NEW WOOD ARCHITECTURE

BETWEEN CONTEMPORARY AND TRADITION

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An Integrated Architectural Education and Research Program Development in collaboration between:
The Bergen School of Architecture, Norway
The Department of Architectural Science, Ryerson University Toronto, Canada

Workshop 1, Toronto

NEW WOOD ARCHITECTURE – BETWEEN CONTEMPORARY AND TRADITION

Canada and Scandinavia share similar bioclimatic characteristics; both are heavily forested, and for centuries wood has represented the primary material for constructing the buildings and artefacts accommodating the needs and cultural rituals of local populations. Building on this shared legacy, the Ryerson University Department of Architectural Science in Canada and the Bergen School of Architecture in Norway have established a research incubator offering students the opportunity to investigate the different qualities and characteristics of wood. Students also studied the historical and cultural context of the material's application in architecture, from the traditional to the experimental.

Wood's sustainable properties were also a central focus of this integrated Architectural Education/ Research Program: the material's provenance, its life cycle, composite material aspects, application and future reuse were incorporated in individual research trajectories pursued by graduate students in both programs. The knowledge and sensitivity gained are advanced through critical discourse on current practices while simultaneously questioning the context of future-oriented architectural design with wood.

This initiative allowed students at both institutions to explore new wood architecture in both local and global contexts and to establish a clearer understanding of the possibilities of this renewable resource as a fundamental component of a more sustainable way of building. It also promoted a model of international cooperation in architectural education, emphasising how sustainable practice is a shared responsibility.

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MAIN OBJECTIVES

The goal of the New Wood Architecture initiative is to advance the way architects think about wood in the 21st century. Four students from Toronto and five students from Bergen took part in the initiative, along with two professors from each institution, overlapping research and education, and collaboration with industry. Over the course of the 2018-19 academic year, students were encouraged to investigate new wood architecture using a hands-on approach in a series of workshops. The first workshop, held in Toronto, focused on the current use of wood in architecture, while the workshop/symposium in Bergen looked to its historical development. Together these workshops provided perspectives for future wood architecture and informed much of the work presented in the theses and diplomas, which explored the following themes:

The embedded responsiveness of wood;

The exploration of ornamental expression in wood;

Multi-scaled community living using a variety of wood construction mehtods;

Densifying the urban fabric with wood construction to create a flexible and communal housing strategy;

The mediation of craft and digital coding;
How to promote knowledge about wood in western Norwegian communities;

On the wooden ground floor - displaying the governance of Bergen;

Assembling old and new wood for everyday spaces.

Architectural professionals were involved in the critical review of the projects, providing valuable insights from practice. The hands-on workshops were supported by experienced craftsmen, helping to develop a deep understanding of the potential of wood, and providing students from the two regions the opportunity to learn from each other in the use of locally sourced wood.

An overarching goal of our programs is to put in place the elements that will help our students to explore, grow, and develop into active and confident professionals. Mobility includes off-campus opportunities for students and faculty alike and provides a stable link to relevant partners.

Both institutions seek to harness education as a platform to bridge aspects of technology and ethnography. A primary focus is to capture both digital and vernacular aspects of managing resources through knowledge, experience and experimentation.

Mobility is integral to the customary academic program. More often than not, students who can participate in mobility activities find them to be immensely rewarding, and a highlight of their education.

These activities invariably distinguish the programs, helping to define who we are, and allow us to engage more fully the issues of our time. They further the institutions' goal to build and maintain bridges with a diverse array of communities – academic and other – located beyond our doors. They help us to network and connect while raising our profile, making our program more competitive, often bringing new insights into the classroom. The process challenges us as educators, enriching our teaching and research while furthering knowledge. As such, they need to be promoted, enhanced, and sustained to enable greater student engagement and success by creating exceptional learning experiences for students, exposing students to the diversity of learning environments and cultural contexts, which were undoubtedly achieved through this collaboration.

Despite being on different academic calendars, the partners were able to achieve the first overlap of research topics which were concurrently worked on and further developed (see: timeline).

The collaboration with industry was limited to working with architecture firms engaged in investigating new wood architecture applications in actual built projects, including their detailed execution.

Gaining insight towards what is currently being produced and considering the potential for further developments, the involvement of industry at this stage was carefully calibrated. A critical approach to the subject matter in the scope of each research project was maintained.

CHALLENGES AND LESSONS LEARNED

Some challenges emerged due to the differing cultures of teaching and research between the two institutions. Ryerson follows a very programmed and structured academic path set out for the Master's program. The Bergen School of Architecture accommodates a Master's/diploma program in a much shorter time with a tendency to more applied, experiential, process-oriented research.

These cultural differences in the academic environment are not seen as limiting but beneficial for each side to expand thinking, understanding and critical review of one's work. Similarly, Ryerson professors have a stronger academic trajectory, whereas Bergen supervisors are 'professors in practice' dividing their time between school and office. The environment created by these alternating views brings in very positive feedback for both sides and has the potential for growth to adapt and learn from each other's cultural differences. These aspects lead to a richness in the collaboration.

Most beneficial are the workshops at the beginning of the project as a kick-off to the research topic, booting the incubator objectives.

Even though a critical distance in relation to the industry is crucial, more enterprises with a focus on new wood components could be incorporated.

The synergies between both institutions are positive and have resulted in a high standard of work compared to student work from previous years.

Experiential Models, Workshop 1, Toronto

RESULTS

The academic quality of both Master's theses at Ryerson and diplomas at the Bergen School of Architecture are further advanced compared to previous years in each institution; each thesis/ diploma is presented in this publication in abbreviated, concise excerpts.

Special presentations for the county Hordaland, the municipality, and the Norwegian Housing Bank were organised. External professionals for each final presentation at each school were invited and participated in discussions around the research topics. One project in Norway included the cooperation with the Sanviken community and exhibited at the Bergen Fishing Museum.

FUTURE COOPERATION

The cooperation between the Bergen School of Architecture and the Department of Architectural Science at Ryerson has been very fruitful.

Both institutions have been working on a successful exchange program for senior undergraduate students and are considering expanding these further into the Master's program.

Currently, planning is focused on exchanging exhibitions of student work, supported by the Norwegian and Canadian embassies. Courses and design studios at both institutions have been developed based on the initiative.

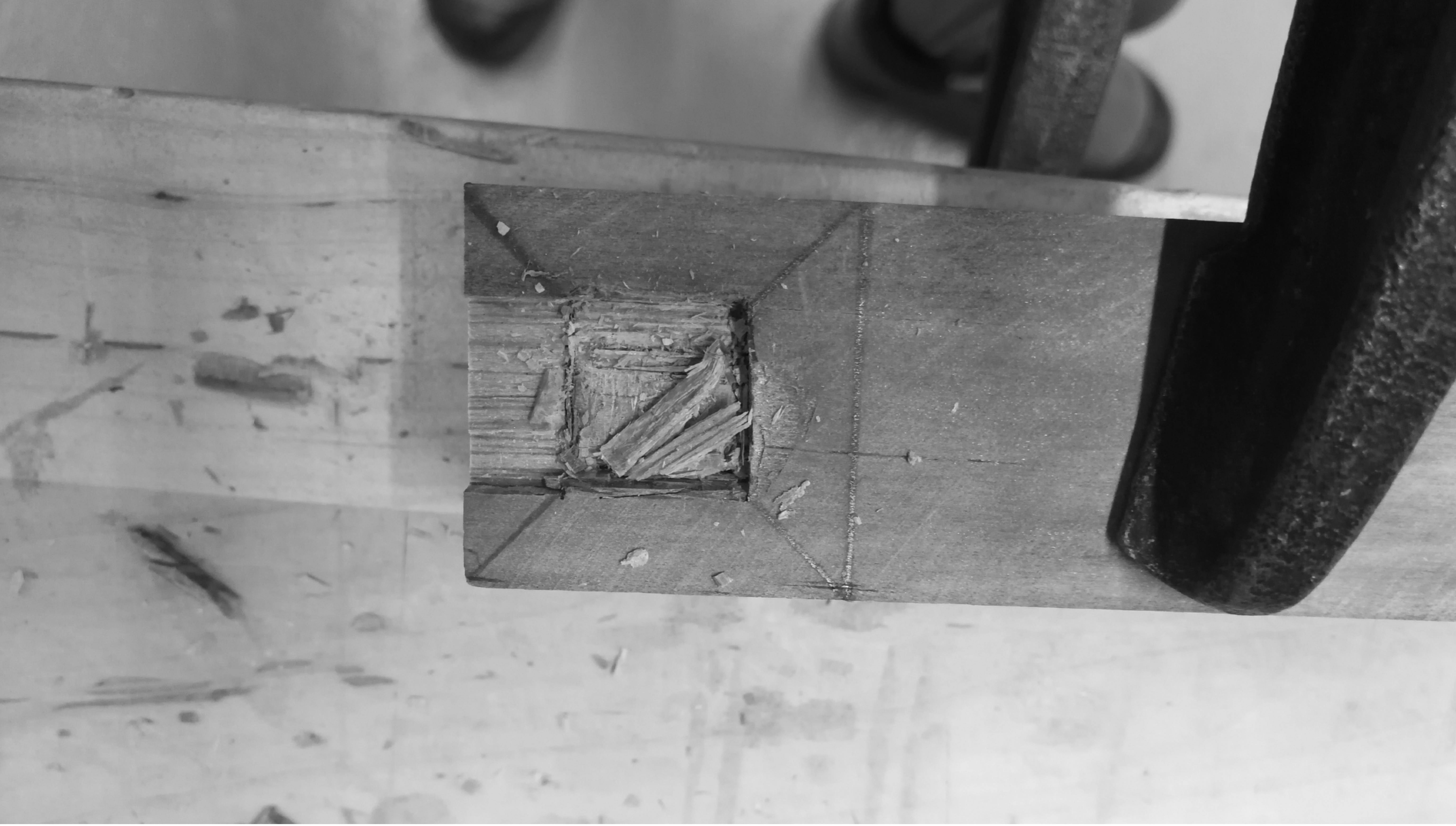
Further, concentration on expanding the collaboration into a joint design-build-project incorporating a new understanding of wood construction and components are on their way.

This undertaking will be an ambitious project including students and faculty from each country, validating recent findings from the New Wood research into applied research. Its implementation will rely on financial support and resources which can hopefully be acquired through further grants.

CLOSING REMARKS

New Wood Architecture - Between Tradition and Contemporary incorporates topics in individual research trajectories pursued by graduate students in both the Ryerson and Bergen programs. The knowledge and sensitivity gained through critical discourse on the material's symbolic, spatial and atmospheric potentials are investigated through design projects as scholarship. Current practices, as well as traditions fundamentally connected to architecture in wood, are equally analyzed.

Historical examples from in each context – the Norwegian stave church or the indigenous Canadian Longhouse – form an essential part of the investigations, including visits to traditional architectural precedents, to contextualize contemporary responses and explore underlying cultural contradictions. A series of dialectic tensions – between traditional and contemporary architecture, between craftsmanship and (digital) industrialized production, between the local and the global, between the pragmatic and the poetic – underlie many of the students' design responses.



RECLAIM // ASSEMBLING OLD AND NEW WOOD FOR EVERYDAY SPACES IN SANDVIKEN

PROJECT BY ALICIA LU LIN

ABSTRACT

WHAT IS THE VALUE OF OLD WOOD TODAY?

The transformation of a neglected log house is the starting point for raising a discussion on how we can give new life to old wood in the historical neighbourhood of Sandviken in Bergen.

How can we rethink our relationship to this disappearing resource? Should we put back the logs exactly how and where they were? Or perhaps the parts could be reclaimed to form something more valuable? How can we continue to reuse the old, both the physical material and the structural logic? How can we reconnect the lost dynamics between the mountainside and the fjord, between our everyday life, craft and tradition in Sandviken?

RECLAIM uses an experimental approach by breaking the log house into different components. In combinations with new wood, they form a series of public spaces that enhance existing situations in Sandviken. The new compositions also act as small acupuncture points to regrow the lost qualities of the area: the tactility of wood, the human interaction and dimensions, and the intimate in-between spaces.

THEORY

This diploma project follows and continues a journey for an old log house and for the neighbourhood Sandviken, where this log house and a lot of other big and small wooden houses used to stand. The design observation, process and strategies are based on my inside-outsider's perspective, as I am not from here but have been living, working and studying in the neighbourhood of Sandviken for two years and have always been fascinated by the quality of the place.

OLD SANDVIKEN

As a small bay on the north east side of Bergen, the name Sandviken means the bay of sand. Old shoreline used to go in and out with wooden houses standing partially on land and water, offering quality of "the Nordic Venice".

There used to be three main typologies of wooden structures in Sandviken - 1, the long rope houses (reperbanen) 2, wooden warehouses standing in water (sjøboder) - e.g. the Norwegian Fisheries Museum building where my main exhibition is 3, clusters of small houses as shops and businesses where the log house used to belong to.Sandviken Today

The road Sjøgaten with the main traffic in Sandviken was built in the 50s to accommodate the stones from making the tunnel towards Åsane. With the landfills of the waterfront, the building of the road, also later placing out-of-scale industrial buildings by the sea, lots of small wooden houses - shops and businesses were taken away. And the log house of this project was one of them.

Bergen Map 1740 and Sandviken Map 1819

Sandviken is on the left to town with three main distinct elements/typologies of buildings : Firstly the rope houses; Secondly, the waterfront storehouses; Thirdly, the hamlets of small houses (where this log house used to belong to)

Maps scanned from book Edens Hage Duftet Tørrfisk

CONTEXT

THE NORDIC VENICE AND A TRADITION OF SMALL SCALE HOUSES

Sandviken, Bay of Sand (as seen in first image on the left), had shorelines that went in and out with warehouse buildings, small workshops and businesses standing along the shore, some in the water, some partially on land and in water.

Small scale component system - adaptive of movement and temporality, reusable material, renewable building system, human-scale construction methodology

Fløttmannen har gjort sin tjeneste, og Fløttmannshuset flyttes til Sandviksbatteriet 1952.
Foto: Birkhaug & Omdal.

Photos scanned from book Sandviksgutter Forteller

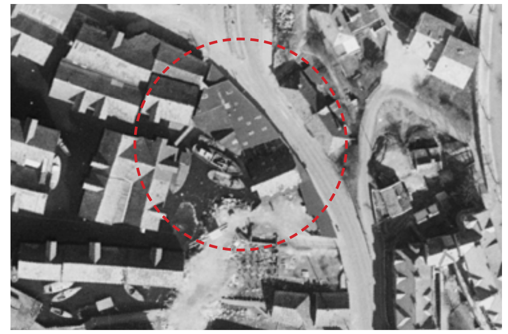
THE OLD LOG HOUSE

FROM SANDVIKEN TO ÅSANE,
THEN BACK TO SANDVIKEN

We found the log house was standing at Sandviksboder 42B in 1953. It was used as a workshop for J. Jacobsen copper and tin smith in Sandviken, before it was moved to Åsane in 1953. We know this because of a note found on the wall of the house.There were a lot of workshops in Sandviken before they were demolished to accommodate the stones from the Eidsvåg tunnel, and to make space for Sjøgaten.

After World War II, there was a timber shortage due to the rebuilding of the city, resulting in the reuse of materials of older houses. Ivar Sårheim bought Sandviksboder 42B and moved it to Åsane to use as an outhouse at his farm, thus avoiding 42B's demolition.The log house was put up in Åsane by timber company Bernt Blindheim and Mons Hetlebakke, together with Ivar Sårheim, and the house was restored as it was before it was moved back again to Sandviken. The materials of the house were most likely reused several times and it might be two or more houses recombined already.

This house is moved from Sandviken to Asane in the 50s to give way to the modernisation process. And last year it was moved away from IKEA area because there are new building blocks developing so this unwanted house has to compromise and go again.



Possible location where the log house stood: today's traffic junction near petrol station in Sanviken - 1951 vs 2016

3D scan of the interior walls in Åsane before we moved the house

STRUCTURAL LOGIC OF LOG HOUSE

Three main points I found interesting on the structural logic of a log house:

- The moment of interlocking at the corner

- There is a hidden space behind the junction that we don't see, that we perceive very differently from the inside and outside

- The fact that it is a massive, heavy structure with the dominating force of compression/gravity.

- This construction is extremely expressive and honest - anyone experiencing the space could read and understand its way of joining clearly.

The Inside

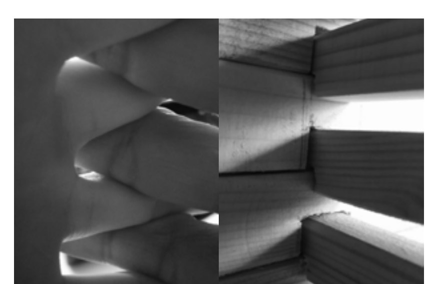
A series of components (fingers) are joint one after another dominated by the force of gravity/compression. Looking from the inside, the "fingers" create a hidden space "behind the corner", at the same time, it encloses a space inside.

The Outside

The interlocking is revealed partially on the outside with an expressive and honest language of structural logic - anyone experiencing the house could understand its construction methodology.

The In-between

When the components are placed at a larger interval, the "hidden dimension" is slightly more revealed. Light travels from the outside to the inside or vise versa. It creates a space between interior and exterior.



MARKING AND DISMANTLING IN ÅSANE

The logs were marked with letters and numbers for the ease to assemble again later. The whole house was deconstructued one piece at a time within half a day, with the team effort of 21 students from Bergen Arkitekthøgskole.

A new frame structure was designed for the house to be put back up again. At the same time, the logs were transported to Sandviken by a truck. On Sandviksdagene, we presented and questioned the history and the possible future of Sandviken to the public along with the story of our log house.

This log house was moved from Sandviken to Åsane to accommodate modernization. It is now moved back to Sandviken to provide space for new development in Åsane. After the exhibition, the logs are stored at the semi-sheltered area at BAS. How to continue the journey and story for the logs? This is the starting point for this diploma project.

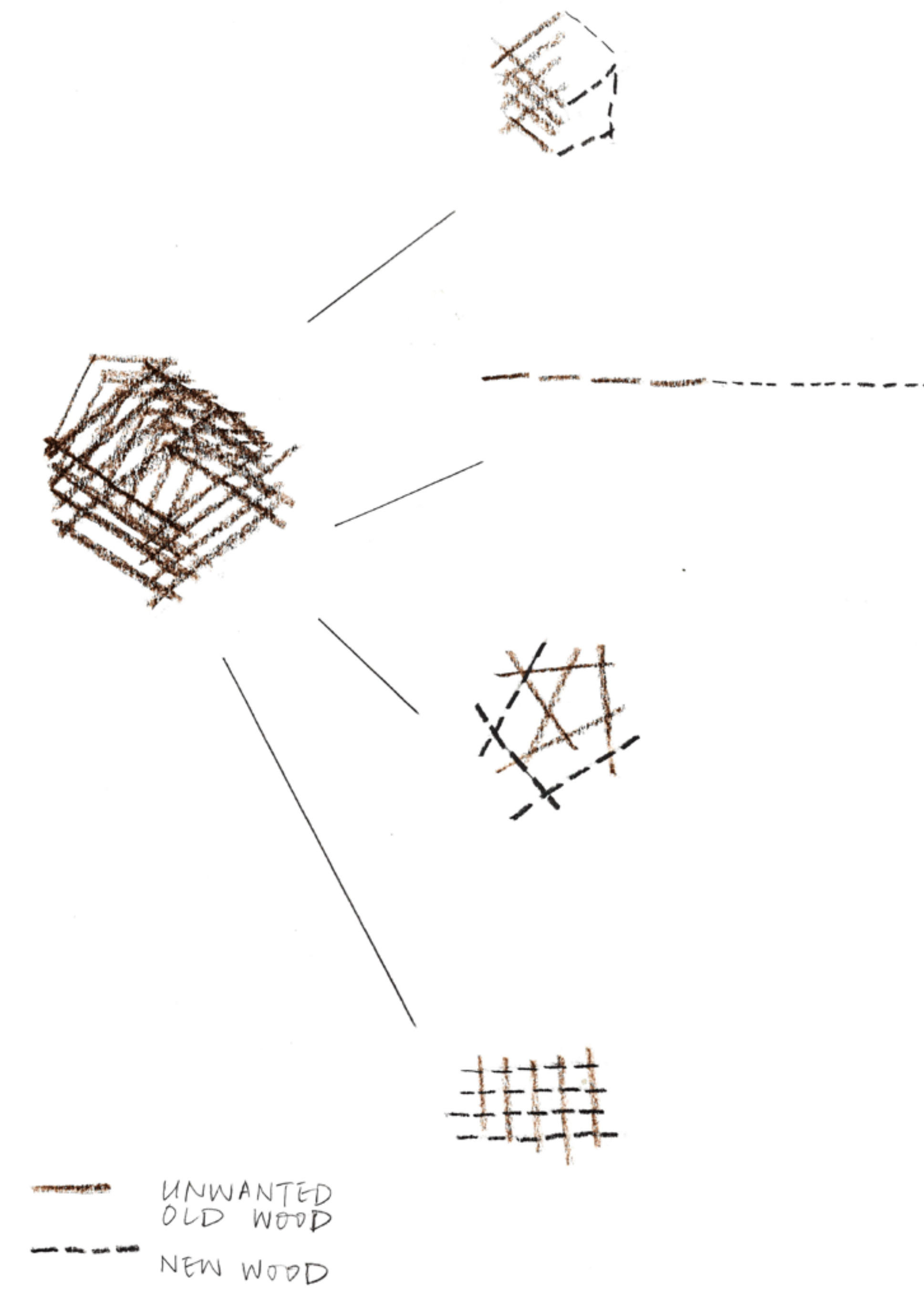
DESIGN INTENTION

THE EVERYDAY

I want to reconcile this dilemma around old wood and its values. In my mother tongue, everyday can be described as an idiom which expresses this idea but also has a second layer of literal meaning - wearing, eating, dwelling, commuting; or as nouns - clothes, food, residence, travel. My designs will be based on this ideas of everyday practices with what was lost and is needed in Sandviken. I want to create everyday public spaces so that people can gain a closeness, nearness and intimacy to the wood and the neighbourhood.

ONE BECOMES MANY

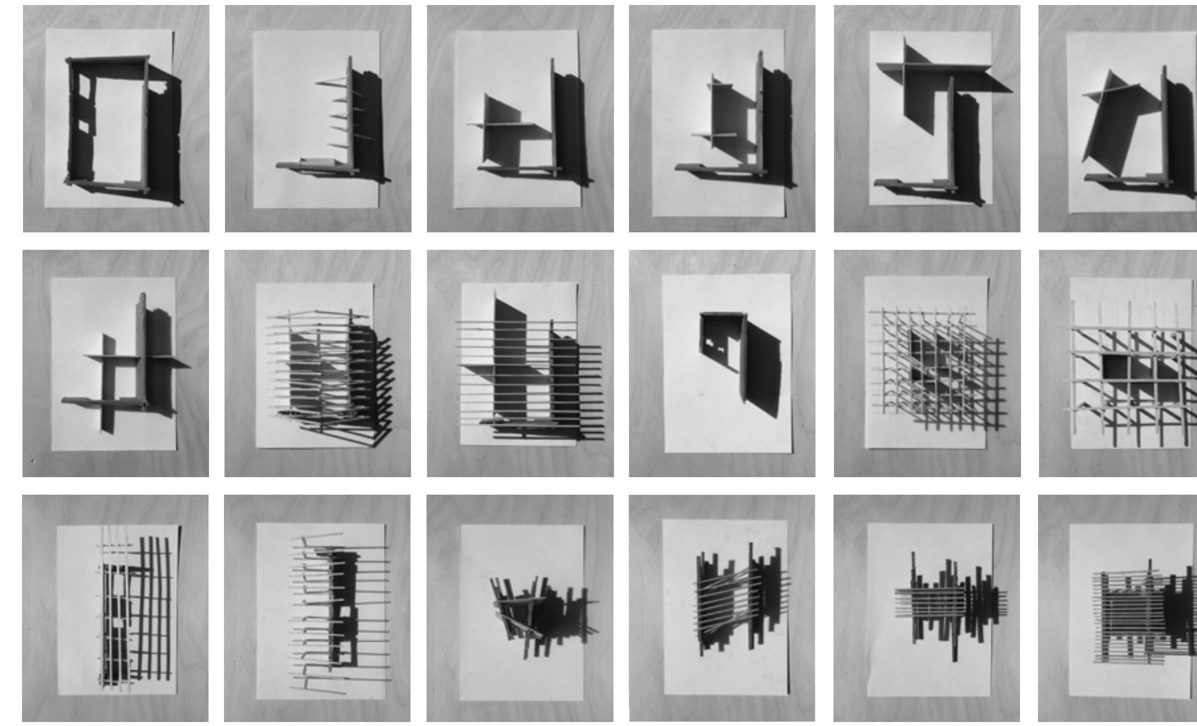
Based on the above analysis, I want to treat the logs as resources than a singular product of a house. Instead of putting it back as how it was - which could easily end up unwanted again, perhaps the parts could become more than the whole. The concept is to break down this one log house and utilise its component system and let it generate many different public spaces. Based on the different conditions of the wood pieces, they can be recombined with new wood in different ways and become small acupuncture points in Sandviken.



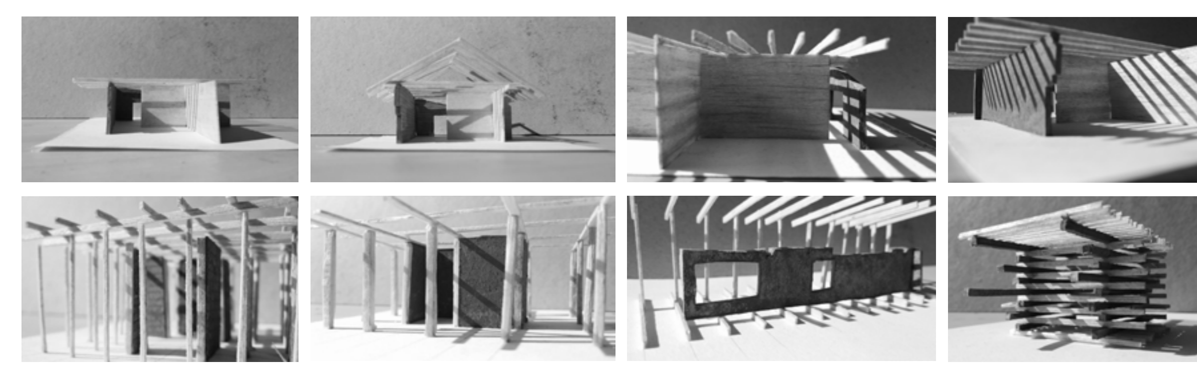
DESIGN PROTOTYPES

A series of experiments of the combination of old and new wood were shown in my exhibition. There are three main structural logics among all of these ideas. Firstly, if the wooden corner is still usable, I would treat the old wood as corners and walls, because the joint is the most valuable part of this type of construction. However, from my interaction with the old pieces, i found that most of them have lost their corner joints. Therefore the second logic is, when the joint is not usable anymore, a vertical support is brought in to slide the old wood inside, so the old wood can still become walls. Thirdly, I treat the old wood as sticks, still continuing the idea of gravity but stack them with new wood one on top of each others.

Three main structural logics of old/new combination



Plans of process on old/new combinations



Different spaces created by different combinations

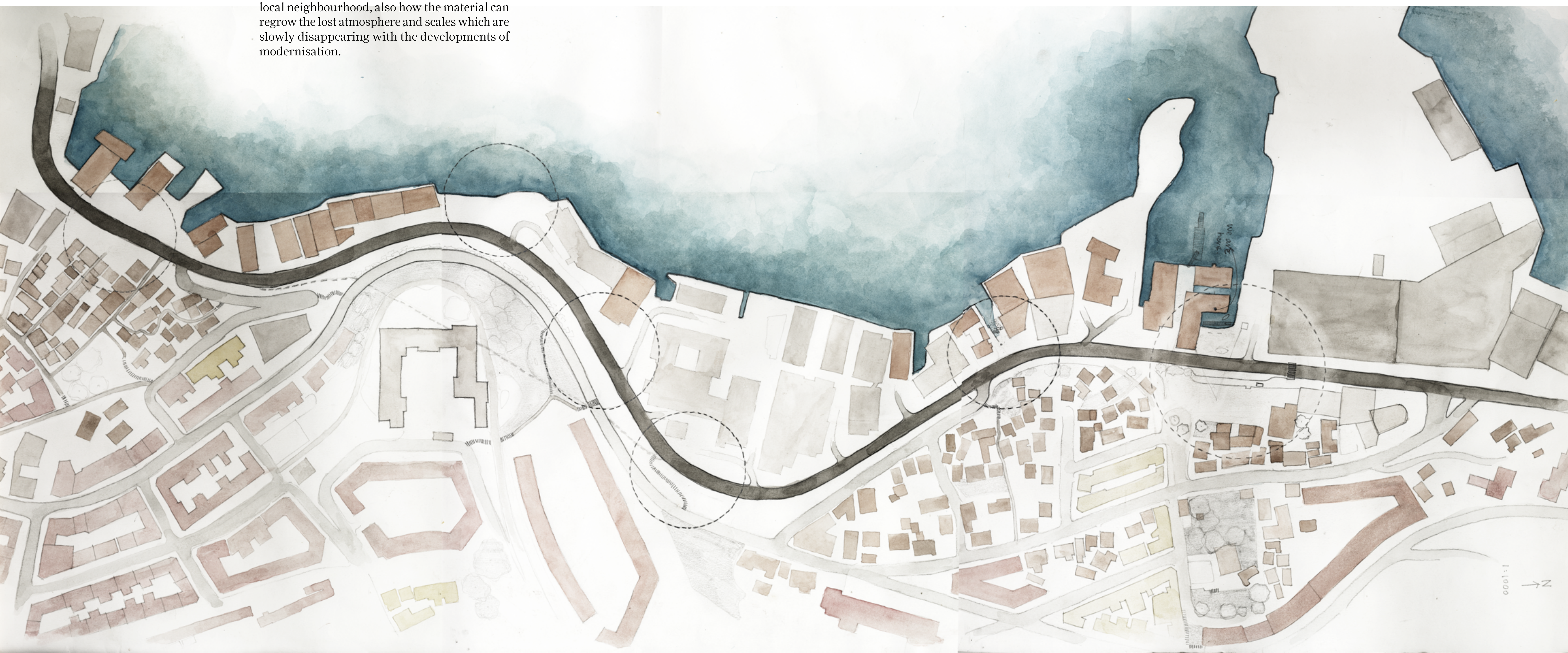
Series of experiments on old/new combinations.

SANDVIKEN PLAN

The circled areas are places identified with potentials of reconneting the mountain and ocean but are currently mostly ashphalt parking grounds. I focused on three main sites with five design interventions.

These five design interventions are extensions of my research and analysis on the topic of rethinking the value of old wood. They are prototypes/examples to demonstrate how the structural languages I developed of the old/new could be applied to a site-specific context in the local neighbourhood, also how the material can regrow the lost atmosphere and scales which are slowly disappearing with the developments of modernisation.


Sandviken Topography

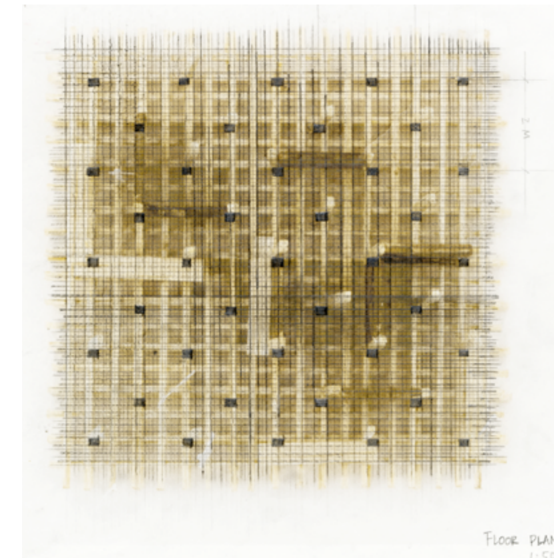


INTERVENTION 1

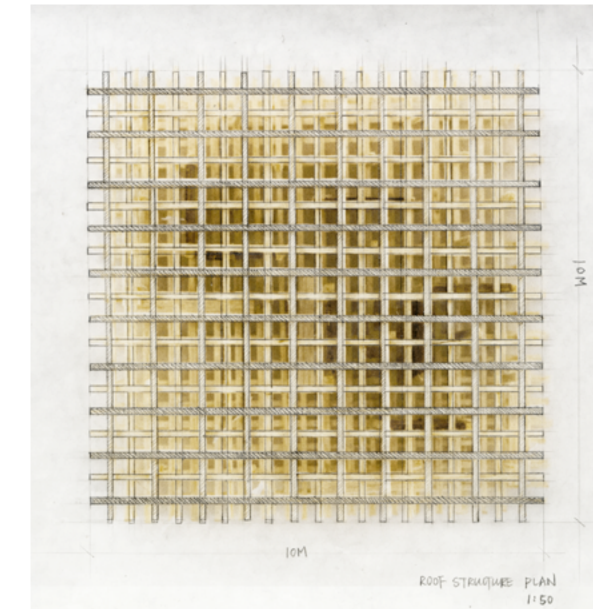
A PLACE TO VIEW THE WIDE OPEN OCEAN SHELTERED BY OLD WOODEN WALLS

The first intervention is located underneath Rothaugen School, the wide empty parking lots by the ocean. When you approach this site from both sides, there are massive, heavy elements (the cliff and the multi-storey warehouses and apartment blocks) surrounding you. Then there is an unexpected open panorama of the fjord. I want to create a space with dense elements and texture in contrast to the massive solid stone and houses to attract people to stop over and enjoy the open ocean view. The second structure language of the old and new wood is applied here, meaning old wooden pieces can be slid into the new vertical supports.

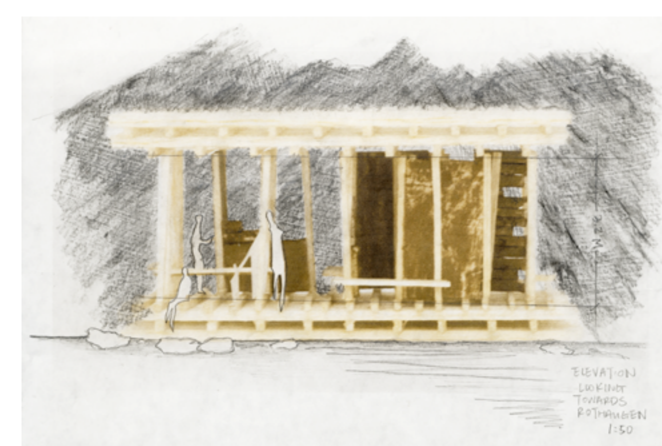
Site/situation plan with the cliff, the road and the ocean



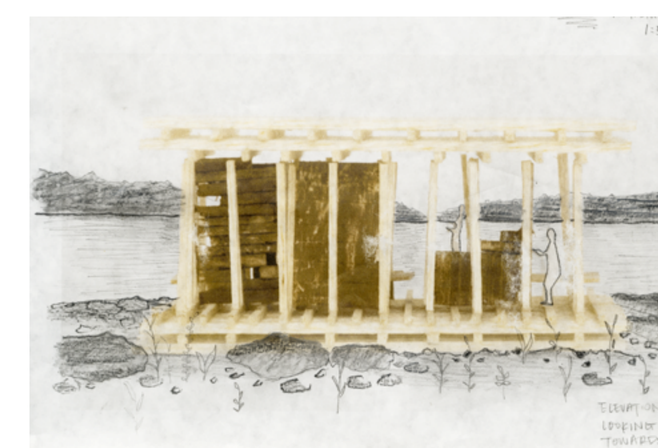
Ground floor plan with foundation and different layers of bolverk getting denser until the last layer of floor



Roof plan with structure inspired by bolverk



Elevation looking towards the cliff Rothaugen



Elevation looking towards the fjord

INTERVENTION 2

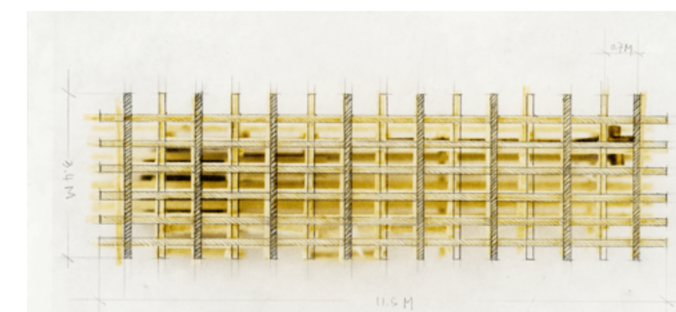
A PLACE TO NOTICE A VIEW TOWARDS THE FJORD WHILE WAITING AND BEING SHELTERED

The site for the second intervention is the current bus stop across the main Sandvikstorget but now without a shelter and is also used as a carpark. People that are waiting never enjoys the open ocean view because they are afraid that they will miss the bus. However, just a few steps away from the asphalt ground, there is a completely different experience of this place. You are now so close to the ocean, you look at the neighbourhood upwards and you are at the same level with the foundations of the surrounding houses.

The intervention gives a shelter to people and the old wood. Placing old/new wood along the slope could also invite people to reach the water and be aware of the interesting change of level and the water tide coming up and down on site. The shelter allows the bus to notice people and the other way - when you approach the site, you only see a little bit of the wood from a distance; but when you come closer, you are offered a long structure leading to an intimate space for viewing the fjord.

Site/situation plan showing the road, the water and the topography

Roof plan

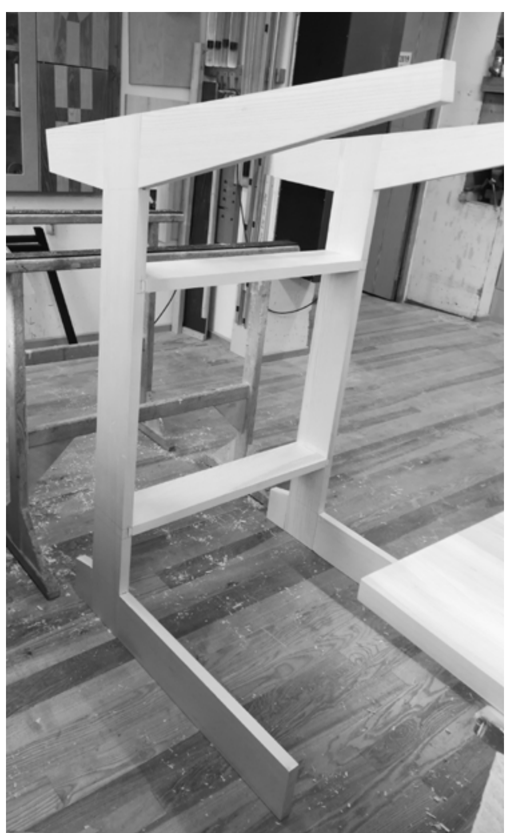


East elevation looking from road side toward the fjord

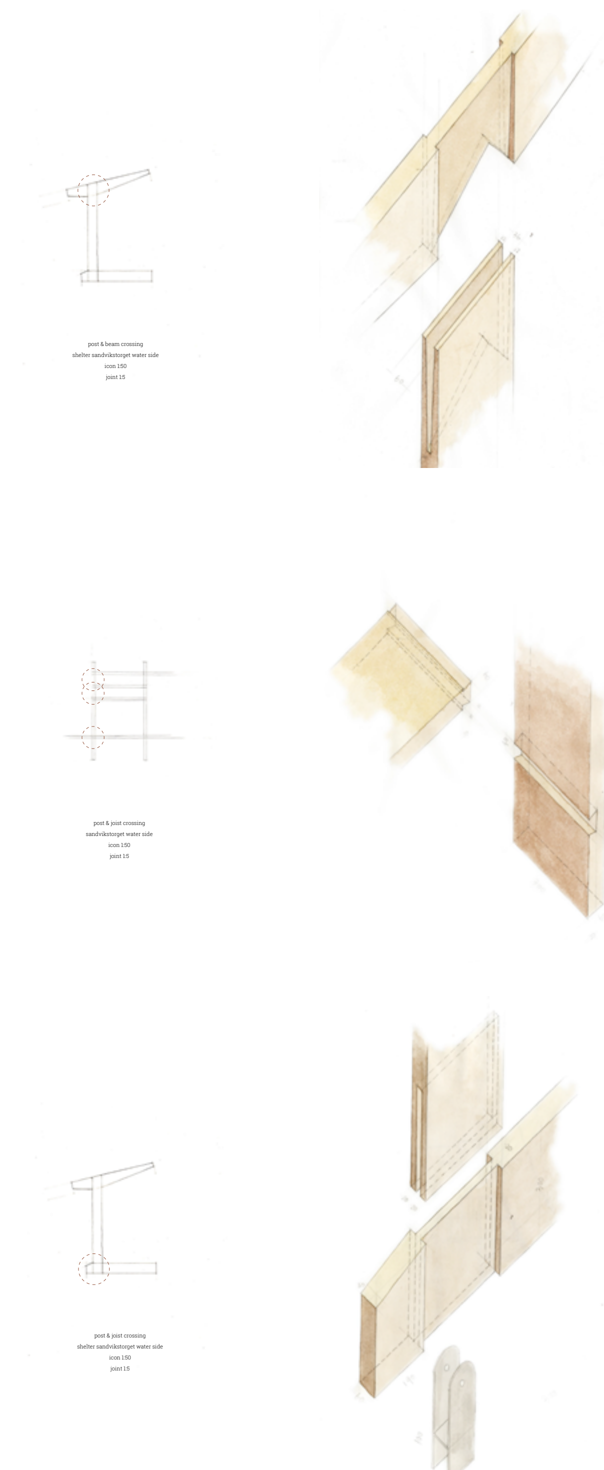
South elevation with rocky ground looking towards the bus direction

STRUCTURAL LOGIC STUDIES

We shall continue the essence of tradition, not just the look of it - which is to pass down the logic old, not the romantic old. In order to learn more about continuing the vernacular construction logic into today's environment, I went on a one-month carpentry internship in Bregenzerwald in Austria. There I made a 1:2 model of the frame of this new wooden element that is sheltering the old wood and the people. The whole structure is joint by wood itself without any use of glues or metal.



