Learning from Eelgrass: A Transformative Spa Experience to Restore Balance Between Humans and Nature

by

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Dalhousie University is located in Mi'kmaq'i,
the ancestral and unceded territory of the Mi'kmaq.
We are all Treaty people.

To eelgrass – you've taught me so much.

Contents

Abstract

While the use of natural materials has proven to reduce embodied carbon emissions, the success of sustainable interventions ultimately depends on shifting the environmental ethos of humans. Here lies an important role for architecture: to shift the way that people interact with and consider materials. Drawing from historical precedent, this thesis reintroduces eelgrass wrack as a carbon sequestering, local, natural building material through an Eelgrass Spa experience at Taylor Head Provincial Park, Nova Scotia. Eelgrass experiments inform material applications and relate the traditional eelgrass processing sequence to an immersive spa journey. The program prompts spa visitors to relearn how to see materials through visual literacy, where eelgrass applications communicate traditional knowledge of material and place. This includes a variety of non-verbal cues throughout the spa that create a dialog between material, user, space, and nature, establishing a new sense of environmental awareness.

Acknowledgements

To Cristina Verissimo, thank you for your knowledge and enthusiasm for material studies. Your inclusion of eelgrass as a member of the super-material family is an honour.

To Hannah Newton, thank you for your mentorship and motivation throughout the highs and lows of this journey. You encouraged me to rediscover my inspiration when at times it seemed lost.

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To my upper studio colleagues, thank you for letting me turn our space into an eelgrass lab and asking first before you smelt it, touched it, tasted it, or tried to light it on fire. You accepted eelgrass and interacted with it, and that's all I could have wanted out of this thesis.

To my family, especially my sisters, thank you for always believing in me. You are my biggest cheerleaders.

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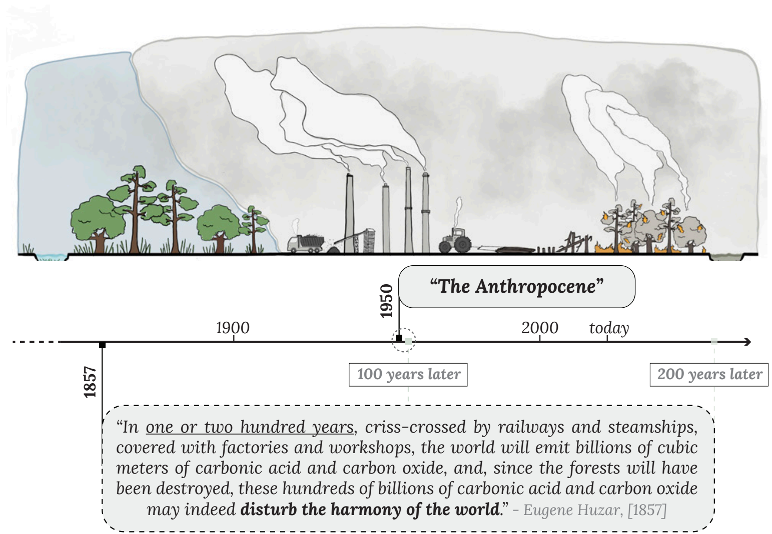
Chapter 1: Introduction



Situating Anthropocene (data from Bonneuil and Fressoz 2017)

Architectural literature expressed concern for the impact of the built environment early on: in *Shock of the Anthropocene*, Bonneuil and Fressoz (2017) resurface Eugène Huzar's prediction from 1857 of a forestless, carbon filled, and unharmonious future. Despite this earlier concern, pollution, exploitation, and carbon emissions have continued to harm the planet, bringing Huzar's prediction to a reality only a few years past the indicated date of the Anthropocene. This acknowledges humanity's "ignorant" push towards ecological unbalance that has resulted in a much worse climate crisis today. The architectural profession must take responsibility and make significant changes to decarbonize and reduce emissions to alter the current trajectory of our future. It is crucial to engage humans in this transition process to develop a better sense of care for the environment, as it is ultimately human lifestyle that determines the success of sustainable interventions. This thesis exemplifies a shift in the way we approach design, inspiring strategies that both reduce carbon emissions and rebalance humans and nature.

Architecture in the Anthropocene:

Today, the 2022 Global Status Report for Buildings and Construction informs the industry that the necessary changes towards decarbonizing the building sector have not yet been made in order to reduce emissions and meet the 2050 Paris Agreement goal (United Nations Environment Programme 2022). The industry was responsible for 37% of global greenhouse gas emissions in 2021 – bringing energy consumption and operational emissions to an all-time high (United Nations Environment Programme 2022). With more

Global carbon footprint (data from United Nations Environment Programme 2022)

urgency than ever, the building and construction industry must take responsibility and progress the built environment towards the highest level of zero-carbon buildings. Operational carbon reductions focused to achieve energy efficient envelopes and building services that consume energy, and now there is a shift of attention towards reducing embodied carbon as a means to achieve whole life cycle zero carbon buildings (United Nations Environment Programme 2022). By adopting design principles to create zero-carbon buildings, with attention to embodied carbon of building materials, a great reduction in greenhouse gas emissions is predicted, prompting material agency in design and a shift towards buildings with zero carbon emissions.

Although current mitigation strategies have acknowledged that reducing operational carbon emissions is not enough and embodied carbon emissions must be challenged too, mitigation strategies also need to consider the human experience in the development of sustainable interventions. How we (humans) perceive and understand man-made structures in the natural environment defines what we see as beauty in design. The idea that beauty lies in the eyes of the beholder alludes to the opportunity to shift the idea of what humans consider beautiful. Design must take on this role to align beauty with environmentally conscious materials and spaces. George Nelson highlights this concept of beauty when documenting the visual cues of man-mades in the natural environment. He explains how a greater awareness about man-made creations can change what humans consider to be beautiful:

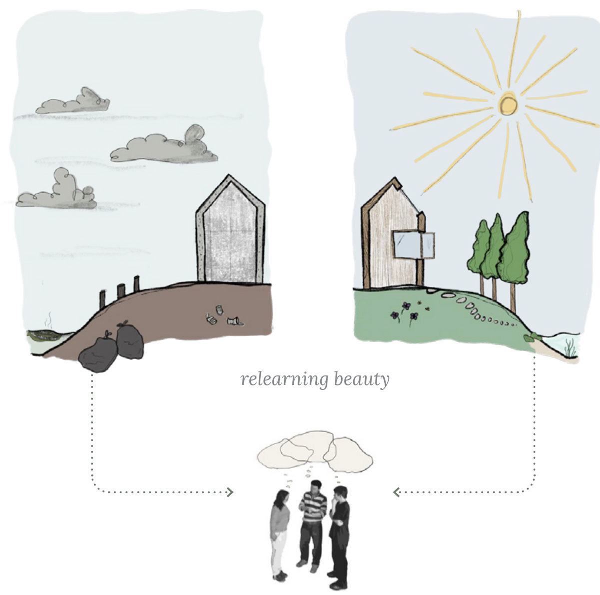
> Our grandparents rejoiced at the sight of smoke belching from factory chimneys because it meant jobs and prosperity. Today, for more and more of us, the sight is repellent, ugly, because we have begun to learn what the smoke does to the air we breathe. In this sense, our vision has changed with our broadened understanding and we see beauty in energy produced without pollution. Beauty, in other words, really does lie in the beholder. (Nelson [1973] 2017, 194)

This concept aligns with the first principle in permaculture design as a response to the environmental crisis; Observe and Interact – Beauty is in the eye of the beholder – where the role of observing and interacting is a means of learning and understanding how to design in balance with nature (Holmgren 2002, 13). Mitigation strategies need to embrace this principle as a strategy to create opportunity for humans to relearn how to live in harmony with nature. A design should enable continuous experiences of observation and interaction to celebrate and aid in the greater understanding of environmentally conscious design decisions – spreading awareness and communicating a new sense of beauty in design for our survival.

Designing for Survival: Reducing Carbon and Engaging Humans with Natural Materials

Thesis Question

How can architecture use locally available natural materials and visual literacy to connect people to their environment and foster an ethic of care for nature?



Reduce carbon and reconnect humans to nature with natural materials as visual cues

In the architecture field, we are at a point where our designs should be considered a design for survival, a category of design that George Nelson highlights in his eye-opening book of "visual adventures", *How to See*. He describes design as a process: "one starts with a need, a problem, and ends up with a design for a thing" (Nelson [1973] 2017, 202). Nelson explains that survival designs are the best designs we know about because of the fine line between good design and – to put it bluntly – death (Nelson [1973] 2017, 204). In the case of survival designs such as airplanes, or scuba suits, the problem is relevant to the activity (airborne vs. underwater) and the need is a constant function: to protect the life of the user. In our current climate crisis (our problem), we have a constant need to design for our survival. This implies that our buildings need to take on this role of survival designs and design with the responsibility to protect the life of the user against climate change.

In the pursuit of survival, reducing carbon is the first step, specifically reducing embodied carbon through local, low-tech, and natural materials. This thesis will look to the Nova Scotian Eastern Shore (the coastline local to this thesis) for material opportunities that will provide zero-carbon and carbon sequestering qualities. With consideration of local, accessible, and underused shoreline materials, the reintroduction of eelgrass wrack to the built environment provides “new” material applications with highly beneficial carbon qualities (chapter 2). An accumulation of research of the historical precedent of eelgrass uses and traditional material processing, recent material explorations, and material property studies inform the potentials of the versatile material (chapter 3), that lead an experimental process of working hands-on with eelgrass to explore material applications. George Nelsons’ obsession with visual literacy guides this experimental process using eelgrass as the medium to provoke curiosity and establish a dialog between the space and the user. This method of communication leads the second step in designing for survival – designing with non-verbal cues to teach and inspire a new way of seeing; expanding the user’s perspective and promoting a shift in the way humans see nature and their environmental impact (chapter 4).

Nelson's concept of total design involves relating everything to everything. To apply this idea, this thesis will strive to relate eelgrass to everything in program, as a tool to relearn how to see. Revealing similar sequences of processing, eelgrass is used in an immersive spa program to showcase its versatility and provide a space that enables people to reflect and relearn how to appreciate materials. To develop this design further, Nelson encourages a collaborative approach, seeking input from experts in different fields. Utilizing this process, a group of designers, architects, and eelgrass experts give insight throughout the design process – informing how to use eelgrass in architecture and the spa design specific to this thesis, while relating to landscape, site, program, place, and form. Working in collaboration, the design will exemplify the use of natural materials, reduce carbon emissions, and promote visual literacy, all while connecting people to nature in the face of climate change.

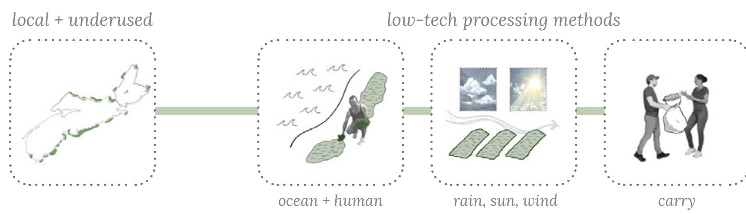
Chapter 2: Examining a Locale: Eelgrass in Nova Scotia

Nova Scotia Coastline Materials

Nova Scotia celebrated shoreline materials: stones, rock, wood

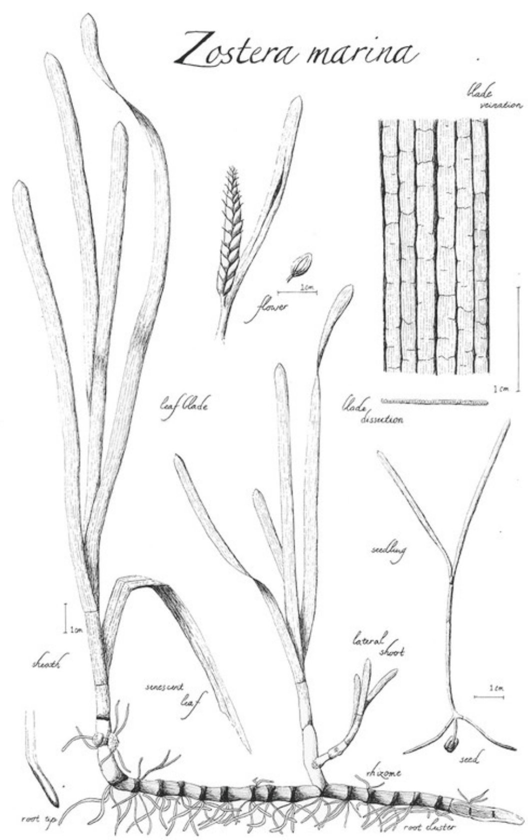
Developing a material palette to reduce embodied carbon prompts understanding the materials of the region's typical environment. Provided that this thesis is focused along the Nova Scotian Eastern Shore, the local, natural materials of this coastline are considered for potential use. While it is typical to find materials such as wood, and stone along the coastline, these natural materials have been widely explored, celebrated, and hold status in the built environment that is familiar in design projects throughout Nova Scotia and Canada widely. Specific to coastal environments, the ocean washes ashore a variety of marine plant life that are understudied as potential materials for architectural uses. With an array of plant life including different algae, seaweed, and seagrass, the Eastern shore reveals potentials in eelgrass wrack as it is commonly washed ashore in large

Nova Scotia shoreline material: eelgrass wrack masses. The mounds of wrack naturally washed ashore, although seen as a nuisance for tourism, provides an accessible and abundant, local natural material for further research and potential architectural applications.



Eelgrass wrack presents opportunities for local, underused, and low-tech material applications.

This thesis is not suggesting that other natural materials or marine plant life are unsuited for building construction, but rather it opens the door – with eelgrass as an example – to explore all materials and their potentials in common building practice.



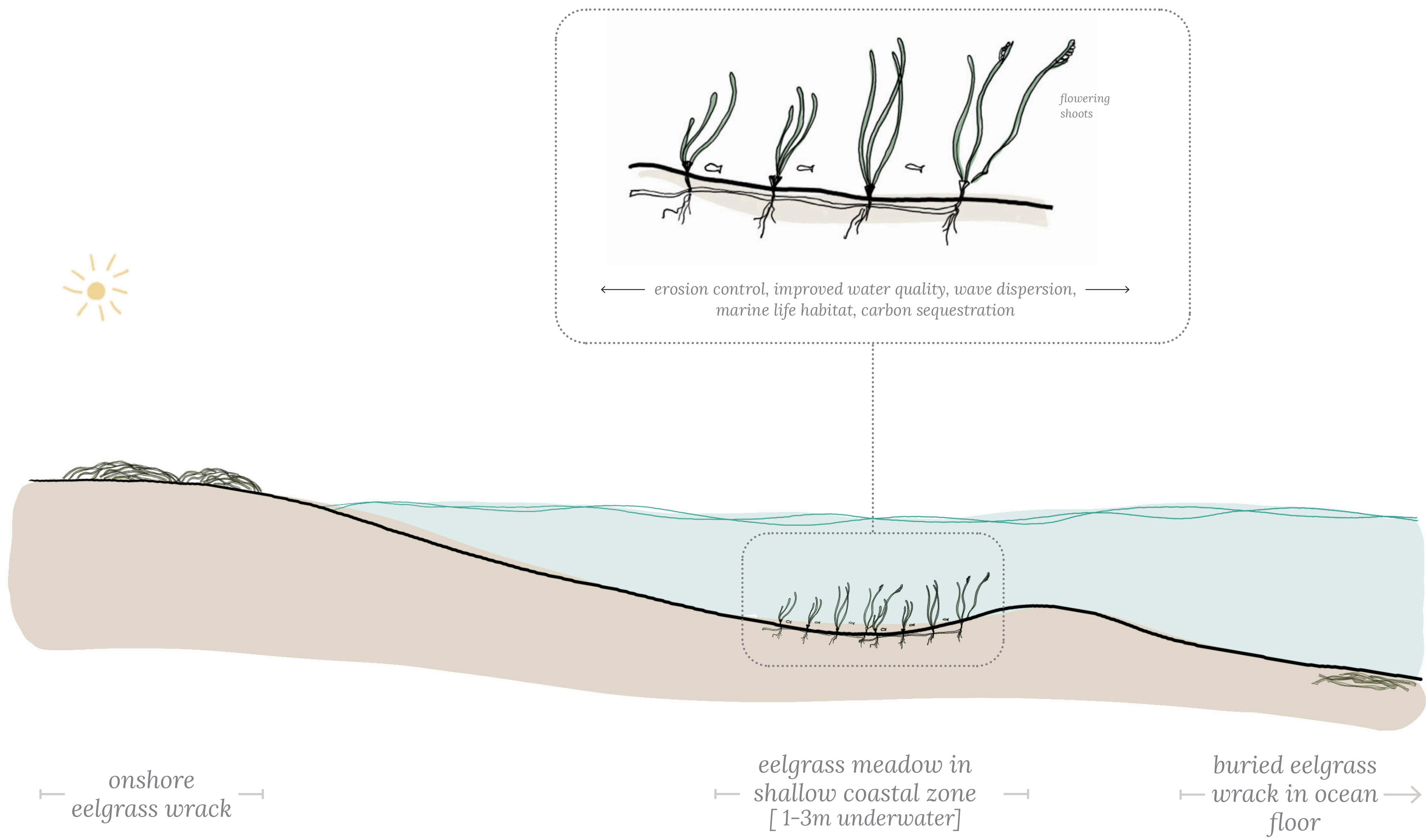
Eelgrass, *Zostera marina* (Hennessey n.d.)

(Re)-Introducing Eelgrass

Eelgrass, the common name for *Zostera marina*, is an underwater deep-rooted flowering seagrass with a plant structure consisting of flowers, leaves, roots, and rhizomes. The root and rhizome system hold linear structures under the sediment and leaves grow vertically forming ‘meadows’, or eelgrass ‘beds’ tidally or fully submerged by brackish and salty waters. Meadows grow across tropical and temperate areas on the sandy floor of tidelands and shallow inlets, bays, and estuaries (Howarth et al. 2021, 2). The dense canopy and strong root system play an important role in protecting vulnerable shorelines by filtering the water column, and providing sediment stabilization, erosion control, and wave energy dispersion. Eelgrass meadows also rank among the most productive ecosystems on the planet with extremely high levels of primary production, serving as a habitat and nursery for marine species and waterfowl (DFO 2009, 2). Many species utilize the support structure of eelgrass and benefit from the low predation rates in the vegetated habitat.

Underwater lawn, eelgrass meadow (Ecology Action Centre n.d.)

Beyond its role in shoreline protection and aquatic habitat, eelgrass meadows are one of the most important blue carbon sinks alongside salt marshes and mangrove forests:

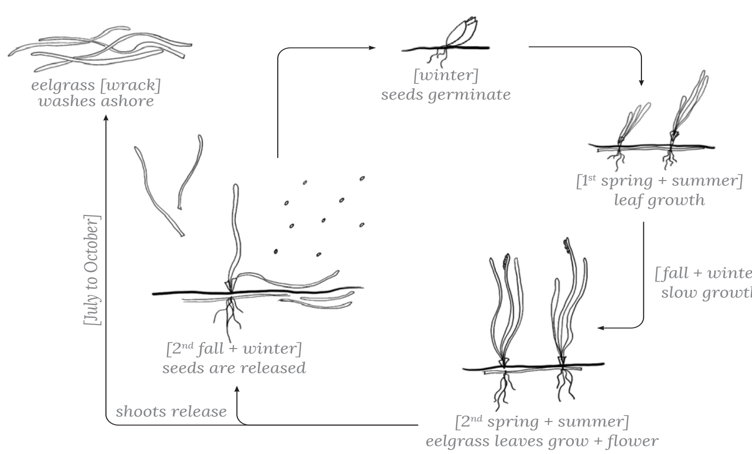


Eelgrass wrack and eelgrass meadows in a typical temperate ocean environment.

seagrasses occupy only 0.1% of the total ocean floor but are responsible for up to 11% of blue carbon storage (Reynolds 2018). With no substitute structuring organism in sand/mud flats with the same function as eelgrass, along with the other major marine life and carbon sequestering benefits the seagrass offers, eelgrass (*Zostera marina*) in eastern Canada meets the criteria of an Ecologically Significant Species (DFO 2009). This calls attention to eelgrass as a major influence on the health and overall ecology of adjacent terrestrial and marine ecosystems. Due to their crucial ecosystem roles, eelgrass meadows are highly protected and must remain undisturbed – which means that under no circumstances should live meadows be harvested!

This being said, during the eelgrass life cycle, from July to October the leaves naturally detach from the rhizome and root system and either bury in the ocean carbon sink or wash ashore, where the dead leaves, known as eelgrass wrack, accumulate on beach shorelines (Wyllie-Echeverria 1999). The leaves and flowering shoots can be dislodged by wave action and distributed by currents over 100 km distances, providing vast locations of eelgrass wrack abundance either along shorelines or buried in ocean sediments, thus

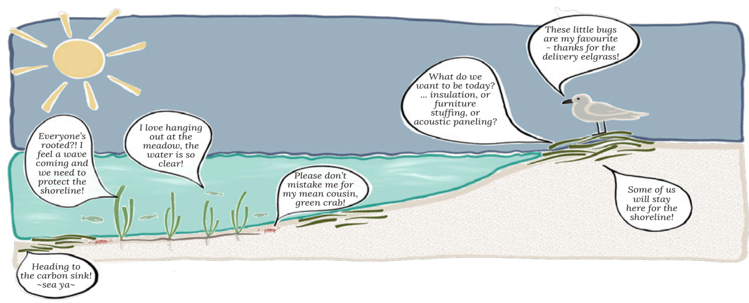
Washed up eelgrass wrack (Kelly 2020)



Eelgrass natural cycle: wrack production contributing to carbon sequestration (DFO 2009, 8). Herein lies opportunity: the natural accumulation of eelgrass wrack on shorelines provides a readily available material for the building industry - and it actually has significant historical precedent (discussed in chapter 3).

Wrack Removal and Shoreline Impacts

Research on the impacts of eelgrass wrack removal on shorelines has not been widely studied. Given this lack of information, removal of organic matter from the shoreline must be done with respect and consideration for



Eelgrass meadow and eelgrass wrack environment comic.

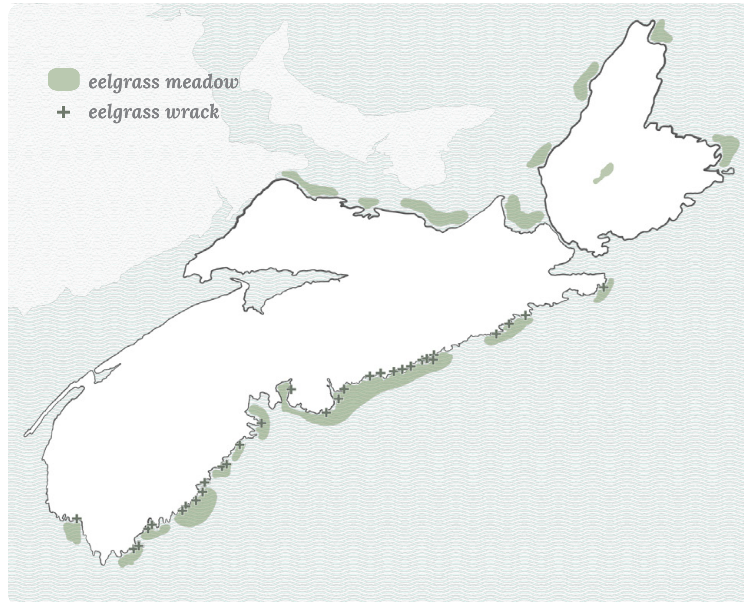
environmental factors. However, washed-up eelgrass wrack has been deemed a nuisance and beach litter for tourism, leading to the need for mechanical removal of beach wrack. Unfortunately, mechanized beach grooming is the accepted approach to beach maintenance, despite its potential to devastate the shoreline ecosystem. Using heavy machinery to rake and grade the beach for tourism creates large-scale disturbances, displaces habitats, and removes organic material, sand, and food resources (Dugan et al. 2003). As eelgrass wrack provides a source of organic matter in food-limited environments for unvegetated nearshore and offshore ecosystems (DFO 2009, 8), these aggressive methods of eelgrass removal are linked to depressing shoreline species richness and declining abundance of macrofauna communities and shorebirds that feed off the wrack (Dugan et al. 2003).

Given that wrack abundance influences the macrofaunal community structure and ecological processes on the beach, less intrusive and destructive methods of eelgrass collection must also be re-introduced as the appropriate and respectful process. Historical harvesting methods and studies on beaches that were not groomed or tourist-driven indicate that limited eelgrass wrack removal is not detrimental to shorebirds or the abundance of macrofauna community richness (Rodrigo et al. 2022; Garbary et al. 2004; Wyllie-Echeverria 1999). Therefore, to reintroduce eelgrass wrack to the built environment, harvesting eelgrass wrack using traditional hands-on methods and community involvement can be done without major implications.

