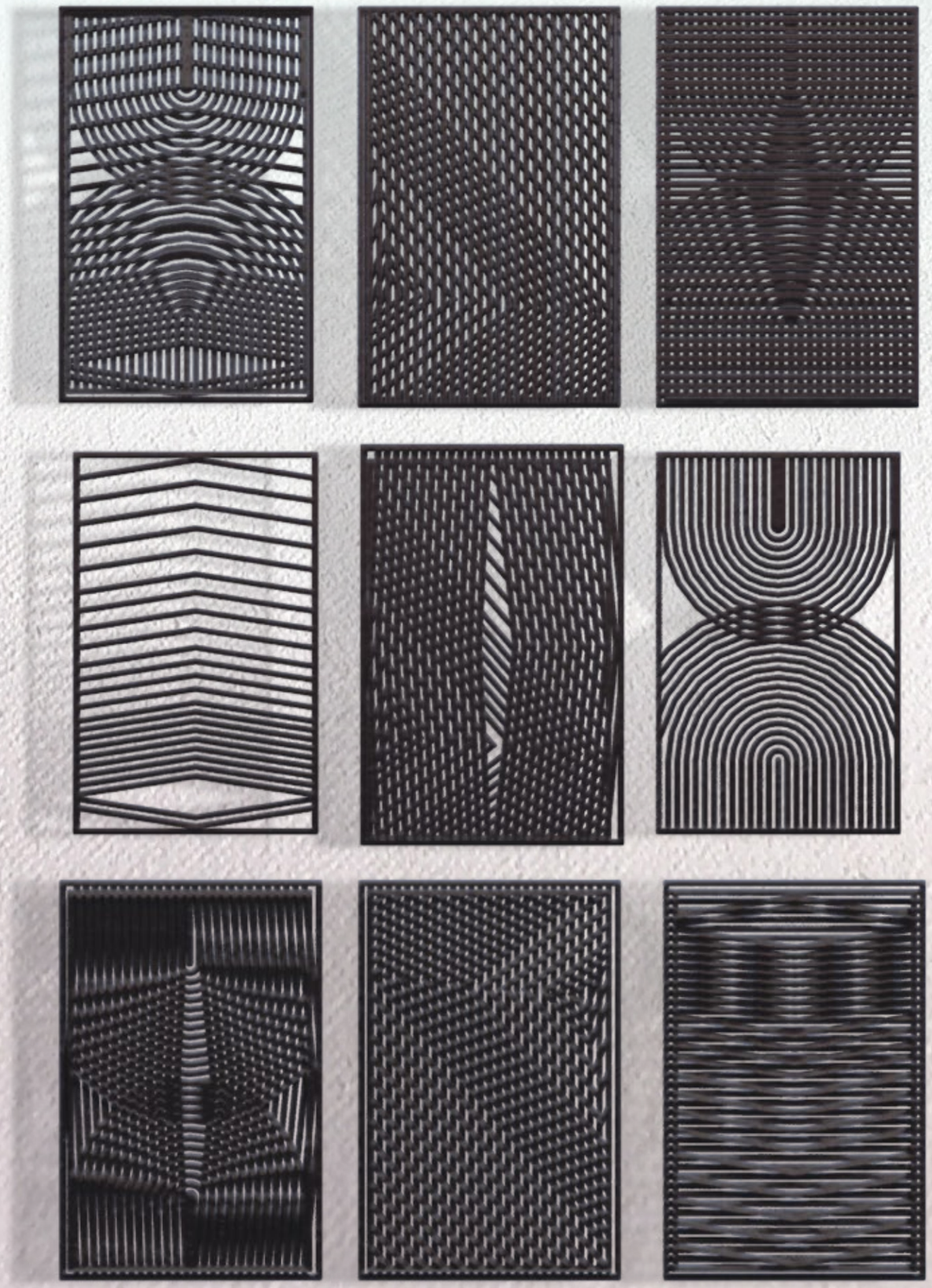
ORNAMENTAL STRUCTURE DETAIL #8

*Milled, super slim





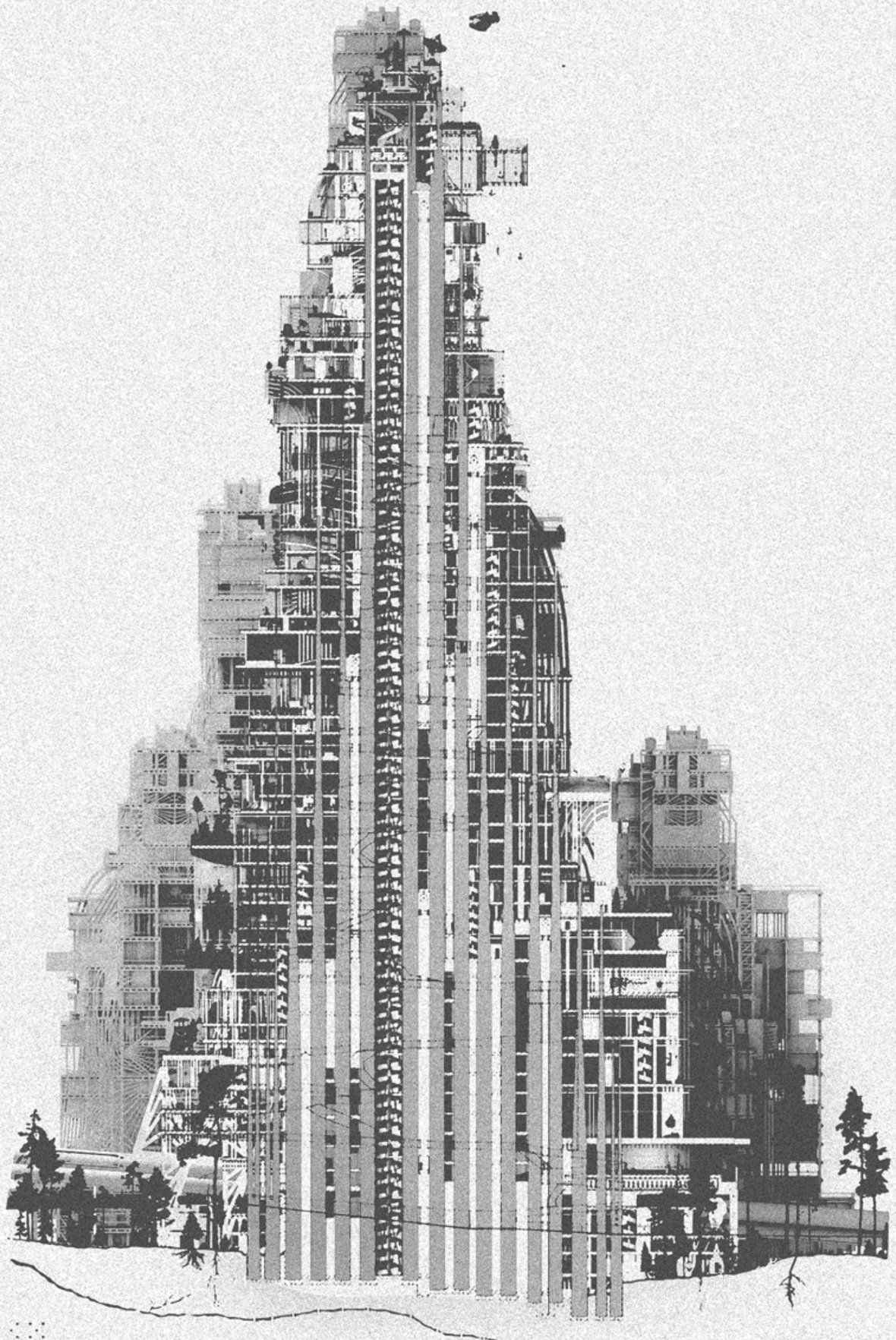
XS,S,M,L,XL



- THE BEAUTY OF THE STRUCTURE

STRUCTURAL PANELS OF ENGINEERED WOOD

*These structural panels show the possibilities of making interesting shapes with engineered wood, that can also contribute to interesting illusions or shadows. It becomes ornamental and at the same time it provides loadbearing stabilizing functions.



