Settled: Culturally and Climatically Attuned Interventions for Ivujivik

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This research examines the dual challenge of addressing climatic and cultural considerations in architecture, specifically using prefabricated mass timber housing in the remote Inuit village of Ivujivik. Situated just below the Arctic Circle, this northernmost settlement in a Canadian province presents unique challenges of isolation at the edge of Nunavik in Nord-du-Québec. An island, not in a geographic sense, but through its remoteness as neither road nor rail link this community to North America's industrial centers, necessitates strategic architectural planning. With a harbor navigable for only 20 days annually, prefabricated design solutions are necessitated for nearly all its building stock, where timing is essential to providing much-needed housing solutions to this distant part of the planet. A liminal condition and cultural heritage that has been disrupted by climate change.

The study is based on projects from a third-year undergraduate architectural design studio conducted in spring 2021. This period of virtual learning due to Covid-19 led to an exploration of Ivujivik's local ecology, resources, and climate, aligning architectural designs with the village's cultural, infrastructural, and environmental needs. The remote learning context paralleled the village's remoteness, making prefabrication and mass timber appealing solutions for addressing the housing crisis sustainably and culturally sensitively. Despite the lack of physical site visits and direct communication with local leaders, extensive secondary research provided comprehensive insights, including academic and multimedia sources and consultations with design experts.

The paper advocates for a holistic architectural approach that harmonizes building science with indigenous cultural knowledge and local perspectives, demonstrating the broader implications and potential of sustainable architecture in remote indigenous settings.

A SENSE OF PLACE

Ivujivik translates to 'the place where ice accumulates because of strong currents', and the likely landing spot of the ancient Thule tribe as the entry point from Baffin Island into the present-day province of Quebec. The village is surrounded by cliffs that plunge deep into the turbulent waters of Digges Sound, and where strong tidal currents of the immense Hudson Bay and narrow Hudson Straight o collide and churn, causing dramatic ice shards to form in winter.

This region has been occupied for thousands of years as a seasonal village by the semi-nomadic Thule ancestors and the First Nations Inuit (Nunavummiut) and the natural harbor provided ample fishing and hunting grounds. It was nearby, on Digges Island, that the Inuit of Nunavik made first contact with Europeans, in 1610 on Henry Hudson's last voyage. In 1909, the Hudson's Bay Company set up a trading post at the present location, followed by the establishment of a Catholic mission in 1938, leading to the gradual settlement of Inuit near these sites after 1947. The federal government began providing services in the 1960s after the mission closed, and in 1967, the Inuit of Ivujivik established a cooperative store and a more formalized settlement.

The landscape is an Arctic tundra covered in lichen, mosses, and dispersed peat bogs and devoid of trees. 2,000 kilometers north of Montreal, and 1,000 kilometers north of the boreal forest and the taiga region which covers much of southern portions of Canada. Ivujivik, like much of northern Canada, is isolated.

Historically accessed by the outside world only by boat and short journeys on land until the late 20th century. In the wintertime, Inuit would use animal skins to insulate, whale oil for heating, and other local resources to create warmth, light and comfort for their interior environments during the long, cold nights of the winter. Maintaining a connection to local, natural, and renewable resources was seen as an important bond to the vernacular across multiple cultures studied.

CULTURAL AND SOCIAL CONSIDERATIONS

Architectural and social responses to Canada's Nordic region encompass more than just solar geometry and building science - a deeper understanding of the diverse geographic and cultural conditions that define this vast area and rich heritage. In Lola Shepperd and Mason White's book *"Many Norths,"* they build

