ENGRAINED:
RE-IMAGINING THE PAST HEAVY TIMBER VISION OF SQUAMISH FOR TODAY'S LANDSCAPES

by

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CONTENTS

ABSTRACT

This thesis aims to make a vision which existed in the past be alive on its own terms today.

This work celebrates the past heavy timber cultural practices of British Columbia's old-growth forestry towns, while acknowledging a shift in the current architectural climate. A situationally-focused intervention in Squamish, British Columbia, aims to re-introduce locally-assembled spaces that respond to contemporary changing conditions in order to express the timber culture relevantly today.

This research identifies the original use of the forests and its inhabitants, how its resources were used, and how the environment exists today. This work will pull from the advancements made in timber technologies, while preserving the built memory and design principles of the place. The objective is to activate the memory of the timber building culture in Squamish while creating a space that engages nature, culture, and history.

GLOSSARY

BC	British Columbia
Carbon Flux	The exchange of carbon from one subject to another.
Dimensional Lumber	Visually graded or mechanically graded sawn lumber cut in the planks, typically denoted as thickness-by-depth.
Heavy Timber	Wooden structures made of large timbers or large lumber.
Light Timber	Wooden structures made of small dimensioned lumber.
LTC	Light Timber Construction
Mass Timber	Engineered wood product systems, typically prefabricated in mass panel form. Examples include NLT, Glulam, Cross Laminated Timber
NLT	Nail Laminated Timber
Sawn Lumber	Lumber that has been air-dried ot kiln-dried to lower moister content.
Shear	Lateral strain in a structure in relation to a plane.
Standardization	A process of manufacturing to a common standard, dimension.

ACKNOWLEDGEMENTS

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To my parents, Cheryl and Ian Fraser, my brother James, and my sister Kaylyn, thank you for the perpetual love and support you have shown throughout this process.

Lastly, a special thank you to my east-side studio mates.

1.0: INTRODUCTION

1.1 A COUNTRY OF MATERIAL

Wood can described as the vernacular building material of Canada. Forests are synonymous with the country's identity from coast to coast. In Canada, wood has played a key role in the language of construction, and each species has become a constituent of locality. Wood has become an economy, a livelihood, a hobby, and a refuge. The material is widely available, easily worked, adapted to its site, and continually renewable.

The varying climate conditions in Canada leant to regionally specific building forms and methods of construction. While a house in Nova Scotia and a house in British Columbia may both be built out of wood, their construction is different. The climate and species of woods have an undeniable influence on the architecture.[1] There was also guidance from the customs and traditions of natives, and the experience and wood-knowledge of the immigrating populations.

1.2 CULTURE OF WOOD

British Columbia is one of the most timber-rich regions in the world. Due to its various geographic conditions, the province's forests range from mono-cultured to diverse. Much of this diversity is found in the southwestern

1 Joseph Mayo, *Solid Wood: Case Studies in Mass Timber Architecture, Technology, and Design* (New York: Taylor and Francis, 2016), 4.

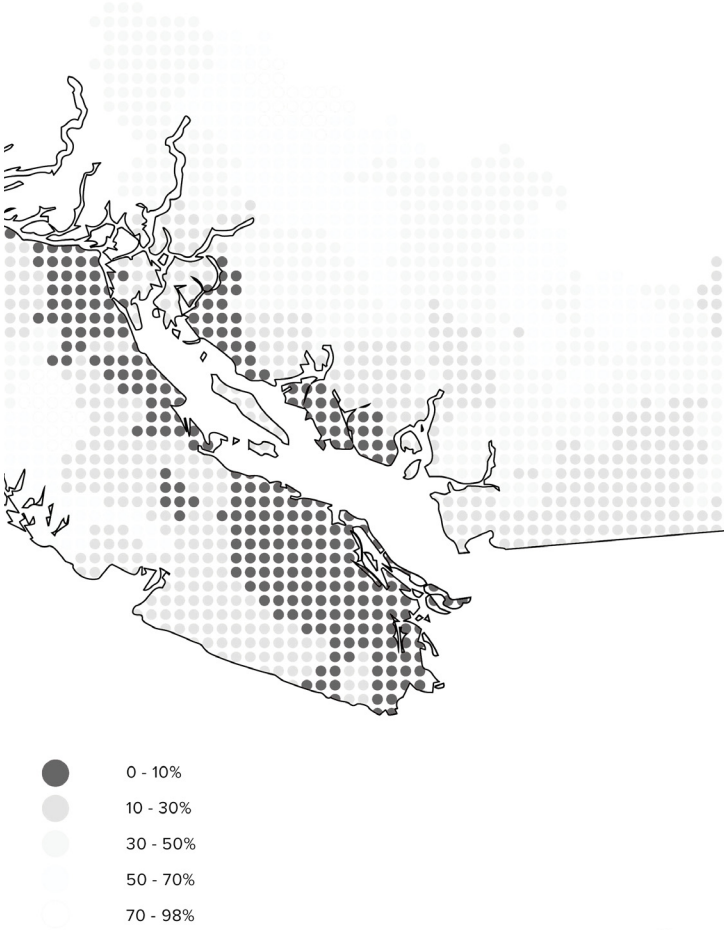
coastal rainforests of the province.[2] A combination of high precipitation, a temperate climate, and fertile soils gave life to these forests.[3] The scale and diversity of the trees in the region is unrivalled.

Loggers resting on old-growth Red Cedar stump at Woodfibre, 1927, *City of Vancouver Archives.*

With the western exploration in to British Columbia, an industry of resource extraction followed. Instant logging towns were built to take advantage of the old-growth

2 Forest Genetics Council of British Columbia, *Strategic Plan 2015-2020*, accessed November 8, 2017. http://www.fgcouncil.bc.ca/FGC_Strategic_Plan_Web_2015-20_04Nov2015.pdf

3 Ibid.



Percent of old-growth forests remaining in southwestern British Columbia. Data from University of British Columbia

forests. Loggers would hunt for the largest timbers for construction or export. Due to the timber richness in the region, the logging towns and infrastructures were predominantly built with the local massive timbers. As the towns matured, this mass timber identity became engrained in the culture of the place.

These coastal towns were initially formed for pluck foresting, or removing individual species from a forest.[4] Massive old-growth Douglas Firs were the typical victims. As the demand for large timbers grew, loggers found mass clear-cutting to be the most economic practice. In southwestern British Columbia, the four most common species were used for structural lumber and cabinetry,[5] making it more economical to clear-cut. This attracted more loggers to the area, growing the industry towns and populations further.

1.3 DEATH OF WOOD

As urban centres grew in the 19th century, the limitations of wood were seemingly reached. New material demands were being made. Demands of material permanence, taller heights, structural innovation and new architecture styles took interest away from the wood as a structural material.[6] Steel, concrete, and plastics took over the

4 Ed Gould, *B.C. Logging History* (Saanichton: Hancock House, 1975), 49.

5 University of British Columbia Centre for Forest Conservation Genetics, *Species range maps with in situ conservation statistics*, accessed October 16, 2017. http://cfcg.forestry.ubc.ca/resources/species-reports/species-range-maps-with-conservation-statistics/

6 Mayo, *Solid Wood: Case Studies in Mass Timber Architecture, Technology, and Design*, 4.

construction of urban centres in North America and Europe. Wood's decline was further emphasized by two major factors; mass deforestation and fire. Additionally, the range in inconsistencies associated with wood construction were bested by these new materials.[7]

With the rapid growth-rate of urban centres during the mid-19th-Century, the adoption of concrete and steel created massive manufacturing infrastructures. Additionally, building codes that now favoured non-combustible construction ensured the dominance of these materials.[8] With the shift to these new urbanized materials in North America, there was generally less research in the heavy timber field.[9] Steel and concrete are ubiquitous materials today, while wood is often viewed as an inadequate material for public buildings.

Even Squamish, a town founded for its forestry, has seen this shift. The majority of public, institutional, and commercial buildings are made of concrete and steel. The massive timber typologies once specific to the area have disappeared.

1.4 RESURGENCE OF WOOD

Today, timber construction is in no way inferior to its rivals steel and concrete.[10] Scientific research has lead to a resurgence of mass timber in urban architecture. A

7 Arne Berg and Hans Jürgen Hansen, *Architecture in Wood* (London: Faber, 1971), 71.

8 Mayo, *Solid Wood: Case Studies in Mass Timber Architecture, Technology, and Design*, 5.

9 Ibid., 5.

10 Marc Wilhelm Lennartz and Susanne Jacob-Freitag, *New Architecture in Wood* (Basel: Birkhäuser, 2016), 12.

renewed interest in environmental sustainability has lead to innovations in wood technologies.

With the current focus on high-tech and fast construction, contemporary heavy timber is able to compete with other materials on cost, with the additional benefits of beauty, sustainability, connection to craftsmanship, and region-specific design.[11] New fastening and lamination technologies have been researched that allow wood to hold more weight and span longer distances.[12] Instead of using old-growth timbers for long spans, these technologies have been developed to serve the same purpose, but at more customizable dimensions.

For the life cycle of a tree, this means a few 40-year-old timbers sawn and laminated together can serve the same function as a single 400-year-old timber. This dramatically decreases the dependence on old-growth forests, and allows forestry industries to focus on the continued life-cycles of trees.

Loggers and children with massive timbers, 1927, *District of Squamish Archives.*

Globally, a shift to mass timber design has clear benefits of renewability, carbon storage, and a reduction in construction-related emissions.[13] For Squamish, this architectural shift has the ability to combine the new wood advancements with the local history and culture of the place.

11 Mayo, *Solid Wood: Case Studies in Mass Timber Architecture, Technology, and Design*, 5.

12 Ibid., 7.

13 Ulrich Dangel, *Turning Point in Timber Construction* (Basel: Birkhäuser, 2017), 20.

1.5 THESIS QUESTION

The resurgence of heavy timber architecture creates a framework for regionalist interpretation. For communities that were founded for their old-growth forestry like Squamish, there is an opportunity to re-imagine the scale of the past mass timber structures from a contemporary perspective. This analysis will be made through the lenses of environment, history, technology, and critical regionalism. The ideas put forth by this thesis aim to bolster and address this opportunity.

How can the vision of the past heavy timber construction in Squamish provide a context for a contemporary regionalist response to new social, economic, and cultural needs?

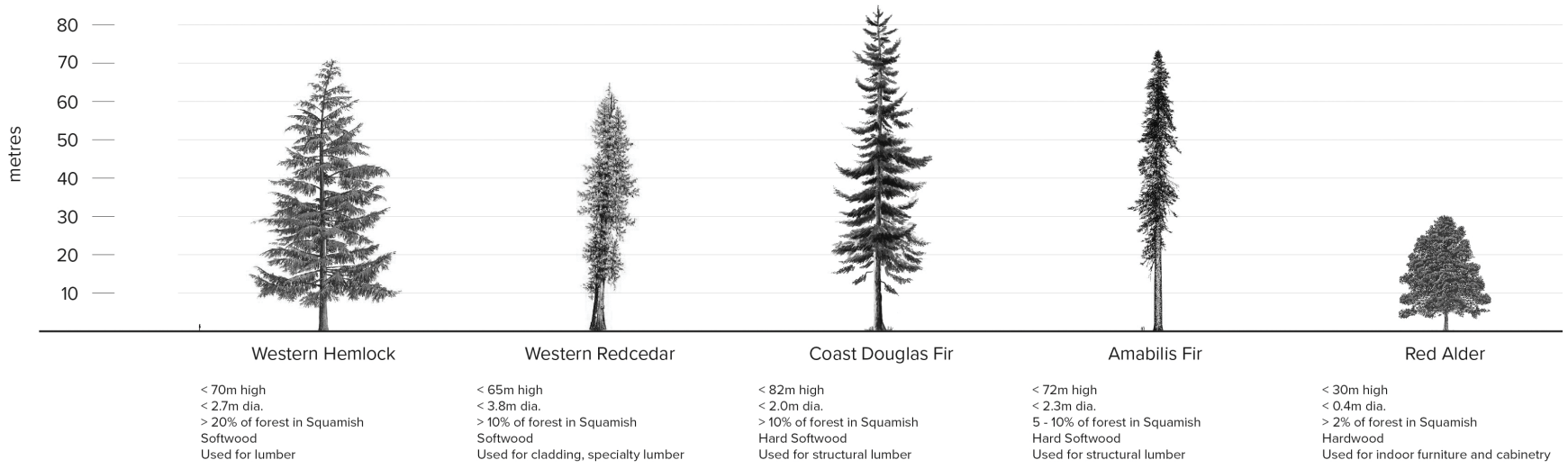
Loggers Sports Day, 1958, *District of Squamish Archives.*

2.0: CYCLES OF LIFE

2.1 BRITISH COLUMBIA'S OLD-GROWTH RAINFORESTS

The southwestern coastal rainforests in British Columbia are some of the most ecologically diverse forests in the world. The temperate forest spans from northern California to southern Alaska. The United States Environmental Protection Agency and the Government of Canada recognize this forest as a Zone 7 forest, under the name Marine West Coastal Forest. The most diverse Canadian region of the forest surrounds Squamish, Vancouver Island, and the Canada/United States border. This is because of a combination of high precipitation, a temperate climate, and soils fertilized by glacial runoff.

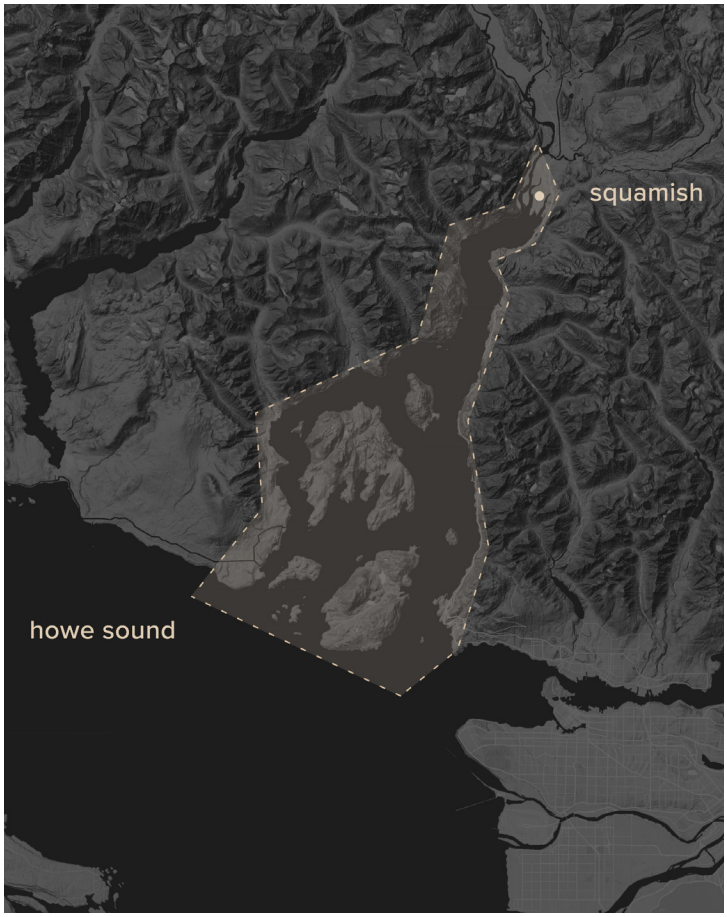
Zone 7 - Marine West Coastal Forest
Data from US Environmental Protection Agency / Government of Canada



Five most common species of trees in Squamish forests. Data from University of British Columbia.

The town of Squamish sits in a fertile valley at the north-end of Howe Sound. The sound was formed by submergence of a glaciated valley. Squamish sits in the rainforests of southwestern BC. A result of this high precipitation and fertile soil has lead to a diverse forest. Western Hemlock, Redcedar, and Fir trees are the majority of the forest, with some trees reaching heights of 85 metres.

Squamish is bookended by two geographic features. The Stawamus Chief is the second largest granite monolith in the world, after El Capitain in California. This feature sits south of the town, or at the town ‘entrance’ if one approaches from Vancouver.

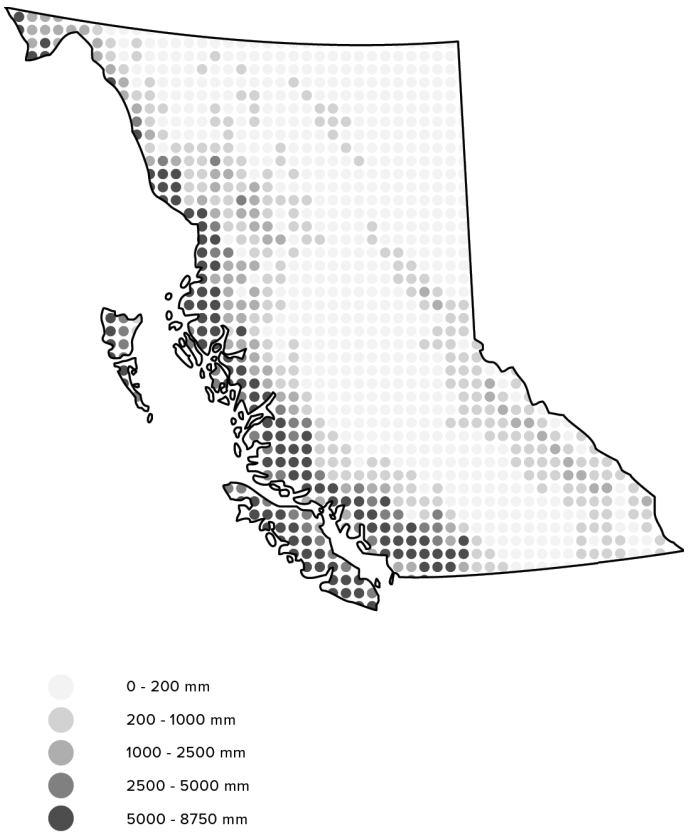


Map of Howe Sound, Map Reproduced from Google Maps.

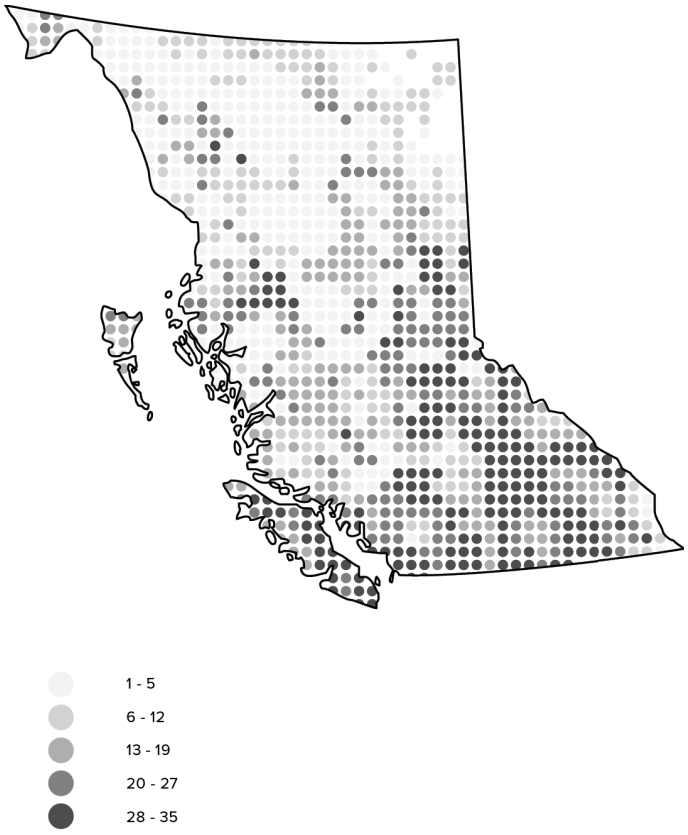
Layers of Squamish Landscape, 2018.