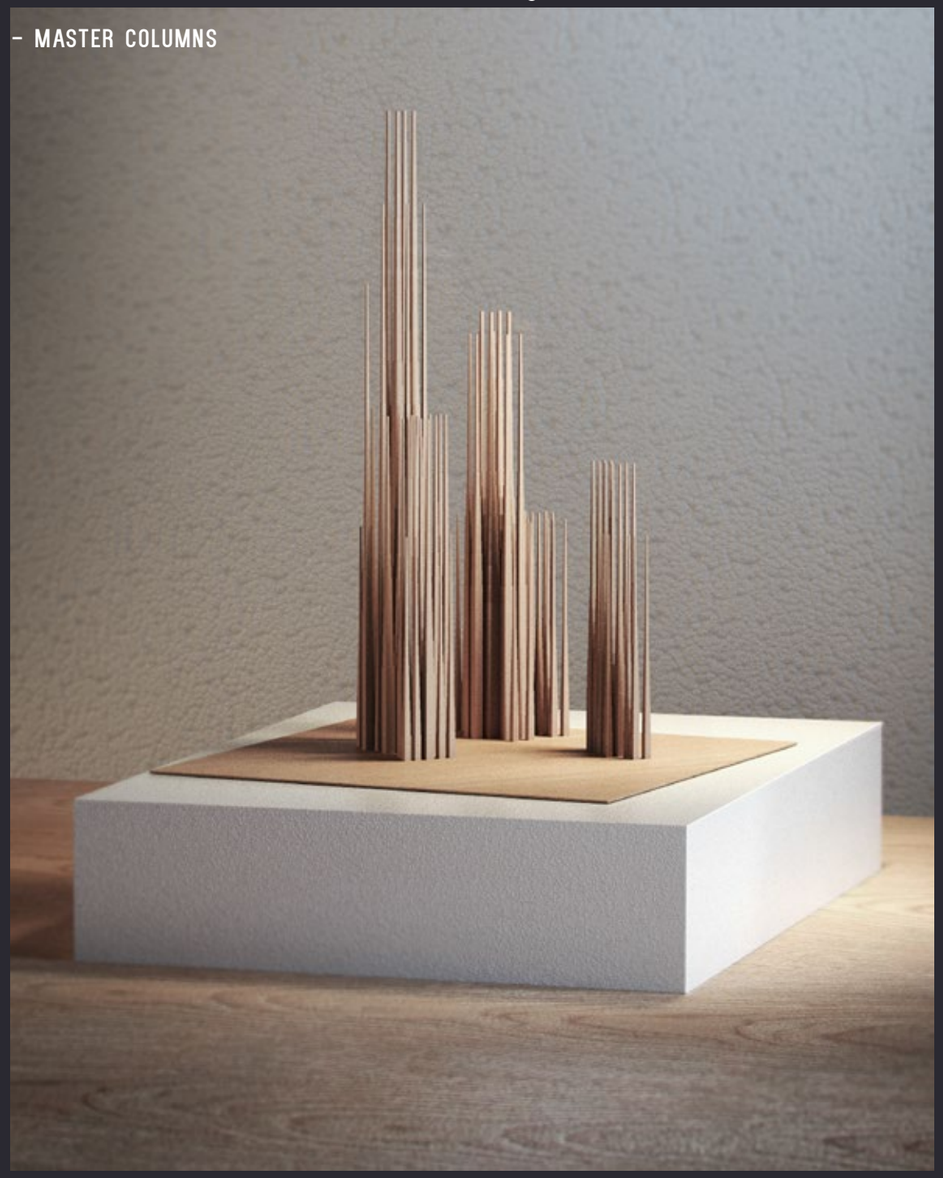
XS,S,M,L,XL

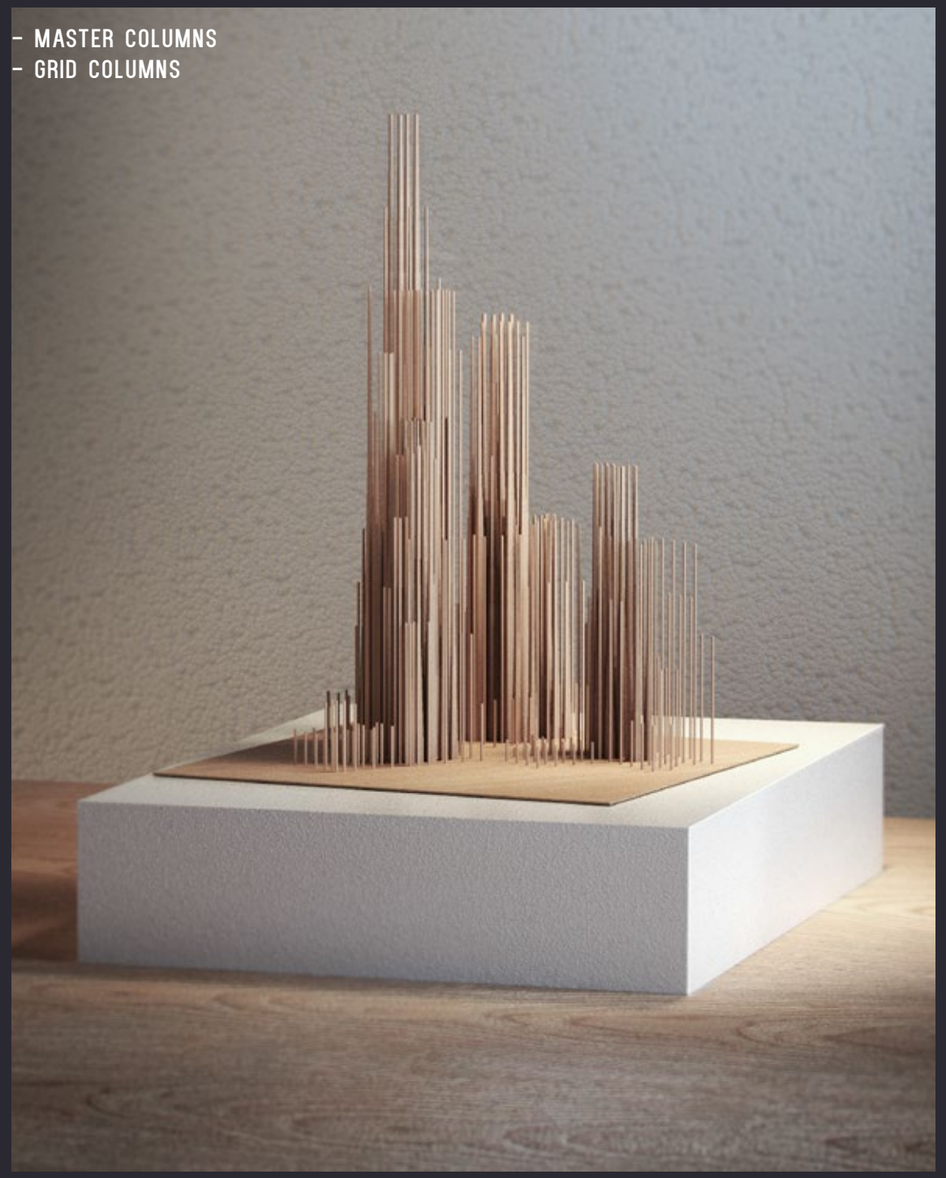
STRUCTURAL SYSTEM & HIERARCHY

STRUCTURAL HIERARCHY

*Vast central pillars, ***master columns***, allow the structure to carry all the stress, leading it down from the top to the solid stable bottom level. This takes up a lot of space, but at the same time it serves as a CO2 storage.

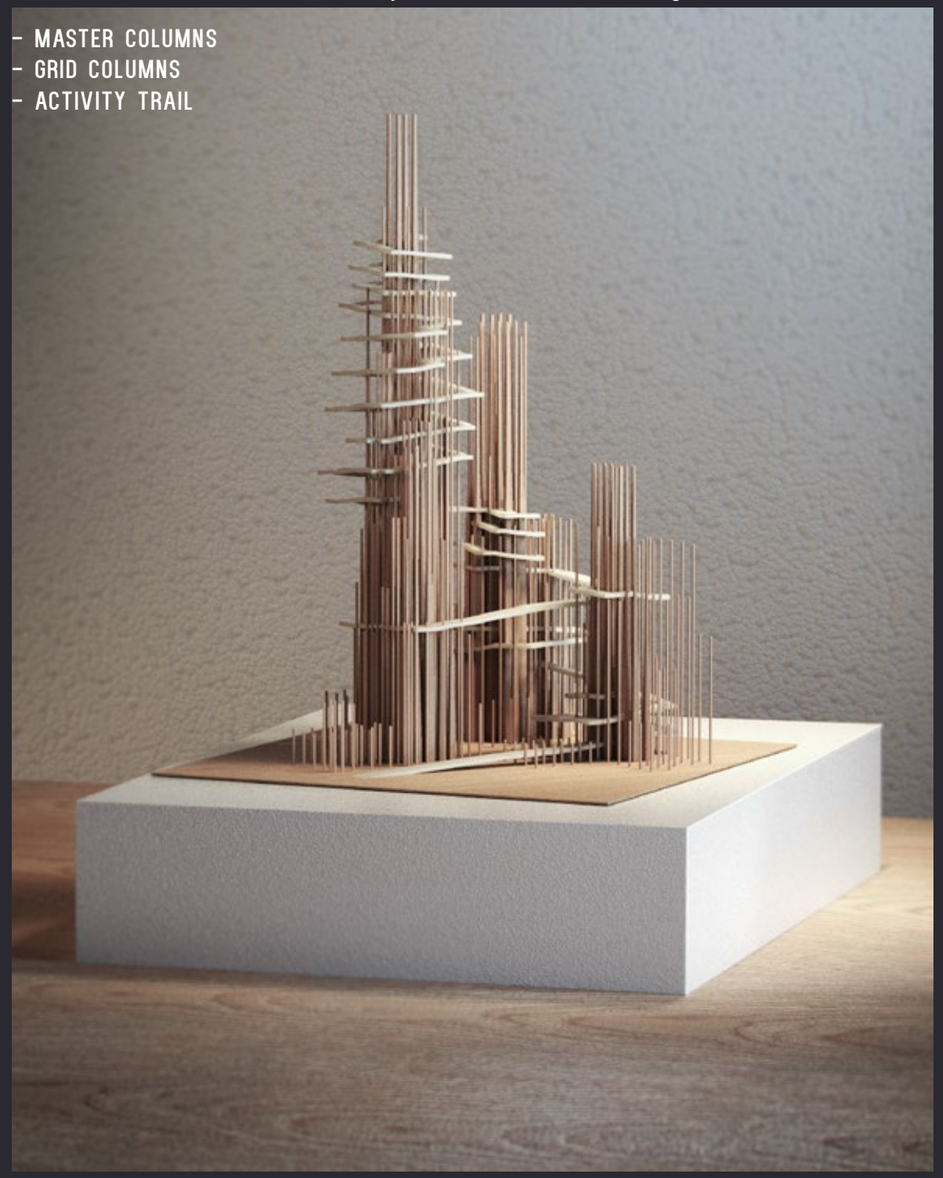
- MASTER COLUMNS





ACTIVATING THE STRUCTURE

*By incorporating walking and climbing trails within the supporting elements, the structure will also be activated for exercise, which almost forces the visitors to touch the structure and use the verticality for more than its loadbearing function.



STRUCTURE ASSEMBLY

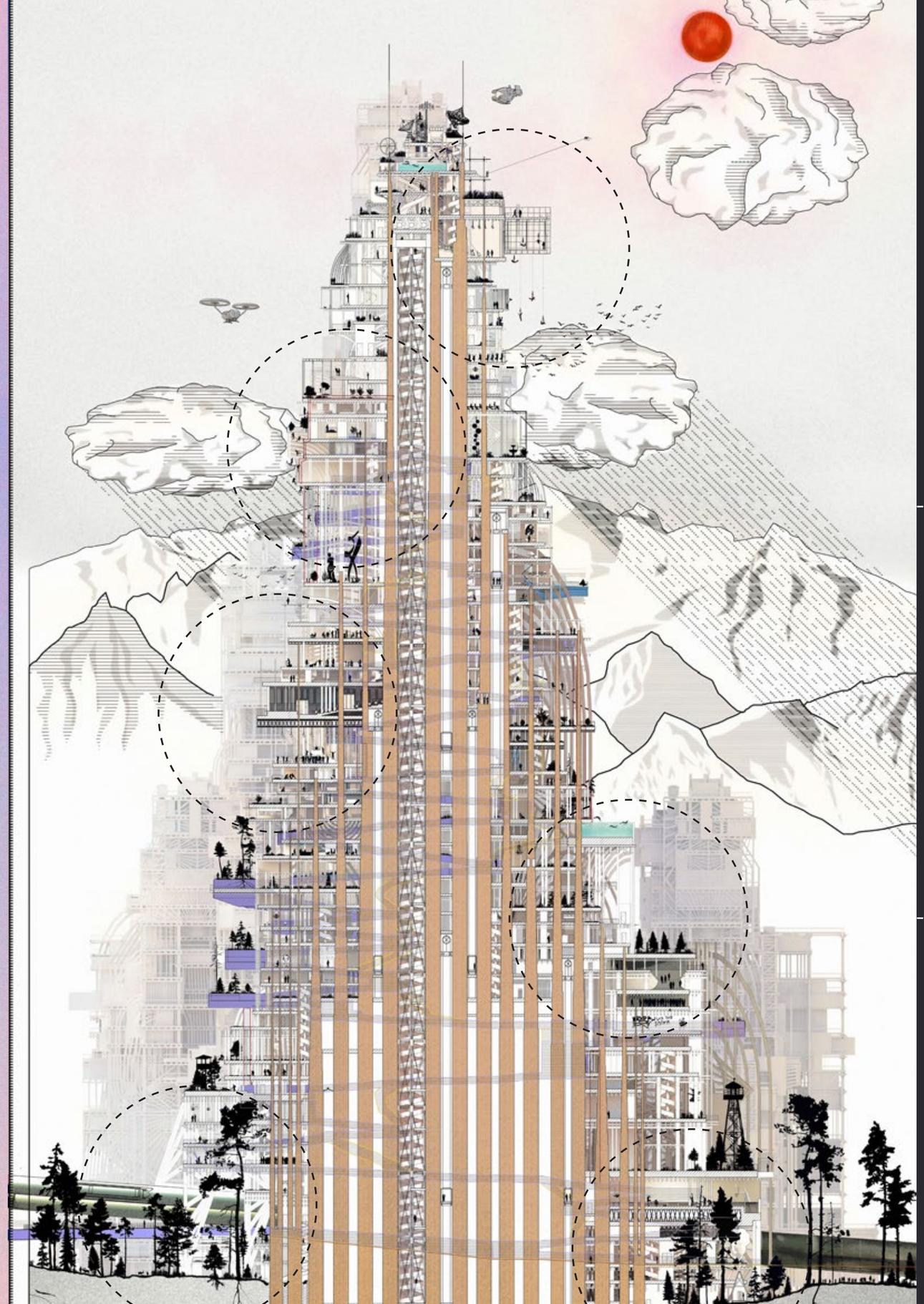
*All elements together create a hierarchical system of support and stabilizing elements. The most visible elements are the structural panels as well as the grid columns and the beam junctions, hence the ornamental design of the building.

XS- XL
SECTIONS

PURITY AND PURPOSE

FINAL DESIGN

- THE JOURNEY



- SKY LEVEL

The high-rise is a typology for mankind to be in touch with the sky, to be able to connect with high mountains and clouds. This can be a place full of possibilities to connect to nature in a comfortable urban way; an experience of both nature and high-rise in that sense.