Locating Eelgrass and Site

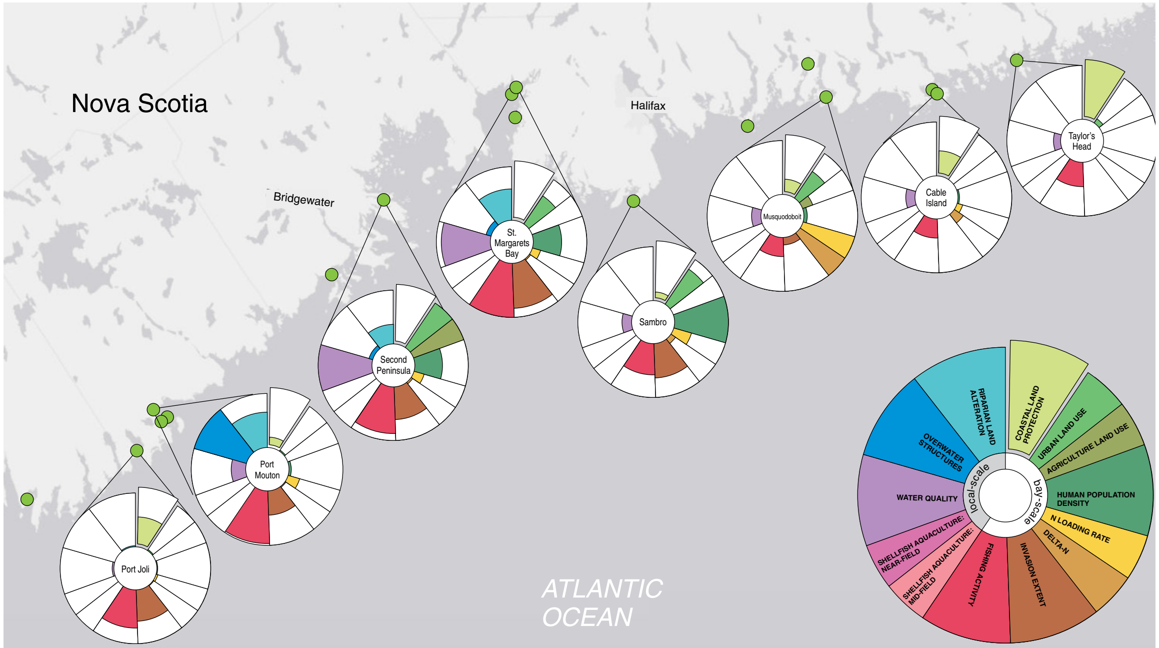
Eelgrass in Nova Scotia

Eelgrass meadows are found along Nova Scotia's Atlantic coast throughout the Northumberland Strait, around Cape Breton, and along the Scotian Shelf down to the south shore beyond Yarmouth (Howarth et al. 2021, 2). As eelgrass does not grow in areas of high energy, turbidity, and extreme tidal heights, it is sparse in the Bay of Fundy (Howarth et al. 2021, 2; Murphy et al. 2021, 142). Efforts by community and organizations are being made to report eelgrass meadows throughout Nova Scotia and Atlantic Canada, however their exact location, density and overall health are largely unclear. Recently, Fisheries and Oceans Canada (DFO) have established a 'National Eelgrass TaskForce' to provide a national eelgrass map through a process of satellite mapping beds and developing distribution models to better

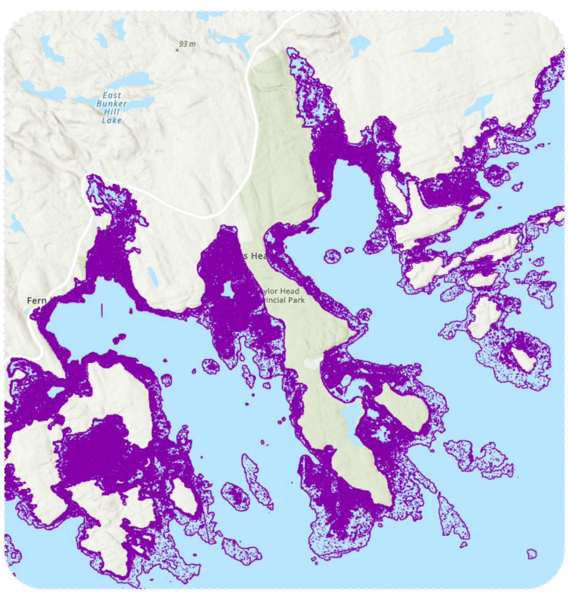


Locating eelgrass in Nova Scotia (data from Managing Aquaculture and Eelgrass Interactions in Nova Scotia; Howarth et al. 2021, 2)

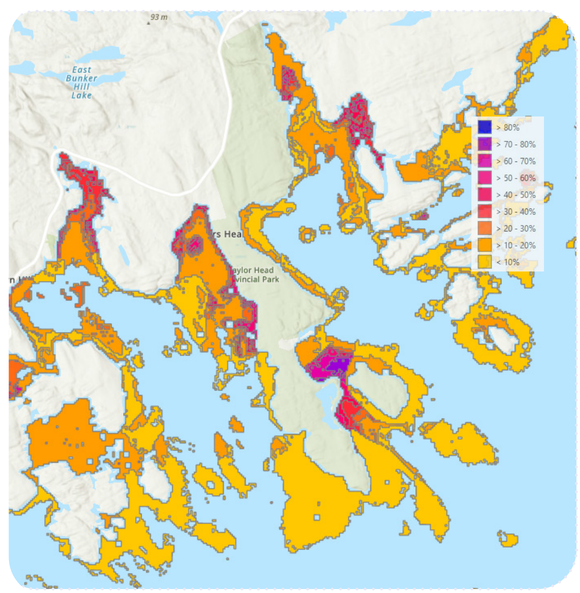
understand eelgrass coverage in Canada. Aiming to quantify coverage is difficult however, as the meadows are highly dynamic landscapes and natural variability can complicate monitoring efforts, making it difficult to determine seagrass meadows and their response to anthropogenic disturbances and climate change (Howarth et al. 2021, 7). A recent study applied a human impact metric for coastal ecosystems to indicate the magnitude of anthropogenic impacts to seagrass beds along the Atlantic coast (Murphy, Wong, Lotze 2019, 210). This metric studied seagrass beds and coastal bays across a wide human impact gradient to provide insight into the most and least threatened beds by human impacts. This study showed that Taylor Head Provincial Park is minimally impacted by human activities relative to other Nova Scotia sites due to higher coastal protection and lower overall bay and local-scale impacts (Murphy, Wong, Lotze 2019, 222). This data, in addition to the identified meadow locations from the NetForce eelgrass mapping, prove the large quantity of



Human impact gradient reveals Taylor Head Provincial Park as a site for healthy meadows and abundant wrack (Murphy, Wong, Lotze 2019, 222)



Submerged aquatic vegetation surrounding Taylor Head Provincial Park NETForce data (DFO 2023)



Eelgrass habitat suitability surrounding Taylor Head Provincial Park NETForce data (DFO 2023) eelgrass meadows that surround Taylor Head Provincial Park. Due to the increased amount of coastal protection in this area, there is high probability that meadows will remain healthy and supply an abundant amount of wrack to the shoreline, indicating Taylor Head Provincial Park an ideal location for the eelgrass focused design intervention.

Taylor Head Provincial Park site visit photos

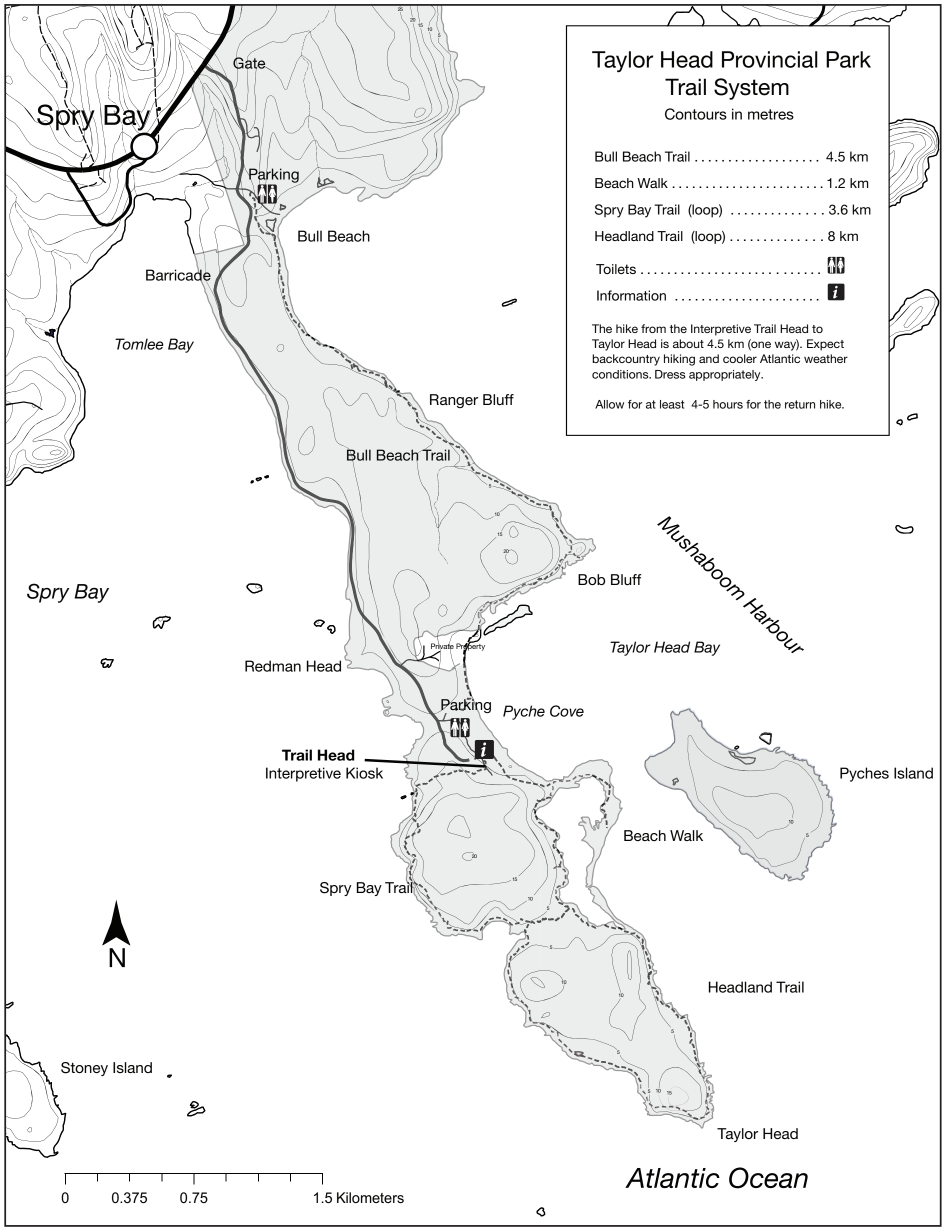
Taylor Head Provincial Park

Through observation and local insight, Taylor Head Provincial Park revealed an appropriate site selection as it is used as a site for eelgrass wrack collection today and has been for decades. Eelgrass wrack is abundant and easily accessed as it washes up to the edge of the Old Taylor Head Rd that travels on the Tomlee Bay on the west side of the park. Visiting the site during the off-season of wash-up (this thesis term just missed seasonal wash-up), there were still large mounds of eelgrass wrack to be found. The locals of the Eastern Shore have accessed this shoreline by the road where they would collect by hand and pitchfork, place wrack in the back of their trucks, and bring it home to be used mostly for fertilizer and occasionally to bank up on the walls of their homes to keep warm during the winter months. This traditional use of eelgrass wrack was passed on from generations and continues to be a seasonal event at Taylor Head Provincial Park because of the abundant and easily accessible collection area. These site characteristics will similarly benefit the design intervention as a local, accessible, and abundant material supply.

Taylor Head Provincial Park site also offers an element of tourism that will be useful in attracting a wide range of people closer to nature. Located under a 2 hour drive from the City of Halifax, the park provides tourism amenities

Taylor Head Provincial Park
site visit photos

(washrooms, info kiosk) and is open and maintained in the off season by volunteer lead group Friends of Taylor Head. As an accessible escape to nature, the park emphasizes the natural beauty of the landscape with a variety of trails that move from different ocean shoreline edge conditions, through coastal forests, up on rocky cliffs, nest to calm ponds, and along a beautiful white sand beach. The natural essence of the site promotes a revived appreciation of nature that will enhance the intention of the design project.



Hiking times are approximate and do not include time to appreciate nature and views from look-offs.

Beach Walk
2 km (1.2 mi.) • Easy trail • Time: 45 mins.
Bird watchers should have lots to see as they follow this trail as it traverses the sandy shores of the Pyche Cove Beach system.

Bob Bluff Trail
3 km (1.8 mi.) • Basic trail • Time: 1 hour
Select this trail for coastal views. The trail begins near the parking area and follows along the shore to the northern end of Pyche Cove providing several enchanting vistas of Mushaboom Harbour and its many islands along the way. The beach and sand dunes at Pyche Cove were formed by sand deposits from the erosion of glacial till and bedrock. The trail links with the Bull Beach Trail at Bob Bluff.

Bull Beach Trail
6 km (3.7 mi.) • Basic trail • Time: 2 hours
Backed by a spruce-fir forest, the trail winds along the coast overlooking the harbour.

Spry Bay Trail
4 km (2.5 mi.) • *Moderately challenging • Time: 1.5 hours*
Hikers wanting to experience a variety of habitats will enjoy taking this loop that passes through a coastal forest, coastal barren, wave-swept boulder shores, coastal freshwater marsh and an inland barren. The trail provides magnificent views of Spry Bay and the rugged coast line.

Headland Trail
8 km (5 mile) • *Challenging trail • Time: 2.5 hours*
Select this trail for the maximum experience as provides a rugged, but rewarding, coastline trek to Taylor Head Point. The trail returns on the opposite side of Taylor Head where it rejoins the Spry Bay Trail.

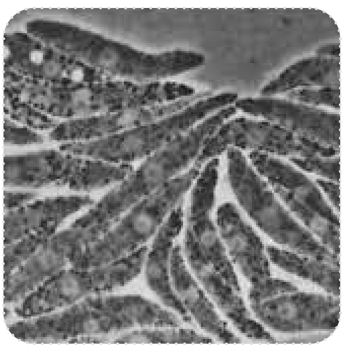
Taylor Head Provincial Park brochure map (Nova Scotia Provincial Parks n.d.)

Chapter 3: Eelgrass Then

Preface

1. Reading the following chapter please note that while research findings about eelgrass interchangeably label eelgrass as a seagrass or a seaweed, this is likely due to mistranslations throughout history. When relaying findings, the term provided in the original text will be used, but to ensure it is explicitly informed: eelgrass is a seagrass, not a seaweed!

2. A 'wasting disease' is mentioned several times throughout this chapter that caused a halt of eelgrass wrack supply for building applications. In the early 1930's this wasting disease caused by an infectious slime mold (*Labyrinthula zostera*) resulted in a decline of eelgrass populations across the Atlantic coasts of North America and Europe (Howarth et al. 2021, 15). The outbreak caused eelgrass shoots to develop black-brown dots and streaks, eventually leading to mortality. This caused 90% of eelgrass beds along the Northwest Atlantic coast to disappear, rising to 99% the following year (Howarth et al. 2021, 15). With a slow recovery, many eelgrass beds had re-established by early 1950's however another hit documented in New England (1984) led to significant declines of up to 80% in some populations (Howarth et al. 2021, 15). Disease continues to affect eelgrass beds in North America and Europe with variable degrees of loss however it is not responsible for present-day declines in Atlantic Canada. This being said, the disease is likely to be an important factor in beds subject to multiple stressors – anthropogenic impacts and climate change – where the seagrass becomes more sensitive



Labyrinthula zostera,wasting disease (Muehlstein, Porter, Short 1991) and susceptible to disease estuaries (Howarth et al. 2021, 20).

Eelgrass in History

Primal Uses

For Agriculture, the Built Environment, & Furniture Design


Fodder use (Arrowquip 2017)


Fertilizer use (Tony 2022)

Norwegian diary entries dating back to 1747 contain details of using eelgrass as fodder for livestock. Eelgrass would drift onshore along the west coast of Norway where cows would eat it as eagerly as fresh grass. Farmers would also row out to eelgrass beds, place an oar down in the water and spin the oar to attach the eelgrass and pull it up into the boat. They would bring the grass back to shore and feed to the cows this way, especially during the winter months. In some areas during the summer months, cows would wade out to the sea until they reached the meadow for a tasty snack (Alm 2003).


Furniture stuffing (Cottrell 2019)


Barn ground cover (Sheepy Hollow Farm 2012)

Another entry dating 1762 took wet eelgrass wrack that drifted ashore and placed it in stacks to rot for green manure and fertilizer on fields. When laid out to dry rather than rot, eelgrass would also be placed in barns and stables to provide warm and dry ground cover (Alm 2003). In the early 1800s in Denmark and Europe, eelgrass was collected, dried, and used as stuffing for mattresses, pillows, and upholstery pieces, and later on it was seen to be used as insulation materials in buildings and roof coverings in the coastal areas of Denmark (Alm 2003). Loosely stuffed eelgrass insulation was found in 1893 when repairing walls in The Old Pierce House, in Dorchester, Massachusetts that was built in 1635. The eelgrass was in perfect state of preservation after more than two and a half centuries thus presenting a case for the

Eelgrass found in The Old Pierce House (Samuel Cabot Inc. 1923)

continued use of eelgrass insulation in the building industry (Samuel Cabot Inc. 1923, 1).

There are additional eelgrass uses mentioned in research that do not reference a specific date of use and were prefaced as possibly misinterpreted during translation between languages and vernacular names – this being said – the uses are worth mentioning out of interest and for other potential applications.

For Food


Fish salting (Michael Willis 2017)

In the southern most part of Norway, a set of vernacular names with the prefix mat- or matt- (food) and the suffix laug(e) or lauk(e) (onion) reveal a relation to eelgrass use as food. Vernacular names MATLOK, interpreted as “food onion” and vernacular name mannlauk (mann- prefix implies a plant used by humans) meaning “man onion” supported the idea of eelgrass as food. Although eelgrass does not produce any bulbs or onions, the shoot base resembles similarities to a small leak, prompting a curious taste test translated from Swedish that describes: “when one chews it, it tastes sweet and pleasant” (Alm 2003, 641). Research also mentions the use of eelgrass for salting fish in Norway (Alm 2003, 641), supported by Danish and European medieval traditions that evidence the use of burning eelgrass for salt-making for preservation of fish, meat, bacon, and butter (van Geel and Borger 2005, 46).


Dike construction (Reina 2021)

For more things!

Traditions in the Netherlands mention eelgrass use in dike construction until the 18th century (van Geel and Borger 2005, 46), similar to the Danish use of eelgrass as strewing material to protect against sand-drift and lining of ditches to

Packing material

Bicycle tube fill (Atmosphere Interior Design Inc. 2011)

conserve ice during summer months (Alm 2003, 644). The use of eelgrass as packing material was mentioned in the Netherlands (van Geel and Borger 2005, 43) and in Venice factories, eelgrass was used to pack famous glassware for shipping that has since been replaced with synthetic packaging material (Alm 2003, 644). Danish uses also include a curious use of eelgrass as filling in bicycle tubes dating around late World War II (Alm 2003, 644).

Scaling-up

Eelgrass was used as roof covering material in the Seaweed Bungalows in China and the Seaweed Houses on Læsø Island in Denmark. These precedents of eelgrass demonstrate traditional methods of eelgrass thatch roofing that have been slightly modified but still functional today.

Seaweed Bungalows

Seaweed bungalows, Jiaodong Peninsula, China (Women of China 2020)

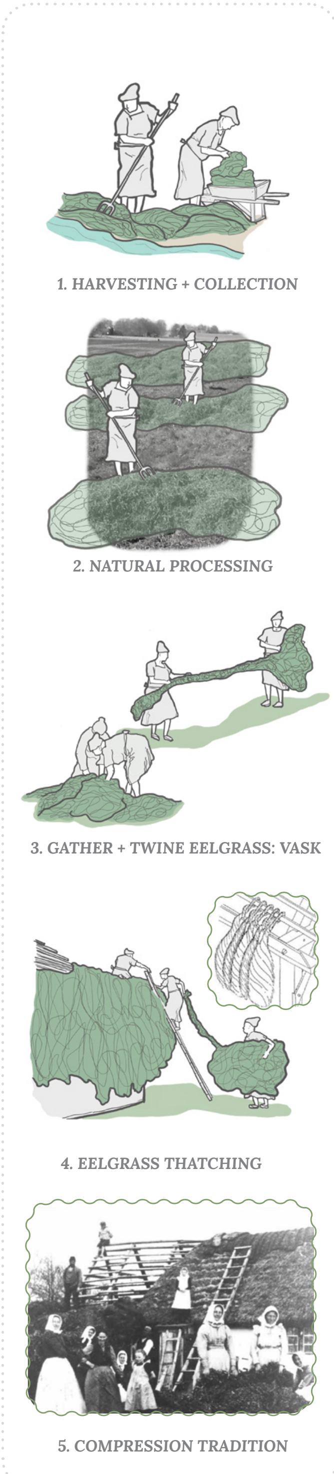
Dating back to the neolithic age, and later becoming more common during the Ming and Qing Dynasties (1368-1911), the traditional Seaweed Houses on the Jiaodong Peninsula, China, evolved from a regional awareness of climate and material over thousands of years (Schikan and Gwóźdź 2022). The roofs are made of thatched eelgrass and are thick constructions - sometimes one roof can exceed 5000 kg - consisting of alternating layers of seagrass and wooden frames (Schikan and Gwóźdź 2022). The seagrass is a proven durable material that if applied correctly will not rot, largely due to the presence of zosteric acid in the leaves which inhibits micro-organisms (Yang 2012). While the houses use other local materials such as mud, sand, and rocks in the construction of the walls, it is the seaweed roofs that give the architecture its distinctive vernacular form, creating connection between the region's inhabitants and historical culture (Schikan and Gwóźdź 2022).

Læsø Island

The Kaline's house, Læsø Island (Realdania By & Byg n.d.a)

The Kaline's house on island of Læsø was built in 1865 along with 300 other traditional Seaweed Houses. Today, only 20 remain as a lasting testament to the culture, landscape and lifestyle of the history of Læsø. Kaline's house is one of the few with an intact seaweed-thatched roof that rests on a layer of twisted seaweed expressing the local materials and traditional building methods of the island (Realdania By & Byg n.d.a).

The sequence of Læsø traditional thatching involved women from the community to do the majority of thatch roof assembly. From July to October, women would harvest and collect washed up eelgrass beach wrack from the shoreline by hand and pitchfork, then carry the wrack to nearby fields to prepare for natural treatment. For 6-8 months, eelgrass that is laid in rows on fields would be treated by the rain and the sun, rinsing the micro-algae and salt water from the leaves with freshwater and then dry the rows, occasionally turning the leaves. In the spring, the women bring the eelgrass to the construction site where it is transformed by hand twining. A ‘vask’ is created as a woman twists one end of an eelgrass bundle into a long rope, while another woman holds down and bunches the opposite end to form a large head end. The vask is wrapped around the lower 3-4 battens of the roof framing to create a dense eelgrass teardrop shaped edge and loose eelgrass is layered on top to cover the rest of the roof. After the eelgrass is laid and packed tightly during roof construction, the eelgrass must be compressed further to release natural binders for eelgrass to “burn together” (translated from “brænde sammen” in Danish). To do this, a women would dance on the thatch roof to activate the binder and enable lasting durability and water resistance. Over time, the eelgrass thatch roof lightens in colour with sun exposure and continues to self-compress and solidify. Families would celebrate the thatching tradition by capturing the craft in family photos that were taken on top of the eelgrass thatch roofs (Larsen 2019; Meier 2013).



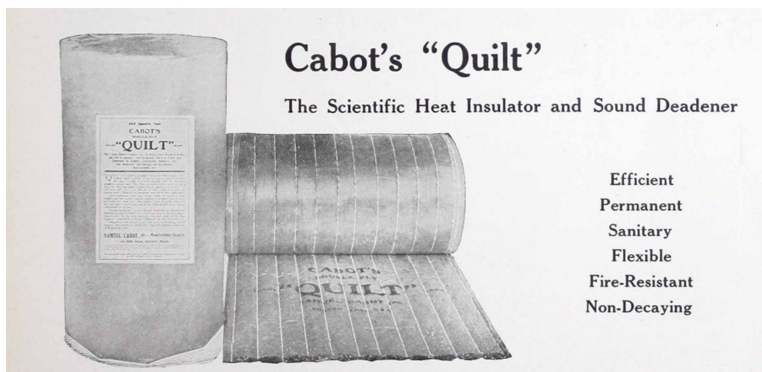
Traditional Eelgrass Thatching (Larsen 2019; Meier 2013)

A properly thatched roof will typically last up to 300 years but in the last 75 years, the Seaweed Houses have been disappearing due to local eelgrass falling victim to disease and the knowledge and labour economy based on eelgrass has been forgotten. The house served as a retirement home for a nearby farm until in 2010, Realdania By & Byg purchased and restored Kaline's House to preserve one of the few remaining Seaweed style homes.

Industrial Production

The use of eelgrass as building insulation was first taken to industrial scale production with Cabot's Quilt, and later Guildford's Seafelt around the turn of the 19th century. These were large scale operations that distributed eelgrass insulation to destinations across Europe and North America, relying upon Nova Scotia as a supplier. As a result, parts of Nova Scotia like Yarmouth County developed a strong communal culture built around eelgrass.

Cabot's Quilt

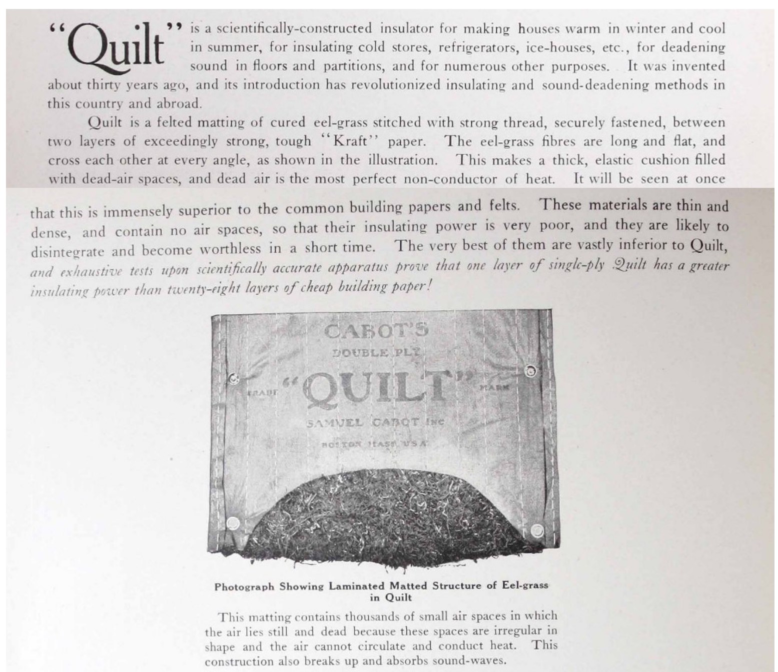


Cabot's Quilt Brochure clipping (Samuel Cabot Inc. 1923, 1-2)

In 1891, Samuel Cabot Inc. created the first "blanket-type" insulation in Boston, MA using dried eelgrass leaves stitched between heavy Kraft paper. Cabot's Quilt product was a thermal insulating and sound deadening product that was heavily used in houses, office buildings, hotels, apartment buildings, warehouses, schools, hospitals, conservatories and lecture halls throughout Canada, the United States and Great Britain during the early 1900s (Wyllie-Echeverria and Cox 1999, 21). Early in production the dried eelgrass leaves came from New England and in 1907 the company imported bales of eelgrass from Yarmouth County, Nova Scotia. In

1914 Samuel Cabot Inc. established storage sheds in the county and by 1920s fourteen collection sheds were in operation - all furnished with scales and stationary hay balers or wooden hand presses – for full scale production (Wyllie-Echeverria and Cox 1999, 22).

