‘The Elite Performance’

Towards a new building culture defined by the exploration and manufacturing of renewable materials

Geological relations.
By author.

Thesis Summary Report

Proposal by
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The Elite Performance - Towards a new building culture defined by the exploration and manufacturing of renewable materials

Preface

This thesis seeks to explore and communicate different means of construction within the Danish building culture, in the attempt to address current biological- and ecological crisis. By seeing the push towards a sustainable building culture, not as a hindrance – but rather as an opportunity to improve the way we build.

Speculating new ways of manufacturing, construction, and design.

Timberframe principles. By author.

Monopolized industry

Historically Denmark has been good at solving social problems by innovating its industries.[1] Through means of legislation, funding, and taxation – new societal problems are often solved by politically altering the private sectors, thus cultivating solutions for the given problem. Most recently the government passed a new CO_2 emissions tax, with a minimum of 750* dkk pr. tonnage CO_2 emitted by any corporation.[2] A push which will inevitably disrupt the material industry, as well as the building culture.

A current building culture which is heavily directed by the 'governmental building institute' (SBI) which in recent decades has pushed for a technocratic system of standardization and certification in an attempt to heighten the general quality of the built. Making buildings is there for an expensive endeavor, in which both building contracts and material productions requires substantial energy and funds. We therefore find ourselves in a material context which is produced by few big conglomerates. Each supplying elements to the conservative building system.

A building system which was once thought of as "unconventional" [3] but today has replaced the rich masonry and timber frame systems of the past. A change that happened not at once, but over time with the help of repeated government subsidiaries.[4] These large cooperations has centralized and refined the manufacturing, transportation, and standardization in a way that prior scattered companies couldn't. The innovation of our current building system was meant as a solution to the social housing crisis of the mid-19th century. A remarkable success of joint efforts to relieve the tension of the housing shortage at that time.

1. *Dansk byplanlægning 1938-1992, Arne Gaardmand. p 53.*
2. *Regeringen indgår bred aftale om en ambitiøs grøn skattereform, Finansministeriet.*
3. *Betonhåndbogen, Betons historie 1.2.*
4. *Ibid,*

Materials dictates building culture

Today however we are (in my opinion) seeing a stagnated building sector which is facing both political, financial, and ecological crisis all at once. And both the realization that building industries has a huge impact on the global environment as well as changing demographics and energy-prices[5] has recently tipped the scales even further. Currently we are seeing a material shortage and rapid price-inflation which are linked to the fact that all materials that we rely on for building today are highly energy consumptive.[6] It's become apparent that there is a lack of resilience in the industry - perhaps because of the monopolized, 'high-entry' nature of the sector.

This rigid system of governance and powerful corporations are a hindrance towards a sustainable transition. Towards the implementation of materials that are low consumption and/or reusable. It is in many ways materials that dictates the built architecture - and by liberating new building materials we also expand the building culture. Allowing us to have a reflected discussion about material- and formal appropriation in regard to both the supply chain and the context in any given building project.

New material thinking also intrinsically prompts a need for diversifying the material logic within the different scales of construction. We have now grown accustomed to a building system which is flexible and applicable in all scales and situations, from small house to giant skyscraper – just by calculating and altering the composition and rebar density. But when switching to a diverse sustainable material system, we need to re-appropriate which materials are suitable for the given task (e.g., span-width). Leaving a more varied building culture, with different 'structural expressions' across all building scales.