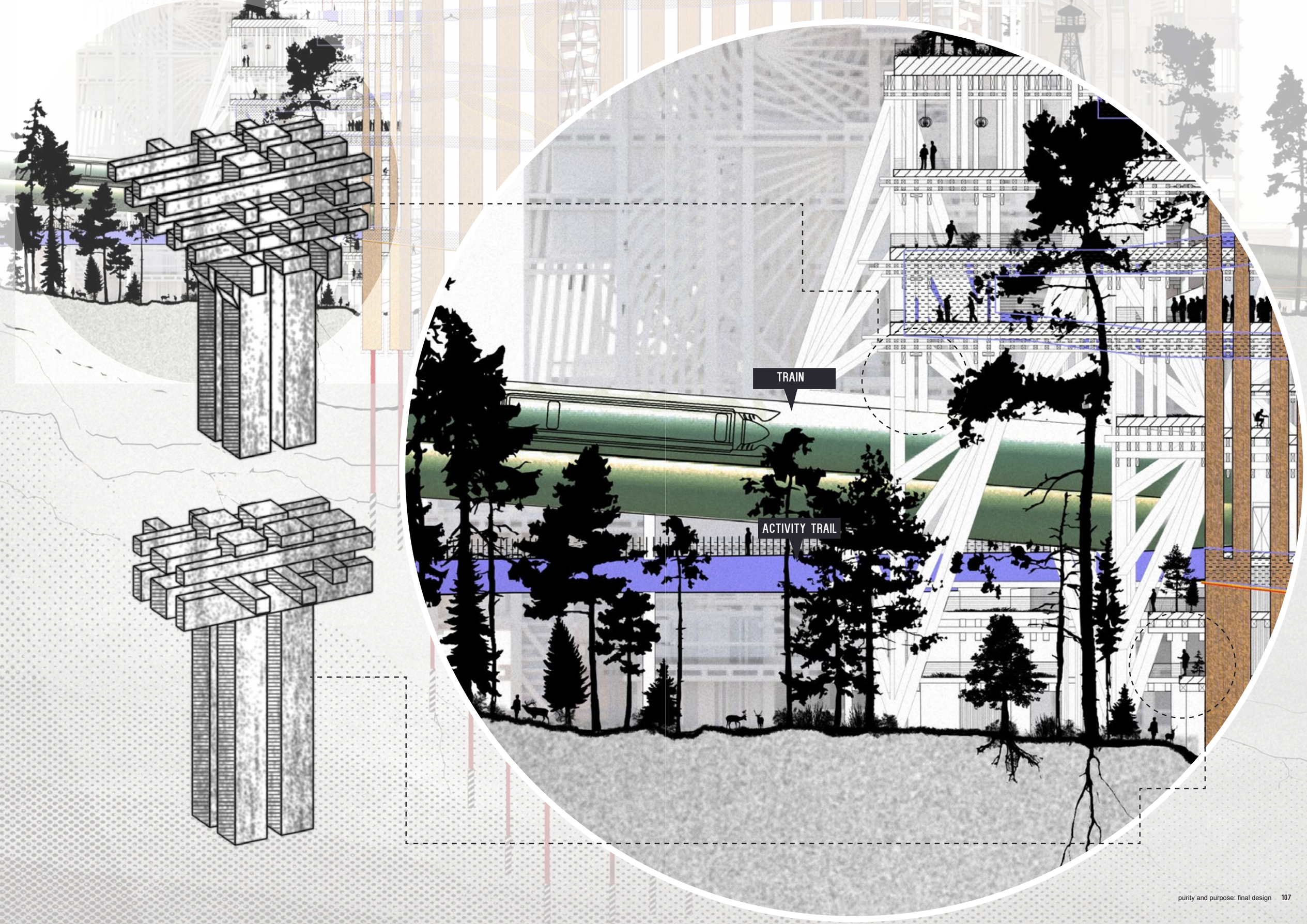
- MOUNTAIN LEVEL

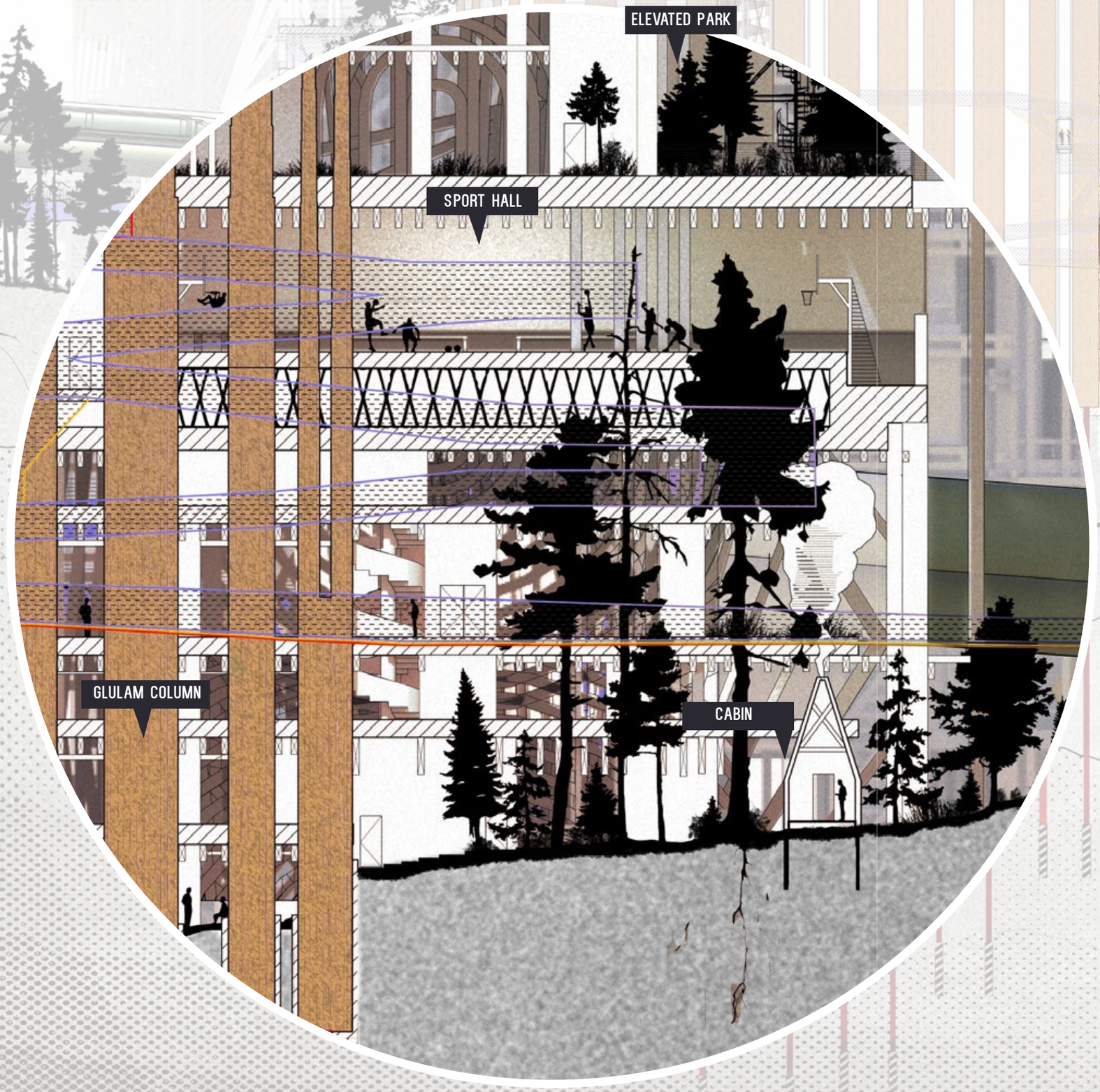
All regular habits also belong here, people will party, have fights, commit crimes and vandalize like anywhere. Additionally, new activities that apply to the surrounding nature also applies within the structure, such as climbing and trekking trails. It makes it possible to do these activities in a comfortable urban way at the same time as nature is the closest element.

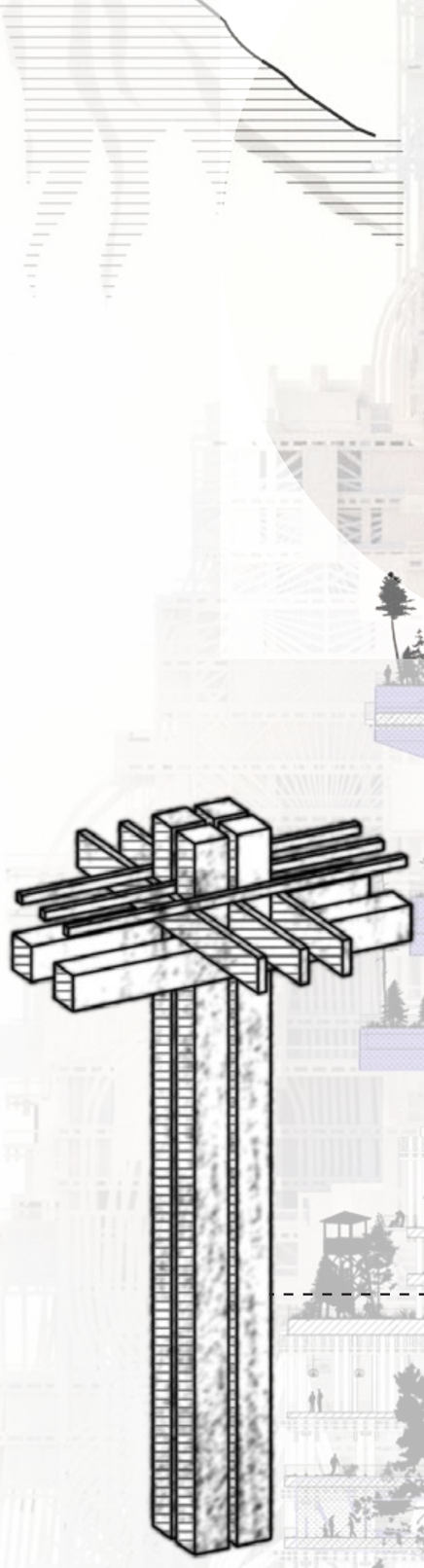
- FOREST LEVEL

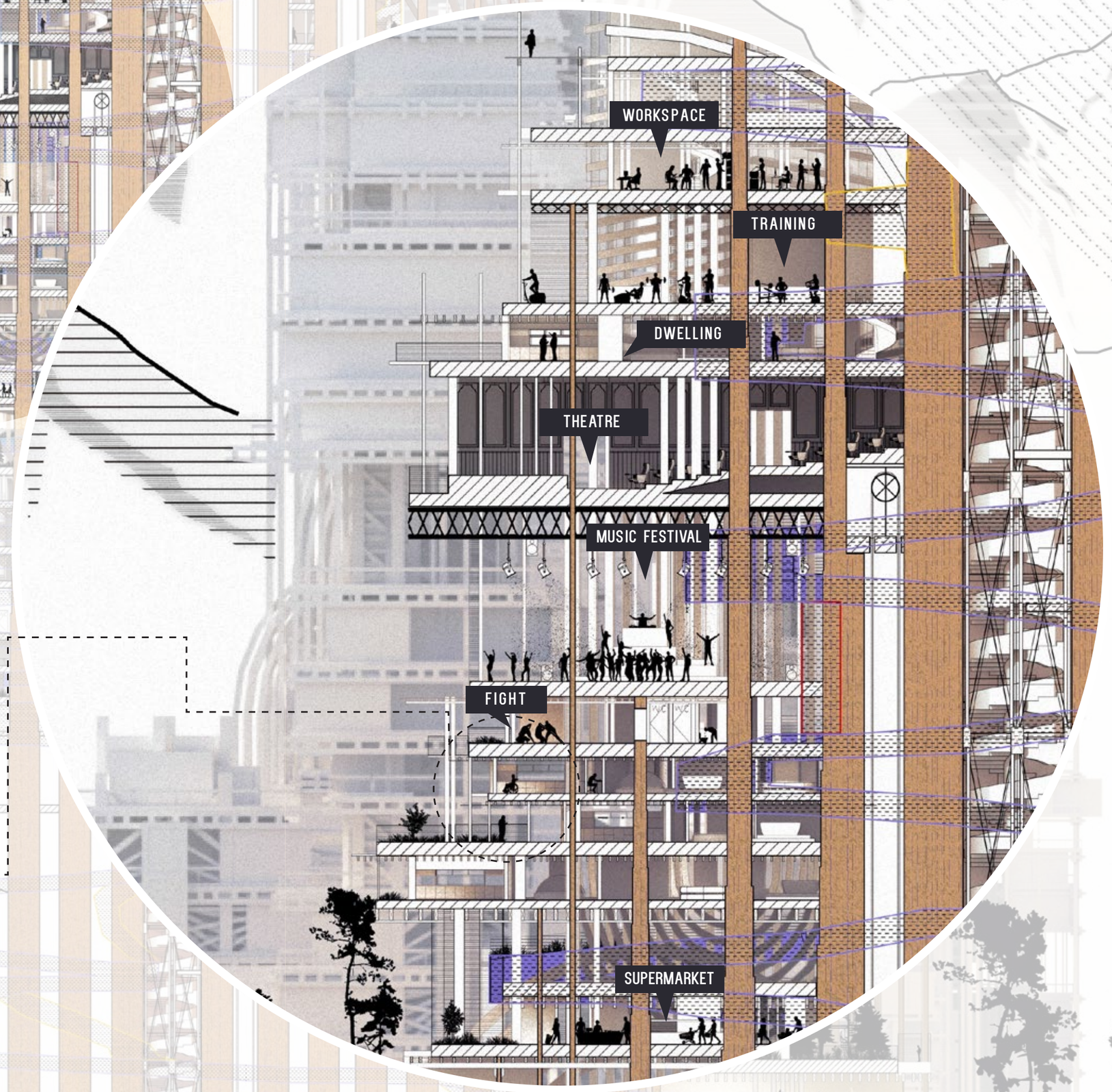
This section relates to the forest landscape, here the structure consists of vast glulam elements and transport functions. At this level there is a connection with the tree tops and the forest landscape.