Cabot's Quilt was made by stitching various thicknesses of dry eelgrass leaves between heavy craft paper to create single ply, double-ply, triple-ply, asbestos quilt and waterproof quilt insulation and sound deadening material (Samuel Cabot Inc. 1923, 24). Later this selection would grow to 8 different grades (Wyllie-Echeverria and Cox 1999, 21). A description of the Quilt from a 1923 brochure Heat Insulation: Cabot's Insulating Quilt promotes the eelgrass stuffed quilt as a scientifically proven and superior insulator.



"Quilt" is a scientifically-constructed insulator for making houses warm in winter and cool in summer, for insulating cold stores, refrigerators, ice-houses, etc., for deadening sound in floors and partitions, and for numerous other purposes. It was invented about thirty years ago, and its introduction has revolutionized insulating and sound-deadening methods in this country and abroad.

Quilt is a felted matting of cured eel-grass stitched with strong thread, securely fastened, between two layers of exceedingly strong, tough "Kraft" paper. The eel-grass fibres are long and flat, and cross each other at every angle, as shown in the illustration. This makes a thick, elastic cushion filled with dead-air spaces, and dead air is the most perfect non-conductor of heat. It will be seen at once that this is immensely superior to the common building papers and felts. These materials are thin and dense, and contain no air spaces, so that their insulating power is very poor, and they are likely to disintegrate and become worthless in a short time. The very best of them are vastly inferior to Quilt, *and exhaustive tests upon scientifically accurate apparatus prove that one layer of single-ply Quilt has a greater insulating power than twenty-eight layers of cheap building paper!*

Photograph Showing Laminated Matted Structure of Eel-grass in Quilt

This matting contains thousands of small air spaces in which the air lies still and dead because these spaces are irregular in shape and the air cannot circulate and conduct heat. This construction also breaks up and absorbs sound-waves.

Cabot's Quilt brochure clipping (Samuel Cabot Inc. 1923, 1-2)

Reductions of export occurred during WWI, however production continued and eventually reached peak exports in 1929. Unfortunately, the wasting disease in the 1930s substantially reduced eelgrass wrack resources. Cabot's quilt production continued, although slower, and gathering in Yarmouth picked back up in 1939 when wrack supply returned in Nova Scotia. In 1942 shortly after, Samuel Cabot Inc. stopped production of Cabot's Quilt due to WWII (Wyllie-Echeverria and Cox 1999, 22).

Guildford's Seafelt

Guildford's 'Seafelt' blanket insulation (MSM Construction Services Ltd. 2010)

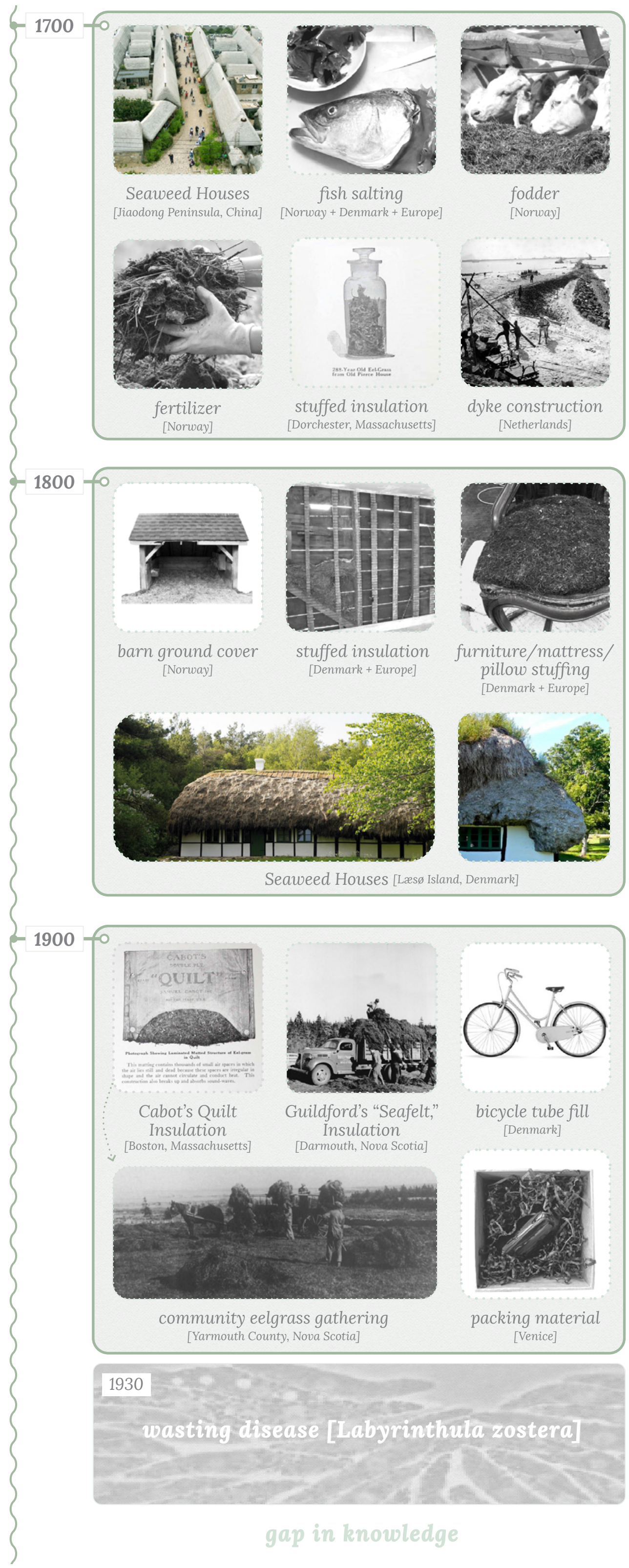
In the 1930s, Guildford's Limited in Dartmouth, Nova Scotia manufactured "Seafelt", another use of eelgrass in a blanket-type insulation, creating competition for Cabot's Quilt markets. The Provincial Government of Nova Scotia encouraged Guildford's Ltd to develop a Canadian based eelgrass insulation to develop a Canadian based eelgrass insulation and take advantage of the already established local demand. (Wyllie-Echeverria 1999). Guildford's continued use of Yarmouth County's gathered leaves and established the company's main base of operation in Sable River, North of Yarmouth (Wyllie-Echeverria and Cox 1999, 67).

The wasting disease that affected wrack supply occurred early in establishing the Seafelt company. Production was reduced until recovery was evident in 1953. Guildfords Limited tried to redeem and commercialize production however in the 1960s “Seafelt” was discontinued when synthetic fibers (fiberglass) replaced natural fibers in many insulation products on the market (Wyllie-Echeverria and Cox 1999, 22, 39).

Yarmouth Community Gathering

Yarmouth community eelgrass gathering (Wyllie-Echeverria 1999)

The cultural value of eelgrass gathering for both Cabot’s Quilt and Seafelt production was evident in the Yarmouth community, not only as a source of income (particularly for those of lower socioeconomic demographics) but also as a community activity (Wyllie-Echeverria 1999, 12). Farmers, fisherman, and town dwellers of Yarmouth all participated in gathering seagrass. It was accessible for families to join in during gathering season as it followed the farming and fishing seasons and minimal investment was necessary with the use of farming equipment they already owned (Wyllie-Echeverria and Cox 1999, 23). The communities would gather the abscised eelgrass leaves from the shore, take them to field to dry, and press them into bales for storage or shipment to Cabot’s Quilt – loose leaves, not bales, were delivered for manufacturing of Seafelt (Wyllie-Echeverria and Cox 1999, 38). Commercial harvest in Yarmouth was discontinuous from 1907 until the early 1960s, yet details of this history is unknown and much of the knowledge remained in the stories of those having direct association of the activity. Interviews done in 1997 with members of the gathering community – all approaching 80 years old at the time – fortunately passed on the mentioned details of the experience (Wyllie-Echeverria and Cox 1999, 48).



A timeline overview of historical eelgrass use until the wasting disease affected meadows in the 1930s. As the eelgrass industry ended and no new uses of eelgrass were recorded, there is a present gap in knowledge that risks the loss of eelgrass knowledge to history. Fortunately, in 2010, historical and new eelgrass uses were being rediscovered.

Chapter 4: Eelgrass Now

Explorations Today

Today, people are beginning to piece together historical knowledge of eelgrass uses and explore new opportunities. A range of explorations at different scales including buildings with modern takes on roof covering materials, acoustic dampening panels and composite bioplastics and bricks support the reintroduction of eelgrass (and other marine plants) to the built environment.

Eelgrass Roof Covering

The Modern Seaweed House

Modern Seaweed House by Vandkunsten, 2013, Læsø Island (Realdania By & Byg n.d.b)

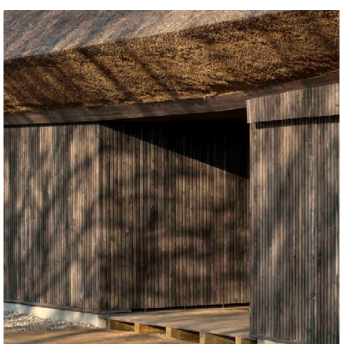
The Modern Seaweed house, built in 2013 and designed by the Danish architects Vandkunsten as a timber-framed holiday home with seaweed cladding and insulation, is part of the collection of Seaweed Houses on Læsø project that aims to preserve and develop unique local building practices. This project borrows from long traditions of eelgrass thatch houses to build modern projects with lasting and environmentally sustainable materials (Realdania By

& Byg n.d.b). The project uses eelgrass in three different ways; the exterior cladding of roof and walls, interior finish features, and as thermal insulation. Eelgrass for cladding is stuffed in long mesh-like socks that give the eelgrass its final form for application (Realdania By & Byg n.d.b). It is a project that serves as a flagship in how traditional and vernacular architecture and materials can be revisited and utilized to design within modern standards of functionality and economy, and broaden the scope of what contemporary architecture and can be. Unfortunately, when the building was sold in 2016, the new owners removed the visible seaweed on the roof do to damage that was not connected to the project's experiment with eelgrass (Realdania By & Byg n.d.b). Nevertheless, the house remains insulated with eelgrass and interior finishes of eelgrass stuffed linen acoustic panels (Realdania By & Byg n.d.b).

Seaweed Bay Health Resort

Seaweed Bay Health Resort by Greyspace Architecture Design Studio, 2019, Weihai, China; photograph by Hao Chen (Shuangyu 2021)

Seaweed Bay Health Resort in Weihai, China, is a 2019 renovation by Greyspace Architecture Design Studio which seeks to connect visitors in the now-popular tourist region to the area's rich history of life connected to the sea. One of the primary methods that it uses to achieve this is with the traditional thatched seaweed roofs from the Jiaodong region (Shuangyu 2022). The seagrass roofing techniques are extensive with 70 different processes, all of which are hand made. To properly thatch the roof, local masters familiar with the craft were brought in to guide the traditional sequence of construction of the seagrass house (Shuangyu 2022). The project is another example of how contemporary architecture can incorporate past processes to create a new system of value and connection in contemporary buildings, as well as being less carbon intensive.



Wadden Sea Center by Dorte Mandrup, 2017 (phase 1) & 2021 (phase 2), Esberj, Denmark; photographs by Adam Mørk (ArchDaily 2017).

Wadden Sea Center by Dorte Mandrup, 2017 (phase 1) & 2021 (phase 2), Esberj, Denmark; photograph by Adam Mørk (ArchDaily 2017)

The Wadden Sea Center

The newest (2021) addition to The Wadden Sea Visitor Center by Dorte Mandrup located in the Danish Wadden Sea National Park presents a modern take on thatch roofing and cladding. These material choices were used to highlight local building traditions and the rural farmhouse style significant to the region (Mandrup n.d.). The Wadden Sea Center thatch roof is also designed to provide a place for the 15 million migratory birds to forage along their travels North and South. The building emphasizes the role of materials in architecture to provide sustainable and natural elements to the built environment, while significantly considering the landscape and site to inform the design (Mandrup n.d.). The project's design intends to create awareness and understanding for the marshland and the Wadden Sea and provides precedent for future uses of regional materials to harmonize with the landscape and site (Mandrup n.d.).

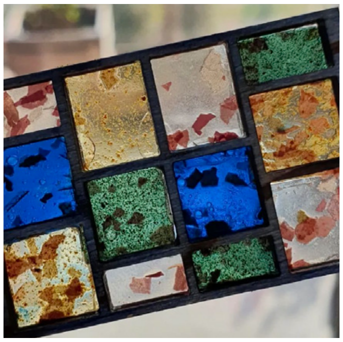
Seaweed Thatch Re-Imagined

Seaweed Thatch Re-imagined (Larsen 2018)

Kathryn Larsen began her thesis research about eelgrass use in Denmark, 2018 and continues to explore different eelgrass applications in architecture today. The thesis work stemmed from the traditional seaweed thatch roofs on the houses of Læsø Island. Using research from historical precedent, Larsen detailed eelgrass as thatch roofing and thatch panel cladding that informed the design of her prefabricated eelgrass panels. Panels were installed on the roof terrace of Guldbergsgade 29N for a year to study how eelgrass reacts over time to the elements. This experimented with eelgrass's capabilities for external use (Larsen 2018).

The Seaweed Pavilion (Larsen 2018)

The Seaweed Pavilion builds upon her thesis, applying the prefabricated panels to the pavilion structure to showcase the external use of eelgrass in architecture. Larsen's pavilion embraced the organic qualities of eelgrass and applied them to a structural form that would engage people to sit amongst the eelgrass panels to better inform people of the potentials of the material.


Bioplastics (Larsen 2022)

Today, Kathryn Larsen is experimenting with a wide range of seagrass applications including bioplastics, and microalgae colouring applications that further exemplify the potentials of marine plants. She engages the public with her studies through her social media platform and continues to share the potentials of eelgrass and other seagrasses in architectural applications (Larsen 2022).

Eelgrass Acoustic Panels


Acoustic Panels (Søuld n.d.)

Søuld

Søuld is a Danish material manufacturer founded in 2010 who promotes eelgrass as a building material that is recyclable, eco-friendly, carbon sequestering and a forward-thinking alternative to synthetic materials. The company focuses on the use of eelgrass in acoustic paneling to emphasize the sound deadening qualities that eelgrass naturally offers (Søuld n.d.). The sourcing and production of

Compression technology (Søuld n.d.)

Søuld and Larsen collaboration on coloured eelgrass acoustic panels (Larsen 2022)

acoustic panels rely on help from community farmers along with machine-based production for air-laid technology, and compression processes. Although the production incorporates machine-based technology, the company claims to have a multidisciplinary expertise to inform a holistic approach to product development (Søuld n.d.). The company showcases great potential of environmentally conscious, scaled production of eelgrass as acoustic paneling that offers sound deadening, thermal and moisture regulating qualities, fire resistance, and carbon sequestering (Søuld n.d.).

Today, Kathryn Larsen (of Seaweed Thatch Re-imagined) is collaborating with Søuld by applying the colouring techniques to the eelgrass acoustic paneling (documented on Larsen's Instagram; Larsen 2022).

Eelgrass Composites: Bioplastics + Bricks

Zostera Stool

Zostera Stools (Tucker 2015)

Zostera Stools were designed by Carolin Pertsch in 2015 using washed up eelgrass wrack that was harvested from the German Coast. Concerned with the disposal of wrack from beach grooming, Zostera Stools were created as a means to reduce waste and provide a new application and potentials for eelgrass composite materials (Tucker 2015). Eelgrass wrack was hand collected, rinsed from beach debris, sorted based on shade of dried material. Creating a composite material, eelgrass was then mixed with a bio-resin produced from vegetable oil to be placed in circular seat molds. The result of the mixture created 4 stools of different shades with a 1 cm thick, fiber reinforced eco-plastic seat (Tucker 2015). Pertsch's intention with eelgrass use in furniture design was to induce interaction with humans and natural materials that are otherwise seen as waste. By creating a new, aesthetic and eco-material stool from eelgrass, the exploration exposes people to a new way of thinking about alternative materials that is fundamental for the future (Tucker 2015).

Different shades of Zostera Stools (Tucker 2015)

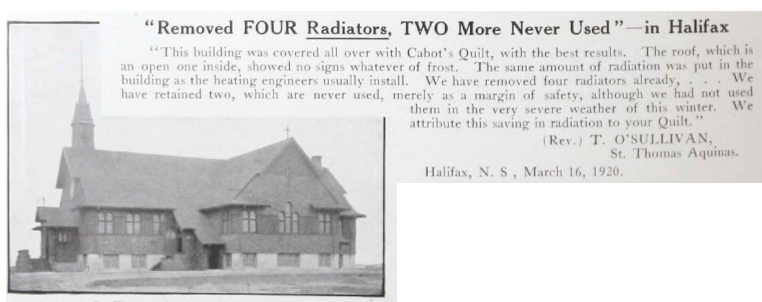
The Seaweed Archives

The Seaweed Archives (Schikan and Gwóźdź 2022)

This thesis, by Joline Schikan and Barbara Gwóźdź in 2022, is an extensive material research study that utilizes eelgrass (and other local supplies) as a building material and design driver. The products of the studies are extremely beautiful, and are pushing the boundaries of what natural materials and their applications within architecture can be. The explorations of seagrass and other available shoreline materials such as algae result in an extensive material catalogue of bioplastics, seacrete, kelp leather etc, incorporating natural pigments and splashes of colour into a stunning final design project that ties together environmental awareness, leisure, recreation, and functionality (Schikan and Gwóźdź 2022).

Material Property Studies

Eelgrass has historically been claimed as a material of many ideal properties including the most promoted thermal insulating, acoustic dampening, fire resistant, carbon sequestration qualities in addition to rot and mold resistant, humidity regulating, and durability benefits. Recent studies based off historical claims have been done that explore these qualities and have informed quantitative data on eelgrass material properties to inform modern day uses.



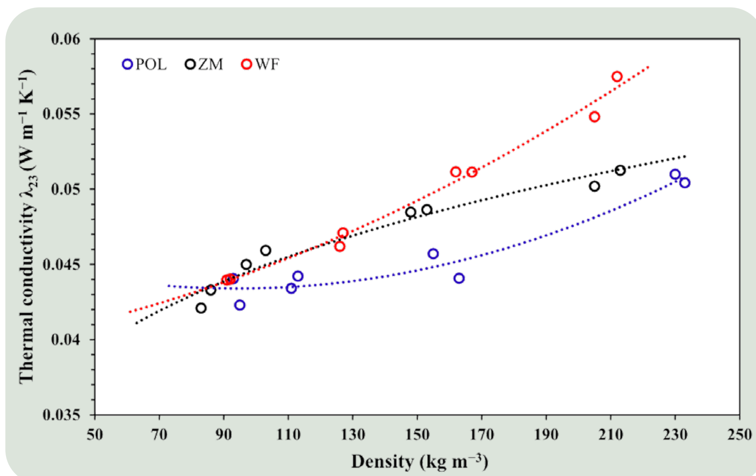
Cabot's Quilt brochure clipping (Samuel Cabot Inc. 1923, 4)

Thermal Qualities

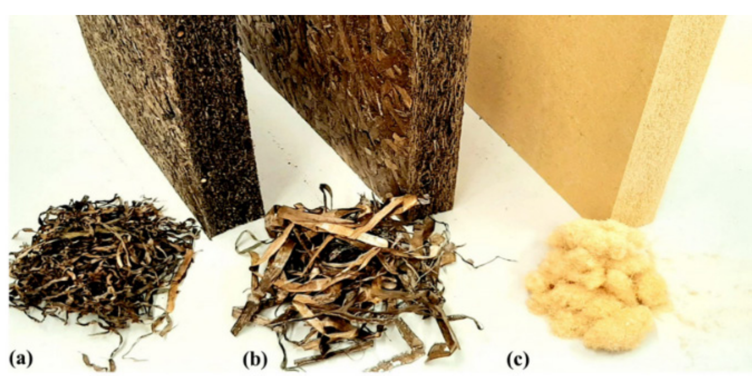
Eelgrass is ideal as an insulating building material because of its low heat conductivity combined with its light weight and flexibility in application. Cabot's Quilt primarily marketed their product through customer testimonials (Samuel Cabot

Inc. 1923), essentially to the tune of “it’s much warmer in the winter and much cooler in the summer”. However, they did use hard data to back up the testimony: thermal conductivity tests done at MIT in the 1920s provide a baseline measure of thermal conductivity that is still comparable to modern insulations today.

Seagrass is again being studied as modern insulation, with testing of rigid eelgrass insulation boards compared to a similar product of wood-fiber board. Findings indicate eelgrass insulation boards to have a thermal conductivity that is superior (5-12% lower) than the tested wood-fiber board (Kuqo and Mai 2022). With a thermal conductivity



Thermal conductivity tests comparing in blue: *Posidonia oceanic* (Neptune grass), in black: *Zostera marina* (eelgrass), and in blue: Wood-fiber insulation boards (Kuqo and Mai 2022).



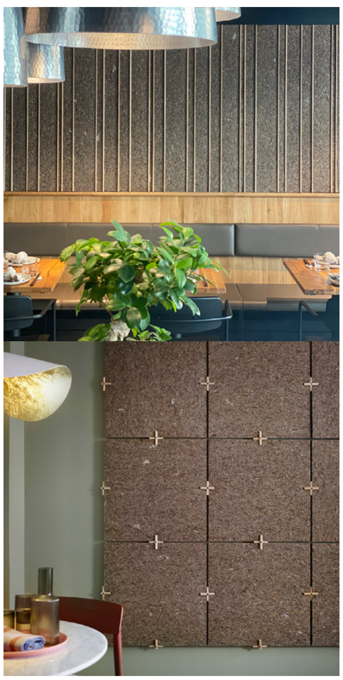
Tested materials a) *Zostera marina* (eelgrass) b) *Posidonia oceanic* (Neptune grass), c) Wood-fiber insulation boards (Kuqo and Mai 2022).

range of 0.043 to 0.050 W/mK, eelgrass, baled, or loosely stuffed or blown to a bulk density of 75 kg/m3 can be used to provide sufficient insulating properties (Pfundstein et al. 2012, 53) Using this range of thermal conductivity to calculate potential thermal resistance values: in a typical 2”x6” wall cavity (5.5” depth), eelgrass can supply an R-value of 15.9-18.5 (RSI: 2.8-3.25) and in a typical 2”x8” wall cavity (7.25” depth), eelgrass can supply an R-value of 20.9-25.3 (RSI: 3.68-4.28). One of the reasons for the lower thermal conductivity of eelgrass insulation (compared against products manufactured in the same process but with wood fibres) is the internal pore structure of the grass blades: the pore structure within the grasses can be seen as an insulation layer itself. *Posidonia oceanic* commonly called, Neptune grass (a seagrass local to the seas of the Mediterranean and southern Australia) has smaller pores (and hence a higher insulating ability) than eelgrass, but both were seen to be in the same range of thermal conductivity (Kuqo and Mai 2022).

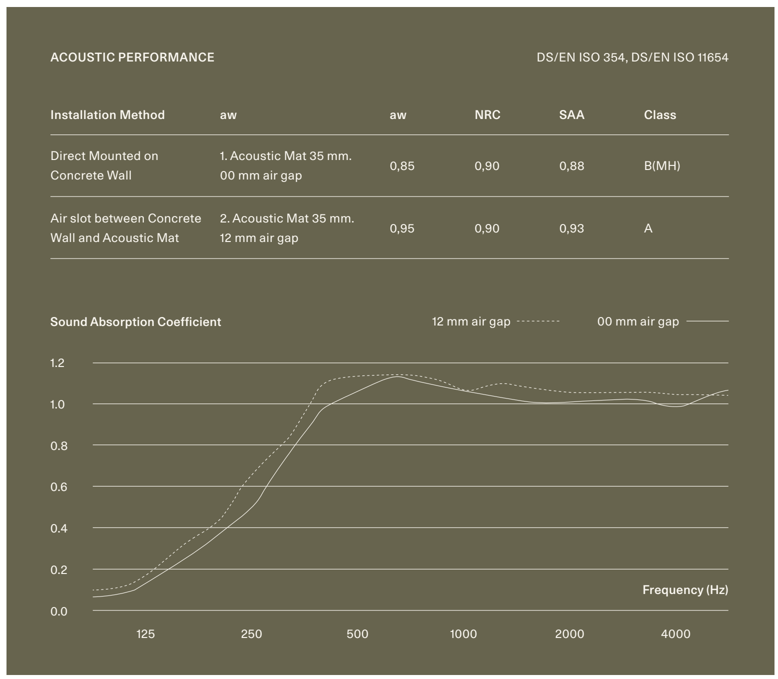
Acoustic Dampening Qualities

In architecture, it is important to insulate buildings acoustically as well as thermally. Cabot’s Quilt insulation was actually one of the first insulation products to promote acoustic dampening benefits in addition to its thermal qualities (Webber 2014). Because of its success as an acoustic insulator, there was a historical demand for it in specialized environments like concert halls and lecture auditoriums (Wyllie-Echeverria and Cox 1999).