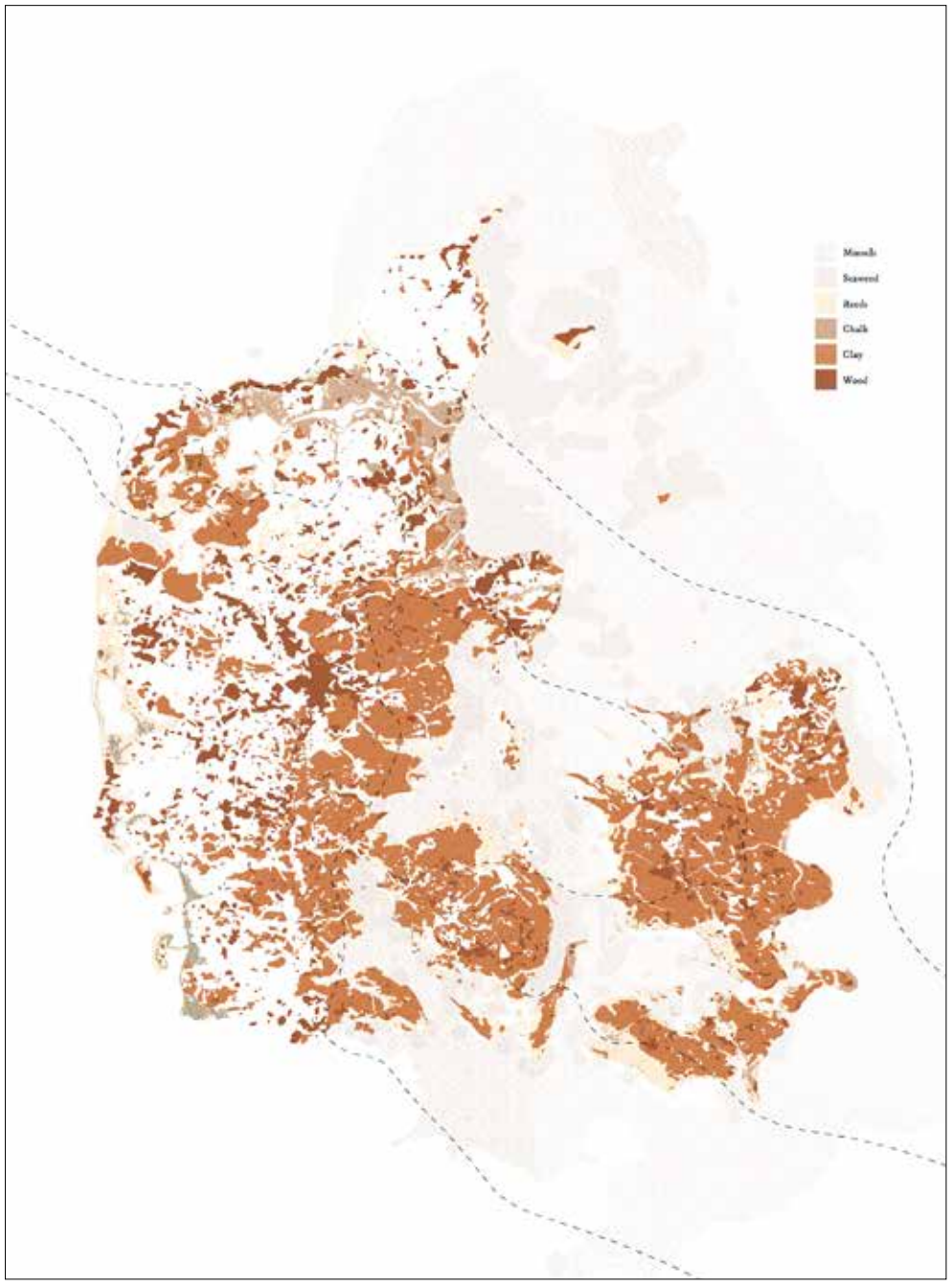
The question thus arrives at how we intend to build future building within a radically different system of both structure, tactility, and ornamentation? Building systems which prompts reflections on material interpretations and generates new aesthetics through the transition from composite to compostable construction.

In this regard is also interesting to reflect upon the authority of the material suppliers and stores and how they govern the material market. As it turns out our country is home to an abundance of local resources, of which only a few of are used. But there are many less processed resources that could be used in a sustainable building culture. Wouldn't we benefit from promoting local initiatives?

5. *Energipriser eksploderer i dag – din regning er mangedoblet, Povl Dengsøe.*
6. *Materialepyramiden, Det Kgl. Akademi.*

left *Resource mapping 1:500.000, By author.*

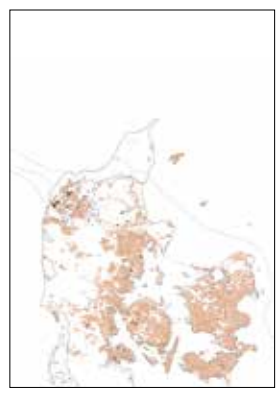
right *Mapping of individual resources, By auther.*



Local resources

When surveying regional situations, it becomes apparent that different ecosystems and landscapes creates a variety of renewable resources. The geological situation constitutes areas of granite, clay and chalk, wetlands, costal cavities of still waters for mussels and seaweed, as well as larger forest and field areas.