Prototype made in Austria

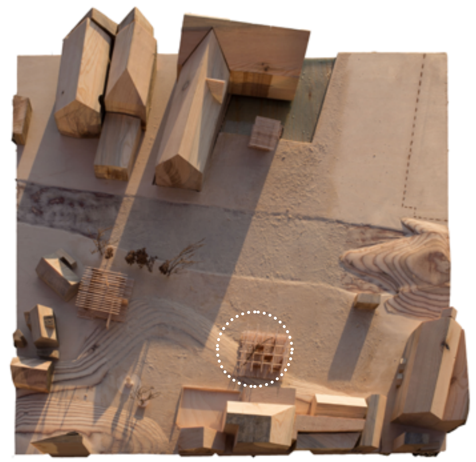


Detailed joint drawings with measurements

INTERVENTION 3

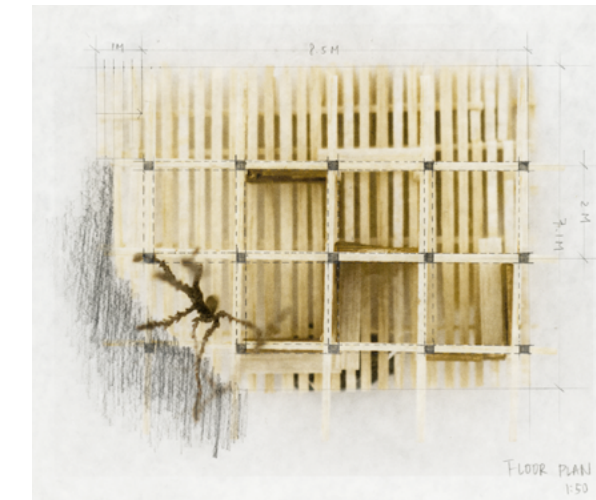
A PLACE WITH ONE SIDE TO CHAT WITH YOUR NEIGHBOUR, THE OTHER SIDE TO HOST EVENTS IN THE SQUARE

In order to strengthen the two qualities of Sandvikstorget, one side is designed to respond to the neighbourhood atmosphere, while the other side responding to the open square offering a space for activities.



Situation plan of Sandvikstorget with intervention circled

Roof plan showing grid of new wood



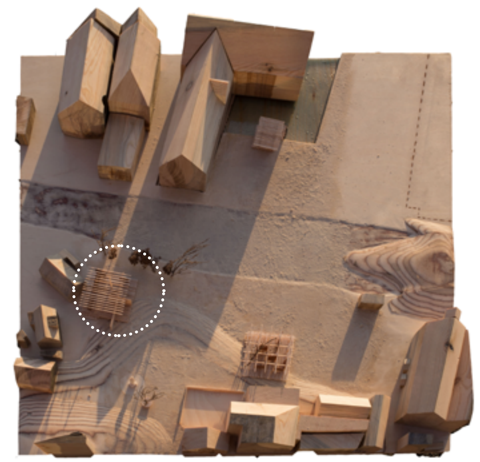
Elevations looking towards the supermarket

Elevations looking towards the ocean

INTERVENTION 4

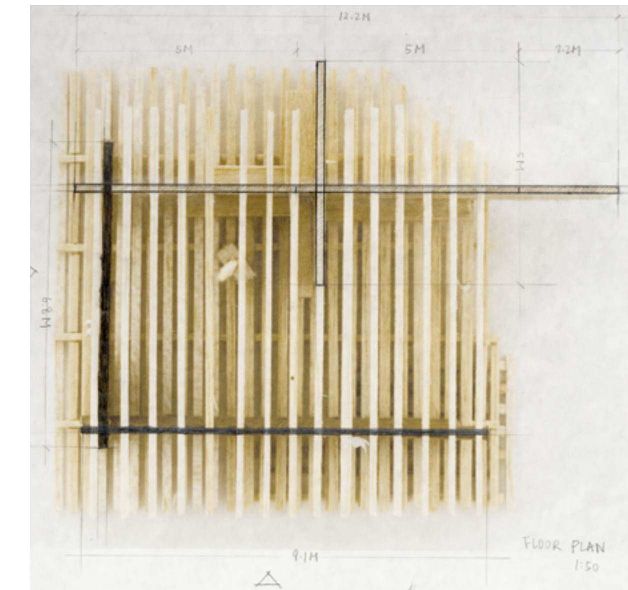
A PLACE TO WARM UP AND GATHER BETWEEN THE FJORD AND ALLMENNINGEN

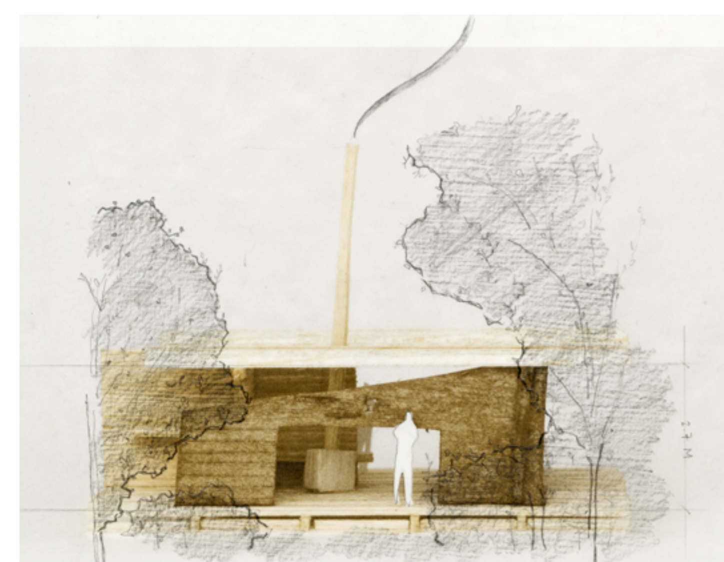
By placing something at this crucial connection point between the mountain and ocean, it allows us to continue the passage from the almenningen down into the fjord. The old wood is used as the main structural supported by another new log wall. Because of the construction type, it creates 5 different spatial qualities, each responding to one side of the square: e.g. the old opening provides a window towards the ocean (see diagrams below)



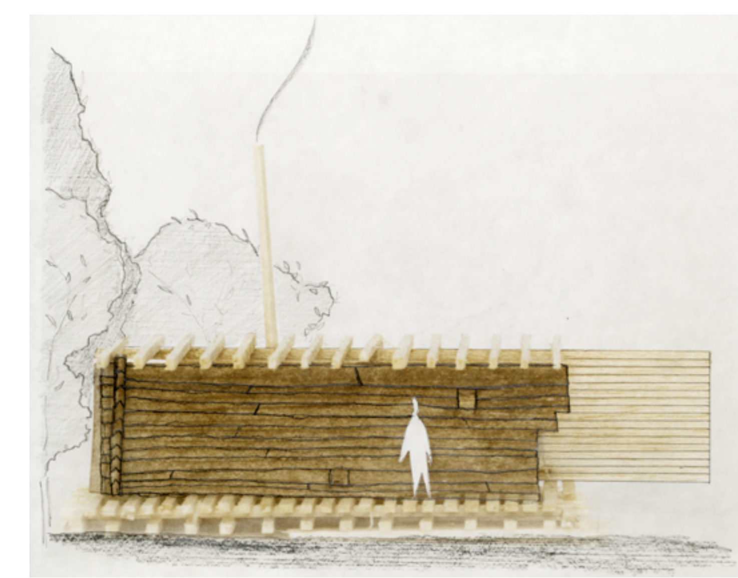
Situation plan of Sandvikstorget with intervention circled

Floor plan with old and new





Elevation looking from road side with opening towards the ocean from old wall

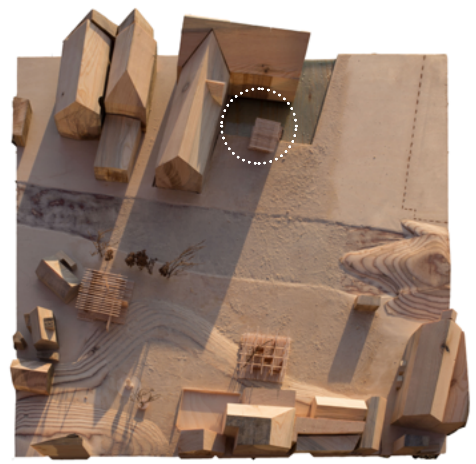


Elevation looking from neighbourhood side showing old/new logs

INTERVENTION 5

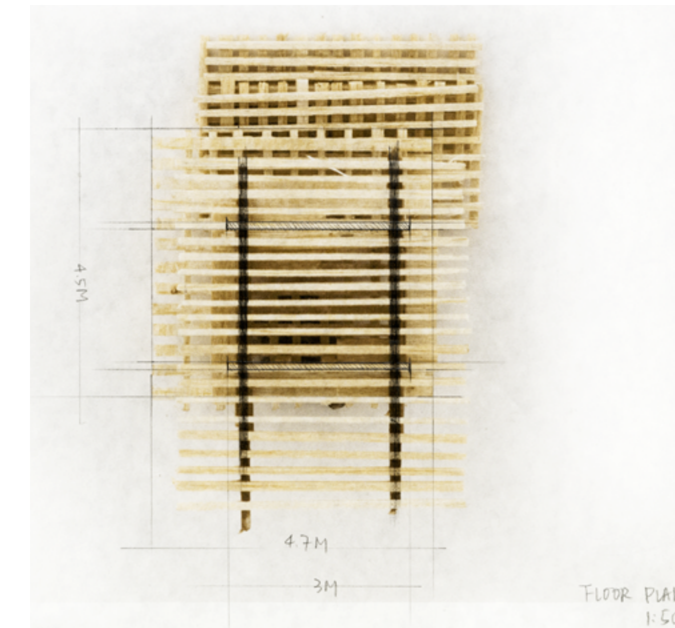
A PLACE TO OBSERVE THE OCEAN TIDE GOING HIGH AND LOW BETWEEN THE CROSSED WOODEN FOUNDATION

The small area of water in front of the Fiskerimuseum was actually revealed from the ashphalt after the renovation of this building a few years ago. It was covered with concrete after the 50s landfill. Although it brought back a lot of lost quality, the water area still has an abrupt transition from the harsh concrete to the soft water. By placing old and new wood there, a more smooth transition is created allowing people to notice the quality easier. Again, one side of the intervention is responding to the intimate space facing the corner of museum, the other side is enhancing the quality to offer a view towards the open fjord.

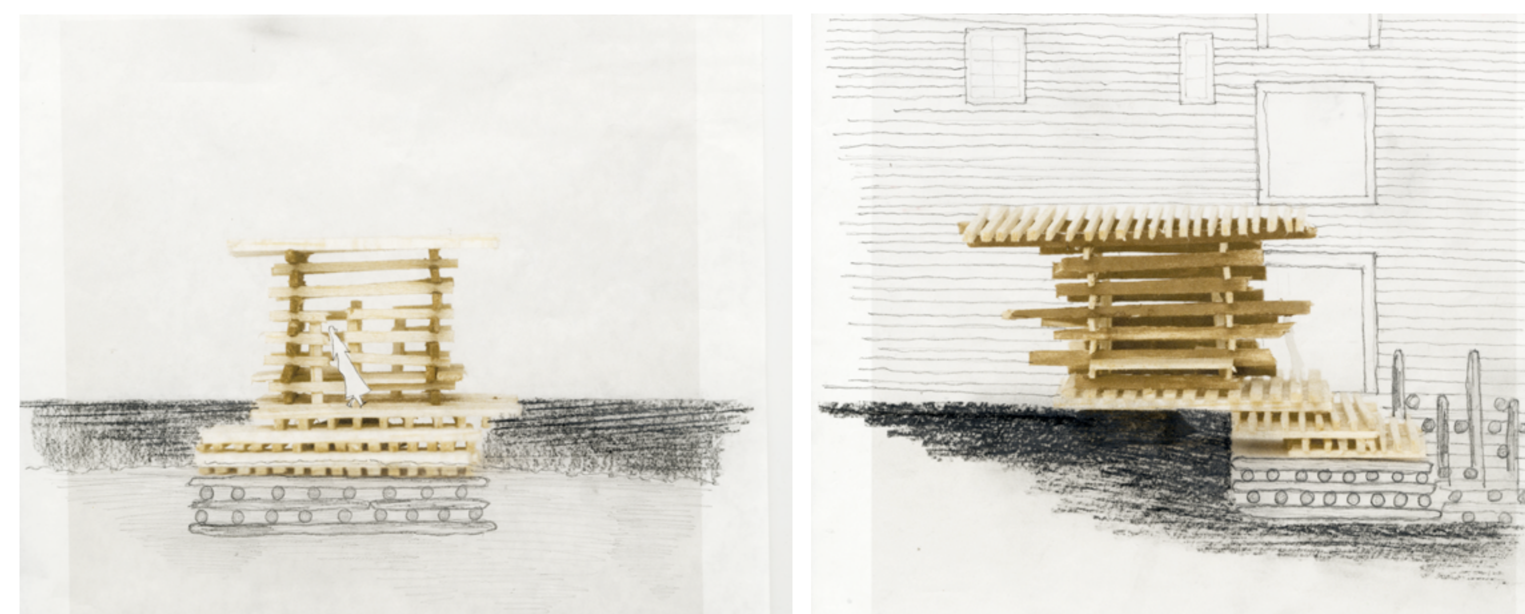


Situation plan of Sandvikstorget with intervention circled

Roof and floor plan



Elevation looking from water side



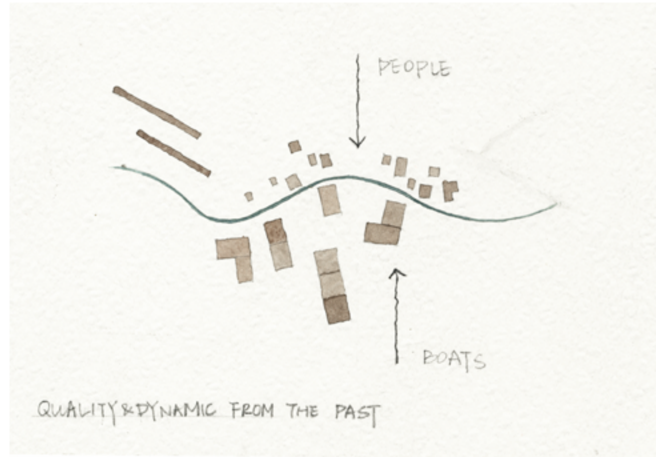
CONCLUSION

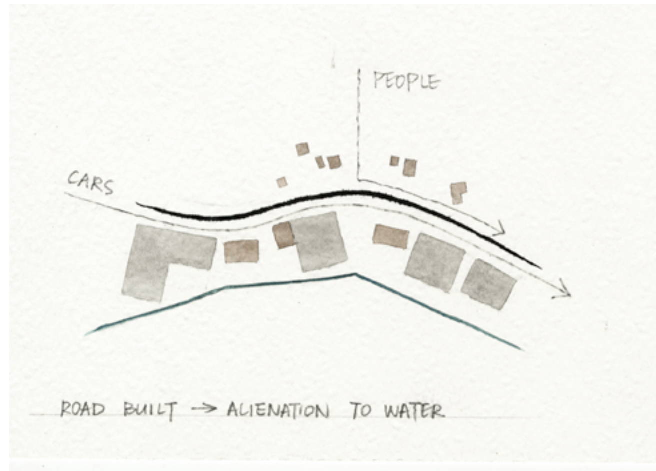
RESPONDING TO DESIGN INTENTION
1 - REGROW THE DISAPPEARING
NEIGHBOURHOOD QUALITY OF SANDVIKEN

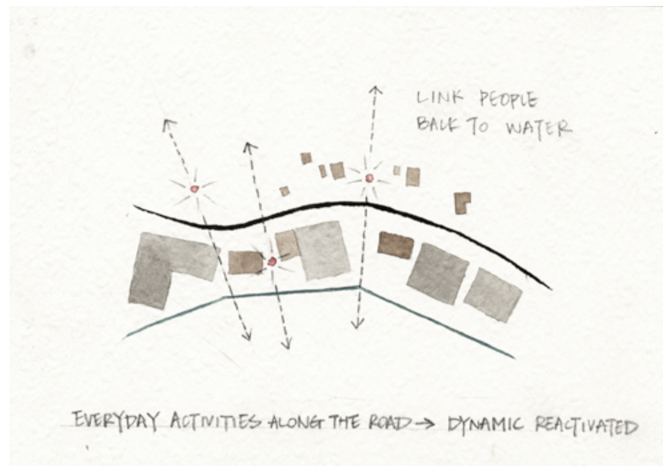
As shown in the above diagrams, by placing different interventions with everyday activities along the ashpalt-covered waterfront, we could reactivate the lost dynamics along the shore.

RESPONDING TO DESIGN INTENTION 2 -
REGROW THE MATERIALITY AND TACTILITY
OF OLD AND NEW WOOD

The design solution could also become a starting point of a bigger system and mentality of care and revival for reusing old wood.



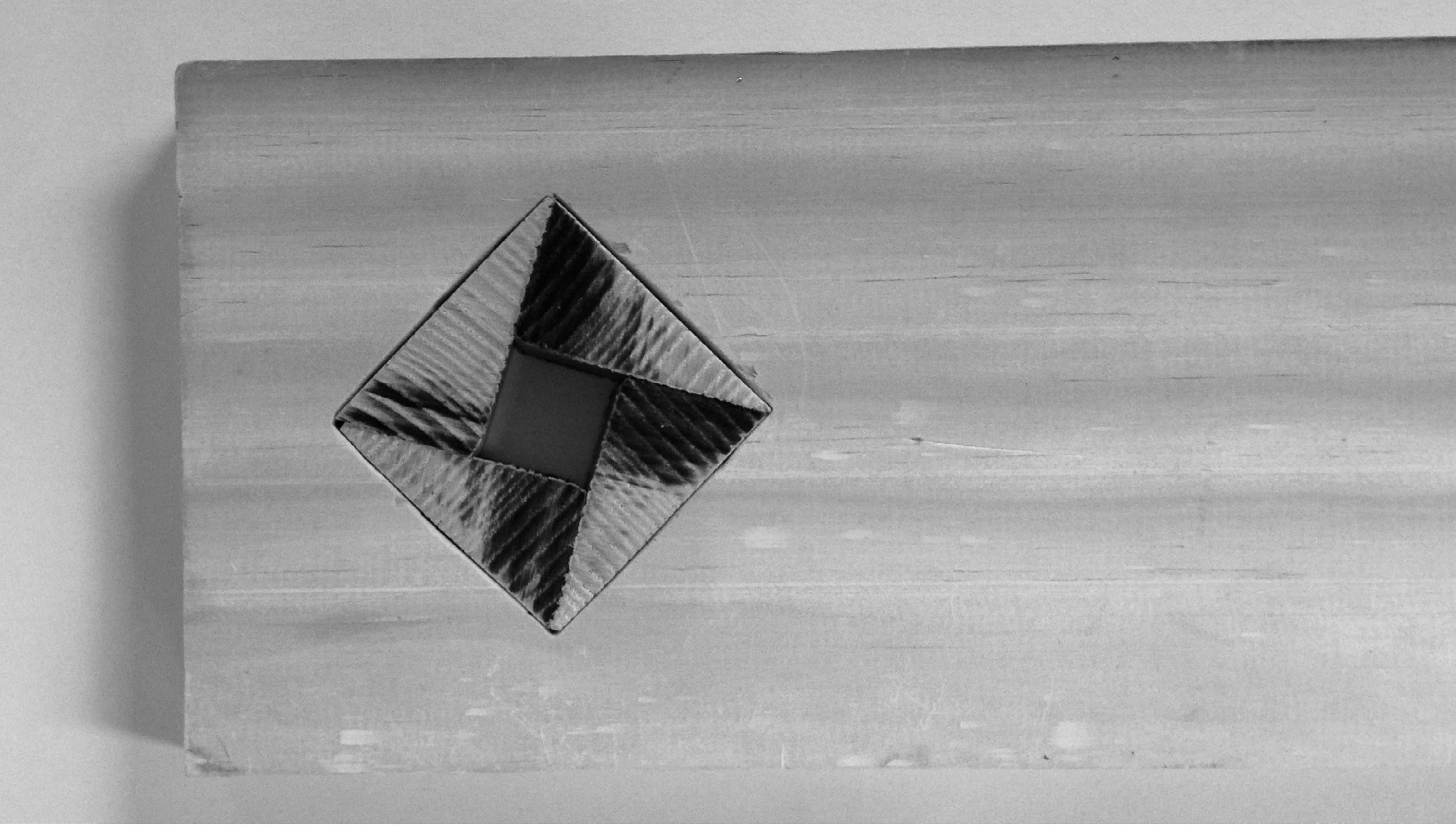




EXHIBITION

This part of exhibition at school offers an introduction/abstract to the main exhibition at Norwegian Fisheries Museum. Four main elements in this exhibition space: 1. model of the neighbourhood showing the mountain and water; 2. a pile of logs categorised in different sizes - mostly coming from the log house that me and my whole class last semester have moved from Asane back to Sandviken. We made an exhibition on the community day. After that it was stored at BAS unused again. 3. a corner of the original log house. 4. a 1:1 part of the structure of my final design intervention 1 and 5 - both of them share the same structure logics with new vertical support hosting the horizontal old wood

Model of Sandvikstorget with Design Intervention 3, 4 and 5
(drawings and sketches aroud the model)



A PRESENTATIONAL THEORY OF ORNAMENT

PROJECT BY DANIEL MAJ

ABSTRACT

Although ornament is typically understood to be a system of communication that operates representationally, this stance is problematic. While some ornament seems to represent disparate or even contradictory concepts, other ornament does not seem to represent anything at all. In both instances representation does not promote communication, it inhibits it. This thesis argues that while ornament may communicate representationally, its primary function is simply presentational. In this capacity ornament is used to communicate information regarding the qualities and relationships of material objects. The first half of the thesis engages with key texts and precedents in order to describe the mechanisms by which ornament is able to communicate. The second half of the thesis provides an example of how these mechanisms can inform the processes of architectural design. The thesis concludes with a reflection on the significance of ornamental communication and its role within the discipline of architecture. Ultimately, this thesis suggests that the practice of ornamentation not only helps us to define our world, but also to define our place within the world.

THEORY

This thesis argues that although ornament may operate in a representational or symbolic capacity, this is not its primary function. Instead, ornament operates in a presentational capacity, by articulating materialistic relationships and conditions. The first half of this thesis describes the mechanisms by which ornament operates presentationally. The second half of this thesis explores how these mechanisms may be used to inform the processes of architectural design. The thesis concludes with a reflection of the significance of ornamental communication and its role within the discipline of architecture.

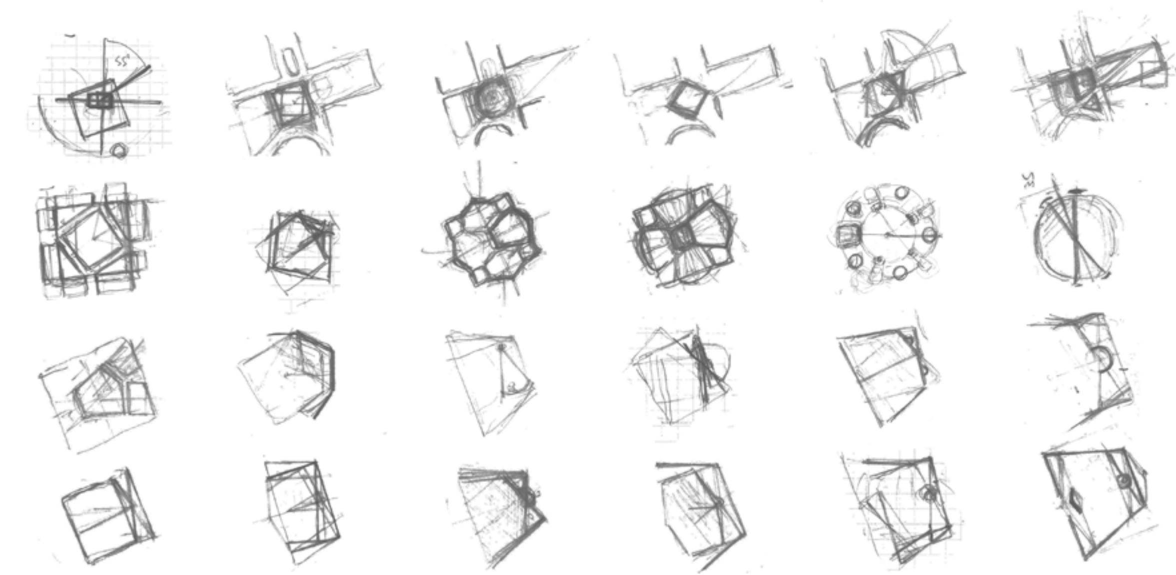
Ornament articulates physical relationships between various kinds of objects across a range of scales. At a small scale ornament articulates the forces and qualities within an architectural element. At a somewhat larger scale, ornament articulates the relationships between architectural elements. At the largest scale ornament articulates relationships between buildings, temporally as well as spatially. Finally, across all scales, ornament articulates relationships between the built environment and people.

At the scale of the architectural element ornament articulates two interrelated qualities: the materiality of the element in question and the processes of its making. It also articulates two connected physical conditions: the structure of the element and its surface. Materiality may be considered an internal force, as it is an intrinsic quality. Making may be considered an external force, as it acts upon materiality. The forms of all elements are a result of these internal and external forces.1 While the materiality of an element influences the process of its making, that influence is only evident in the making itself.[2] The process of making therefore articulates material qualities, and different processes of making articulate different material qualities.[3,4]

If making is understood as the articulation of material qualities then structure may be understood as the articulation of making. The crucial difference between making and structure is that making is a process of articulation, while structure is a product of that process. The structure of an architectural element articulates both its materiality and the processes of its making.[5] In the same way that different processes of making articulate different material qualities, different structures articulate different processes of making. Likewise, in the same way that structure articulates these qualities, surface articulates the qualities of structure.[6] Furthermore, the surface of an element also articulates the processes of its making.[7] As the surface and structure of an element become more articulated they become more articulate, which is to say that as they gain more physical definition they communicate more information about the materiality of an element and the processes of its making.[8] The form of an element emerges from the intersection of materiality and making.[9] While each of these qualities influence one another they may be thought of in a linear fashion. Materiality is articulated though making, making is articulated through structure, and structure is articulated through surface.

At the scale of the building ornament articulates two more interrelated qualities: continuity and difference. Continuity and difference are articulated through figuration and the configurations of figures. In this sense continuity and difference are similar to materiality and making in that they are architectural qualities which are being articulated. Figures and configurations, on the other hand, are comparable to the structures and surfaces of elements in that they are means of articulation. In the same way that different structures and surfaces articulate different material qualities and processes of making, different figures and configurations of figures articulate different types of continuity and difference. However, this analogy should not be overstated as the relationship between the concepts do not correlate exactly. While materiality and making are qualities which exist in isolation within an element, continuity and difference exist largely in the relation between elements. Similarly, though the relationship between structure and surface is articulated within individual elements, the relationships articulated through figuration and configuration often occur between elements.

At the largest scale ornament articulates relationships between buildings. The relationships which ornament articulates between buildings are not unlike those which it articulates between



Studies of the Intersection of Three Orientations elements within buildings. Like elements, buildings articulate continuity and difference. Like elements, buildings articulate these qualities and relationships though figuration and configuration. Finally, like elements, the continuity and difference between buildings may articulate material qualities, processes of making, or spatial conditions. However the relationships articulated between buildings differ in a critical way from those articulated within buildings. Within the context of a building architectural elements generally exist simultaneously. Therefore the relationships between elements are primarily physical in nature, not temporal. Buildings on the other hand relate to one another temporally as well as physically. This may be readily observed through the use of precedents in architectural design. Buildings and the elements they contain are not articulated in isolation, nor are they merely articulated in physical relation to one another, they are articulated in relation to a vast body of architectural work that extends backwards in time. The articulation of materiality, making, structure, and surface each occur in relation to past articulations of those same qualities and conditions. The same holds true for the use of figuration and configuration in the articulation of continuity and difference. It is through the articulation of these temporal relationships that architecture operates as a reflexive discipline.

The temporal relationships articulated through ornament may be described in terms of convention and invention.[10] To understand convention and invention it is necessary to reiterate the two meanings of articulation. Articulation denotes the act of making something distinct in relation to other parts as well as the act of expressing something clearly. An element which has been articulated is articulate – it expresses a particular understanding of material qualities. Considered in this way, ornamental conventions are not simply common methods of structural or surficial figuration and configuration. Rather, ornamental conventions represent a continuity of understanding.[11] If an ornamental figure articulates certain material qualities, a variation of that figure may articulate slightly different qualities. Similarly, If an ornamental figure articulates a certain process of making, a variation of that figure may articulate a different process of making. The same is true for ornamental configurations; if an ornament articulates the relationship between two elements or figures then a variation of that ornament may articulate a different relationship.

Ornament does not simply articulate material conditions and relationships in the abstract. Instead, ornament is an inherently experiential phenomenon which articulates these conditions and relationships to people.[12] Indeed, articulation, as the act of stating something clearly, actually presupposes the existence of a subject. And to the extent that ornament operates on a materialistic level, it must be engaged with by the viewer in a materialistic fashion.[13] Put slightly differently, materiality implies an encounter with a material subject.[14] The nature of our relationship with ornament is not primarily intellectual, verbal, semiotic, or metaphorical - it is embodied.[15,16,17] These additional layers of meaning arise from an embodied condition and depend on that condition. Although this might seem to hinder communication, it is actually beneficial. While intellectual and linguistic frameworks may be culturally bound, the condition of being embodied is both universal and immediately comprehensible.[18] Our bodies serve as the mechanism by which we measure, organize, and ultimately comprehend our world.[19,20]

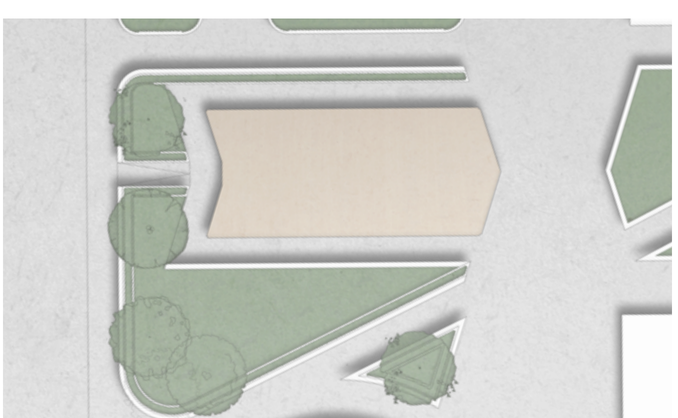
Our physicality is so intertwined with the physicality of our world that experience and tectonics are essentially coterminous.[21] As a result, ornament not only articulates materialistic conditions, in doing so it also articulates an embodied relationship to those conditions. In addition to communicating information about the material world, our embodied experience of ornament also shapes how we understand ourselves as material entities in that world.[22] This relationship between the external world and the embodied subject is reciprocal and recursive; the more we articulate the world, the more we articulate our place within in.[23] Through this cyclical process both the world and the subject co-emerge.[24]

View of Main Entry

The theory of ornamentation outlined in the first part of this thesis is primarily descriptive in that it provides a conceptual framework for analyzing and discussing existing designs. This framework consists of a series of interconnected terms and definitions. Although these terms and definitions are useful as analytical tools, to the extent that they are descriptive they do not facilitate the process of design. In order to so they move from being primarily descriptive to being primarily prescriptive. The transition from a material theory of ornamentation to a material practice of ornamentation therefore depends on re-framing the terminology involved.

This may be accomplished by using the key terms as the basis for a series of inquiries into the nature of an architectural element. Thus, instead of describing the materiality of an existing element, we may inquire about the materiality of a potential element in the very process of its design. The other terms introduced in the first part of this thesis may be re-framed in a similar manner. Furthermore, these questions may be posed in conjunction, and may inform one another in the same way in which the terms themselves do. Instead of simply inquiring about the materiality of an element in isolation a designer may investigate multiple characteristics of an element in an ornamental fashion at once.

View from Church Street



Site Plan

PROJECT

A multi-faith space was chosen as an ideal program for the investigation of a material practice of ornamentation. This program is well suited to this investigation because it accentuates the complex relationship between ornamentation and representation. Many multi-faith spaces are empty, white, often windowless rooms.[25] The design of these facilities is predicated on the correct notion that individuals should not be confronted by the symbolism of other traditions.[26] However, in their attempt to promote pluralism and universal accessibility these spaces tend to be architecturally featureless. They are not only devoid of explicitly representational iconography, they are devoid of any form of ornamentation altogether. Implicit in this aesthetic sensibility is the conflation of architectural articulation and representation. The removal of architectural articulation is premised on the idea that these acts of ornamentation communicate in the same manner in which a cross, a crescent moon, or a Star of David communicate. However, multi-faith spaces which are designed in this fashion are in some sense self-defeating. The more universal they attempt to be, the more placeless they become. Furthermore, as these spaces are stripped of architectural articulation they become increasingly incapable of differentiating sacred from profane space.[27] A drywall room with an acoustic tile ceiling does not inspire the awe or mystery which are typically associated with places of worship.

The decision was made early in the design process to construct the proposed design primarily out of wood. This choice was made for two reasons. First, the versatility of wood as a building material makes it an ideal vehicle for the exploration of tectonic ornamentation.[28,29,30] This versatility is evident in the variety of species of wood used in construction. Although these species share some material qualities, they may also differ substantially from one another. For example, all wood is anisotropic and features an inherent linearity.[31] Similarly, through the processes of growth all trees are characterized by annual rings, heartwood and sapwood. However, differing species of wood may also have differing qualities. For example, lumber yielded by different species may vary in size, colour, texture, density and elasticity. The qualitative continuity between species of wood tends to be articulated through the processes by which it is made into architectural elements. Conversely, the qualitative differences between species of wood tends to be articulated through the nature of the elements themselves. Thus, while black spruce, bur oak, and eastern red cedar may all be milled and sawn into planks, they are typically used to make different architectural elements. The straight grain of spruce is suitable for dimensional framing lumber, the density of bur oak makes it appropriate for flooring, and the rot resistance of eastern red cedar allows it to be used as exterior cladding.

Wall Section

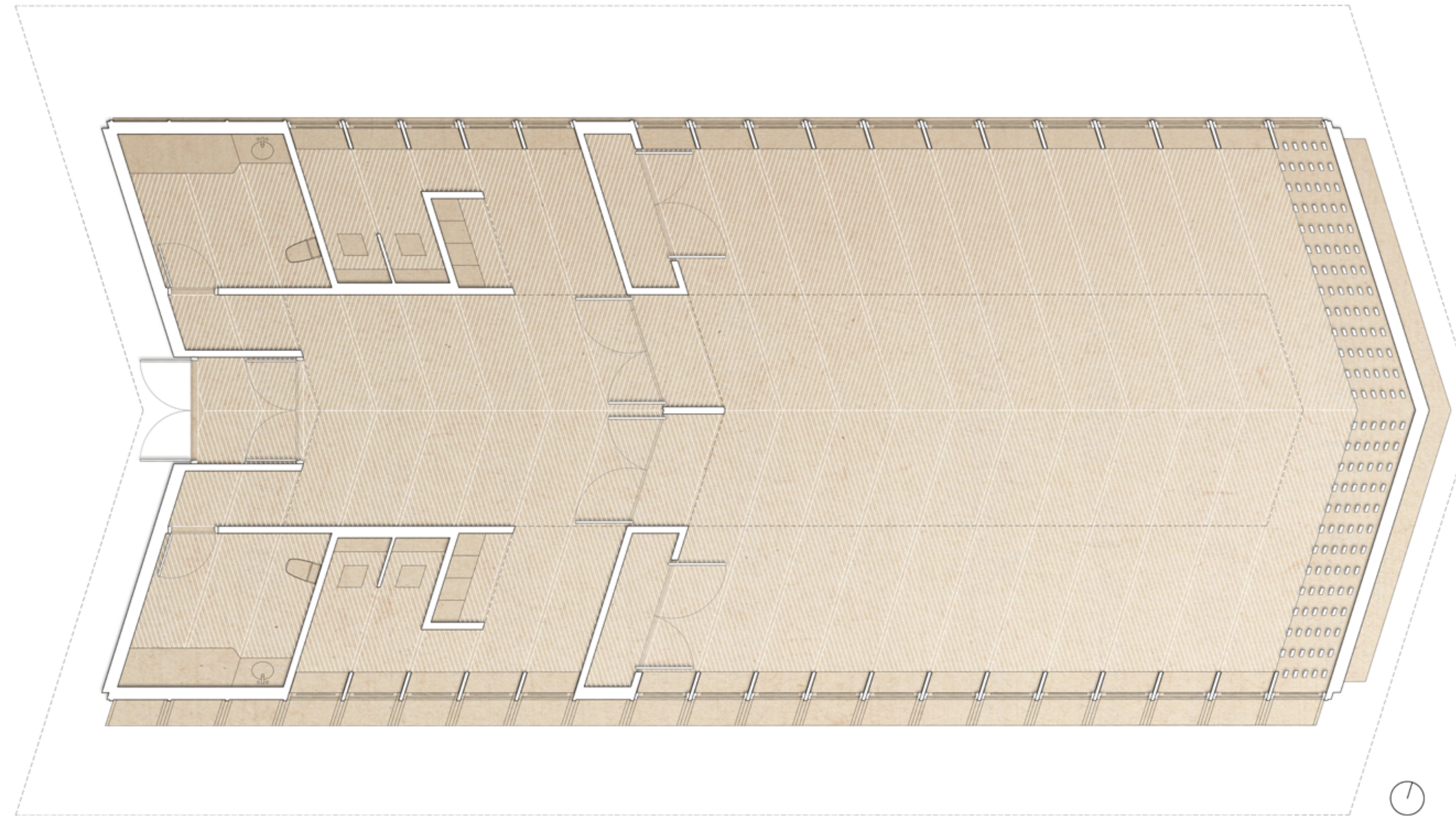
View of Garden

East Elevation

The variety of species of wood which are used to make architectural elements, the variety of elements into which they are made, and the variety of ways by which they are made into those elements collectively allow many kinds of qualitative continuity and difference to be articulated within a single material. Furthermore, these same qualities allow wood to articulate spatial continuity and difference as well. For example, a building might be constructed of elements made from many species of wood, each of which are used in response to different spatial conditions which suit their particular qualities. Alternatively, a building might articulate different spatial conditions using elements which have been made entirely of one species of wood, but which have been worked in different ways. Or a building might use some combination of the two approaches. In any case, the use of wood simultaneously acts as a control variable while also providing a rich basis for forms of articulation.[32]

The proposed design for the Ryerson Multifaith Centre was generated by the intersection of three orientations. The first of these is the urban grid of Toronto, which is rotated -17 degrees from geographic north. The second orientation corresponds to geographic east. The practice of orienting places of worship towards the east has precedent in Judaism, Christianity, Buddhism and Hinduism. The third orientation corresponds to the Kaaba in Mecca which is 56 degrees from geographic north in Toronto. Remarkably, the orientations toward true east and Mecca mirror one another across the east-west axis of the Toronto grid. As a result, although the proposed prayer hall affords three distinct orientations, it is also perfectly symmetrical. The intersection of these orientations not only defines the geometry of the prayer hall, but is carried throughout the entirety of the building. this may be seen in plan, section, and elevation.

Throughout the process of design the questions outlined at the beginning of this chapter were used to inquire into the nature of architectural elements and their relationships. Through this process of inquiry a distinct material strategy emerged which focused on ornamental configuration in lieu of ornamental figuration. This strategy is by no means the only viable approach



Floor Plan

West Elevation

to design – rather it is one of many equally valid ornamental approaches. Most of the individual architectural elements in the design were left largely un-ornamented. Furthermore, most of the architectural elements in the building were constructed from different indigenous species of wood. These wooden elements were made through conventional processes of milling and sawing. As a result the structural and surficial characteristics of each element are also highly conventional – most are simply rectangular boards or slats of varying dimensions. However, although these elements are un-ornamented, they do articulate a particular material understanding. The quality which they articulate most clearly is the inherent linearity of the material. The processes of milling and sawing, as well as the forms which these processes generate, have become conventional precisely because they take advantage of this property.

The figuration of elements is used throughout the design to articulate qualitative continuity and difference. Qualitative continuity is articulated by creating architectural elements which are structurally and surficially similar out of different species of wood. The framing members, for example, are made from spruce, pine and fir, while the exterior cladding is made from cedar, and the interior finishes are made from bur oak, hard maple, and black cherry. By making similar elements out of different species of wood their common characteristics are articulated. Conversely, by using different species of wood in different spatial conditions their differences are articulated. Thus, although the flooring and the cladding both articulate the inherent linearity of wood, they also articulate some of the differences between maple and cedar. While the density of maple makes it a suitable flooring material, the ability of cedar to resist rot makes it a suitable cladding material. So, although these elements have not been extensively articulated, they are still articulate.

Although the individual elements which make up the building have not been articulated in an ornamental fashion, the manner in which they are configured in relation to one another is highly ornamental. And while the figuration of elements is used to articulate qualitative continuity and difference, their configuration in relation to one another is used to articulate spatial continuity and difference. Like the figuration of the elements, these acts of ornamental configuration depend to a large extent on the inherent linearity of wood and the directionality which that quality implies. This may be seen to some extent in the design of the facades, but is most evident in the large number of elements which are configured to be either parallel or perpendicular to one of the three orientations which inform the geometry of the design.