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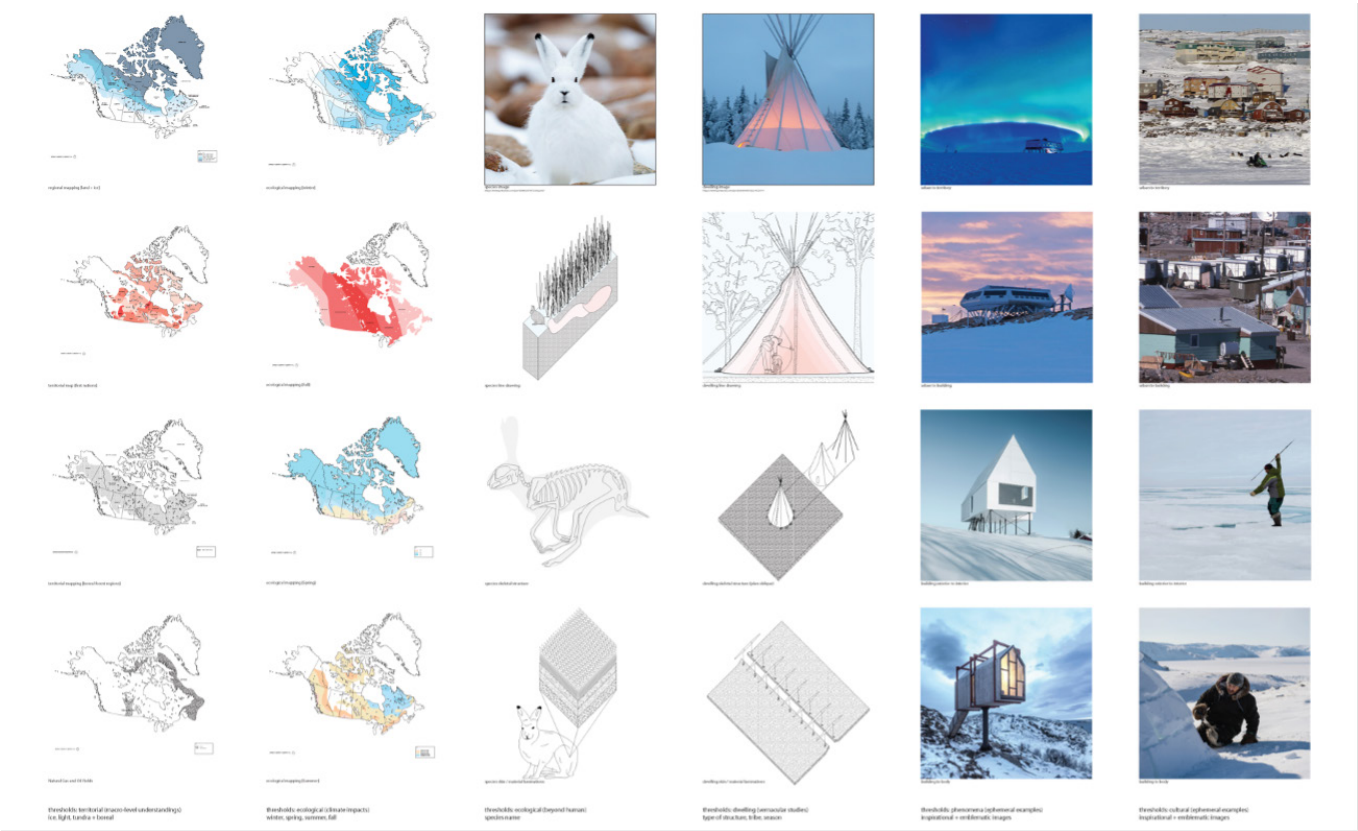

Figure 1. DNA Matrix drawing describing the territory, climate issues, thresholds of biological and vernacular architectural systems, and current cultural situations within the region. Image Credit: Colton Grieger.

upon Louis-Edmond Hamelin's concept to explore the multifaceted nature of this expansive territory by presenting a nuanced approach that considers ten distinct factors, including economic aspects, infrastructure, the boreal zone, mean summer temperatures, the Heating Degree Days Line, and permafrost.[1] Ivujivik, situated beyond these conventional markers, exemplifies the complexity of categorizing regions in the Canadian Arctic, demanding a more comprehensive and adaptable framework for understanding and addressing its unique environmental and societal challenges. With median temperatures range from –24°C in January to 11°C in July, its northness is unquestioned.