The landscape can be read in layers. The green, murky water forms a basin. The mid layer features a belt of green forests. This line has a distinct beginning and end, from the water to the mountains. The mountain ranges in the area surpass the line at which trees can grow. The tallest mountain in the immediate area is Mount Garibaldi, at 2678 metres. Mount Garibaldi sits at the northern end of the town. These landscapes of water, green valley, and craggy mountains create three distinct conditions where a response can be found in the regional architecture.[14]

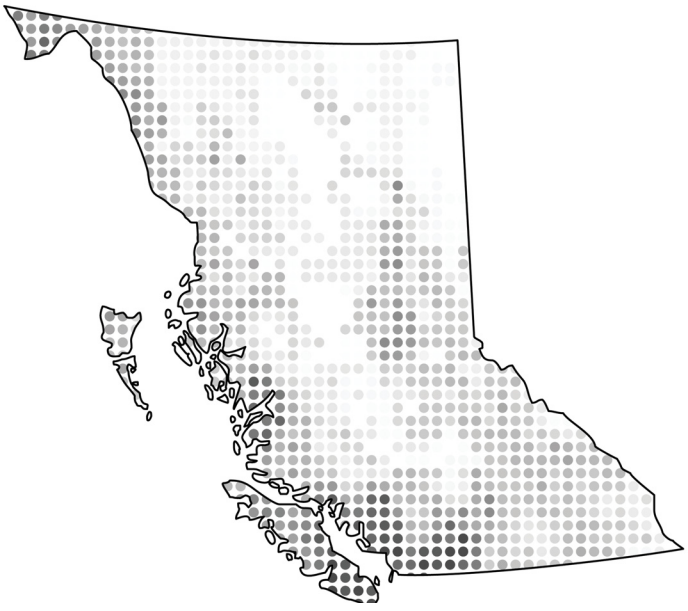
14 Kenneth Frampton, *Arthur Erickson: Layered Landscapes* (Halifax: Dalhousie Architectural Press, 2013), 7.



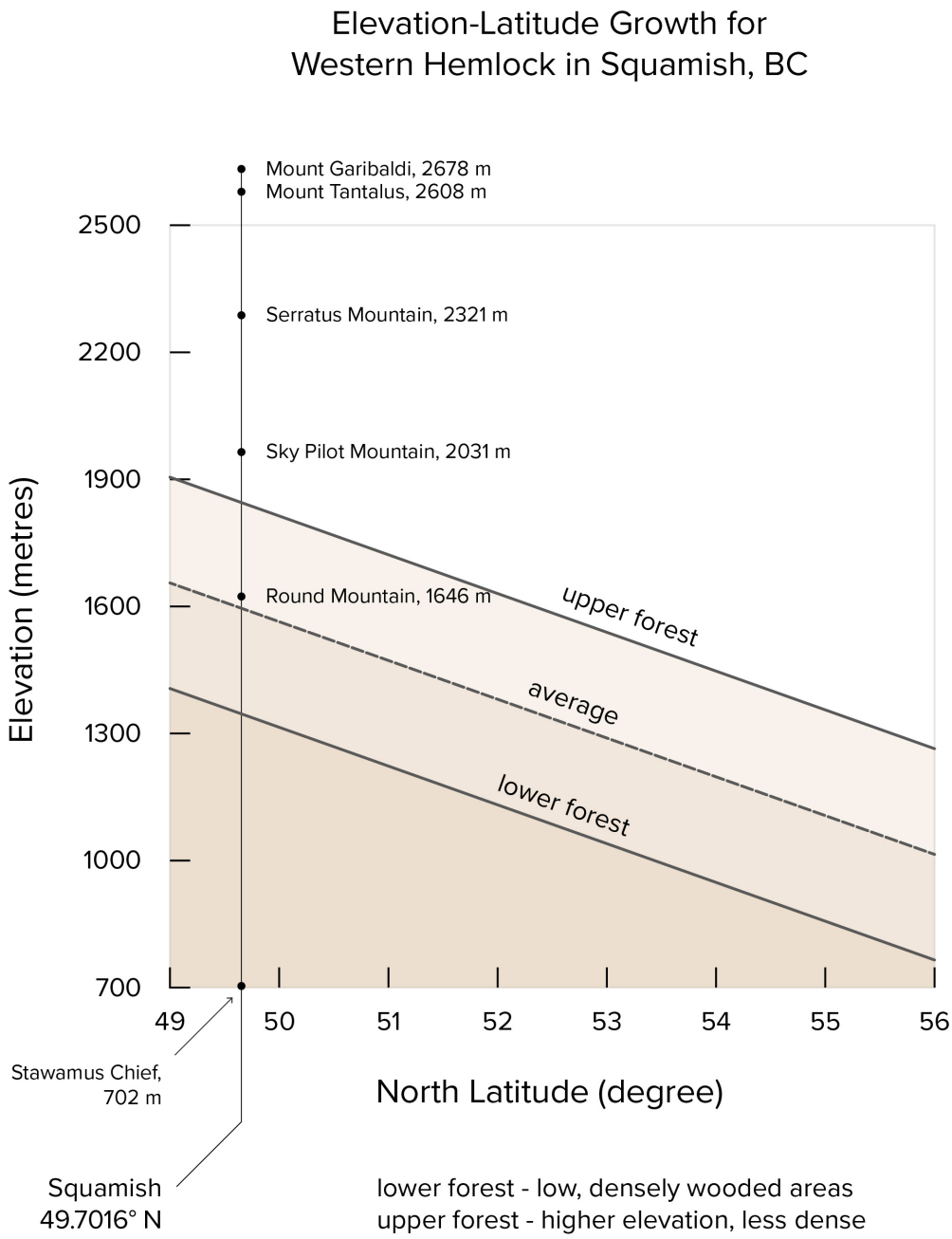
Precipitation Levels in British Columbia. Data from University of British Columbia.



Forest Diversity Levels in British Columbia. Data from University of British Columbia.



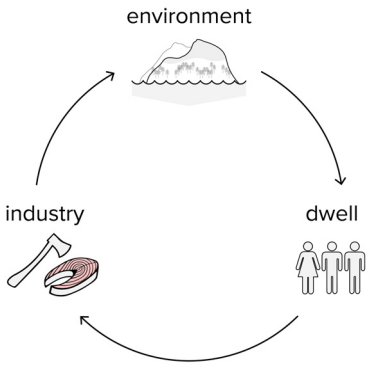
Climate Intensity (Temperature Change, Precipitation, and Forest Diversity) in British Columbia. Data from University of British Columbia.



Western Hemlock Growth by
Latitude with Local (Squamish)
Mountain Heights.
Data from Canadian Wood Council

2.2 SQUAMISH FIRST NATIONS

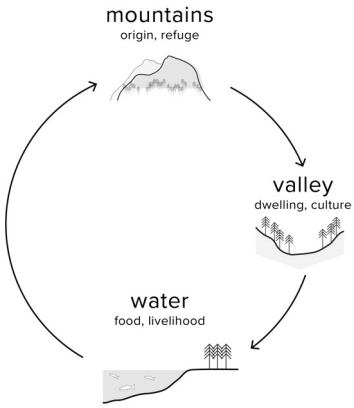
The origin of Squamish relates to a balance between people and landscape. “Two-eyed-seeing” is a phrase often used to describe a landscape from both a colonial and a first nations perspective. The origin of the name Squamish derives from the Coast Salish language. Squamish is an English adaptation of Skwxwu7mesh, meaning “mother of the wind, people of the sacred water.”[15] The name has been further adapted to define the regional winds. A ‘squamish,’ also known as an arctic outflow, is a cold, strong wind that forms as a result of the fjords and inlets of coastal British Columbia.[16]



Activity Cycle of First Nations People

In an 1897 interview between a Vancouver professor and the Squamish First Nations Chief,[17] the chief tells the narrative of Squamish’s creation. The origin of Squamish relates to a balance between people and landscape. This balance is held by the Great Spirit of the land.

The spirit created the lakes and rivers, then the trees and animals. The first man and woman created were given the two tools essential to survival; an adze (a tool similar to an axe, used for cutting or shaping wood), and a salmon trap. The couple populated the land and used its resources for sustenance. The land soon became populated, and people began abusing it. The Great Spirit made the waters rise above the land, killing the



Activity Cycle relating to environment

15 District of Squamish: *About*, last modified January 2018 https://squamish.ca/discover-squamish/arts-culture-and-heritage/history/

16 Ibid.

17 Hill-Tout, C., *Notes on the Cosmogony and History of the Squamish Indians in British Columbia* (Vancouver: Buckland College, 1897), 63.

environment and the people. Everyone perished but two survivors. The two endured the violent landscape while seeking refuge from the water at the peak of the mountains. They battled the temperature and starvation, as the wood and salmon they depended on to live was submerged and killed. After the waters subsided, the two descended into the valley and repeopled the land, as the land repopulated its own resources.

Coast Salish First Nation Distribution. Data from www.squamish.net

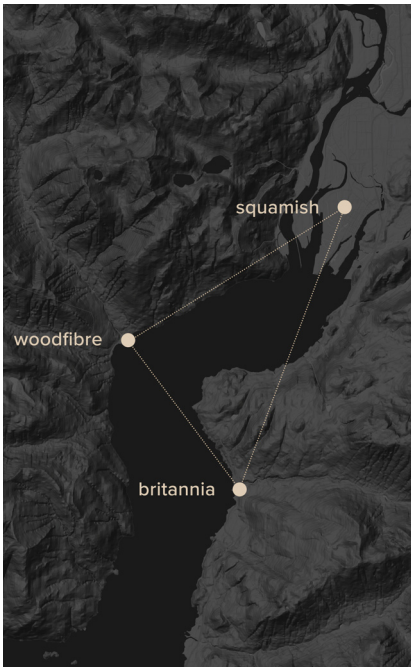
Coast Salish First Nation Longhouse. Image from www.squamish.net

As the interview suggests, the cycle between environmental disasters and death and repopulation is a recurring theme. The Great Spirit's anger was always a result of people exploiting the landscape. Refuge was always sought in the mountains, but the livelihood was found in the base of the valley. This ancient narrative creates a cycle of dwelling in the mountains, descending in to the valley for food and materials to create shelter,

and returning to the mountain tops for protection. This is highly specific to the region. While providing little architectural insight, these narratives are telling about the environmental conditions. In the landscapes cycle of environment, dwelling, and livelihood, the environmental conditions are the instigator.[18]

2.3 RESOURCE HUNTING

The inlet of Howe Sound provided active and immediate industrial benefits at the turn of the twentieth century. Environmentally, the sound had many features that could not be found elsewhere in British Columbia, due to the unique coastal environment. The abundance of quick-flowing streams added value (energy), as did the scale and diversity of the local forests. At the northern end of the sound, the damp soil was nutrient rich.



Map of industry towns in northern end of Howe Sound. Map Reproduced from Google Maps.

Although the recorded history is relatively minimal, it is believed that Squamish was the first area the colonials settled in Howe Sound. George Vancouver first surveyed Howe Sound in 1792. Explorers initially searched the area in pursuit of gold, but only found trace amounts. Instead, these explorers found a fertile land rich with trees and hops.

These environmental conditions lead to a number of industry town's being born along the sound, each supporting one-another. Squamish, initially called Newport, quickly became a site for large-timber

18 Edward Mills and Harold Kalman, *Architectural History of Indigenous Peoples in Canada* http://www.thecanadianencyclopedia.ca/en/article/architectural-history-early-first-nations/.

harvesting and hops exporting.[19] As Squamish matured in to a forestry and milling town, other supplementary towns appeared along the sound.

2.4 BIRTH OF THE HEAVY TIMBER INDUSTRY

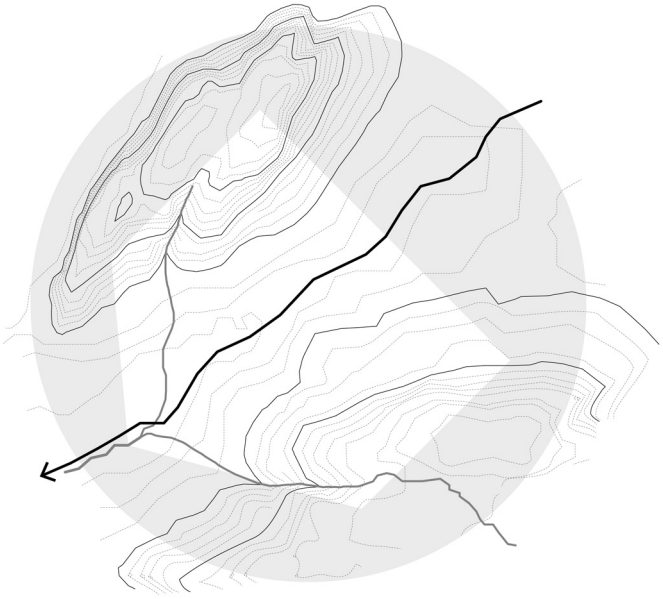
New forestry practices had to be developed to deal with the unique weight of the heavy timbers. Before the time of internal combustion engines, timbers were typically moved by muscle power, whether it be horse or man. In the old-growth forests of British Columbia however, this was a difficult, energy inefficient method.[20]

Horse moving timbers, 19XX, *District of Squamish Archives*.

With the varied topography in the area, loggers quickly

19 Britannia Mine Museum, Archive, conversation with curator, August 27, 2017.

20 Gould, *Logging: British Columbia's Logging History*, 46.

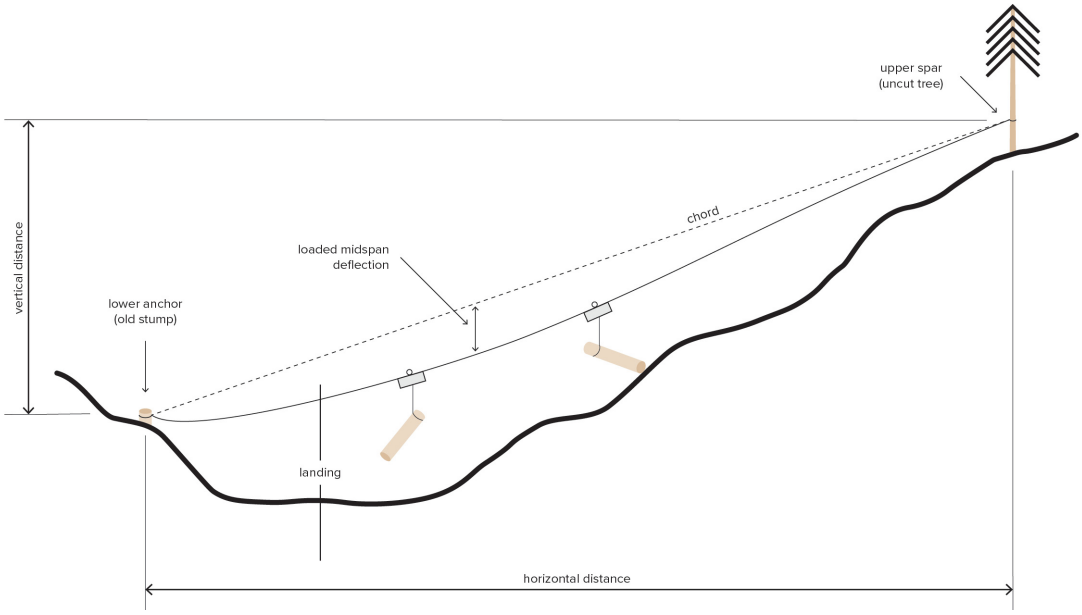


Typical mapping of traditional clear-cut.

developed methods of letting gravity to the work.[21] This influenced how clear-cuts were planned, and how the individual timbers were moved.

The image below shows the typical layout of how forests were cleared. Paths were usually drawn parallel to

21 Steve Conway, *Logging Practices: Principles of Timber Harvesting Systems* (San Francisco: Freeman, 1986), 37.



Timber Dragging Method, Conway: *Logging Practices*

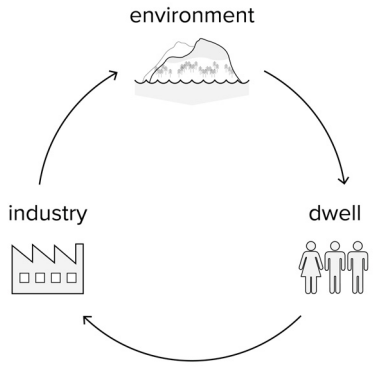
topographical shifts. Streams were used as secondary routes. The initial clear-cuts were typically between 60 and 90 acres.

Universal Steam Donkey, Image: *www.advocatesfnm.org*

The topography and gravity were used in tandem to help bring the timber down to the logging paths. Other technologies began to appear, such as the universal steam donkey. This was a steam-powered piston that was used to generate energy. This energy would typically be used to drag trees, or power timber-rafted boats.

Britannia Beach town, 1919, *Britannia Beach Mine Archive*

2.5 THE MACHINE OF HOWE SOUND



Activity Cycle of First Nations People

Britannia Beach was settled for its copper mining. Copper mining was an active industry along the western parts of North America - as far south as Mexico, and as far north as Alaska. The Britannia Beach mine opened in 1900. The forests on the site were clear cut, and the wood was sent to Squamish for processing. A small town of repeating homes and a town hall were quickly built to house the workers. The copper to rock ratio in the mountains was higher than most mines, at upwards of 4% in areas. Companies typical mine in areas of as low as 0.5%. As the global demand for copper increased, Britannia Beach became the largest producer of copper in the British Commonwealth by 1929.[22]

While Squamish handled most of the forestry and logging,

the town did not have a pulp mill. In 1912, the town of Woodfibre was founded as an additional milling company. The site was chosen for its creek, which had more than enough power from its current to power a mill. However,

Woodfibre Pulp Mill, 1919, *Britannia Beach Mine Archive*

22 Britannia Mine Museum Archive, August 27, 2017.

due to the challenging topography and demands of the local industries, Woodfibre quickly became the site of a pulp mill.

Mill Creek was one of the deciding factors in this, as it was one of the few creeks in British Columbia powerful enough to power a pulp mill. As in Britannia Beach, a small company town was built, along with a cable ferry that departed from Britannia Beach. Due to the current of Howe Sound, workers were able to timber-raft wood from Squamish to Woodfibre for pulp processing.

These towns shared an inherent connection with each other, through shared environments, people, and industries. The life cycles of this industries, along with the Squamish First Nations, was a shared system. The link between environment, culture, and livelihood was ever-present.

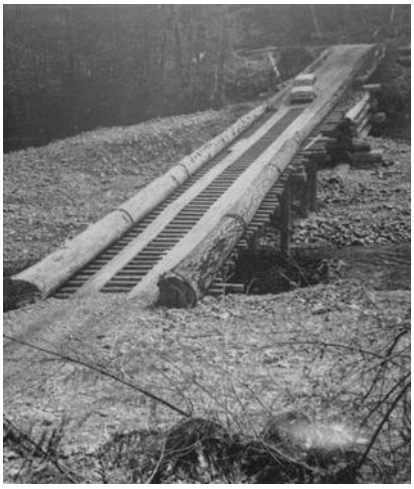
Loggers resting on old-growth timber, 192X, *District of Squamish Archives*.

The common theme between these industry towns was the notion of using the local materials for local and global use. Loggers would come to Squamish specifically to harvest and export the huge timbers, but local workers would also use the timbers in local construction.

The environmental landscape had a tendency to be inhospitable. The geographic conditions, including the challenging topography, 'squamish' winds, and shifts in water levels were key contributors. Britannia Beach suffered one of the worst landslides in Canadian history. In 1915, a combination of melting snow and loose rock created significant avalanche, killing 56 workers and injuring several more.[23] In 1921, the mine saw a significant

23 Britannia Mine Museum Archive, August 27, 2017.

fire that destroyed one of the two mills, closing the mine for months to rebuild. During the reconstruction, a natural dam in the mountains broke loose creating another landslide, taking the lives of 36 residents.[24] The town of Woodfibre experienced similar losses, with a series of floods, landslides, and industrial fires. There was an imbalance between the preservation of landscape, the economics of industry, and the inhabitation of people.



Car crossing timber bridge, 1954, *District of Squamish Archives*.

2.6 SITUATED PRINCIPLES

The structures made during the boom of the industry had key elements of economy, immediacy, and materiality. There was a singular use of wood, as the material was widely available. Due to the abundance of wood, builders had little concern over how much material was being used. For temporary structures, like bridges or cabins, the wood would remain un-sawn so it could be used elsewhere. When timbers would be left exploded to weathering, the bark would be left on to keep water away from the grain. Although each structure used different methods of assembly, they all shared a consistent architectural rhythm. Structures were often divided into bays; a kit of parts to make a whole. The colloquial systems created a balance of practicality and poetry. The rugged elegance of these structures tells a narrative of place through their composition.