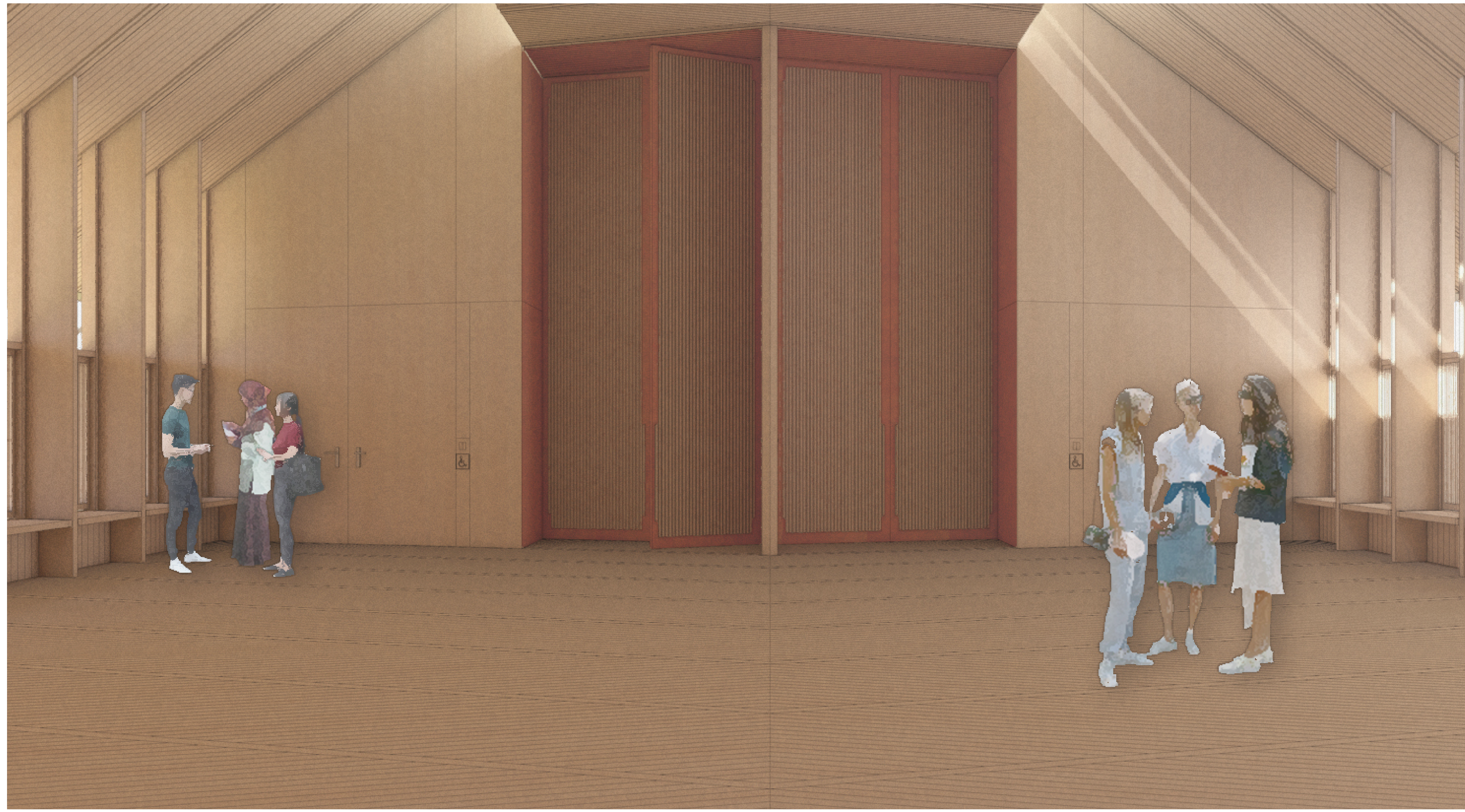
The configuration of the flooring throughout the design serves as a prime example of this phenomenon. The floor is divided into sections which correspond to the structural system of the building. The southern wings of the resulting chevrons are perpendicular to the east, while the northern wings are perpendicular to Mecca. The remainder of the flooring, however, is oriented in the opposite fashion. The flooring on the southern half of the building is perpendicular to Mecca, while the flooring on the northern half is perpendicular to the east. The resulting pattern of ornamental nestings and adjacencies articulates the continuity and difference of space. Although the figure of each chevron articulates a difference in space, their repetition articulates a continuity of space. Likewise, while the two wings of each chevron articulate a difference in space, the configuration of the elements which make up those wings articulates a continuity in space.

The ornamental configuration of elements is also used to articulate a spatial continuity between the interior ceiling and the exterior soffit. The wooden planks which make up the surfaces of both elements are arranged to be perpendicular to the east on the south side of the building, and perpendicular to Mecca on the north side of the building. Furthermore, the elements which make up the ceiling are precisely aligned with those that make up the soffit. This configuration articulates a relationship between the two conditions which is very similar to the previous example. While the orientation of the elements is used to articulate the spatial continuity between the ceiling and the soffit, the manner in which the elements are aligned to one another articulates

the continuity of space more generally. Through the configuration of these elements the orientations toward the east and Mecca which inform the interior of the design are implied outside of the building as well. The ornamentation of the design differentiates it as a sacred space, even as it extends the qualities which make it sacred outwards into profane space.

Although these ornamental strategies are used throughout the design, ornamentation is also used to articulate significant moments in the building. These moments include the entry into the building itself, the entry into the prayer hall, and the east wall of the prayer hall. Each of these spaces is articulated through the introduction of architectural elements made from black cherry, a material which is not used elsewhere in the building. These elements are, for the most part, qualitatively continuous with the elements around them insofar as they have been fabricated using the same processes of making. However, this level of qualitative continuity makes their difference in materiality that much more noticeable. In these instances the difference in materiality is enough to articulate a difference in space. Furthermore, the continuity in materiality between these three spaces is enough to articulate a continuity in space. In this way, materiality is used to simultaneously articulate three different thresholds, while also uniting those thresholds into a clear procession.

These three spaces are further articulated through the ornamental configuration of elements. At both the entry to the building and the entry to the prayer hall elements made from white oak are nested within the elements made from black cherry. At the east wall of the prayer hall the elements made from black cherry are adjacent to elements made from white oak. In each instance the configuration of elements generates an alternating pattern of coloured stripes. While this pattern serves to emphasize the difference in materiality between the elements, it also operates as an ornamental motif. Like the black cherry wood itself, this stripe pattern differentiates these places from the spaces around them and articulates a spatial continuity between them.

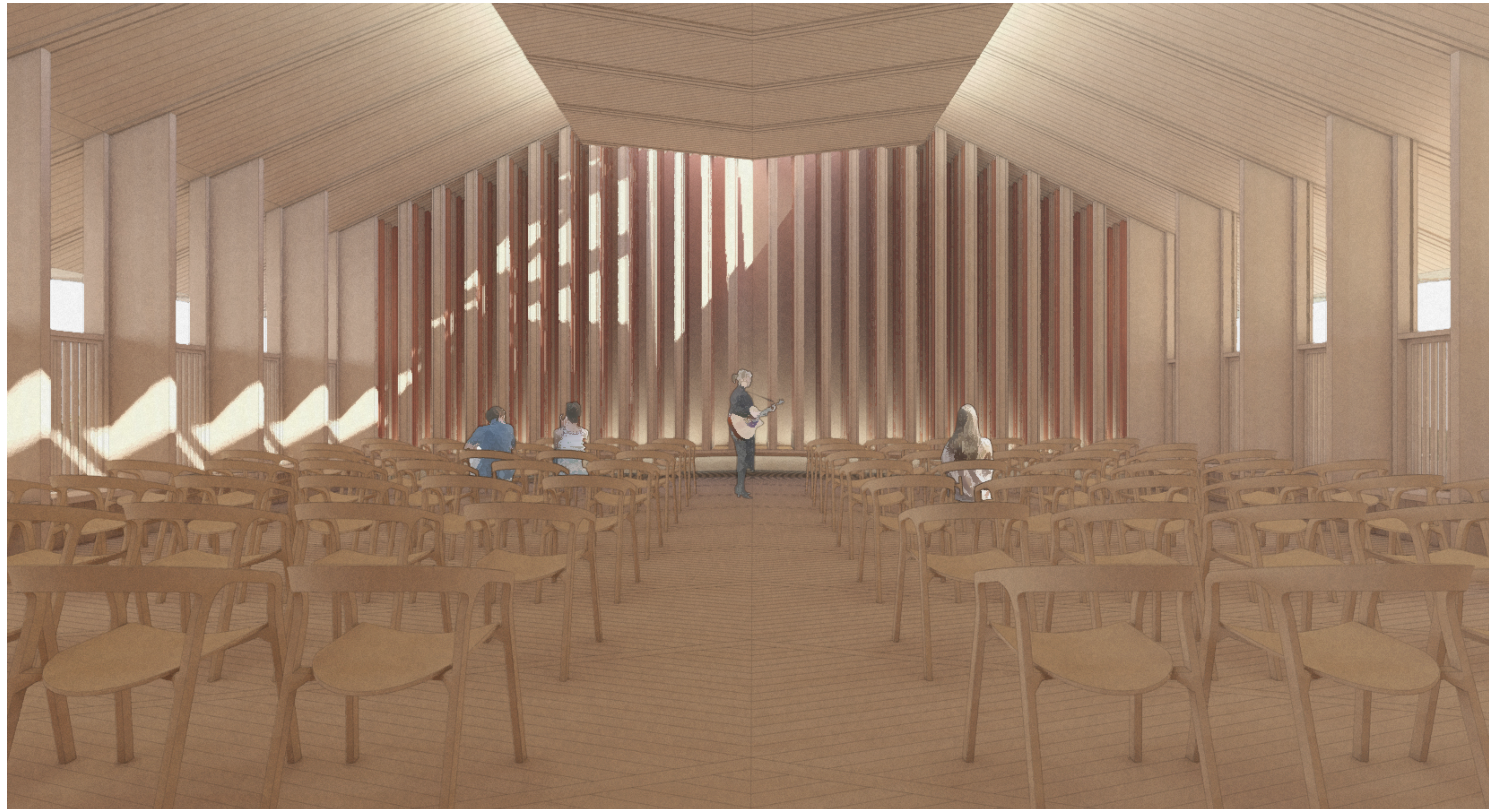


View of Prayer Hall Entry II

REFLECTION

Over the course of this thesis theoretical analysis of texts and precedents provided a basis for understanding the nature of presentational ornament. However, the processes of designing yielded additional insights which had not become apparent in the course of theorizing. The first thing that became evident through the act of design is the highly idiosyncratic nature of ornamentation. Although the theory outlined in the first part of this thesis describes many distinct methods of ornamentation, some of these practices feature prominently in the design of the multifaith centre while others hardly feature at all. For example, the proposed design relies heavily on the ornamental configuration of elements in relation to one another. Conversely, very few individual architectural elements in the design feature any surficial articulation at all. While the design speaks to the materiality of wood and the processes by which it is made into elements in a broad sense, it also speaks to my particular understanding of that materiality and those processes more specifically. It is not difficult to imagine that the ornamental mode of investigation put forward in this thesis could generate a very different design in the hands of another architect. Thus, while ornament ultimately serves as a means of communication, it also serves as a means of self-expression.

The second thing which became clear in the process of design is the manner in which ornament is able to address programmatic or contextual considerations without operating in a representational capacity. This may be seen in the intersection of the three orientations which generate the geometry of the design. While the orientations towards Mecca and the east facilitate the programmatic function of the building, the orientation to the urban grid of Toronto locates the design within a particular place. Although these orientations are not ornamental in and of themselves, the patterns which are generated through their relationships to one another are. The notion that ornament can convey this kind of information in a purely presentational capacity is both powerful and surprising. This idea conforms to the conventional understanding of what ornament communicates while simultaneously defying the conventional understanding

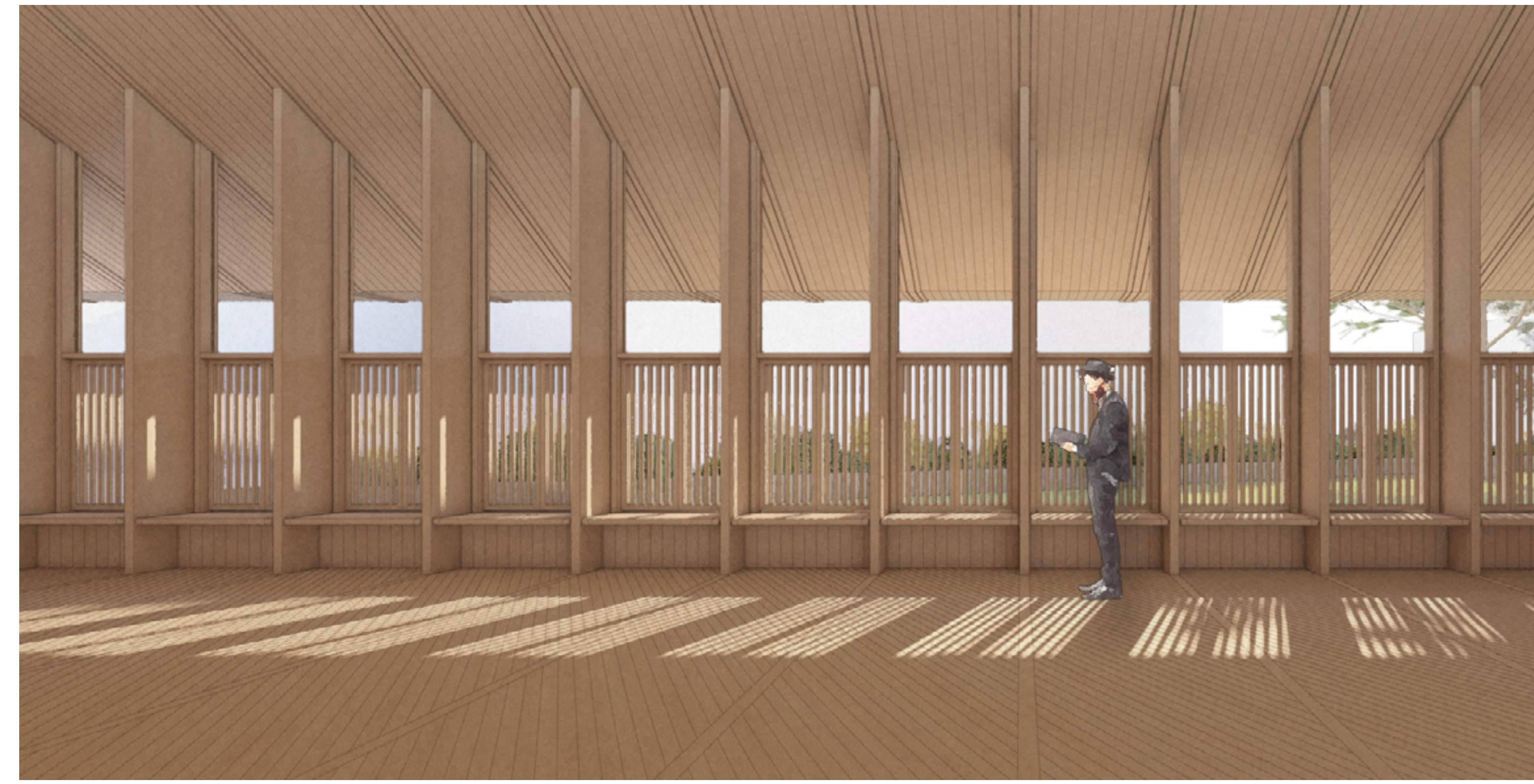


View of Prayer Hall I

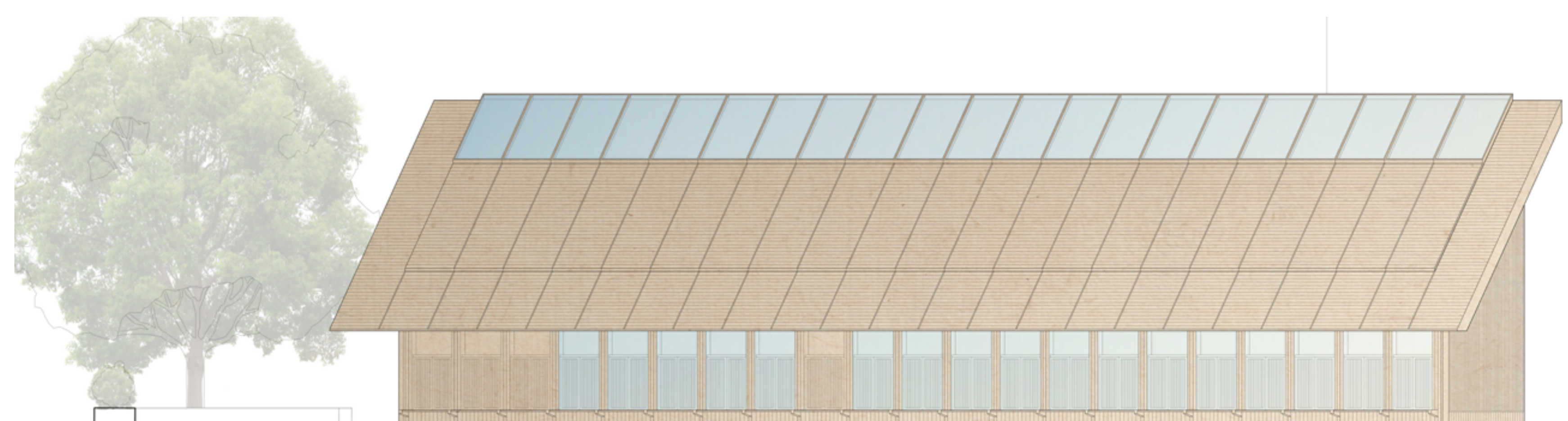
of how it communicates. In a sense this serves the interests of both the people who use buildings and the architects who design them. On one hand presentational ornament may allow the lay person to more easily grasp the function of a particular building and thus engage with architecture more broadly. On the other hand presentational ornament allows the architect to engage with the public without reference to phenomena outside the discipline.

However, the most significant aspect of ornament which became clear in the course of design is the manner in which it is able to elucidate the intimate connection between materiality and space. By using ornament to simultaneously investigate materiality and space novel aspects of both "things" came to light. In many instances the ornamental articulation of materiality provided a fresh insight into the articulation of space. Similarly, the ornamental articulation of space often prompted a re-examination of material conditions. This relationship may be seen in the connection between the aforementioned spatial orientations which generated the geometry of the project and the inherent linearity of wood. In this instance the directionality implied in both considerations brought the two lines of inquiry together. Within the final design the orientation of space and the linearity of wood mutually articulate one another. This example highlights the generative potential of ornament and the manner in which articulation contributes to the iterative processes of design. Ornament is not only a means of communication and self-expression, it is also a means of investigation. Architects may use ornamental inquiry to discover spatial and material qualities which they may choose not to communicate, or to come to a particular understanding which they may choose not to express. In other words, ornament may be a useful tool, even in the design of unornamented buildings.

Collectively, these reflections point to the real power of ornament: the fact that it operates as a tool for both investigation and communication. As a process of design presentational ornamentation may generate profound insights into the nature of the material world, the ways in which we shape that world, and our place within it. As

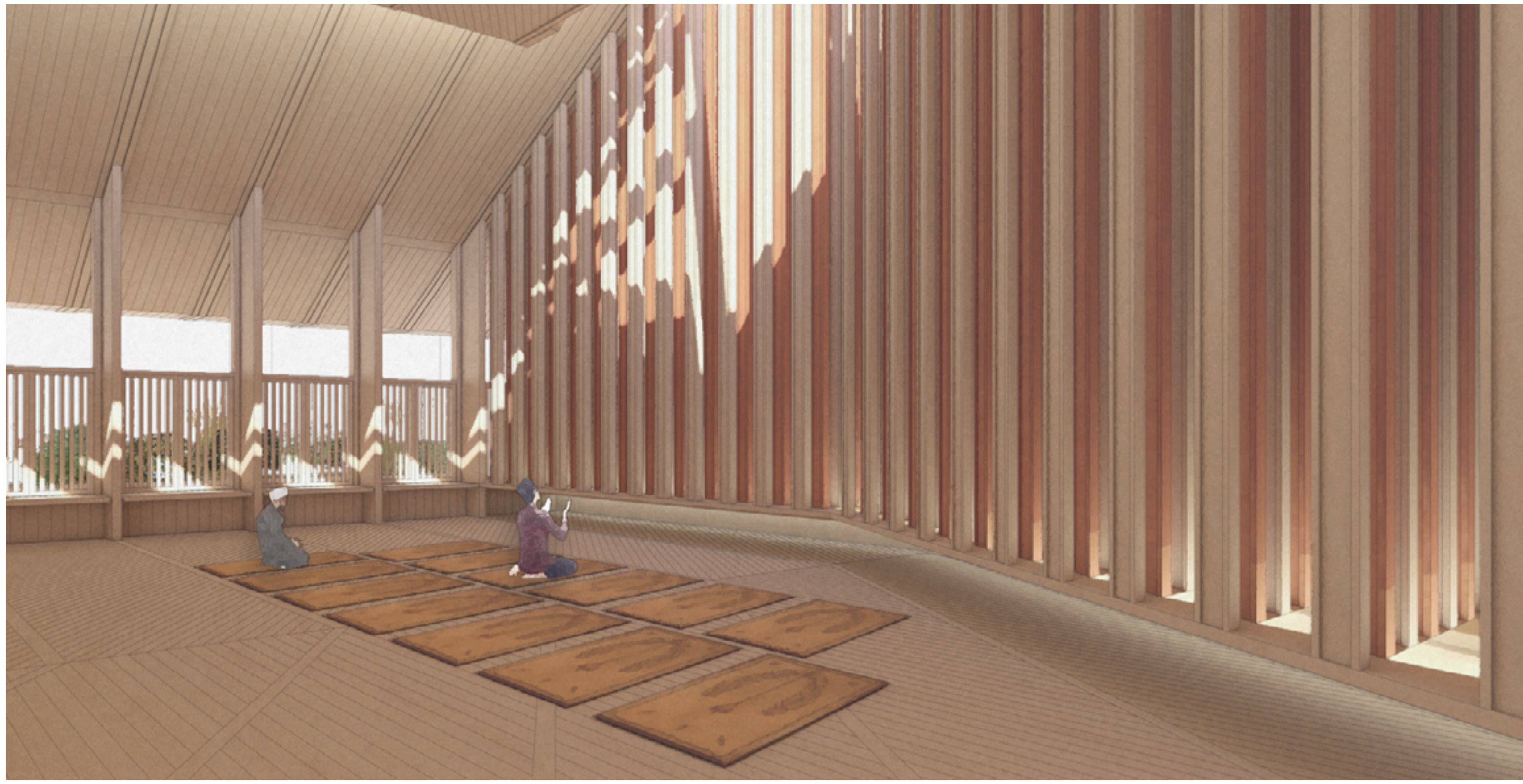


View of Prayer Hall II

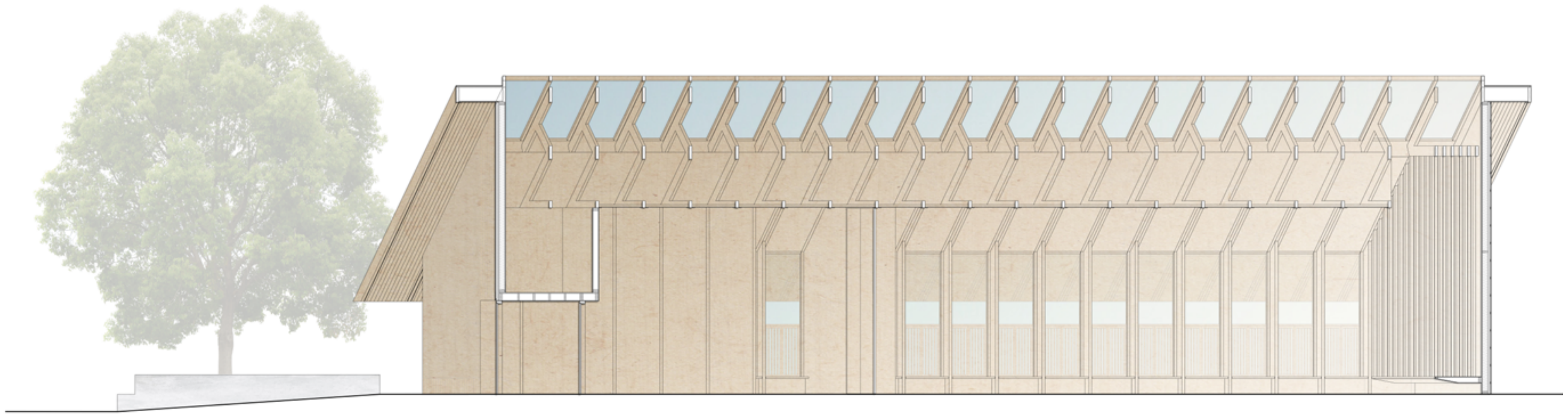


South Elevation

a product of design, presentational ornament may convey those insights with an immediacy which representational architecture simply cannot. Ornament allows architects to explore the materiality of architectural elements, the processes by which they are made, the diverse ways in which they relate to each other, both spatially and qualitatively, as well as the ways in which they are situated within the discipline of architecture. Through all of this, ornament also allows architects to examine fundamental architectural concerns such as program and context in a new light. Ornament concentrates all of these considerations into a physical form which is intensely personal but also highly legible. On one hand, a return to ornament would provide architects with a renewed means for engaging with their discipline. On the other hand, it would also provide architects with a renewed means for engaging the public more broadly. Ornament is not only a crucial part of the practice of architecture, it is a crucial part of how architecture operates as a cultural force in the world.



View of Prayer Hall III



Longitudinal Section

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BARKING UP THE RIGHT TREE -
or how to promote Local
wood knowledge in Western Norwegian Communities

PROJECT BY IDA WRESSEL & NIKOLINA SØGNEN

ABSTRACT

The outset for this project is investigating the role of the architect in the use of natural resources, acknowledging ecological, social and spatial consequences of a material choice.

While Norway has a long history of highly refined competence in building with wood, its current use is rather generic. With the introduction of industrial forestry and modern building materials, it appears our traditional wood knowledge has increasingly been pushed into the antiquarian domain. The geographical origin of wood has become arbitrary. The web of small refinement facilities once so flourishing is underused and unknown to most. These changes are manifest in our landscape: today there is a boom both in permanently protecting forests and in clear-cutting and replanting spruce plantations.

We propose an exemplary project to show a way to differently manage our forests and cultivate our wood knowledge. The wood academy at Voss demonstrate how to investigate specific use of specific types of wood with experimental solutions at the core of the academy. In the future, with forests carefully cultivated and craft traditions continued, we can propose architecture that challenge the perimeters of wood as a building material. The starting point is a place promoting collaboration and the gradual growth of the acadamy is in respons to the landscape.

THE EXISTING WEB OF SAWMILLS

There used to be a lot of sawmills in Hordaland and Sogn og Fjordane that sustained one or two full-time positions and milled timber harvested by farmers. These typically origined from co-owned farm sawmills that were modernised and became businesses during the 1980s. Today most of these sawmills have old machinery that depends on heavy manual labour, which makes it hard to make a profit today unless the material has very high value. Also due to increased cost of labour, there was a rapid decline in farmer's forestry from the 1990s, leaving most harvesting to large-scale entrepreneurs that prefer industrial milling. Although many of the small-scale sawmills are still operating today, few can hold full time positions and most are run by men nearing or past retirement. There are a few examples of younger generations taking over and investing in modern equipment.

Today there is a new trend in farmer's forestry, with many investing in mobile band saws. The current boom in spruce harvesting does not affect the regional wood refinement system significantly: the enormous quantities of timber is mostly shipped to Sweden or Germany as logs. However, in some places the pine from the clear-cut areas is delivered to local sawmills. Some of the spruce is also too old and large for the industrial forestry, but the smaller sawmills have better facilities for handling such high-quality timber. We can expect an abundancy of this old and coarse spruce in the next decades, as we do not cut nearly enough to keep up with the growth of the plantations.

Some small-scale sawmills are organized in Bygdesagforeningen, an association working to increase the contact, competence and market share among its members. 38 sawmills in our region are members. Many municipalities are unaware of what refinement is happening within their boundaries, since most terminated their forestry coordinator positions in the 1990s.

As an architect you are normally dependant on an extensive network and a long time horizon in order to implement locally refined wood into your project, as few sawmills have stocks of dry material and rather produce on request. An efficient way to shorten the drying period (and also reduce the wear on machinery) is to start the drying process before the tree is cut by various scarring methods. This requires communication and planning between the end user, the forester and the sawmiller and is not practised anymore.

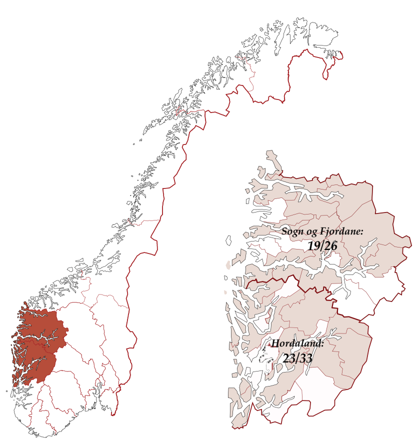
Sawmiller Svein at Vossestrand bygdesag

REGIONAL REFINEMENTS

We believe architects could contribute in redirecting the focus from quantity to quality: we could demand wood with more specific properties, allowing for wider spatial and constructive possibilities. Such a redirection of our system, however, requires more aggregated thinking and longer time horizons. Perhaps most importantly it requires contact and collaboration between the people involved. We see that this is greatly lacking today. An example is the saw miller Svein, at Vossestrand bygdesag. He has immense knowledge about both the local conditions and the material wood. He have little collaboration with other actors and is worried no one will take over after him.

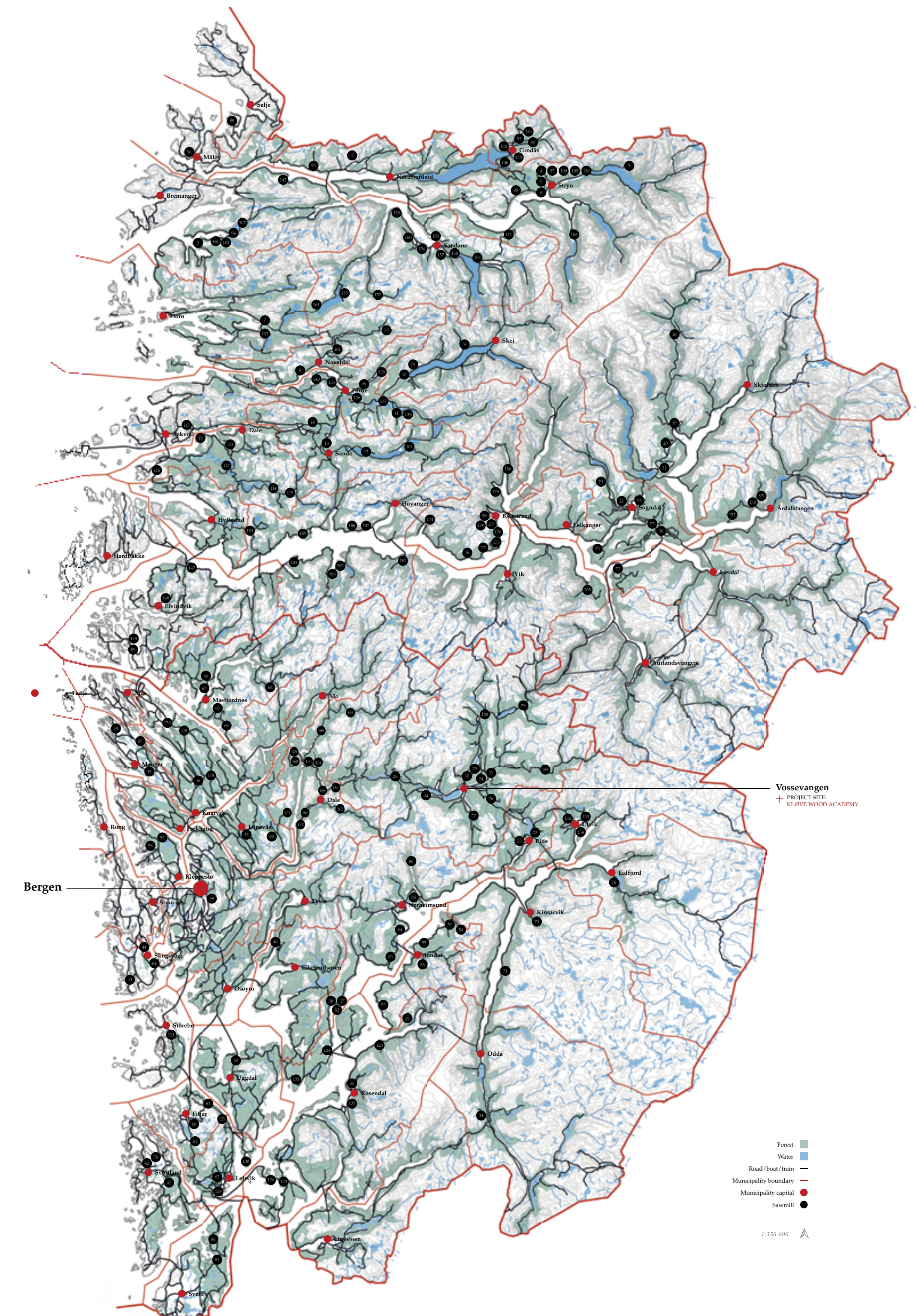
SOURCES

1 **Municipality survey -** questions about refinement directed to each municipality
2 **Norsk bygdesagforening** - national association for non-industrial sawmills
3 **Brønnøysundregisteret** - official database of registered businesses
4 **Skog i Sogn** - forestry collaboration project in Sogn og Fjordane



Focus area
Counties of Hordaland and Sogn & fjordane

Response rate
Municipality survey



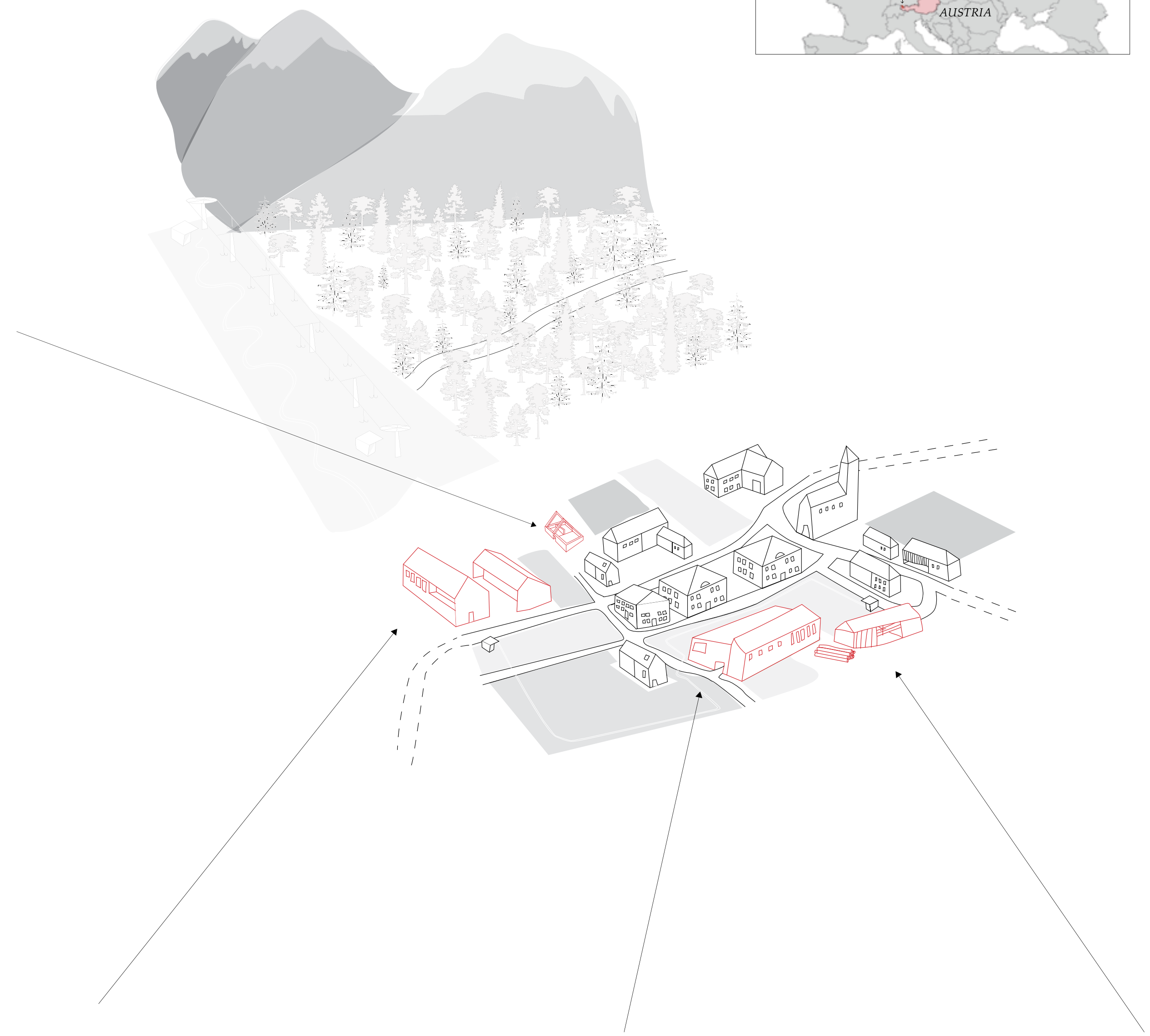
Regional refinmenets in Hordaland and Sogn og Fjordane

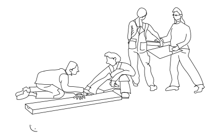
FIELD TRIP

BREGENZERWALD

Our knowledge of Bregenzerwald was gathered during a two week study trip. We stayed with a local carpenter and his wife in one of the 22 villages. In exchange for helping out in his workshop, the carpenter taught us about the local system for working with wood. We visited numerous modern and vernacular buildings, most of which where private homes, and got to know members of the local community. These all had specific roles in the wood system: architects, farmers, foresters, carpenters, cabinet makers, floor makers, sawmillers, teachers, apprentices, clients. A recurring position among all the individuals we spoke to was that locality contributes greatly to their quality of life: actively using the local landscape, the food, the crafts, the community. We were struck by their dedication in collaboration and public discussions, both focusing on specific objectives and general topics to do with how they want to live their village lives.

Bregenzerwald translates as "the forests of Bregenz" and is made up of a series of lush valleys in the prealpine region of Austria. The region has 30,000 inhabitants distributed across 22 small villages. Secluded by the topography, the Bregenzerwälder have a strong sense of community and identity. A part in this can be challenging to obtain as an outsider. The local history for craftsmanship is proud and continuous. There is a lot of agriculture and strong focus on local produce, crafts and tradition. The average level of both education and income is high, as several large cities lie only a short commute away. Today the major source of income is tourism, but there is strong aversion against cabins and mass tourism and thus the Bregenzerwälder manage to make the most out of each guest, who typically comes to experience the landscape, the architecture and the good village life.



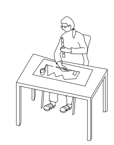


THE BUILDING SITE

During construction all the professions meet on site, discuss and find solutions together. This is a very important social situation to maintain the local value chain. It is also a crucial occasion for innovation and reinterpretion, as most building projects take place within a strong vernacular context where knowledge of traditional crafts is demanded.

THE FORESTER

In each village a government representative is in charge of the all the forest . This person ensures holistic forest management by coordinating felling, mediating in conflicts and securing the function of protective forests.

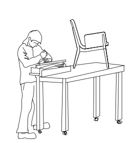


THE ARCHITECT

Most architects in the area work within the vernacular traditions, both restoring and reinterpreting the old typologies. Drawing on the competence of the local craftsmen and the quality of the local material, they typically design all-wooden buildings with sophisticated detailing.

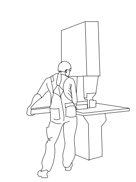
THE FARMER

Owns the forest and cuts trees when needed or requested by the forest manager. Either fells himself of uses a contractor. Can sell the material or pay for refinement. Also uses his forest for collecting firewood.



THE CABINET MAKER

Mostly produces custom pieces on request. A big portion of their work is making kitchens. Cabinet makers always have their own wood storage and typically request wood with certain properties directly from the forester. Also buys the best material from the sawmills.



THE CARPENTER

Buys material from the sawmill. Some are also foresters and harvest specific trees themselves. Many carpenters have large workshops and build modules. Practice modern and traditional crafts simultaneously. It is fairly easy to get motivated apprentices in the area, though hardly any are female. Twice per year all the carpenters take part in a social event hosted by the Bregenzerwald carpenter union.

THE SAWMILLER

Buys timber from the farmer or refines on his behalf. Sells refined material to carpenters and cabinet makers. Typically cuts into coarse dimensions, leaves to dry and then refines further on request.

LEFT to RIGHT: The network of wood actors and their roles in Hittisau, Austria

NORWEIGAN WOODS

DEVELOPEMENT

Almost 40% of Norway is covered in forest. This landscape type is believed to sustain about half of the 60.000 species of the Norwegian flora and fauna. The forest can roughly be divided in two: in the warmer areas in the south and along the coast are predominantly broad leaf forests, while the rest is part of the boreal conifer belt with spruce and pine.

Although we have always experimented with our forests, spruce has been extensively planted since WW2 especially in the western part of Norway. The afforestation strategy (skogreisinga) was implemented by the state both to increase the living conditions of the marginalised western Norwegian farmer and to provide a basis for industrial wood refinement. The aim was to plant 27 million plants each year for 60 years and most all school children were occasionally sent out to contribute to the effort. The preferred tree type was spruce and especially the foreign sitka. Everywhere was planted, both productive farm land and areas where the topography makes it impossible to harvest today.

The general state support for planting forest was not removed until 2004. Norway has received international criticism for failing to ensure the biodiversity of its forests.