ARCHITECTURE AS AN EMBODIMENT OF CULTURE

In Barry Lopez' 1986 book *"Arctic Dreams: Imagination and Desire in a Northern Landscape"* is an evocative and meditative exploration of the Arctic landscape, its wildlife, and its history. Lopez blends travelogue, natural history, and philosophical reflection to create a rich and nuanced portrait of the Arctic. In one passage, Lopez describe the difference between indigenous culture and ours is that "we have irrevocably separated ourselves from the world that animals occupy."[2]

The Inuit, and many other indigenous tribes, utilized biogenic and natural occurring resources within dwellings to reinforce relationships and reify the natural world through cultural beliefs. As students became engaged with this foreign land, history and culture, extensive study was required to better comprehend the many ecologies of Nunavik and the Nord-du-Québec (Figure 1).

As an embodiment of culture, architectural artifacts can connect humans to our histories. Architecture has long been used to establish dominance over native populations by directly embodying power structures and distant cultures they represent. Inserting architectural forms that ignore the indigenous culture or the vernacular rooted in climate specificity, local or natural materials, and the place is a form of colonization.

The Canadian government during the 19th and 20th centuries used formal settlements to fix indigenous populations of northern Canada to lay claim to extensive lands to the north. However, indigenous histories of seasonal migration and connection to the natural world were severely altered. Additionally, climate change, overfishing, and the exploitation of the European whaling industry from the mid-1800s decimated the once extensive local food supply of wild animals and inhibited the Inuit's ability sustain their livelihood. This caused local populations to rely more and more contemporary means of living including the importation of food, clothing, and even buildings to survive.

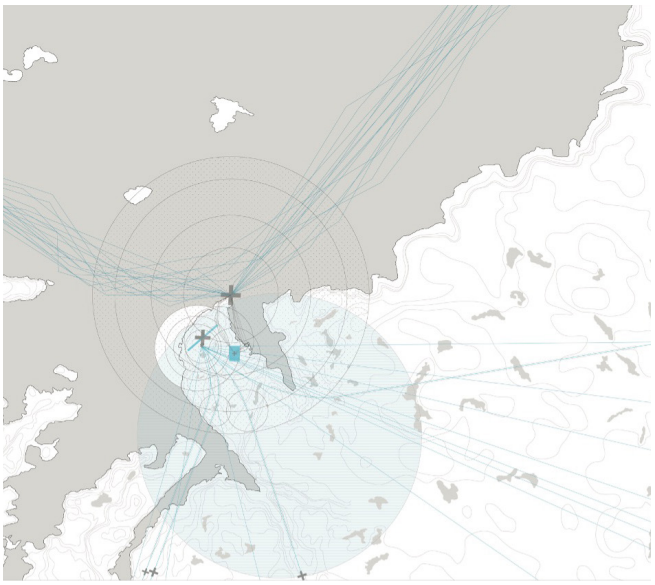

Figure 2. Mapping regional connectivity; nautical, aerial, and land-based migration patterns within Ivujivik. Image Credit: Juliet Hollister.

CONTEMPORARY CHALLENGES AND CONSTRUCTION

Housing remains a primary need for the Inuit population in Canada, with many of the 60,000 residents living in small, often underprivileged communities. It is estimated that 53% of Nunavik families are living in overcrowded homes.[3] This situation, exacerbated by health issues such as chronic lung disease and high suicide rates, calls for a critical reevaluation of architectural design and material choice in these underserved areas.[4]

Ivujivik, a typical Inuit community, exemplifies remoteness, situated far from major North American population centers like Montréal, Québec City, or Toronto, with no road or rail connections to major metropolitan centers and their industrialized building material infrastructure. While there are local roads connecting similarly sized Inuit communities along the coast, with twice daily flights by Air Inuit bringing essential supplies to this 414-person community, larger shipments of buildings and materials only occur during the 3-week window when the harbor is ice-free. The student mapping above illustrates the geographic precarity along the northern coast with connections to the outside (Figure 2). This location demands a contemporary approach to solving the housing shortage, that must be imported.

Prefabrication in construction offers numerous sustainable benefits, particularly in remote areas like Ivujivik.[5] Employing robust and renewable materials like mass timber through industrial prefabrication offsets the limitations of local building resources and skilled labor. However, it also presents challenges, as the design and construction of these units must occur in advance, to be shipped and deployed during the brief navigable period. This requires precise planning to ensure the quality and durability of the housing units, which are critical in the harsh Arctic environment.