Mussels



Clay

Chalk

Wood

Reeds

Seaweed

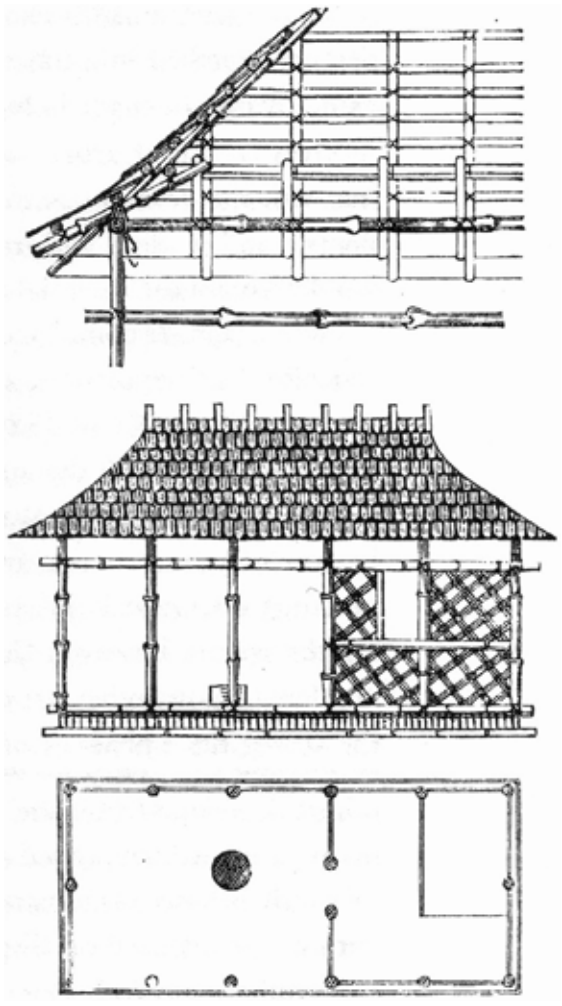


Fig. 03

	Tectonic		Stereotomy	
Element	Enclosure	Frame	Hearth	Mound
Technique	Weaving	Carpentry	Ceramics	Masonry
Material	Textile	Wood	Clay	Stone

Investigating materials resources

The German architect Gottfried Semper (b. 1803) classified raw materials into four categories according to their individual properties. Those which are:

- Flexible, tough, and highly resistant to tearing.
- Rod-shaped, elastic, and strong in tension.
- Soft and moldable, which, after working are able to be hardened and stay in shape.
- Unyielding, dense, and strong in compression; use in construction being by manageable pieces in regular courses.

The individual natures of the materials described under these four categories gave rise to four crafts in the working of them. These crafts, while respecting the qualities of the particular material with which they are concerned, transform it into useful form. In his work he stumbles upon the Caribbean hut in the 1852 world exhibition which fulfilled all elements. Elements which were made up of 'vegetarian materials resources'.[7]

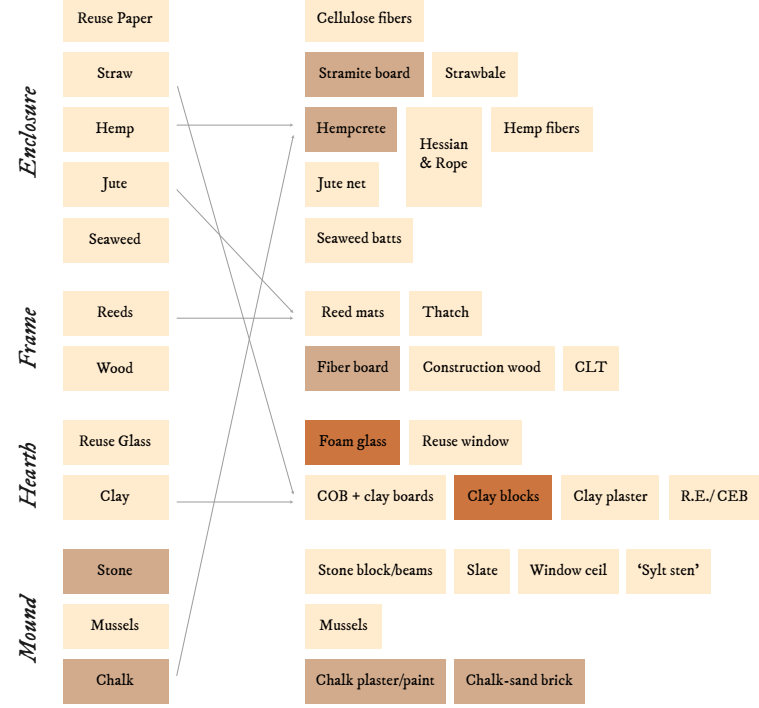
Fig. 04

03. *The Caribbian hut. Gottfried Semper.*

04. *Vegetarian materials. Andrea Bocco Guarneri.*

From resources to materials

When mapping the possibilities of building materials, it is important to reflect upon which require exhaustive processes, and which don't. Treatments such as heating and high-pressure mechanical treatments are relatively more harmful to the local environment. Especially water and chemical treatments.[8]



Mapping of treatments during production. By author.