If we were to cut and sell all the standing Norwegian forest in 2018, we would make 220 billion NOK. Since the Norwegian government conducted the world's first forest taxation in 1919 the timber volume has tripled. The first registration was motivated by a growing concern that we were putting too much pressure on our apparently sparse forests. There are four reasons for the growth in volume:

1. Increased site productivity (bonitet)
2. Overgrowing agricultural areas from lack of activity
3. Extensive forest planting
4. Extended growth season due to climate change

The annual increment is more than 25 million m3, but despite record activity levels each year we only manage to harvest 40% of this growth. The harvest is almost exclusively clear cutting of spruce plantations. Forest owners need to apply for permission not to replant after a clear cut. The government is criticised both for granting too many permissions and for failing to follow up on the replanting injunction.

Parallel with the harvest boom, there are also rapidly increasing numbers of forests becoming permanently protected for the sake of biodiversity or recreational value. Currently 3,6% of our productive forests are protected. The parliament voted in 2017 that 10% should be the aim, as recommended by environmental scientists. They also increased the financial compensation for protection. In a protected forest it is illegal to cut down trees.

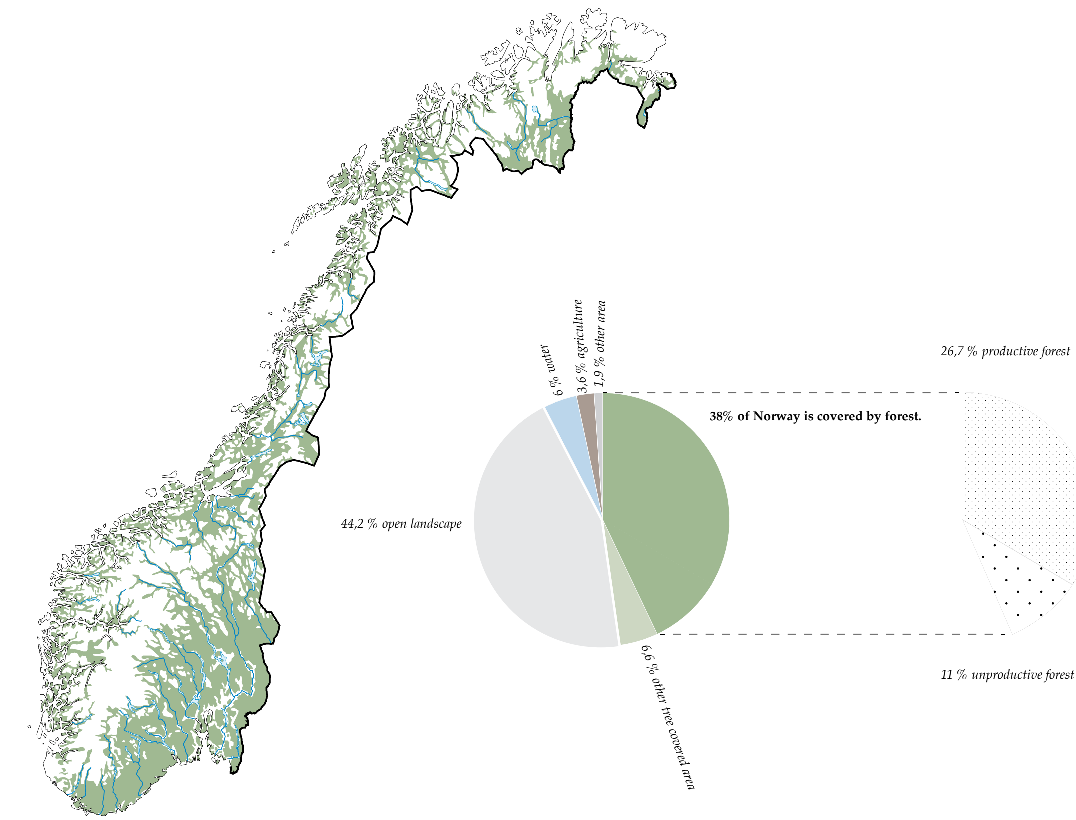


Diagram of forest resources in Norway

"We are experiencing two parallel booms right now. One is industrial clear cutting of the spruce planted in the mid-twentieth century. The other is that of voluntary permanent protection of important forest. We should rather talk more about the middle way."

Dirk Kohlmann, county governor forestry department
Bergen, 15.05.19

"The information we have on our forest resources is too schematic, we should draw more on the local knowledge of exactly what grows where in order to make better use our woods."

Kristin Støren Wigum, coastal forestry coordinator
Skype, 21.11.18

LANDSCAPE

TIME HORIZON

The recommendation from the government to the forest owners in the area has been to focus on spruce plantations. Still this is under strong critique for the implications it has on biological diversity and ecological sustainability.

The land ownership is fragmented, and many small parcels make a patchwork of different forest lots. When you see an aerial photo of the site, you can actually tell the properties apart by what the forest looks like from above. In the 2014 clear-cutting, four farmers joined forces to get their timber harvested. Industrial forestry is only applicable to larger areas.

In order to raise the quality of timer and the variety of species we suggest to transform the site, defined by the clear cut, into a natural re growth forest.

Forest from site with pine and broad leafes

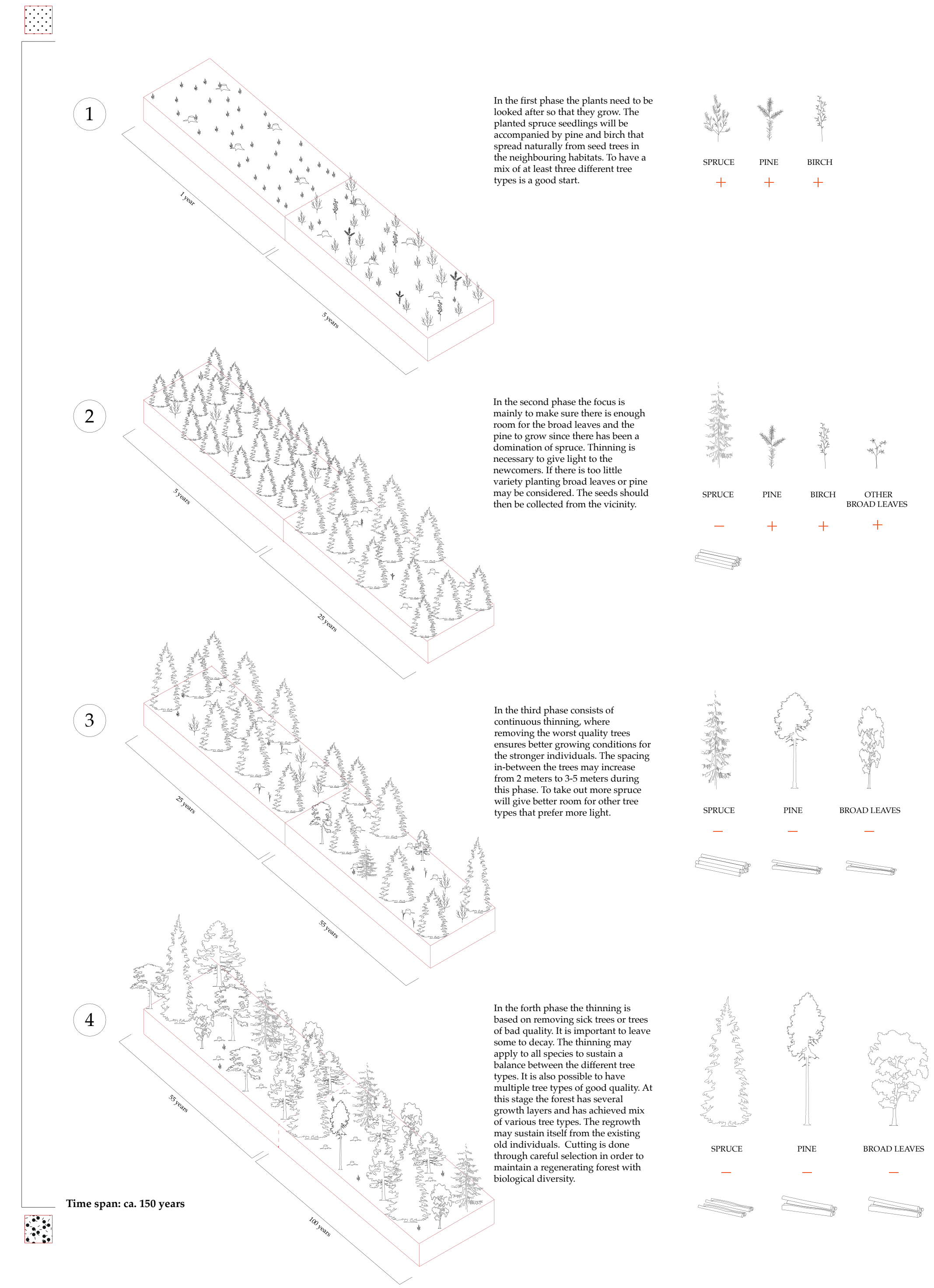


Diagram of transformation of existing clear cut area on site

Village of Kløve with the site in the background,

voss

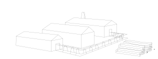
LOCAL WOOD SYSTEM

We propose an exemplary project to show a way to differently manage our forests and cultivate our wood knowledge. Abundance of forest, density of sawmills and proximity to urban areas led us to choosing Voss as the site for our project, though our strategy could be implemented almost anywhere. Over a century long time span we envision a wood academy - understood as a collective of skilled people- incrementally growing into being. Drawing on the local competence such as saw millers, craftsmen, foresters and academics, we establish a gathering spot with facilities for wood refinement. Our site, a 10 hectare spruce plantation, is also large enough to provide Voss with much needed space for drying of wood.

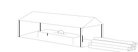
The purpose of the academy is to connect the community of wood-people with facilities for them to collaborate and experiment. Within the wood academy, younger generations can gain a holistic hands-on experience in working with wood, from nursing the forest to harvesting the right tree to crafting an object.

Inviting the public into the academy is critical in order to challenge the current paradigm within forestry and wood application. A hiking route will take visitors - locals and tourists alike - from a new bus stop and through the academy, through different forest spaces and to several remnants of historic use of the forest.

SAWMILLS



1 Moelven Granvin bruk



2 Lars A. Graue
3 Almeland sag
4 Voss bygdasag
5 Gjerald sag
6 Mugås sag
7 Vossestrand bygdesag
8 Øvsthus sag
9 Kløve grendesag
10 Knut Dagestad
11 Tvinde sag og flis
12 Seimen høvleri

EDUCATION

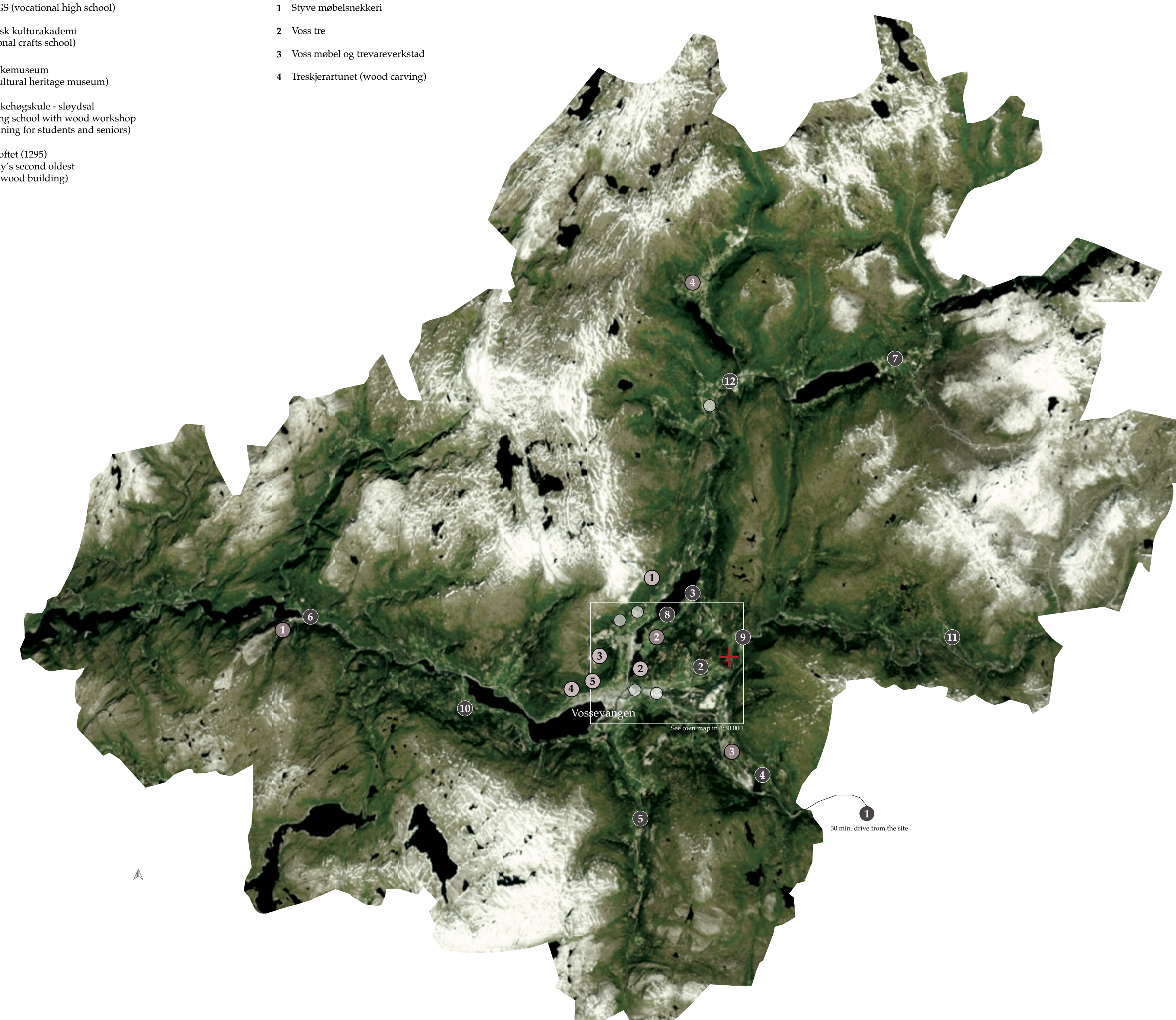
1 Voss VGS (vocational high school)
2 Vestnorsk kulturakademi (traditional crafts school)
3 Voss folkemuseum (local cultural heritage museum)
4 Voss folkehøgskule - sløydsal (boarding school with wood workshop and training for students and seniors)
5 Finnesloftet (1295) (Norway's second oldest secular wood building)

CABINET MAKERS

1 Styve møbelsnekkeri
2 Voss tre
3 Voss møbel og trevareverkstad
4 Treskjerartunet (wood carving)

BUILDING SUPPLY STORE

PROJECT SITE:
KLØVE WOOD ACADEMY



Map of Voss with the network of wood actors within given area.

PUBLIC TRAIL

WELCOME TO KLØVE WOOD ACADEMY!

Along this trail you will learn about the forest and what we can do with it. If you brought good shoes you should go up into the old woods and look at the remnants of our predecessors' forest use. If you just fancy a bonfire coffee then head straight to the gathering place and enjoy the view. Make sure to pass by the workshop coming back, this weekend the craftsmen are experimenting with tar.

Feel free to ask questions to anyone you meet, but please remember that this is a work place with occasional dangerous situations. The people working here have different backgrounds but are all members of the academy and share their passion for wood. In return for helping out in running the place they can use the facilities freely. Some come regularly while others stay for shorter or longer periods. If you want to know more about the academy, please just ask.

On of the stops is the gathering place with carfully situated shelters. This constantly changing cluster of floors, walls and roofs is actually our testing ground for wood detailing. We can investigate the life span of different types of cladding or test the durability of wooden fundaments. Someone is always modifying or building something here, but this is also the place where we gather for lunch or social events.

Model photo of the gathering place, one of the stops along the trail where you may pause for a bonfire coffee.

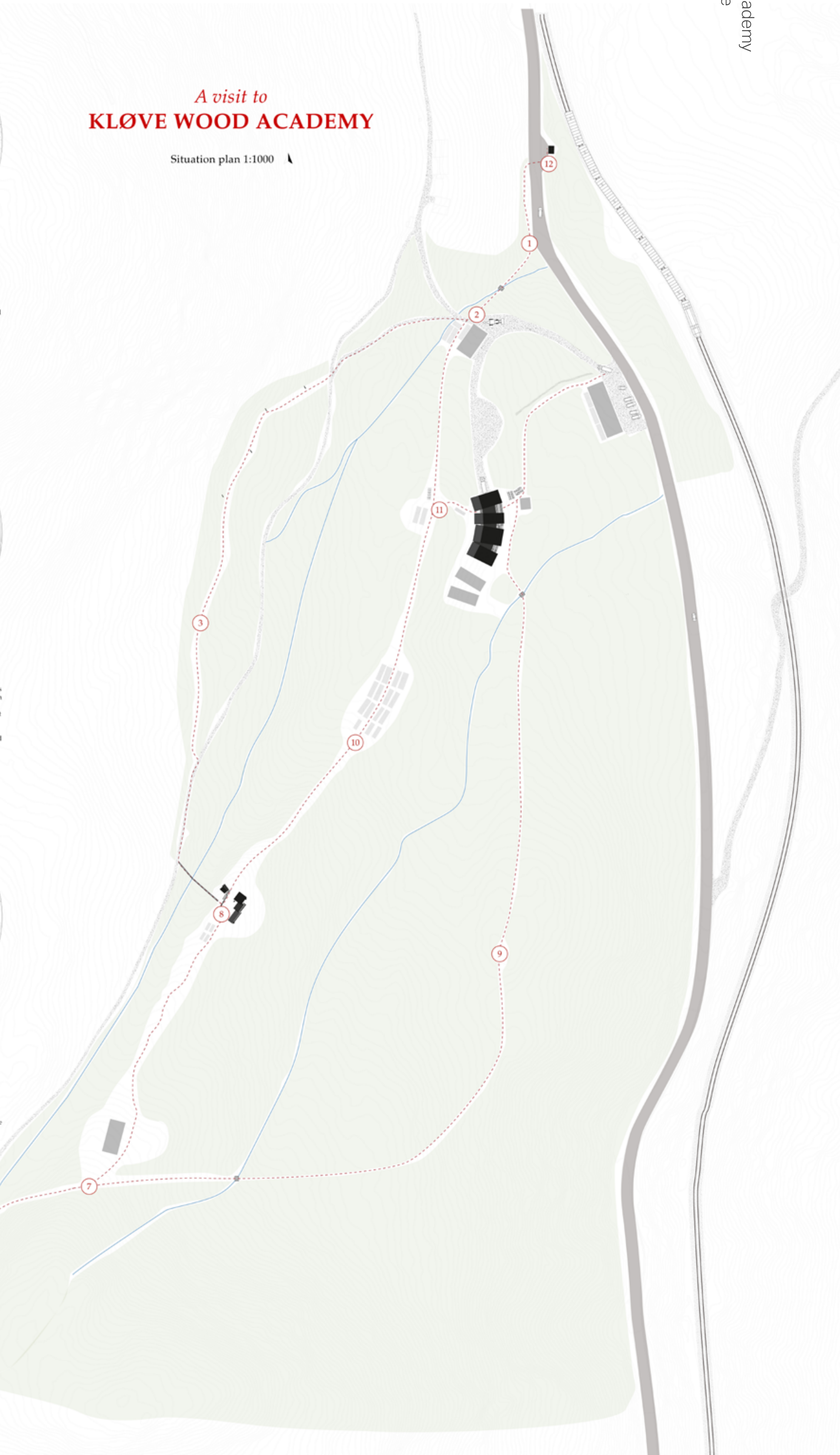
Model photo of the gathering place, the service buildings overlooking the forest

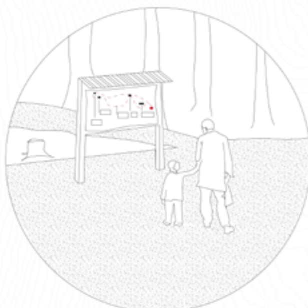
Situation plan of the wood academy and public trail, describing the experience of the journey

A visit to

KLØVE WOOD ACADEMY

Situation plan 1:1000





1 Welcome to Kløve wood academy!

Along this trail you will learn about the forest and what we can do with it. If you brought good shoes you should go up into the old woods and look at the remnants of our predecessors' forest use. If you just fancy a bonfire coffee then head straight to the gathering place and enjoy the view. Make sure to pass by the workshop coming back, this weekend the craftsmen are experimenting with tar. Feel free to ask questions to anyone you meet, but please remember that this is a work place with occasional dangerous situations. The people working here have different backgrounds but are all members of the academy and share their passion for wood. In return for helping out in running the place they can use the facilities freely. Some come regularly while others stay for shorter or longer periods. If you want to know more about the academy, please just ask!

2 Drying wood

You will see stacks of drying material everywhere. As fresh logs it was cut at sawmills all over Voss before it was brought here. Different types of wood demand different techniques, but all material needs protection from rain and steadily circulating air in order to dry. This narrow valley gives plenty of wind. After a few years the wood can be brought into the workshop to be sawn into final dimensions and further refined. If it is to be used in a warm house then you simply leave it in the heated part of the workshop for a few days first and soon the wood will have adjusted to indoor climate. We can also put the material in our mechanic dryer after drying outside, that takes less time but can affect the quality of the wood.

3 Farmer's forestry

Our forestry is based on carefully selecting which trees to cut in order to improve the life for the remaining ones, the traditional way of cultivating a forest. Most trees want light, water and good soil, but a pine is much less demanding than an aspen. The forest you are in now used to be a spruce plantation. The crowns were so dense that little light came through them and not much else grew here. One of the first things we did was to cut a lot of these old spruces - they actually became roof beams in the workshop. All the different seedlings you see spread here naturally and are protected by the large spruces, but in a few years we need to cut more of the big trees so that the smaller ones can continue to grow.

4 Tar rock

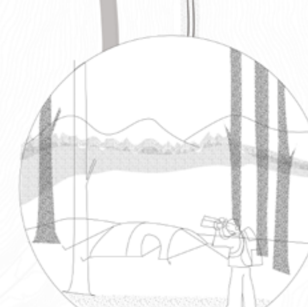
This rock has been carefully carved into a kind of sink, sloping towards a hole in the middle. Up until WW2 the farmers would make tar here. It would take a whole year to prepare enough old pine roots, turf and birch skin as all these tasks must be done in different seasons. The knowledge needed for this process is extremely specific. You want to heat the pine roots just enough to make the resin in the core wood melt. This cavity in the landscape is a great spot since you have more control of the air. The tar was typically used to protect materials such as wood and our stave churches were luckily tarred. Tar has a sticky texture and a very particular smell. We host a tar extraction weekend every year, so you can come experience it for yourself!

5 The axing spot

This clearing in the pine forest is known locally as "the axing spot". After felling a tree, you would pull it here by horse. Here is enough space to debark it and shape it roughly with your axe. Fresh material is wet and heavy, so you were clever to do this work in the forest. If you were building a house, you would adjust the log to the right length and form here before assembling it at the building site and precisely chisel the pieces to fit together. The timber houses were built with fresh wood and the rough construction would have to dry for a year before you could continue on it.

6 Coal pits

Can you spot the three big circular pits next to the stream? They were used for burning coal until about 1900. Coal is wood that has been heated sufficiently to let go of all water. It will burn much warmer than regular firewood and was used for instance to extract iron from the soil. Building a coal bonfire was a specialised task that required heavy labour, but in return you could use any type of wood. You want the core of the bonfire to burn without spreading to the rest, so you cover the wood with spruce twigs and clay and make channels for regulating air flow. Making coal requires careful attention over several days and you want access to water in case the fire gets out of control.



7 Campsite

If you feel like staying, you can bring a tent or a just a sleeping bag and spend the night right here. This spot boasts the best view along all of the ridge and is where the morning sun hits first. We recommend sleeping in between the old pine trees, where you can listen to the sound of the trembling broad leaves and practice telling them apart. A lot of our members and visitors express a wish to stay here for longer periods of time, so we hope to be able to build a simple dormitory here in the near future.

8 Gathering place

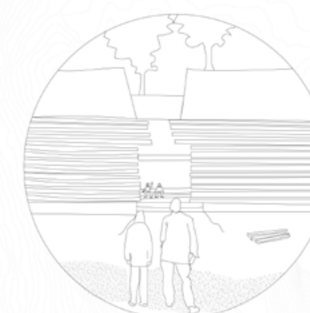
This constantly changing cluster of floors, walls and roofs is actually our testing ground for wood detailing. We can investigate the life span of different types of cladding or test the durability of wooden fundaments. Someone is always modifying or building something here, but this is also the place where we gather for lunch or social events. The lumber can have a chat with the cabinet maker, or a sawmiller can have a cup of coffee before after delivering material. We always enjoy visitors stopping by here - during breaks we have more time to explain and discuss. When the weather is nice we host public lectures here. The oldest children in Kløve kindergarten bring their lunch here every Friday and they make everyone hot blackcurrant juice on the bonfire.

9 Young forest

In 2015, this large field was covered in spruce forest. After they cut it all down and replanted it, we have made large efforts to help the right trees grow here. As you see there is now a mix of different tree types, but they are still quite young and fragile. We must carefully curate the forest and remove weak or dominant trees. The birch and spruce can stay for now but will eventually be sacrificed for the sake of other broad leaves. All the 7th-graders in Voss come to help in this work twice per year.

10 Large drying racks

This is the main spot for drying larger pieces of wood as it is easy to reach with a small tractor. The racks stand on wooden poles that are burned and stuck into drilled holes in the ground. With increasing research activity we will probably at one point need more suitable spaces for lectures and academic work. We plan to then reuse the drilled holes for the fundament of the new building. But this project is far from our priority right now, and who knows, perhaps our needs will be very different in a few decades!



11 The workshop

Feel free to stroll through our workshop but please respect the work going on and beware of the overhead crane! This place is usually busy with local craftsmen coming to use our prime facilities as most lack workshops of their own. There are usually about ten people working here during the week, but at weekends there are often workshops with double as many participants. If you look down through the central hall you can see wood work on many different scales. Along the room are different spaces required for different tasks: certain processes require strict control of e.g. the indoor climate and air quality. Although the building is quite flexible, we also try to confine the most noisy work to the hall since many people are working on different projects at the same time.

12 Steam bent bus shed

This bus shed is made from three pieces of steam bent ash wood. Since few manage ash forests carefully nowadays we spent ages tracking down specimens suitable for bending, as this requires very specific properties of the piece. The bending itself was also a big project since we had to improvise a jig and tools. But Norwegian craftsmen were pioneers in steambent laminated wood for furniture, so we could draw a lot on the same principles. Along with the knowledge of local boat builders we managed to get it right and we had a big celebration after. Only elastic tree types with long fibres are bendable, but we already have a few individual trees that we look after with this purpose in mind.

ADAPTED SPACES

A DAY IN THE WORKSHOP

Curving along the slope, the woodworkshop is built from modules in cross laminated timber and solid wood. The main hall has a crane to move heavy timber along the curve and is supported by various smaller workshops on each side.

A tractor just came to deliver a rack of dry timber for one of the ongoing courses in wood bending. It is cut into smaller dimensions in the space where it arrives and is later on moved further in to the hall.

One of the local caropenters have occupied the upper workshop for the weekend. Large pices are moved in through the openable large windows facing the main hall. The crane reaches in and no heavy lifts are needed.

At the same time two long term wood academy participants are building furnitures for a project in alder wood. They can work without being interrupted by the loud machines in the hall but are now and then going down to use on of the big tables during discussions with the other academy colleagues whom are working on larger dimensions in the hall.

As the wood bending course is being prepared the stem box have been heated. The hall is temporarily closed to control the temperature and the moisture in the air from the rest of the space.

Painting and polishing is kept in the upper corner work space shield from the dusty enviornment in the hall.

LEFT ABOVE: Interior view of the main hall of the wood workshop

LEFT BELOW: Section cut through the wood workshop showing the transition through the building in the landscape.

RIGHT ABOVE: Wood workshop curving along the slope, situation model in scale 1/200

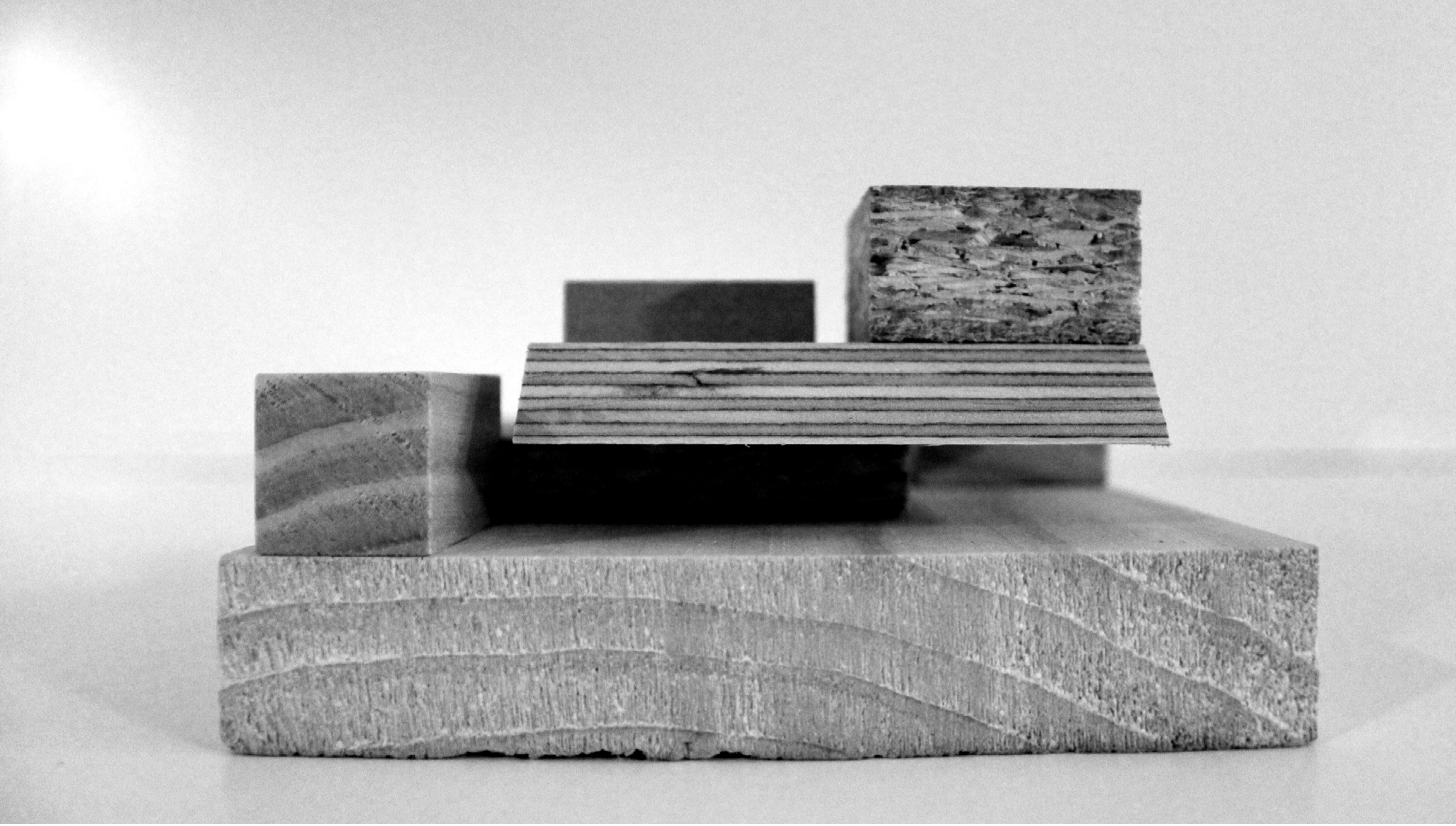
RIGHT BELOW: Situation model of selected interventions along the highest axis on the site, model in scale 1/200

Steam bent bus shed,
model in scale 1/50

Gathering place, view from east,
model in scale 1/50

Wood workshop, main entrance on
the east side, section model in 1/50

Exhibition at Bergen Arkitekthøgskole



ALT: BETWEEN THE GRAIN

PROJECT BY KAYLA MURRELL

ABSTRACT

Current housing developments are built for one type of user at the time of construction, and neglect core values of community and adaptability. The way we build is a static misrepresentation of a dynamic society, ignoring ever changing patterns of growth, shrinkage, requirements and ideologies. Flexible housing strategies employing wood construction will support social inclusion while creating spaces that will serve all (societies) in a sustainable way. This poly-scalar (XS,S,M,L,XL) thesis will explore our basic understanding of physical spaces (architecture) and behavioral relations (people) to reconsider the "family" dwelling. This thesis aims to find a convivial housing architecture that supports and establishes flexible connections between architecture and community living.

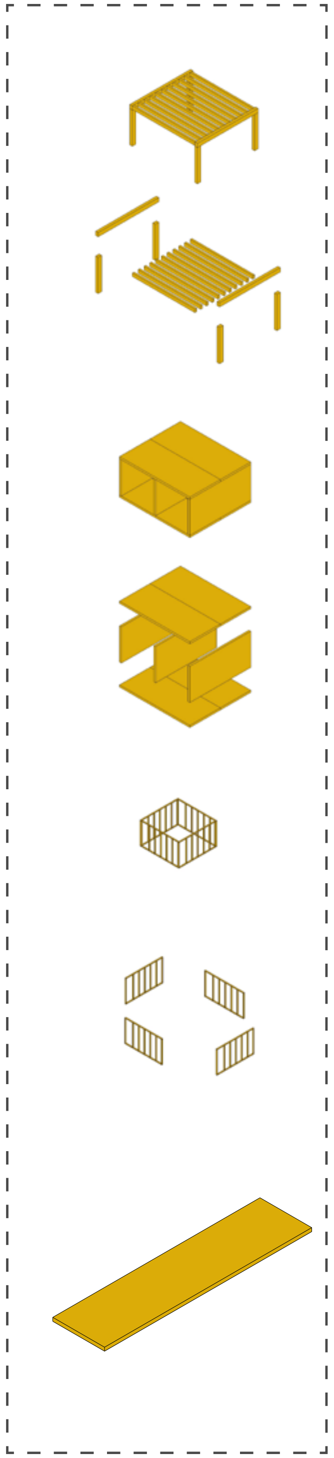
THEORY

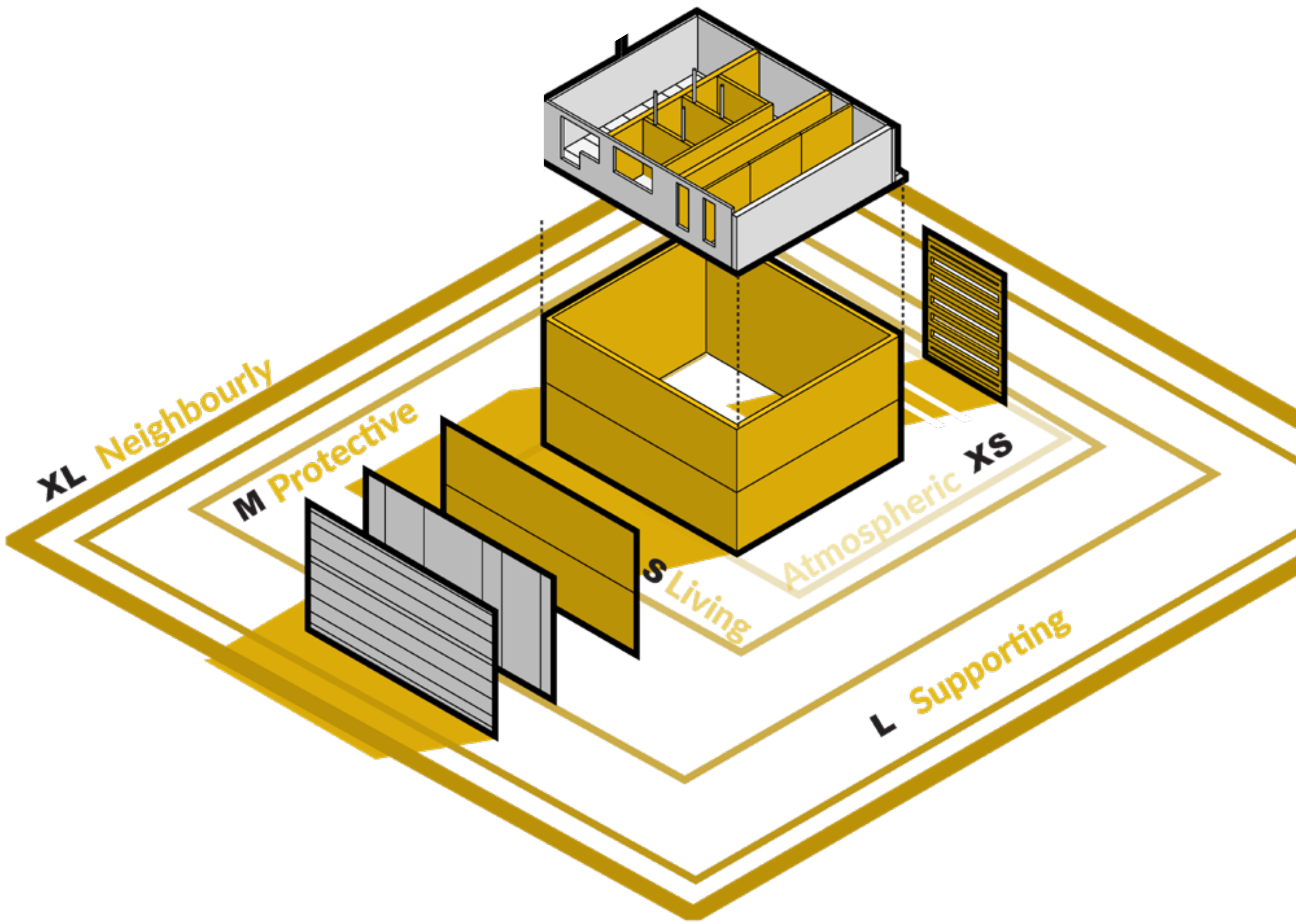
Christian Schittich mentions in his book High-Density Housing that in order to retain the affluent and educated individuals in the city there is a need to provide space that would currently only be found in penthouses and single family homes, to all places we call home (Schittich, 2004). Home should have the best quality of living that everyone agrees upon, which is why this project aims to provide a baseline design that gives the homeowner the necessities to high quality living, in a way that allows for change over time. Flexibility for managed complexity for user diversity provides the single most desired element to residents, choice.

Wood is a versatile material that allows for richness on both the interior and the exterior. This living material can support a systematic approach to design and construction demonstrating incremental growth, and providing schedule flexibility in abundance. This thesis project aims to design for future expansion opportunities within a mid-rise application to offer the chance to host existing complexity that is demonstrated in the way we live.

By designing XL, L, M, S, and XS layers, flexibility using wood can be achieved in hopes of producing built forms that harness difference for people who do not live the same way yet understand that home is not to be designed for isolation but in connection with the 8 design parameters and considerations for a more satisfied built form for living.

Neighbourhoods, living spaces, envelopes, atmospheric qualities and structural layers should all address and serve this goal. Neighbourhoods are directly integrated into the structural fabric of this module, ensuring that the basic functionality of a variety of layouts support change and interaction. These scales also achieve the creation of a social framework for children to thrive and for adults to support each other while enjoying their own desires and preferred level of interaction.





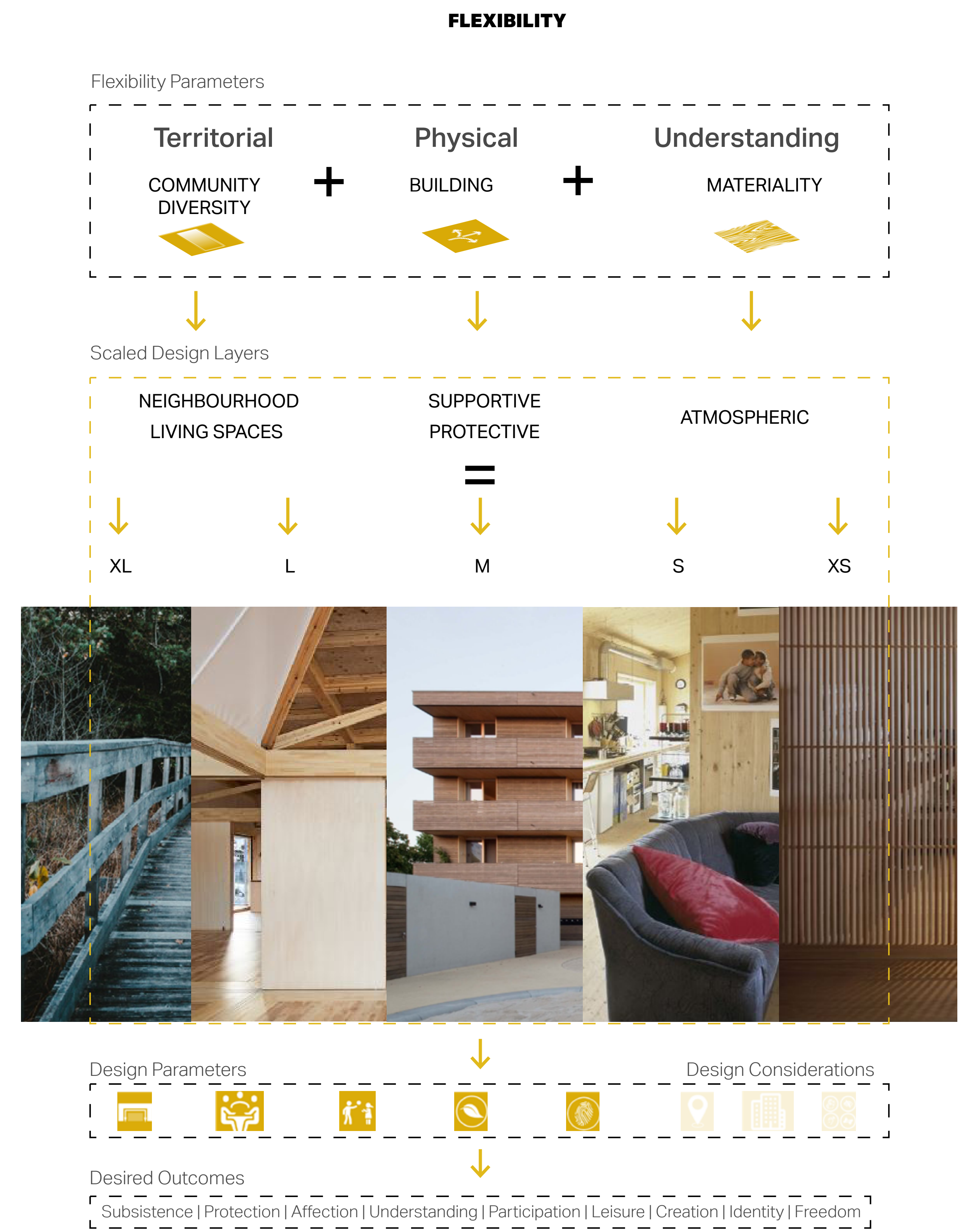
This thesis project is founded on a theoretical basis looking to the complementary works of John Habraken, Manfred Max-Neef, and Dolores Hayden for design understanding. Habraken frames the built environment saying that it is defined by orders of physical, territorial and understanding nature. Habraken's approach is a top down approach while Hayden on the other hand views the issue from the bottom up. She looks at precedents and theories to define how the woman's relation to home has been altered through example. Hayden's approach greatly informs this research in relation to the needs of specific groups (singles, families, seniors etc).