Industrialization has intensely impacted the construction industry since the late 19th century, however timber has only played a "subordinate role." [6] Recent changes to the International Building Code (IBC) provided allowance for using cross-laminated timber (CLT) in exterior/interior walls, floors, and roofs for Type IV Construction, initiating several advances in the design and construction of mass timber buildings. While much has been published on this topic recently, it is important to reinforce that utilizing local, renewable resources is an effective means to store carbon and offset life cycle impacts" and possible achieve negative-zero carbon solution for buildings.[7] Advancements in life-cost analysis and the shift from a "prescriptive approach to sustainable design toward systematic, performance-based considerations" allows designers to make better informed decisions about what materials and products utilize.[8] From this new and multi-faceted vantage, there are three primary rational for investigating mass timber products for housing in Ivujivik.

OPPORTUNITIES FOR CULTURAL CONNECTION

Mass timber offers an excellent solution to many of these challenges, ensuring more resilient, environmentally sustainable, culturally sensitive, and practical housing solutions for the growing population of Ivujivik.

The cultural significance of using bio-based, organic, and locally sourced materials creates a veritable connection to the locale and indigenous culture of the Inuit people. Historically, the Inuit and their Thule ancestors erected temporary structures and camps from naturally occurring materials readily available as they followed animal migration patterns, fishing near the sea, or gathering, farming, and trading.[9] Driftwood and shrubs were the primary wood source, along with bone, and other naturally occurring materials which washed onshore as primary structural components of their dwellings, boats, sled and for heating.[10] These materials would be gathered in the summer, with the assistance of ocean currents, and transported back to fabricate seasonal settlements. Utilizing mass timber harkens back to the cultural connections to wood. Timber is a renewable resource that can be sustainably harvested and is readily available within the province of Quebec, using contemporary pre-fabrication methods and summer shipping lanes to convey natural materials to Ivujivik harbor en masse.

Canada has abundant national resources, and is home to 9% of the world's forests, covering over 361 million hectares and 38% of the country's land mass. With over 90% of these forests on public land, the government has well-organized silviculture practices for sustainable management of these areas, and could safely employ these resources for the upcoming building boom. Sustainable harvesting is key, as it seeks to maintain residual forest structures dispersed evenly throughout and grouped into islands of intact pieces of forest that are left to maintain diversity and protect wildlife habitat.[11] Sustainably harvesting certifications such as FSC "must be paired with legal protection of intact forests if biodiversity and ecological services are to be