**** The holistic perspective highlights qualities in micro and macro perspectives. This combination of scales and methods can tell us and give us an understanding of the connection to nature and the materiality of the structure.***

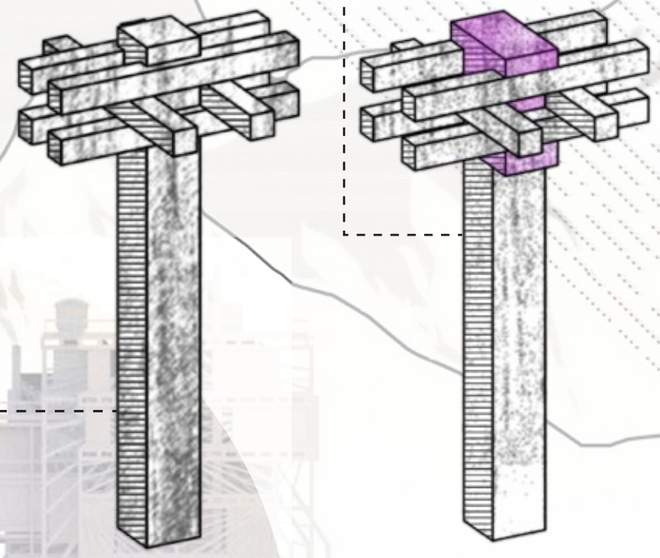

TRAIN
ACTIVITY TRAIL

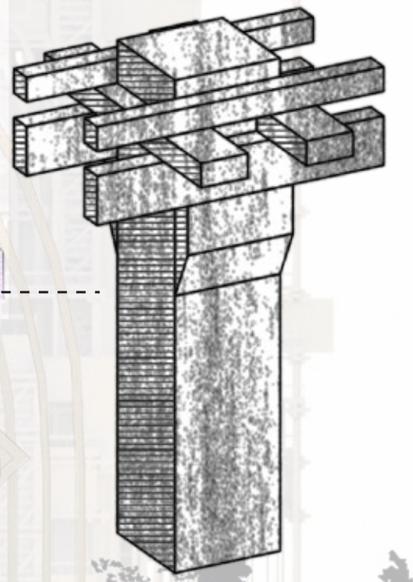

ELEVATED PARK
SPORT HALL
GLULAM COLUMN
CABIN

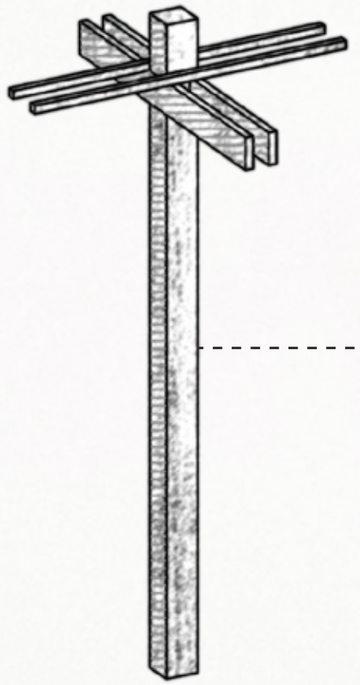


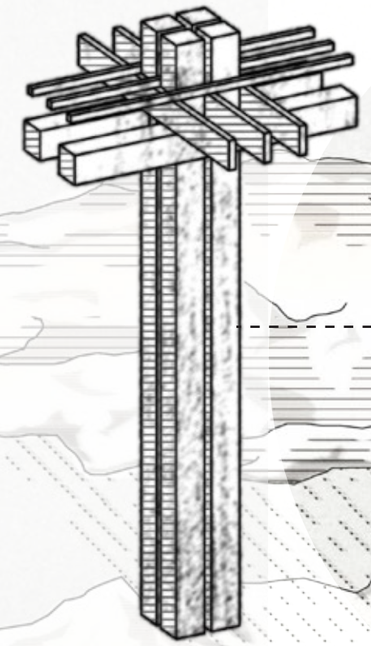

WORKSPACE
TRAINING
DWELLING
THEATRE
MUSIC FESTIVAL
FIGHT
SUPERMARKET

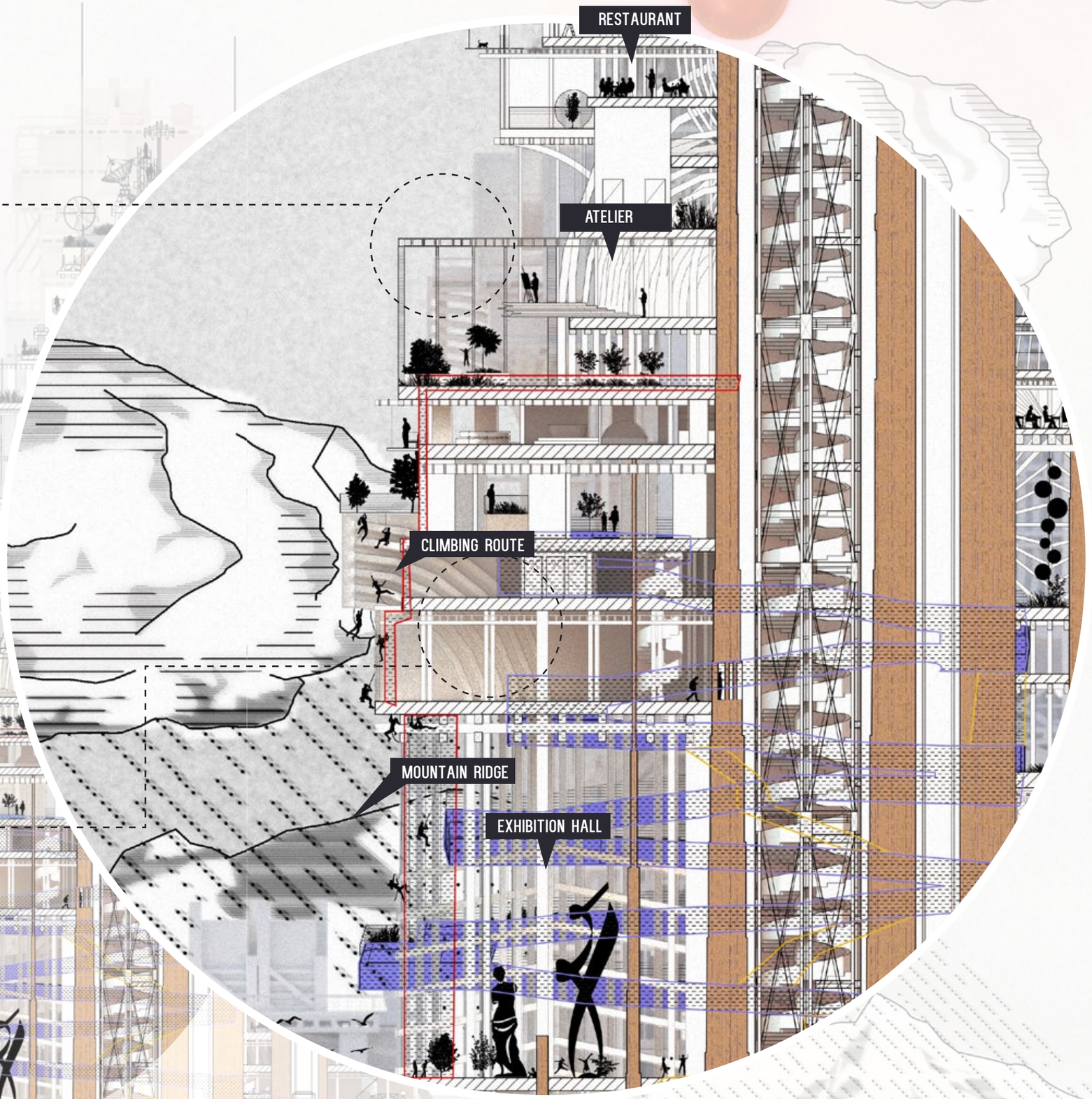

SWIMMING
DWELLING
ELEVATED PARK
VILLAGE HALL
VANDALISM
FUCK THE SYSTEM

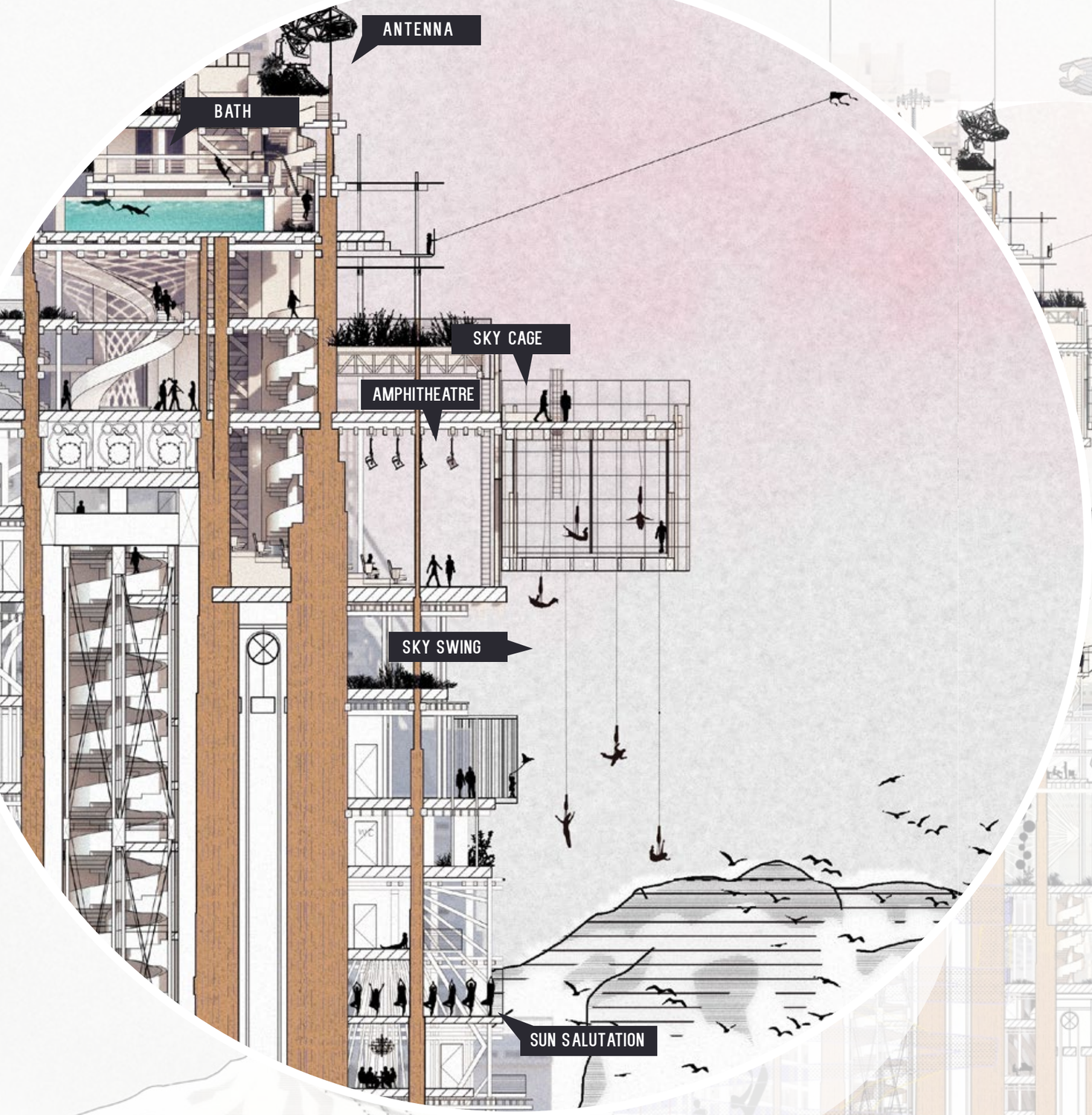




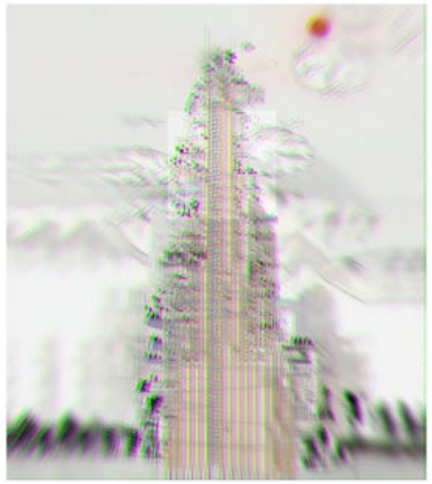


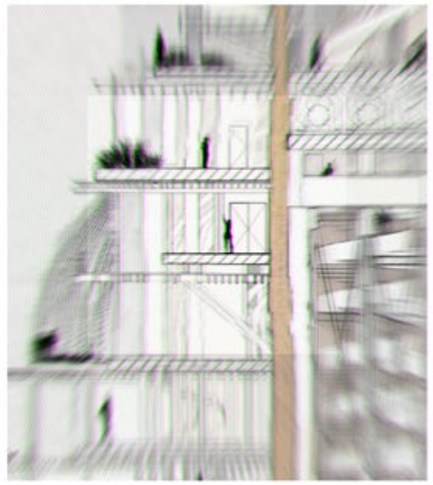