> We come to see not the work of art, but the world according to the work[25]

24 Britannia Mine Museum Archive, August 27, 2017.

25 Maurice Merleau-Ponty quoted in Juhani Pallasmaa, *The Eyes of the Skin* (Chichester: Wiley, 2014), 21.

mountain, valley, and water relationship

seasonally-intense climate

unique scale of timber

timber richness in region

economy of assembly
multiplate parts to a whole
retained material value
singular use of wood
repetitive systems

tectonic relationship
minimal tooling
material excess
understanding of material

unconventional process
immediacy
interpreted modesty

culture based on landscape
culture material relationship
culture in technology

3.0: TIMBER CONSTRUCTION

During the boom of the logging industry in southwestern British Columbia, heavy timber harvesting was driven by a call for more wood and larger buildings. Before the eras of steel and concrete, heavy timbers are the simplest way of building long span spaces. As well, the trees harvested in the region were less likely to have knots than smaller trees from different regions.

Today, timber construction is in no way inferior to its rivals steel and concrete. The resurgence of mass timber architecture is a result of scientific and environmental intent.[26] A shift to mass timber architecture has three clear environmental benefits. Primarily, wood is the only naturally renewable structural material.[27] Wood also has the ability to store carbon throughout the life of a timber building, leading to a significant reduction in green-house gasses.[28] Lastly, forestry is an established industry, meaning less research and testing is required.[29]

This thesis looks at the traditional heavy timber constructions from a contemporary perspective. Estimations have been made as to why certain moves

Squamish Townsite, 1949, *District of Squamish Archives*.

26 Andrew Bernheimer, *Timber In The City* (San Francisco: Oro Ed., 2015), 9.

27 Ibid., 11.

28 Dangel, *Turning Point in Timber Construction*, 14.

29 Ibid.

were made. However, as with the disparity in memory versus fact, these are estimations.

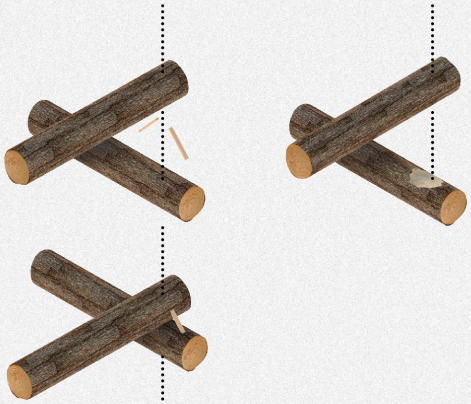
3.1 LANGUAGE OF CONSTRUCTING

The Squamish First Nations tells a narrative of life beginning in the mountains. The mountains served as the origin of life (to people and the environment) and refuge (from people and the environment). For the forestry industry, mountain tops also served as scouting points, so loggers could plan where to cut next. The historical structures from the initial logging industry and First Nations dwellings were the clearest forms of regional architecture. The materials, knowledge, and skills were isolate to the site.

As the town of Squamish developed, these building practices disappeared. Looking at traditional building practices allows one to look at the programmatic notions that were associated with site. In the context of the mountain, this meant refuge, viewing, and environmental education (relating to material harvesting).

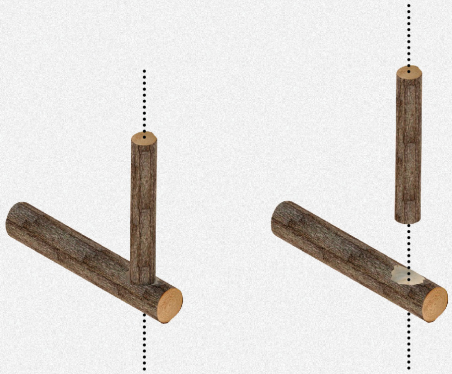
Regionalist architecture can often be generalized in to a toolkit of materials and systems that create a relationship between building and site. On a basic level, this is seen in southwestern British Columbia with the use of heavy timbers and basic connections. Older architecture often used preexisting forms (gable roof, shed roof, flat roof) and standardized systems.

Structures built during this time were primarily made of horizontal elements. Stacking was the simplest tool. In a region with varying topography like Squamish, big



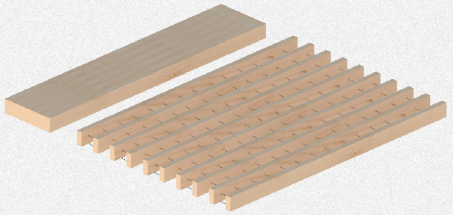
timber cribbing for beams

Timber cribbing was the simplest way to built up on a challenging topography with an abundance of trees. Despite the high quantity of timbers used, these structures were typically more temporary. As a result, minimal cuts or modifications would be made to the timbers, to allow for further reuse. Lap connections would sometimes be cut (above, right), but these were more for covered/indoor situations. Stripping the bark away from the timbers increases the risk of weather-related decay.



vertical timbers for columns

Carving timber beams was the simplest way to create a perpendicular vertical connection. Although cribbing has been used to make vertical walls (see, log cabins), timber columns were occasionally used to spare material. There is also precedent for angled lumber to be added for shear strength. Previously, these connections were hand carved, meaning the fitting between column and beam was imprecise. Today, superior connections can be made with more advanced tooling.



nlt for horizontal slabs

Nail Laminated Timber (NLT) is the oldest form of mass timber construction made from multiple boards. The construction of NLT comes from old boat and warehouse construction. Colloquially known as wooden decking, NLT was a viable with the introduction of the wire nail. Like other mass timber systems, NLT is made in pre-fabricated panels. It is typically used with horizontally. There is no glue in an NLT panel, which also helps with weathering compared to a glue composite systems.

Traditional toolkit.

timbers were used to span horizontally across gorges. Due to the scale and height of these trees, longer distances could be spanned.

With the scale of local timbers and topographical levels in the area, it's understandable why builders would simply span a long timber from one ledge to another. This system used the weight of the wood to its advantage, and nailed dimensional lumber for bracing and decking.

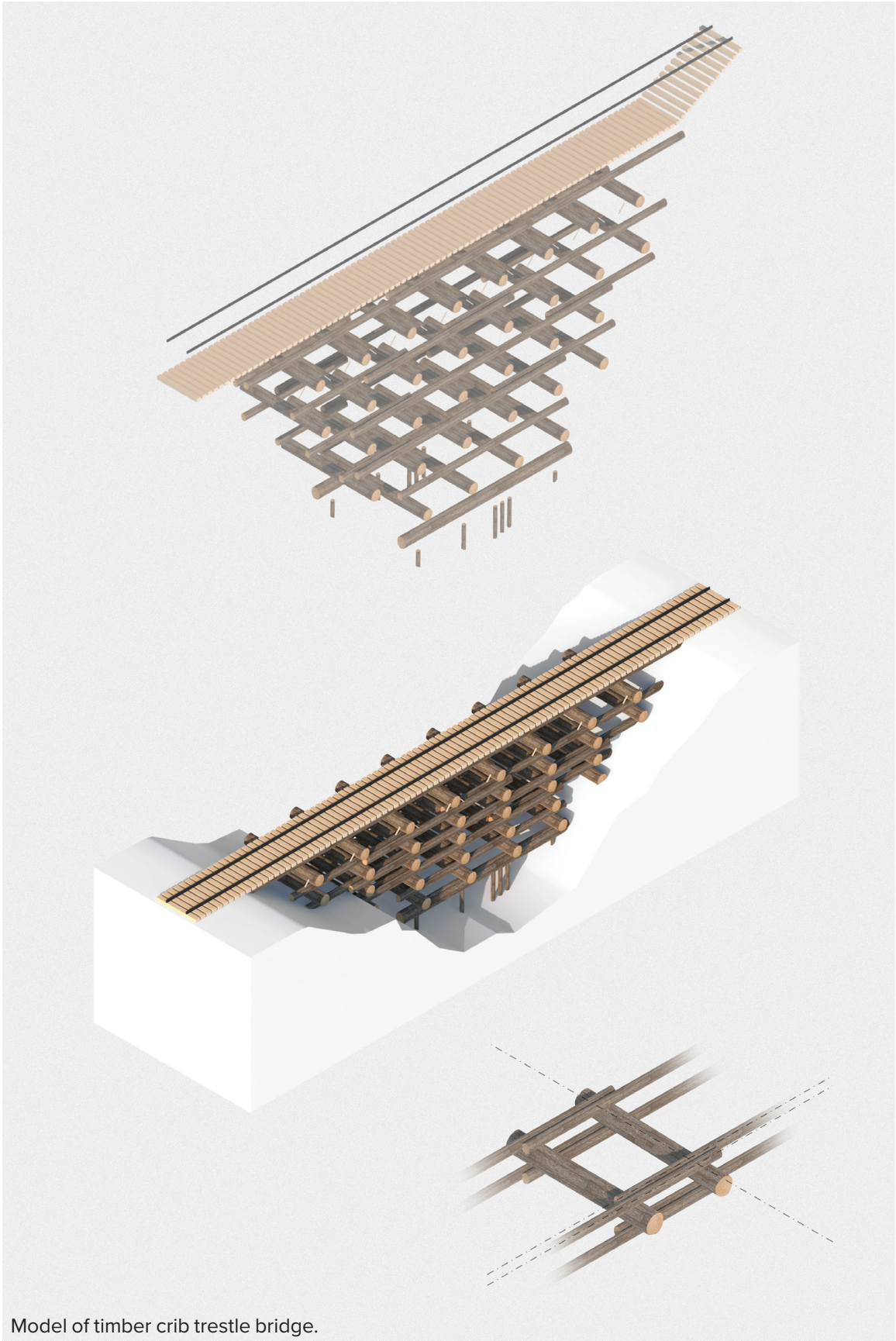
Like timber cribbing, these bridge designs force the loads diagonally to the outside. Thicker timbers are typically used lower in the structure. Timbers rarely see detailed joinery and complicated fasteners. Metal rods, nails, and bolts were used from when these bridges were first documented.

Originally, bridges of this nature were limited by the dimensions of the timbers. When chainsaws and planers became more prevalent, timbers would be debarked, planed, and sawn in sections.

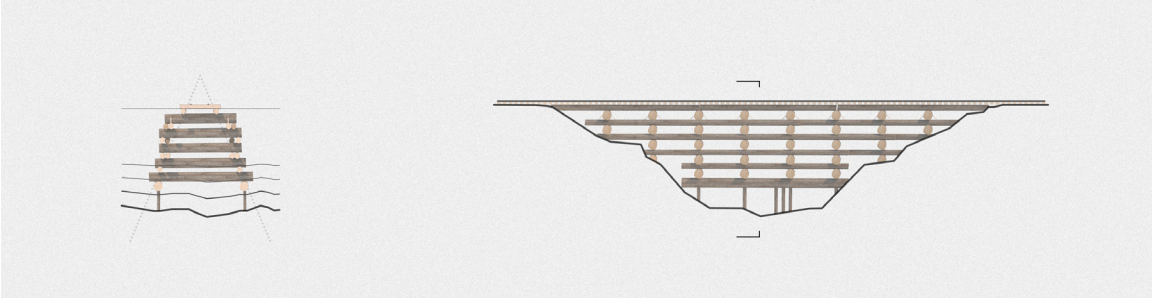
3.2 ANALYSIS OF SOURCE PRECEDENTS

Timber cribbing is typically selected because of site conditions. In areas with plenty of trees, varying topography, and solid ground, cribbing is a quick solution. As these conditions are commonly found in southwestern British Columbia and in the throughout the Marine West Coastal Forest, timber cribbing was often used as a means of level foundation-making. Like the other studied systems, timber cribbing uses uniform repeating connections. Steel nails and rods fasten the rough-sawn boards and rails to the cribbing.

Timber cribbing foundation for bridge. *District of Squamish Archives*



Model of timber crib trestle bridge.



Section, elevation of timber crib trestle bridge.

Piles are used to create a horizontal plane to build from. Loads are spread diagonally, outwards of the structure (see section). Perpendicular timbers are thicker. This increases the vertical height while simplifying the assembly process. As the parallel timbers are longer than the perpendicular, using smaller timbers reduces weight and energy input. Parallel timbers overlap by one bay to help spread loads evenly.

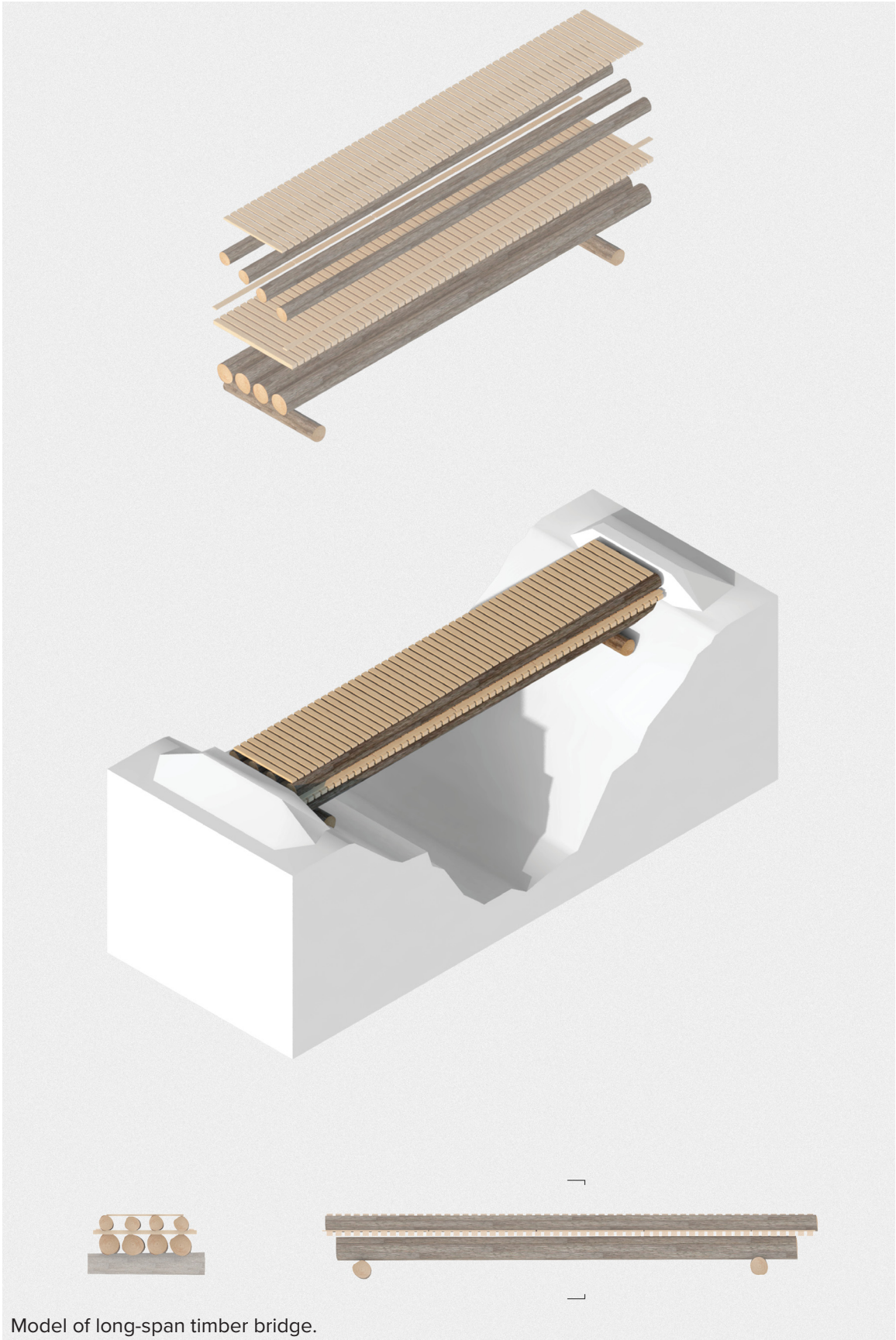
The log cabin is the image that's most frequently related to heavy timber construction in British Columbia. These are a simple expression of using horizontal members to build vertically.

The simplest structure to analyze is the long span timber bridge. These were popular at the time, due to their quick assembly, use of local materials, and lack of detailing required. The concept is clear: find a timber long enough to span from one mound to another. Decking was often nailed to the top for both shear resistance and to provide a surface to drive over.

3.3 A SHIFT IN CONSTRUCTION

The transition from tradition to standardization was an iterative process. As the populations (First Nations,

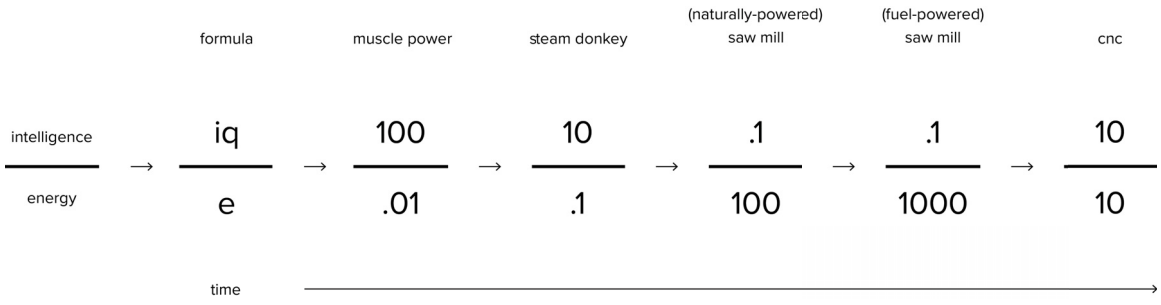
Model of heavy timber log cabin



Model of long-span timber bridge.

logging) in Squamish grew, but urban development began to grew in tandem. This introduced standardized systems to the area. The logging industry in Squamish handles forestry and milling. As a result, wood manipulation (lumber cutting) became a key process of the industry. This process was handled in the valley of Squamish, but created more of a global market. Timbers would be brought down from the mountains, processed in the valley, then exported by rail, road, or water. Like the industry, wood standardization transcends the local to a regional scale. Much of the lumber is produced to a standardized dimension and proportion.

Today, wood technologies have been innovated to create large-span, heavy-load structures. In Squamish, buildings using these qualities are made of concrete and steel, which is ill-suited to the regional culture outlined. In *The Eyes of the Skin*, Juhani Pallasmaa states that "our understanding of the world is structured and articulated by our constructions, both material and mental, past and present."[30] In the case of Squamish, idea of local wood creating large spaces has disappeared.



Wood Manipulation Industry Formula, Source: Conversation with E. Jannasch.

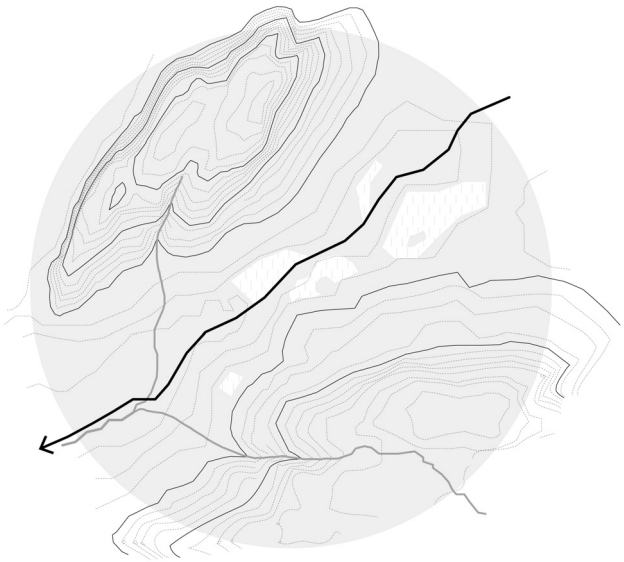
30 Juhani Pallasmaa, *The Eyes of the Skin,* 36.

4.0: ENVIRONMENTAL ARCHITECTURE

4.1 BENEFITS OF WOOD

Building with wood has several environmental benefits that we now understand. Originally in Squamish, wood was used because of the local availability. Forest conservation and responsible cutting was not a factor in the early industry. Forestry has changed, however, and harvesting techniques have been developed to keep the life cycle of the forest continuing.[31] As an example, branches and brush from trees are left behind on site and allowed to decay. This returns the nutrients back in to the soil, allowing a new tree to grow.