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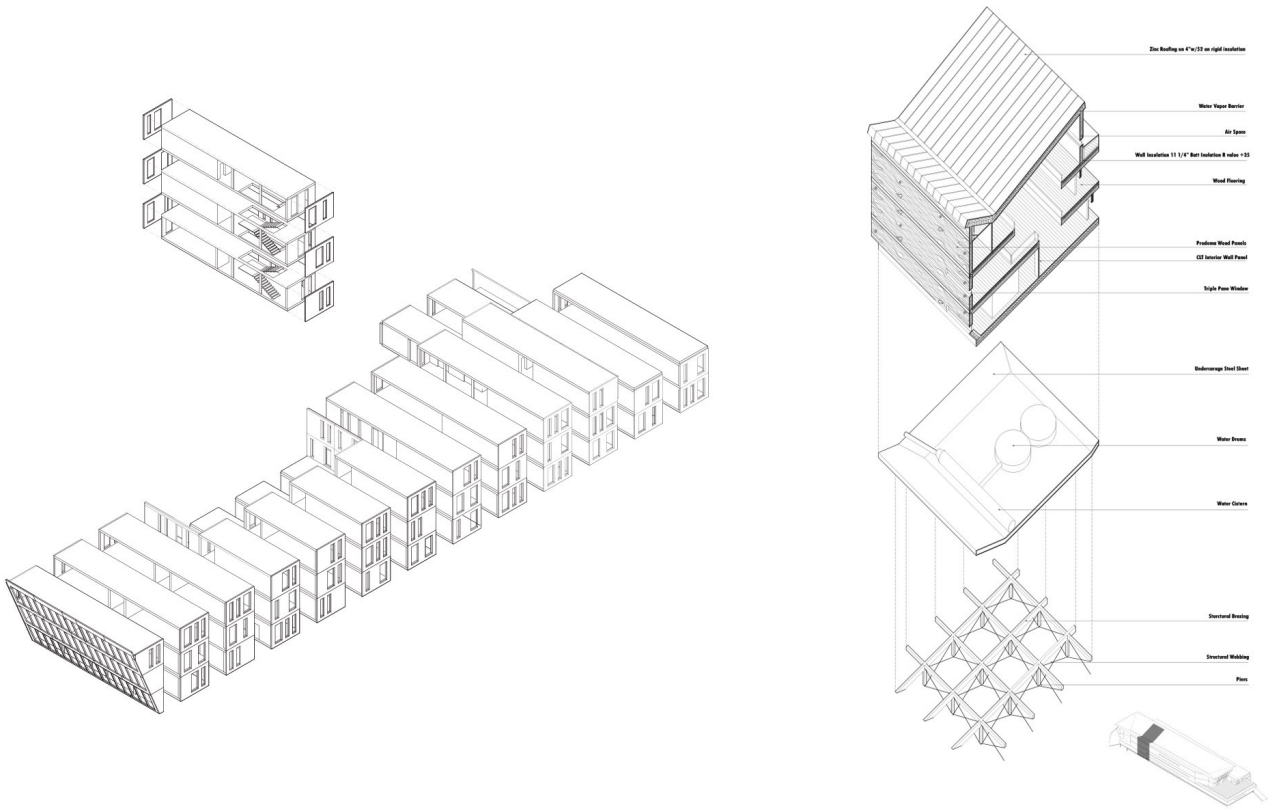

Figure 3. Building module drawing and exploded isometric drawing demonstrating constructability and assemblage of students' design for prefabrication. Image Credit: Joseph Garcia, (left), and Robin Hatherill, (right).

maintained over time."[12] Sustainable forestry practices aim to promote new growth to preserve renewable resources while conserving invaluable ecological zones of biodiverse areas. Similar to collecting driftwood, sustainable harvesting of existing timber resources could be a carbon-negative exercise and help solve the housing shortage while ensuring cultural connection for Inuit communities like Ivujivik.

Lastly, Québec has four manufacturing plants for mass timber and expertise working with the robust store of timber resources. Nordic Structures, based in Montréal, manufactures CLT and glue-laminated timber (GLT) products at its Chantiers Chibougamau Limited plant. The major Quebec ports for shipping cargo to Ivujivik are Montréal, Bécancour, and Quebec City. CLT is structurally stable, thermally massive, and easily assembled for modular housing applications, while GLT would be utilized for taller structures and longer spans and can replace steel and concrete in beam, columns and other load bearing structures. The benefits of using mass timber for housing offer a robust yet lightweight material that can withstand the environmental impacts of the Canadian Arctic while creating a liveable space that better connects the Inuit to their land and sturdier, more resilient materials that could reduce reliance on future materials for repair.

STUDIO METHODOLOGY

This undergraduate architecture design studio was offered in the spring of 2021, amid the Covid-19 pandemic, and offered entirely virtual. The studio prompt of 'Remote Control' was born from the idea of remoteness and attempted to recreate connectedness through a virtual, synchronous studio format using platforms such as Zoom for audio and video connections and Miro as a virtual studio 'pin-up' space to record the ongoing and iterative student work. With two semesters of virtual studios previously completed, the format was fine-tuned by inviting several experts to present virtually to the studio to present their ongoing work and expertise in environmental design, mass timber fabrication and implementation, cultural connectivity, and Arctic design via remote interviews and presentations. Since travel was cost-prohibitive and a health risk due to the ongoing pandemic, experts joined via Zoom from the University of Montréal, Arctic Design Lab, and several architects, building scientists and engineers who deal with the climate complexities, mass timber and native communities. Climate specialists and mass timber engineers joined virtually for design reviews and discussions essential to the studio's success.