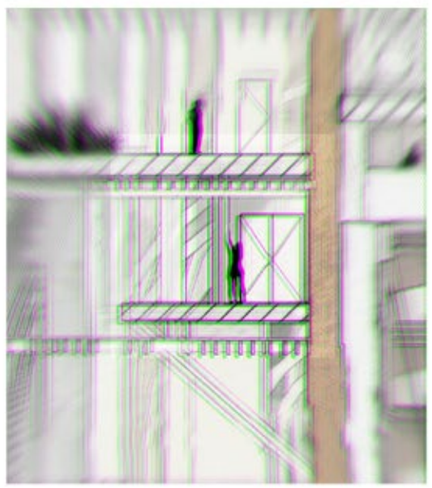
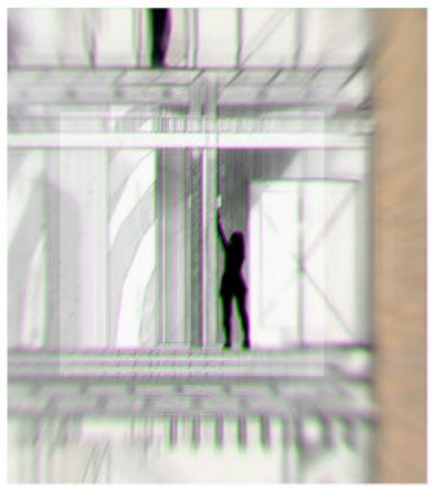


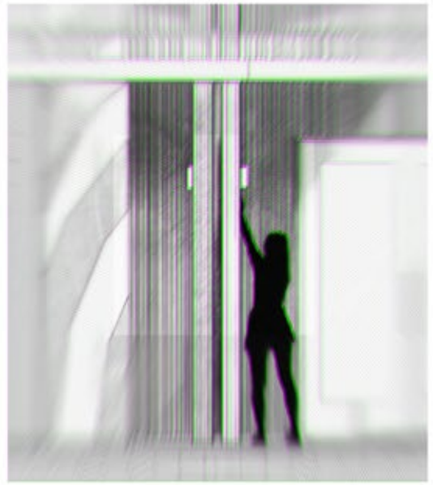
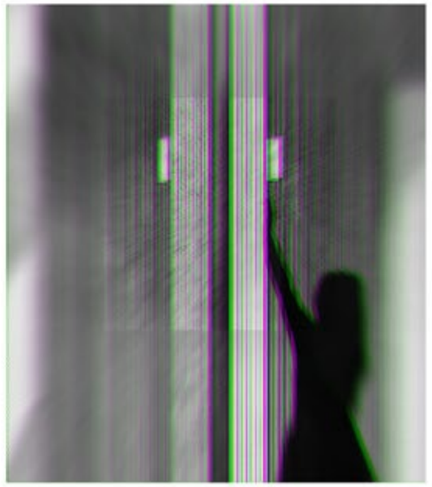

RESTAURANT
ATELIER
CLIMBING ROUTE
MOUNTAIN RIDGE
EXHIBITION HALL

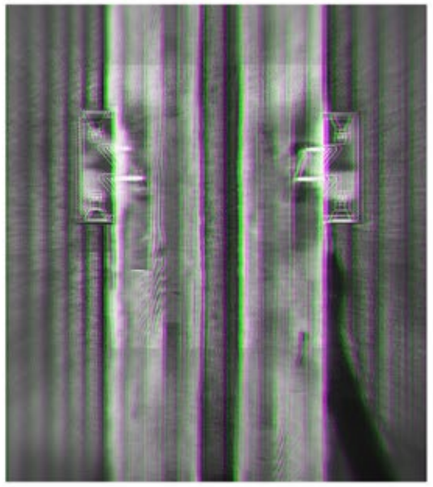
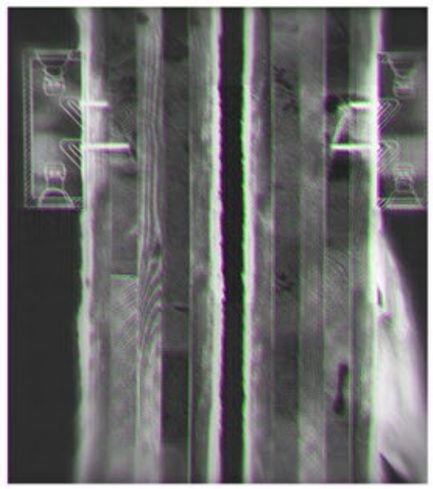
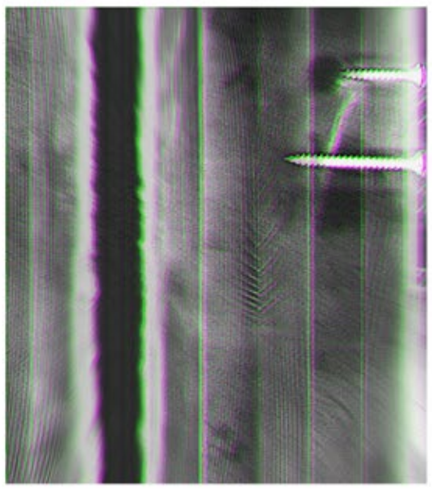


CONNECTION TO NATURE, SKY AND CLIMATE



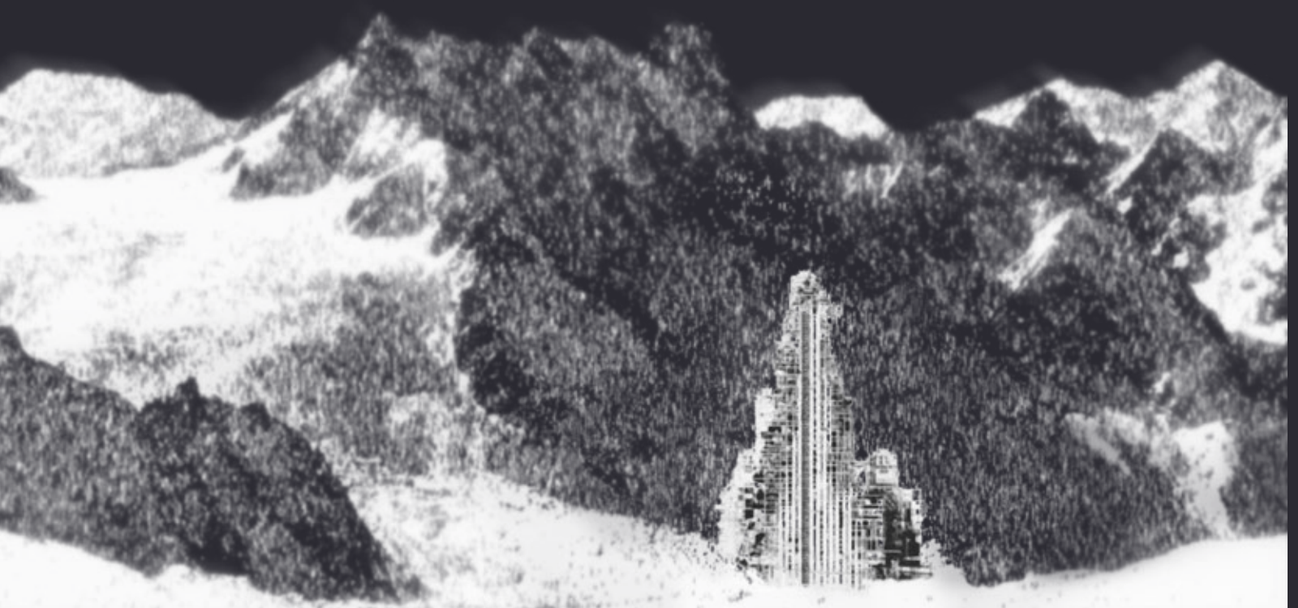
XXX IS VERY INTO THE WOOD.

SEQUENTIAL VISUALIZATIONS

PURITY AND PURPOSE

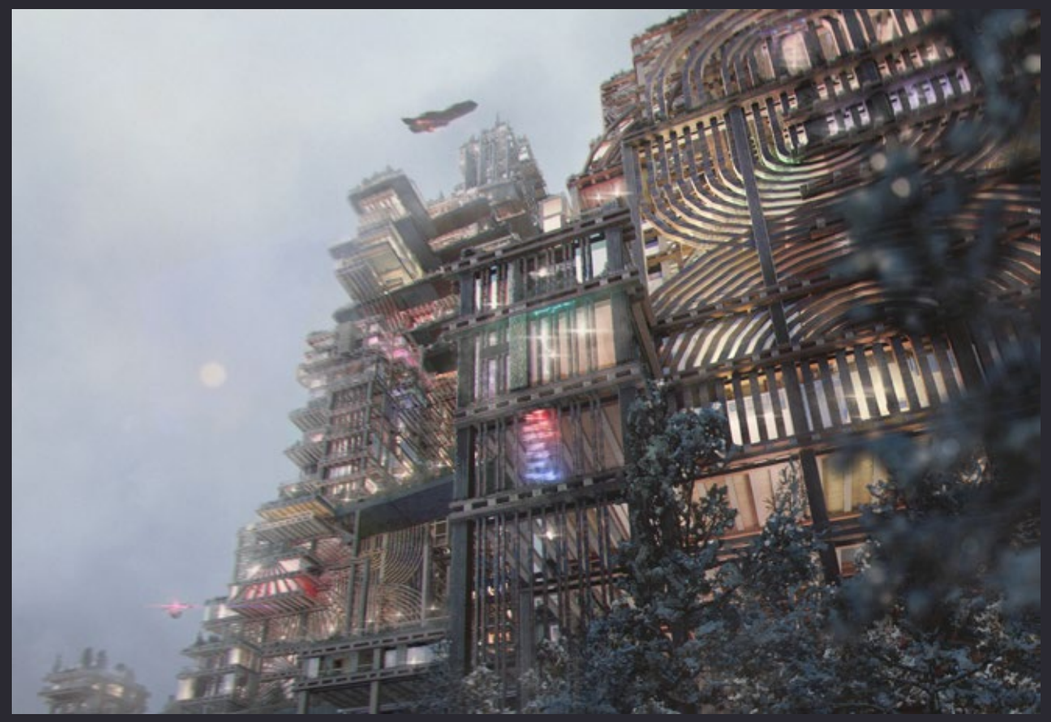
FINAL DESIGN

- THE JOURNEY



A WOODEN HIGH-RISE INTO THE WOODS COULD LOOK LIKE THIS.

ENORMOUS GLULAM ELEMENTS ARE JOINED TOGETHER WITH GRIDS OF THINNER SUPPORTING COLUMNS AND PANELS, TOGETHER IT CREATES A COMPLEX SYSTEM OF A STRUCTURAL HIERARCHY.