Today, eelgrass is again being used as an acoustic dampener material, with the Danish company Søuld producing rigid acoustic mats made from compressed eelgrass that are functional and beautiful. The company datasheets provide a quantitative acoustic performance study of the eelgrass panels indicating that 35 mm thick panels (either directly mounted on a concrete wall or with air space between) obtain a 0.9 Noise Reduction Coefficient (NRC) where 0 indicates zero absorption and 1 is total sound absorption (Søuld 2022) These acoustically sufficient panels have since been applied to a wide variety of projects from homes, cafes, restaurants, galleries, and public spaces, mounted on walls and ceilings (Søuld n.d.).



Søuld acoustic panel products (Søuld n.d.)



ACOUSTIC PERFORMANCE — DS/EN ISO 354, DS/EN ISO 11654

Installation Method	aw	aw	NRC	SAA	Class
Direct Mounted on Concrete Wall	1. Acoustic Mat 35 mm. 00 mm air gap	0,85	0,90	0,88	B(MH)
Air slot between Concrete Wall and Acoustic Mat	2. Acoustic Mat 35 mm. 12 mm air gap	0,95	0,90	0,93	A

Acoustic performance datasheet from Søuld material testing (Søuld 2022)

Fire Resistance Qualities

Eelgrass was known to be fire resistant from the early days of Cabot's Quilt (Samuel Cabot Inc. 1923). The Cabot's Quilt installation brochure explained the fire-resistance of eelgrass because of the silicon content within the leaves due to the saltwater habitat that the plant grows (Samuel Cabot Inc. 1923, 2). It was encouraged to test the sample

Flame test on pressed eelgrass.

with a match to see the leaves char and shrivel under the flame, but the flame will not carry – out of curiosity during personal experiments, a lighter was placed under a piece of compressed eelgrass and proved this claim as the flame did not carry and rather the wooden pin holding the eelgrass began to catch fire instead. In a promotional brochure for the quilt, stories were related by architects about buildings that had been saved from fire destruction by the Quilt; when fire broke out, it burned available flammable material until it reached the quilt, whereupon it went out or smouldered without spreading far (Samuel Cabot Inc. 1923). Even where whole buildings were engulfed in flame and reduced to rubble, mats of eelgrass apparently remained intact (Samuel Cabot Inc. 1923).

Insulating material textbooks also acknowledge eelgrass fire-resistant qualities and indicate that without any further additives, again due to the impregnated salt within the leaves, seagrass insulation is naturally fire retardant and achieves DIN 4120 building materials class B2 (flammable), the same rating as wood fiber insulation (Pfundstein et al. 2012, 53). Additionally, in recent testing, rigid eelgrass fibre-boards released 110% lower peak heat release when ignited by a burner, and the flame extinguished itself in less than 30 seconds (Kuqo and Mai 2022). In addition to being difficult to ignite during the testing, the total heat release was also less than half of what was exhibited from a wood-fibre board (Kuqo and Mai 2022). While eelgrass is a fire retardant in itself, products such as Søuld acoustic panels also incorporate a natural fire-retardant product called Burnblock into their mixture as an additional measure (Søuld 2022).

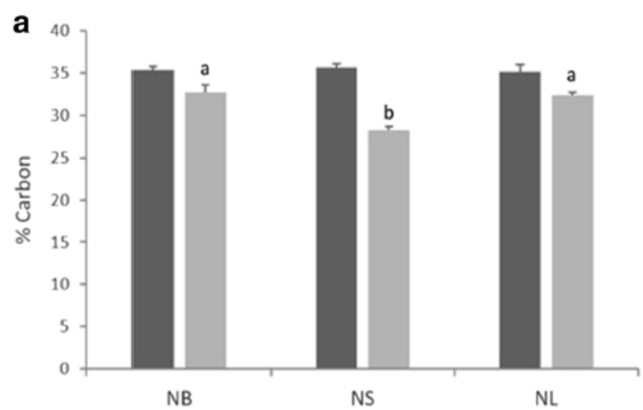
Type of Composite	Bunsen Burner Analysis at the Surface for 15 s				Bunsen Burner Analysis at the Edge for 30 s			
	Ignition	Time to Flameout (s)	Soot Cone Height (mm)	Pass/Fail *	Ignition	Time to Flameout (s)	Soot Cone Height (mm)	Pass/Fail **
ZM-80	No	n/a	35	Pass	No	n/a	32	Pass
ZM-100	No	n/a	27	Pass	No	n/a	30	Pass
ZM-150	No	n/a	27	Pass	No	n/a	41	Pass
ZM-200	No	n/a	28	Pass	No	n/a	41	Pass
POL-80	No	n/a	35	Pass	No	n/a	47	Pass
POL-100	No	n/a	32	Pass	No	n/a	55	Pass
POL-150	No	n/a	31	Pass	No	n/a	51	Pass
POL-200	No	n/a	31	Pass	No	n/a	38	Pass
WF-80	Yes	19	118	Pass	Yes	>60	All ***	Fail
WF-100	Yes	60	110	Pass	Yes	>60	All ***	Fail
WF-150	Yes	28	90	Pass	Yes	44	112	Pass
WF-200	Yes	49	All ***	Pass	Yes	>60	All ***	Fail

Each measurement was performed in duplicate. * The test is regarded as pass when the flame extinguishes within 15 s after burner is removed without passing the cone height of 150 mm. ** The test is regarded as pass when the flame extinguishes within 30 s after burner is removed without passing the cone height of 150 mm. *** The entire surface of the specimen is burned.

Bunsen burner tests on *Zostera marina* (ZM), *Posidonia oceanic* (POL), Wood-fiber (WF) insulation boards (Kuqo and Mai 2022).

Carbon Sequestering Qualities

As mentioned in chapter 2, live eelgrass meadows contribute largely to sequestering blue carbon in the ocean floor (Reynolds 2018). As eelgrass wrack typically collects on beaches or is cleaned from beaches it is deposited in landfills or composts to decompose. When eelgrass wrack is collected and processed into building materials, however, the carbon is held within the eelgrass and stored rather than being released back into the atmosphere. One study shows above ground eelgrass as having a content of 36% carbon (Cullain et al. 2018).



Graph showing mean percent tissue carbon in above- and below-ground eelgrass tissue across New Brunswic 36), Nova Scotia (NS, n=36), and Newfoundland (N The above-ground data is relevant to the eelgrass l wrack with an average 36% carbon. The Lower cases letters indicate significant differences (p≤0.05) between regions (Cullain et al. 2018).

This data can be used to calculate an example of the carbon stored in a 12”x12”x5.5” bale of eelgrass – compressed to a density of 75 kg/m3 for proper thermal qualities, the bale stores approximately 350 g of carbon. Using this example, if placed between studs of an 8’ wall assembly, one 12” wide section of eelgrass bale insulation will store 2.8kg of carbon (8 x 350 g). This indicates that eelgrass bale insulation sequesters more carbon in one 12” section than the carbon produced when a car burns 1 L of gasoline (typically produces 2.3 kg of carbon) (Natural Resources Canada 2014).

Eelgrass carbon qualities compared to wood insulating products, which is typically comprised of approximately 50% carbon, is lower in carbon content, however it must be taken into account that wood products take much longer to grow and require more energy intensive processes to harvest, and manufacture compared to eelgrass (Kuqo and Mai 2022). As eelgrass is lightweight and can be harvested with manual hand collection and processed with rainwater and sunlight, the low-tech processing does not produce carbon, but rather is seen as a carbon neutral – providing eelgrass a carbon negative material. This is evidenced by the -3.6 kg CO2eq/m2 Global Warming Potential calculated of Søuld acoustic panels (Søuld 2022). Additionally, because eelgrass will not rot once rinsed and dried - Cabot's Quilt offices claimed a sample of eelgrass that was 288 years old (Samuel Cabot Inc. 1923) - putting eelgrass in watertight cavities as insulation is form of long-term carbon sequestration.

EPD (ENVIRONMENTAL PRODUCT DECLARATION)					ISO 14025/EN 15804
Parameter	Unit	A1: Raw material	A2: Transport	A3: Manufacturing	A1-A3: Sum
GWP – Total	[kg CO_2-eq/m^2]	-4,3	0,2	0,5	-3,6
GWP – Fossil	[kg CO_2-eq/m^2]	1,5	0,2	0,4	2,0
GWP – Biogenic	[kg CO_2-eq/m^2]	-5,7	0,0	0,1	-5,6
GWP – Luluc	[kg CO_2-eq/m^2]	0.0	0,0	0,0	0.0

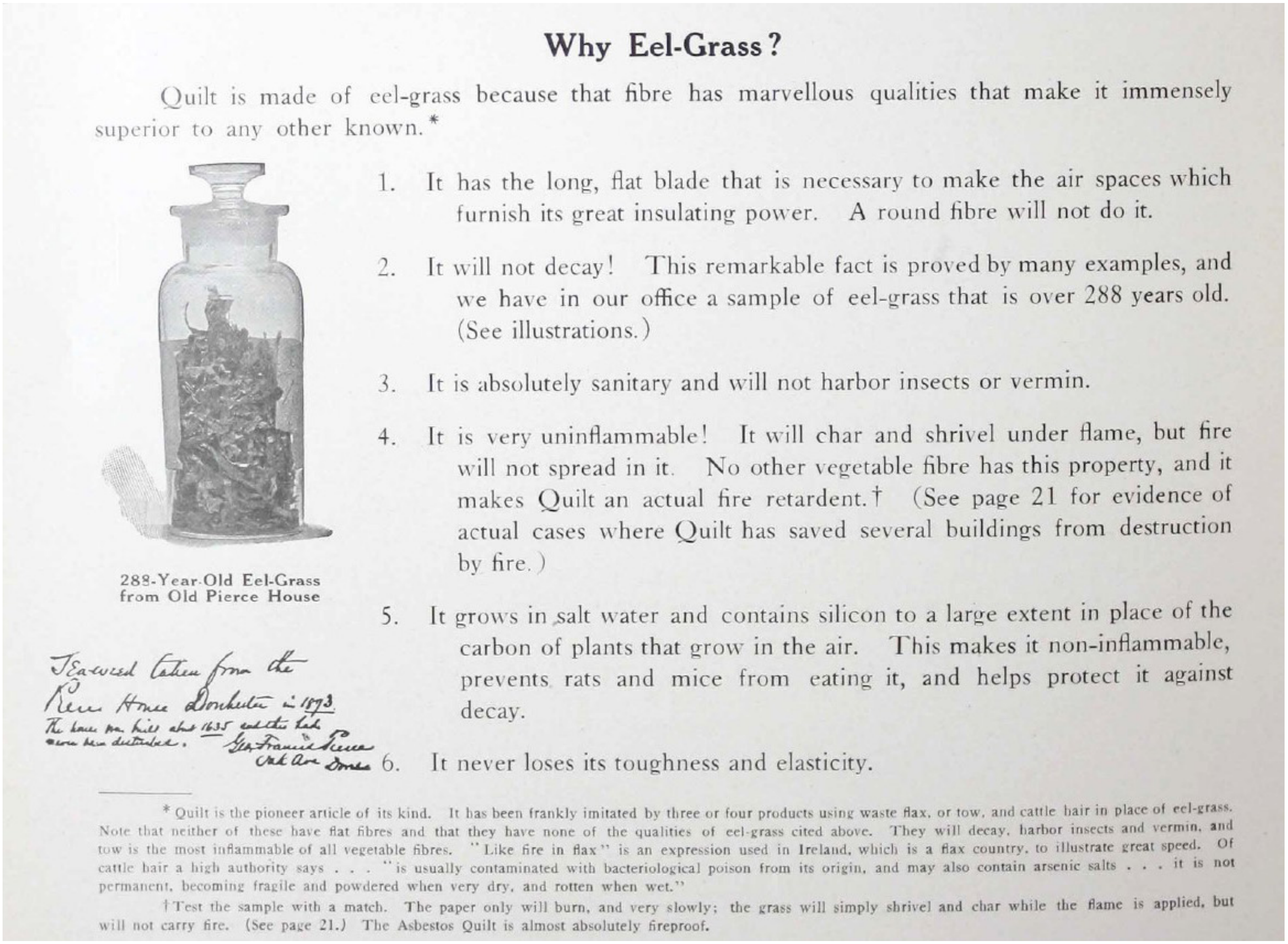
Global Warming Potential calculated of Søuld acoustic panels (Søuld 2022).

Other Mentionable Qualities

Eelgrass has additional material qualities that are less emphasized but important to consider for modern building applications. In descriptions of the Cabot's Quilt brochures that promote fire resistance due to eelgrass salt content, this also contributes to eelgrass not rotting or molding, preventing rodents from eating it, and reduces rate of decay (Samuel Cabot Inc. 1923). This quality is also mentioned in Søuld product information as the natural impregnation of the salt in eelgrass fibers impedes growth of bacteria that contributes to healthy indoor air qualities. Additionally, Søuld mentions the moisture and humidity regulating qualities of eelgrass – the leaves absorb excess indoor humidity and release it when the humidity levels drop. This further contributes to healthy indoor air quality benefits of using eelgrass material. Lastly, as seen in traditional methods of thatching on Læsø and in the discovery of 288 year old eelgrass found in a wall cavity, eelgrass provides a durable and long lasting material for industry use.

Research Takeaways: Informing Eelgrass Experiments

Using the existing material property research (historical and current) to inform how eelgrass can be used in the modern built environment, this thesis will aim to promote the versatile properties (thermal, acoustic, fire resistant, carbon sequestering, durable, rot resistant and humidity regulating) of the material through a variety of experimental applications. Using the historical processing methods of eelgrass and informed transformation methods of the material, the experiments will focus on how eelgrass can be compressed, stuffed, or twined to provide different material experiences throughout the design project.



Why Eel-Grass?

Quilt is made of eel-grass because that fibre has marvellous qualities that make it immensely superior to any other known.*

288-Year-Old Eel-Grass from Old Pierce House

Seaweed taken from the Pierce House Dorchester in 1873.

1. It has the long, flat blade that is necessary to make the air spaces which furnish its great insulating power. A round fibre will not do it.
2. It will not decay! This remarkable fact is proved by many examples, and we have in our office a sample of eel-grass that is over 288 years old. (See illustrations.)
3. It is absolutely sanitary and will not harbor insects or vermin.
4. It is very uninflammable! It will char and shrivel under flame, but fire will not spread in it. No other vegetable fibre has this property, and it makes Quilt an actual fire retardent.† (See page 21 for evidence of actual cases where Quilt has saved several buildings from destruction by fire.)
5. It grows in salt water and contains silicon to a large extent in place of the carbon of plants that grow in the air. This makes it non-inflammable, prevents rats and mice from eating it, and helps protect it against decay.
6. It never loses its toughness and elasticity.

* Quilt is the pioneer article of its kind. It has been frankly imitated by three or four products using waste flax, or tow, and cattle hair in place of eel-grass. Note that neither of these have flat fibres and that they have none of the qualities of eel-grass cited above. They will decay, harbor insects and vermin, and tow is the most inflammable of all vegetable fibres. "Like fire in flax" is an expression used in Ireland, which is a flax country, to illustrate great speed. Of cattle hair a high authority says . . . "is usually contaminated with bacteriological poison from its origin, and may also contain arsenic salts . . . it is not permanent, becoming fragile and powdered when very dry, and rotten when wet."

† Test the sample with a match. The paper only will burn, and very slowly; the grass will simply shrivel and char while the flame is applied, but will not carry fire. (See page 21.) The Asbestos Quilt is almost absolutely fireproof.

Clipping from Cabot's Quilt brochure describes material properties of eelgrass (Samuel Cabot Inc. 1923, 2).

Chapter 5: An Experimental Approach: Eelgrass Meets Design

Working with Eelgrass

As research informed the basis of the material experiments, working hands-on with eelgrass continued to inform how to best process, treat, and manipulate the material. Below are the general notes that were learnt when working with the material, informing the production for each experiment:

1. When preparing the eelgrass for treatment, it is important to sort through the eelgrass wrack that is collected off the shoreline for other types of marine plants and onshore plant life, feathers, garbage, shells etc. This can be done during manual harvesting and in preparation stages, however it is likely that you will continue to remove these objects throughout working with eelgrass. The best method to do this is by feel – you will know when you grab a handful of eelgrass and there is a tiny stick in it, eelgrass doesn't poke you!

Marine plants sorted from collected eelgrass wrack (top left).

Hand mulching leaves process and result.

2. After rinsing and drying the eelgrass wrack, the leaves go from being long and flat to curling up and becoming more brittle. This informs a few different things:

Dry curly leaf (top) vs. rehydrated flat leaf (bottom)

- Dried eelgrass can be brittle. Rehydrating the leaves with fresh water brings flexibility back into the leaf structure. When working the eelgrass into forms, spraying the leaves with water prevented crumbling during compression.

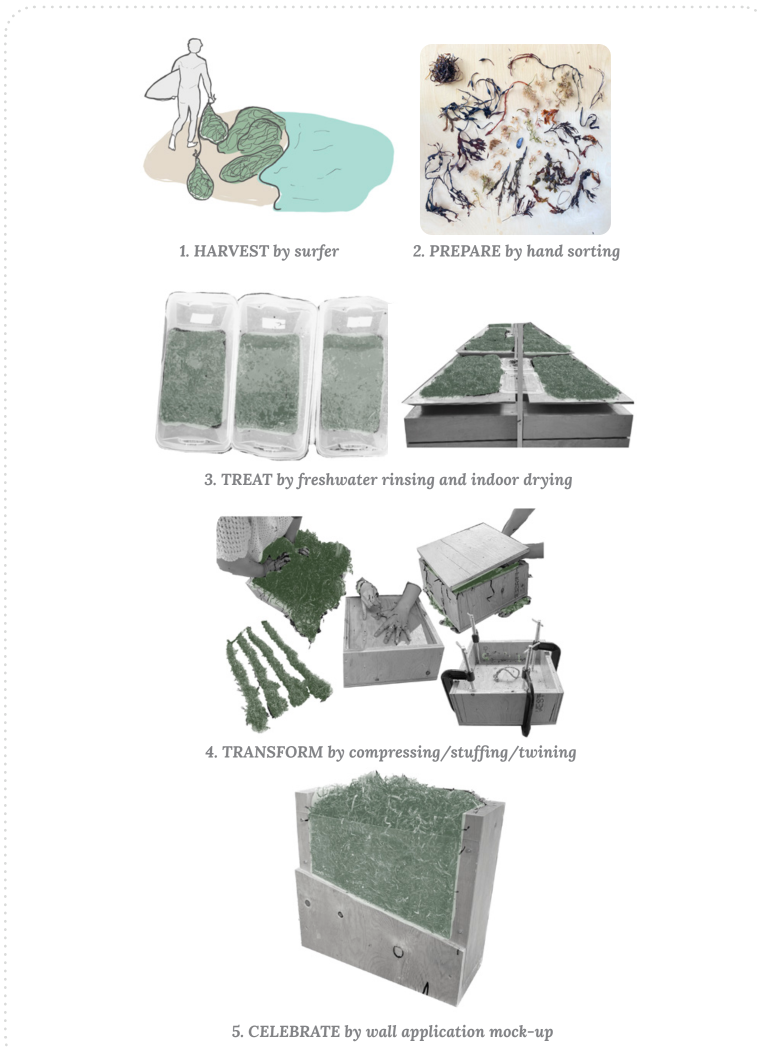
- As eelgrass dries and curls together, it tangles the leaves and forms natural clumps or twines of wrack. This observation informed another potential benefit of rehydrating eelgrass before putting it in the form, as eelgrass would naturally interlock and hold shape as it curls together.

- The brittle dried leaves provide opportunity for hand mulching the material when dry for different textures in the experiment as shorter pieces do not curl as much when drying.

3. Lining the wooden forms with packing tape ensures eelgrass does not adhere to wood when drying… but it also ensures the eelgrass products would not dry in the form! This information changed the drying process, as eelgrass was compressed in forms for 3-5 days to set and then were taken out of the form to freely finish drying. This revealed that when dried outside of the compressed form, eelgrass withholds most shape and compression of the form.

Typical Experimental Eelgrass Process:

By slightly modifying the historical eelgrass processing sequence based on personal eelgrass discoveries, a typical process was established that each experiment generally followed: 1. eelgrass wrack was manually **harvested**, 2. **prepared** for treatment by hand sorting, 3. **treated** in fresh water rinsing buckets and laid out to dry in indoor conditioned space (due to limited outdoor space), 4. **transformed** by (usually) rehydrating, compressing/stuffing/twining, and air drying, to produce and **celebrate** potential eelgrass products for building applications.



Sequence of experimental eelgrass process.

Stuffed Eelgrass Experiments

Applications of stuffed eelgrass were influenced by the traditional methods of hand-stuffing eelgrass into wall cavities as insulation and for furniture and mattress stuffing. For these applications, the leaves were not rehydrated. This is important to note because with this method of transformation, eelgrass is applied directly where it will be used and there is no guaranteed air-dry time compared to the compression experiments. Stuffing dry eelgrass for these applications prevents molding of adjacent materials.

Eelgrass Stuffed Insulation

For this experiment, the amount of eelgrass to be stuffed in the mock up wall cavity was calculated based on the required density for thermal insulating applications (75 kg/m³). A 12”x12” portion of a 2”x6” wall cavity requires 974 g of dry eelgrass to be stuffed between typical plywood sheathing. Keeping in mind the brittleness of the dry leaves, eelgrass was bundled and stuffed by hand, avoiding severe crunching of the leaves.

Process of stuffing eelgrass insulation in wall mock-up.

Final result of eelgrass stuffed insulation experiment.

EELGRASS STUFFING

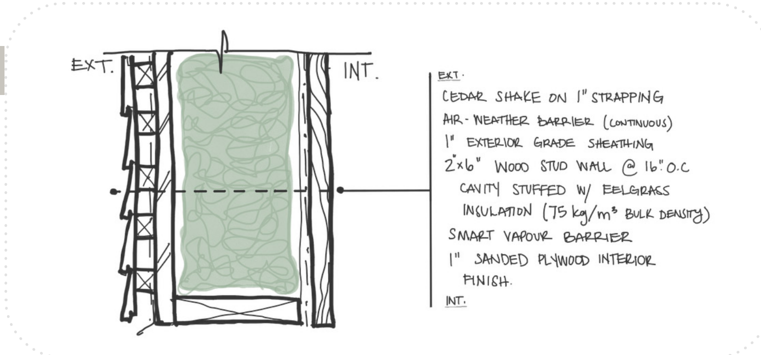
transformation: *loosely stuffed*

eelgrass quantity: 1421 g dry

carbon sequestered: 511 g

application potential:

- *2x6 cavity insulation [thermal conductivity range of 0.043 to 0.050 W/mK = R-value of 15.9-18.5]*
- *furniture stuffing (quantity and carbon amounts vary)*



Sketch of stuffed eelgrass insulation application in wall assembly.

This experiment provided a successful and easy method of applying loose eelgrass into a wall cavity to demonstrate the reintroduction of stuffed eelgrass insulation. Directly after rinsing and drying stages, the loose eelgrass is ready to be applied and requires very little building construction knowledge for installation. Quantity of eelgrass used is dependent on cavity volume and can be informed on a per assembly basis. Placed in a wall, the stuffed eelgrass would also offer acoustic dampening qualities and sequester 36 g of carbon for every 100 g of eelgrass used in the building assembly.

Eelgrass Stuffed in Fabric

This experiment was done out of curiosity of eelgrass stuffing in furniture and mattresses. Eelgrass was stuffed in a 16”x16” cotton pillowcase until reaching a comfortable density comparable with other stuffed pillows. This amounted to approximately 500 g of stuffed dry eelgrass.

Eelgrass stuffed pillow experiment.

This experiment provided a successful and easy method of fabric stuffing that can be applied to furniture. With bacteria and rot resistant qualities, the eelgrass provides a healthy and comfortable cushion. However, a crunching of the dry leaves is noticeable when using the pillow and over time this type of application may need more eelgrass added or potentially require a full restuff of the pillow. This being said, if crunched eelgrass needs to be replaced with use, the smaller bits of eelgrass can be used as fertilizer and new eelgrass can be stuffed to revive the pillow. The eelgrass used in this application would sequester 180 g of carbon. This experiment can also suggest the use of eelgrass stuffed fabric in applications that are handled less, potentially similar to the interior linen acoustic panels of the Modern Seaweed House. Loose eelgrass could be stuffed in linen to keep the eelgrass contained for interior finishes.

Twined and Woven Eelgrass Experiments

Inspired by the traditional eelgrass roof thatching techniques at Læsø Island, eelgrass twining and woven applications were experimented with at a small scale.

Eelgrass Twining

Process of twining eelgrass for thatching experiments.

As seen in historical precedent, the twining of eelgrass can be used as roof covering material. Experimenting with the historical process, rinsed and dried eelgrass was pulled from a mound and twisted to begin the twine. Twisting and pulling on the eelgrass to release it from the mound, began to form the twine. Once the twining was established, it was effective to hold down the smaller end of the eelgrass, and twist and pull the mound to lengthen to twine. The eelgrass (to my surprise) did not break away while twisting and rather held the rope like form without resistance or untwisting.

The first experiment with twining resulted in a 9' rope or 'vask' (in Danish traditional terms) that was then looped over a wooden frame to produce a similar application to historical eelgrass thatch precedent. This proves the historical theory that twined eelgrass could be a potential application for a modern eelgrass thatch roof covering.

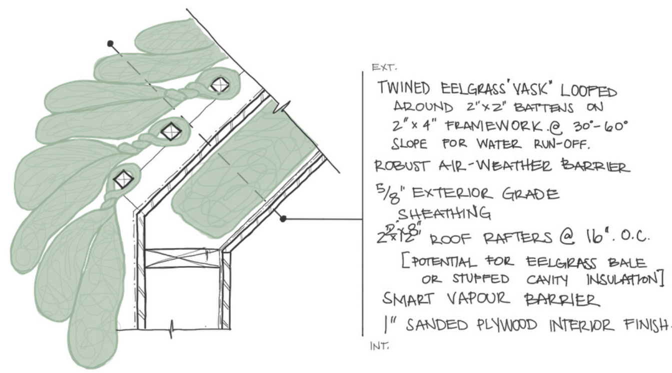
EELGRASS THATCH

transformation: *twined full length leaves*

eelgrass quantity: *~250 g (but can vary with length)*

carbon sequestered: *90 g*

application potential:
- *roof thatching material*
- *thermal, shading and acoustic dampening exterior finish*



Sketch of twined eelgrass application as roof covering.