31 Dangel, *Turning Point in Timber Construction,* 20.

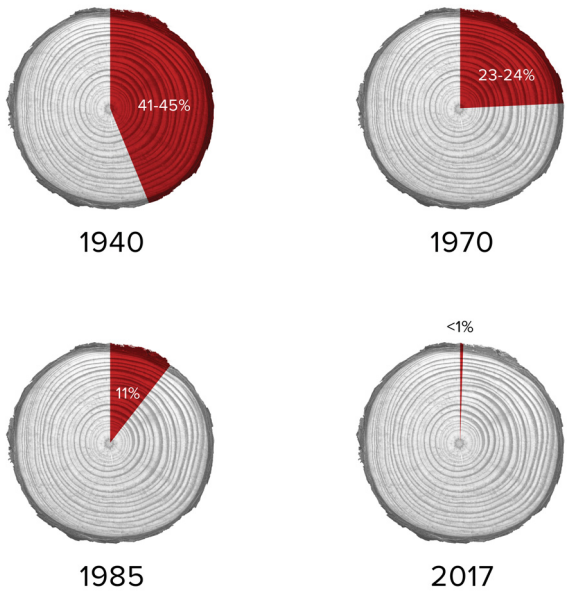


Typical mapping of contemporary tree harvesting. Data: Canadian Wood Council, Gould: *B.C. Logging History*

Wood is the only naturally renewable structural material. That is a critical factor, as we now know how to keep our forests growing while foresting, and create nearly no waste in the process. Previously, there was little consideration made for the life cycle of the forest and the amount of waste generated.

4.2 CARBON FLUX

Carbon forms the basis of all known life. It is found in every living organism and most non-living substances. It has the ability to be stored in gas, liquid, and solid states. The exchange, or flux, of carbon between these states is known as a carbon cycle. This carbon flux plays a critical role in regulating the planet's climate, as the amount of carbon in the atmosphere has a significant influence on the global temperature.



Waste generated from forestry. Data from Dangel: *Turning Point in Timber Construction*

The relationship the forest has with carbon is simple. Like people, forests breathe. Trees inhale carbon dioxide and exhale oxygen. Trees are able to sequester the carbon from the carbon dioxide, and store it in the grain. Simply put, as the trees grow, they have the ability to store more carbon.

Photosynthesis is the clearest example of a carbon cycle. During photosynthesis, vegetation absorbs carbon dioxide from the atmosphere. The carbon dioxide is sequestered, and while the oxygen is released, the carbon is stored for essential growth of new cells.[32] Trees specifically have the ability to store a large amount of carbon. The rate of growth of a tree dictates how much carbon can be absorbed.

As trees age and mature, they require increasing amounts of water and sunlight.[33] This inhibits the growth of the tree, and the carbon flux as a result. Older trees are able to store more carbon, while younger, growing trees are able to absorb more carbon.[34] Mature forests with young growth are the ideal condition for increasing carbon storage potential.

The only way for forests to experience carbon loss is through fire or decay. When trees are harvested from forests, the carbon is still stored in the wood. Throughout the processing, manufacturing of lumber, and construction of a wooden building, the carbon store is maintained. Again, the carbon can only be lost in the

32 Dangel, *Turning Point in Timber Construction*. 50.

33 Ibid., 51.

34 Ibid., 62.

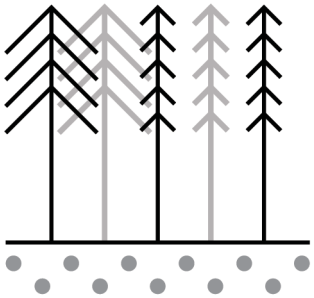
event of fire or decay, even when the wood is in the form of a building.[35]

The leading cause of global warming is excess carbon emissions. Continued global growth and manufacturing has lead to an increasing amount of carbon dioxide emissions.

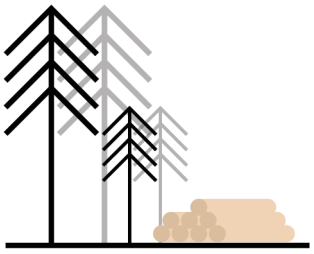
35 Dangel, *Turning Point in Timber Construction*. 50.

carbon is absorbed and stored in mature forest with young growth

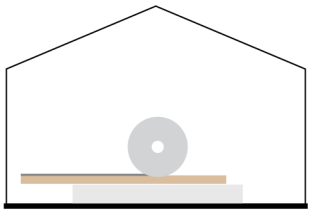
mature trees are pruned, offcuts to decay and return nutrients to soil



mature trees harvested, younger trees retained new trees planted

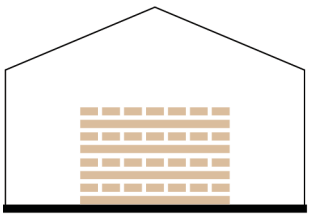


wood is debarked and sawn to dim. for structural lumber



Carbon loop between forests and buildings. Data from Bernheimer: *Timber In The City*

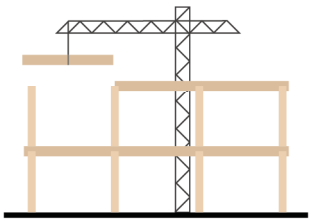
wood is stacked and dried in
controlled climate



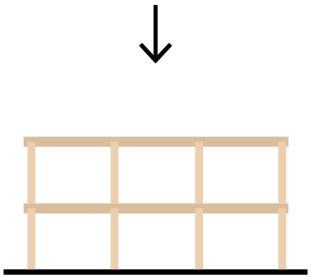
wood is planed and strengthened

wood system is fabricated
(nail laminated timber), and final planes
and cuts are made

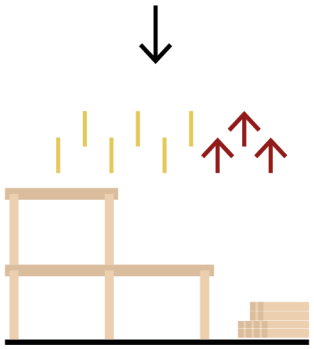
wood is debarked and sawn to dim.
for structural lumber



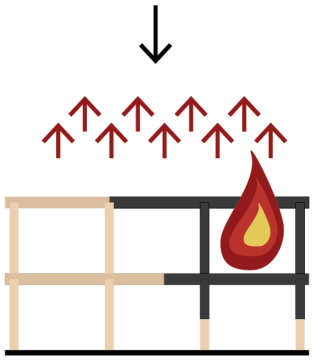
building life



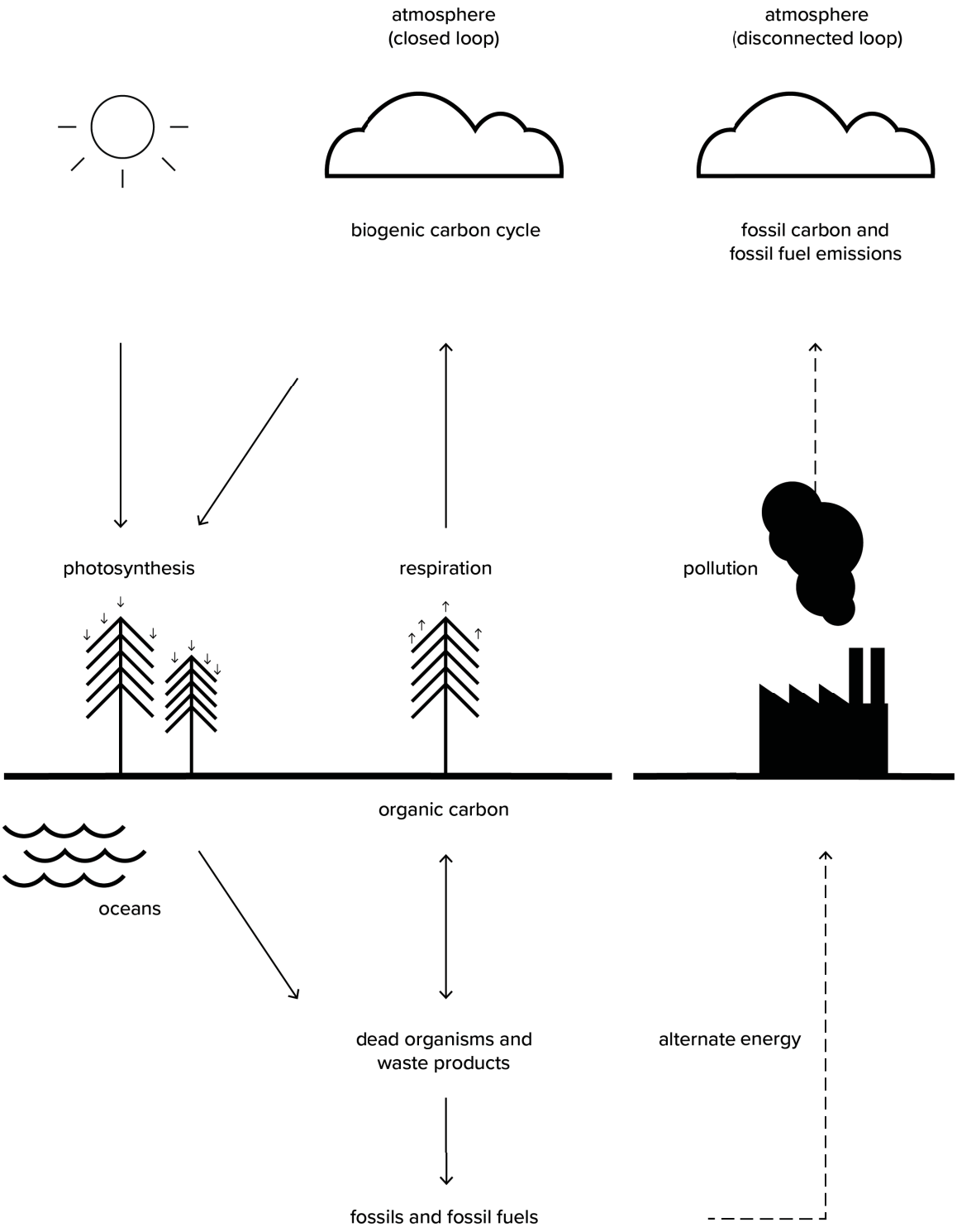
building end-of-life; deconstructed with some wood to be reused (some carbon loss)



building burns down, total carbon loss to atmosphere



carbon is returned to forests through respiration and the cycle repeats



CO_2 Respiration Cycle. Data from Dangel: *Turning Point in Timber Construction*

5.0: FINDING TRADITION IN MODERNITY

5.1 BUILDING A REGIONALIST BASIS

Regionalism is the predominant discourse in architecture in that it focuses on design in terms of region, material, and culture. It is neither intentional or accidental, physical or mental. Architectural critic Juhani Pallasmaa argues that culture embodied in building is an entity of facts and beliefs, history and present material realities.[36] The southwestern forestry towns of British Columbia have a significant environmental and economic history.

Building in Squamish has always carried a tectonic relationship with the environment. In construction, the forest dictated the dimensions of materials, and the harsh climate dictated how these materials were assembled and finished. These simple expressions of survival create the most telling references to living in the region. The intense climate and abundance of material was a strong driving force in how structures were built, cladded, and weathered.

E. J. Hughes, *The Mill at Mesachie Lake*, 1986.

Like many forestry towns in British Columbia, Squamish has an inherent relationship between environment and industry. These industry towns exist and continue to endure because of this relationship. The cause and effect leads to the industry becoming part of the landscape. This symbiosis is a reality Canadian artist Edward John Hughes captured in his paintings of British Columbian

36 Juhani Pallasmaa, “The Feasibility of Regional Architecture in Post-modern Society,” in *Architectural Regionalism,* ed. Vincent B. Canizaro (New York: Princeton Arch. Press, 2017), 131.

industry towns.[37]

This culture carried specific principles throughout their buildings; namely relating to notions of economy, immediacy, and durability. In many regions, economy may be interpreted as a monetary discussion however in Squamish, the labour and time were the driving factors in construction. The building materials used had a direct tectonic connection with the natural. From a contemporary perspective, one can admire the pragmatic integration of natural materials in buildings that are built for their landscape.

Throughout time, the tectonic has the potential to yield play between material, structure, and craft.[38] Tectonic qualities of architecture serve as a constituent of locality throughout the entire structure and finishes. This creates a balance between the pragmatic use of a material and the poetic narrative of a material harvested from the landscape. In doing so, a balance is formed between the Western tendency to view the environment as a framed image as a human tactile experience.[39] Although Squamish had a bustling urban core during the boom of the industry, the buildings people decided to document sat outside of this area. Looking through the archived images, the structures photographed were either highly ornamental, or highly elementary (such as the long spanning bridge or the crib trestle bridge). As a result,

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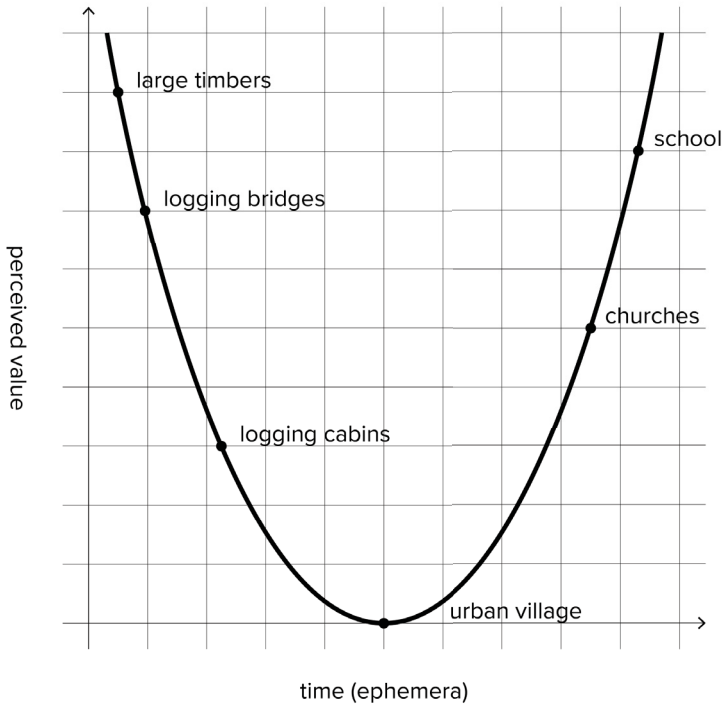
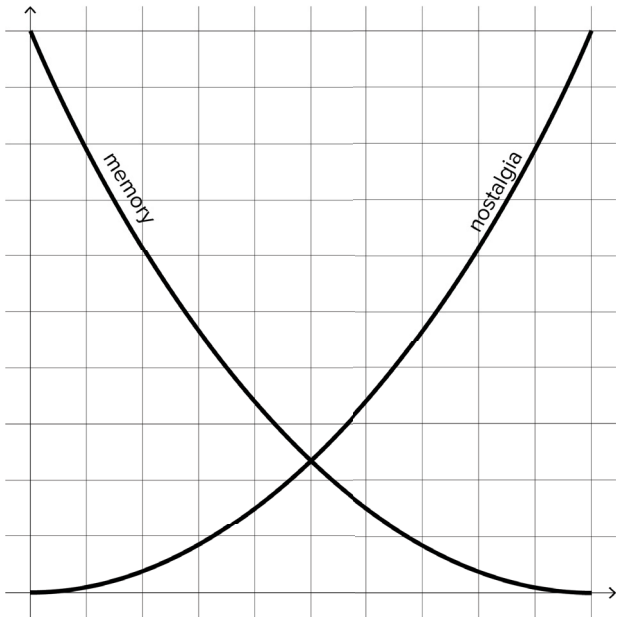
37 Ian Thom, *Masterworks from the Audain Art Museum* (Vancouver: Figure 1, 2016), 24.

38 Kenneth Frampton, “Towards a Critical Regionalism,” in *The Anti-Aesthetic*, ed. Hal Foster (New York: New Press, 2002), 28.

39 Ibid., 29.



Analyzing what buildings were recorded pre-1960 from *District of Squamish Archives*.



Memory vs. Nostalgia, from *5 Paradoxes of Architecture*, Strelka Institute.

this has been interpreted as perceived value; what the was documented was what was valued.

5.2 REINTERPRETING A PAST CULTURE

> Between tradition and modernity there is a bridge. When they are mutually isolated, tradition stagnates and modernity vaporizes; when joined, modernity breathes life into tradition, and tradition responds by providing depth and gravity.[40]

The poetry of the original logging infrastructure was a result of the inherent connection to the environment. This connection was often very literal, with timber remaining un-sawn and rested in place on site. The material and building culture, as outlined in Section 3.1, was based on the local availability of materials. With the timber richness in the region, it seems only logical that such a significant use of timber would be adopted.

In responding to these cultural principles and motifs, it is essential to maintain the inherent relationship with the environmental landscape.

In reinterpreting local traditions for a contemporary building, Harwell Hamilton Harris suggests that to be expressed architecturally, an idea must be particularized, localized, and set within a region.[41] The importance is put on the resources of the region, rather than the limitations of the region.[42] Harris says the important resources

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40 Octavio Paz, *In Search of the Present: 1990 Nobel Prize Lecture* (Orlando, Fla.: Harcourt Brace & Co., 1990), 20.

41 Harwell Hamilton Harris, “Regionalism” in *Architectural Regionalism,* ed. Vincent B. Canizaro (New York: Princeton Arch. Press, 2017), 67.

42 Ibid., 68.

are a free mind, a stake in the future, and energy. Most importantly, Harris says regionalist building must consider its climate, its topography, and "the particular kind of sticks and stones it has to build with."[43] An emphasis must be placed not only on the past, but how these ideas will continue to be communicated in the future.

Coincidentally, mass timber design is seeing a significant resurgence. Due to its energy efficient construction that considers material resources, the environment, and its livability, timber construction is beginning to see a rise in popularity.[44] There is still a key area that needs to be resolved. Wood is often associated as a local resource, however several mass timber systems require specialized manufacturing tools and spaces.

The old bridges and cabins in Squamish were unscripted and individual. Despite this, they shared the same design principles. Responding to the call for economy, immediacy, and durability, these structures typically used one simple repeating connection. The joinery was often simple, easy to replicate, and adapted to its context. Materials and labour used were locally available. Referencing these unscripted building motifs literally would lose the meaning the original structures had. Alvar Aalto argues that, "vernacular style is usually an unorthodox mixture of influences and motifs which have lost much of their original meaning and intactness."[45] This thesis aims to reinterpret and abstract the traditional building cultures of the region. Whereas a vernacular study may attempt to

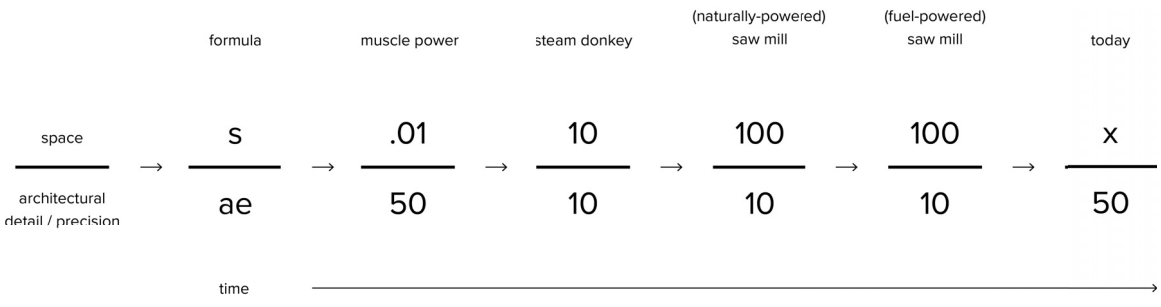
43 Harris, "Regionalism," 68.

44 Dangel, *Turning Point in Timber Construction.* 52.

45 Kenneth Frampton and John Cava, *Studies in Tectonic Culture* (Chicago: Graham Foundation, 2007), 33.

recreate the building designs of the past, this study aims to reinterpret the traditional design principles and motifs in the context of architecture today. Aalto's regionalist architecture attempted to recreate historical designs, rather than replicate. In his work, Aalto treats the detail as a constituent of locality.

Aldo van Eyck's architecture is described as being simultaneously autonomous and culture-bound. The cultural connection is always related to local tradition, environment and context, while the autonomy is found in the individual artists' expression.[46] This richness can be found in the old forestry structures in southwestern British Columbia, as their designs are individual, yet their principles are the same. Given that these structures were mostly built of wood, a tectonic relationship between the building and the landscape can be seen. Architectural critic Kenneth Frampton argues that in order to achieve regionally specific designs, a tectonic idea must "be embodied in structural and constructional form."[47]



Phenomenological Formula based on time-based technology.