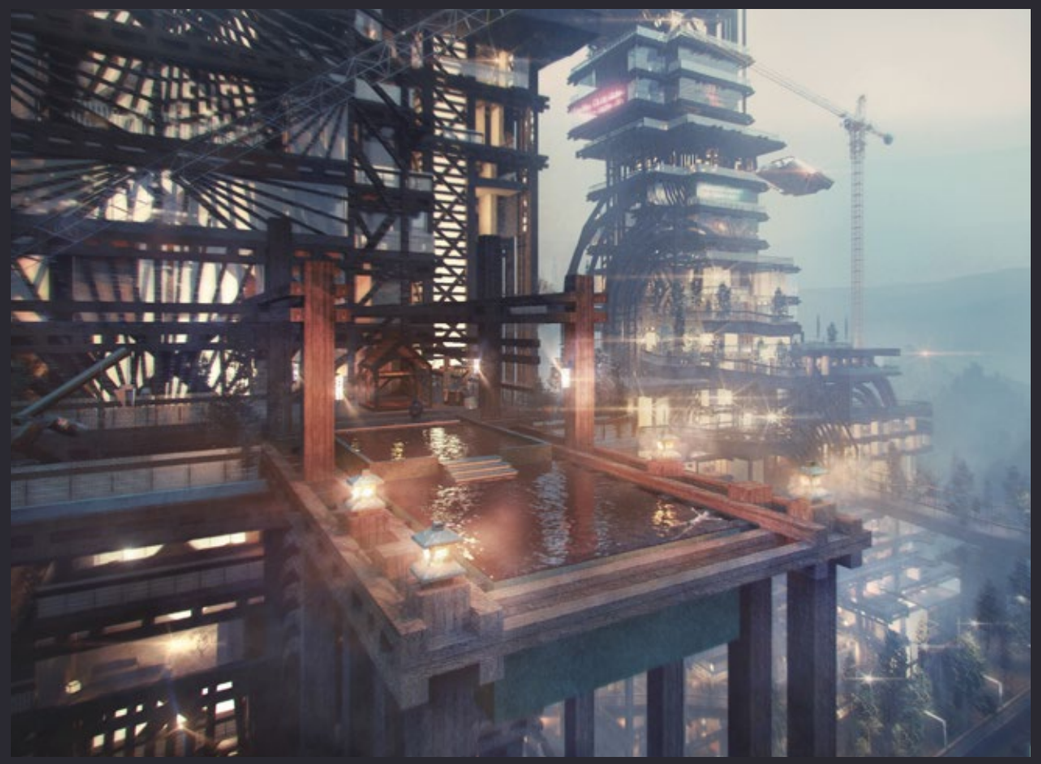
THE EXPOSED AND NEAT DETAILS COMBINED WITH THE STEPPED VOLUME OF TERRACES WILL GIVE A HUMAN SCALED EXPERIENCE WHILE ENTERING THE HIGH-RISE FROM THE GROUND LEVEL.

THE SUPPORTING WOODEN SYSTEM ALLOWS FOR EXTENSIONS AND FLEXIBLE USE OF SPACE. THE GUIDELINE IS TO KEEP THE ROBUST STRUCTURAL ELEMENTS VISIBLE WHILE THE INTERIOR WALLS CAN BE DISPLACED.

OPEN FACADES AND CHANGING ALTITUDE IN THE BUILDING CREATES DIFFERENT RELATIONSHIPS WITH THE OUTSIDE NATURE AND THE VARYING WEATHER.

SKYDIVING VIEW: BEING ON THE TOP CAN BE AS WINDY AND RAINY AS ON A MOUNTAIN PEAK. PRESENCE ON THE PINNACLE OF THE FOREST CAN BRING THE TRAITS OF THE WOODS INSIDE.

SPLITTING UP THE VOLUME ALLOWS FOR MORE SUNLIGHT AND CROSS VENTILATION.



THIS CAN BE A WAY TO CONNECT TO NATURE IN AN URBAN COMFORTABLE WAY.

AN EXPERIENCE OF BOTH NATURE AND HIGH-RISE, CREATING A JUXTAPOSITION.

CAN A MODERN HIGH-RISE RELATE TO SOMETHING ORGANIC AND SELF-CREATING AS NATURE ITSELF?

FURTHERMORE, COULD WOOD BE USED TO GIVE SUCH A STRUCTURE MORE MATERIALITY, OR TACTILITY, THROUGH A MICRO AND MACRO PERSPECTIVE?

DISCUSSION & CONCLUSION

The design transformation process has been through a bottom-up process with an interplay of material investigations and digital tools. In order to create a design proposal, all studies from micro to macro perspectives have been utilized to create the basis for the design proposal.

Working with various scales, from huge loadbearing construction level to fibre details of wood, creates a greater understanding of how the building could be experienced from materiality, tactility, spatiality and the loadbearing structure. From these investigations, conclusions can be made regarding the benefits of using different perspectives and scales whilst designing. Instead of seeing the building as one volume, elements from dissimilar perspectives can together be utilized and combined step by step. This creates a deeper understanding of the spatial, material and ornamental imaginations. The final design aims to take you, the reader, on a journey through the building whilst telling the story of the proposal by different methods and scales.

Creating a high-rise is hugely complex and too vast to be fully developed by this thesis alone. Thus, the design proposal is about presenting a journey through the structure at different levels of perspectives and detailing. These are shown via section drawings and visualizations, since they are effective methods of communication. The images have been generated from photos and analogue tools, the latter two combined with matte painting, used to effectively communicate materiality, ideas and atmosphere.

This proposal might be seen as a critique to the explosive and repetitive way of designing contemporary high-rises in cities, which often lack a connection to the materiality and outside nature. As mentioned before, engineered wood such as glulam and cross-laminated timber are not being used for its intrinsic material qualities. Instead, it is often simply used to replace concrete in a sustainable way. This could offer possibilities to challenge the traditional high-rise typology-style.

By placing the mega-structure in nature new qualities appear. As previously stated, a juxtaposition forms and suddenly the high-rise gives characteristics from nature to the manmade inner atmosphere. By analysing different scales and the capacity of the material in different sizes, and by adapting the structural program to its landscape, the high-rise can indeed relate to nature.

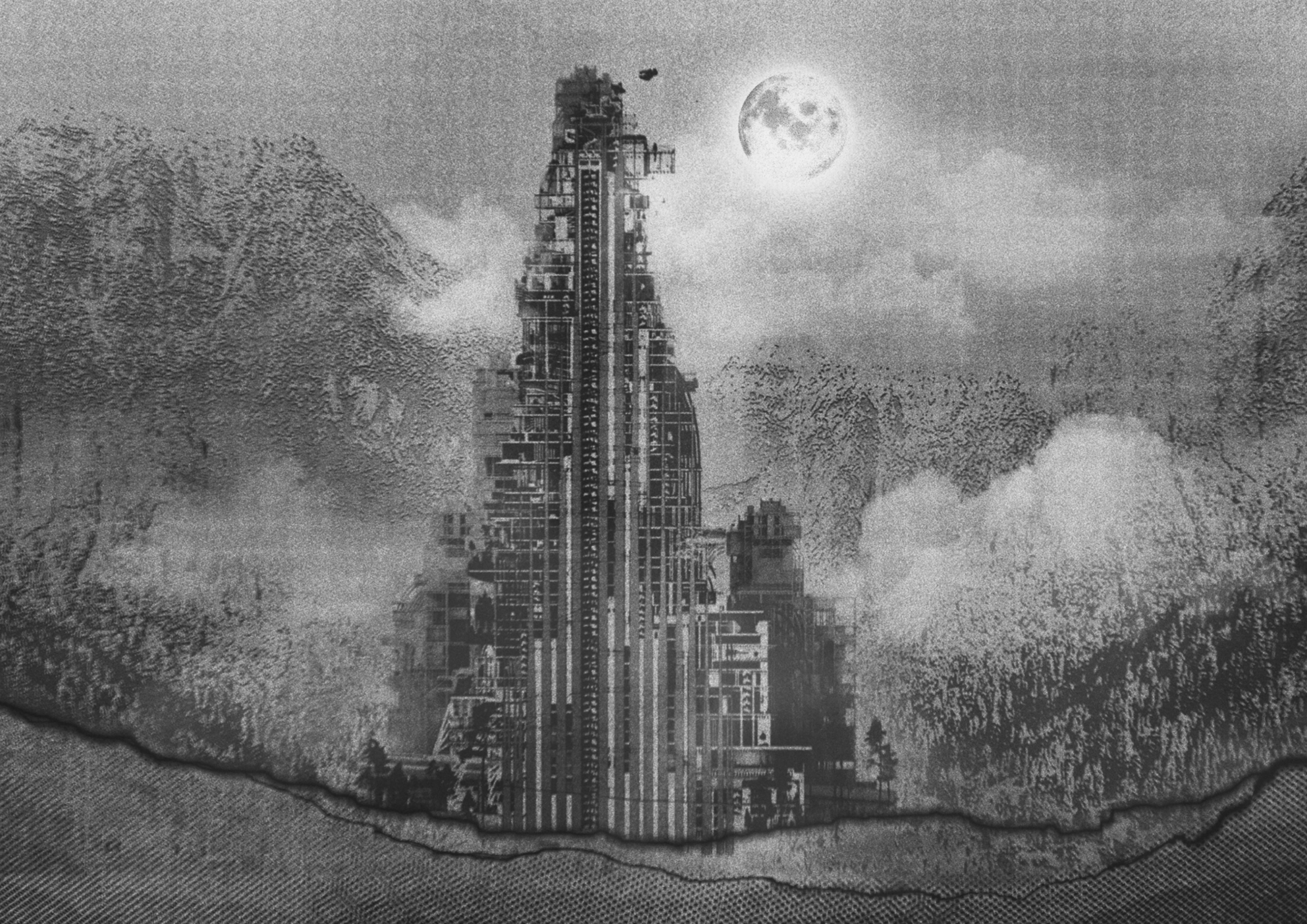
Lastly, the result also forms a celebration of wood, its character and spirit by being the main ingredient for a loadbearing and ornamental structural program for a high-rise. Perhaps this thesis could lead to further discussions on the future use of wood and nature living.

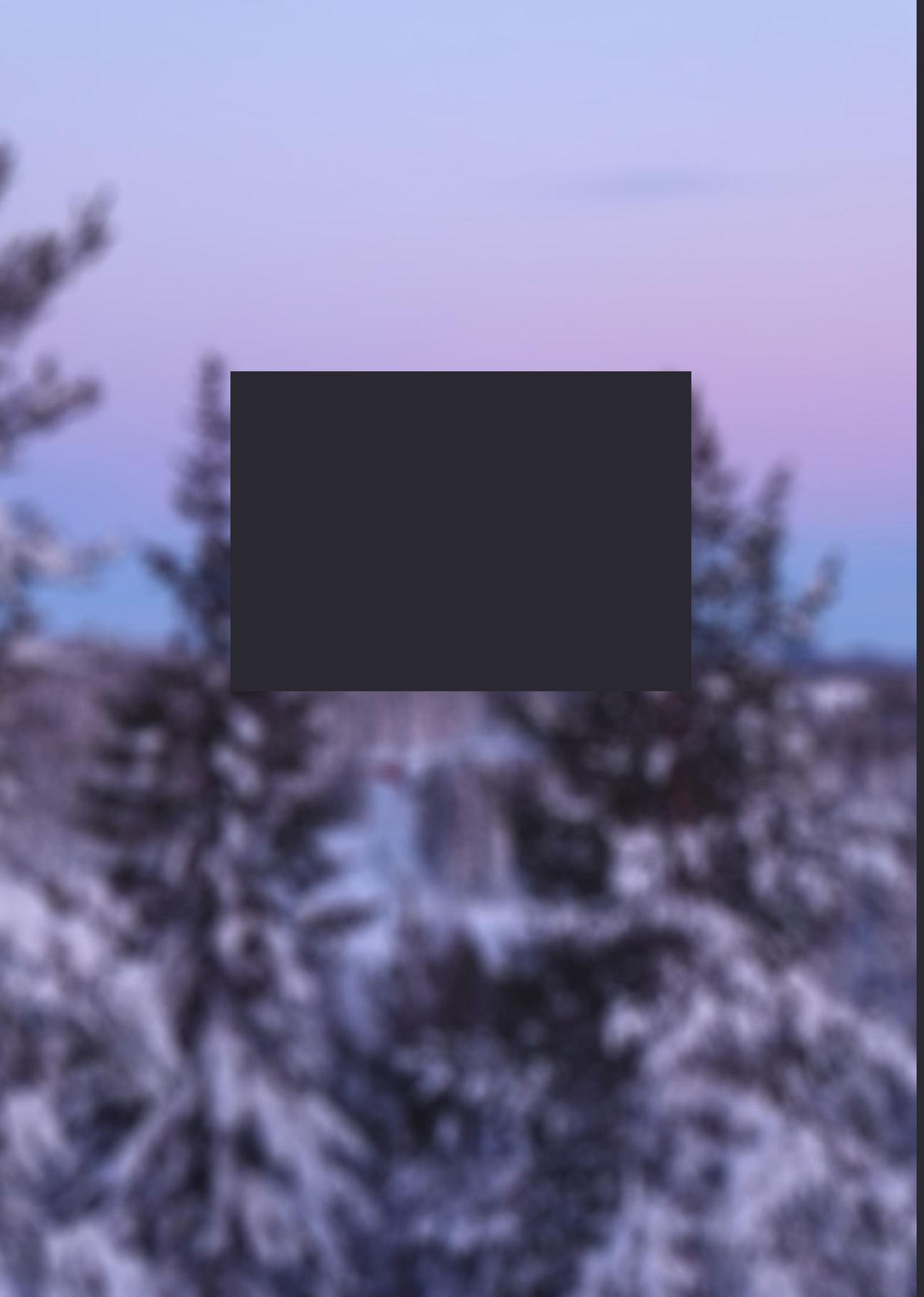
* ***Explained analysis and investigations:***

Micro & macro perspectives

- **XS** X-rays: wood
- **S** Samples: wood
- **M** Structural joinery + detail drawings
- **L** Structural panels
- **XL** Master collumns

XS-XL - Holistic perpective





THEY LIVED HAPPILY EVER AFTER.