The resulting question from this investigation is, then, what constitutes a successful design? This thesis proposes that a successful model, based on an understanding acquired through research, is design that accommodates easy adaptability. It is a design that provides essential social opportunities. Habraken, Hayden, and Max-Neef all have theories that have tested time that speaks to its power and relevance in response to people and their needs. If the need is to create adaptable living forms to support diverse community then the creation of a flexible housing system that promotes opportunities for human-scaled development which are all implicitly or explicitly highlighted in these three main theories require discussion. Quotes one and two advocate for a human-scaled development that will grant the resident the power (participation and interpretation) over their own space, their residential domain. This power cannot be given, however, without designing for it. In the same way, this thesis layers these three key flexibility parameters to create an architecture that supports diverse interpretations of space and spontaneous interaction better supporting human-scaled development.

1 "If people are to be the main actors in Human Scale Development both the diversity as well as the autonomy of the spaces in which they act must be respected... It is necessary to analyze to what extent the environment represses, tolerates or stimulates opportunities. How accessible, creative or flexible is that environment? The most important question is how far people are able to influence the structures that affect their opportunities."

2 " Development geared to the satisfaction of fundamental human needs cannot, by definition, be structured from the top downwards"

- Max-Neef, Human Scale Development

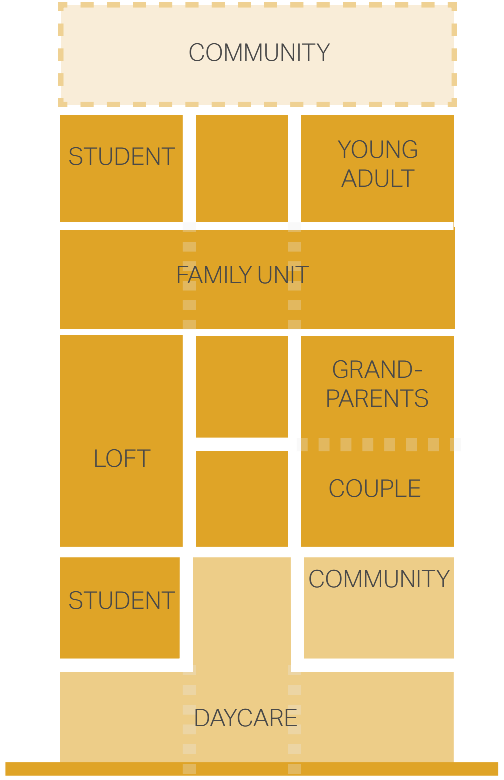


PROJECT

227 GERRARD ST. E

Urban residential design does not make sense at the standard 2 storey low rise height, nor do the high rise buildings at 78 storeys. There are a few mid-rise buildings along Dundas street, College Street, St. Clair Avenue, and Bloor Street West typically built of concrete construction sacrificing flexibility for convenience. They are so rare that this proposal aims to reintegrate them into the fabric seamlessly. The current Building Code allows for 6 storey buildings in wood frame construction, so this will be the target height. This site will be demonstrate a socially, environmentally, and economically sustainable mid-rise timber framed structure. It will provide residents a cozy residential feel unencumbered by high rises peering over gardens and balconies.

As per Jane Jacobs' principles regarding density and buildings, it is important to note that the thesis proposal is for mixed used buildings. The main level is, where possible, commercial, with residential above, unless placed in a strictly residential zone. The chosen site is also within a well scaled neighbourhood that surrounds the sites with heritage buildings. This provides a context that supports the principle of maintaining a street that is visually definable and differentiable. Aging buildings that are well kept with different activities bring life to the street.



Program diagram

View south from Gerrard St.

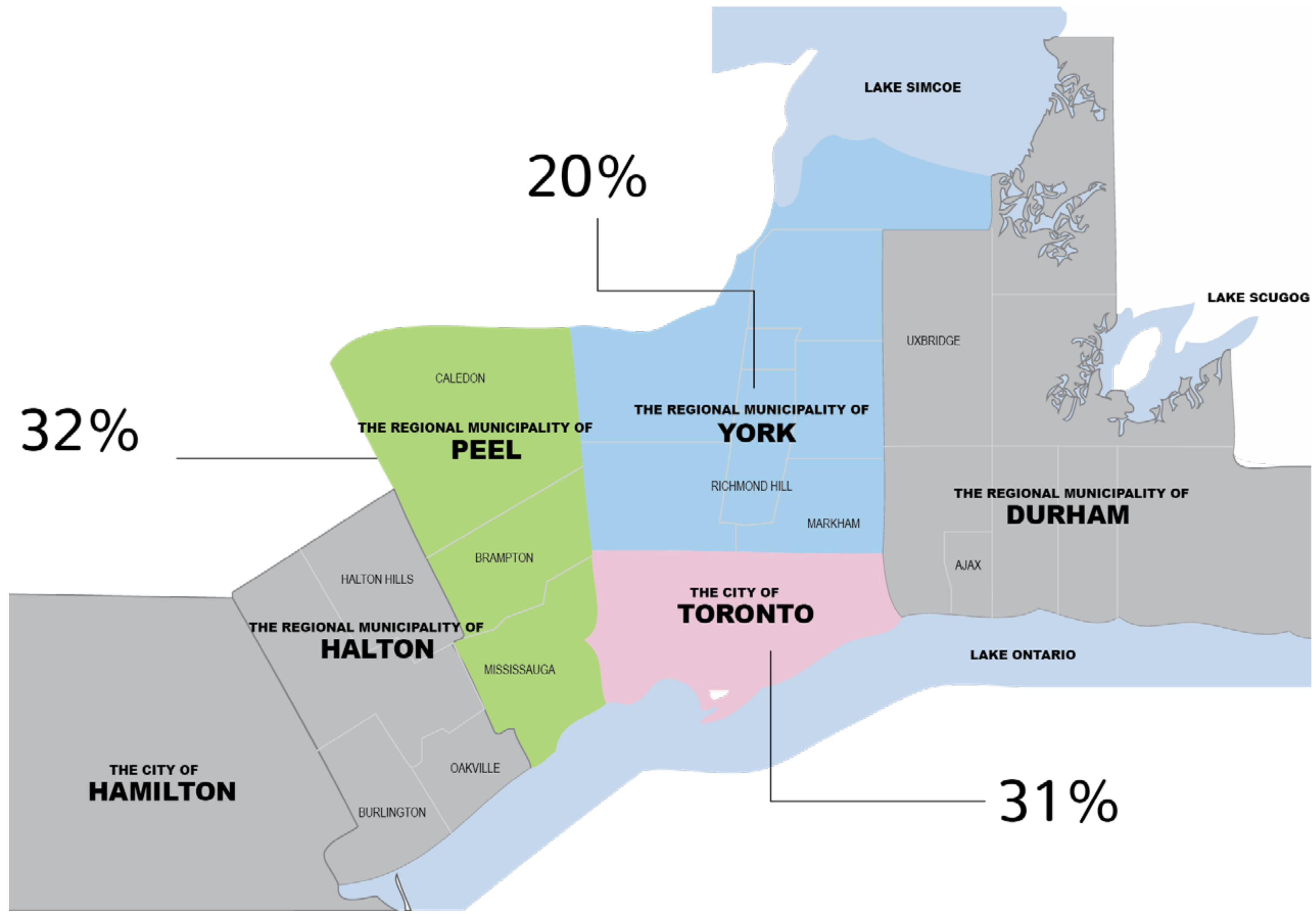
XL

THE NEIGHBOURLY LAYER

If we want to design adequate housing in the city we have to step past only addressing the problem from the age or square footage perspective to one that also accounts for the complexities in which we live. Torontonians live in one of the most diverse cities in the world, and living structures have changed. No longer is the nuclear family standard. There are multigenerational families, blended, skip-generational, co-living and more which make the case for a thorough investigation on how to design for this.

In 2016, Statistics Canada showed that multigenerational households – which include three generations of the same family – were the fastest growing type of household in the country: between 2001 and 2016 all household types grew by 21.7 per cent, while multigenerational homes grew by 37.5 per cent.

By 2016, 2.2 million people lived in a multigenerational setting. One size does not fit all. According to Statistics Canada 32% of families in Peel, 20% in York and 31% in the city of Toronto are living in multigenerational households. This number has been the fastest growing number for family types in the past few years, but housing design does not account for this. This project will aim to find new alternatives that better support aging in place in the urban core which is not a relatively profitable model for developers, but this project is not about financial gain for some but overall resident satisfaction for all. Finding ways to house and unite the greater community and their differences operates at the XL scale.



Percentage of multigenerational households by region

L

THE STRUCTURAL LAYER

Structural flexibility is achieved through hierarchy of the built form. The starting point is to choose a material. Typically there are 3 main ways of constructing wooden enclosures; post and beam, panelized system and light frame construction (seen next to the Table of Contents). Each have their advantages and disadvantages. The post and beam system facilitates larger spans and openness while CLT establishes an innate flexibility and aesthetic qualities. For the purposes of this project since the 12m CLT wall will become the standard residential material, any span required to be larger than this will be constructed using post and beam construction. Light frame construction provides a level of simplicity and everyday user constructability. This lumber can be found at retail building supply stores, allowing for a greater level of flexibility for the dweller.

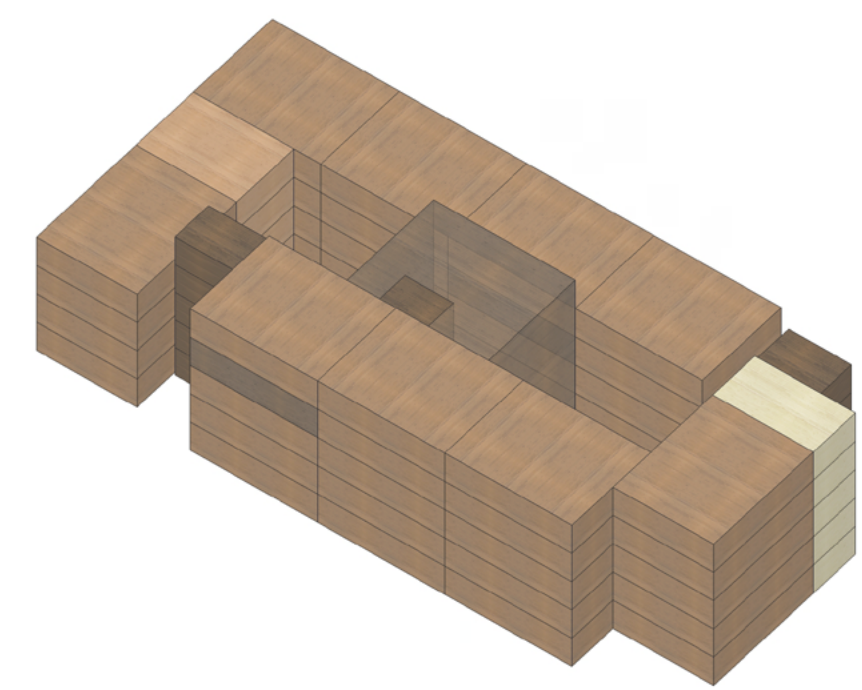
The form of the building directly impacts affordability and construction. Simplifying unit configurations will reduce materials and heat loss which will result in construction, cost and time efficiencies. Dimensioning the building to accommodate a modular form, size and configuration, will also make for a simplified construction. Designing to standard dimensions for structural framing members and to 4-foot (1.2 metre) modules with a 24 inch (610mm) stud spacing can reduce lumber used by 8% as compared to standard stud spacing practice of 18 inches (457mm) (Smith, 2010). That being said, this project will optimize all construction based on this rule to facilitate construction and efficiencies. Exterior building materials, structure and interior framing all will receive the same approach. This will allow for unlimited floor heights which will easily satisfy ground floor commercial requirements set by the City of Toronto's Performance Standards for 4.5m floor to floor heights (City of Toronto, 2010).

THE MODULE

Units are designed with the understanding that the module will be superimposed with a similar secondary unit that is thus extended above the corridor (skip stop corridors) allowing spatial flexibility that enables users to open secondary level space to the existing primary unit through an interior set of stairs. This flexibility provides the opportunity for each unit to own one to four potential spaces. Floors to secondary levels have been designed to allow for future expansion. The selected brand of CLT panels come in 2.4 or 3 metre widths and 12m lengths. Designing to the standard 1.2 metre grid will streamline the construction process and future floor installations (bays 1 and 3 of module). This will be approached with the understanding that the 2.4 m panels will be ordered and divided in 2 before shipping to the site. Once shipped, they will be hoisted to the appropriate level through the flexible window configuration.

SYSTEM

ASSEMBLY

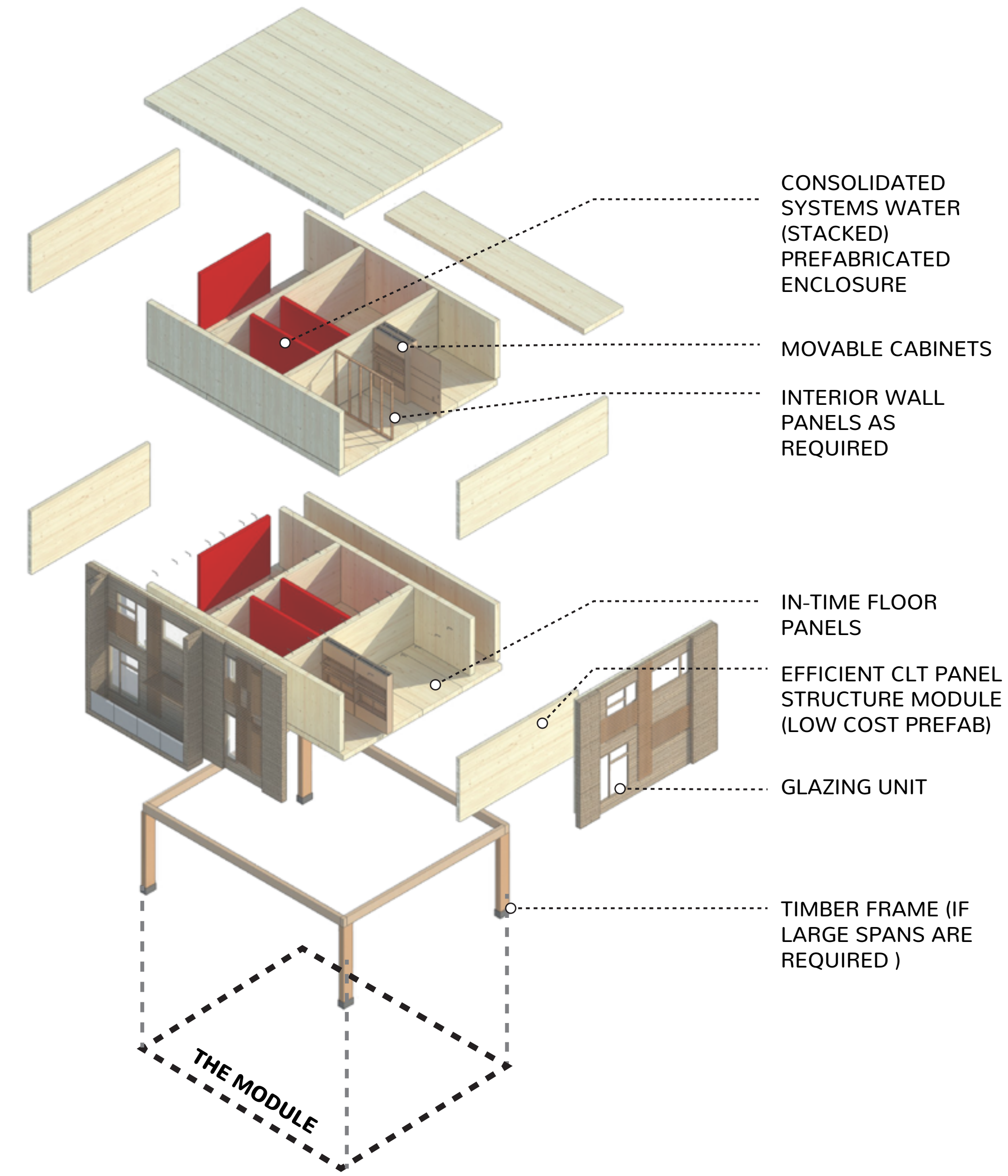


Building System and assembly

The structure has been layered as well to provide a hierarchy of flexibility for residents as they utilise their units over time. Light framing will be used for interior partitions that may require more frequent alteration, allowing materials to be sourced from building and hardware stores. CLT will be used for the main structure and post and beam construction will be used in spaces that require large spans.

Neighbourhoods in this project refer to the combination of two levels within the buildings that come together. Every other level will host a communal floor that hopes to support all users thanks to its flexibility. Each neighbourhood will be configured to potentially accommodate any form of family structure with the future option of expansion or decreasing unit size for the present and growing future diversity requirement seen in this image.

The advantage of designing units such as these is that there is variety. There is a versatility of large and smaller spaces that can be distributed according to the owner's wishes. Should the owner prefer a smaller space, there is the opportunity to open / fold walls, remove floors to provide a larger loft-like space or simply occupy half of the floor plate. This 3 bay module provides this versatility through its cores. With wet or circulatory cores provided centrally, spaces within the module can be used differently to support this level of adaptability. The larger 4.6 metre bays are coordinated to provide a wider space for social gathering.



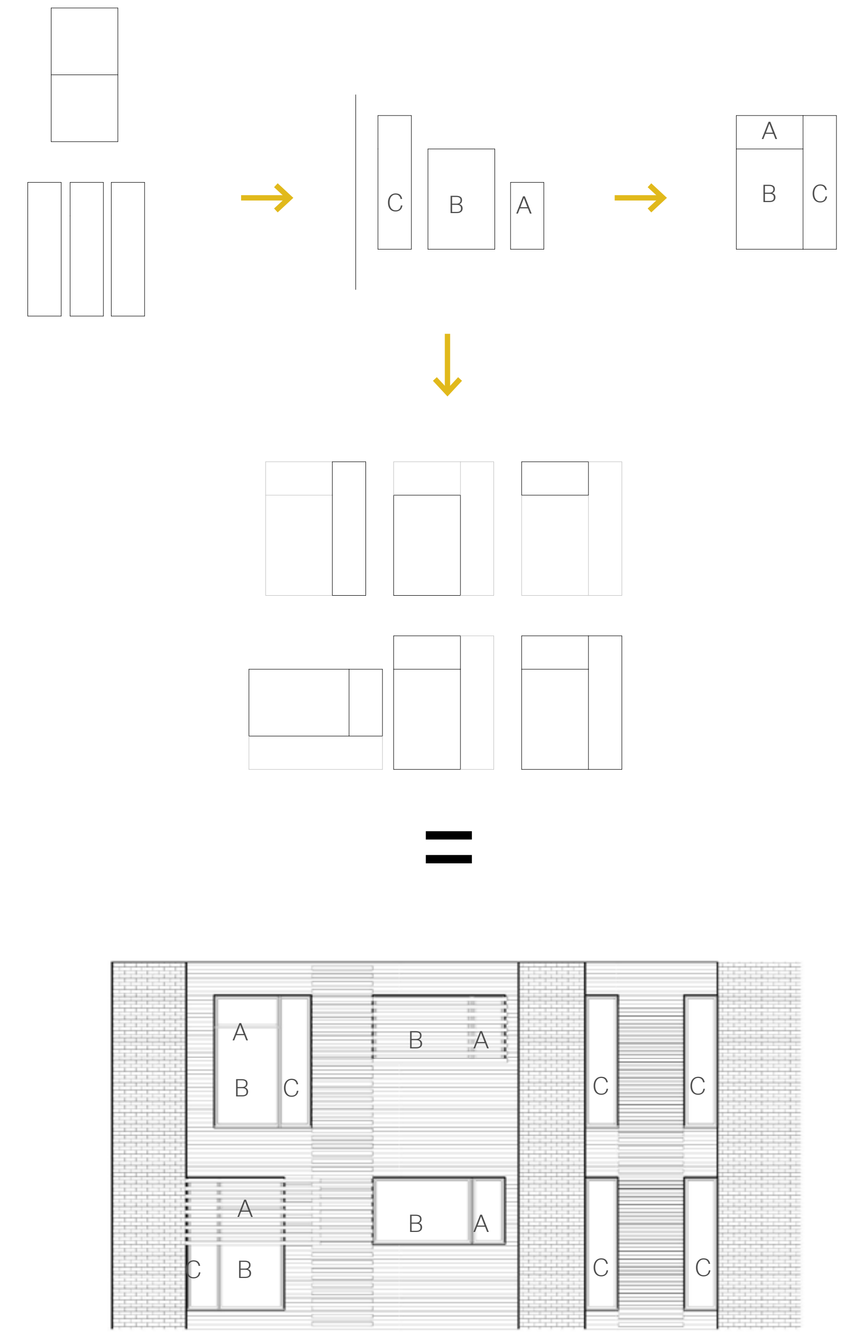
Exploded module axonometric

M

PROTECTIVE LAYER

Like the tree, structure composition is based on a layering system. It consists of the elements that shield the interior from the exterior. The first layer is the exterior layer of bark that is connected to the structure. It is the outer shell of the building that uses wood brick technology to conceal the CLT structure. Next is the inner raw live facade that wraps the interior and Juliet balconies that shave the wooden bricks away. Structured on a grid, three window frame dimensions are extrapolated from the contextual panes on the Victorian homes on Gerrard St. This interpretation allows for variation as they can be arranged in combination or used alone to glaze the building. This is the secondary level of protection followed by the unit layer which exposes the interior facade to the communal courtyards which are to be understood as different from the outer protective layer. Next are the units that represent the sapwood. Sapwood is between the protective bark layer and the heartwood that contains the functioning vascular tissue. This layer represents the units that house the people who are the nutrients that keep this housing project alive, active and well. The last layer is the heartwood which is the heart and centre core of the project. The heart is what ties everything together to keep the system moving and flowing and that is in support of the communal space. This communal space is the heart of every project of this type.

Section Layering



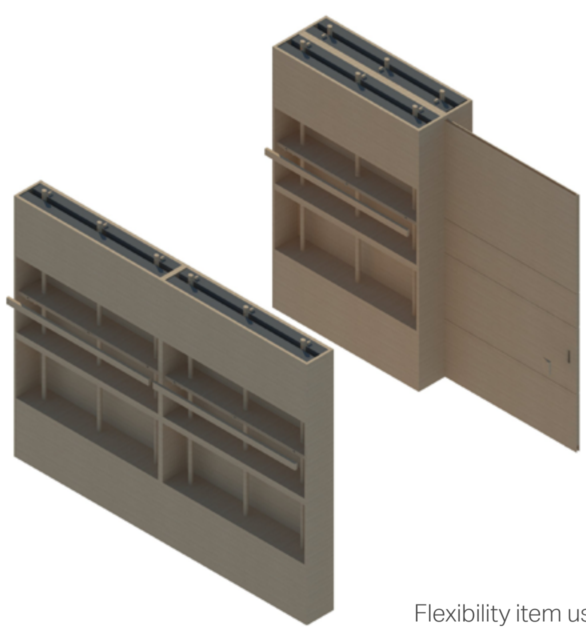
Window configuration development

S

THE LIVING LAYER

The Small scale represents the living layer. This is where spaces through materiality and design are altered to suit the resident's needs within the larger structure. This layer considers the use of fast flexibility for easy transitions. Fast flex consists of mobile wood furniture that opens and closes to allow for easy spatial transitions such as screens, folding shelves, and sliding walls, that support environmental preferences over time are items that require no time at all to alter.

Small also considers interior space as it may within the semi-public context. Understanding how to organize spaces and programs to allow occupants the sense of privacy they require within a communal centric design.



Flexibility item used in images to the right.

Bedroom opened to secondary space

Bedroom opened to secondary space

Bedroom created using small scaled furniture

The module component diagrams begins to illustrate how these units can operate. Starting off with the base module in beige outlined on the right.

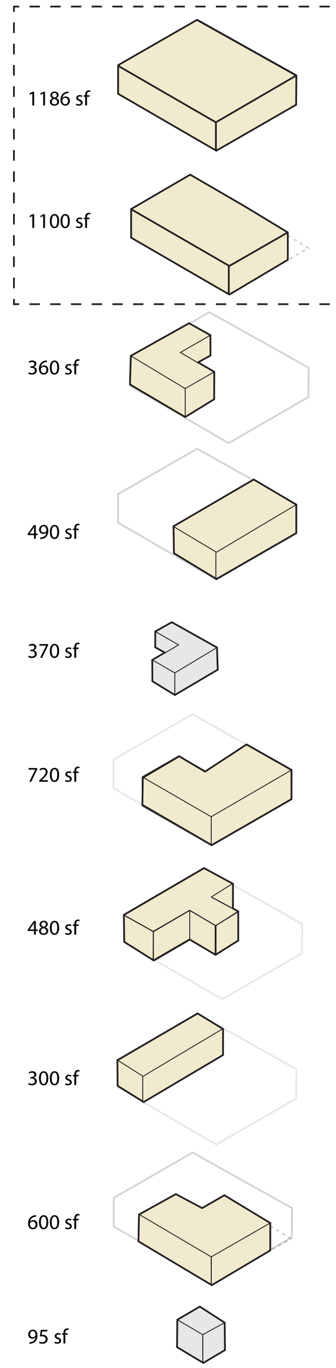
Let's say that there are two friends who want to invest in a home. They buy this module. One friend could own the southern portion of the lower level and the other the northern portion. Over time they find someone who wants to use the secondary level. So a single mother accesses the secondary level and raises her child.

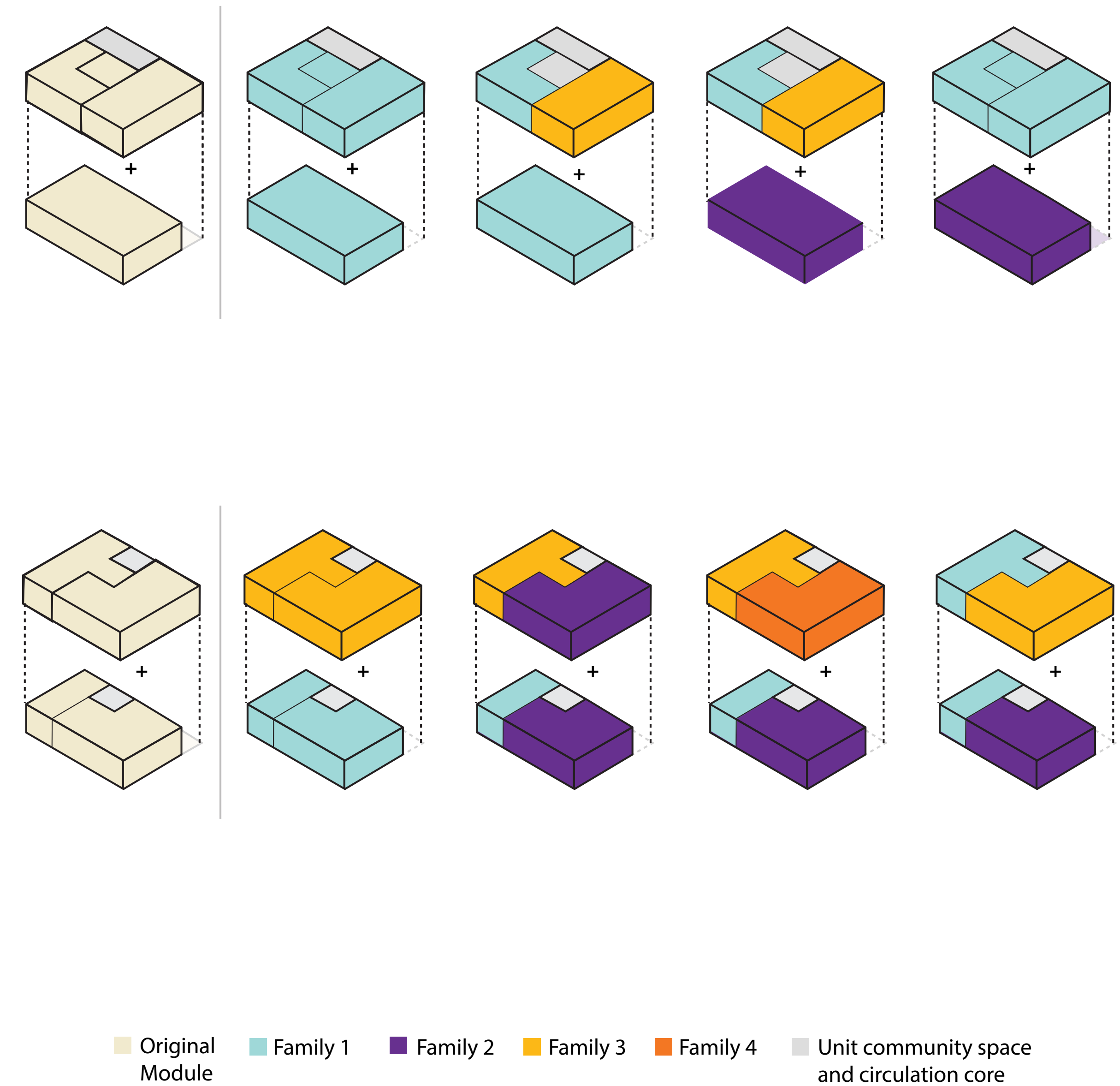
This mother has recently found true love and marries her partner who has a child of his own. They now need more space. So they renovate (using light frame and small furniture) to add another bathroom to the unit, a secondary bedroom and a living space at the northern side of the unit. Below on the primary level, these original students have also decided they'd rather live together so they have altered their space to create a master bedroom and a smaller secondary room.

A few years later, the family on the secondary level have decided they want to buy out the primary level from the couple below to host their new addition to the family (her husband's parents). They have trouble with stairs, so they take the primary level, and when they want they can share space above.

If grandparents or children or adults along this lifetime move out this space will be used for different purposes, and the cycle continues.

Unit component diagrams for module #1+2 begin to break down the parts to understand module components.





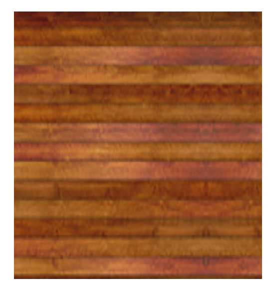
LEFT: Module Components
TOP RIGHT: Unit component diagrams for module #1
BOTTOM RIGHT: Unit component diagrams for modules #2

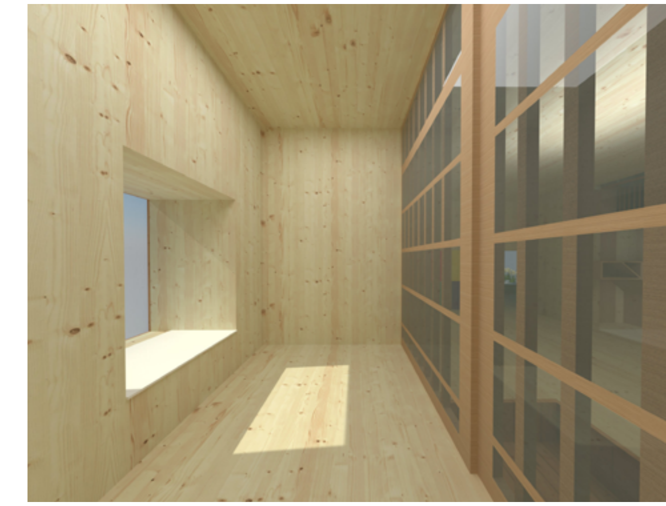
XS

THE ATMOSPHERIC LAYER

At all scales wood has played a part in being exposed through design to seek a residential feel. The extra small works in hand with the small and medium scale to provide texture, acoustics, and visual screening techniques as seen in the images throughout this study to highlight this exceptional material.

XS represents the atmospheric flexibility layer that is used to take fast flex a step further. It allows the occupant to move past the physical adaptations of space and allows for the manipulation of one's sense at a given time. Often large scaled residential buildings lack material qualities and are often bland and stark. This layer gives agency to users as they manipulate their atmospheric surroundings in a way that is also used in this project to speak to individuality within the community.





Daycare qiuet space

Module common space

Lobby entrance

Outdoor view from West

DESIGN PARAMETERS

OUTDOOR SPACE

Outdoor Space is used to connect private residents to the public realm. It becomes the threshold between scaled communities providing opportunities for connection through a shared space. This project investigates ways in which outdoor space can be used to support community while understanding that there is a strong need for varying levels of outdoor space. These spaces are dispersed throughout the building creating pockets of social liveliness as well as quieter spaces for reflection.

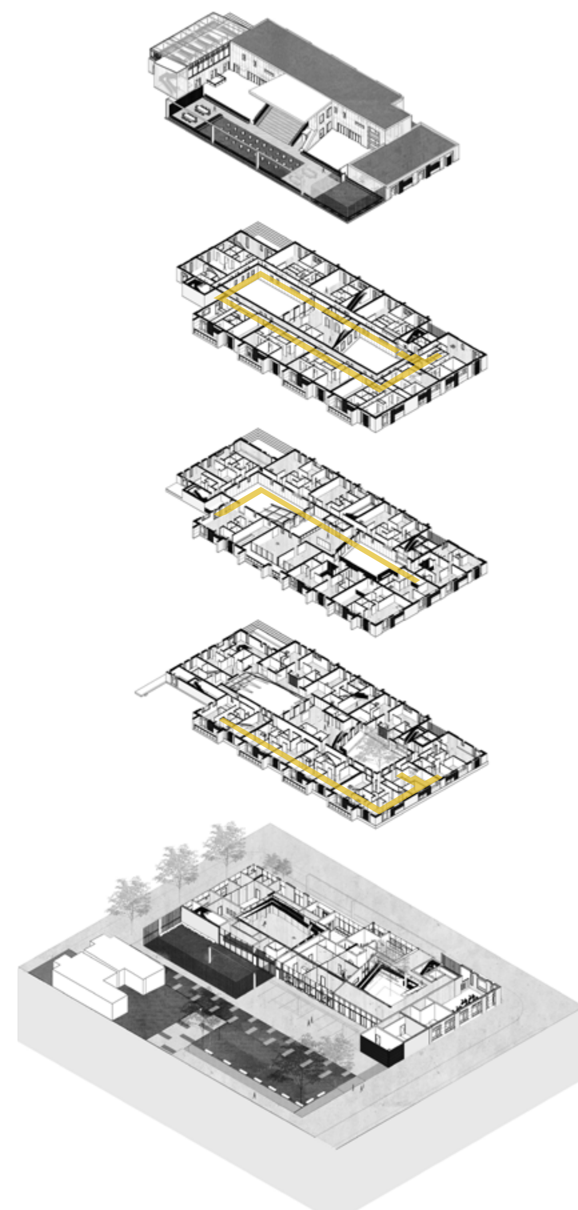
COMMUNITY IDENTITY INDICATOR

Individuality is achieved through groupings. The base module is dimensionally grouped into two floors of 3 bays. This should be visible on the exterior; a proud indication as to what is happening on the interior because there is something to boast about as onlookers see this building and the life it hosts.

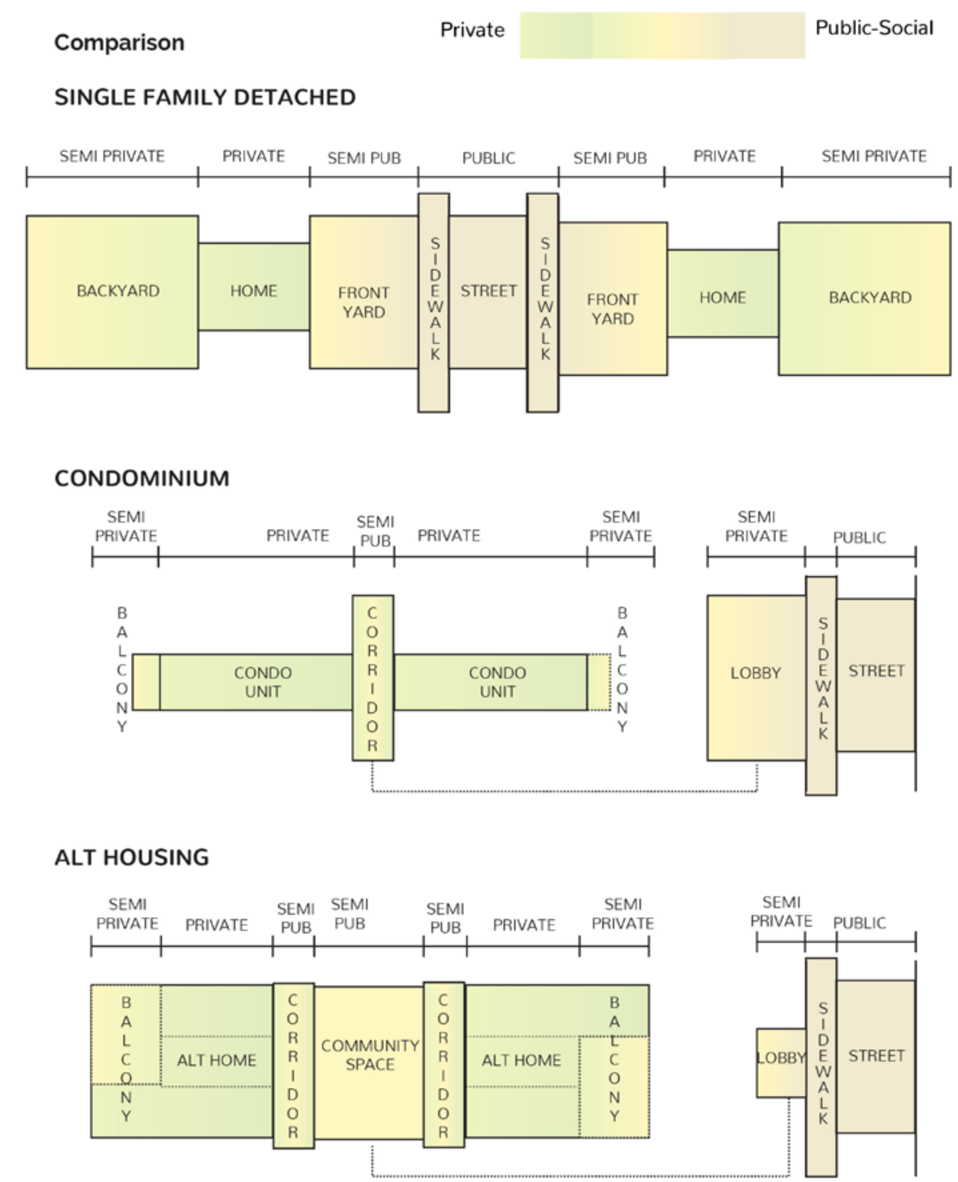
CIRCULATION TO CENTRAL

Within the communal areas there is also the opportunity for varying levels of the spatial gradient as the larger lower level may be too busy and a quieter retreat may be desirable. In this case there is a secondary level of privacy available on the second storey of the communal space. This gradient unlike many condominiums livens the central vertical circulation and corridors, as streets and sidewalks sometimes operate, but it does so in an central interior manner providing advantageous opportunities to residents.

Skip-stop corridors are used throughout this design. This helps to create the needed flexibility vertically by granting access to secondary levels. Residents will enter their units through the corridor and will have the opportunity for varied unit designs as the secondary units will provide more space. Every 2 floors would become a neighbourhood, with a central communal space supporting both primary and secondary floors. Single loaded corridors provide visual access to residents who are either outside or across the building in the communal spaces.



Circulation axonometric



Privacy gradients for different housing typologies

This circulation strategy provides accessibility to those in need, it finds a way to join neighbourhoods and divide them for a manageable number of neighbours. The yellow highlight on page 23 shows where access to primary levels of suites are located via corridors.

CHILD SPACE

The need to support parents with local places for their children while they are at work is needed but child space is not needed in every building. In the two developed schemes, there is a daycare in one building. What this design aims to do, is explain that buildings do not work in isolation. Every block should have its own daycare that supports the children within it and ultimately supporting the parents.

INDOOR COMMUNAL SPACE

Once passing through the exterior threshold, dwellers will enter the residential building lobby, that will grant access to the elevator core. Most dwellers in residential buildings no matter the height do not take the stairs, so the aim is to provide choice. The elevator will be the main point of circulation that will be supplemented by interior core stairs that are separated from the exit stairs. This allows for spontaneous and inclusive interaction. The dweller is taken from the elevator core through the central area where there may be a quick exchange between residents, for them to arrive at the corridor before arriving at their unit. At the unit there is another chance for a brief exchange through proximity to other unit entrances, until full privacy is obtained.