The specificity of choosing a remote location such as Ivujivik premeditates some design decisions, such as prefabrication

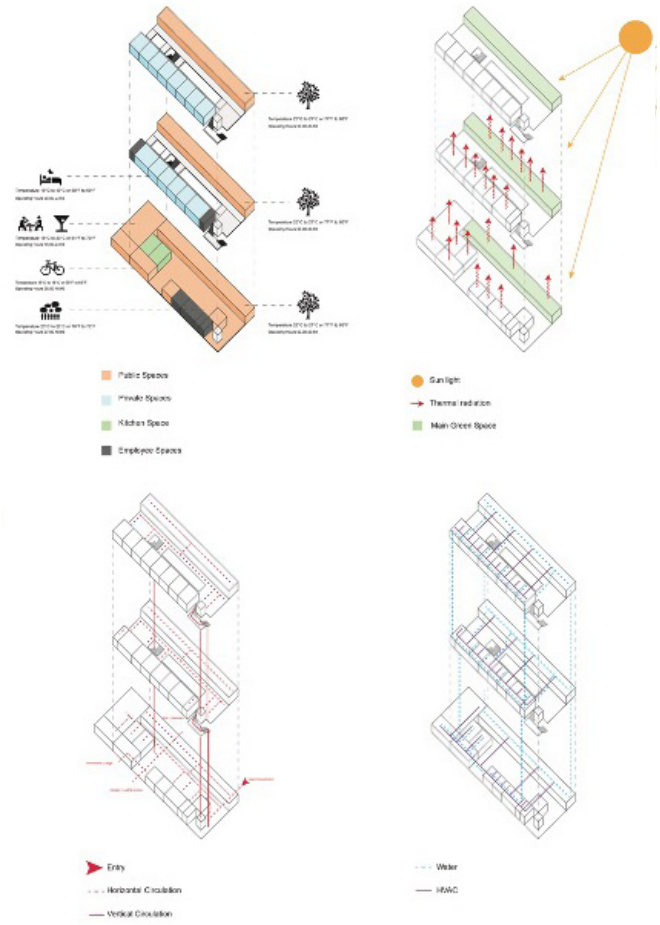

Figure 4. Systems diagram of open and closed systems that exchange with the larger environment. Image Credit: Timothy Tipparch.

and climate-based design strategies that deal directly with the severity of the site. The realities of the place were presented as the precursor for design decisions. The studio investigation was organized in the following ways;

1) explore local resources and seasonal climatic conditions - both historically and currently - of Inuit in Nunavik,

2) research qualitative and quantitative understanding of renewable and biogenic materials for sustainable architectural assemblies, and

3) speculate on prefabrication possibilities of mass timber in contemporary design for architectural interventions within remote locations.

From the onset, pre-fabricated housing modules were mandated while the benefits of using carbon-negative and renewable building materials for architectural ideation was established as a cultural connection. Students were asked to investigate specific methodologies of construction for their building designs to understand the fabrication and assembly processes (Figure 3).

Initially, students began researching existing climate and weather patterns within the area, coupled with the selecting a specific indigenous group to understand how vernacular structures varied depending on resource availability, climate, and culture.

Students were also asked to find exemplary case studies of contemporary buildings that embodied the region to address preconceived notions of representation and place-making. The final portion of semester's initial research phase was for each student to pick a native animal from the Arctic region of Canada to study skeletal structures, thermal resistance through skins, furs, and fat tissue, and how each animal burrowed, hibernated, or migrated throughout the year as a toolkit of vernacular and biomimetic structures rooted to place (Figure 1).

During the research phase of the semester, which included interviews with people and experts from the community, the studio grappled with the humanitarian disaster of housing in Canada's Aboriginal region. Addressing the severe housing shortage in Canada's northern territories requires sustainable solutions that improve material use and create comfortable living spaces. Solid wood provided by mass timber interiors offer more resilient surface and a lower thermally emissive material to increase thermal comfort. Pairing this technology with thermally efficient windows enhance comfort while also addressing overcrowding and enhancing liveability.