46 Frampton and Cava, *Studies in Tectonic Culture*, 35.

47 Ibid., 37.

5.3 PHENOMENOLOGY IN WEATHERING

> Finishing ends construction, weathering constructs finishes.[48]

Environmental weathering adds a factor of material subtraction. Rain, wind, and sun take away the edges, surfaces, and colours from wood over time.[49] Weathering can not be seen only as a minus however, as it adds to a building, conveying the phenomena of a place. In the text *On Weathering*, authors Mohsen Mostafavi and David Leatherbarrow suggest the process of weathering is "associated with a romantic appreciation of the appearance of buildings."[50]

The relationship between architecture and place is not a means of surrendering to a place. Weathering and materiality in architecture has the potential to enhance the phenomena of place. To a passerby, material weathering and memory can show how people interact with a building, and how the local climate changes throughout the year.

Looking at the various structures throughout Squamish's history, the freedom expressed in building from the natural created an outcome that exposed the limitations of wood. End-grains of timbers were often left open and exposed. One can assume that, as a result of weathering and lack of protection, these materials decayed over

48 Mohsen Mostafavi and David Leatherbarrow, *On Weathering* (Cambridge: MIT Press, 1993), 71.

49 Ibid., 72.

50 Ibid., 72.

time, and that is why these structures no longer exist.

Material failure due to weathering in early structures had a significant impact on how building technologies were developed over time. As a result, weathering is often seen as a negative. However, in any local climate, weathering creates an inherent connection to place.

Wood has a clear material memory. More than stone or metal, wood has the potential to convey the poetry of a place due to the speed at which it wears, especially when exposed to the elements. Wood gain can open and close as a result of its relationship with humidity, water, the moon, or the sun.[51] The tone of wood changes over time with weathering. In a sense, wood is an impressionable material. Consistent human interaction over time creates wear, reshaping and re-texturizing the material. Over time, this adds to the phenomenological experience of

Villa Mairea, Alvar Aalto, in ArchEyes, August 30, 2016, http://archeyes.com/villa-mairea-alvar-aalto/.

51 Robert McCarter, *The Work of Mackay-Lyons Sweetapple Architects: Economy as Ethic* (London: Thames & Hudson, 2017), 6.

a space.[52] Alvar Aalto's Villa Mairea finds this balance between wooden elements for human interaction and a form that reflects the rhythm of the trees in the forest. Aalto's notion of material memory coincides with wood construction:

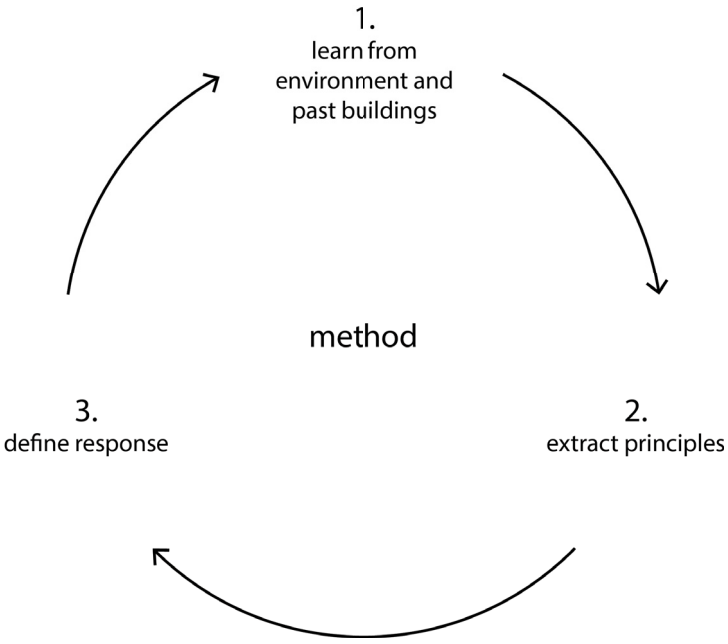
> What matters is not what the building looks like the day it opens, but what it is like to live in 30 years later.[53]

In Squamish, wood is a constituent of locality. Given that wood can be used as structure, cladding, finishes, and furniture, each building component can tell a narrative. The dialogue between a wooden shingle, a wooden door handle, a wooden floorboard, and a wooden chair can tell and observer how a building is lived in, and how it has aged over time.

52 Mostafavi and Leatherbarrow, *On Weathering,* 73.

53 Robert McCarter, "The Legacy of FInnish Architect Alvar Aalto," Lecture at Saint Louis Art Museum, October 8, 2014.

6.0: APPLICATION OF DESIGN



Design methodology

6.1 SITE AND PROGRAM

The opportunity exists for a contemporary interpretation of the past to evoke a sense of a place through architectural design. This response aims to address how the past heavy timber culture of Squamish can be reinterpreted to express the situational qualities of the place.

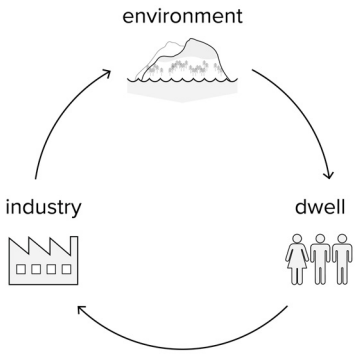
Throughout time, the three situational lenses of environment, culture, and livelihood have existed. From the relationship the Squamish First Nations had to living within the landscape to how birth of the industry towns,

there has been a continuous cycle. In addressing the needs of each landscape (environmental, cultural, and livelihood), protection appeared to be a common theme.

In this context, protection can be distilled down to fire prevention and mitigation. Fire would eliminate the forests, which would break the cycle of living off the land. A firehall deals with the protection of the three landscapes. Moreover, the programmatic requirements seemed to fit in the three studied structures — a long span garage, a compartmentalized space, and a vertical element. Additionally, building a firehall out of heavy timber highlights the material's fire resistance when used in this scale. A public aspect has been considered to keep the building culturally present. Two pavilions have also been included to heighten the site's relationship with the landscape.

The two existing fire hall facilities (both volunteer) in Squamish are lacking architecturally and programmatically. Furthermore, the town lacks a clear-span space to hold public events.

In response to the thesis question, a fire hall with additionally public programmatic spaces has the ability to highlight the culture of Squamish, while also conveying the benefits of wooden spaces and heavy timber architecture.



Squamish Life Cycle

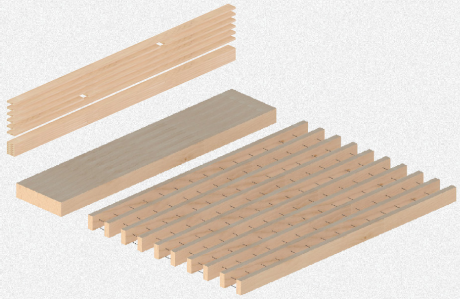
dimensional timbers for beams and columns

In response to the timber logs used in cribbed systems, or long spanning applications, the same theory is used for dimensional lumber. Today, with the minimal amounts of wood waste and lumber mill in Squamish, dimensional lumber can be treated as a log.

With tighter structural requirements in today's construction, weathering is carefully considered. However, to express the scale grain of the wood, they can be fastened together to make a larger timber.

dimensional lumber for sheathing

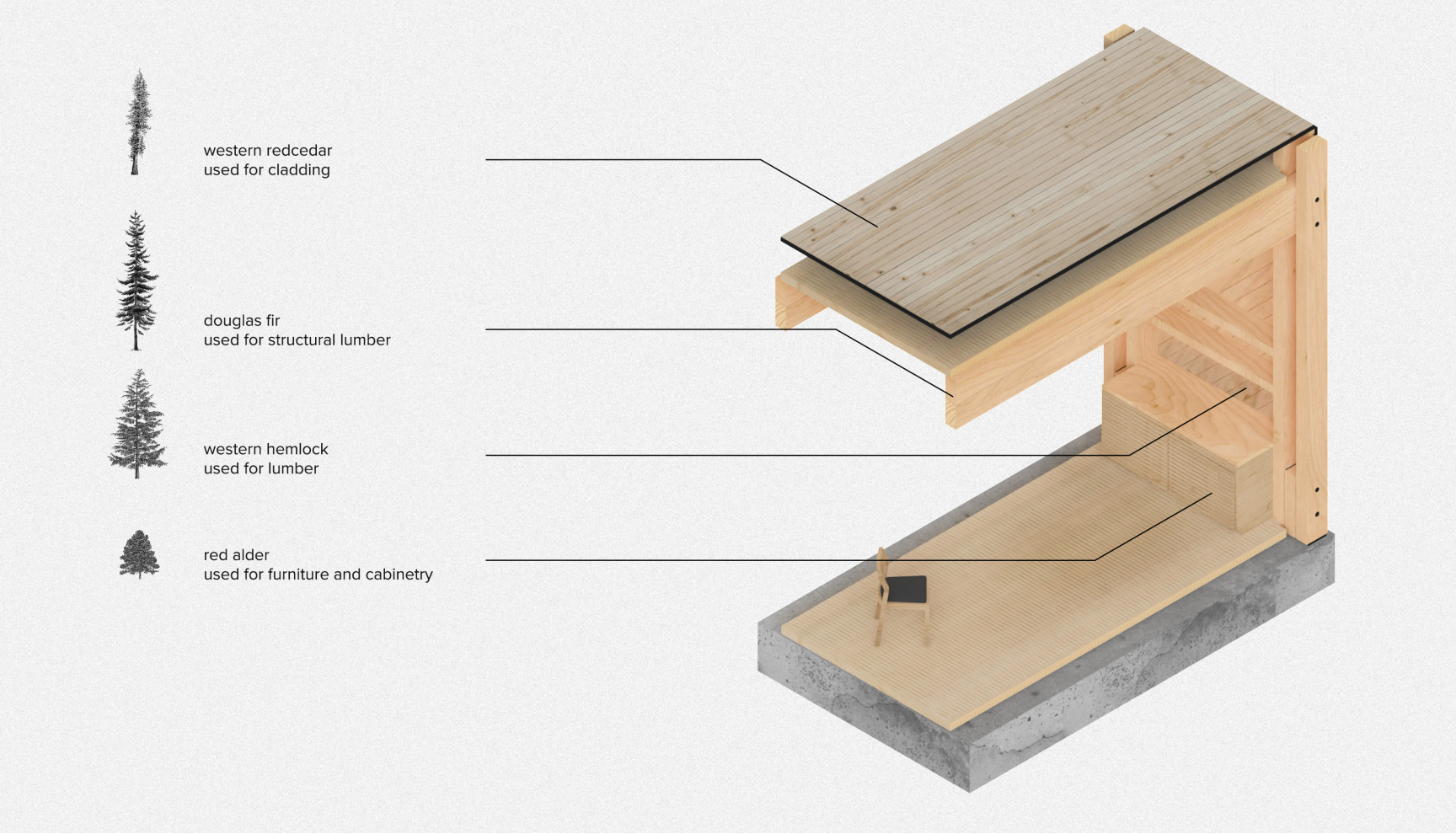
Wood plank sheathing is a time-proven system. Boards nailed directly on to the columns create a surface to mount cladding and insulation off of. Additionally, they add to the wood-first phenomena of the interior space. Most importantly, when the boards are fastened as if a panel, they provide of shear resistance accross each bay. This is a easy to install, easy to prepare, and easy to manipulate system that follows the design principles of the place.



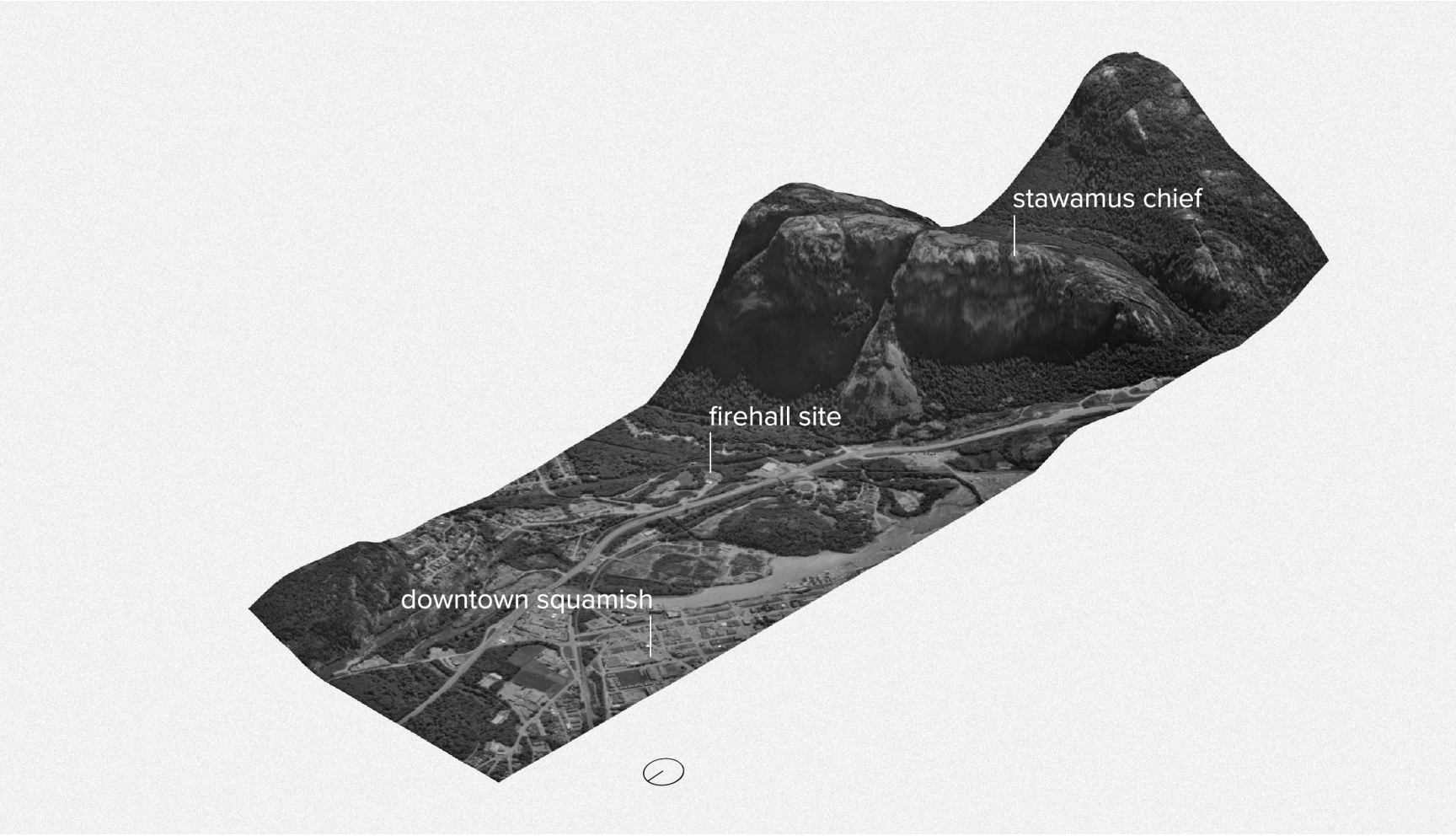
nlt for horizontal and vertical slabs

Nail Laminated Timber (NLT) is the oldest form of mass timber construction made from multiple boards. The construction of NLT comes from old boat and warehouse construction. Colloquially known as wooden decking, NLT was a viable with the introduction of the wire nail. Like other mass timber systems, NLT is made in pre-fabricated panels. It is typically used with horizontally. There is no glue in an NLT panel, which also helps with weathering compared to a glue composite systems.

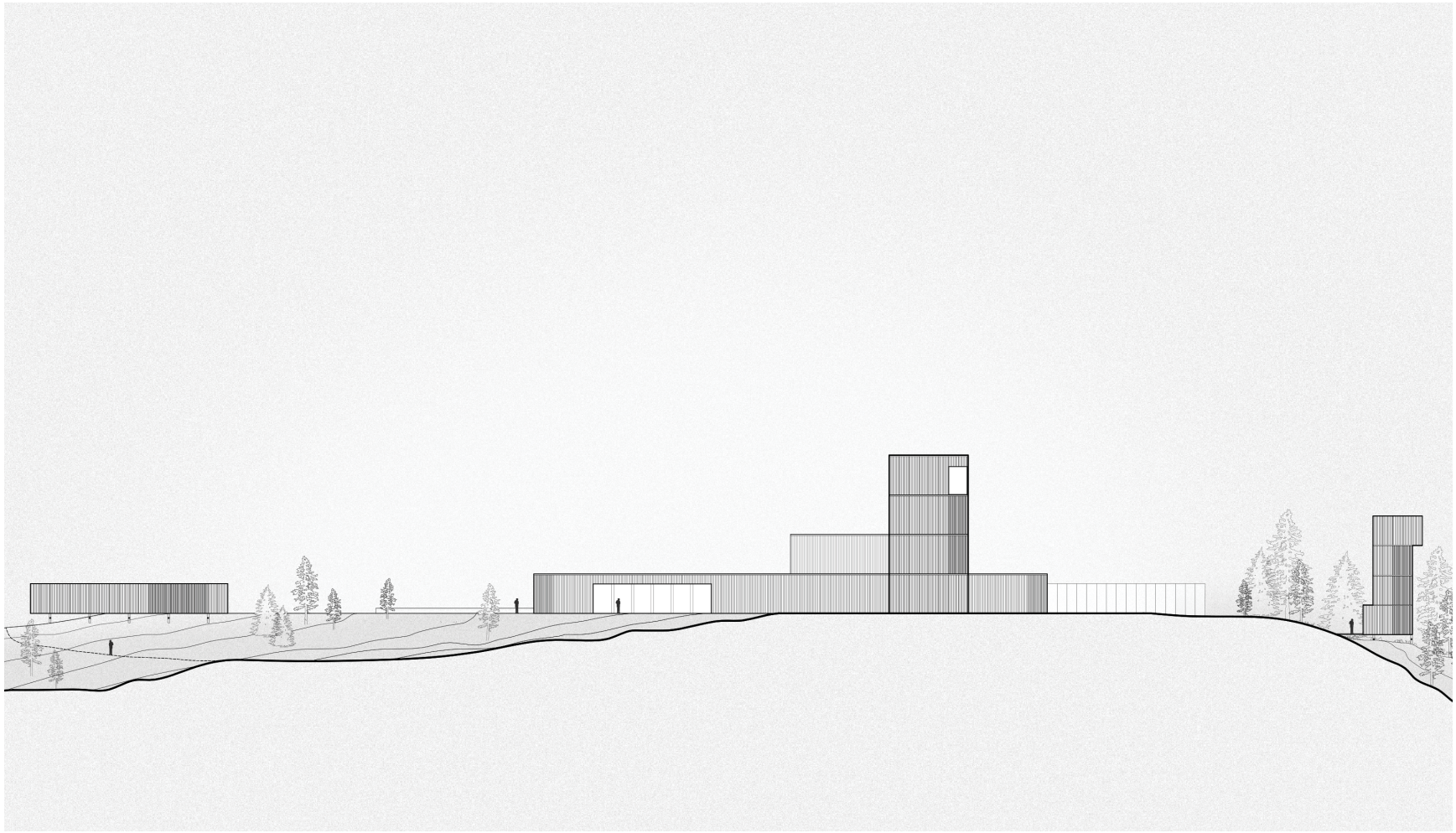
Responding to the generalized toolkit of the past, a re-imagined system has been outlined. This re-imagined toolkit treats sawn lumber as raw timbers were treated in the past. Dimensional lumber makes up the bulk of the structure (primary, secondary, tertiary). These systems act in shear, with metal fasteners and ground-connection plates for assembly.