Final result of large (9' long) eelgrass twining experiment.

Twining at a smaller scale was experimented with next. Smaller mounds of eelgrass for a shorter vask were twined and a lattice was used as the framework to loop and layer the twines. Using the same twining method informed from the Danish thatching and from the larger vask experiment eelgrass proved twining at a smaller scale was would still hold the rope like form.

Final result of smaller scale eelgrass twining experiment.

This experiment suggested the potential use of eelgrass thatching methods to provide an exterior shading system for buildings. Reflecting an organic curtain, the eelgrass thatch can be looped on slats to provide a pivoting window covering that blocks sunlight, and dampens outdoor noise.

Compressed Eelgrass Experiments

Most experiments relating to the compression of eelgrass were prompted by Cabot's Quilt's use of eelgrass bales for distribution and Søuld compressed products. For this reason, two forms were made for material experiments. An assembly of ¾" plywood, wood screws, jute (for a handle), paper and packing tape (for lining wood) and C-clamps created the forms. Form A was designed for larger 12"x12" experiments that could range in depth with a maximum thickness of 5.5" – this was based on potential uses in a typical 2"x6" wall cavity. Form B was designed for smaller 6"x6" experiments that could range in depth with a maximum thickness of 3.5" – this was based on the intention to experiment with smaller eelgrass block forms.

Form A (left) for 12"x12" experiments, Form B (right) for 6"x6" experiments.

Eelgrass Bale Insulation

Like the stuffed insulation experiment, the amount of eelgrass compressed was calculated based on the required density for thermal insulating applications (75 kg/m3). Form A was used to create a 12”x12”x5.5” eelgrass bale. Calculations indicated that 974 g of dry eelgrass would provide ideal bulk density in the volume of Form A. Following the typical process, after eelgrass was rinsed and dried, it was rehydrated and stuffed in the form, predicting the leaves would interlock and the bale would not lose form when drying – because the eelgrass bale was not under full compression, there was concern that the looser leaves would not hold form. The bale was fully wet when taking it out of the form, but after 7-10 days of air drying out of the form, the experiment produced a bale that can be picked up and handled for distribution.

Final result of eelgrass insulation bale experiment.

The eelgrass bale is specifically designed to be stacked within a building assembly cavity as a thermal insulator. This bale would provide an R-value of 15.9-18.5 and can be

Process of compressing eelgrass insulation bale.

improved by increasing eelgrass and the volume of the form to fit in deeper wall cavities. Placed in a wall or ceiling, the eelgrass bale would also offer acoustic dampening qualities and each bale would sequester approximately 350 grams of carbon. Although the bale was to experiment specifically with an insulation product, the bale can essentially be used as a way to distribute eelgrass without packaging for multiple uses (agricultural, furniture, etc.).

EELGRASS BALE INSULATION

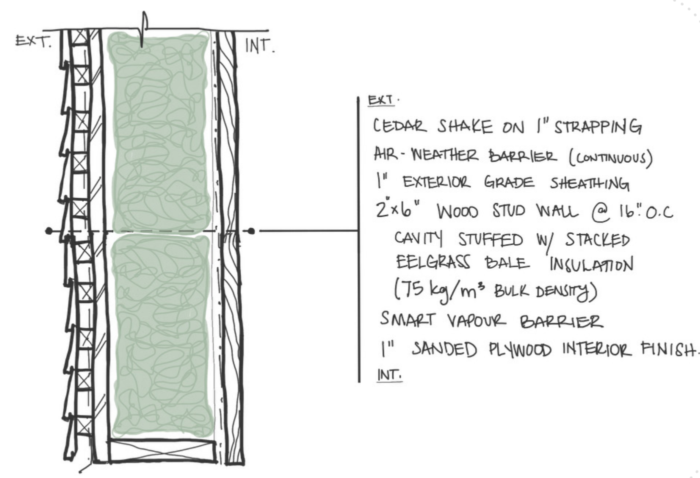
transformation: *re-hydrated and compressed (to the density of 75 kg/m³) of full length leaves*

eelgrass quantity: *974 g dry*

carbon sequestered: *350 g*

application potential:

- *2x6 cavity insulation [thermal conductivity range of 0.043 to 0.050 W/mK = R-value of 15.9-18.5]*



Sketch of eelgrass bale insulation in wall assembly.

Small scale (5 g) eelgrass sheet tests done before larger sheet experiments.

Eelgrass Sheet

In contrast to the eelgrass bale, testing smaller amounts of eelgrass with full compression was experimented with to see how the eelgrass would bind together and hold form. After typical processing and rehydrating the eelgrass, the first sheet experiment (Sheet A) used 100 g of full-length eelgrass leaves in Form A, that were fully compressed by pressing the inset lid to maximal compression. This created a 12”x12” sheet with a thickness of approximately ¼ inch. When Sheet A was taken out of compression, it was initially very flat. When set to air dry, the leaves began to curl, maintaining overall sheet form but creating an organic, lifted texture. Sheet A is cushiony and delicate but remains rigid to form when held up.

Final result of eelgrass Sheet A experiment.

This prompted Sheet B experiment to see if mulched eelgrass material would remain flatter in sheet form rather than curling like the longer leaves. Using half the amount of eelgrass material for Sheet B, 50 g of leaves were mulched by hand (simply crunching and tearing the dry leaves to smaller pieces), rehydrated, and compressed in Form A. After days of setting the material in compression, the sheet was removed and air dried, resulting in a much flatter, thinner sheet at 1/8” thick. While the mulching did seem to have an effect on the flatness of the sheet, it also provided a less cushiony material. Although still fragile because of thinness, the Sheet B seemed more ridged to form and less likely to bend than Sheet A. It was also noticed that with less eelgrass in Sheet B, when the mulched eelgrass dried, small pinholes were created throughout the sheet that can be seen when held up to light.

This inspired Sheet C and Sheet D experiment. Both made with 30 g of eelgrass, Sheet C used full length leaves compared to Sheet D that used mulched eelgrass to see

Process of compressing eelgrass sheet experiments.

Final result of eelgrass Sheet B experiment.

Shading and lighting effects from Sheet C (top) and Sheet D (bottom) onto wall.

how flat, thin, and perforated the sheet could be while maintaining form. The use of different leaves informed how mulching effects the structure of a very thin sheet compared to the interlocking structure of a the sheet made with long leaves. In the same process as previous sheets, both Sheet C and Sheet D were compressed in Form A. After removing from the forms and air drying, the experiments resulted in a thin sheet with long leaves interlocked and a very thin and fragile sheet with small mulched pieces. Both Sheet C and D had many more perforations in it that could be seen without putting it up to light however Sheet D was much flimsier in maintaining sheet form compared to Sheet C. Both were more fragile than pervious sheet experiments.

The application potentials of the eelgrass sheet experiments include an eelgrass interior finish material that can be mounted on a wall, and another potential in what was called ‘eelglass’ shading devices. The ‘eelglass’ shading device would comprise of an eelgrass sheet sandwiched between panes of glass. Using the range in perforation to adjust

Final result of eelgrass Sheet C.

Final result of eelgrass Sheet D.

EELGRASS SHEET

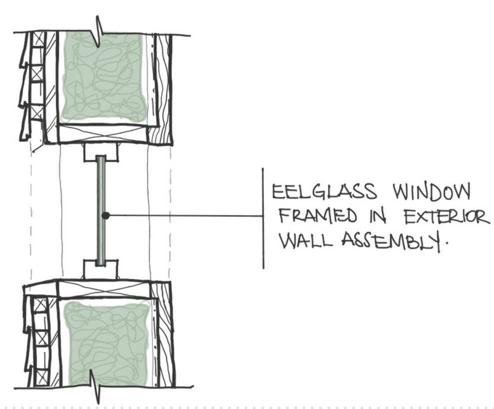
transformation: *re-hydrated and compressed (to maximum density) of mulched or full length leaves*

eelgrass quantity: *30-100 g dry*

carbon sequestered: *10.8-36 g*

application potential:

- *"eelgrass" shading device*
- *interior finish material*



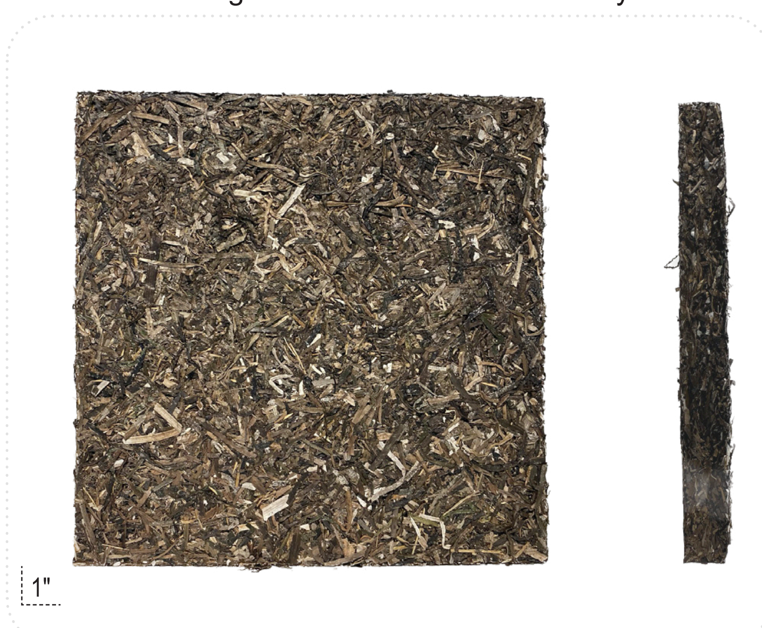
Sketch of eelgrass sheet application as 'Eelglass' shading device.

shading opacity, the sheets can provide light diffusion and an organic aesthetic value.

Eelgrass Panel

The eelgrass panel experiment was largely inspired by the Søuld eelgrass acoustic panels and was informed by the Sheet A experiment. Two panels were created. For Panel A, the eelgrass was mulched to achieve a flatter texture (similar to Søuld - they also mulch eelgrass for their product). The quantity of eelgrass used to produce a desired thickness for the panel was determined by the amount used for Sheet A. Aiming for a 1” thick panel A, 500 g of eelgrass was mulched, rehydrated, and placed in Form A. When compressing the panel, the lid was inset and compressed to achieve a ~1 inch panel, however this did not provide the panel with full compression and it was noted that it could have been compressed more. Bringing out of the form to air dry, the panel remained flat on the 12”x12” surfaces, however dried with more texture on the edges. The mulched eelgrass also resulted in a flakey texture as

Process of compressing eelgrass panel experiments.



Final result of eelgrass Panel A.

some of the leaves will fall away if they are rubbed. Panel A was also cushiony and seemed to have a weaker spot in the center line as it tends to bend under tension when picking up. This weak point is a possible result of not having the panel under full compression, or perhaps because the mulched eelgrass does not interlock, it is weaker for thicker and larger surfaces.

This prompted the Panel B experiment that followed the exact process as Panel A but without mulching the leaves. Panel B had much more texture to it and expanded more during drying time. This resulted in a greater cushiony effect than Panel A. The leaves in Panel B are observed to hold the structure of the panel more as it does not have as much of a weak point in the center of the panel and feels slightly more durable and rigid to form.

EELGRASS PANEL

transformation: *re-hydrated and compressed (to 1" thickness) of mulched or full length leaves*

eelgrass quantity: *500 g*

carbon sequestered: *180 g*

application potential:
- *acoustic dampening panel either mounted or directly on wall/ceiling*
- *interior finish material*

Sketch of eelgrass Panel application.

Final result of eelgrass Panel B.

The potential application of the panel would be an interior finish acoustic panel that could be mounted directly or with air space on wall or ceiling. As the mulched eelgrass provides a flakey texture, the panel could either be placed in a zero-traffic area, or placed within a linen covering similar to the Modern Seaweed House interior finishes.

Eelgrass Block

Process of compressing eelgrass block experiments.

The eelgrass block experiments used Form B which has a volume approximately 6 times smaller than Form A. Based off the amount of eelgrass used for the eelgrass bale experiment, while accounting for full compression in the block, approximately half the amount of eelgrass was used to create Block A. Maintaining full leaf length, after testing mulching for larger experiments with the panel, 400 g of eelgrass were rehydrated and heavily compressed into Form B. After the block was set in the form for a few days, it was removed to air dry. Creating a 6”x6”x~3” block, the long leaves slightly curled but overall the block seems very strong in compression and durable to touch.

Final result of eelgrass Block A.

The success of Block A prompted the creation of Block B to experiment with mulched eelgrass to test if leaf structure played a role in tensile strength and form rigidity that was questioned with the panel experiment. Using the same amount of eelgrass but mulched, Block B was much easier to compress than Block A and could have potentially been compressed more but trying to maintain similar dimensions in blocks halted the compression. (With this, a new general note can be observed; mulching eelgrass makes it easier to compress and may require more eelgrass compared to full length leaves to achieve full compression while maintaining desired block dimensions). The Block B experiment resulted in a flakier but flatter textured block that kept form but had more cushion than Block A.

Final result of eelgrass Block B.

Block C experiment followed the same processes of Block A, but with a wooden irregular form placed in the center of Form B to create an angled puncture through the block. Using 400 g of full length leaves, eelgrass was directed in and around the irregular shape and then fully compressed in the form. When taking this block out of the form, a thin and very heavily compressed layer of eelgrass needed to trimmed away with scissors to reveal the puncture in the block. As longer leaves slightly lifted when doing this, they were also trimmed to keep the shape of the irregular block. Block C dried to an organic texture similar to Block A and has a durable form that did not seem to be compromised when creating the irregular shape.

Final result of eelgrass Block C.

The potential applications of the eelgrass blocks can be considered similar to glass block applications. As a partition wall, or feature in a structural wall, the blocks are self-supporting, would provide acoustic dampening qualities, and with the irregular forms, play with lighting qualities of interior spaces.

EELGRASS BLOCK

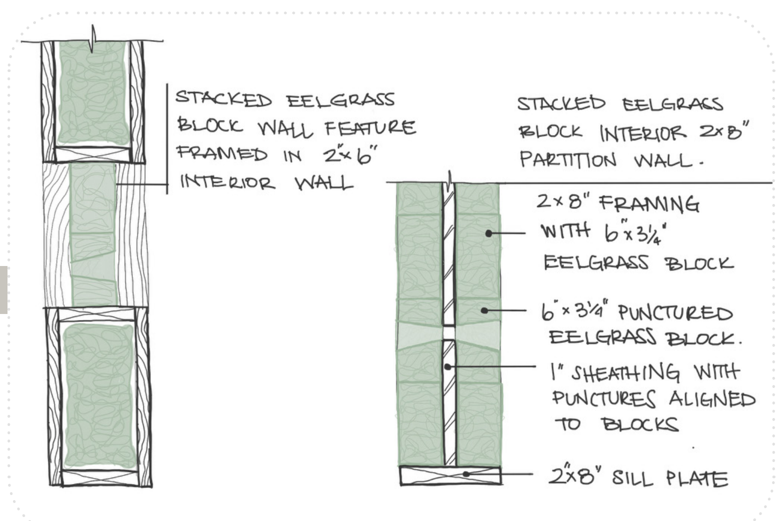
transformation: *re-hydrated and compressed (to maximum density) of mulched or full length leaves*

eelgrass quantity: *400 g dry*

carbon sequestered: *144 g*

application potential:

- *acoustic dampening partition wall either mounted or self-supporting*



Sketch of eelgrass block application as feature in structural wall or framed partition wall.

Communicating with Eelgrass

While working hands-on with eelgrass experiments was used to inform carbon negative potential applications for the design, it also was an opportunity to learn the material's visual language. With George Nelson as a guide to understand visual literacy in materials and surrounding objects, opportunities for non-verbal communications through eelgrass and light, shape, colour, texture, lines and patterns, and movement are realized within the eelgrass material experiments. These visual cues inform how eelgrass can be used as a medium, placed throughout the design, to communicate with the user and encourage observation and interaction with the natural material mitigation strategy.

Eelgrass and Light

Visual literacy: eelgrass and light

Opportunities to communicate with eelgrass and light are seen with the sheet and block experiments. With applications of 'eelglass' shading devices, the small perforations in the sheet twinkle light into the interior of a space, bringing subtle attention to the material and provoking a user to engage in learning about what the material may be. The block experiment can provide a partition wall with a combination of full block and punctured blocks. Allowing light to poke into interior spaces, the user can peak through the punctures to join in on the dialog between eelgrass and sunlight.

Eelgrass and Shape

Visual literacy: eelgrass and shape

The punctured blocks also provide elements of shape that can induce interaction between the user and a partition wall. As a user sees that one side of a punctured block produces a different shape on the opposite side, it initiates a sense of discovery. The user can become excited about revealing the hidden shape of each block as they move throughout the space, making an effort to see and compare the different sides of the partition wall.

Eelgrass and Colour

Visual literacy: eelgrass and colour

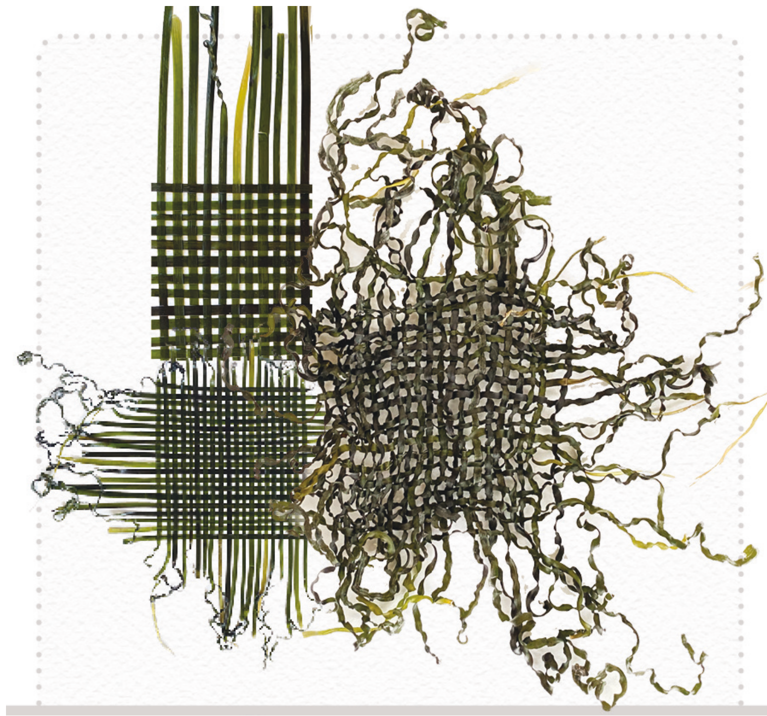
Eelgrass naturally has a gradient of colour that ranges between light beige, light and dark greens and darker brown. Similar to the Zostera stool process, eelgrass can be sorted based on dried colour and applied in the variety of experimental products. Assembling panels, blocks, or sheets based on colour can interact with the user, as they see the material colour shift throughout the same product application. As seen in Læsø island seaweed roofs, the colour of eelgrass lightens with the sun, presenting a silver colour that contrasts with the fresh wrack (typically darker and brown). With this, eelgrass and colour's relationship with time can develop curiosity in user observation. Additionally, washed up wrack that is freshly detached from meadows provides a vibrant green colour for material applications. Although more sparse on shorelines, (at least during my experimental harvesting period) when pressed in a similar process to the larger sheets, the fresh green leaves resulted in a rich green material. Eelgrass sheets made from sorted colours and applied as eelglass also has the potential to initiate a dialog between eelgrass, light and colour that prompt a new quality of space for user to learn about and observe.

Eelgrass and Texture

Visual literacy: eelgrass and texture

The experiments using different amounts of compression and different leaf structures offer a range of organic texture that can be applied in interior spaces. Contrasting mulched leaf flat products with longer leaf curly products can play with the observant - make them want to touch the panel or the sheet, while hesitant because of the natural, fragile essence of the leaves. The natural textural qualities of the eelgrass lure the visitor to interact with the material, encourage the user to touch it but there is a hovering sense of hesitation inherited by the unfamiliarity of the material. This initiates awareness, promoting the user to learn more about this material they so badly want to touch.

Eelgrass and Lines and Patterns



Visual literacy: eelgrass and lines and patterns

As eelgrass leaves naturally tangle and curl, flat and rigid patterns and lines are inorganic to the material. When wet, and pressed and air dried the leaves reveal the natural pattern of the curly tangle in a pressed, abstracted quality. Small experiments of weaving the leaves can explore opportunities within the material to push the limits of the organic, curling patterns. Leaves that are wet and flattened for the entirety of drying time are restricted from curling and will dry (eventually) to form a pattern that resembles eelgrass in the underwater meadows rather than wrack. Assembling woven individual leaves between panes of glass, like the application of eelglass, can restrict the natural patterns of eelgrass wrack and create a scheme of inorganic and organic patterns within the material application. The user can observe the change in pattern as the material remains constant, creating conscious thought to understand how the material is being manipulated differently and why.

Eelgrass and Movement

Visual literacy: eelgrass and movement

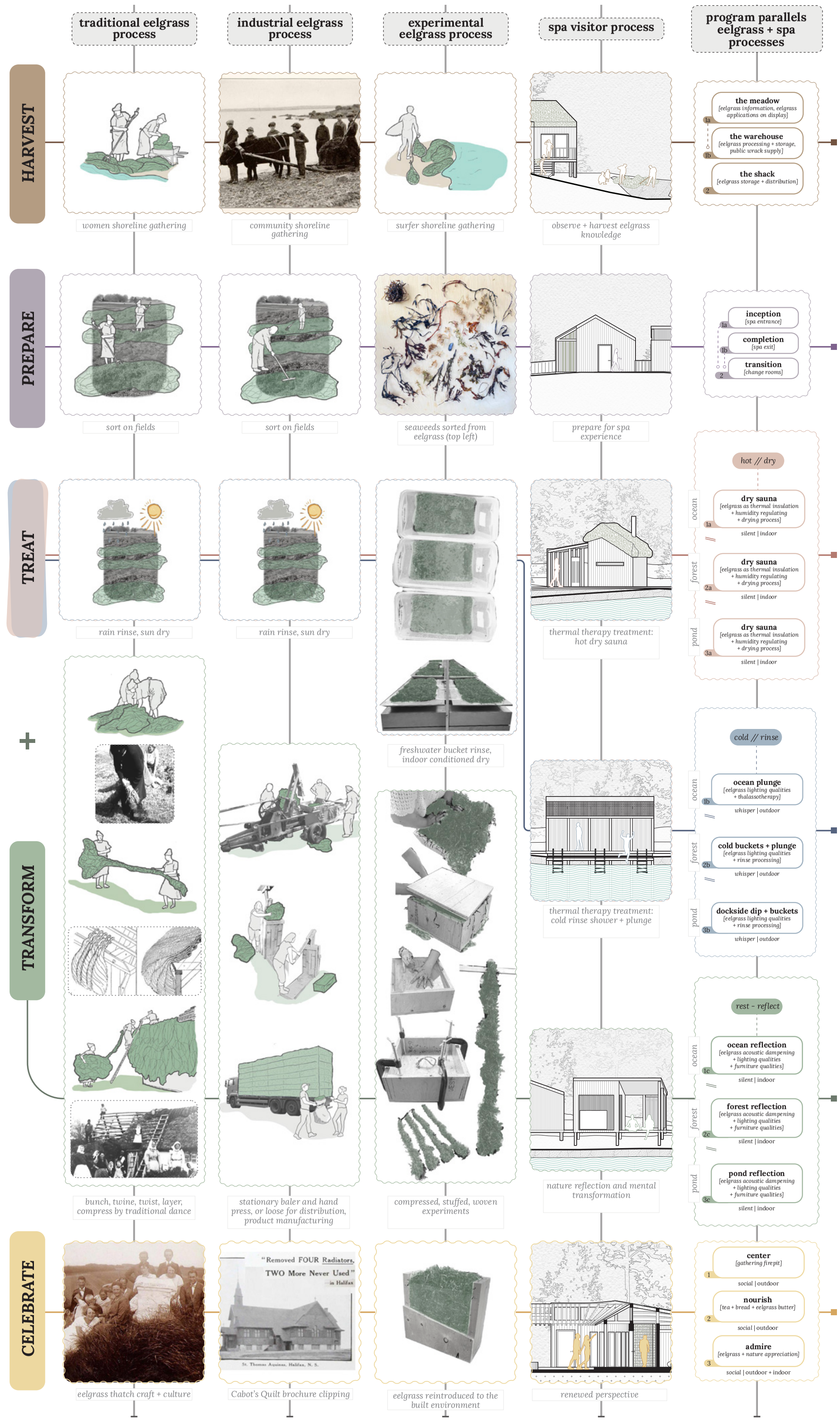
Eelgrass leaves provide communication through movement as the leaves react to moisture content within a space. During experiments, as water rehydrated dry leaves, the leaves would uncurl and flatten and as wet leaves began to dry, they would spring up and curl away from the surface they were laid on. In a space were eelgrass is presented with different levels of water content, the movement of the leaves can prompt a new discussion with the user and the material that inform the indoor humidity levels. Eelgrass signals to the user with a curling or uncurling movement, bringing attention to the material and informing the user about the indoor space.