Attempts were made to design spaces that are enjoyable to live in during the long, dark winter months without negating a physical and phenomenal connection to the site. The studio emphasized airtight construction and innovative prefabrication techniques to meet these challenges. This approach prepares students to address climate change's impacts on future architecture, equipping them with the skills and knowledge to develop solutions that are environmentally sustainable and culturally respectful. Larger programmatic concerns demanded that students address the local community through a shared amenity space(s) to better connect designs with the village context.

During the second phase, as students grappled with the environmental and site contexts such as the sloping permafrost, existing rural community, and the sea, the architectural program was introduced. Accompanied by a series of readings, film screenings, and lectures from outside experts, students developed 'wildcard' spaces that introduced a specific need or amenity that was either lacking or required attention. For example, some students determined that a community meat locker and kitchen would be beneficial, others a community library or café, and others still thought an indigenous heritage center or greenhouse would be most appropriate. This offered a diverse array of architectural solutions that were tied to the people and designed with the larger community in mind (Figure 4).

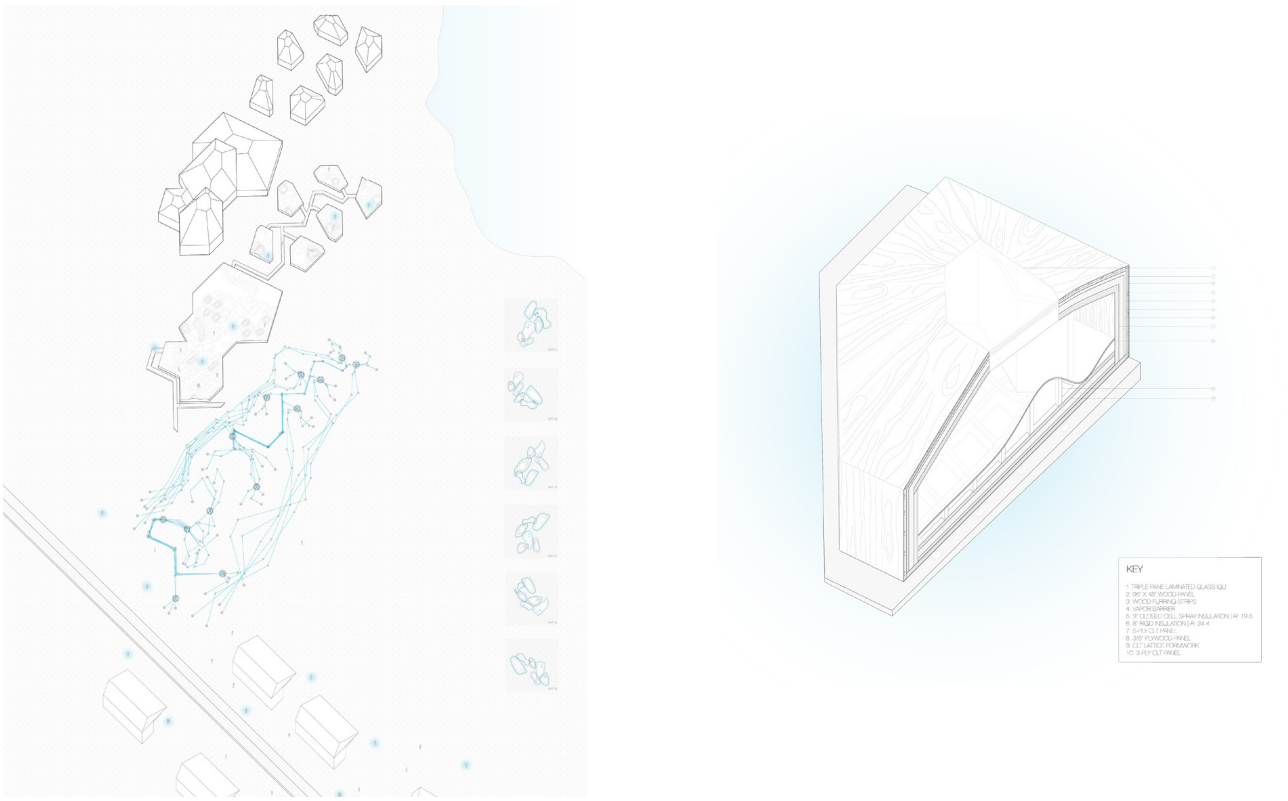

Figure 5. Overall modular housing assemblage (left) and 'bay model section' translating the insulative properties of arctic hare into the thickened 'poche' of the architectural envelope. Image Credit: Juliet Hollister.