Top of Daycare ramp looking south

Connection between child space and indoor communal area

REFLECTION

BERGEN + TORONTO

Ryerson wood students met BAS wood students in Bergen, Norway in February. This trip was particularly rewarding as the experience granted first hand opportunities to explore and investigate a city so deeply rooted in wooden architecture. It was a way for us to work in a shop unknown to us with materials and tools never yet explored in Toronto. I personally want to highlight that architecture is a field that is both precise and experimental. With its inherent understanding of physical limitations and explorations I think it is advantageous to support the use and fabrication of models. This can only happen once supportive staff and workshops such as these provide the opportunities for exploration to all.

Tours and daily lectures on local wooden structures, sawing and material explorations gave this opportunity a unique touch that I have never witnessed in my years of study. Our workshops also provided the opportunity to test our previously gathered ideas to date with professionals and students who are in the same head space. It was two extraordinary weeks of collaboration with faculty and students to push our ideas one step further towards a conclusion that we would defend. Working on a thesis is fairly challenging, and after a while of working on something attempting to gather and create there is a high chance of hitting a “wall”. This is why the structure of the wood workshop was also successful as this trip would generate the needed inspiration to cheerfully aid the student into the final months of thesis completion.

The strongest forests do not grow all trees at once, some take the lead and others follow in sun streaked slow growth forests.
- KM

ALL GROWTH - MONOCULTURE

SLOW GROWTH - POLYCULTURE

Sketches made at one of the Bergen lectures

Exploratory models

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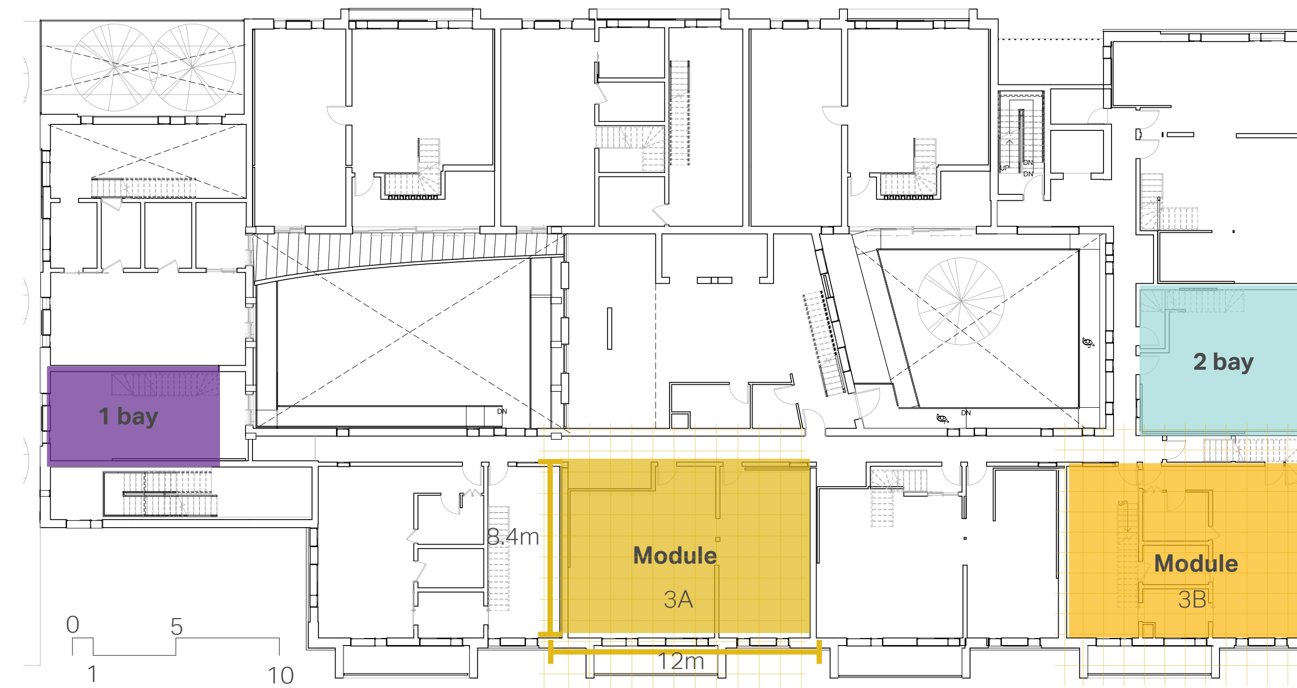
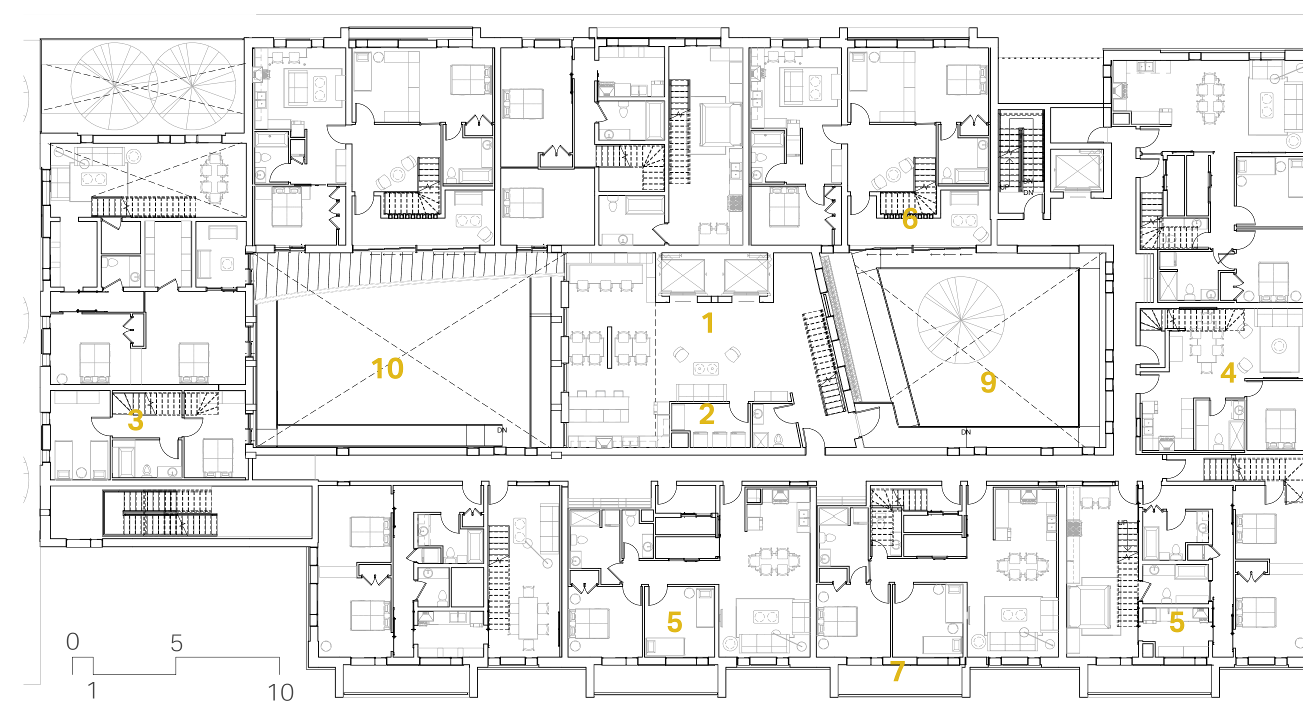
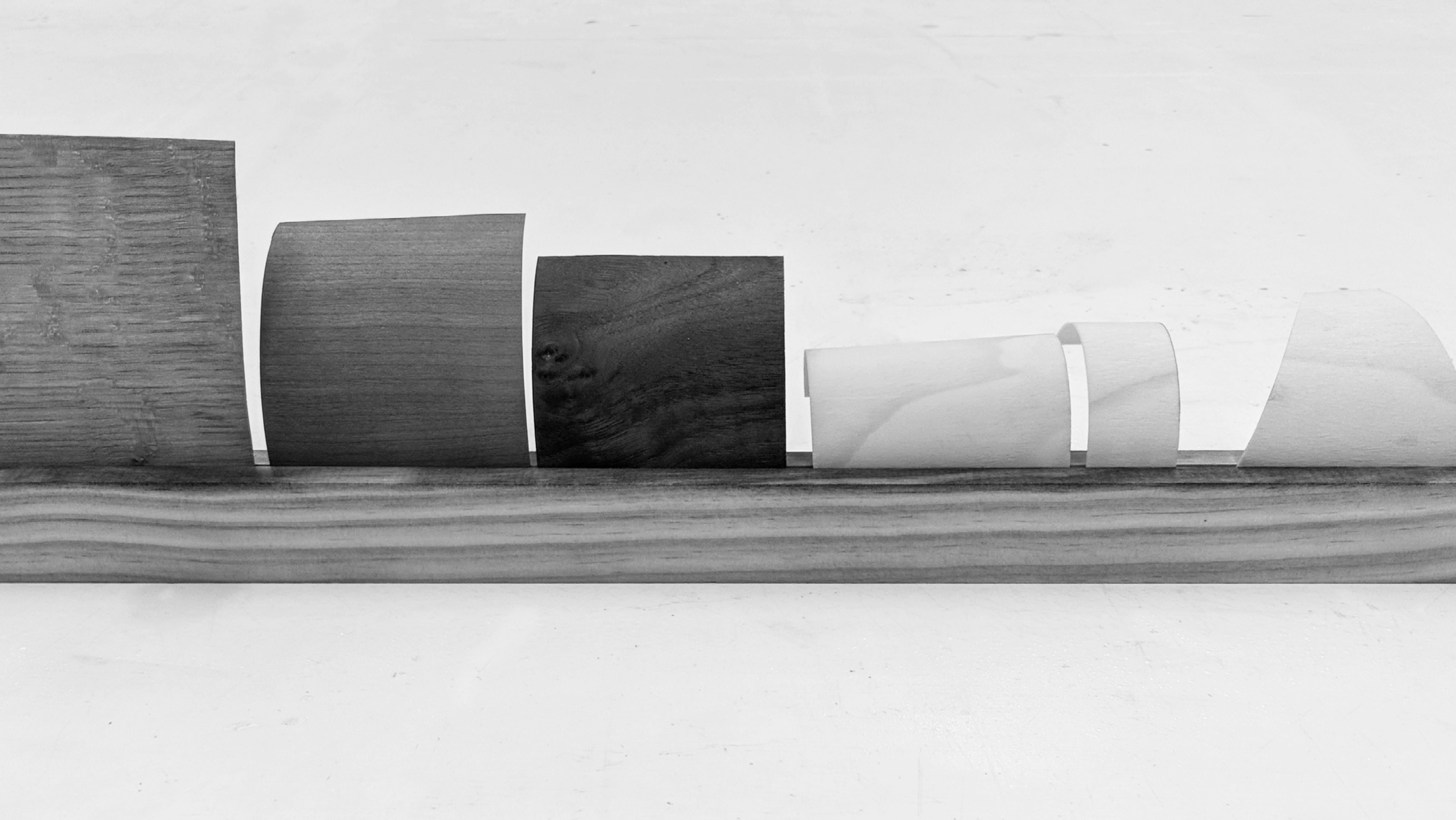




TOP: Level 2 - Fixed (Unfurnished)

BOTTOM: Level 2 - Flex



WOOD: EMBEDDED RESPONSIVENESS

PROJECT BY RYAN FERNANDES

ABSTRACT

Architecture provides the material context in which everyday life unfolds. As a material practice, architecture is constantly in flux, responding dynamically to changes in the surrounding environment. The emergence of New Materialism, stemming from Modernist ideas, marks a shift in architecture from a discourse of symbolism and metaphors, towards one of performance and material behaviour. This thesis studies material performance in the context of wood architecture. Wood is a heterogeneous material with unique performative capacities as a result of its biological makeup. This heterogeneity is often viewed as a disadvantage when compared to more uniform materials that behave more predictably. However, when reconsidered, the unique qualities of wood can be used to inform design. This thesis investigates these qualities with a focus on the material's responsiveness to moisture. In doing so, it attempts to unravel the potential of wood in the advancement of a new wood architecture.

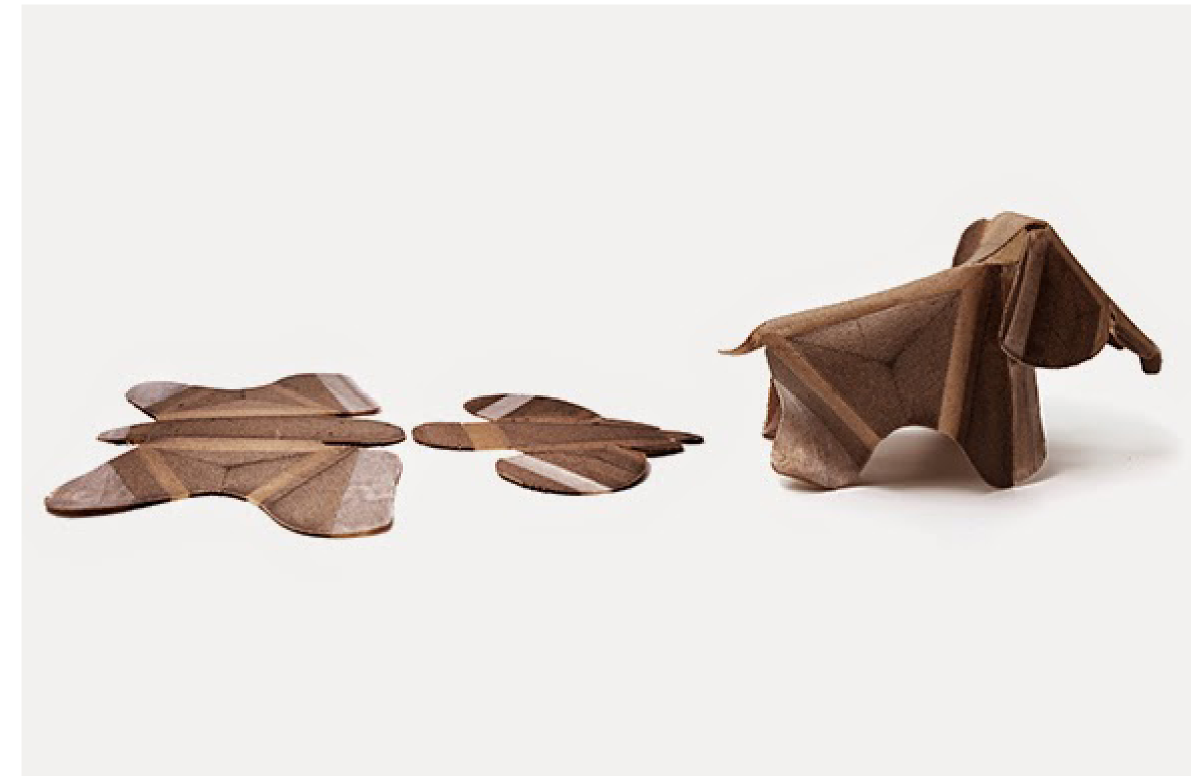
INTRODUCTION

"No man ever steps in the same river twice, for it's not the same river and he's not the same man."

—Heraclitus[1]

Through his famous quote, Heraclitus illustrates a world of eternal flux—a world that is constantly interacting and transforming. Though architecture has often been associated with ideas of timelessness, it is really a format ion of matter and energy that is constantly transforming.

Within the context of wood design, this thesis explores architecture as a material practice that is in constant interaction with the surrounding environment. While wood is a material that has been used in buildings for thousands of years, architects have rarely taken full advantage of its ability to facilitate and accommodate changes in the surrounding environment. In investigating the unique characteristics and capacities of wood, this thesis attempts to uncover an ecologically embedded responsive architecture capable of enhancing human experience.



Programmable Materials

RESPONSIVE ARCHITECTURE

Throughout history, architects have been interested in creating spaces that have a capacity to respond to changes in the surrounding environment. Some of the first concepts of responsive architecture emerged in the 1960s and 70s, and it was first envisioned in science fiction in work such as J.G. Ballard's Psychotropic House—a machine-like house that could sense and mirror the psychological state of its owners—and Ron Herron's Walking City—a hypothetical project that envisioned cities as giant robotic structures that could traverse water and land, and move to wherever they were required.[2]

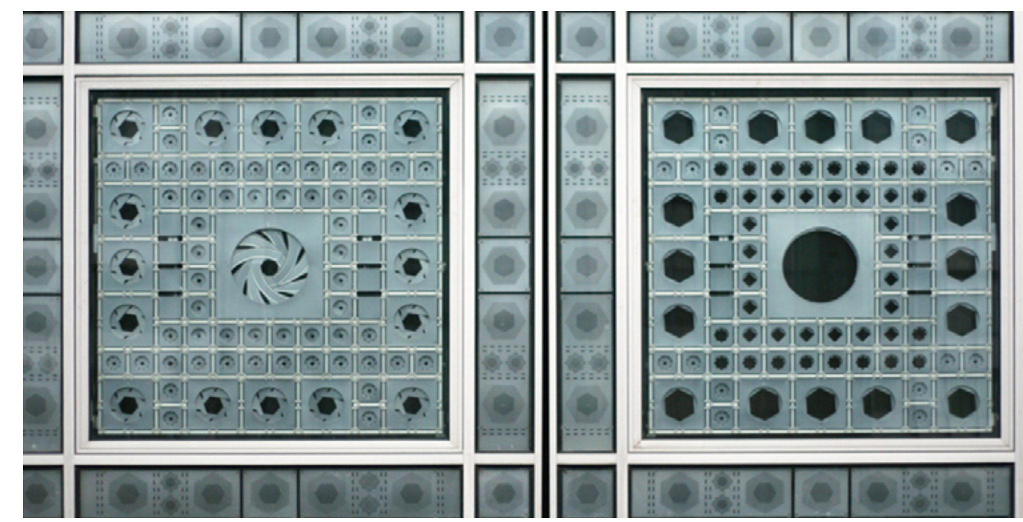
These ideas ultimately found their way into the built environment in projects like Jean Nouvel's Institut du Monde Arabe in Paris. Completed in 1989, it was the first large scale building to have an adaptive facade that responded to environmental changes.[3]

Today the field of adaptive, responsive architecture is vast, with designs that range from the highly technical and pragmatic, to the speculative and conceptual.

While today adaptability and responsiveness is often achieved through high-tech means, in the past it was achieved through simple technologies. For example, traditional Japanese homes can be transformed to serve various programmatic functions through the use of lightweight furniture and sliding partitions.

One promising approach to low-tech responsive design involves the use of materials that transform in response to external stimuli based on their inherent characteristics. Achim Menges argues that architecture as a material practice is still predominantly based on design approaches that struggle to take advantage of the performative capacities and richness of materials: "Materiality is usually conceptualised as a mere passive property assigned to geometrically defined elements, and materialisation is implicitly conceived as a secondary process of facilitating a scheme's realization within the physical world. Consequently, material information is understood as facilitative rather than generative".[4] Menges goes on to explain how contemporary methods of digital design have reinforced this notion by placing emphasis on form generation without taking into account the specific characteristics of materials.[5] Today, aspects of materiality are commonly dealt with in later phases of projects when the design needs to be adapted for fabrication and construction.

Tapping into the complexity of materials to unleash their potential in design requires a reconceptualization of materiality as a whole. This reconceptualization is happening within the field of Active Matter, where designers have been investigating the ability of materials to respond to changes in the environment based on their inherent characteristics.



Institut du Monde Arabe dynamic facade

ACTIVE MATTER

The integration of active materials with the capacity to compute behavioural responses based on environmental conditions represents a growing field in architecture and construction. Championed by Skylar Tibbits, Active Matter is a field in which digitally controlled mechanisms are replaced by material systems that are based on the inherent capacities of the materials themselves. Skylar Tibbits describes the newly emerging field of Active Matter as one that is "focused on physical materials that can assemble themselves, transform autonomously, and sense, react, or compute based on internal and external information".[6]

In the preface to the book *Active Matter*, Neil Leach suggests that the emerging field of Active Matter can be linked to the shift from the representational logic of Postmodernism toward a more process-based way of thinking that is emerging in design today.[7] He explains that this shift from a discourse of symbolism and metaphors to one of performance and material behaviour stems from the philosophy of New Materialism.[8] New Materialism rejects the Aristotelian view that "matter is an inert receptacle for forms that come from the outside", as well as the Newtonian idea of an "obedient materiality that simply follows general laws".[9] Instead, New Materialism presents a new conceptualization of an active matter empowered by its own tendencies and capacities.[10]

Within the field of Active Matter, there is potential for a future world in which material assemblies at various scales can be designed to dynamically respond to changes over time. Materials will be able to transform, triggered by external stimuli such as heat, pressure, and moisture. Thus, material transformations can be triggered by environmental changes allowing for smart, energy-saving, and sustainable solutions in architecture and other industries.

WOOD

Wood is one of the most well-known active materials used in architecture and other crafts. Humans have been building with wood for thousands of years. Not only does the material embody a rich history and deep cultural roots, but it also provides a remarkable synergy of structural and environmental performance.

In wood, material transformations are triggered by different activation energies such as heat, light, and moisture. These transformations are dependent on the material itself and its unique response to external activation energies.

Unlike most other building materials, wood is not industrially produced according to prespecified requirements. Rather, wood is a material that grows from the earth in response to the biological requirements of trees; therefore most properties of wood are directly rooted in the microscopic make-up of the material.[11] Generally speaking, the characteristics of any given piece of wood depend greatly on the tree species, where the tree was grown, when the tree was cut, and what part of the tree the wood comes from.

Wood joinery studies

MOISTURE RESPONSIVENESS

After studying wood in great depth, it became clear that one of the most overlooked capacities of the material is its ability to respond dynamically to moisture. Wood is a hygroscopic material, meaning it absorbs moisture from the atmosphere when dry and releases it when wet, thereby maintaining a moisture content in equilibrium with the surrounding relative humidity.[12] As wood absorbs and releases moisture, it exhibits anisotropic dimensional change. The magnitude, strength, and actuation range of these changes are remarkable when compared to those of synthetic materials. As cited by Wood et al.[13], the extremely high forces resulting from the dimensional changes that occur at the cellular level (measured as the swelling pressure of wood) have a measured value of 91 MPa and a theoretical value of 158 MPa. Anecdotally, this force is exemplified by the known use of hygroscopic expansion in wooden wedges as a method for splitting granite stone from quarries in ancient Egypt.[14]

Often, the hygroscopic behaviour of wood and its related transformations are considered to be a deficiency of the material. Rather than suppressing wood's innate ability to respond dynamically to moisture, this thesis embraces the behaviour of the material in the pursuit of a new wood architecture based on material performance.

DESIGN PROPOSAL

The investigation of wood's responsiveness to moisture will be carried out in an architectural context through the design of a bathhouse on Lake Ontario. The variation in moisture and temperature conditions inherent to a waterfront location and bathhouse typology afford an excellent opportunity to test the ideas of this thesis.

The bathhouse will be limited in scale (less than $100m^2$) with a program that includes a sauna, a bath, and a gathering space. Limiting the scale of the project was important as the work requires a detail-oriented approach. In addition, the project is one of the first of its kind in Toronto, and its aim is to catalyze the growth of bathing culture across the city. Starting with a humble structure that provided an intimate bathing experience was therefore a seemingly appropriate first step.

The bathhouse will be located in Toronto, on the northwestern shore of the future Villiers Island precinct. Formerly referred to as Cousins Quay, the Villiers Island precinct is slated to become a new waterfront community in Toronto's Port Lands, just minutes away from the downtown core. The development of the island will be centred on principles of sustainability, resiliency and innovation.

The Future Villiers Island

DESIGNING WITH WOOD, WATER AND HEAT

In order to study the relationship between wood and moisture in an architectural context, a series of design explorations were carried out. The studies have been broken down into two categories: structural studies and environmental studies. The structural studies investigate how wood's responsiveness to moisture can inform form and joinery. In these studies, material and structure are not separate but one and the same. The environmental studies investigate how wood's responsiveness to moisture impacts the environment both directly and indirectly.

STRUCTURAL STUDIES: FORM - BENDING

This study investigates the inherent elasticity of wood, and how it is affected by moisture. Each species of wood has a unique elastic range. In addition, thicker pieces of wood are generally less easily bent. Further, it is known that the moisture content of a piece of wood plays an important role in determining how elastic it is. Wood is generally more elastic when it contains more moisture.[15]

In addition to its inherent elasticity, wood can be treated in ways that take it beyond its elastic range and into its plastic range. This is done through steam bending or chemical plasticization.[16] Together, heat and moisture can soften wood and produce a degree of plasticity roughly 10 times that of dry wood at normal temperatures.[17]

In this study, a number of wood samples varying in species, shape, and size were bent using steam. The findings made it possible to speculate on potential architectural applications for steam bent wood at various scales.

STRUCTURAL STUDIES: JOINERY

This study investigates the use of moisture in the joinery of wooden members. Wood joinery using moisture is based on the principle that wood changes shape as it absorbs and releases moisture. As such, there is potential for members to be joined together forming tight fitting connections without the use of glue and/or metal fasteners.

In this study, a series of joints were developed that rely on the moisture responsiveness of wood.

Twisted white oak

Wood joinery studies

ENVIRONMENTAL STUDIES: MOISTURE BUFFERING

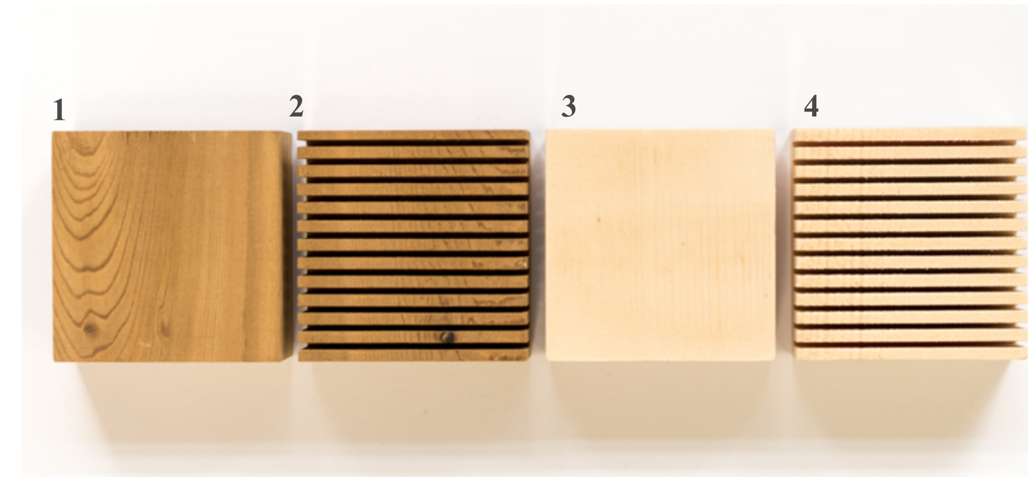
This study investigates the potential for wood to buffer moisture levels in interior environments. In high humidity environments, wood absorbs moisture, whereas in low humidity environments wood releases moisture, thus adjusting the indoor relative humidity without energy consumption.

In this study, the rate of moisture absorption and release in wood samples varying in species and surface area was measured. First, the weight of the samples was recorded. Then the samples were submerged in a bath of water for two minutes. After an additional two minutes, the samples were weighed again to determine how much moisture they had absorbed. It was found that the samples with a high surface area absorbed significantly more moisture when compared to samples with a low surface area.

ENVIRONMENTAL STUDIES: RESPONSIVE ENVELOPES

This study investigates the use of wood as a responsive material that can be used in the creation of low-tech responsive building systems that react to fluctuating environmental conditions. The programming of such systems gives way to the possibility of a simple yet truly ecologically embedded architecture in constant feedback and interaction with its surrounding environment.

In this study, veneers of various shapes, sizes, and wood species were exposed to fluctuating humidity conditions in order to gain firsthand knowledge of how various factors affect the response. Although no long-term tests in a full range of weather conditions were conducted, such tests have been conducted by others. In one study, researchers tested the durability of responsive wood cladding systems over a one-year period, and found that in general, they performed extremely well across the board.[18] These results provide the basis to speculate more accurately on the design of responsive wood systems for the built environment.



Moisture buffering studies

Sample	Wood Type	Surface Area	Weight (Dry)	Weight (Wet)	Delta
01	Cedar	Low	100.9	110.0	9%
02	Cedar	High	78.2	108.2	38%
03	Pine	Low	79.7	85.4	7%
04	Pine	High	61.0	89.5	47%

Impact of venner cut on response

Impact of grain direction on response

In addition, a study of Shou Sugi Ban investigated how wood's responsiveness to moisture can be diminished. In this experiment, a sample of cedar was charred on all of its faces, leaving behind a dense layer of carbon that sealed the wood and made it more resistant to rot, insects, and fire.

Shou Sugi Ban study

BATHHOUSE

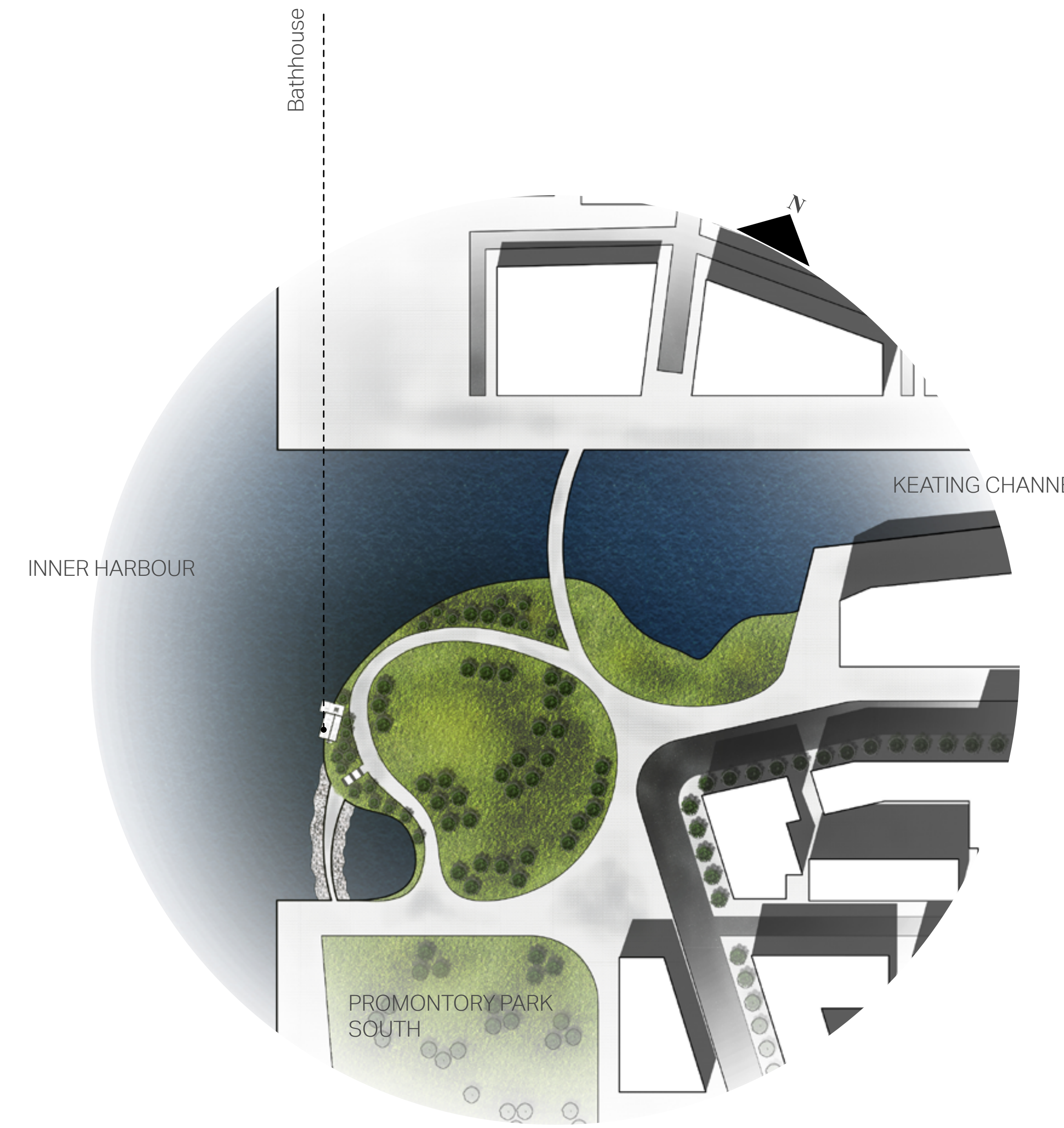
The bathhouse is situated within a rich context on the northwest shore of Villiers Island overlooking Toronto's inner harbour. Placing the building within its context was a very important part of the design process. In order to have the landscape accept the building, one of the critical considerations was the choice of materials. Ideally, a building should be made of materials that belong to the site and can be sourced from it. In the case of the bathhouse, the building is constructed of wood sourced almost entirely from trees native to the area. The bathhouse aims to unravel the very essence of the selected wood species, and use each one in a precise and sensuous way, expressing and celebrating their natural characteristics. At the same time, the design carefully considers the role of water, fire, and stone.

The bathhouse is open to all members of the public, and can be used by up to 10 people at a time. To get to the bathhouse, one follows a path originating from an urban plaza located 100 meters south of the site. As one walks along the path, they quickly become immersed in greenery and begin to leave behind the excitement of the city. Similar to the Japanese practice of ***shinrin-yoku*** or "forest bathing", the journey of getting to the bathhouse provides the opportunity for one to wander through nature, mindful of their surroundings. The sounds and smell of the trees, the sunlight filtering through the leaves, the fresh air—all of these things help to dissolve one's stress and worry while giving them energy and vitality.

As one nears the bathhouse, its charred wood exterior begins to emerge. At once it feels both ancient and modern. In fact, the entire building exudes a primal aura—both in the way that it functions, and the way it was constructed. Like many of the earliest bathing structures, it embraces minimalism, and advocates for a life stripped down to the bare necessities. Though the construction of the building is simple in its concepts, it is also highly sophisticated, with well-conceived details that embrace the joints and reveal methods of construction.

From the outside, the building appears to be firmly rooted, yet in actuality it touches the site very gently. For the most part, it rests on a wooden structure that hovers just barely above the earth. In order to bring visitors closer to the lake, part of the building extends beyond the shore, bearing on wooden posts submerged in the lake water. The lack of oxygen in the water prevents the submerged wood from rotting over time. Furthermore, using wood that has been cut from the centre of the log gives the structural members enhanced moisture and decay resistance. These submerged timber posts form the basis of the structural grid for the building. Bearing on these posts are beams that carry the weight of the building above. At the intersection of the post and beam, the general approach to joinery is apparent. Structural members interlock and are secured with wooden dowels that were dried prior to installation. Once in place, the dowels naturally re-absorb moisture from the air, expanding in volume, and forming a very tight connection without the use of glue or metal fasteners. Here, and in several other instances throughout building, the dowels used to secure the joints become an important part of the building's expression.

Within the post and beam framework sits the building—a rectangular bar that emphasizes the sloping terrain of the site. The exterior walls of the bathhouse consist of 4x8 cedar planks laminated together without glue, but rather with a combination of dowels, and dovetail joints to ensure air tightness. This simple assembly is at once the interior finish, exterior finish, insulation, air barrier, and structure. Cedar was chosen for its durability, pleasant aroma, and high insulating capacity. At R-10, the assembly provides just enough of a thermal buffer so that on the coldest of days, one's thermal experience of the bathhouse is amplified and elevated. On the interior side of the walls, custom profiles are milled into the cedar planks to increase the surface area to volume ratio, thereby increasing the moisture buffering capacity of the wall. This in turn helps to maintain a comfortable humidity level within the space. At the same time, the milled profiles increase the potential for the wood to absorb and diffuse sound, thereby improving the acoustics of the space. On the exterior face of the walls, the cedar planks are charred to provide resistance to rotting, insects, and fire.



Site plan

Over time, this black and blistered surface will transform as it is touched by various forces.

Cedar is also used for the outdoor terrace located on the north side of the building. As it ages, the cedar will develop a wonderful silver-grey patina and take on a character of its own.

Perhaps the most essential facade is the west façade, which overlooks the lake. It is divided by vertical posts that extend from below the water to the underside of the roof. A narrow passage, accessible to visitors, separates the façade from a timber screen that sits in front of it. Where the façade has windows, the timber screen consists of panels of vertical white oak fins. Using a process of steam bending, the fins were strategically twisted to create a system that blocks harsh western sunlight, while at the same time guiding views towards the city skyline. For the rest of the façade, the timber screen consists of panels of thin beech wood strips that change shape in response to fluctuations in humidity and temperature. These panels pivot on wooden hinges and can be opened or closed throughout the year. In the summer, the screens will remain open and enable visitors to sit on the edge of the structure gazing over lake. In the winter, the screens will remain closed and shelter the passage, which will then be used to store firewood.

Inside the bathhouse, natural light enters from above through skylights and clerestory windows that wrap the entire building. On the east and west side, these windows are operable, offering the potential for cross ventilation in the warmer months of the year.

A 'V'-shaped extensive green roof encloses the building, minimizing the volume of interior space, and thus the amount of energy and time required to heat the space in the cooler months. The construction of the roof is based on traditional Norwegian birch bark and sod roofs, which have been said to last 50-70 years before needing to be refurbished. Birch bark is both water and decay resistant, and as such, has been used in the construction of canoes for centuries. The construction of a birch bark and sod roof begins with the harvesting of birch bark in the spring or early summer. One must take care in removing only the outer bark of the tree so as to not damage the tree. The bark must then be pressed and dried for several months before it can be used. Once it is ready to be used, the bark is laid on the structure of the roof in multiple shingled layers without using nails or any other means of fastening. Simultaneously, sod is laid in two layers on top of the birch bark from the eaves of the roof to its peaks. The first layer of sod is traditionally placed with the grass facing down to protect the bark from the acidic humus and act as a drain. Over time, the grass roots from the top layer permeate the lower layer and form one solid structure. At the eaves of the roof, the sod is held in place by strong beams. The sod both insulates the roof and protects the birch bark from sunlight and wind.

The interior of the bathhouse is organized in such a way that guides visitors through the space. One enters the building through a heavy wooden door that leads into a vestibule. To the right is a canvas curtain that brings them into the main hall of the bathhouse. Looking back for just a second, the curtain seems to glow as it filters southern light into the main hall.

The hall is the spine of the building, extending from the south end to the north. The finished flooring consists of 3" wide pale oak planks with 1/2" gaps between them. This configuration ventilates the service space below the floor, and also creates a distinct yet comfortable walking surface. At the same time, the hardness of the wood makes it very durable, ensuring that it will last a very long time. Upon entering the hall, one stores their coat and shoes and proceeds to walk down the hall where they encounter doors on either side. These doors lead to spaces where one leaves their garments and other belongings. Within the space, all the elements including sinks are made of wood. The benches and lockers are made of cedar, the counters of oak, and the sinks are made of ipe—an extremely durable and rot resistant hardwood.

Free of garments, one proceeds to shower. Showering before using a sauna or bath is important both for hygienic reasons and to remove the oily film from one's skin, enabling them to sweat faster. As the water from the shower flows off one's body, it travels across the dense ipe floor, before being naturally filtered and returned to the site. At the same time, some moisture is ab-

Approach

sorbed by the cedar that surrounds the space, intensifying its aroma. Having showered, one dries their body thoroughly and then makes their way towards the central hall before entering the sauna.

One hangs their towel on a wooden hook just outside the sauna and then proceeds to enter the space through a short door standing just 5.5 feet in height. The low door height prevents hot air from escaping the sauna when it is open. At the same time, as one lowers their body to pass through the door, they are faced with a condition that invites them to reflect on their presence within the space. The sauna is heated by a wood burning stove. Well-dried birch wood is used for the fire to ensure a long lasting burn and pleasant aroma. Inside the sauna, most of the surfaces are made of cedar. When the space is first heated, the cedar absorbs the heat evenly and its pleasant aroma is enhanced. For the benches, the low conductivity of cedar and the selection of planks without any knots ensure that the surfaces that one comes into contact with remain at a comfortable temperature. The sauna consists of three levels enabling one to choose the temperature they desire. As one climbs to a higher level, the temperature also rises. In addition, the temperature one experiences varies depending on how one chooses to sit or lie on the benches. Aside from the skylight and clerestory windows within the space, there are no other windows. This aspect of the design, in addition to the sound dampening properties of the sauna's walls, aids in creating an introspective atmosphere. Above the skylight—and all the skylights throughout the building—is a system of responsive apertures made of beech wood that respond dynamically to fluctuations in humidity and temperature. As conditions change throughout the day, the apertures open and close, casting shadows on surfaces within the sauna.

Throughout the session, occupants can ladle water onto the hot rocks in order to create a cloud of steam that envelops the bather. In Finland, this steam is referred to as löyly, which comes from the old Finnish word for spirit or soul. When the steam is created, the level of humidity in the sauna rises sharply, and occupants suddenly feel intense heat. However, this sensation lasts only for a brief period as the increased moisture in the air is quickly absorbed by the wood surfaces in the sauna. This rise and fall in humidity triggers another change within the space. As the humidity within the space fluctuates, the walls of the sauna, which are clad in strips of wood veneer, begin to breathe. When water is poured on the stones, the strips absorb the humidity in the air and begin to curl. Then as they dry out again, they return to their flat state. In this instance, the material assumes a poetic quality.