Chapter 6: Relating Everything to Eelgrass to Program

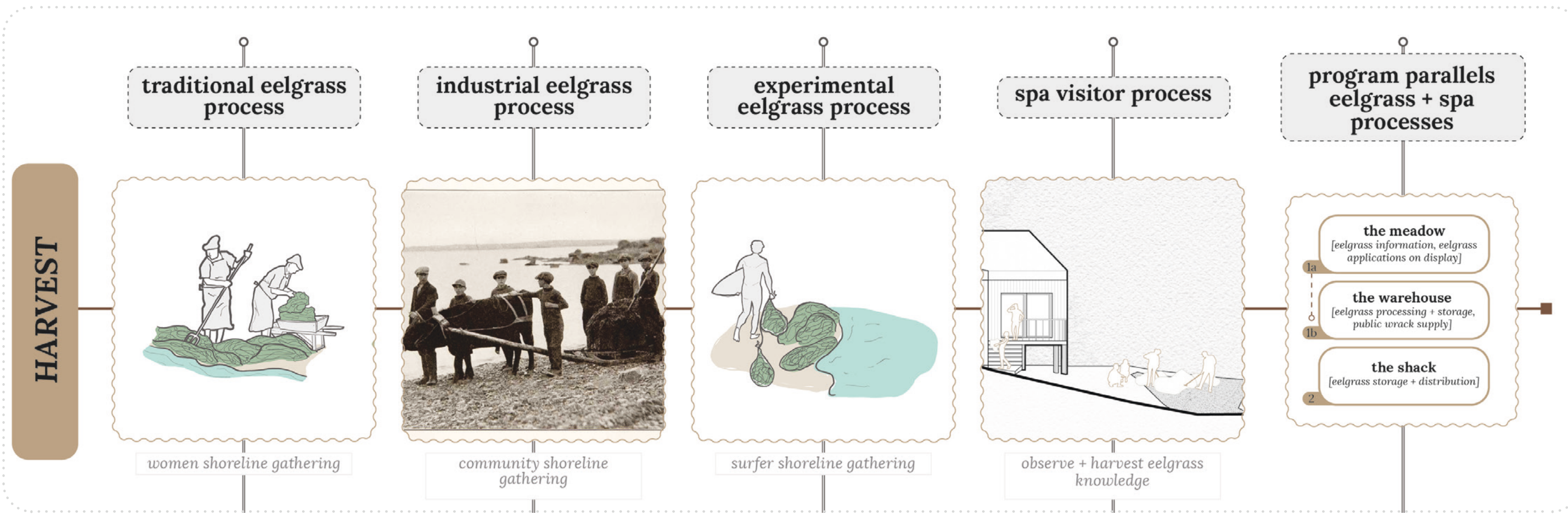
With a variety of eelgrass products established, the role of program and design will collaborate to enable people to observe and interact with eelgrass. An immersive program will bring the body of the user in parallel with eelgrass while providing opportunities in the design to showcase the versatile properties of eelgrass as a building material. Together, the design and program will enhance the natural beauty of eelgrass, provoke curiosity to learn about the material and understand the role of using eelgrass materials to reduce carbon in the face of climate change.

Parallel Processes

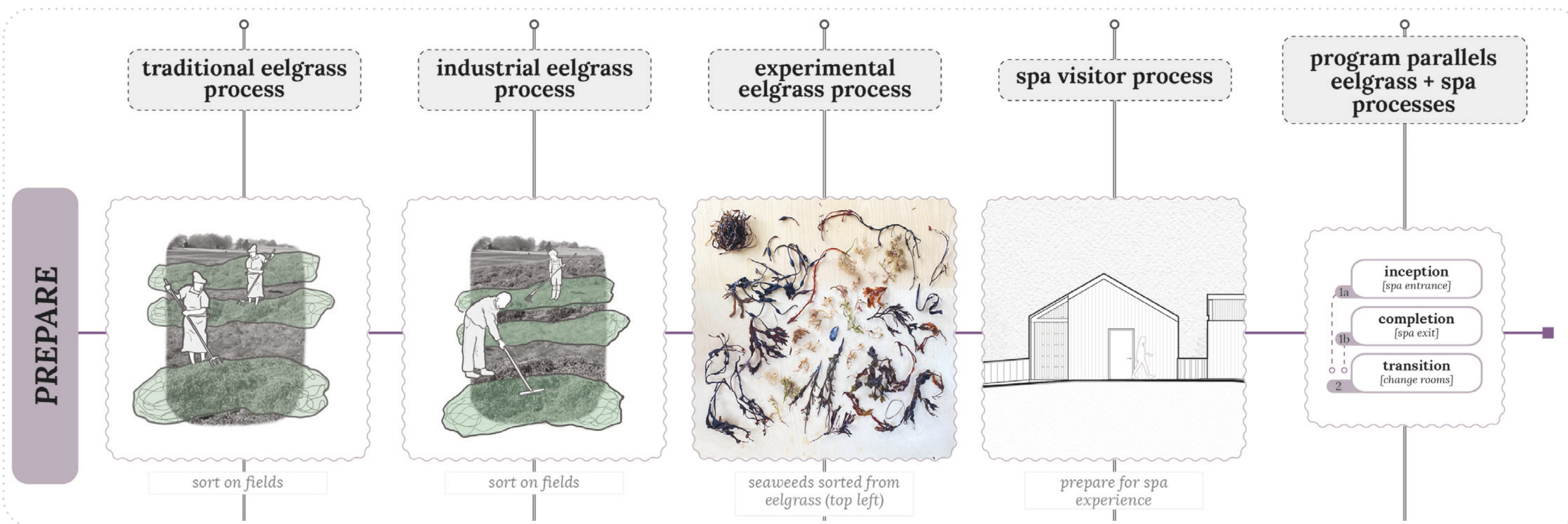
With a goal to relate everything to everything inspired by George Nelson's concept of total design, a sequence of harvest, prepare, treat, transform, and celebrate is revealed in the evolution of traditional, industrial and my own experimental eelgrass processing. This sequence informed a parallel process to the journey of a spa that enables an immersive experience for spa visitors to observe, interact, and transform with eelgrass. The Evolution of Parallel Processes diagram illustrates the sequence of processes that informs the spa program and buildings that will be designed to support the program and reintroduce eelgrass material throughout the design intervention. Incorporating eelgrass in the spa building construction, each program contributes to using eelgrass in different types of applications to show the versatility and potentials of the material.



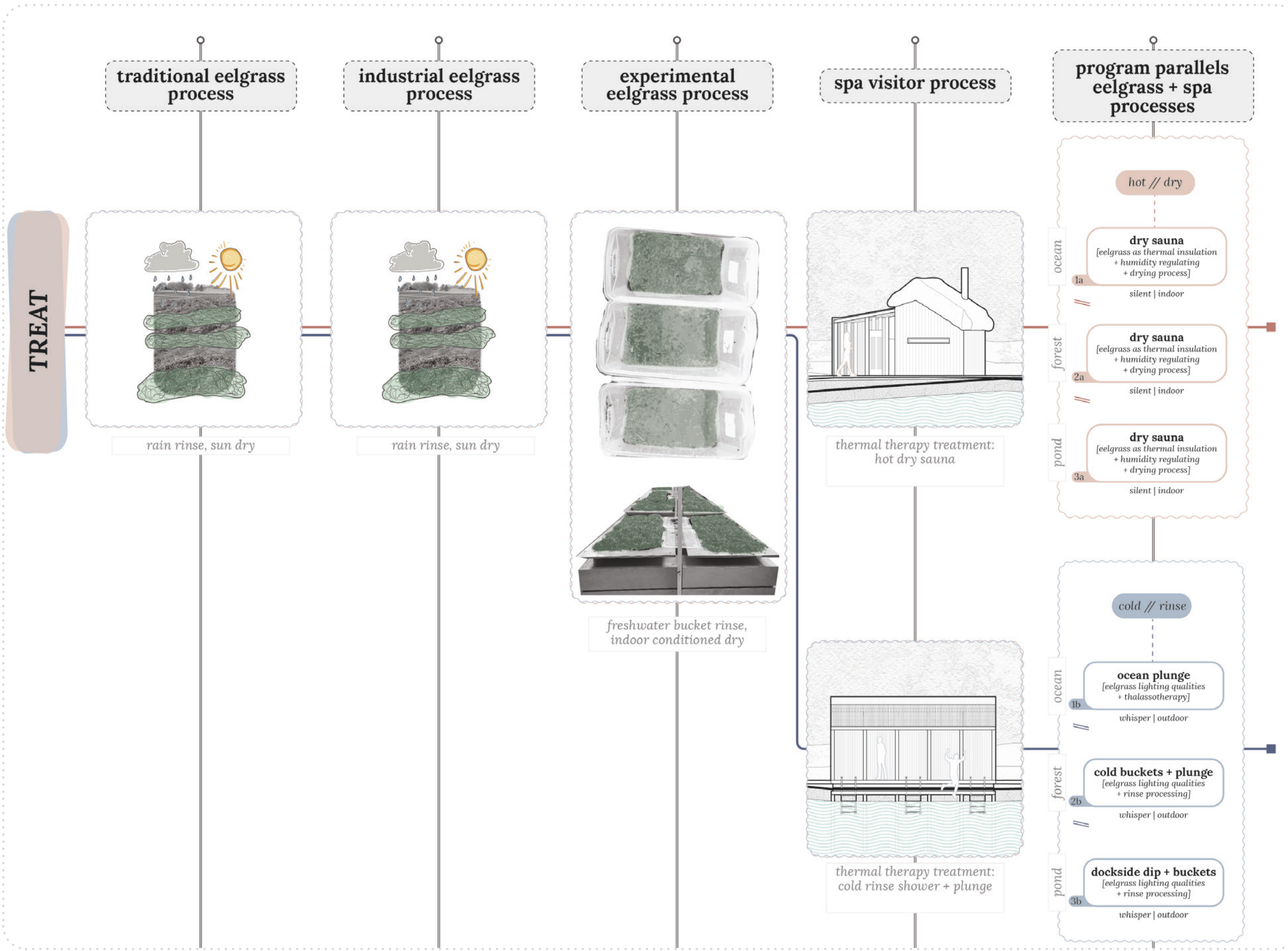
Evolution of Parallel Processes: Relating eelgrass processing to the spa visitor process to inform program, building amenities and eelgrass applications for the design project.



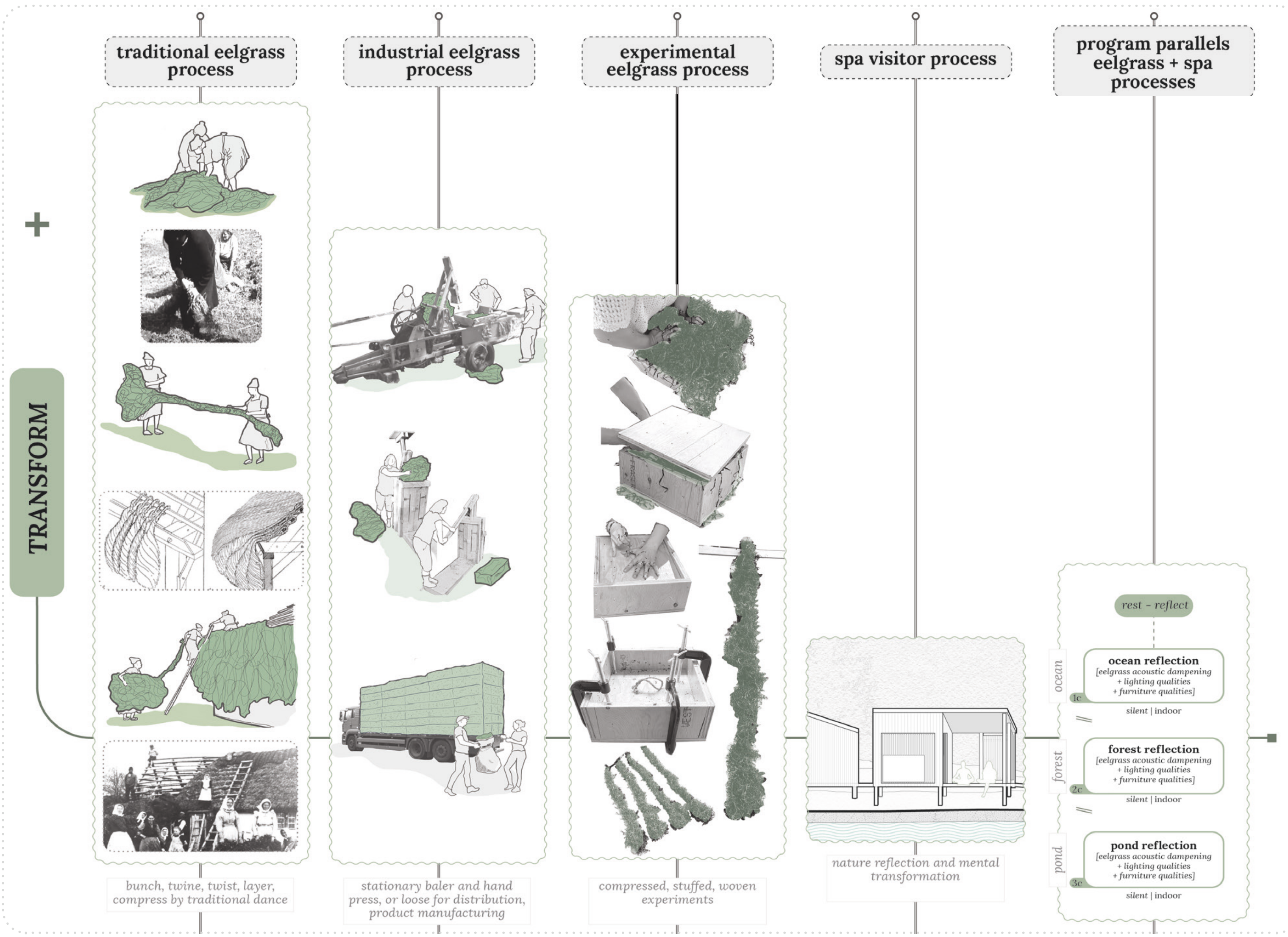
Evolution of Parallel Processes: Harvest. (Larsen 2019; Meier 2013; Period Paper Historic Art 2023)



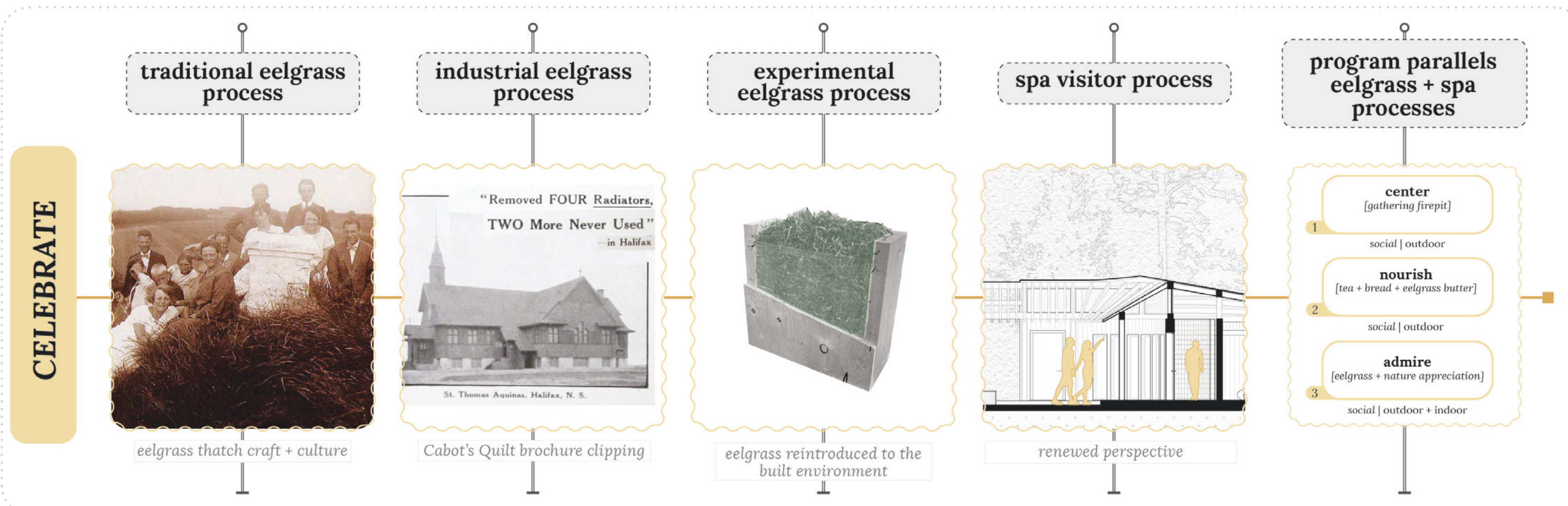
Evolution of Parallel Processes: Prepare. (Larsen 2019; Meier 2013; Wyllie-Echeverria and Cox 1999)



Evolution of Parallel Processes: Treat. (Larsen 2019; Meier 2013; Wyllie-Echeverria and Cox 1999)



Evolution of Parallel Processes: Transform. (Larsen 2019; The Best in Heritage 2013; Wyllie-Echeverria and Cox 1999)



Evolution of Parallel Processes: Celebrate. (TangTag 2022; Samuel Cabot Inc. 1923)

Harvest

The harvest program provides a space for physical eelgrass harvesting where eelgrass knowledge can be harvested by the spa visitor, provoking curiosity and initiating the relationship between the user and eelgrass. Eelgrass is shown during the processing stages and will also be used to demonstrate the potential as modern roof thatch covering, insulation, and eelglass sheets. This program enhances the contrast between the raw and transformed versions of the material.

Prepare

Prepare is a threshold program where sorting and preparing eelgrass for transformation pairs with the entrance and change rooms of the spa where visitors prepare for the spa journey. Bringing the user in and out of the set of buildings, eelgrass is emphasized as a thermal conditioner of indoor spaces. As the user moves from the entrance to the change room and the change room to the exit, the indoor and outdoor atmospheres present the thermal qualities of the eelgrass insulation and prepare them for the indoor-outdoor experience of the spa.

Treat

Treat parallels the rinsing and drying of eelgrass processing with the hot and cold cycles of the spa, creating sauna and cold-bucket shower amenities. While the sauna is conditioned to support extreme heating conditions, traditional thatch roofing applications, and eelgrass insulation both contribute to maintaining a warm environment. Additionally, incorporating wet eelgrass within the building applies the humidity regulating aspect of eelgrass to increase steam in the sauna. The cold bucket showers demonstrate the use of eelgrass as a shading device by incorporating eelglass partitions between rinsing stalls. These accentuate the colour and light diffusion qualities of eelgrass as a building material.

Transform

Transform relates the transformation of eelgrass into a material application with the rest and reflect space within the spa. A combination of indoor and outdoor zones provide a calm space in nature for environmental perspective to be transformed. Eelgrass acoustic dampening qualities are emphasized in this space with the application of eelgrass panels and interior wall finishes to support the quiet reflection atmosphere.

Celebrate

Celebrate connects the celebration of eelgrass as a natural material in building applications where spa visitors celebrate awareness and new appreciation for eelgrass and nature in the central hearth of the spa. Demonstrating the self-supporting qualities of eelgrass blocks, curved walls are placed in spaces for admiration. While producing acoustic dampening qualities the stacked block partition walls invite a new appreciation for eelgrass in building application.

Chapter 7: Eelgrass Spa Design

Site Overview

Taylor Head Provincial Park

Taylor Head Provincial park is a nature based tourist attraction in Nova Scotia offering a variety of natural features along a 6.5 km peninsula that juts out into the Atlantic Ocean (Nova Scotia Provincial Parks n.d.). With 16 km of coastal views, the park features a variety of natural environments that expose visitors to coastal forests, rocky cliffs, freshwater marshes, brackish ponds, cobble shorelines, and a white sand beach. As mentioned, Taylor Head Provincial Park is the ideal site of the Eelgrass Spa design intervention as the vast amount of eelgrass meadows that surround the park supply an abundance of onshore eelgrass wrack. Mapping the eelgrass meadows that surround the park (informed by the NETForce mapping data, DFO 2023) emphasizes the area of underwater meadows as a comparable mass to the land-base area of the park - granting equal importance as a natural feature of the park.

The park has established trails ranging from 1.2 km to 8 km that meander the visitors along the shoreline into the breezy, cool air of the Atlantic Ocean (Nova Scotia Provincial Parks n.d.). At the end of the gravel road designated for vehicle entry, there is an established Trail Head where most of the trails in the park converge and is supported with parking, washrooms, change rooms and an interpretive kiosk. Taylor Head Provincial Park is a prime and equipped location, just under a 2-hour drive from Halifax, for people to reconnect with nature – this reconciliation will be emphasized through the design intervention of the Eelgrass Spa.

Site plan of Taylor Head Provincial Park (data from HRM Open Data 2023; DFO 2023; Nova Scotia Provincial Parks n.d.)

Situating Design Intervention

The design intervention is situated in two main spaces of the park. On the west side is the Harvest site and on the east is the Prepare, Treat, Transform and Celebrate site at the northern point of Power's Pond.

Locating site boundaries in Taylor Head Provincial Park (data from HRM Open Data 2023; DFO 2023; Nova Scotia Provincial Parks n.d.)

Already used as a collection site today, the western side of the park has ideally located Taylor Park Rd. for locals to drive in, back their truck up close to the shoreline and shovel wrack into the beds of their truck for a variety of uses. This access to onshore wrack is ideal for the Harvest program of the design intervention and will be the starting point of the full design journey. Continuing into the park from the Harvest site, Taylor Park Rd. ends at the parking lot where visitors will proceed to the spa program by foot. The choice to walk along Pyche Cove white sand beach or the coastal meadow trail offer different journeys that bring you to the starting point of the new boardwalk along the shoreline. This boardwalk brings you to the Prepare program of the spa.

Enlarged site plan of Eelgrass Spa design interventions at Taylor Head Provincial Park (data from HRM Open Data 2023; DFO 2023; Nova Scotia Provincial Parks n.d.)

Site plan of Harvest design interventions at Taylor Head Provincial Park (data from HRM Open Data 2023; DFO 2023; Nova Scotia Provincial Parks n.d.). Looking out into Tomlee and Spry Bay, the Harvest site initiates the relationship between locals, visitors, and eelgrass. The Harvest site is positioned to the shoreline and is supported with storage sheds along the entry driveway.

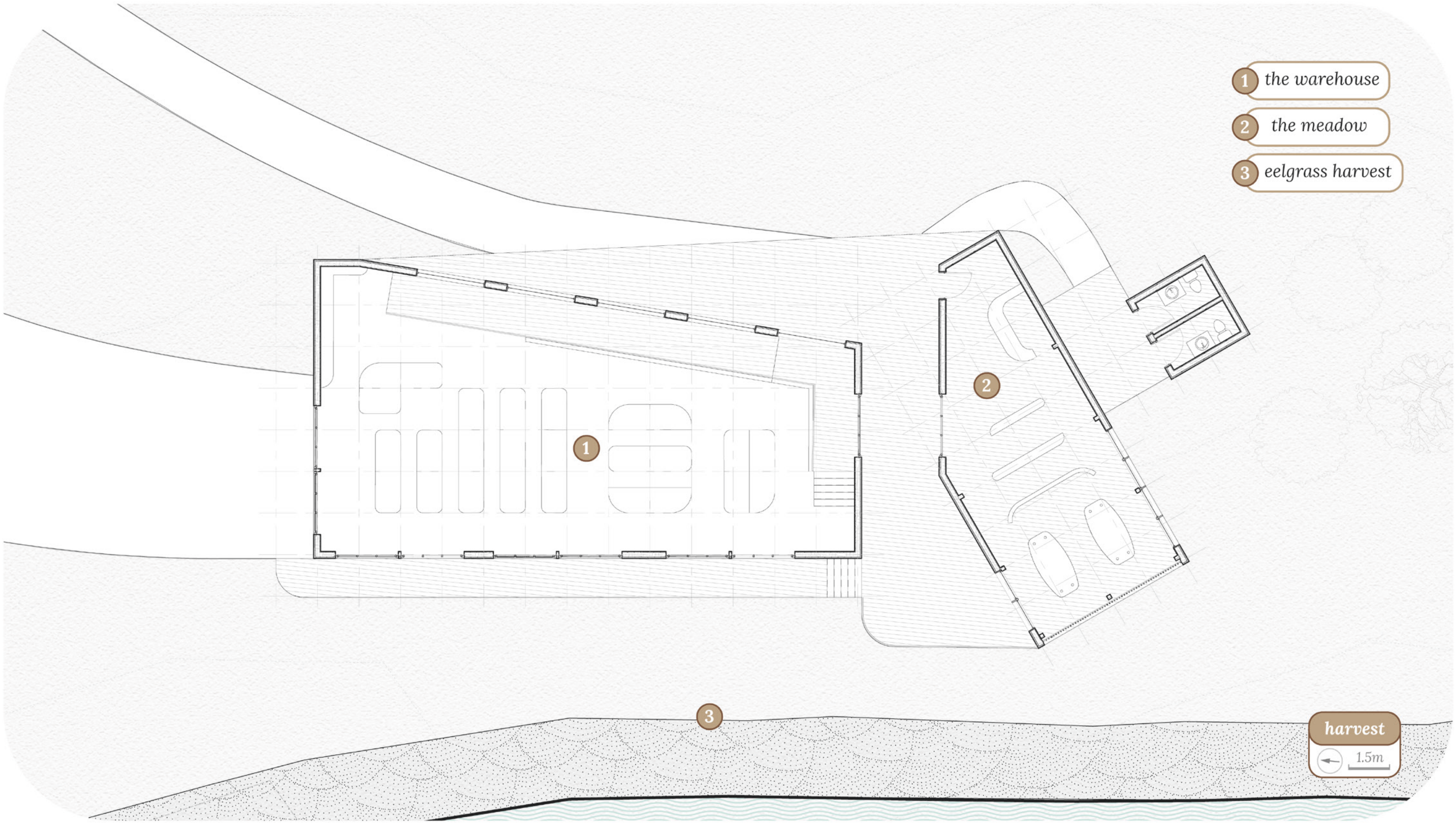
Site plan of Prepare, Treat, Transform, and Celebrate design interventions at Taylor Head Provincial Park (data from HRM Open Data 2023; DFO 2023; Nova Scotia Provincial Parks n.d.). Visitors will start their spa journey, and meander in nature between the three cyclical loops that focus on ocean, forest, or pond natural features during the Treat and Transform stages. As visitors complete the loops, the boardwalk circles back up and along the site's natural topography to the Celebrate program, where the transformative journey and new appreciation for nature is emphasized.