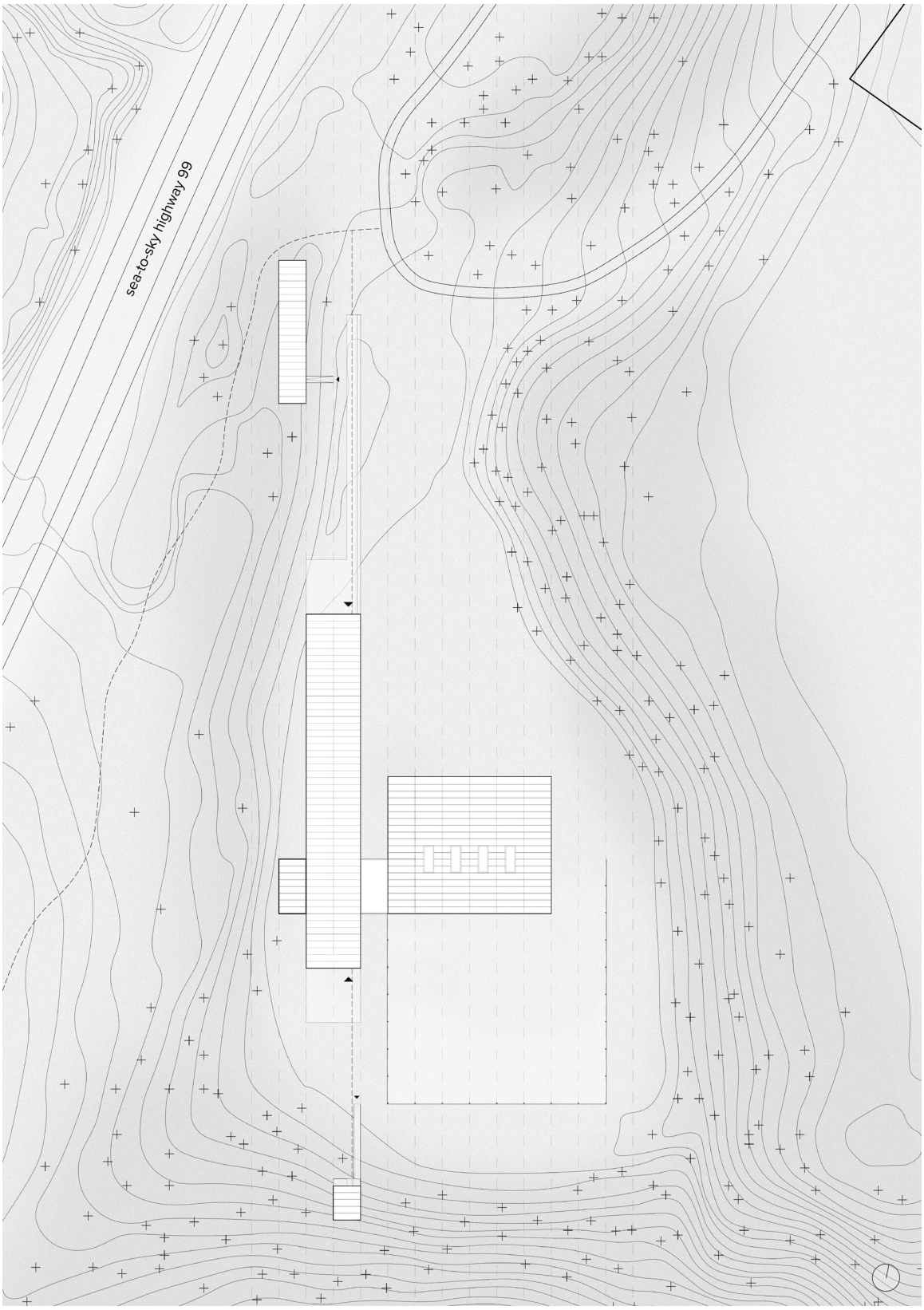
The dominant local species can be integrated to suit the characteristics of their grain within the building design.



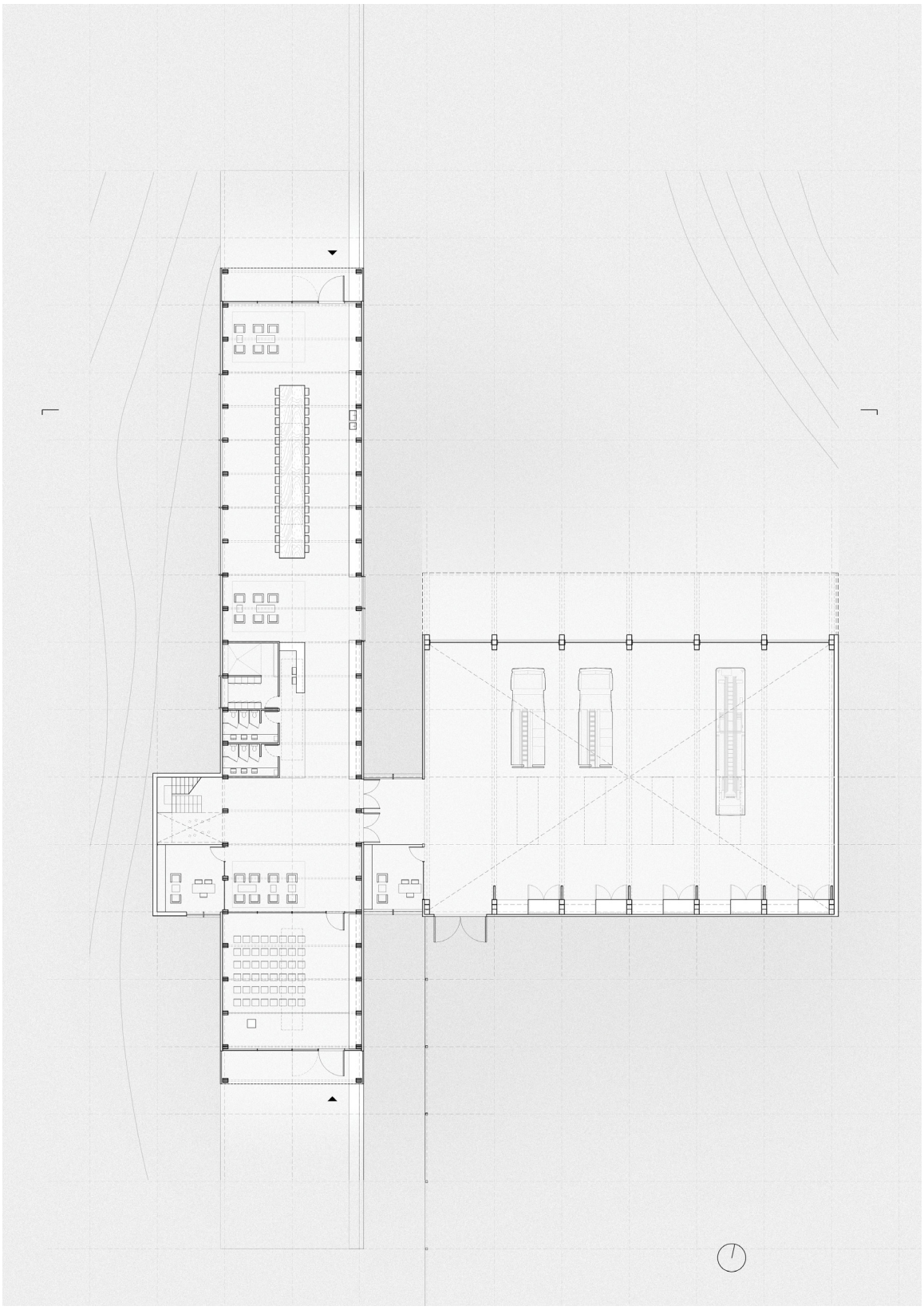
Context Isometric Map



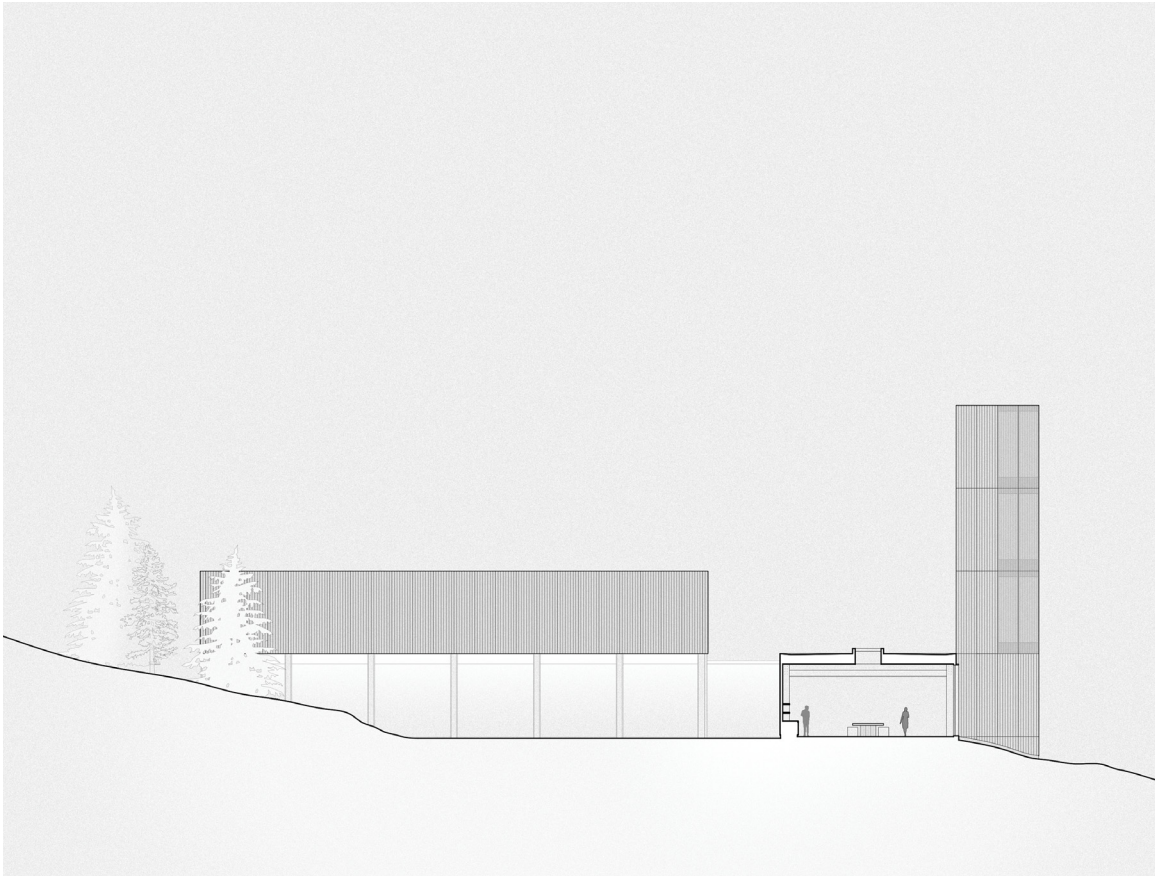
Site section running in the north-south direction.



Site Plan: Overall site



Plan, Elevation: Stawamus Chief Pavilion



Section through the community kitchen, elevation of garage and hose-drying tower beyond.

6.2 INTERPRETING TRADITION THROUGH MODERNITY

Architecture is simultaneously autonomous and culture-bound. In a history like Squamish's, the individual expression in unscripted buildings created autonomy, while the trades, materials, and tools added a situational significant.

Building is culture-bound in the sense that situated design principles and traditions provide a basis for individual creativity. Various cultural practices can be defined by a geographical region and environmental

conditions.[54] The tangible connection between materials and the natural environment, or patterns of life and the architectural form, adds a sense of causality to regionalist design.[55] The design response uses the natural materials of the region, along with the standardized local building systems, to define a regional architecture.

6.3 LANDSCAPE RELATIONSHIP

The site is bookended by two significant geologic features; the tall Mount Garibaldi and the Stawamus Chief granite monolith. As most of the studied precedents were bridges, the site layout has been thought of as a bridge, running north-to-south.

In developing the three volumes for the firehall, their structure has expanded on the bridge idea. In response to the crib trestle, the public, compartmentalized spaces have been developed on the north-south axis. The structure runs in cross section, much like the heavy timbers in the crib trestle.

For the hose-drying tower, the motif of horizontal elements stacked vertically was used in response to the log cabin. NLT towers are somewhat unconventional, however the system uses the materials and labour from the area, and systems from the toolkit.

The long-span garage maintains the north-south relationship with beams running on the primary axis.

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54 Suha Ozkan, “Regionalism within Modernism,” in *Architectural Regionalism,* ed. Vincent B. Canizaro (New York: Princeton Arch. Press, 2017), 105.

55 Juhani Pallasmaa, “Tradition and Modernity,” in *Architectural Regionalism,* ed. Vincent B. Canizaro, 132.

The heaviness (weight and size) of the beams aims to recall the weight of the timbers used in the simple long-spanning bridges of the past.

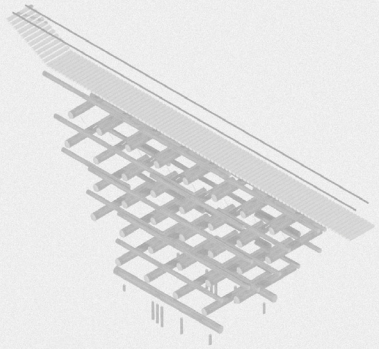
The site is bookended by two pavilions, each responding to the respective geologic feature. These pavilions act as a gateway to the firehall, as site access happens from both ends of the site, while also responding to their context.

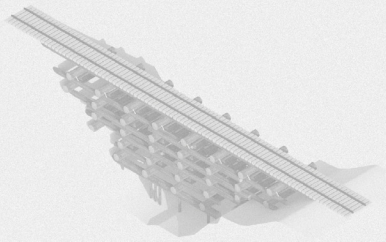
A long structure at the north-end of the site acts as a dwelling and aperture to respond to Mount Garibaldi. This pavilion uses the same systems outlined in the re-imagined toolkit. Fixed seating, as part of the building, frames a view for the user.

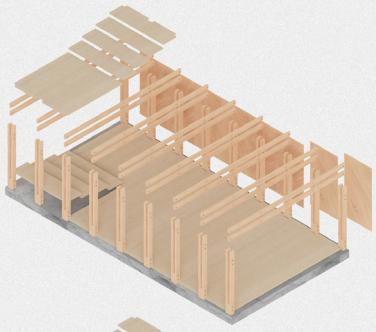
The pavilion at the south end of the site has a similar function. The intention of this building is to bring the users above the height of the trees to an aperture to look at the Stawamus Chief granite monolith. Whereas the Mount Garibaldi pavilion was a horizontal structure, this form is vertical.

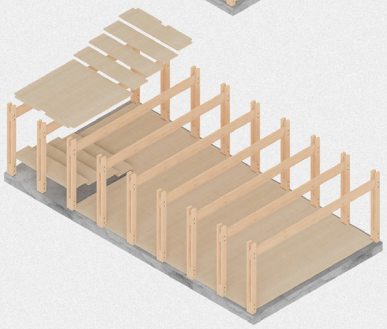
Aperture opening of Mount Garibaldi Pavilion.

inspiration drawn from the compartmentalized spaces created by timber cribbing

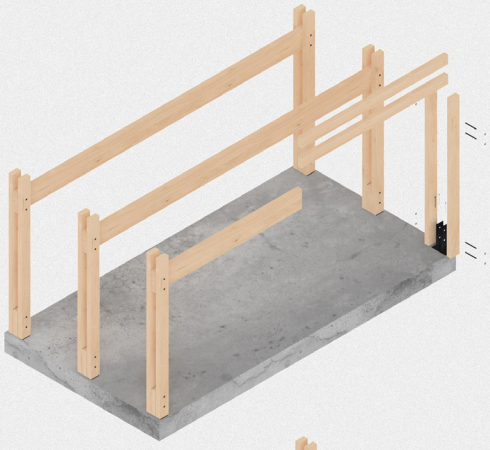








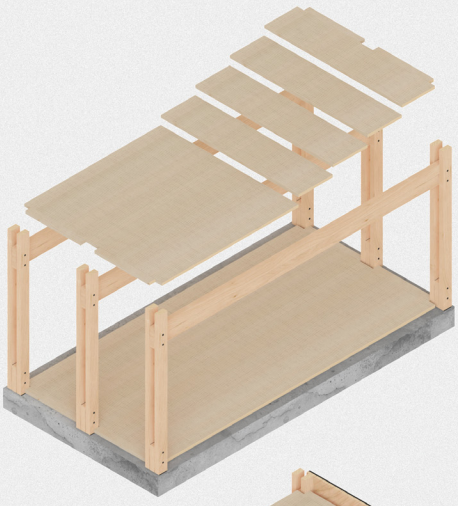
01
sawn timbers are bolted together with a knife-plate showing the seperation between timbers at the ground connection



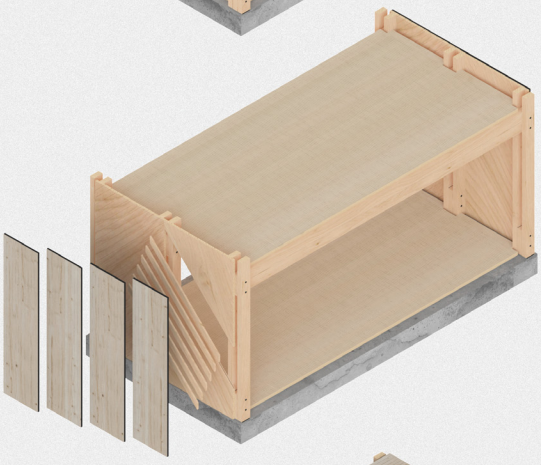
02
nlt flooring panels are used to reflect the decking found in precedent bridges

Structural Response 1: Compartmentalized space.

03
nlt slab panels act in shear, reflect the decking found in precedent bridges

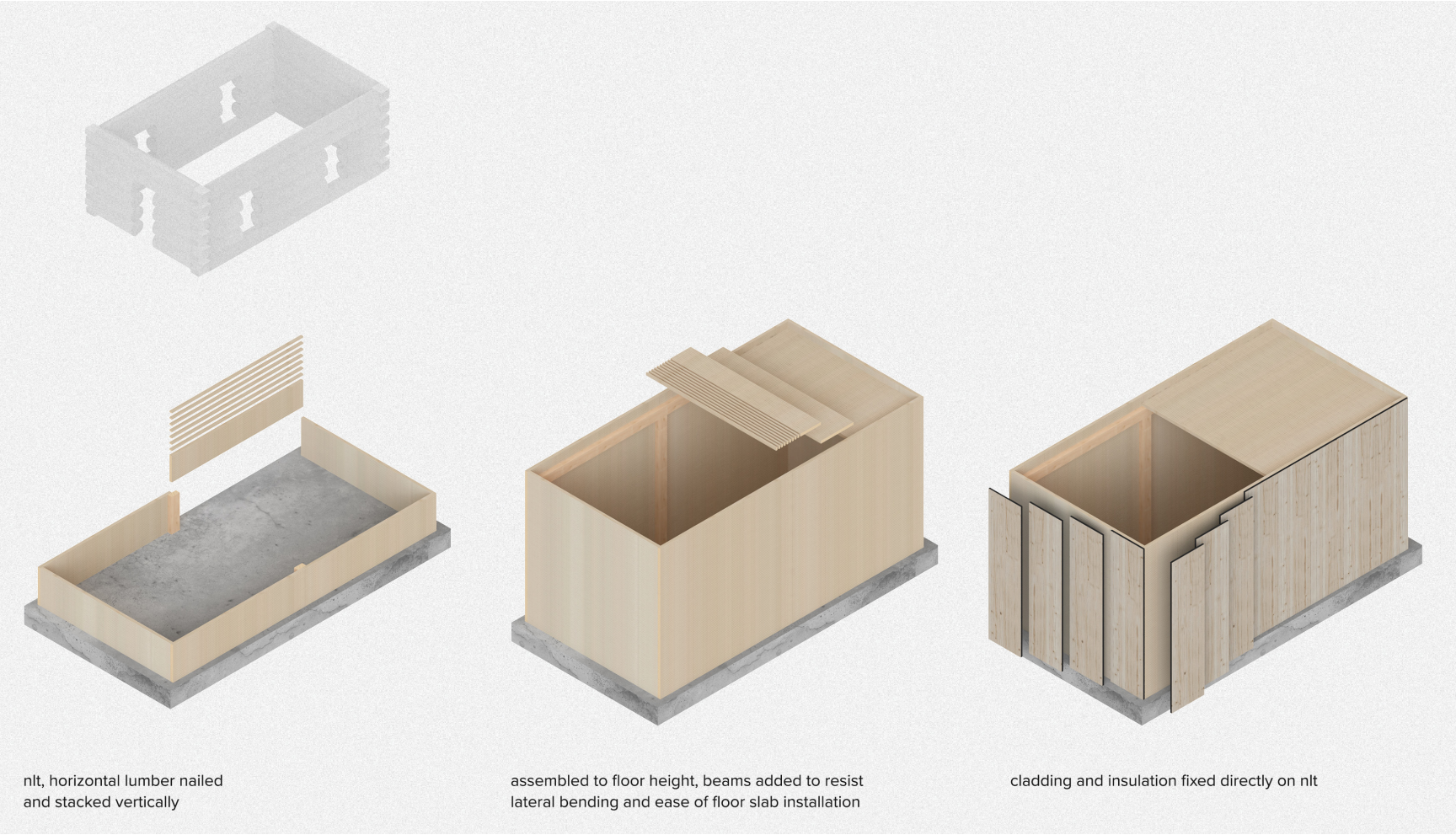


04
dimensional boards create interior finishes, shear resistance, and surface to attach insulation and cladding