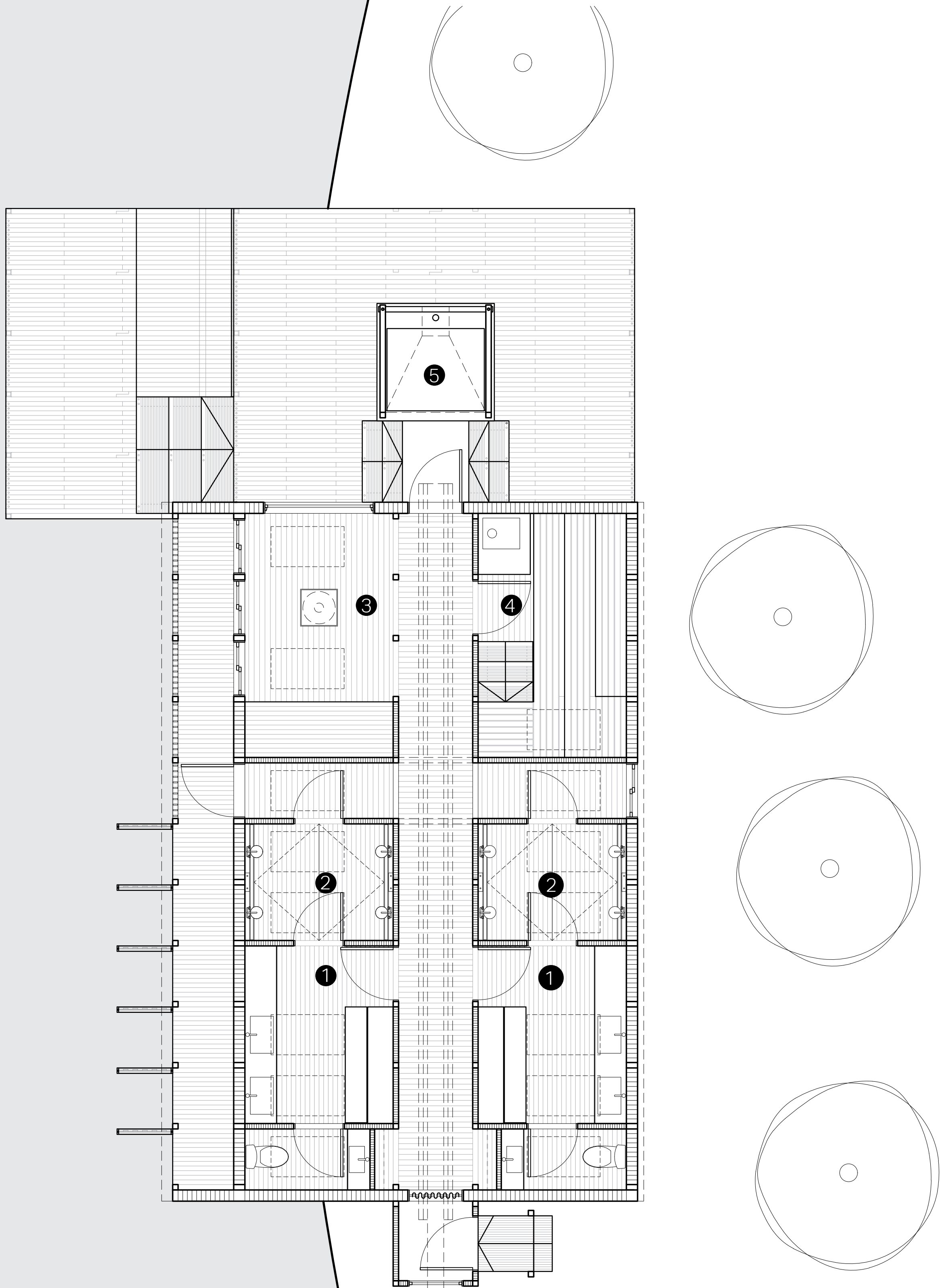
It is also common in Finnish sauna culture for bathers to gently whisk their skin with a small bundle of fresh tree branches. Proponents argue that the ritual exfoliates the skin, improves circulation and relieves muscle pain. Most often, the whisk, or *vihta* is made of fresh birch twigs that are warmed in hot water and release a pleasant aroma when used.

Contrasting the heat of the sauna with cold exposure is common in many cultures. The benefits of this ritual are both physical and psychological. The transition from intense heat to intense cold causes the body to increase its heart rate, constrict blood vessels and induce a rush of adrenaline and endorphins. In the context of this project, the chilly water of Lake Ontario provides a convenient means for visitors to cool off after exposing their bodies to the heat of the sauna. The lake can be accessed from the northern terrace which steps down to the water. From here, one has the option to dip their feet in the water, or perhaps submerge their entire body. In any case, the cold water offers an invigorating jolt as it draws heat from the body.

After cooling off, one's body is stimulated and their heart rate elevated. It is thus crucial at this point in time to relax and let one's body return to its natural rhythm before repeating another thermal cycle. This time can be spent outside on the terrace or inside the building.

Should one choose to remain outside, they will be welcomed by a large wooden lounge chair, built into the terrace. Consisting of a series of wood slats that have been bent into shape, the chair is warm to the touch and cradles one's body as they lie on it and take in views of the lake and city skyline.

N-W perspective



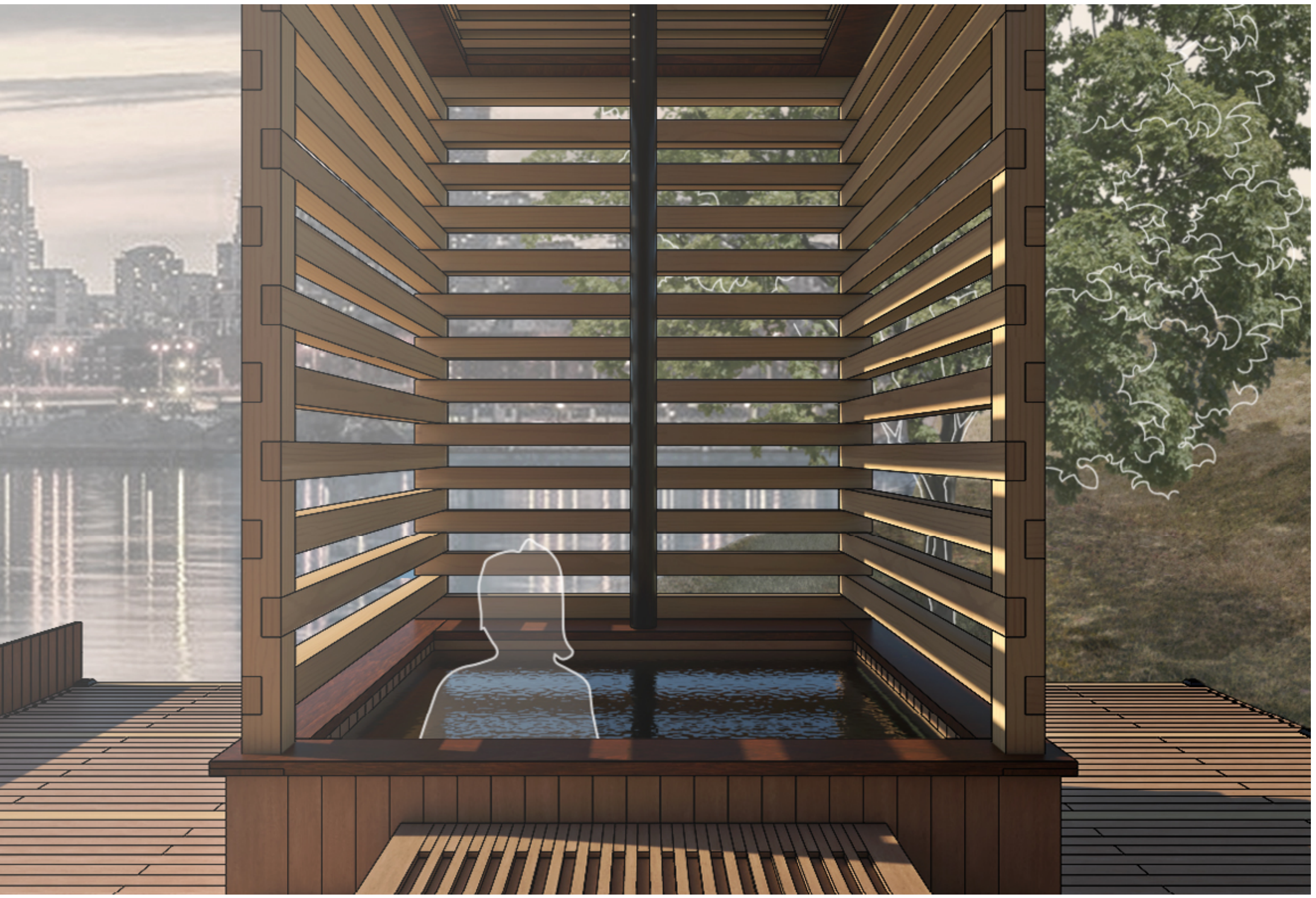
Bathhouse plan

1.Change
2.Shower
3.Lounge
4.Sauna
5.Bath

Inside the building, the main gathering space was designed to facilitate social interaction while offering majestic views of the inner harbour and city skyline. In the centre of the space is a hearth that draws people together, in addition to providing heat for the entire building. Cushions on the floor, made from plant-based materials, invite guests to sit around the fire and interact with one another.

Once one's body has returned to a neutral state, it is ready for another thermal cycle. This time, it begins inside the waters of a hot bath. Baths have often been places of pilgrimage, immersed in the surrounding landscape. The first baths were located at thermal springs, and they have since evolved into various iterations within different cultures. For this project, the design of the bath focuses on reconnecting one's body and mind. As one bathes, the combination of uniquely treated wood elements contributes to a mindful experience of one's body in space and time.

The bath is situated just outside the building to the north. Surrounded by lush greenery and views of the lake, it exists within a space that blurs the boundary between the constructed and the natural. The bath was built using joints that tighten when exposed to moisture. Enclosing the bath is a wood screen consisting of 4x4 cedar members laid horizontally, and stacked on top of each other with gaps in between. As hot water splashes onto the wood, the aroma from the wood engulfs the bather. Due to the low thermal diffusivity of wood, regardless of the outside temperature, the wood structure never feels too hot or too cold when one comes into contact with it, making it comfortable to lean on throughout the year. Above the bath is a vertical shaft that rises beyond the roof of the main building. Its purpose is to exhaust smoke from the wood fire that heats the bath water. At the top of the shaft is a square opening that provides a window to the sky and brings in light. After spending several minutes in the bath, one climbs out to cool off yet again, only to repeat the cycle as many times as they desire.



CONCLUSION

Today more than ever, the virtues of using wood as a building material cannot be understated. We are living in an era that will be defined by our relationship to the planet. As the effects of climate change continue to reveal themselves, the way we live will need to be transformed. This includes changing the way we build our cities, as well as the materials we use to build them. Of all the materials, wood is the only one that can be grown by the power of the sun; not to mention, as it grows it consumes carbon.

In Canada, a country in which 40% of the land is covered by forests and wooded areas, there is a tremendous opportunity to significantly advance the art and craft of building with wood. If taken, this will help reduce our impact on the planet, and at the same time help to establish a national architecture that expresses regional identity.

Excitingly, the revival of wood building culture in Canada is already beginning to take place, and innovation in wood building is on the rise across the country. As we strive towards a new wood architecture, it would be wise to look to the past, as much can be learned from the technical ingenuity embodied in historical wooden structures, both at home and abroad. In addition, we must approach design with feet strongly planted both in the abstract world, as well as the physical world, striving towards a design approach that is informed by the unique capacities of the materials we build with. Pursuing this kind of a design approach is not easy, but it can be remarkably fulfilling. It requires a tremendous amount of dedication and humility, which only comes from learning to respect the materials we use; which is why I choose to conclude this thesis with the following quote from Michael Green:

> Each tree is a beautiful part of the answer to climate change, and yet we are only beginning to ask of its potential... [E]ach time [we] choose to build in wood [we are] part of a critically important chain of responsibility that will see the elegance of the living tree through to a new life in a building. That responsibility includes understanding the tree's genesis, its place in the ecosystem, its unique characteristics, and its remarkable potential when incorporated into the built world.[19]

POST SCRIPT

The bathhouse typology has often been used as a vehicle for exploring new architectural ideas. In this thesis, the typology serves as a means for investigating how a new wood architecture can emerge from a deep understanding of how the material responds to the surrounding environment. This is an area of architecture that has largely been neglected to date. The focus of this thesis was on the hygroscopicity of wood—a responsive capacity of the material that is often regarded as a disadvantage. The design project was informed by this potential, as well as its other unique characteristics. As such, emphasis was placed on material performance and behaviour rather than representation and form.

The first step in the design process was to study the physical and mechanical properties of wood, both at a general material level and at the level of individual wood species. This eventually formed the foundation on which the design project was based. After studying the various characteristics and capacities of the material, the focus shifted to one in particular—the material's responsiveness to moisture. From here, several studies were conducted that would later inform the design of the bathhouse.

One important decision that was made early on in the design of the bathhouse was the decision to work exclusively with wood, including avoiding the use of glue and metal fasteners. This decision played a significant role in determining the construction and architectural expression of the building. It demanded a detail-oriented approach that led to the creation of unique joints and systems that were informed by the responsiveness of the material being used. Often, the use of the material was inspired by very old techniques that had fallen out of favour and have since rarely if ever been reconsidered. Looking at the historic use of the material with an understanding of today's technology brought to light new and improved ways of working with the material throughout the design process. This challenged mainstream approaches to design which often apply materiality to previously defined forms. Through the design of the bathhouse on Villiers Island, this approach was tested, and from it emerged a low-tech and ecologically embedded responsive architecture.

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ON (WOODEN) GROUND FLOOR

PROJECT BY TORD ØYEN

ABSTRACT

Erling Viksjø´s high rise City Hall from 1974 has been controversial since it was finished. The people of Bergen love to hate the concrete tower and there is no doubt that the building is a symbol of power and constantly reminds us of the governing of the city.

The proposal On (Wooden) Ground Floor tries to bring the governance of Bergen municipality in closer contact with it's inhabitants. By dispersing several volumes of differing sizes, the spaces for the politicians and counsellors becomes equally important as the spaces in-between for the public.

In contrast to the rough and heavy existing City Hall, the new addition will consist of structures and surfaces made entirely out of wood. Bergen is and have always been a city of wooden houses.

PREFACE AND INTENTION

The outset for the diploma started with a study- and exchange trip to the Department of Architectural Science at Ryerson University in Toronto, Canada. The goal was to understand how wood is used both as structural and functional element in contemporary architecture, combating resource scarcity and severe impacts on the global climate, but also how wood is a material from the past for the future.

Combined with BAS' focus on vernacular and traditional Norwegian west-coast architectural style, studytrips to the Alps and experimenting with 1:1 scale construction principles in wood, the intentions for the diploma was quite clear.

When talking about wood several properties comes to mind. The warmth, the structure, the smell, the craftsmanship, the touch and feeling. It is considered a luxury to use wood as a visual and tactile element in architecture.

It is still quite common to use it as a structural element from solid logs to timber frames in smaller houses and as interior walls in larger buildings. These are normally clad and there is no visible trace of wood.

My interest lays in the borderline between the "technical wonder" of standardised building elements and the great properties of wood as something flexible, ever changing and as a sustainable resource. Not necessarily flexible in everyday use, but expandable and easy to transform to new uses.

Over the course of the spring I want to look into how modular systems have been used to accommodate both practical solutions and needs, but also how the poetics and grandeur of a space can be obtained.

A commonly stated assertion is that elements in solid wood is advantageous because of quick assembly and that it is uncomplicated to re-use in another structure. So far there are non or few examples of recycled CLT.

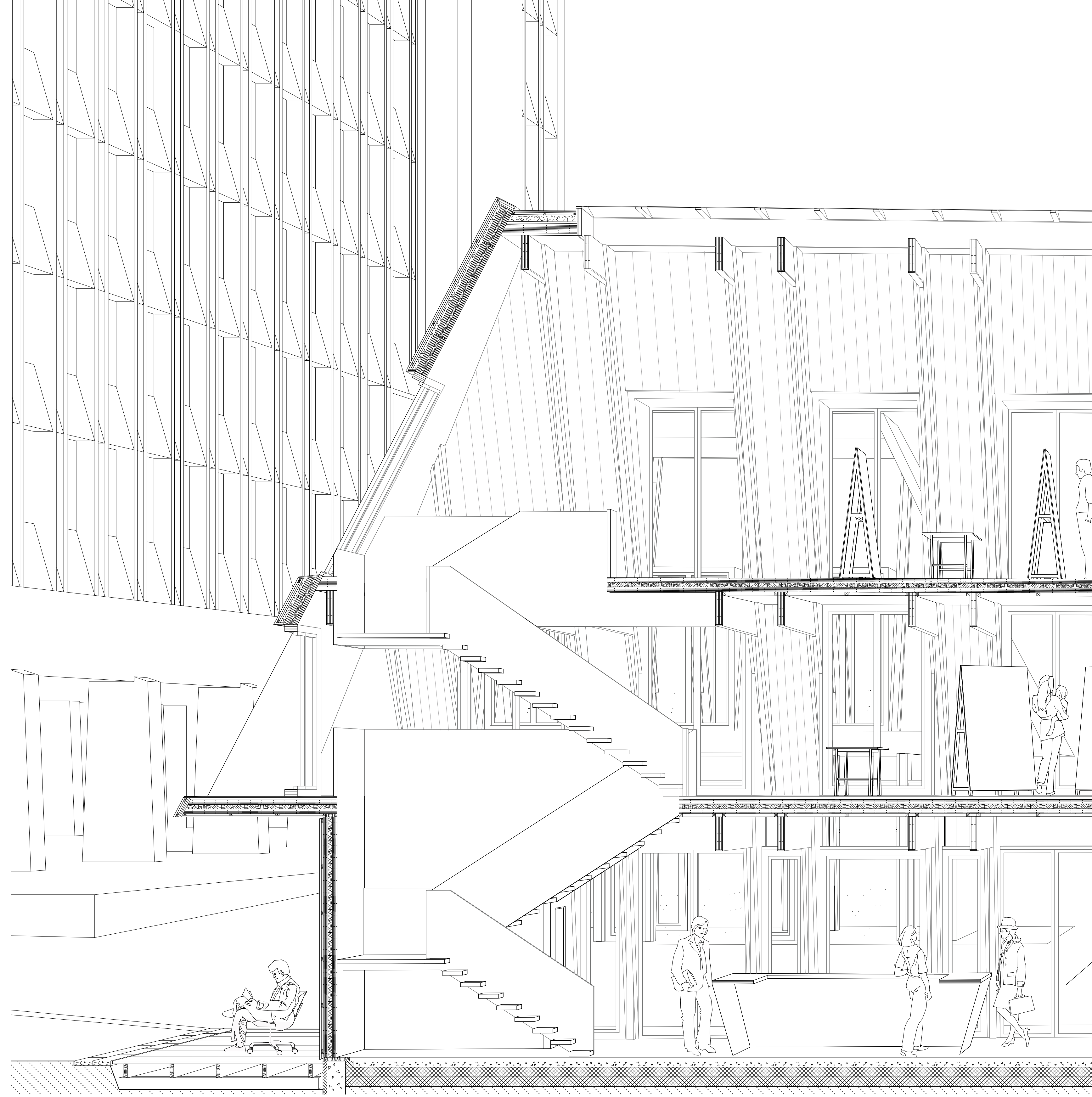
The part about quick assembly is mostly interesting when it comes to the economy of a project and normally not the architectural space itself.

The aim is to show the whole process from the development of a modular wooden system to a possible re-purposing and re-use in a not too distant future.

Can the same elements make great spaces both in a home made for dwelling and a hospital made for recovery? Is it possible to work with universal measures and still maintain the individual expression?

By combining craftsmanship, industrial automation and architectural theory, can wood be the main building material for the future in both smaller and larger structures?

Through investigations around former solid wood-constructions and projects, and by testing the properties of wood and precise spatial studies; there will hopefully be an answer.



MONO-MATERIALITY

In recent years the technology and interest regarding industrial processed wood known as glulam (glue laminated wood) and CLT (cross laminated timber) has increased seemingly. Moelven and Artec Architects were able to set a record for the world's tallest wooden building in Bergen, but now a 30 meter taller structure is being erected in the eastern part of Norway. China and Singapore has shown a increasing interest and it will probably not take long before we see international skyscrapers made out of wood.

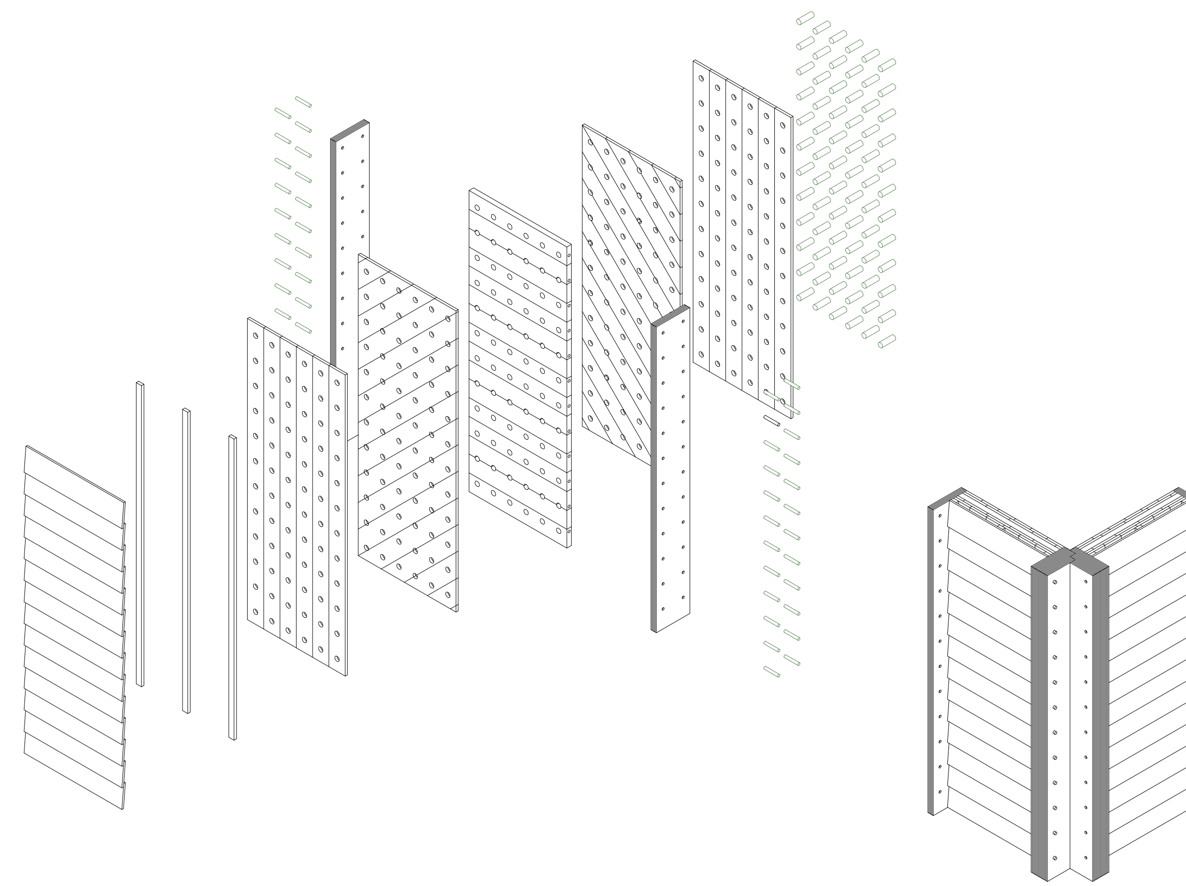
As mentioned in the intro a commonly stated assertion is that elements in solid wood is advantageous because of quick assembly and that it is uncomplicated to re-use in another structure.

To be able to reuse the structure both as modular panels and the wood as a building material the proposal will consist of panels which are cross laminated only using wooden dowels. The panels can then be re-purposed easier because there's no metal or glue used.

Another great feature will be that there is no toxic emission of chemicals from the panels which can be a problem with normal glue laminated timber. And no stubborn metal screws to unscrew or metal nails to be pulled out.

1:20 CLT panel assembled

1:20 CLT panel disassembled



Exploded view of a CLT-panel
with wooden dowels

1:1 EXPERIMENTATION

During the first phase of the diploma a small experiment were conducted to se how a simple cross laminated element could be made without any adhesives.

The lumber was first cut on thw school's portable sawmill and left to dry.

The timber were cut in different dimensions to accommodate different needs as panelling, structural purposes, stiffening and cladding.

The boards were the put together using a compressed air gun with wooden nails.

Raw-material

1:1 panel before assembling beam and last layer

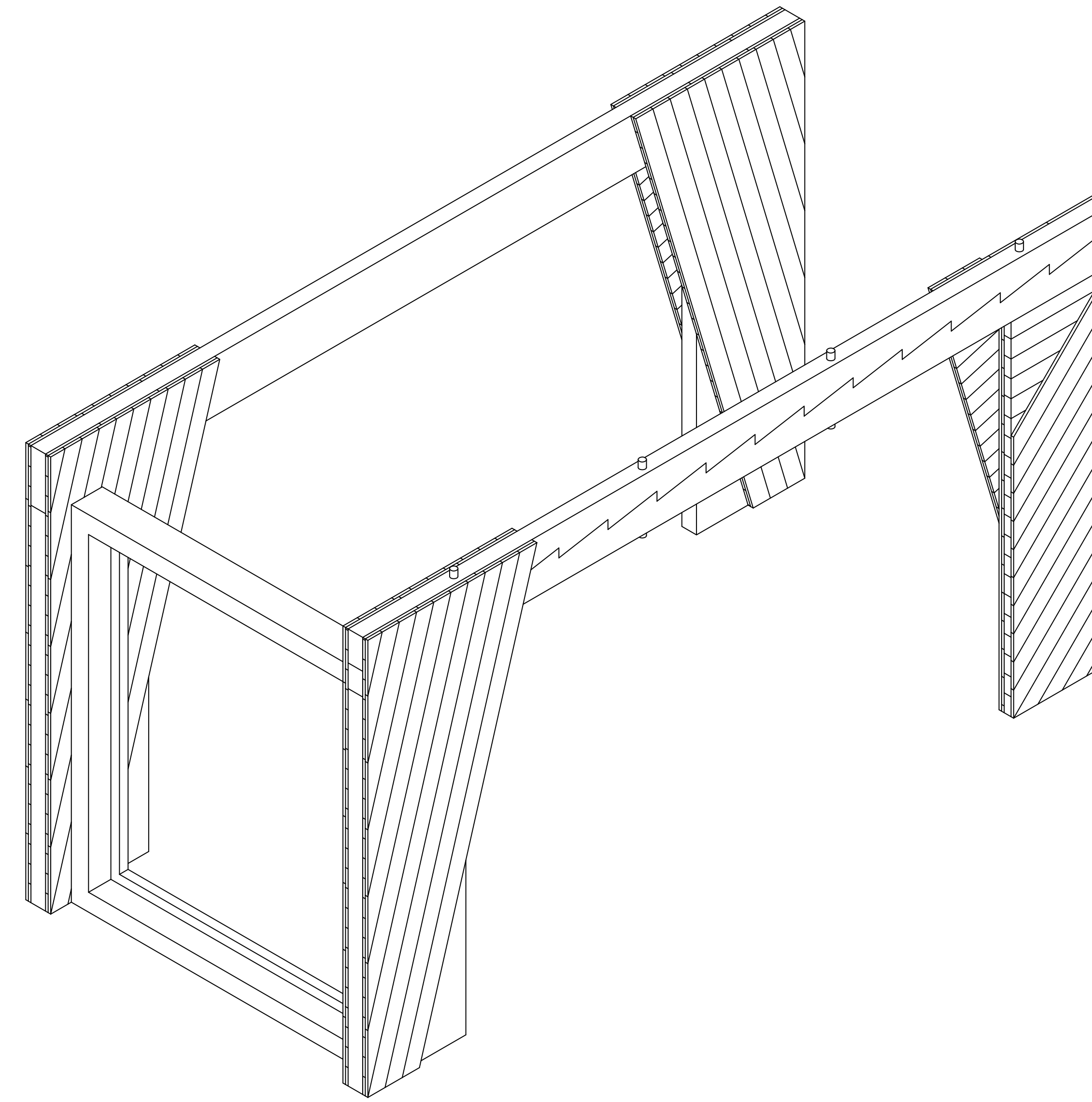
Structural core and diagonal layers

CONSTRUCTION

Inspired by Helen & Hard architects (Preikestolen Mountain Cabin) the columns are made up of several layers of timber laminated both 90 degrees and 45 degrees. To ensure rigidity the last layers are put on diagonally and fastened to the beam.

Detail of loadbearing columns made of CLT with diagonal board to ensure rigidity / Photo of 1:1

Model showing the main construction principle



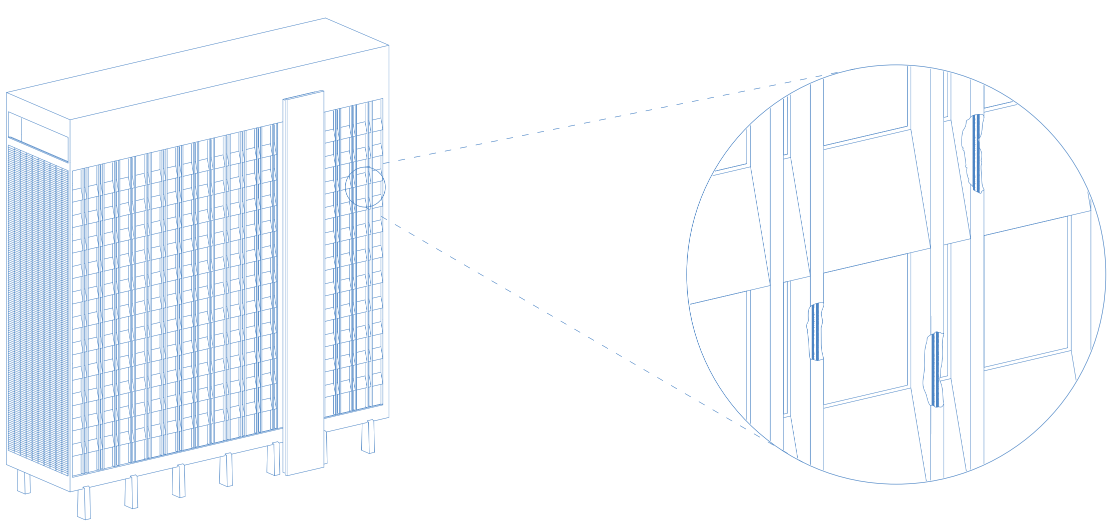
CITY HALL OF BERGEN

- A CRUMBLING SYMBOL OF POWER

The city hall of Bergen is crumbling away. The facade with small riverbed stones and the concrete structure were predicted to persist several decades after it finished construction in 1974. But already in 2012 large pieces of the facade started to fall to the ground. The decision to refurbish was postponed and by mid 2018 a consultancy revealed that severe mistakes were made during construction. In the columns there are only four ironbars for reinforcement, where it should have been eight.

Large parts of the building were emptied for bureaucrats and a few weeks later asbestos were discovered in the ceilings. 250 persons, both politicians, counsellors and bureaucrats are today relocated. For a short time there was a debate whether the municipality should demolished or sanitise and refurbish. In the end the City Council voted for renovation and it is estimated to be done by 2022. Today the former occupants are spread across town.

Erling Viksjø´s high rise has been controversial since it was finished. The people of Bergen love to hate the concrete tower, there is probably only a small group of people which likely have studied architecture, that would dare to say that they actually love it. We can argue back and forth about the aesthetics, but there is no doubt that the building is a symbol of power and constantly reminds us of the governing of the city.



ON (WOODEN) GROUND FLOOR

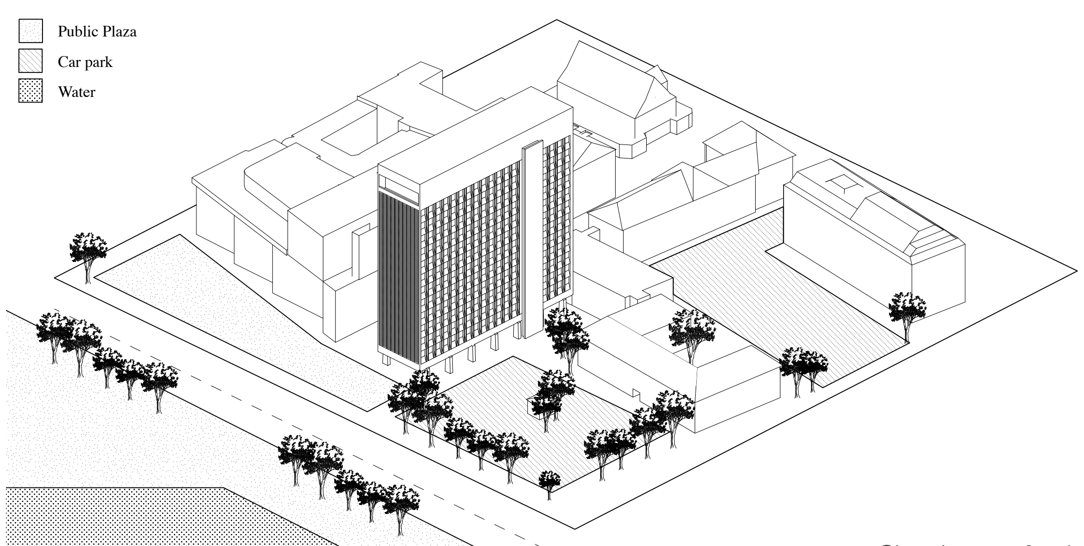
DISPLAYING THE GOVERNANCE OF BERGEN

The proposal On (Wooden) Ground Floor tries to bring the governance of Bergen municipality in closer contact with it's inhabitants. By dispersing several volumes of differing sizes the spaces for the politicians and counsellors becomes equally important as the spaces in-between for the public.

Instead of being an impenetrable tower from the middle age, a new public and transparent structure closer to the ground would be a more suitable solution.

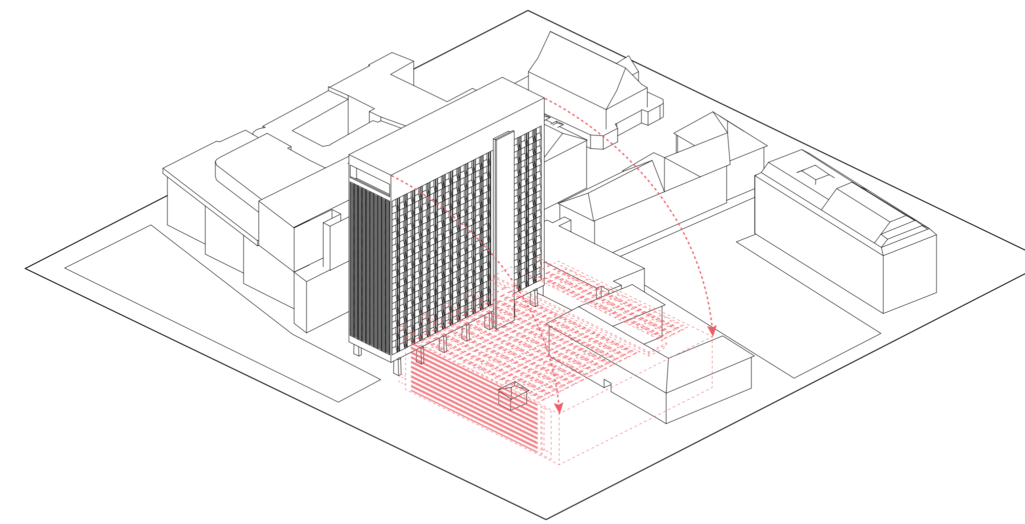
The administration of Bergen and it's surrounding county has been located in the City Hall quarter for more than 300 years. Individual buildings have and are still housing separate departments of the municipality all around the city centre.

This kind of dispersement means that the different departments and the city council needs to move around both inside the quarter and the in the city centre of Bergen in general.

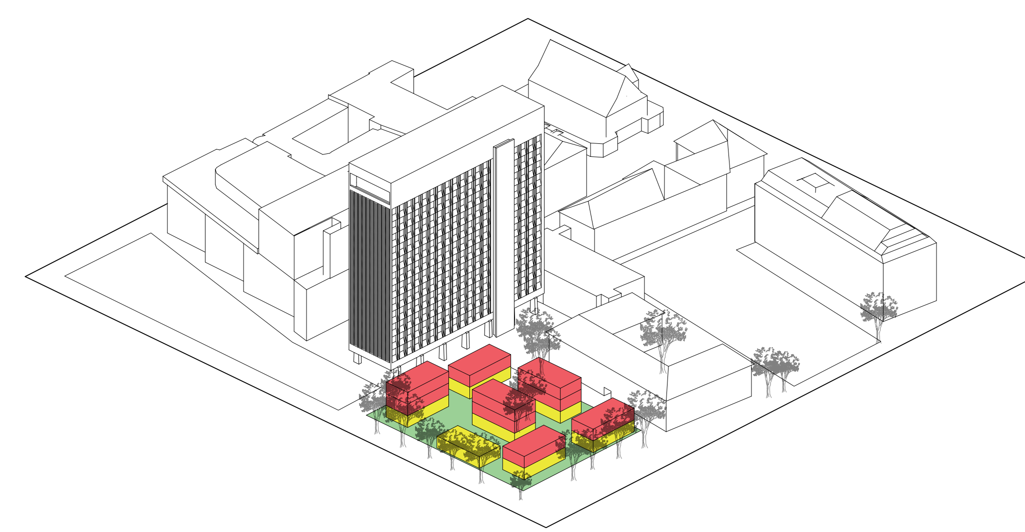


Situation as of today

Insted of beeing stacked on top of each other as an inepenetrable tower from the middle age, a new public and transparent structure closer to the ground would be a more suitable solution.



New solution, dispersed buildings in wood.
Max three levels, ground floor public.

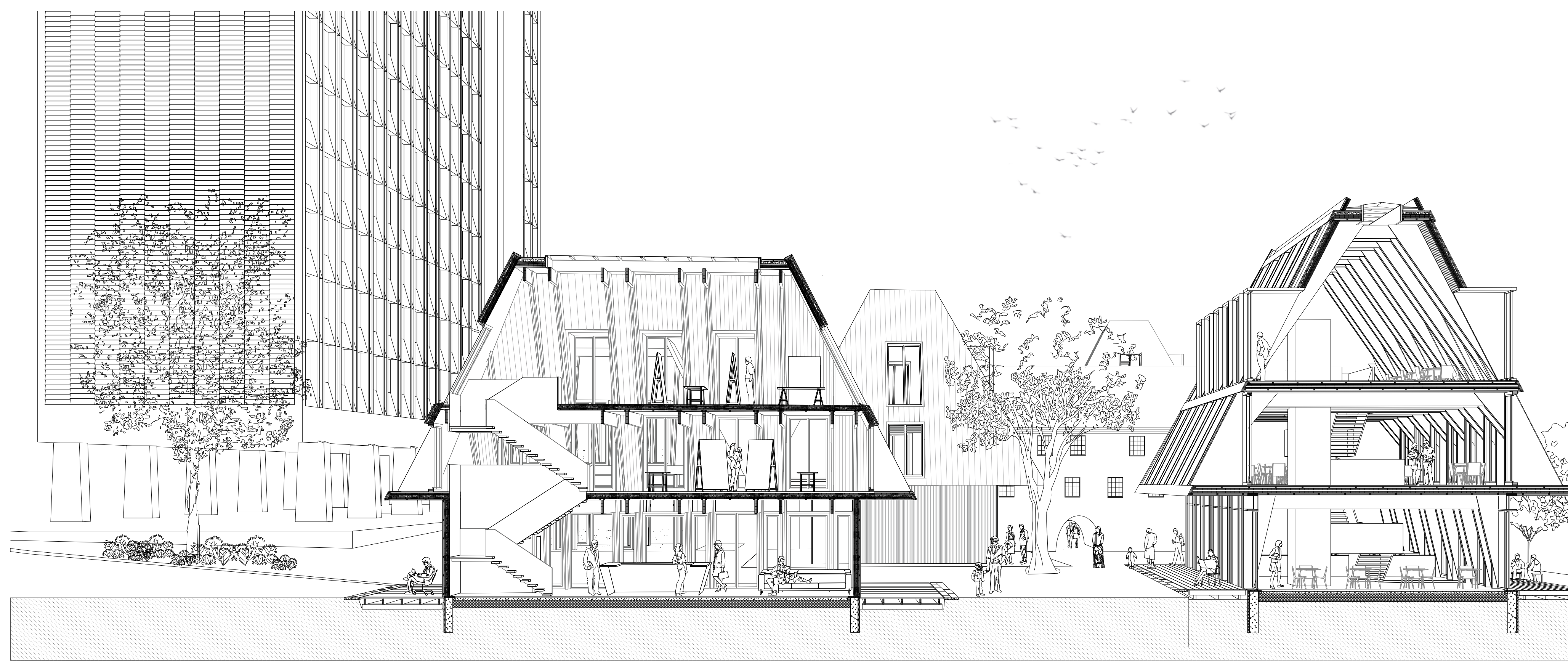


A common trend in displaying democracy is to make a transparent facade only consisting of glass. Off course a quite literal type transparency is obtained, but transparency is not solely about the ability to look through a window. It is rather a question of understanding and be able to partake in the different processes of local democracy and governing.

Now when the City Hall is closed for several years to come due to renovations, meeting rooms and offices are needed and the proposal On (Wooden) Ground Floor seeks to combine the need for offices and meeting rooms together with a more visible governing of the city.