• *Jute* •

• *Hemp* •

• *Straw* •

• *Reuse paper* •

• *Wood* •

• *Seaweed* •

• *Reeds* •

• *Reuse glass* •

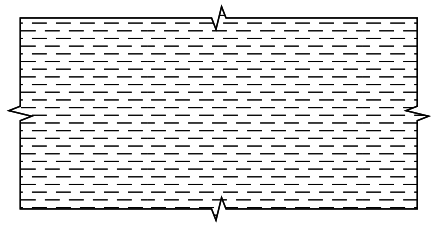
• *Clay* •

• *Mussel Shells* •

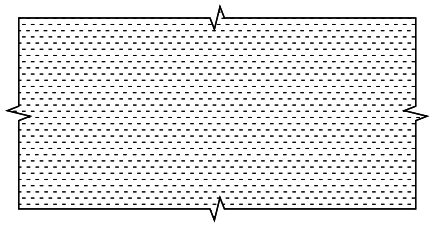
• *Chalk* •

• *Stone* •

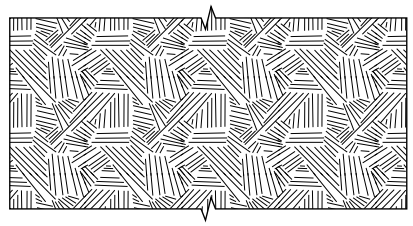
Photographs of resources.
By author.