05
cladding and structural relationship responds to tectonic materials and climate conditions

Structural Response 1: Compartmentalized space. (continued)

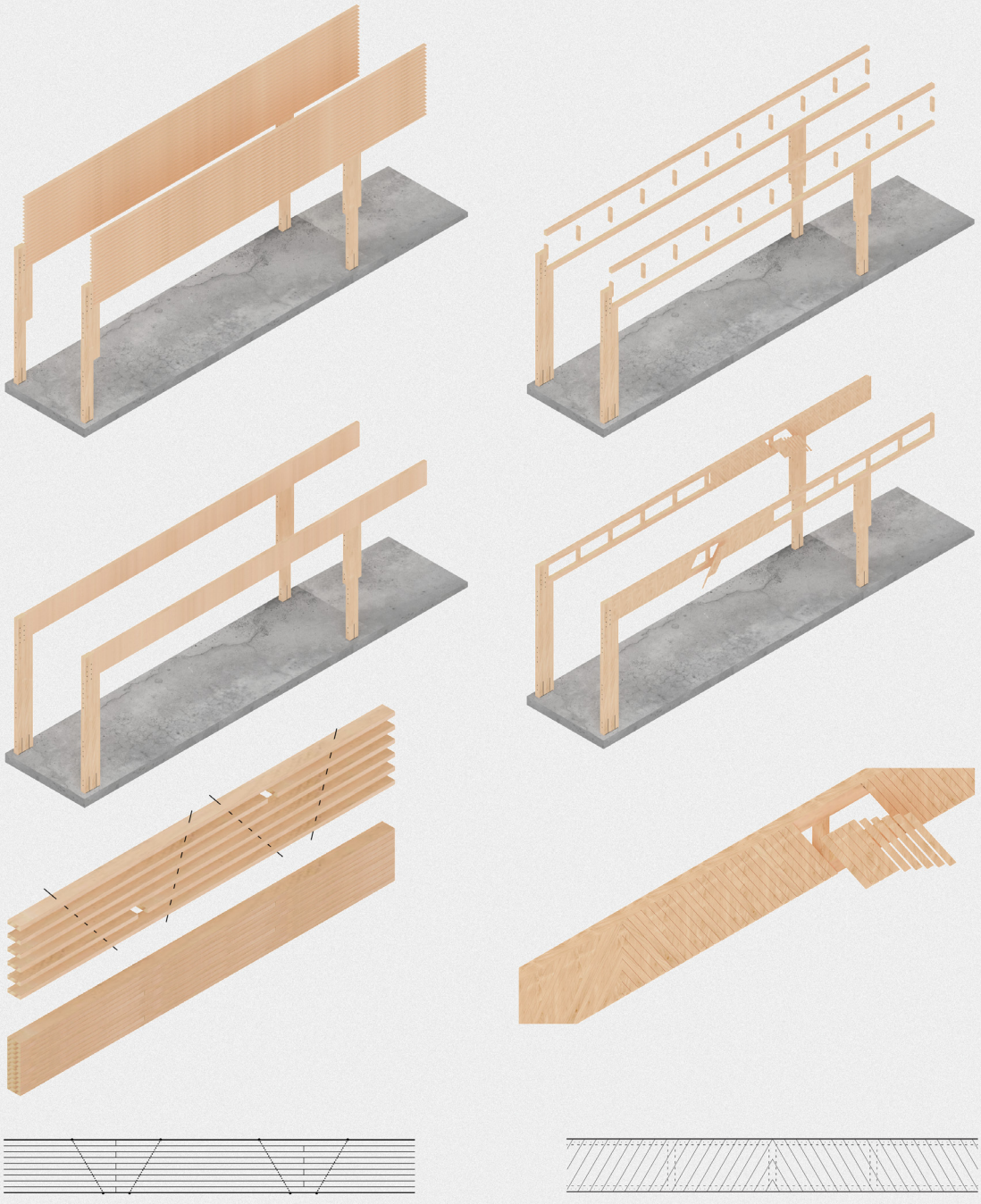


Structural Response 2: Horizontal elements, stacked vertically.

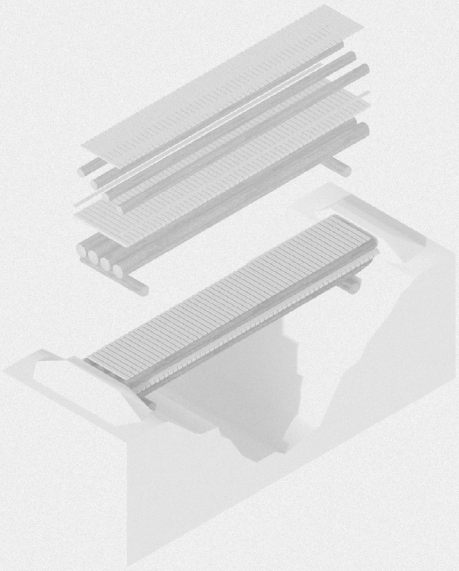
objective: make composite beam of sawn lumber, with no glue, to reflect the weight of the past timber bridges.

01
nail composite with through-bolts for shear

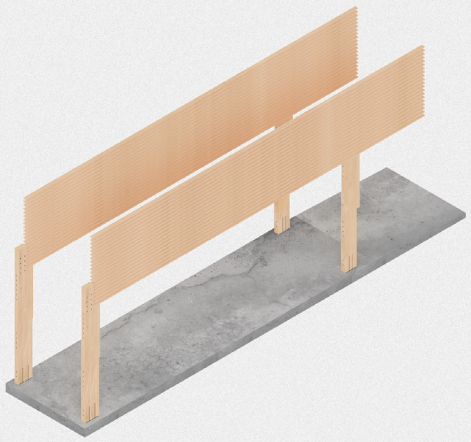
02
flat truss with board sheathing for shear



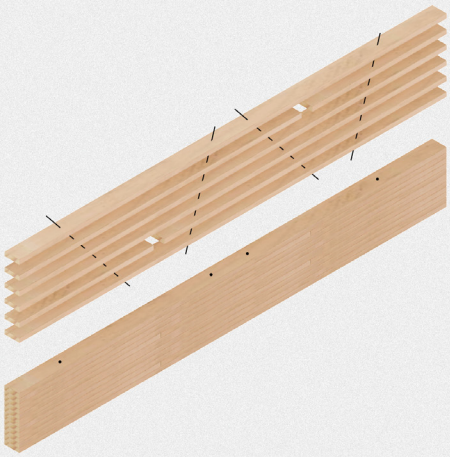
Structural Response 3: Long-span space. (process)

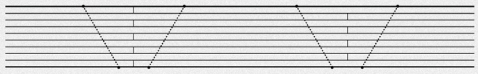


inspiration drawn from long span timber bridges, full span timbers

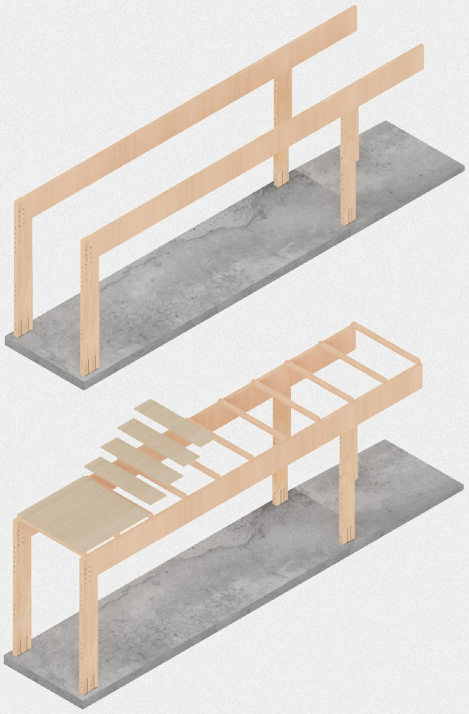


beams are built up and attached to columns (bolted sawn lumber)
columns and beams are fixed together in bents



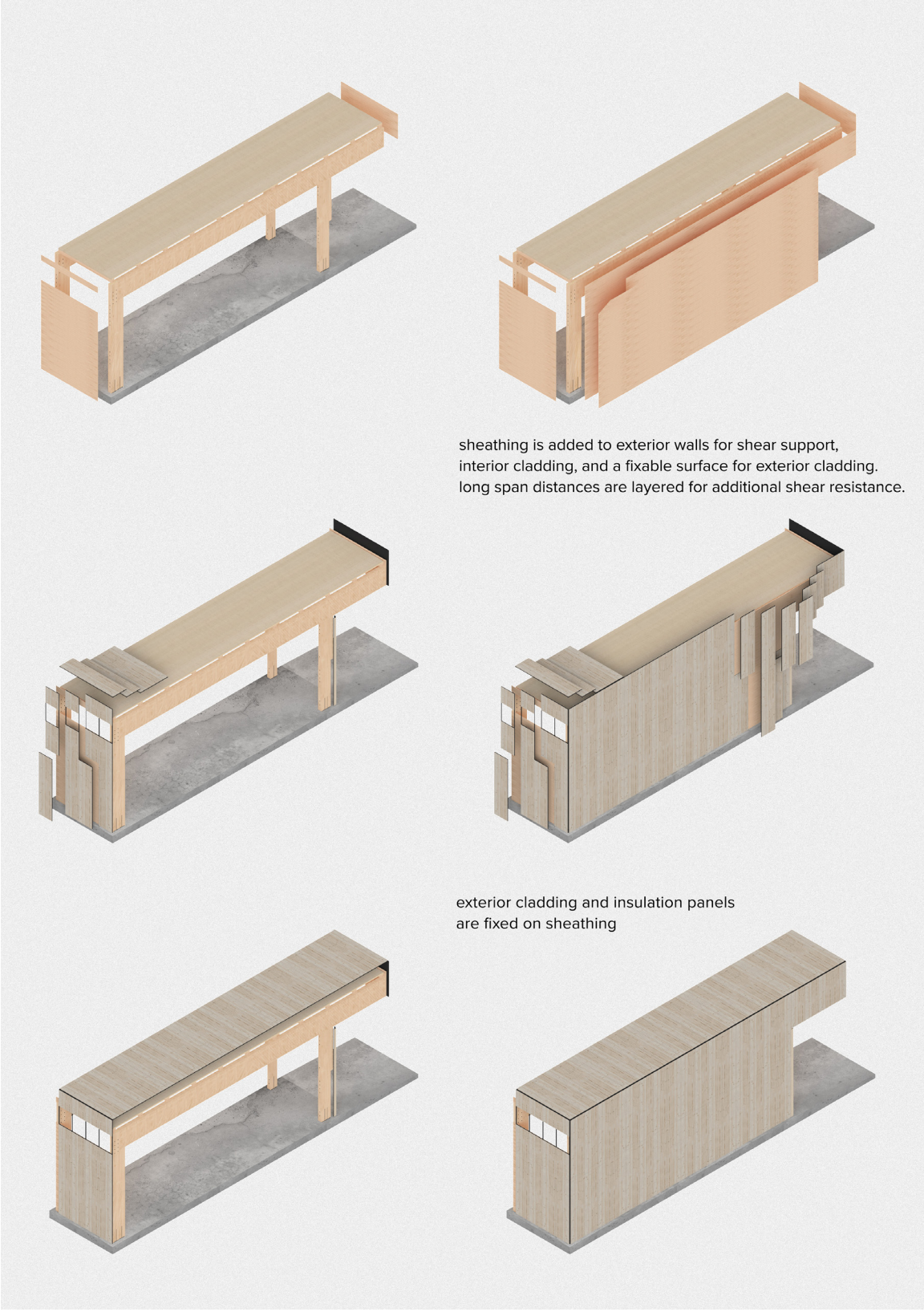


sawn timbers are nailed together vertically.
system resembles nlt.
diagonal through-bolts are added when boards are joined (for shear resistance).



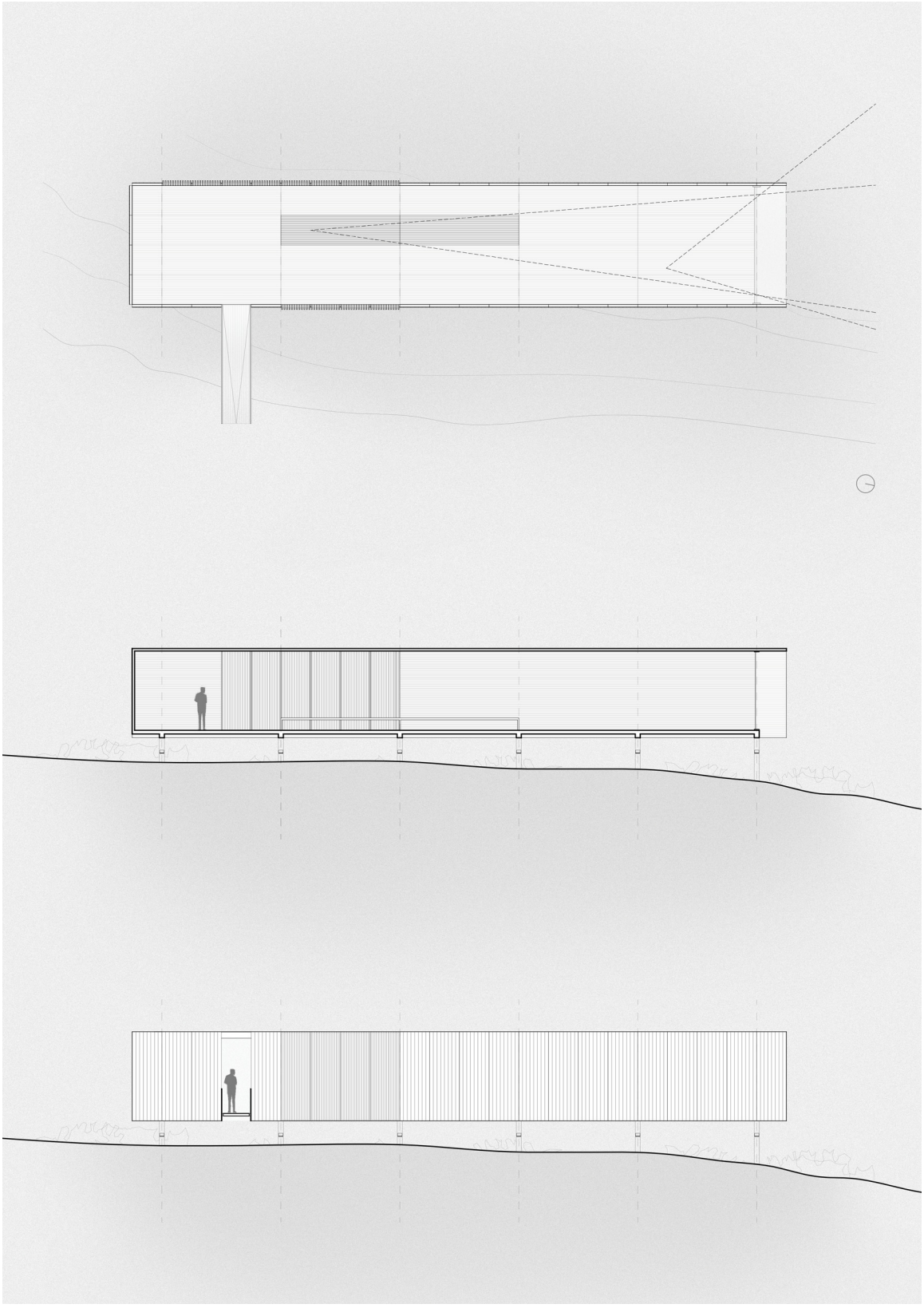
nail laminated timber panels and secondary beams are added to form 16' bays

Structural Response 3: Long-span space.



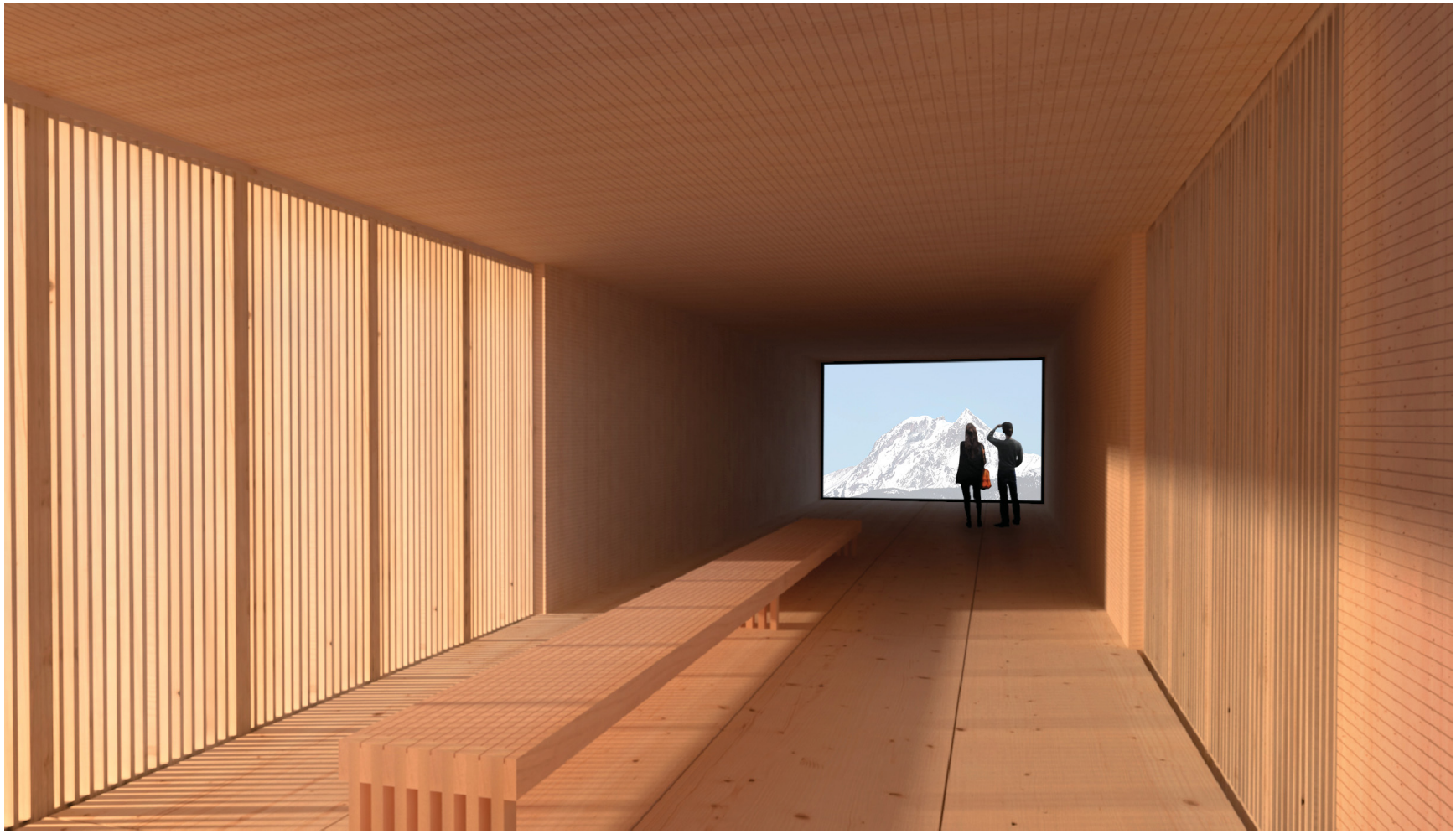
Structural Response 3: Long-span space. (continued)

Model of proposed Mount Garibaldi Pavilion, 3/32” scale. This building uses the length of the structure, combined with fixed seating, to frame a view of Mount Garibaldi.