BIBLIOGRAPHY

Literature

Engel, H. (1997). Tragsysteme *Structure Systems.* Germany: Hatje Cantz Verlag

Erikson, C. (2007). *Sverige bygger åter stort i trä - 55 exempel på modern träbyggnadsteknik i stora konstruktioner.* Stockholm: Sveriges träbyggnadskansli

Jodido, P., (2011). *Wood Architecture Now!*. Köln: Taschen

Koolhaas, R., Mau, B., Sigler, J. (1997) *S,M,L,XL*. New York: The Monacelli

Miki, T., Vervoordt, A. (2011). *Axel Vervoordt: Wabi Inspirations*. Paris: Flammarion

Sjömar, P. (1988). *Byggnadsteknik och Timmermanskonst.* Gothenburg: Avdelnigen för arkitekturens teori och historia, Chalmers tekniska högskola.

Weinand, Y. (2016). *Advanced Timber Structure: Architectureal Designs and Digital Dimensioning.* Basel: Birkhäuser

Wines, J., (2000). *Green Architecture*. Köln: Taschen

Yeang, K. (1996) *The Skyscaper Bioclimatically Considered: A Design Primer. London:* Academy Editions

Journals

Heintzman, P. *Nature-based recreation and spirituality: A complex relationship.* Leisure Sciences. (2009): 32(1).

Schätz, F. *SKY-HIVE - Structure-Tonics, Studio Florian Schätz* AY2017/2019. National University of Singapore, Department of Architecture, (2017): 1(4)

Magazines

Illustrerad Vetenskap (2019). De nya hantverkarna är datorstyrda: Robotarna tar över bygget. 16(30-37)

Video

九龍城寨 *- Kowloon walled city Hong Kong eng.subs (2015) [video] YouTube, added by Frank Bolte [online]. Available at https://www.youtube.com/watch?v=EacVa0Ge1sM Axel Vervoordt. Lecture*

Fire safety design: we need to talk about timber (2019). [video] YouTube, added by The Institution of Structural Engineers [online]. Available at https://www.youtube.com/watch?v=rND9M-kmVX8

Frisk av naturen (2019) [video] SVT, added by Vetenskapens värld. Avaiable at https://www.svtplay.se/video/23469350/vetenskapens-varld/vetenskapens-varld-sasong-2-frisk-av-naturen?start=auto

City of Imagination: Kowloon Walled City 20 Years Later (2014) [video] YouTube, added by Wall Street Journal [online]. Available at https://www.youtube.com/watch?v=dj_8ucS3lMY

Web articles

BBC. (2017) Watching nature programmes makes you happier new research reveals. Derived from http://www.bbc.co.uk/mediacentre/ worldwide/2017/rhp

BBC. (2019) 'Football pitch' of Amazon forest lost every minute. Derived from https://www.bbc.com/news/science-environment-48827490

Centre for Urban Design and Mental Health. (2017) *UD/MH Hong Kong Dialogue, Hong Kong: 15 November 2017 at Asia Global Institute, What we talked about.* Derived from https://www.urbandesignmentalhealth.com/hong-kong-dialogue.html

Spiegel. (2006) "Evil Can also Be Beautiful" . Derived from https://www.spiegel.de/international/spiegel/spiegel-interview-with-dutch-architect-rem-koolhaas-evil-can-also-be-beautiful-a-408748.html

Imagery

All images. © 2020 Beata Karlsson. All rights reserved.

Visual inspiration

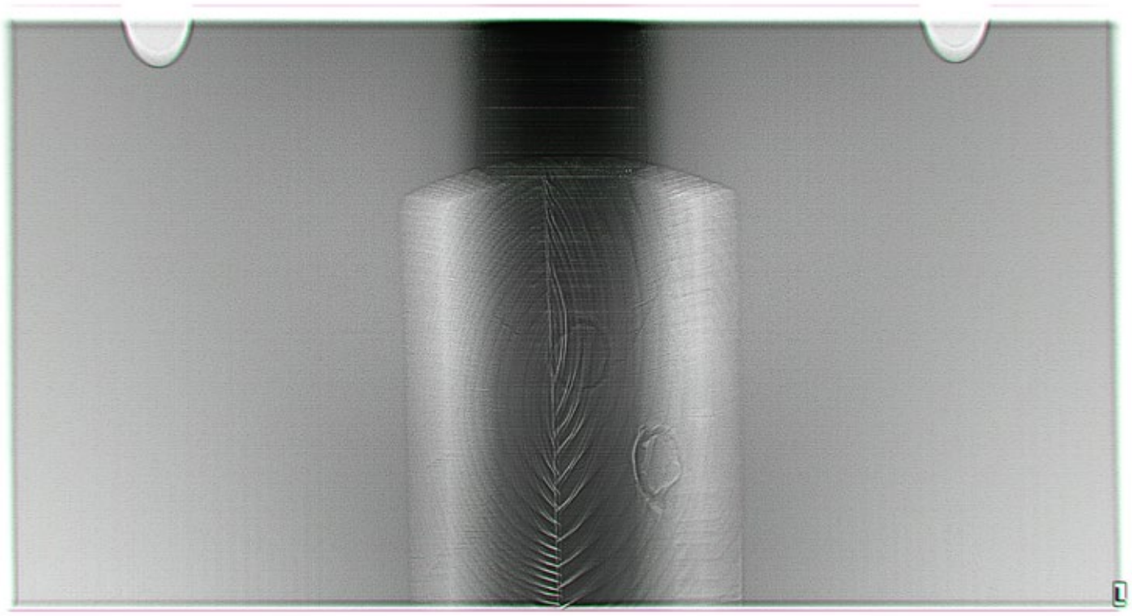
Nesbitt, L. (2015). *Brodsky & Utkin.* New York: Princeton Architectural Press

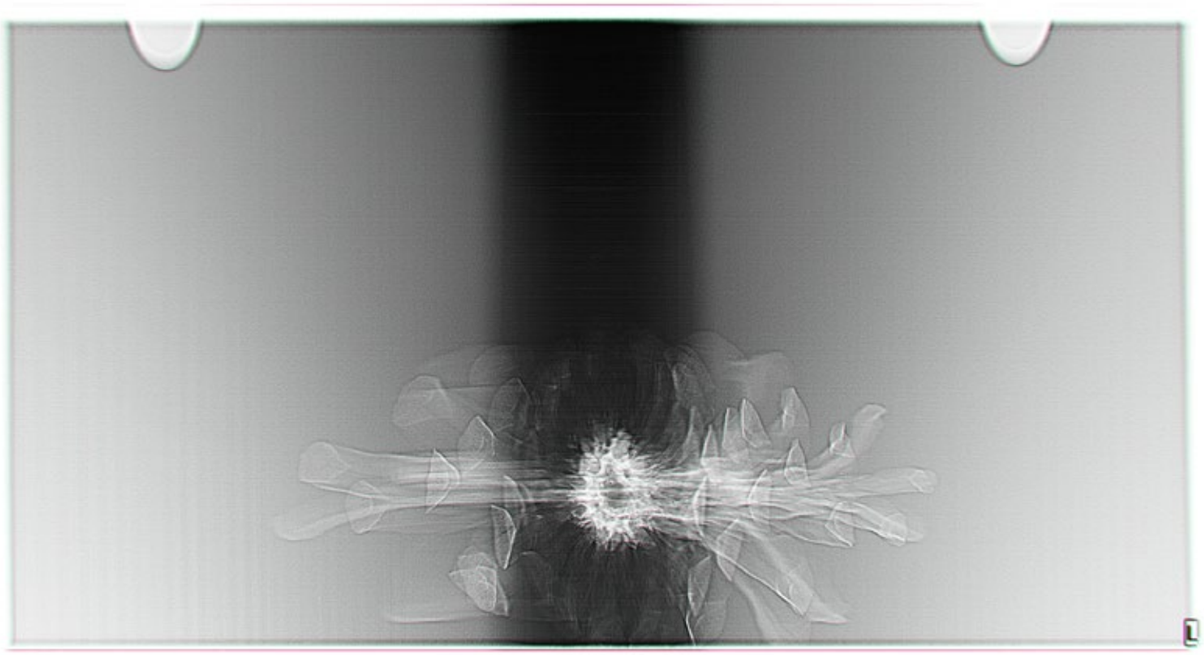
Contact

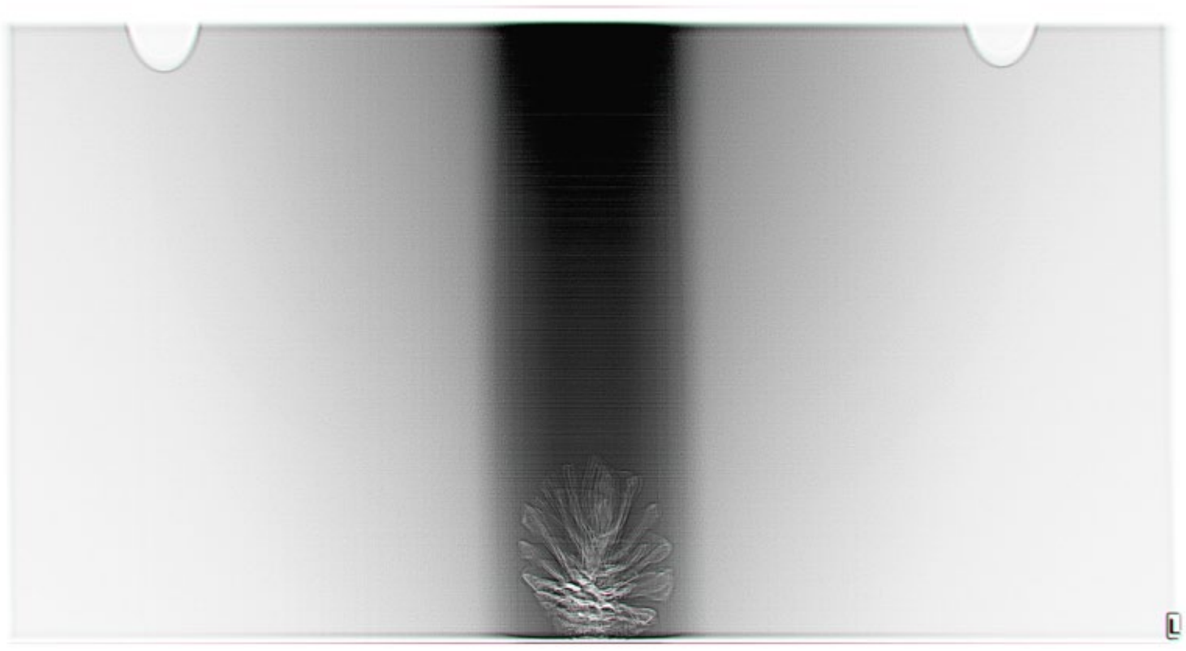
Beata Karlsson
» hello@beatak.se
» www.beatak.se