Coinciding with the mid-term review, students were asked to break down their prefabricated modular systems into their component parts. This translated initial room modules based on the structural and manufacturing limits of building with timber through to the aggregated building designs (Figure 4). For the final phase of the semester, students were required to create animations to show the construction process of how these individual components would be brought to the site, staged, and assembled for the final built project. These simple exercises required an understanding of the construction processes as well as regard to dimensional limits posed by the material.

LESSONS LEARNED

The unique global location offered a counterpoint to the student's tendency of taking solar exposure for granted. The limited daylight hours, a total of only five hours during the winter, coupled with nearly twenty during the summer months, students explored the region's unique climate, including extreme variations in daylight and temperature, and how local fauna and people adapt to these conditions. Their studies, supplemented by readings and films, provided insights into environmental challenges like sun angles and temperature shifts. Emphasis was placed on understanding the dynamics of the Arctic environment, thereby informing design choices that are both ecologically sensitive and culturally appropriate. This comprehensive approach integrates traditional knowledge with modern architectural techniques, ensuring that the built environment harmoniously blends with its natural surroundings (Figure 5).

FUTURE DIRECTIONS AND RECOMMENDATIONS

The current housing stock for Inuit populations across Nordic Canada is both inadequate in number and isolates occupants from culturally valuable environmental connections. Flimsy construction techniques inhibit occupants to easily manipulate or mend their structures once deployed. It is the hope that by studying a more reflexive model both designers and users could pair culture with climate requirements for more resilient architectural models. Using more robust, and permanent materials can foster more emphasis on self-reliance while dismantling the exploitative power structures that have been in place since first contact.

While the studio researched the local community and indigenous vernacular structures to attempt to reconsider building practices that can reconnect the Inuit people with their natural surroundings through architecture rooted in phenomenology and culture. It could be argued that any architecture designed and constructed without the input of the citizenry and culture would continue to reinforce colonization structures. This topic would be an entire paper unto itself. The studio itself was speculative, using technical with ecological and environmental knowledge within a single, sixteen-week semester.

Purely technical rationale, solving only issues of acclimatizing the interior space without considering connecting the people to the land ignored the indigenous culture and history of colonization embedded within the architecture. Throughout the semester, students grappled with fanciful design ideations and the harsh reality of climate, culture, and construction, ultimately balancing the imaginative with the pragmatic. Many students desired to engage the sky, stars, and distinct landscape features keeping in mind tha importance of maintaining minimal envelope penetrations to the thermal envelope. This differs somewhat from more traditional architecture studios in more temperate environments that can more freely employ fully glazed floor-to-ceiling façade solutions in that more nuanced and purposeful strategies are required. While others wanted to address the lack of fresh food by incorporating space for agricultural production within the public spaces to increase the self-sufficiency of the local population and embrace the long and sunny days of summer.

CONCLUSION

There are many complexities embedded within architectural constructs, including technological, material, and social. Designers could benefit from reframing environmental design through the lens of culture and meaning.

The Inuit people have gone through an incredible shift from nomadic to settled in the past seventy years. These changes have massively affected the population's mental health and well-being. This studio's investigative work offered a learning opportunity for the faculty, students, and critics involved throughout the process. The connections forged with scholars, architects, and technological specialists left a lasting impression on the students enrolled in the class. Even today, faculty and students often reference the overwhelming success of the studio as it asked important questions and elicited novel solutions that were both practical and inventive.

If provided the context to offer this studio again in the future, is to dialogue more with the Inuit community directly, to integrate more indigenous knowledge into the design process.

Only through involving indigenous voices early in the design process can we truly ensure that their culture is respected and demonstrated within building designs. The true success of this studio would be to find better housing solutions that are both climatically attuned and representative of the cultures of these unique communities to influence the health and well-being of current populations for a more sustainable future.

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