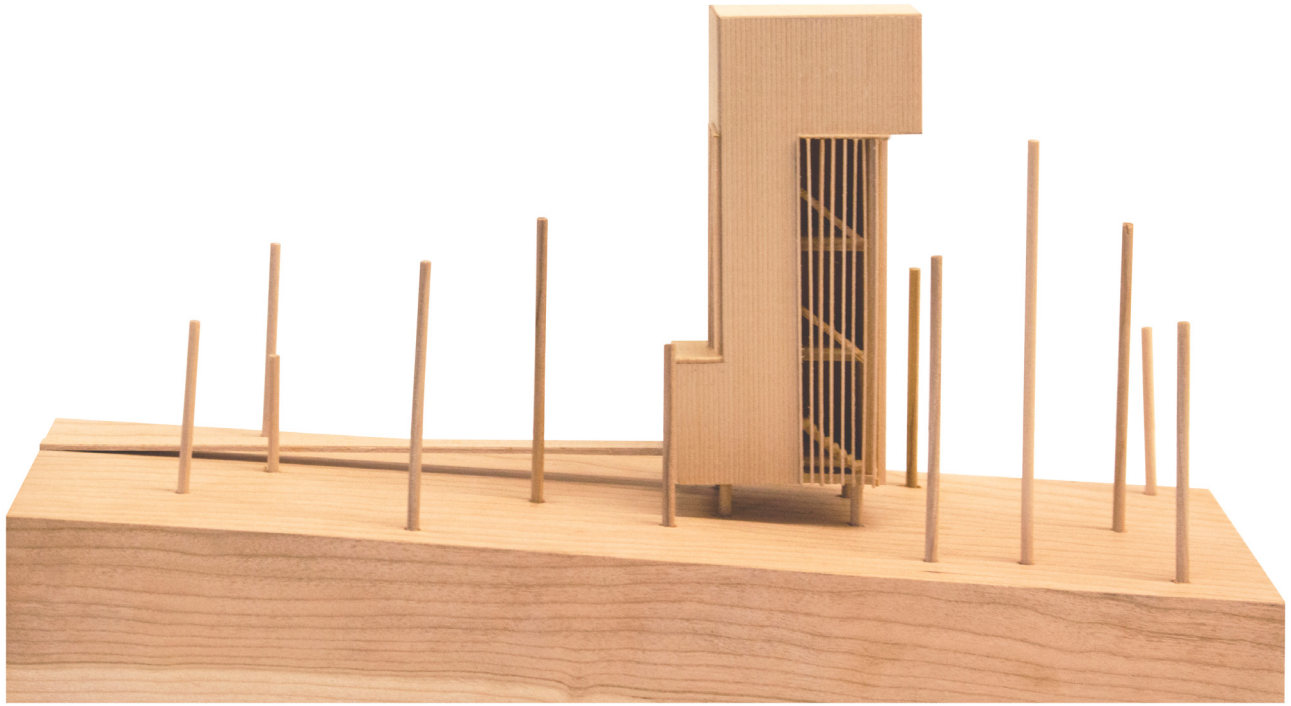


Plan, Section, Elevation: Mount Garibaldi Pavilion

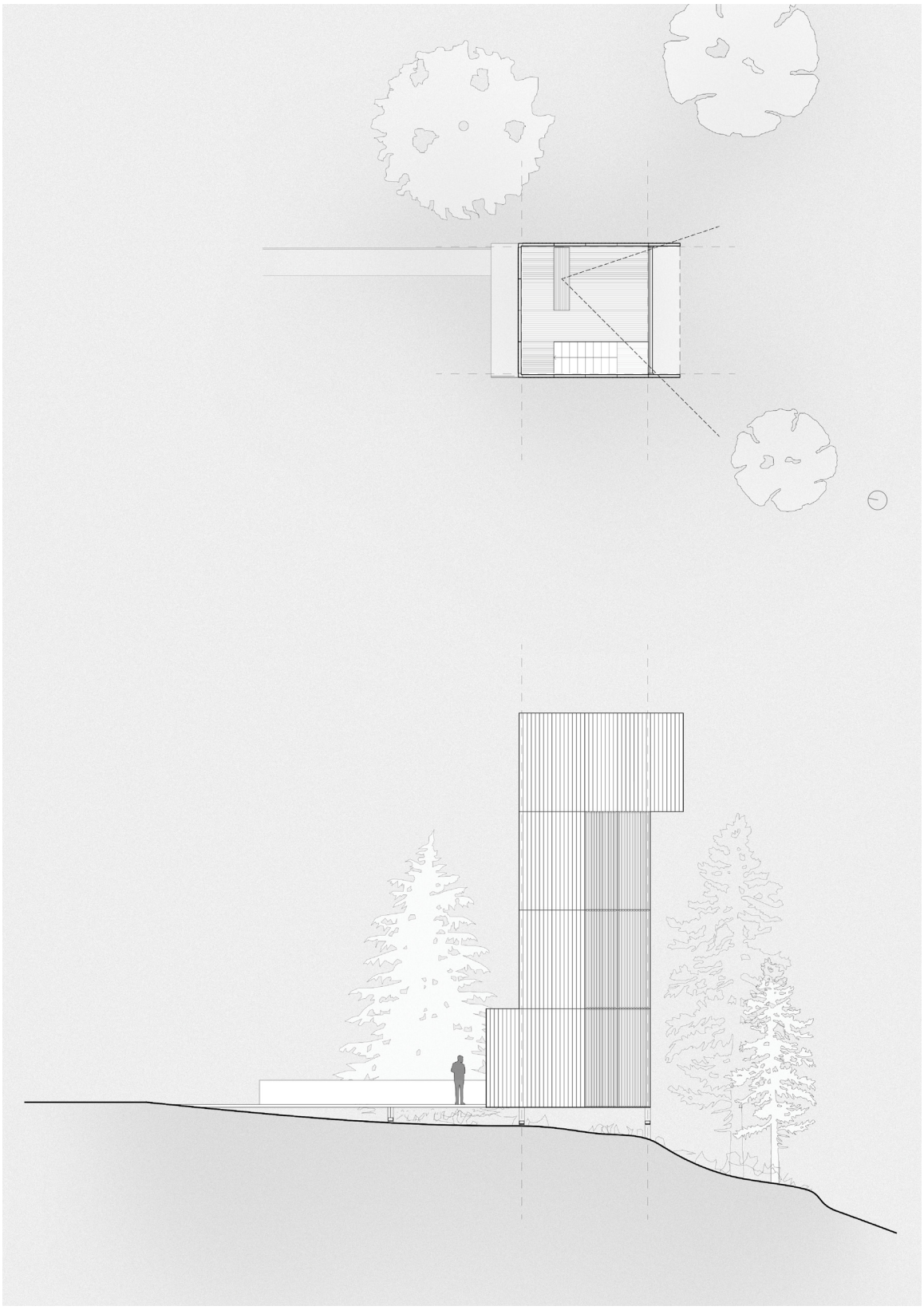
Render, exterior of Mount Garibaldi Pavilion



Render, interior of Mount Garibaldi Pavilion



Model of proposed Stawamus Chief Pavilion, 3/32” scale. The intention is to bring the users above the height of trees with an aperture to look at the Stawamus Chief granite monolith.



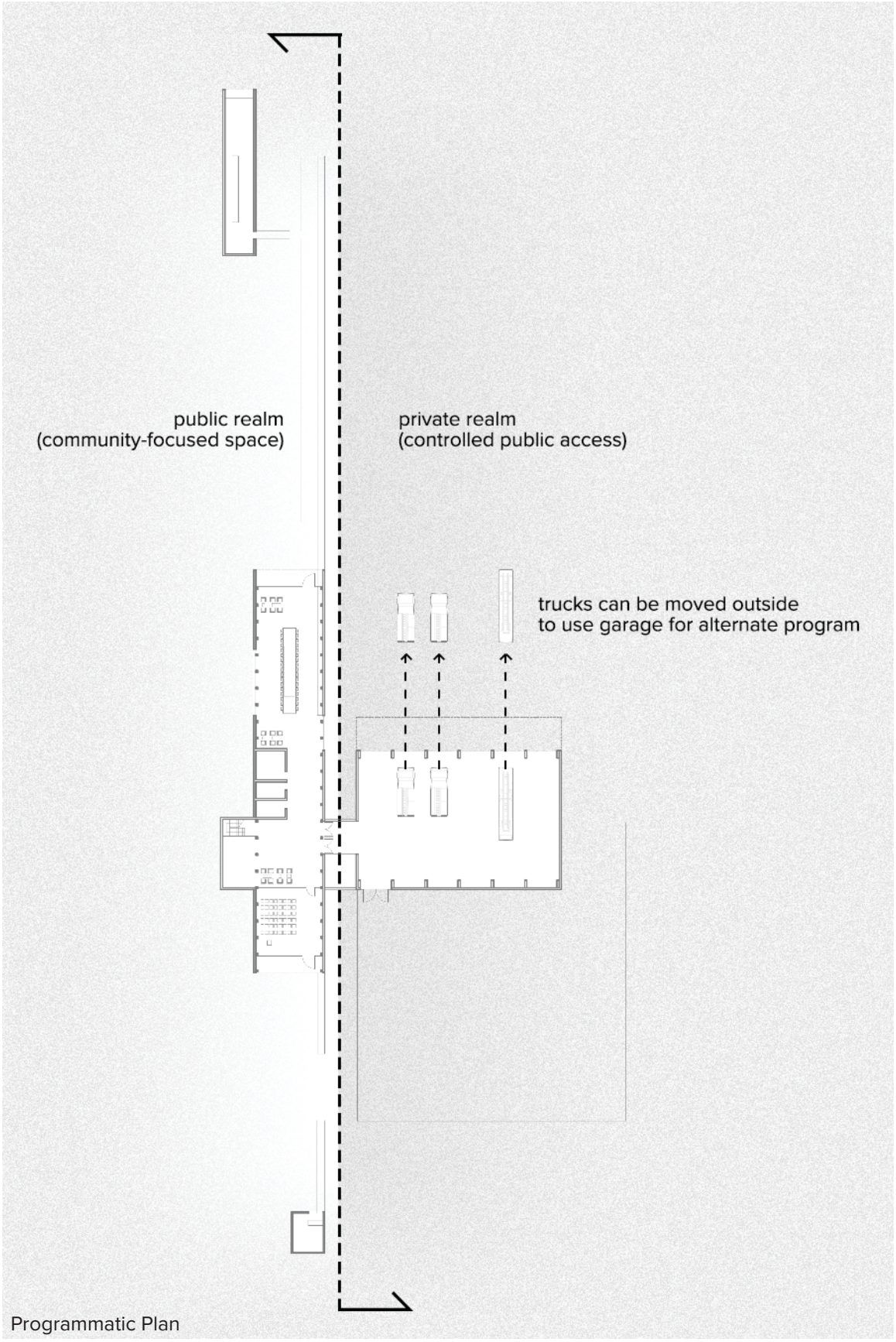
Plan, Elevation: Stawamus Chief Pavilion

Render, exterior of Stawamus Chief Pavilion

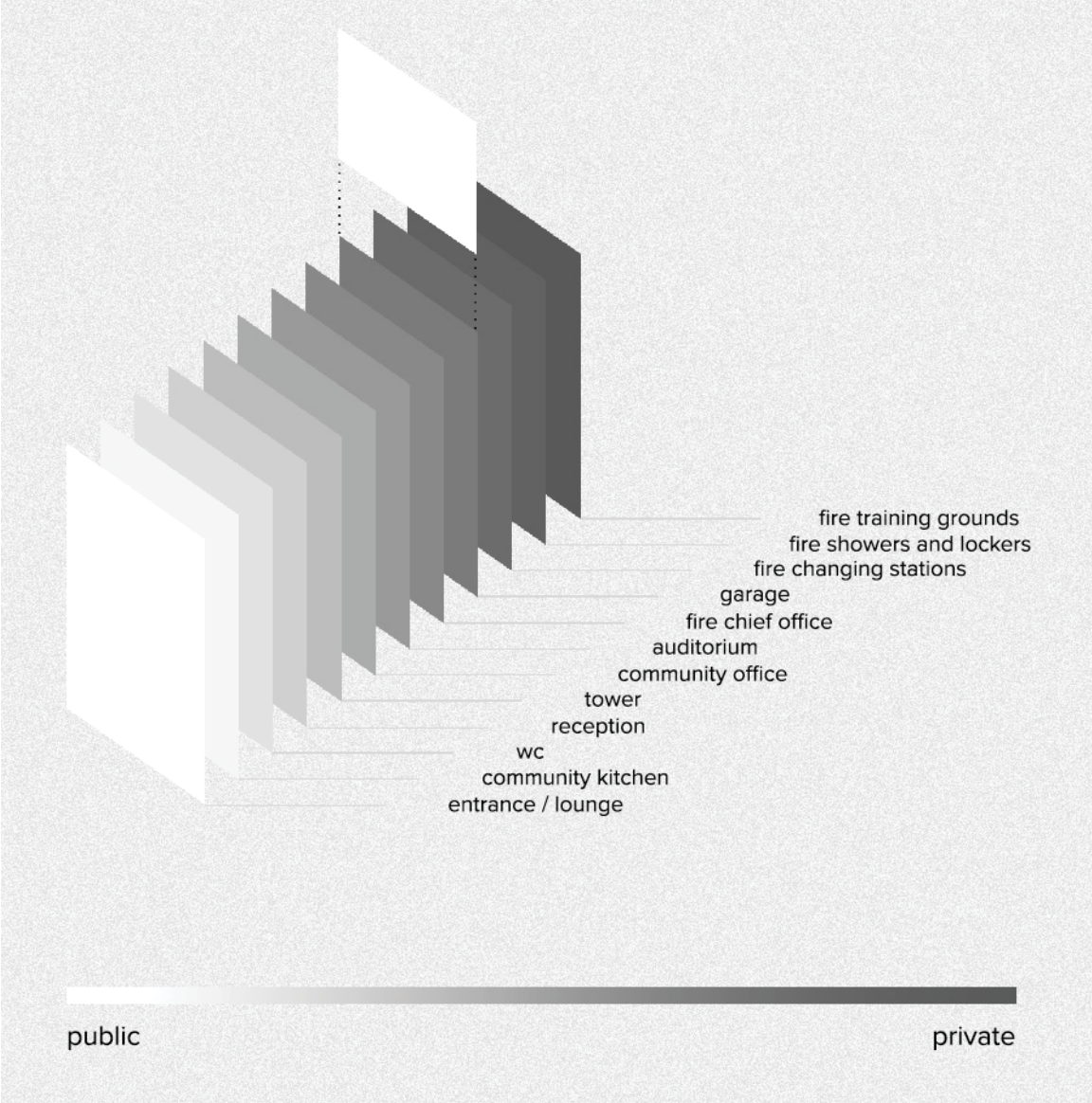
Render, interior of Stawamus Chief Pavilion

Render: proposed community gathering space / kitchen

Model of firehall, 3/64” scale.



Programmatic Plan



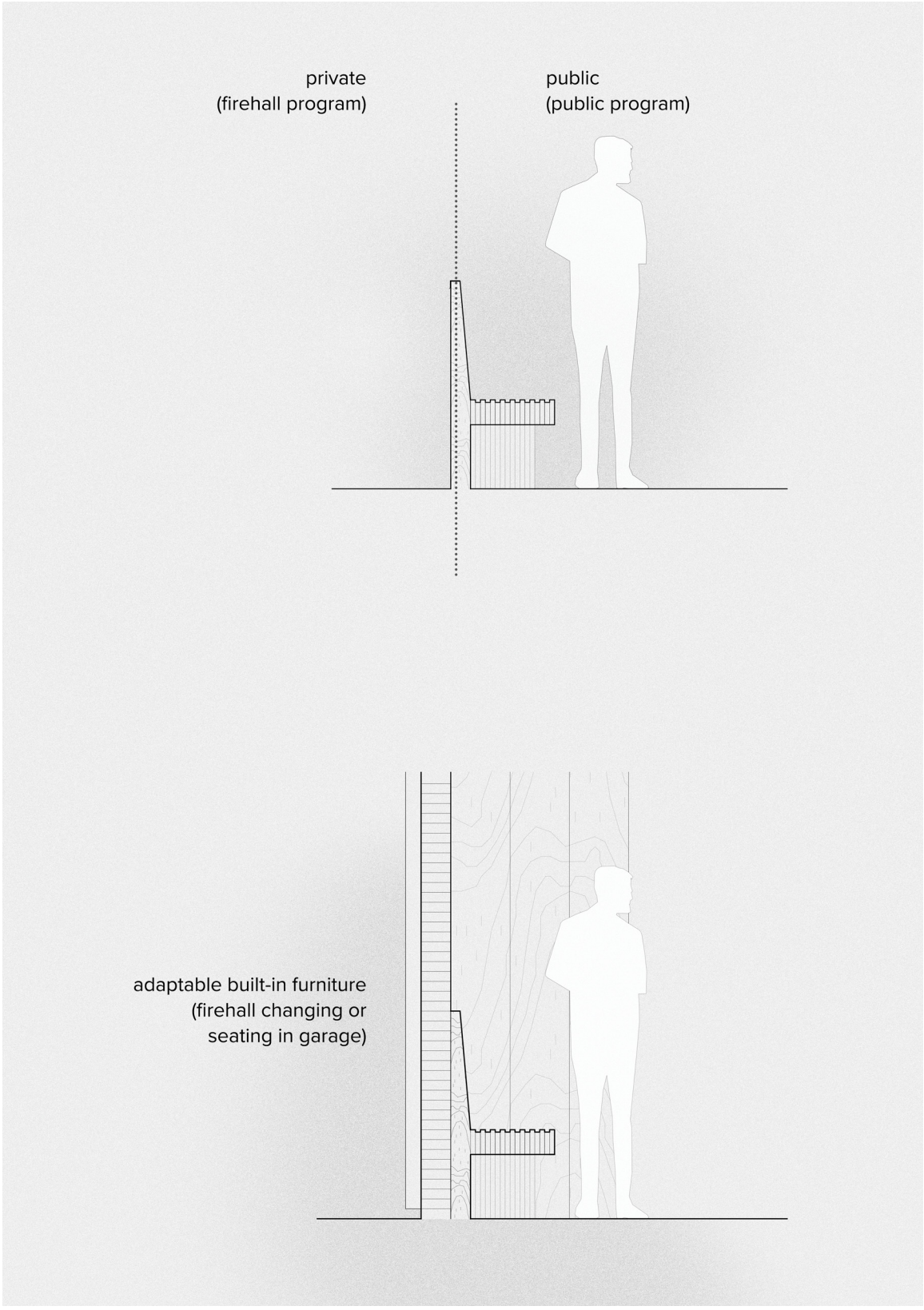
6.4 PROGRAMMATIC ADAPTABILITY

With a public aspect in a firehall, the threshold between public and private needs to be carefully outlined. The building design uses the three volumes of the firehall to separate program. With circulation running on the north-south axis, the public-private division happens on east-west.

The long compartmentalized form running north-south

houses the bulk of the public program, with access from both ends of the form. Similarly, the tower has public access. The tower of the firehall has the split function of drying hoses, stair-training fire fighters, creating a viewing platform for all, and serving as an architectural beacon from the highway. The garage, while not in use, has controlled access.

Different programmatic uses for clear-span space.



Programmatic Details

7.0 CONCLUSION

The conclusion this thesis led resulted in was focused on locality.

Architectural critic Harwell Hamilton Harris suggests that for a building to be expressed regionally, the idea must be particularized, localized and set within a region.[56] He argues that the importance should be put on the resources of the region (being environmental, labour, industrial), rather than on the limitations of that region.

Most importantly, Harris says a regionalist building should consider its climate, its topography, and the particular kinds of sticks and stones it has to build with. After exploring the assembly of tradition structures and how their design principles relate to their locality, this thesis would expand this statement to include the local workforce and how the sticks and stones are put together.

The resulting design used wood and its detailing acts as a constituent of locality. An emphasis must be placed not only on the past, but how these principles will continue to be communicated architecturally in Squamish through the future. The approach to interpreting local principles can be used in many places, however the result will only be specific to its place.

56 Harwell Hamilton Harris, “Regionalism,” in *Architectural Regionalism,* ed. Vincent B. Canizaro, 68.

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