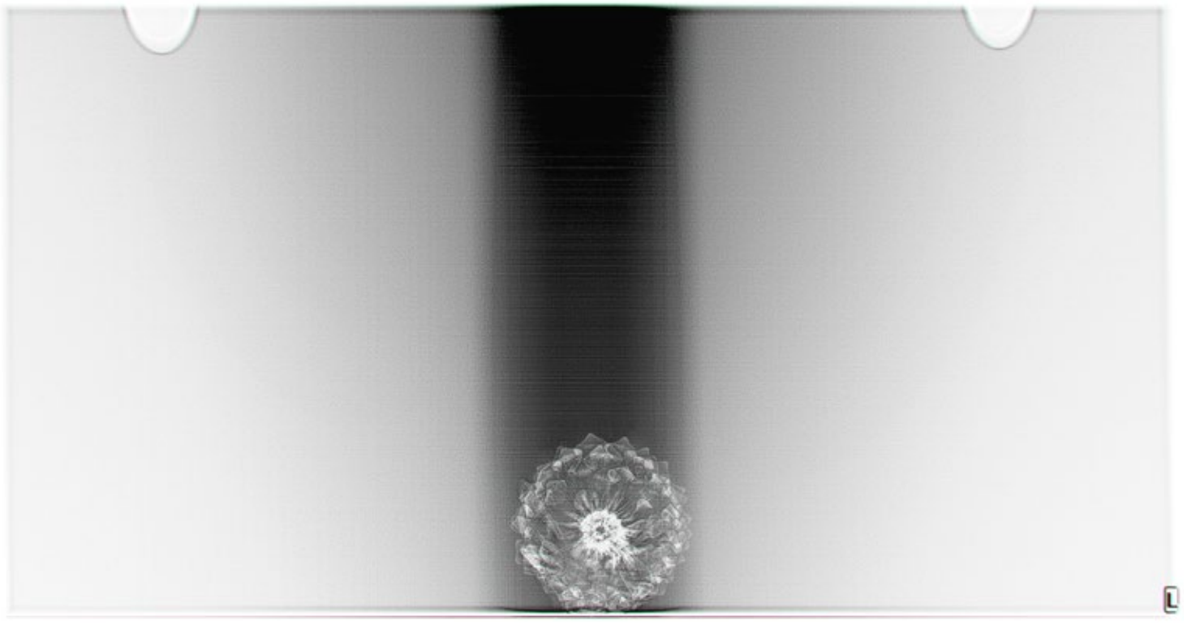
APPENDIX

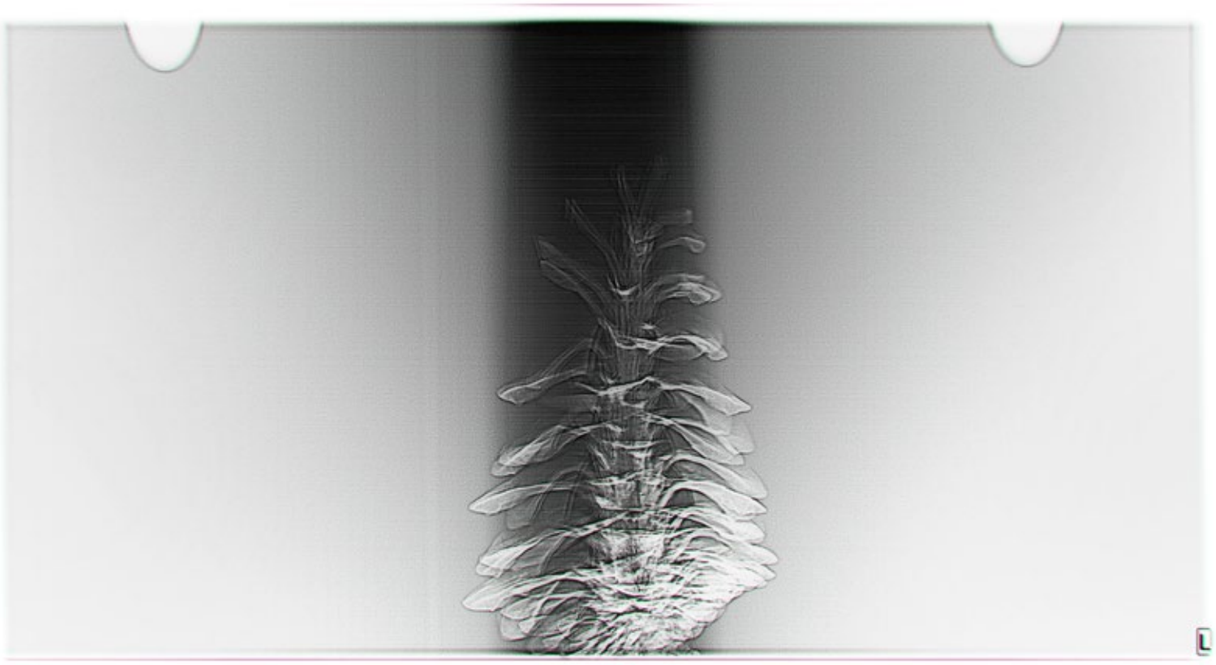
X-RAY: WOOD





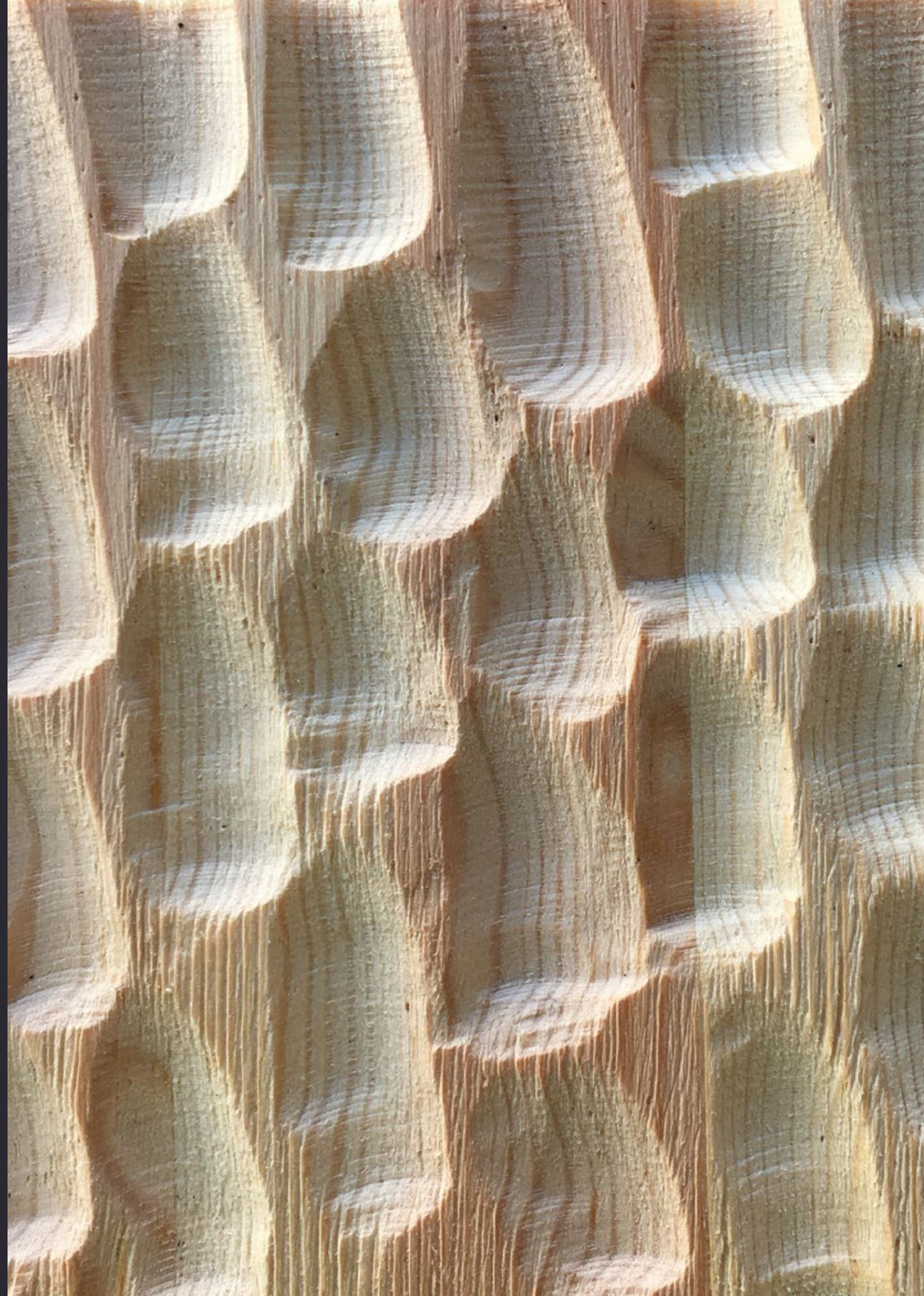


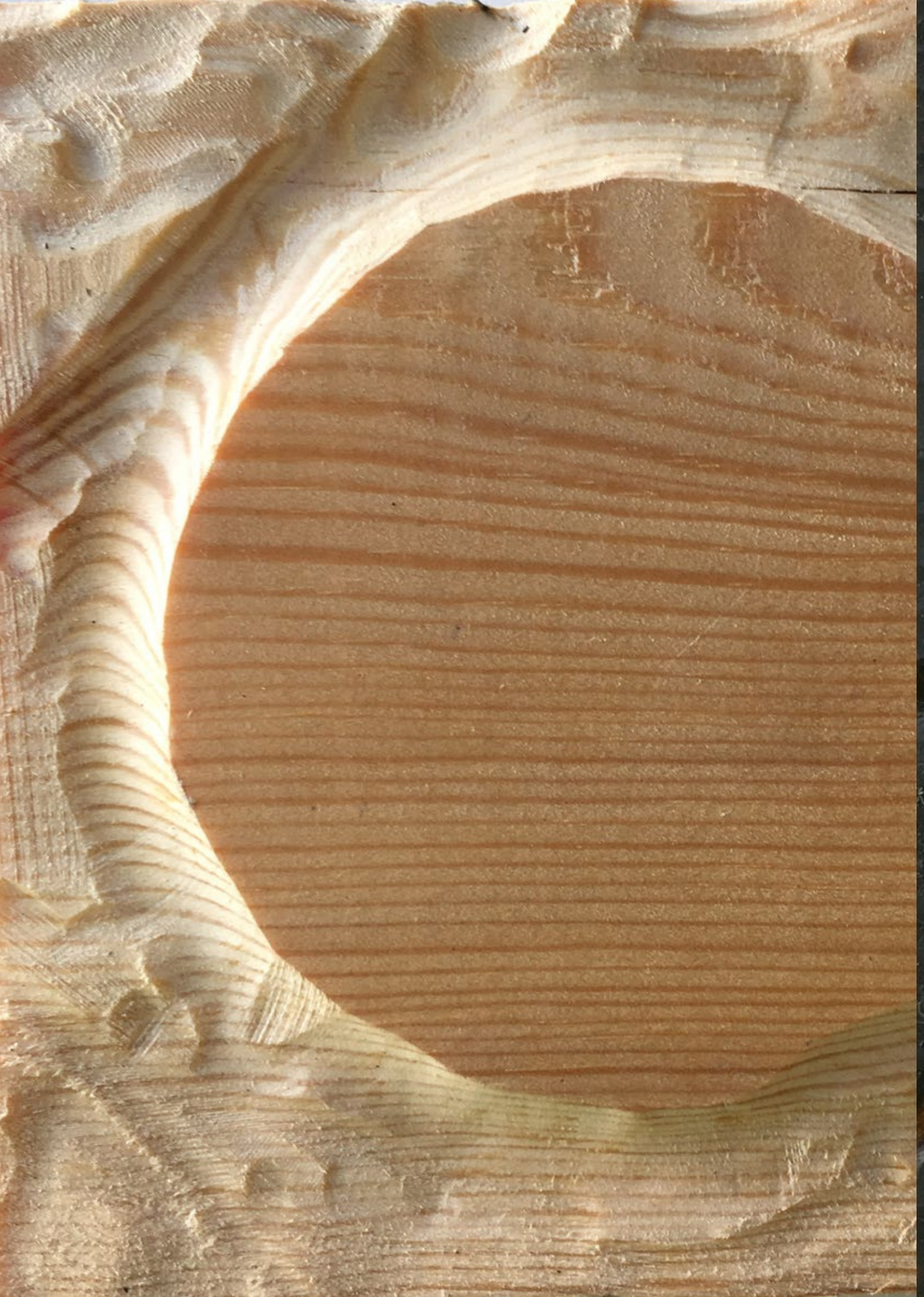




- VOLUME + LANDSCAPE

SAMPLES: WOOD





Into the Woods: A Vertical Wooden Village

Chalmers University of Technology
Department of Architecture and Civil Engineering
Architecture and Urban Design
Studio Matter, Space, Structure

Gothenburg, Sweden


MSc
ACEX35
MPARC
CHALMERS
university
06.2020
a wooden
vertical village
WOODS
Beata
Karlsson