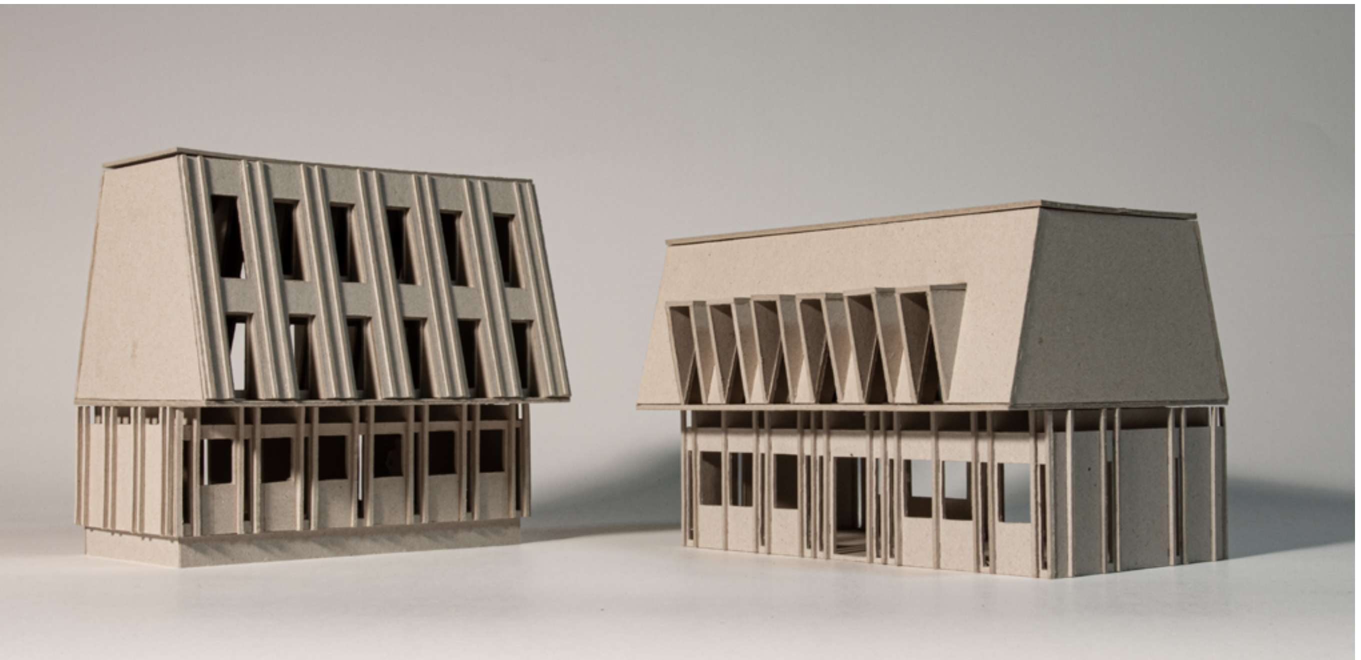
In contrast to the rough and heavy existing beton brut City Hall, the new proposal will consist of structure and surfaces made out of entirely wood. Bergen is and have always been a city of wooden houses. Even after several great fires, strict prohibitions to prevent new accidents and impulses from the rest of the world on the use of brick, the city continued to favour the material.

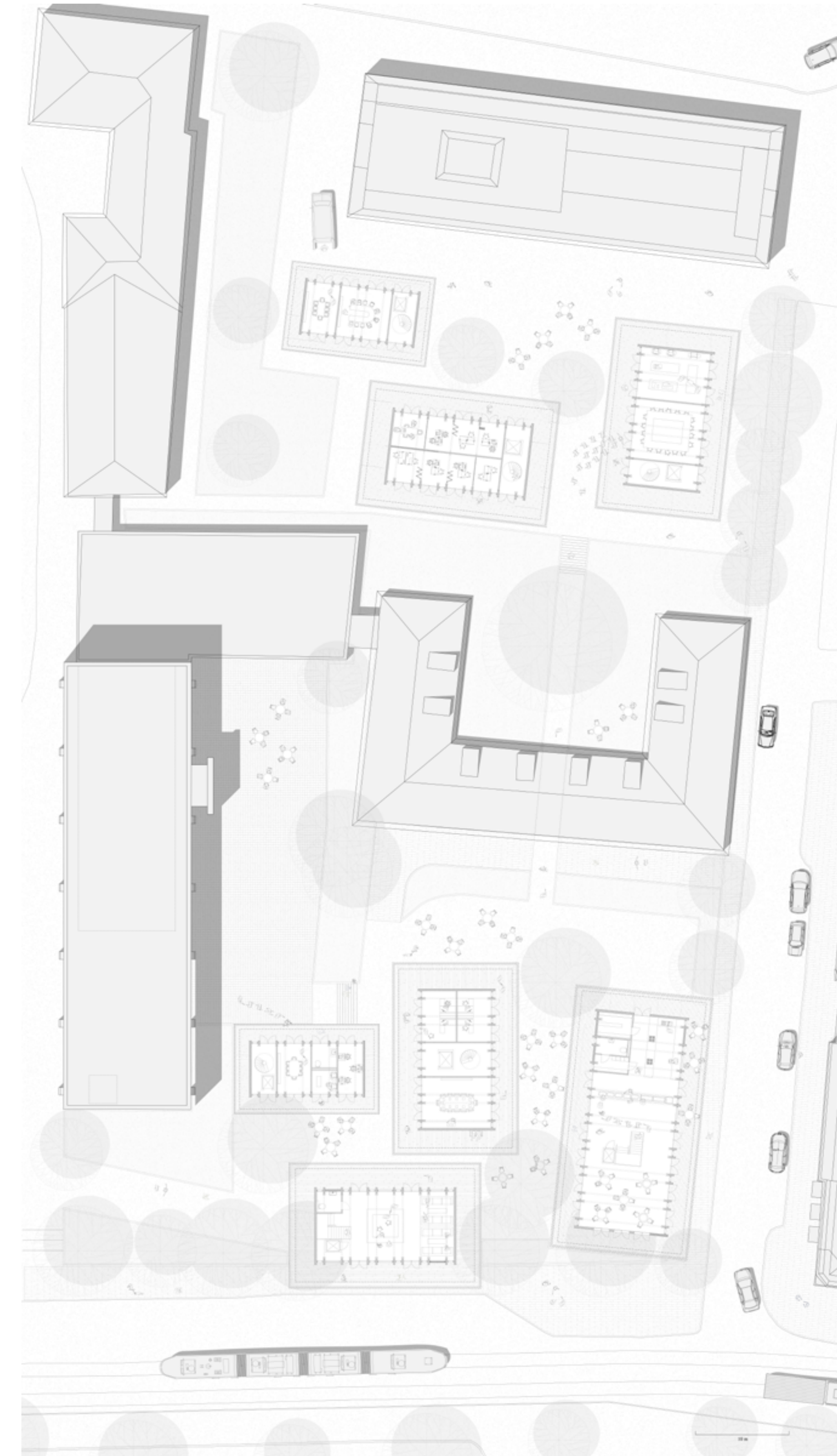
On (Wooden) Ground Floor continues in the tradition with the aim to strengthen the interaction between the surrounding neighbourhood, the city and the governance.



TOP: Elevation

BOTTOM: Perspective section through reception and cantine





Exhibition

NEW WOOD TECTONICS

PROJECT BY NIKITA YAKUSHEV

ABSTRACT

In building with wood, different cultures have established their own vernacular methods of working the locally available materials and methods into built form. Technology has always played a part in this process, with industrialization having transformed this material from it's organic state into an ecosystem of dimensional lumber, plywood, and other modular components available to builders and architects.

Defining new-wood as this emerged material framework, this paper investigates digital fabrication as a new method of making architecture. The synergy of computer-aided design, -manufacturing and engineered wood products is investigated for its potential to generate possible new tectonics and typologies within the modular logic of the proposed digitally-guided method.

THEORY: THE AGENTS OF MAKING

Any building that can be occupied by a human body is inherently physical. It's style, function and scale can all vary, but the end goal of any architectural project is in the making of place. This quality of the Architecton (Greek for Master Builder) to make solid a home, temple and everything in between has historically granted this profession great agency in creating the collective built environment. Guilds of Masons and Carpenters for centuries honed the craft of local building traditions, and even before sedentary lifestyle, mankind always sought to convert available materials and energy into some form of practical shelter.

As is the case within the nomadic traditions of Mongol and Kirgyz people, the role of the architect was often assumed by the head of the house. Using only locally sourced materials, traditional building techniques, and the energy of one's own hand-tools, the making of a vernacular Yurt was under full competence of its maker. Even prior to the profession itself, access to the three making elements of ***Materials***; ***Information***, and ***Energy*** enables individuals and collectives in the making of architecture form.

The template by which different buildings are made is generally defined by the vernacular ***code***. Whether kept within a system of guilds, encoded into the local language or formalized into a legal document, these local codes archive the most lean practice of building within a given material, informational and technological matrix. If any of these three elements undergo change, the vernacular method also evolves. The effects of discrepancies in material composition is generally self evident in the way that the Igloo differs from a Yurt. Even within the scope of a single material, however, effects of the informational component play a major role as be seen in comparison of the Nordic and Finish/Russian vernacular. Here, the latter two share a wood-intensive method of horizontally interlocked logs, while the Nordic tectonics are heavily influenced by the naval tradition and especially prevalent in the stave-church construction.

For the longest time all cultures relied on hand-tools as the primary source of energy in the making of wood buildings, but the recent emergence of machine-powered saw mills

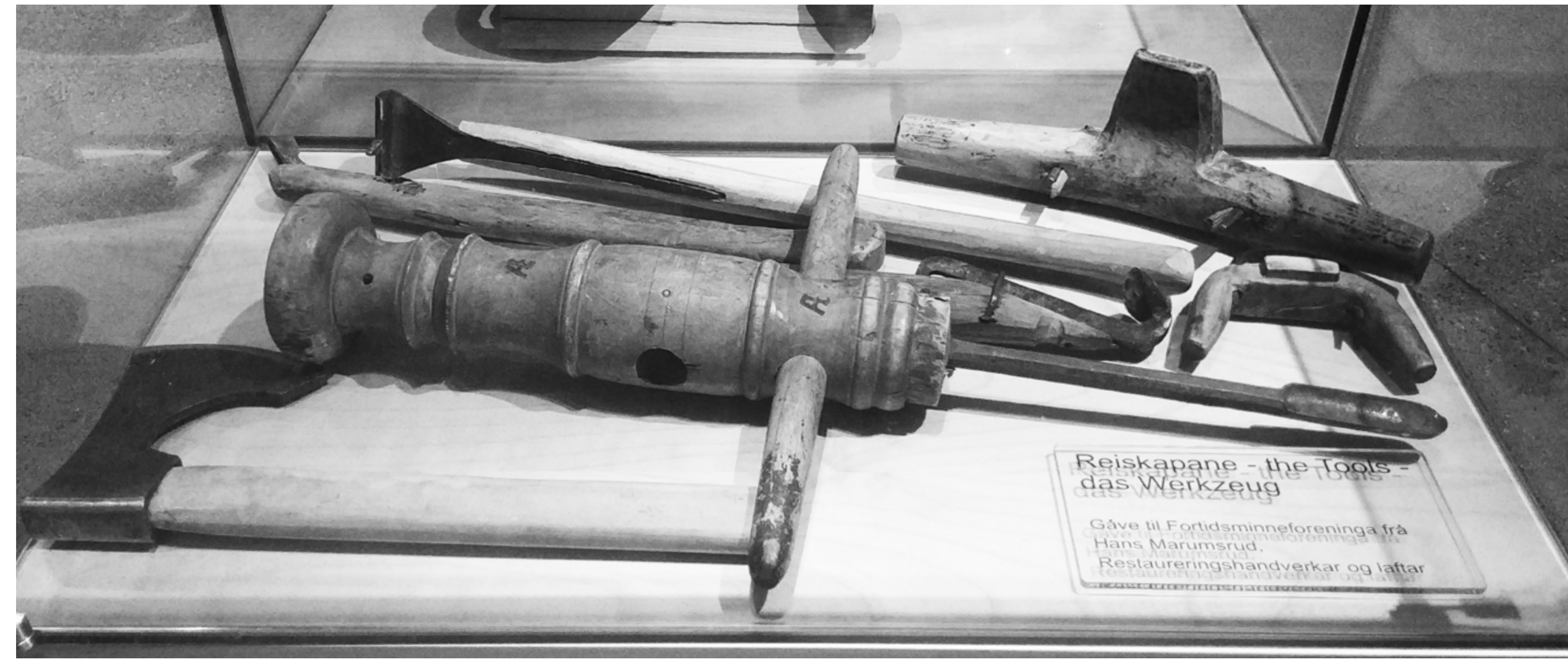
changed the material framework into that of standardized dimensional lumber. This modular new-wood product, multiplied by mass availability of metal fasteners meant that wood was no longer needed to be felled, squared and joined, but instead could be ***assembled***. Able to be stack into the trains and deliver it to any part of the North-American continent ensured that the emerged balloon-frame method dominated the residential and other low-rise typologies. Having access to a local lumber yard and being able to work with this easier 'vernacular' code, local farmers were able to construct homes, barns and other buildings without relying on the service of a Master Builder. Capitalizing on this technology, companies like the The Sears Company sold DIY designed homes which often came shipped with all the required siding, asphalt roofing and drywall. Most important of all, these catalogue homes came with a set of design drawings and specifications which were distributed by means of a paper print and effectively encoded the matrix of the buildings-to-be.

Separated from the physical act of making, the architect as Master Builder thus made way to architect as Designer; and instead of creating the original object, the crafting of an original 'mold' became the logic of the industrialized world. With architecture often being a single-item product; however, absence of direct engagement in the construction process does not necessarily reduce the agency of an architects; for with every detail articulated and every stone hand-picked, projects like Mies's Farsnworth House are indeed crafted by their maker. This type of design as ***simulation***, where all the parts of the whole are fully defined, enables architect as designer to retain maximum agency over the making process while being physically removed from it. Such a high level of articulation stands in contrast to design as ***representation***. Here the architect defines only the mold, with the empty voids left to be filled in by the local vernacular code.

At the level of representation the loss to architectural agency is most severe, with craftsmanship and even material selection often left to the builder. Today this approach is most often seen within residential construction, where all of the building's wood components are covered or are left as "unfinished". Within the context of the site-intensive stick frame construction this division of labour is logical; however, some architects like Konrad Wachmann, Walter Gropius and Marcel Breurer have sought to harness the process of mass-production in the making of modular homes, in part regaining control over the making process. While many of their projects not being successful, this concepts of architect with a factory laid the ideological foundation for today's modular design-build practices like Wikelhouse and Flat-Pak House which integrate design and fabrication under a single roof. This capacity of an architect to be also the fabricator offers a new mode of operation in regaining the agency of physical making. Within this parading, architectural design does not entirely rely on the existing vernacular code, but instead iterate on new materials, tools or methods to generate a proprietary code which would lay the foundation of a future design-build system.

Computer-aided design (CAD) plays a pivotal role in empowering this type of process, and while wide adoption of CAD greatly enhanced the efficiency of producing drawings, specifications and 3D visualizations, its true potential may lie in direct integration of design and physical making. Within the framework of computer-aided fabrication (CAM), data is extracted from CAD and is used to ***directly*** instruct various additive and subtractive operations, with projects like the House 4178, Pahu Pavilion, and the Wiki House shedding light on possible uses of this emerging technology. Mass-customization logic of this method stands in contrast to that of mass-production and can enable complex architectural forms to be accurately fabricated and assembled. Furthermore, this technology is becoming rapidly accessible to architects and hobbyists alike, meaning that to a small degree the means of physical manufacturing can again be in direct control of the maker.

As it stands, the goal of this thesis is simple: To investigate the potential of digital fabrication in the making of architectural form; and, to explore possible tectonics and typologies which are enabled when the use of this technology is combined with the existing organic and modular ecosystem of old and new wood.

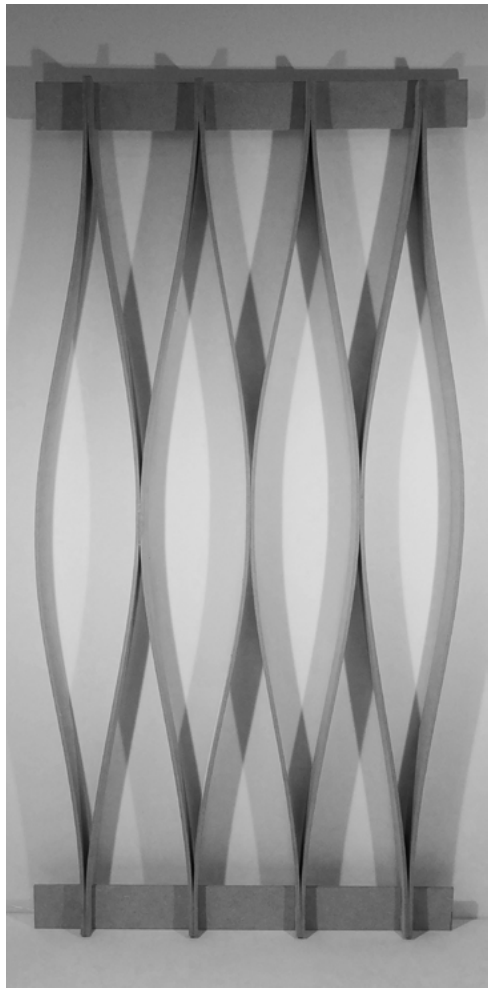


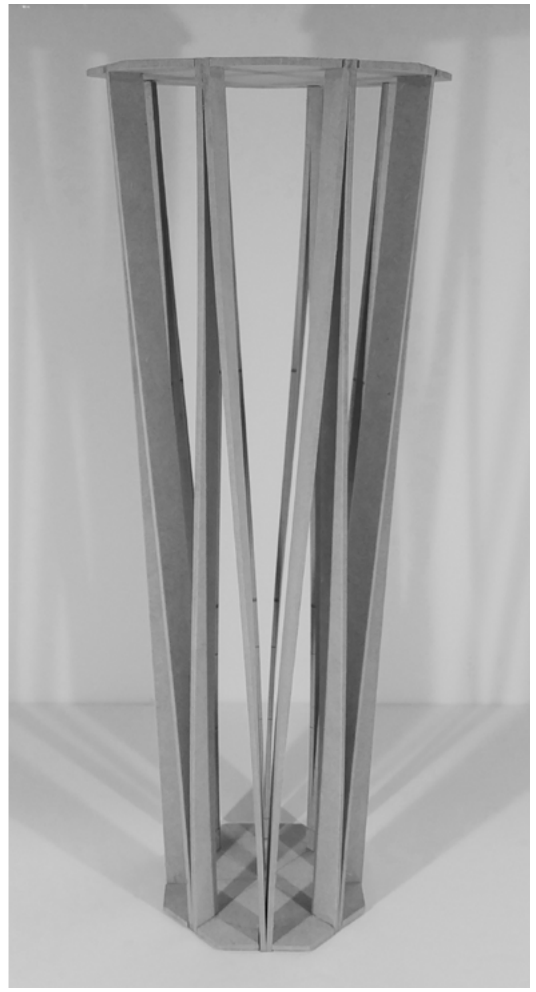
PROJECT

A DIGITAL TEMPLATE

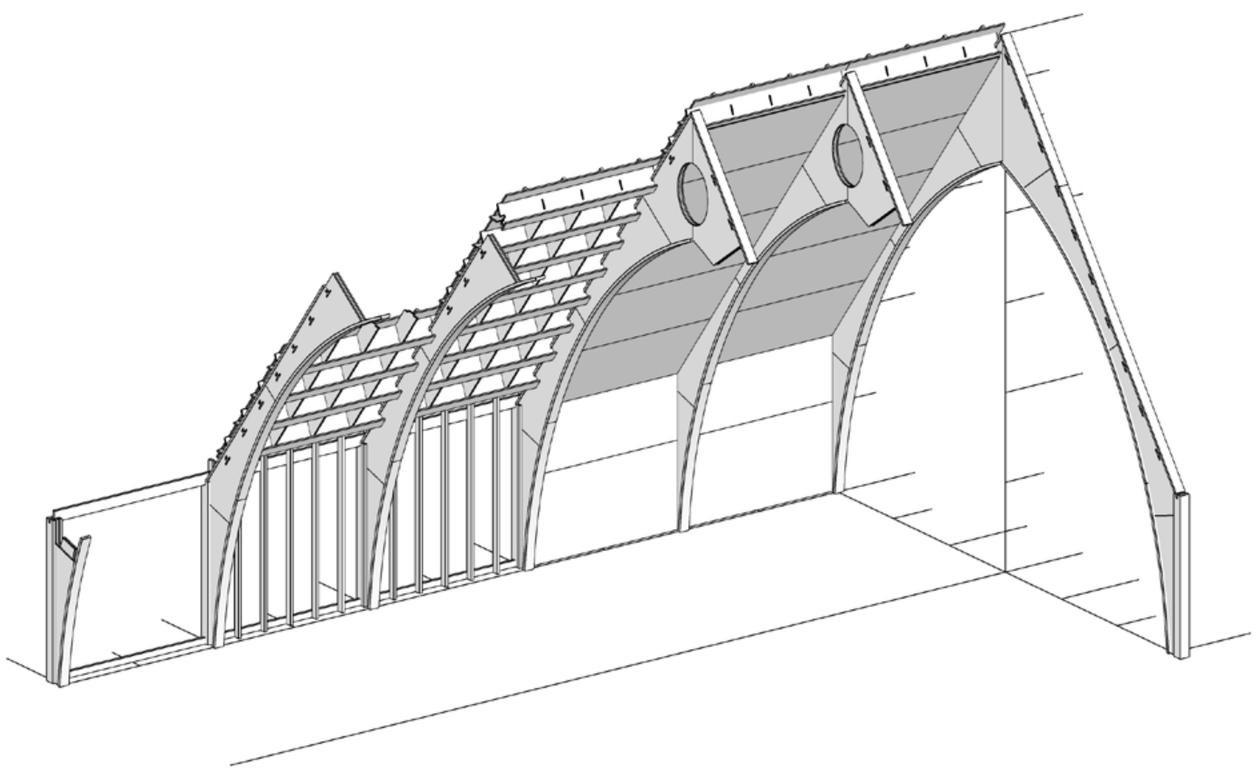
It's already possible to digitally fabricate many things like toys, chairs and even pavilions. Larger buildings, however, are more difficult to make mostly due to their size. As such, the decision was made early on in favour of a modular method where smaller components would come together to form the 'puzzle' of the final building design. One of the earliest experiments in this direction was focused on producing columns, wall partitions and other elements form a hypothetical sheet of 4' x 8' plywood. Having past experience with the CNC process, a 1:6 scale was chosen for logistical and economic reasons. It quickly became clear that plywood alone was not sufficient in the making of a practical building system past the scale of a small pavilion. The structural logic of plywood/OSB family meant that it was only economical to use in synergy with other new-wood products like dimensional lumber.

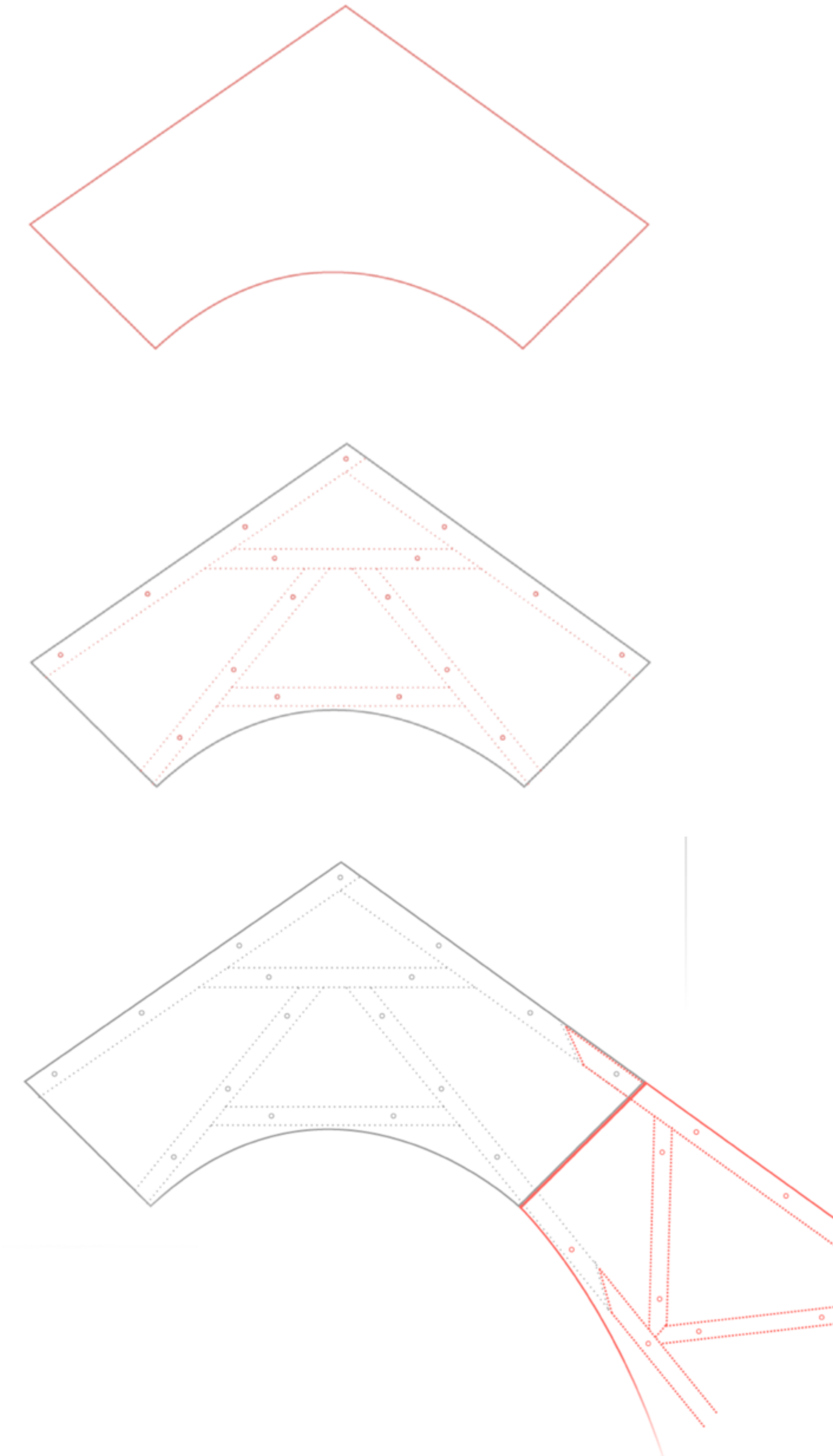
In conventional stick-frame construction it is most practical to design within the standard dimensions of 8', 10' 12' and 16' increments. The mass-customization logic of CAM, however, allows for a much greater degree of freedom, with existing commercial machines now able to automatically cut and mill the required lumber size and connections. Presently, such machines are mostly used in the prefabrication of residential wood trusses, but if used in combination with a CNC table router they can produce a wide array of composite architectural components.





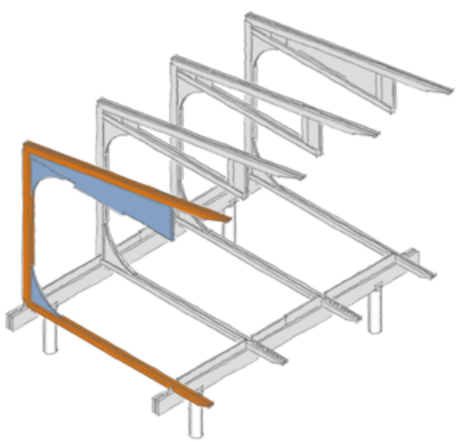
There are four key advantages to using of digital fabrication in the making of building components: Firstly, any irregular geometries can be cut with no downside to each element being unique. Second, it is a much more accurate way of cutting when compared to the contemporary rough carpentry practices. The third aspect lies in the ability to score construction guides and part numbers onto the members, effectively making them into 1:1 construction details. Lastly, all of these aspects combined enables the making of a modular and scalable system. This type of a Digitally Guided Method (DGM) allows for the creation of various box beams and composite trusses, with the size and number of the wood members varying depending on project parameters. Below is one of the earliest designs which explored this system within a 4' grid and a 3-4-5 ratio gable.

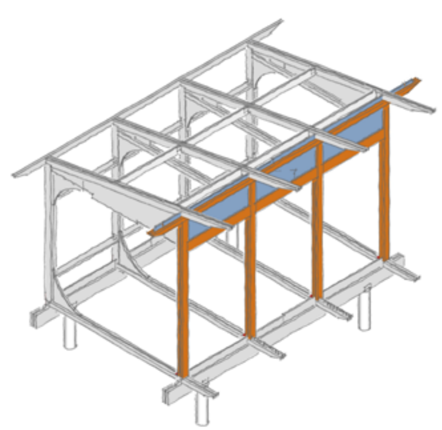




THE CABIN

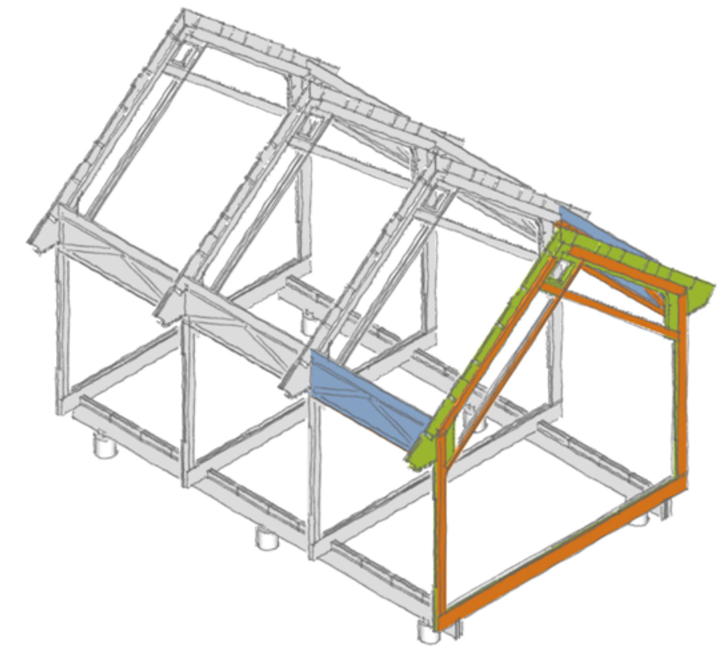
In designing this micro-cabin the goal was to define the subtle tectonics of the above method while relying primarily on uncut dimensional lumber. Here, the exterior detailing of the digitally-guided joints was expressed to drive the overall look aesthetic, while the sectional profile of the skeleton guided the curvature of interior cedar walls. This design utilizes the lumber-plywood-lumber variation of the DGM; and following the principle of design-as-simulation, every component of this project was detailed and could be re-produced physically.

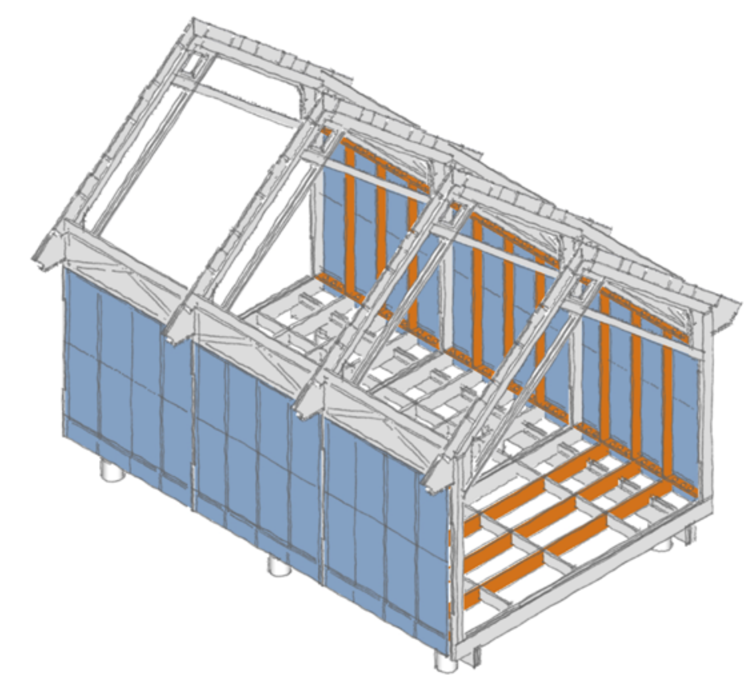




THE COTTAGE

A larger residential typology was made as cottage, bringing the joint articulation into the interior space. Oak plywood roof-truss templates help define the tectonics of the structural frame, while the birch-plywood wall finish supports the material palette of this new-wood cabin design. The width of this modular platform is dictated by 16-feet long floor members, while the vertical walls are 8 feet wide by 10 feet tall. Additional bays can be added along the linear axis indefinitely, while the interchangeable 8x8 side panels can be used to insert windows, sliding door or corridor modules.

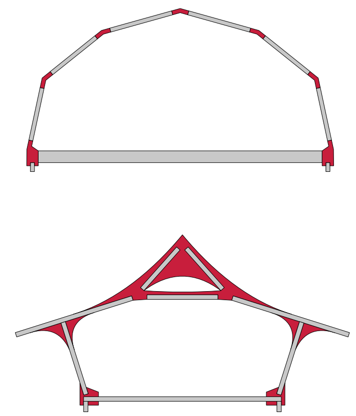




THE COTTAGE

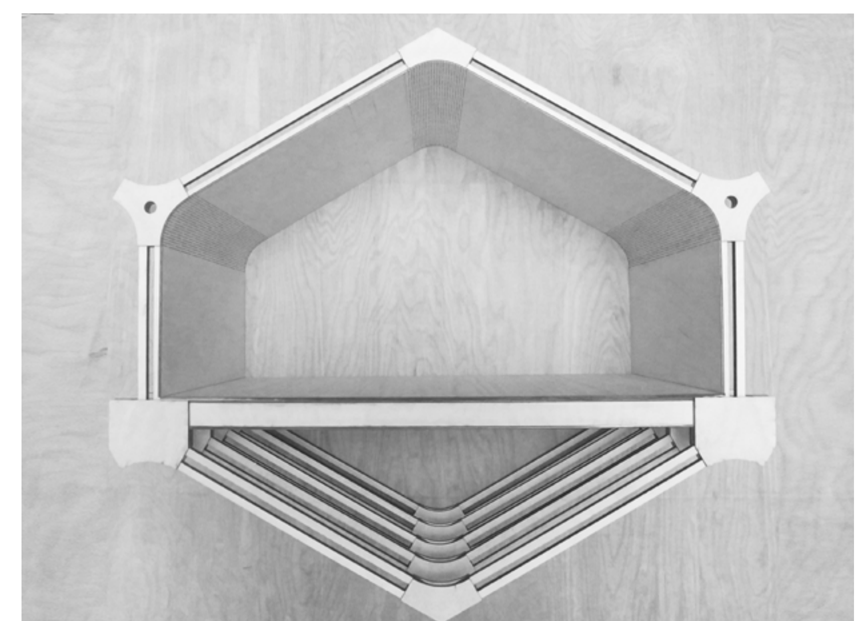
THE ADAPTABLE JOINT

After a series of experiments in which the original DTM was employed it became clear that this method could be distilled down to the scale of the joint. Similar to variations in traditional wood joints which differentiate Nordic, Russian and Japanese traditional architecture, the articulate expression of the Adaptable Joint (AJ) became a major tectonic component of the DGM ecosystem. Two projects were created to reflect both the explicit and implicit tectonics of this detail. The below chapel is an example of accentuated joinery and is meant to accentuate the layering logic of this joining technique.



Similar to panelized DGM, mass-customization and labelling of each AJ allows it to take on almost any angle and create non-orthogonal architectural typologies. This angular variance enables the typologies outside the box-like form factor commonly seen within the prefabricated project delivery method.

Where joints need to be hidden within the wall assembly, their curvature still carries an implicit impact on building's tectonics. In each cell of this 'Hive Hotel' (below) the curved gabled roof is an integral part of this modular method, with the kerfed pattern of bent plywood further reflecting the fabrication method employed.

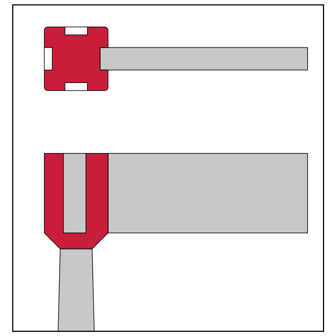


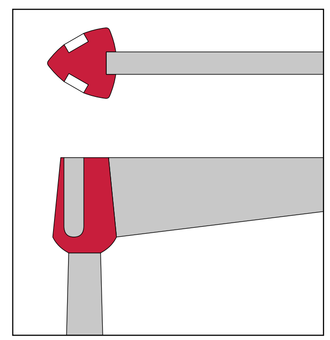
OLD & NEW WOOD

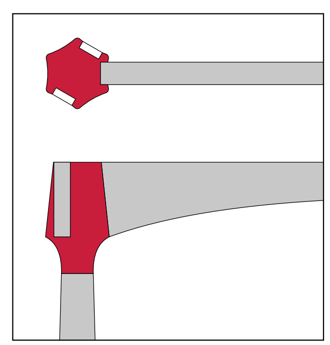
Larger typologies necessarily require larger structural members, and while the I-truss is made to for most efficient spawn, a wood trunk remains the most simple of columns. This synergy of new and old wood is explored in the below green-house experiment, which can be made linear or loop into a circle by means of customised double-I beams. Such use of logs in their least-refined way can be especially practical if this wood is locally sourced, while engineered wood can be clad in kerfed plywood and empty cavities utilized for built-in lighting, irrigation and sensors.

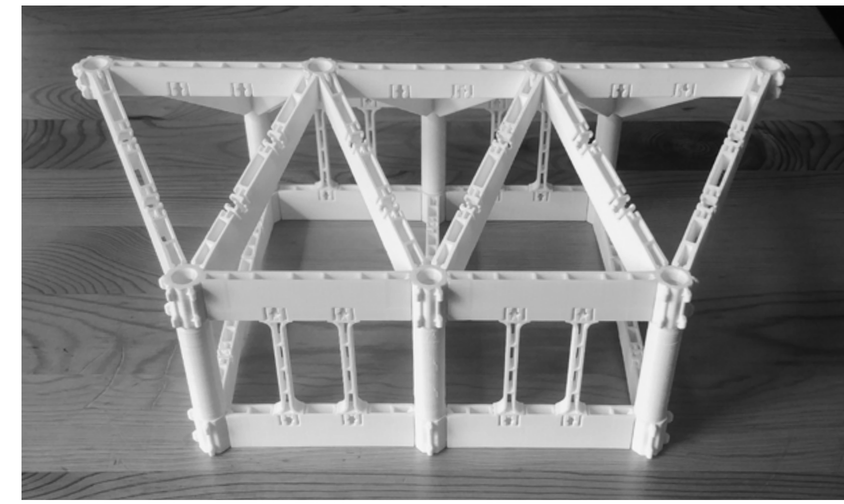
In the question of joining the double-I beam to the traditional wood column another DGM variant can be employed. Similar to the Adaptable Joint, this Adaptable Hub (AH) could serve as interface between the old and new wood components. Unlike traditional wood columns which mostly come is a rectangular profile, thereby limiting the structural grid to a 90º logic, flexible nature of the AH offers a greater degree of geometric flexibility in the making of different architectural objects. Triangulated, hexagonal and nonstandard grids can be easily employed in various parts of the project, producing a wide array of medium and large building typologies.

To assist with the rapid prototype and modelling of these building variants, a scaled system was designed and 3D printed, representing in scale some variants possible within the AH ecosystem.







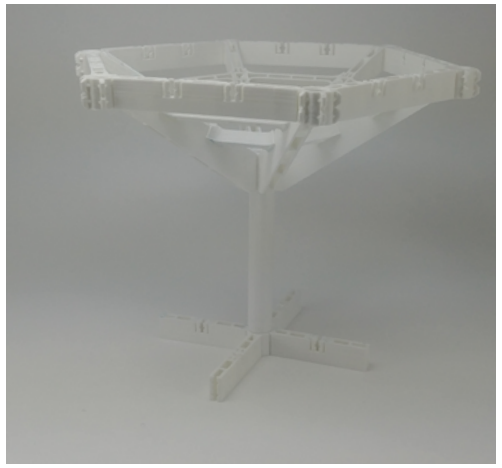


THE OFFICE

This typology reflects the standard geometric approach to an office space. The implicit tectonics of new-wood in this project are a re-imagining of concrete-steel offices of the 19th century, with the open-plan modules equally lit through the built-in lighting within the plywood-covered I-truss members. The cross-sectional hybrid of columns+shear walls allows for the this type of structure to be scaled vertically, while the horizontal floor-ceiling partitions are made out of CLT/NLT to further articulate the new-wood material palette of this design exploration.

THE MARKET

This project imagines the kind of atmosphere possible when curved wood geometry is used in a public environment. Inspired by the Gothic vaults, the scale of this market enclosure is meant to evoke both a feeling of grandeur and lightness by employing the plywood-enclosed truss component of the digitally-guided method. The vertical transition of the log footings into the above canopy is intended to mirror the movement of a seed from initial sprouting, through to upward growth and towards final bloom.



REFLECTIONS

I've been told that there are two definitions of architecture: First views it as a system of establishing relationships; the second creates space through use of materials and light. This thesis falls in the second category. It began as a study of vernacular building traditions, post-industrial wood building practice, and the emergence of digital fabrication as another instrument in an architect's toolkit. At first the goal was to formulate a new possible way of building with wood given the materials and technologies available. Parallel to being an academic body of work, this thesis took on a personal journey of answering what architecture means to me. Looking back, it seems that Architecture is none-other than an agent of change. It creates villages and cities - the very physical matrix that envelopes our lives. It has the power do define, strengthen or challenge a paradigm. Perhaps even to create one. This thesis is part of a broader inquiry into the means and methods of living in greater balance with the forces of nature. Here wood serves as the perfect platform, being a renewable, workable and versatile material. It is abundant both in it's natural form and as various building products. But what can we do with it in context of emerging technologies? Today people are able to download songs, movies and other digital media over the internet, but what if they were able to download a whole house? What if fabricating and building this house was easy due to all the advantages of digital fab? And what if this house could be customized to their needs, expanded and eventually upgraded to allow for a net-zero living? Today's ability to download and CNC a chair may one day evolve into the ability to locally fabricate almost all the things that are needed for a dignified and sustainable lifestyle. The era of hand-craft may very well be behind us, but the age of digital crafts is yet to begin. It will be different, and it may be better. Let's make and see...

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HAND LINE
·HAND + MACHINE LINE
Cracked ! :(
15MIN
15 MIN
HAND LINE
·Chisel + Wood Hammer
· 3MIN
5 MIN
BAND SAW + SANDING MACHINE