Harvest

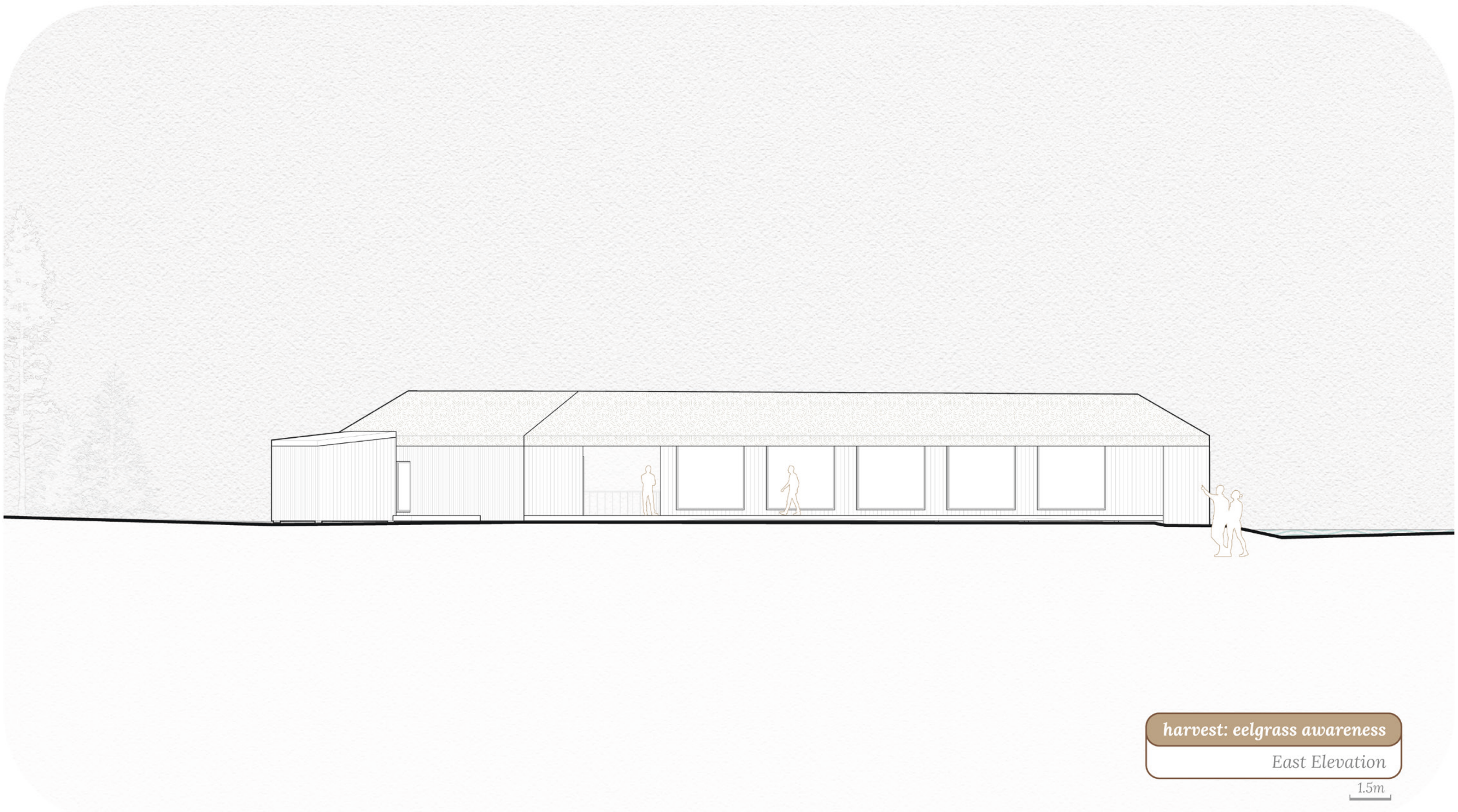

Harvest Plan (data from HRM Open Data 2023)

The harvest program consists of the warehouse building and the meadow building with supporting washrooms and storage sheds along the driveway of the site. Placed along the existing road, the building form takes inspiration from the Wadden Sea Center by Dorte Mandrup (Mandrup n.d.) with the intent to lure visitors into the building and initiate the relationship between the park visitor and eelgrass design intervention. As the front elevation angles towards the entry and observation space between the warehouse and the meadow, the modern thatch roof ties the two buildings together, inviting a connection between the observers in the meadow building and the eelgrass processing in the warehouse. A modern take on the traditional eelgrass thatching is demonstrated on the roof and creates a new awareness for eelgrass, to prompt people to come in and learn more about the material and processing that is taking place in the warehouse.

The warehouse building is designed to be a larger scale processing shed similar to the sheds that supported the storage and processing of eelgrass for Cabot Quilt production. Equipped with drying tables, rinsing bins and transformation tables, the warehouse garage doors open up to the shoreline where eelgrass can be harvested and brought directly in for material processing. Locals are encouraged to use the space to continue their traditions of gathering eelgrass while the warehouse offers supporting space to preform the low-tech processing methods. Garage doors at the North entrance offer easy eelgrass pick-up for material distribution and direct interaction with eelgrass.



Harvest Plan (data from HRM Open Data 2023). Form lures visitors into the building from Taylor Park Rd. as they enter the park. The warehouse and meadow buildings join under one thatch roof form to connect the meadow observer space with the warehouse processing space. Placement on site and form angle gestures to the eelgrass harvesting area, connecting the building to the shoreline site.



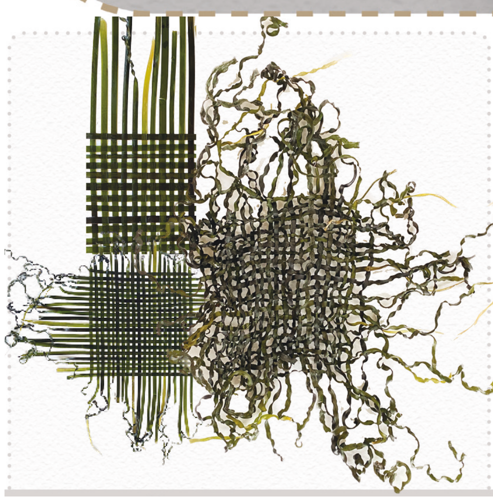
Harvest elevation from Taylor Park Rd. Angled form and eelgrass thatch roof intrigues visitors and initiates eelgrass awareness.

Harvest elevation of public garage entry and eelgrass pick-up.

Harvest elevation from water. Eelgrass gathering site and Atlantic Ocean shoreline connect with the warehouse processing garage door openings and the protruding form of the meadow observer space.

The meadow building adjacent to the warehouse supports the observer role for visitors, allowing them to visually connect with the program in the warehouse, learn about eelgrass and the displayed eelgrass material potentials and connect them to the ocean shoreline site. Tying the building in with the tradition of place, a modern take on the Nova Scotia fishing shed creates the form that protrudes towards the water, connecting visitors learning about eelgrass directly to the eelgrass harvesting site and the Atlantic Ocean. With inspiration from the Mirror Point Cottage project by MacKay-Lyons Sweetapple Architects (McCarter et al. 2017, 248) the traditional fishing shed form is elongated towards the water to gesture to this shoreline connection. While the meadow building overlooks the oceanfront with a large window and outdoor deck, an observation window and garage door connection allows visitors to flow directly from the meadow observation space to the warehouse eelgrass processing.

The set of buildings work together to create a space for visitors to be intrigued, ask questions, and harvest the knowledge of eelgrass. Eelgrass communicates with the visitors through a visual language of lines and patterns in the space, where visitors learn to see the organic curl and tangled pattern of the raw eelgrass wrack contrasting with the rigid and flat lines of the transformed woven eelglass panels in the warehouse garage door windows. Hinting at the beginning and end result of eelgrass material processing, the harvest space initiates the transformative experience and new awareness for eelgrass that will continue to reveal itself to the visitor throughout the spa journey.



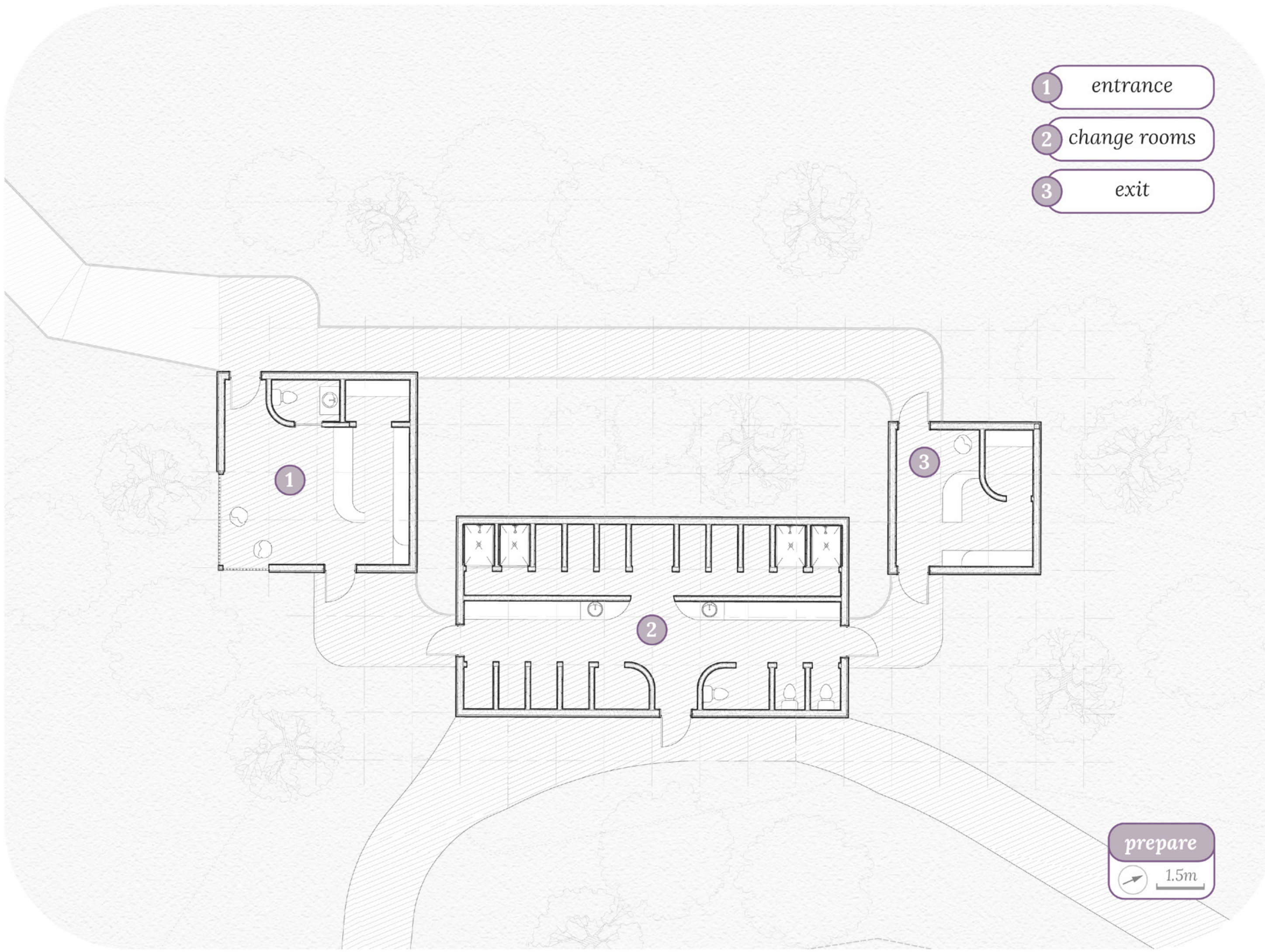
Harvest eelgrass visual literacy. Communicating to users with eelgrass visual cues of lines and patterns; the organic curl and tangled pattern of the raw eelgrass wrack contrasting with the rigid and flat lines of the transformed woven eelglass panels in the warehouse garage door windows.

Prepare

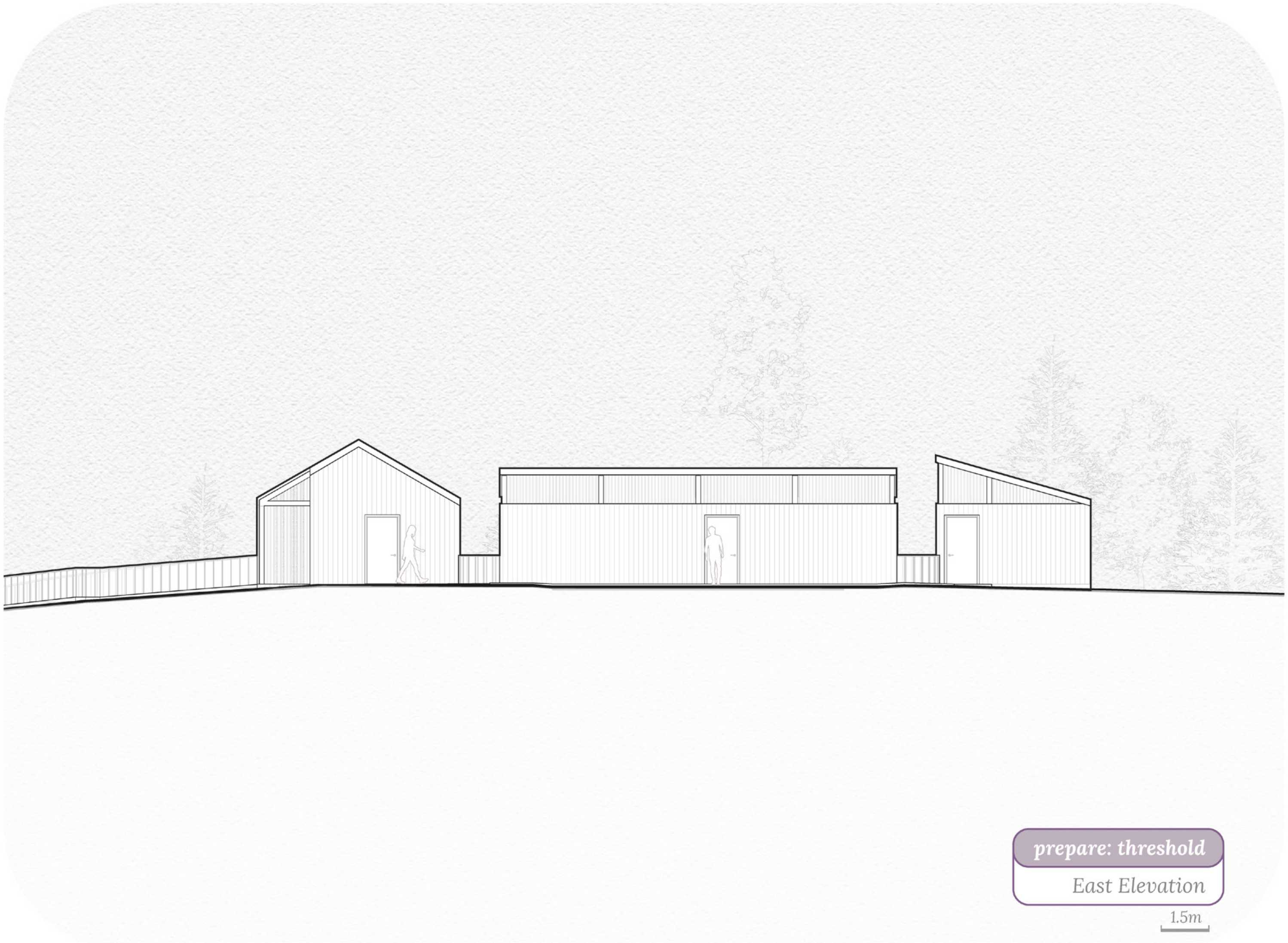
Prepare Plan (data from HRM Open Data 2023)

Moving into the spa, the prepare buildings offer a moment of threshold before the visitor continues on with their spa journey and again as they complete their transformation and exit their journey. The set of buildings make up the entrance, the change rooms and the exit of the spa. Boardwalks direct visitors throughout this threshold space to maintain a gradual flow of circulation, setting a calming, cyclical atmosphere that will carry out during the spa visit. Reflecting on the connection to place with a modern take of Nova Scotian vernacular fishing sheds, the prepare space provides simple form while emphasizing the traditional materiality of cedar shake and wood structure. The set of fishing shed inspired buildings work together to bring visitors in and out of conditioned spaces in preparation for a nature focused spa journey. Eelgrass insulation is used and highlighted within this set of buildings as it enhances the bodily experience within the thermally regulated spaces compared to the breezy open aired boardwalks.

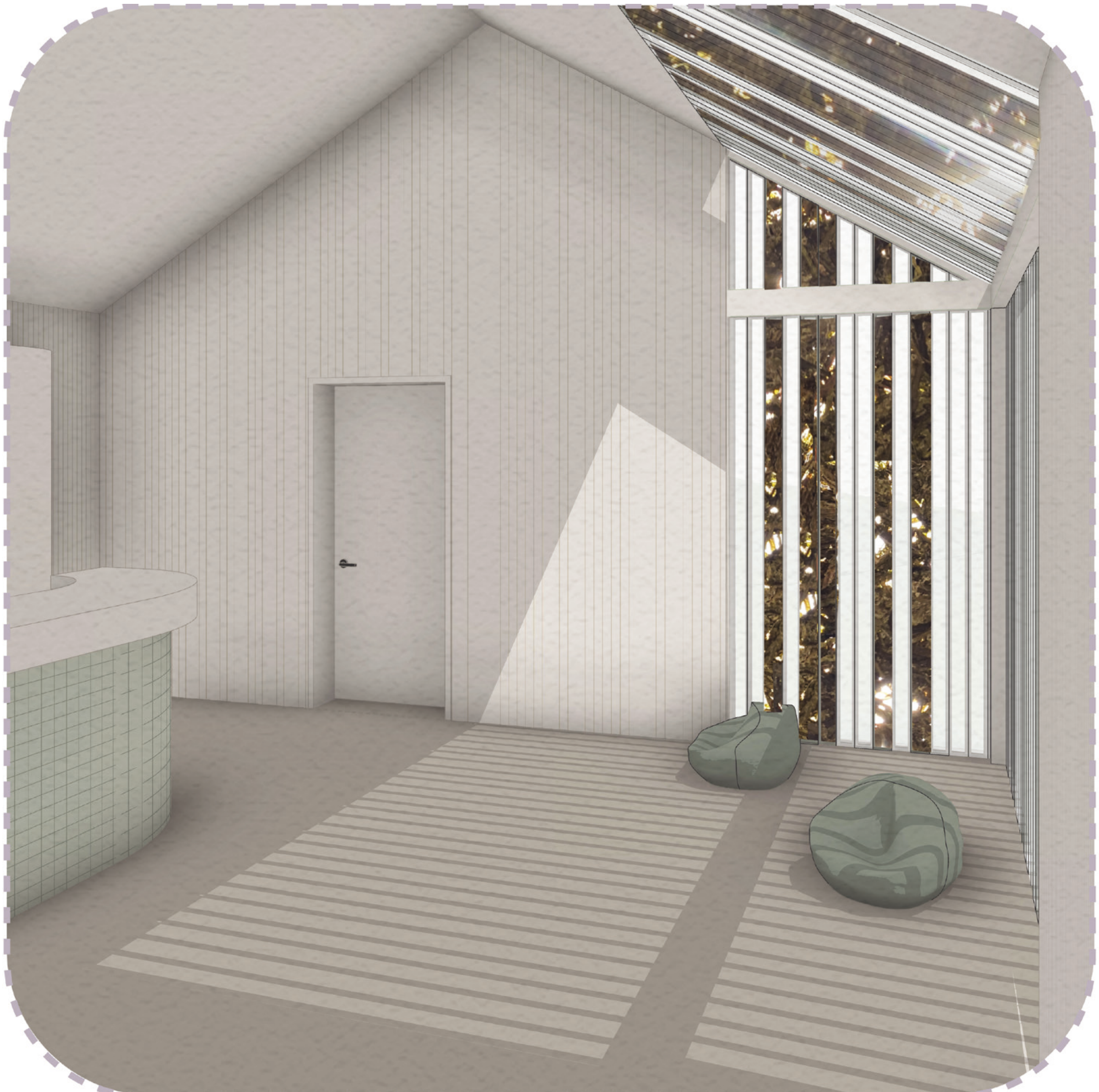
While the eelgrass conditioned spaces communicate with the user through changes in temperature, visual literacy cues are emphasized through eelgrass applications in 'eelglass' panels. Eelglass panels play with the language of light as they diffuse the natural sunlight within the spaces in contrast to the direct sunlight on the boardwalks. The twinkling light continues the dialog between eelgrass and the visitor that was initiated in the harvest space, emphasizing the role of eelgrass as a natural material and focal point of the design intervention.

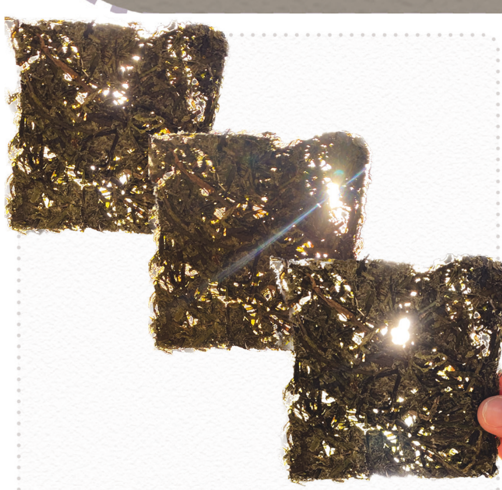


Prepare plan (data from HRM Open Data 2023). The set of buildings provide a moment of threshold as visitors move in and out of conditioned spaces to prepare them for the natural environment that is emphasized throughout the spa journey.



Prepare elevation from inside the spa.





Prepare eelgrass visual literacy. Communicating to users with eelgrass visual cues of light; the perforations in the eelglass shading devices catch the attention of the user to engage with the material as it diffuses and twinkles light within the space.

Treat and Transform

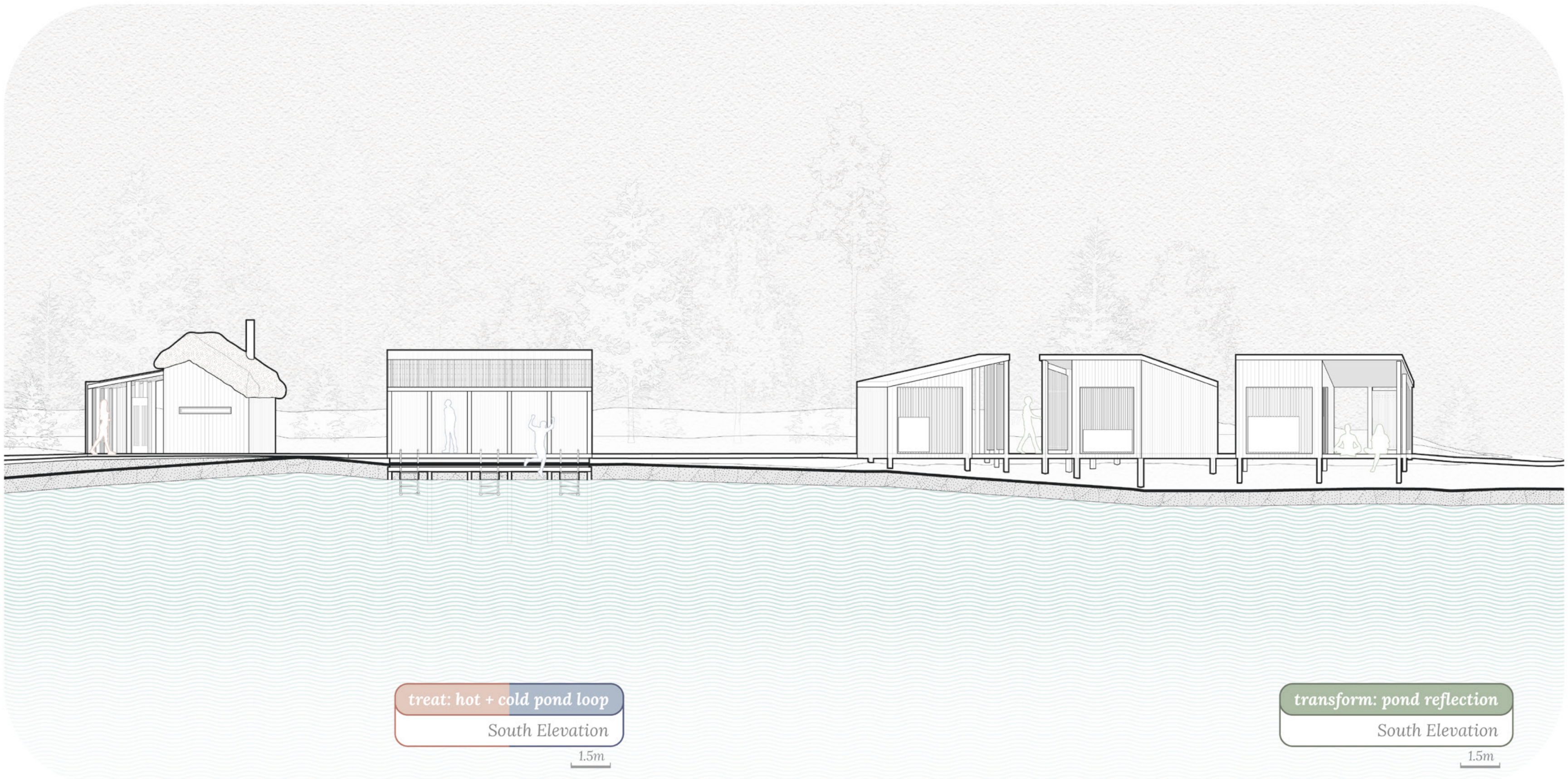
Treat and Transform Plan (data from HRM Open Data 2023)

The Eelgrass Spa offers three different journeys of treat and transform that focus on ocean, forest, or pond to illuminate the beauty of nature in the different natural features of the site. The board walk directs each loop and connects you back to the celebrate space where visitors can choose to repeat the same loop or venture along the boardwalk to a new treat and transform space.

Each loop begins with a hot treatment wood fire sauna. A covered outdoor space attached to the sauna offers slatted storage for visitors to hang their robes before entering the sauna. The sauna spaces are designed with inspiration from the traditional thatch roofs on Læsø island on the exterior and the traditional Finnish Sauna spatial design for the interior (The Building Information Foundation RTS 2014). The traditional eelgrass thatch roof and eelgrass bale insulation applications provide maximal thermal insulating qualities that are required for the extreme heating of the sauna. The interior is finished with cedar siding and provides different levels of seating around the wood fire stove for variation in sauna experience. Within the sauna, wet eelgrass is hung to provide humidity, while the hot air simultaneously dries eelgrass that can be used for other future material applications at the harvest site.

This application of eelgrass offers visual communication with the visitors using the sauna through the language of movement. Visitors in the sauna can observe the eelgrass as it dries and curls in the hot sauna air. Eelgrass communicates its reaction to moisture content through this movement, informing the visitor more about the material and its preceding natural environment where it moves freely

Treat and Transform plan of the Pond loop (data from HRM Open Data 2023). Each loop provides a hot treatment sauna, a cold treatment bucket shower or plunge and a transformative resting space to reflect in nature.



Treat and Transform elevation of the Pond loop. View from Power's Pond.

Treat (hot) eelgrass visual literacy. Communicating to users with eelgrass visual cues of movement; the wet leaves in the hot sauna air spark a dialog with the user as they preform in the motion of springing and curling as they dry.

underwater, compared to its onshore environment where it tangles and curls in mounds.

As the visitor completes the 15-20 minute hot cycle of the treatment, the boardwalk directs them to the next stage of the cycle, the cold treatment. The cold treatment is supported through cold bucket shower stalls and, along the ocean and pong loops, plunges into the natural water elements. The cold treatment is an outdoor experience to fully immerse the visitor in the natural air conditions. With inspiration from coastal communities on Cape Cod, the Hatch House by Jack Hall (McMahon and Cipriani 2014, 66) inspired the slatted forms and indoor and outdoor stall spaces that the cold bucket shower stalls mimic. Blurring the indoor and outdoor environments though light slatted structure attempts to emphasize the visitor’s exposure to natural elements and increase the cold atmosphere of this stage of treatment.

The shower stall privacy screens are designed with eelglass panels to communicate with the visitor through the language of colour. The range of colour in eelgrass is accentuated as it shades and diffuses the light, attracting the visitors to appreciate the natural gradient of the material, learning more about the variety that the material offers. While the cold bucket showers create a shocking sensation to the body, the natural atmosphere communicated by eelgrass greens, beiges, and browns emit a calming sensation for the visitor to ground to.

After completing the 15-20 second cold cycle, the board walk offers the choice of returning to the sauna to repeat the treatment or moving to the transform and rest stage of the loop. As the board walk offers a new path to return to the

Treat (cold) eelgrass visual literacy. Communicating to users with eelgrass visual cues of colour; eelglass privacy screens accentuate the a natural gradient of colour found in eelgrass wrack that ground visitors as they treat in cold bucket showers.

sauna to maintain a natural flow, the wood storage support area is revealed near the back of the showers to ensure heating conditions in the sauna are maintained.

Continuing to the Transform, the final stage of the loop, a set of three pods are designed with indoor and outdoor reflection spaces for a moment of rest and meditation as visitors complete their treatment cycles. Taking inspiration from the coastal Artist Studios on Fogo Island, Newfoundland, Bridge Studio and Squish Studio by Todd Saunders (Saunders Architecture n.d.) inform small spaces with intentionally directed views for visitors to focus in on the natural features that surround them. Directing the user's focus through glazing placement and outdoor framed views provides the opportunity for the user to reflect amongst nature, where their relationship with nature is transformed and renewed. As the spaces are designed to highlight either the ocean, forest, or pond, the visitor can observe and relearn the beauty in the natural surroundings of the site. Eelgrass acoustic panels mounted on the interior walls of the spaces showcase the sound dampening qualities of the material and provide a calming and quiet atmosphere for reflection. While visitors choose to either sit outside in the framed cubby or inside on the stuffed eelgrass bean bag chairs, this simply designed resting stage allows for a reset in the body, the mind, and the human relationship with nature.

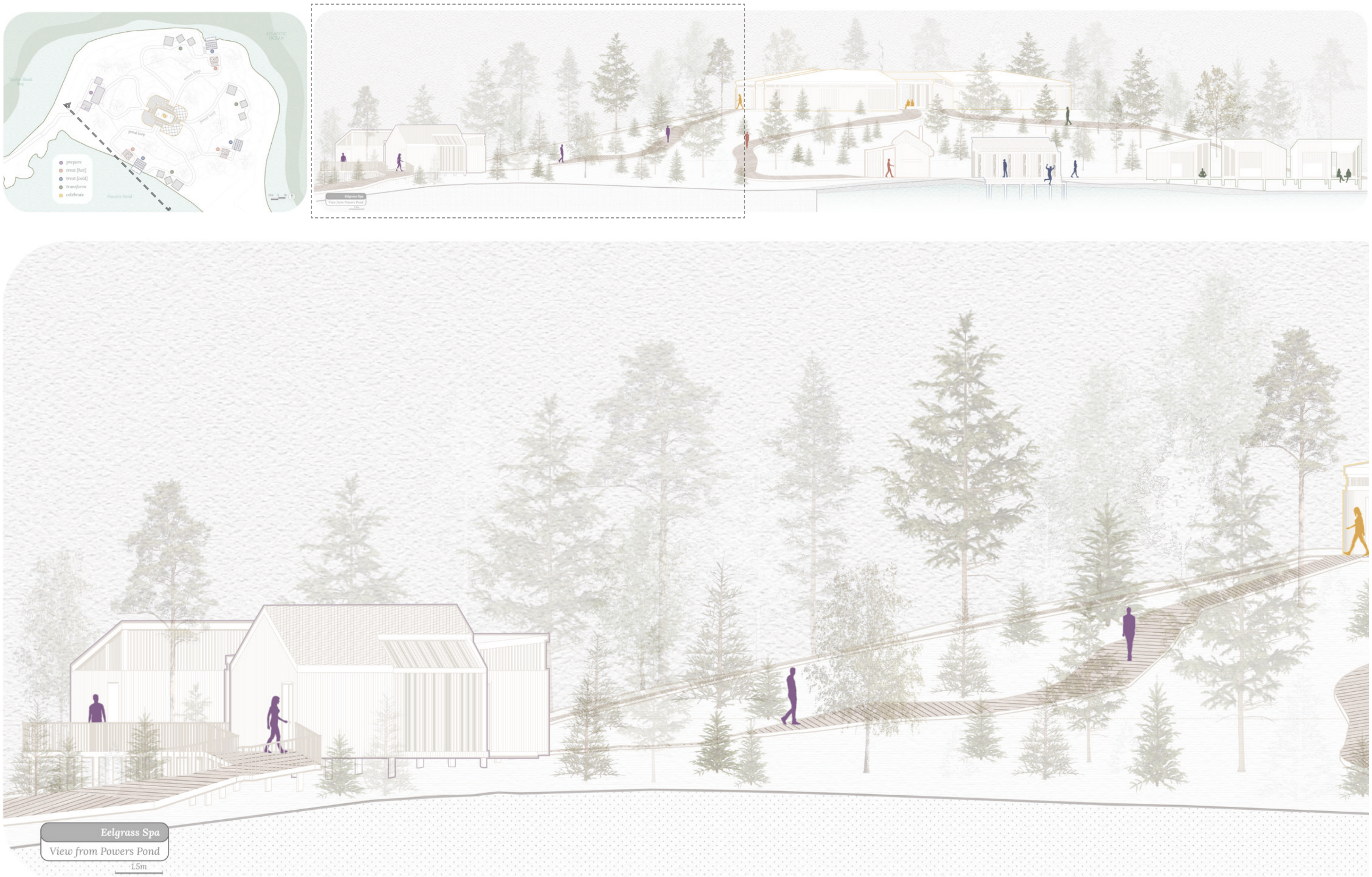
While application of eelgrass acoustic panels within the spaces are intended to provide a quiet atmosphere, the tactile qualities of the panels communicate with the visitor through the language of texture. Different uses of mulched eelgrass panels and long leaf eelgrass panels entice the user to interact with the material, first through visual curiosity and then potentially through touch. Expanding the

Transform eelgrass visual literacy. Communicating to users with eelgrass visual cues of texture; acoustic panels applied to the walls of the rest area provide a calming, tactile experience, enticing the user to feel the natural material and difference in mulched and long leaf aesthetic.

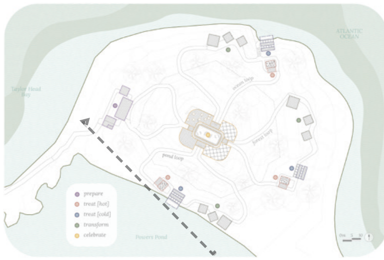
dialog to a tangible aspect of communication, strengthens the interest in eelgrass as the visitor is now not only visually connected but also physically. Designing with eelgrass and texture in this space connects the user visually to the natural surroundings, while relating nature to the tangible materiality within the space.

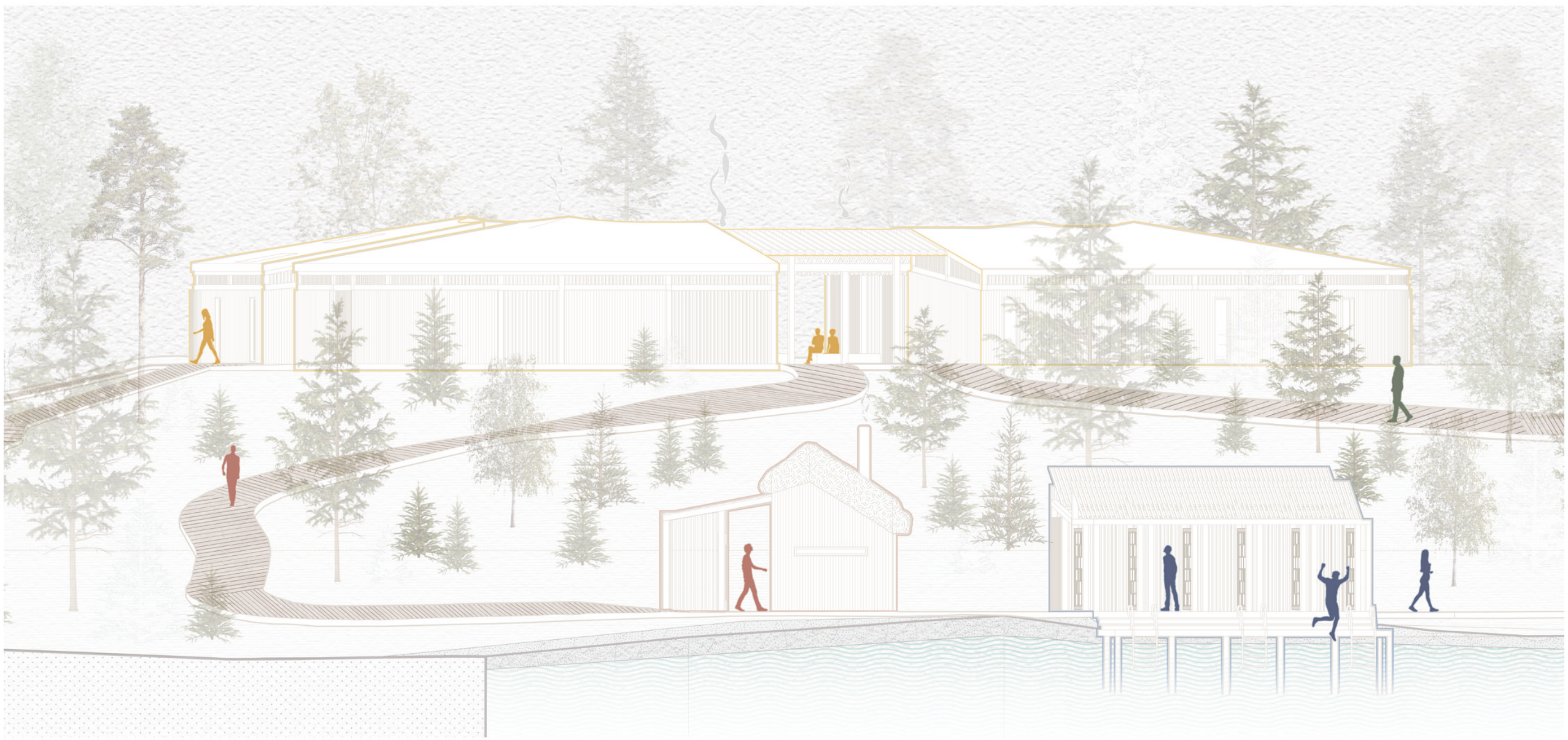
As the transform stage completes the treatment and transform portion of the spa, the meandering boardwalk takes you from each loop into the central celebration space. Following the natural topography of the site, the boardwalk takes the spa visitor for a walk amongst the coastal forest with their refreshed outlook on nature. Bringing visitors to the high point of the site, this is where the shift in perspective is validated. The celebration space grants each visitor a space where their new appreciation for nature can flourish and revive the balance between humans and nature.

Eelgrass Spa journey of the pond loop. Boardwalk connects each stage of Prepare, Treat, Transform, and Celebrate.



Eelgrass Spa journey of the pond loop [enlarged part 1]. Boardwalk connects each stage of Prepare, Treat, Transform, and Celebrate.





Eelgrass Spa journey of the pond loop [enlarged part 2]. Boardwalk connects each stage of Prepare, Treat, Transform, and Celebrate.

Eelgrass Spa journey of the pond loop [enlarged part 3]. Boardwalk connects each stage of Prepare, Treat, Transform, and Celebrate.

Celebrate

Celebrate Plan (data from HRM Open Data 2023)

The Celebrate space of the Eelgrass Spa is made of a circular form, split by the boardwalks of each Treat and Transform loop and the entry and exit boardwalk of the Prepare space. The set of four buildings complete a curved central space at the highest point of the site, where the Center Firepit establishes the central hearth of the spa. This space is an open aired space with three campfire areas that can be seen as visitors approach the celebration space, inviting an uplifting and higher connection between nature and humans. Here, with the visitor's new appreciation for materials and the environment, visitors can sit amongst nature and the wood rafter canopy of the architectural forms to further embrace this new perspective on the environment. The Center Firepit is surrounded by the Wood Storage pavilion, the Nourish Nook, and two Admire Pods that showcase eelgrass materials and provide space to appreciate this rediscovered sense of beauty in nature.

The Wood Storage pavilion supports the Center Firepit, where users can access the wood supply that is covered and protected from natural elements. The pavilion allows light to enter the space through the wood slat partitions and translucent roof material that sits on the wooden grid structure. The simple design provides a functional wood storage space to ensure the central firepit can be easily supported and maintained by spa employees or visitors during their peaceful admiration of nature. For safety, loose eelgrass wrack is collected and stored within the pavilion to be used as a fire smothering material for the end of day use or in case of an emergency.

Celebrate Plan (data from HRM Open Data 2023)

Celebrate section of Wood Storage, Center Firepit, and Admire Pod.

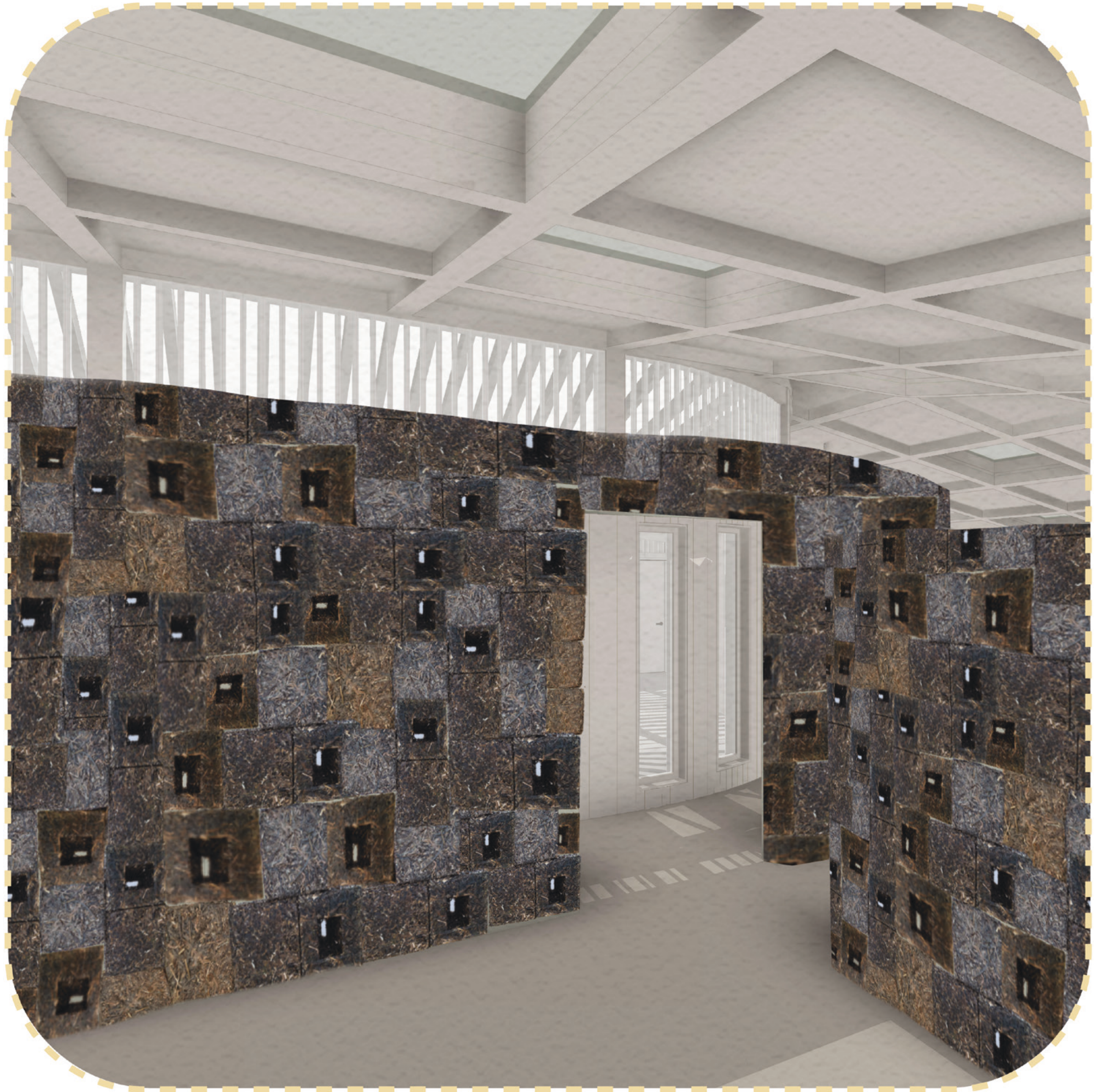
The Nourish Nook, seen from the west elevation, is a space for visitors to have a snack after they have completed their body and mind transformative experience. The Nook's space is designed with an eelglass transom and full height panels to continue to showcase the use of eelgrass as a building material. Additionally, the space reveals eelgrass's potential as food. Inspired by the Norwegian diary entries where eelgrass was sampled (Alm 2003), and the discovery of the iconic seaweed butter made in Brittany, France by Jean-Yves Bordier (Great Big Story 2019), the snacks provided include tea, bread, and eelgrass butter. Guests can sit around the fire or eat at the seating within the nook to enjoy their snacks surrounded by natural elements.

Seaweed butter by Jean-Yves Bordier (Great Big Story 2019)

The Admire Pods complete the revolving form. With two pavilions offering different experiences for appreciating nature's beauty, the northern admire space keeps to a more individual and divided layout, whereas the southern space is more social with an open concept design for admiration to take place. Both spaces are designed with curved eelgrass block partition walls that provide sound dampening qualities, privacy partitions and lighting qualities. Alongside the eelgrass block wall feature, the design incorporates moments of eelglass transom and narrow panels, eelgrass stuffed chairs, and interior panel finishes. The combination of eelgrass material applications summarizes the conversation between the visitor and eelgrass material that was communicated throughout the spa experience. As the visitor has engaged with and admired the material throughout the Eelgrass Spa, now in one room, fully emerged in the eelgrass material, the visitor's new appreciation for eelgrass and nature can expand this shift in perspective towards a greater environmental awareness.

Celebrate elevation of Admire Pod and Nourish Nook.

While the eelgrass blocks showcase the self-supporting potentials of the material, the solid and irregular shaped blocks present a new method of communication with the visitor through the language of shape. The blocks are arranged in a random pattern along the curved wall that adds organic and natural aesthetic qualities for visitors to observe and interact with. Varying shapes in the blocks intrigues the visitor to look closer, observe the changes in the blocks, and reveals the abilities of form making with eelgrass. Communicating with the shape qualities in eelgrass materials, the Admire Pods bring the visitor into a space where they can admire and see the full potential of eelgrass materials, concluding their journey with eelgrass as they celebrate the beauty in nature and their transformative experience.



Celebrate eelgrass visual literacy. Communicating to users with eelgrass visual cues of shape; the eelgrass block wall application provides varying shapes for the user to engage, look through, and compare shape from block to block as they move throughout the space.

Chapter 8: Conclusion

As visitors leave the Eelgrass Spa, they feel reconnected with themselves and with nature. Maybe they stop at the harvest warehouse to gather eelgrass for their own uses, or maybe as they walk along the beach, they identify the eelgrass wrack on the shoreline. Maybe they think about the materials in the spaces around them differently, wonder: where did this came from, is it local? If visitors leave Taylor Head Provincial Park thinking about their surroundings differently and potentially their impacts on these surroundings, then The Eelgrass Spa has fulfilled its design intention.

While the Eelgrass Spa reintroduces eelgrass as a building material through the sequence of design interventions and demonstrates its versatile material properties, it is the visual dialog established between eelgrass and the visitors that will carry the excitement and spread awareness about natural materials outside the boundaries of this project. The visitor had to first see the material to understand what it was doing. Designing with eelgrass as a medium to communicate with the user, enlightens architecture's role in visual literacy to help people know how to see, what to look for, what to interact with, and what to take away from the space. The eelgrass material applications use the variety of visual cues to shift the focus of the visitor and direct their engagement throughout the intervention. Without explicitly saying, “look at me, look at what I do”, the eelgrass material applications gain the attention of the user in a way that requires only a subtle form of interaction. While the spa program is typically seen as a luxurious amenity, this project uses the spa's transformative experience and moments of reflection to ground the visitors within nature and provide the time and space for visitors to understand this new way of seeing. By creating a space for people to reconnect with nature and have a more conscious understanding and awareness about natural materials, the hope is that the awareness will spread, mitigation strategies will be understood, and we will be closer to rebalancing the relationship between humans and nature in our pursuit for survival.

Throughout my process of working with eelgrass, discovering its potential applications and its material language, in many ways tested and proved this thesis's concept. The best way to learn about a material is to work with it, interact with it, try to transform it, and see what you learn from it! I spent many hours learning with eelgrass, and every time I discovered something, it was exciting. Discovery is exciting – it is news that people want to share and often people want to hear about. This is what happened when I started bringing eelgrass into spaces where people were unfamiliar with it. As I was rinsing eelgrass on the small grass boulevard in front of my house in downtown Halifax, most people who walked by took the unfamiliarity of the situation to ask questions – they were curious to know what I had discovered. This trend grew when I brought in a large supply of eelgrass to the School of Architecture to do my eelgrass experiments. As I would discover something new about eelgrass, I would tell my colleagues and they would be interested – sometimes they would ask questions and I would attempt to answer. If I didn't know the answer, we would test the eelgrass and learn from the material. Eelgrass awareness was spreading in studio.

Soon after, people from different parts of the school started to visit the eelgrass upstairs – most times without talking to me – they simply wanted to see the eelgrass. They would touch it, smell it, and play with it in their hands. They would bring friends up to see it, I think even some parents were given a tour to see the eelgrass. Poking my head up from my desk when people approached the tables of eelgrass, I first felt the need to protect my experiments and my supply but later realized, wait – this is exactly what I am trying to accomplish with my thesis. Without me explaining my project or the intentions of my thesis, people throughout the school had observed and interacted with eelgrass out of curiosity and the pure joy of discovery. Eelgrass awareness spread throughout the school before I had even defended my thesis.

During my defense, eelgrass took the spotlight. While the design drawings were on the wall with the information about eelgrass and its potential building applications, viewers would first interact with the eelgrass material and later look to the drawings to learn and understand the project more. After the defence, people commented how even simply being in the presence of the material had a calming effect and noted how they were able to learn from the material by seeing the different ways that I had used it. No longer feeling the need to protect the experiments, I encouraged people to "play with the experiments". And they did – people smelt it, picked it up, poked it, and handled it (more aggressively than I ever had). I was thrilled. People wanted to discover things about eelgrass, and now people knew about eelgrass.

Unfamiliarity can make people hesitate. While eelgrass is familiar along the local shoreline, it is unfamiliar to see it in architectural applications. Yet, materials that are unfamiliar to the natural world are seen widely used in architecture. I was once hesitant with eelgrass – my colleagues were also once more hesitant with eelgrass, but with exposure and opportunities for interaction with the material, the hesitation subsided. This is where my thesis and the architecture field can make the shift – to re-familiarize the natural, relearn what is beautiful, and reconnect people to nature – the thing which we should feel most familiar with.

Packing up the eelgrass lab.

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