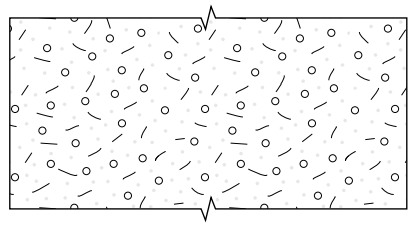
• *Jute in Elevation* •



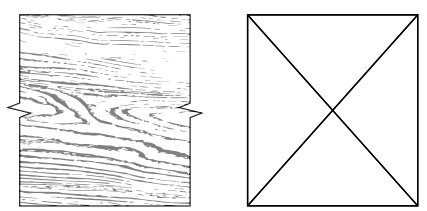
• *Hemp in Elevation* •



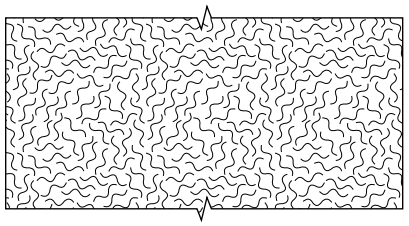
• *Straw in Section*•



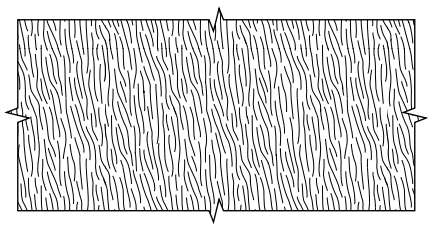
• *Reuse paper in Section* •



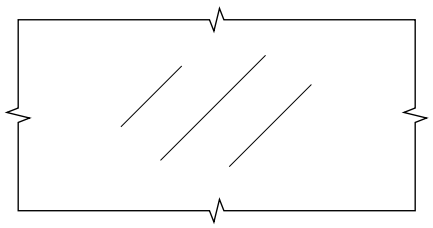
• *Wood in Section/Elevation* •



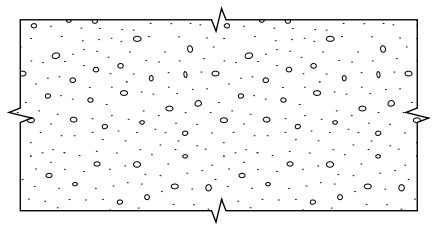
• *Seaweed in Section* •



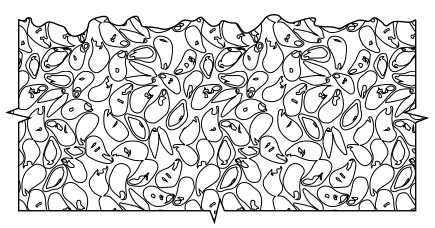
• *Reeds in Elevation* •



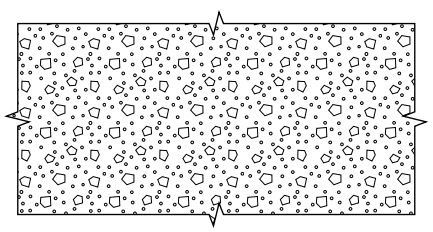
• *Reuse glass in Section/Elevation* •



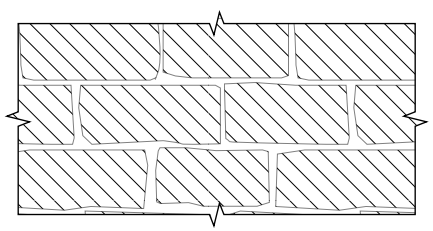
• *Clay in Elevation* •



• *Mussel Shells in Section* •

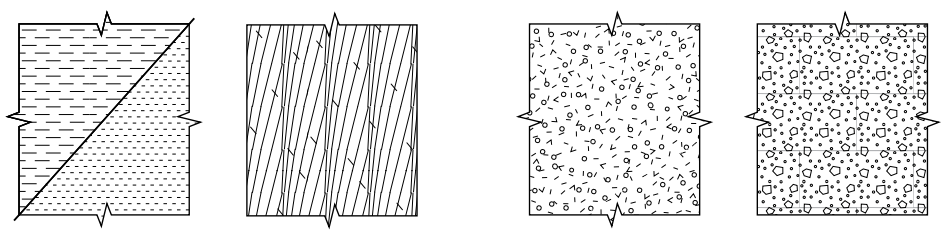


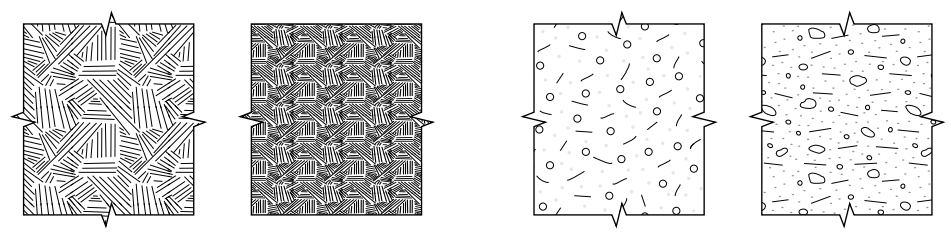
• *Chalk in Elevation* •



• *Stone in Sectiom/Elevation* •

Resources pictography diagram.
By author.





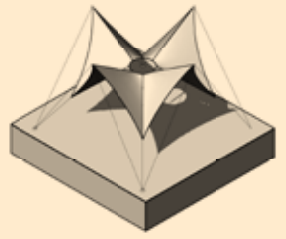
Material pictography diagram.
By author.

Architectons'

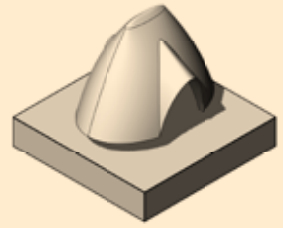
Ar•chi•tec•tone | noun

'tone'/ node/ sound/ voice
the architectural voice' of a material; it want's to be something/ somebody.

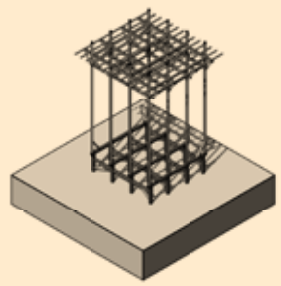
'Highest Form' - The Elite Performance'



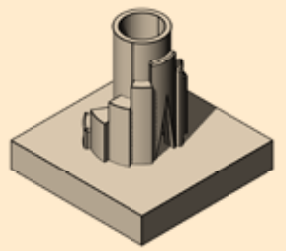
Textile
Weaving



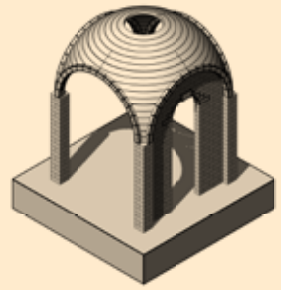
Thatch
Weaving



Wood
Carpentry



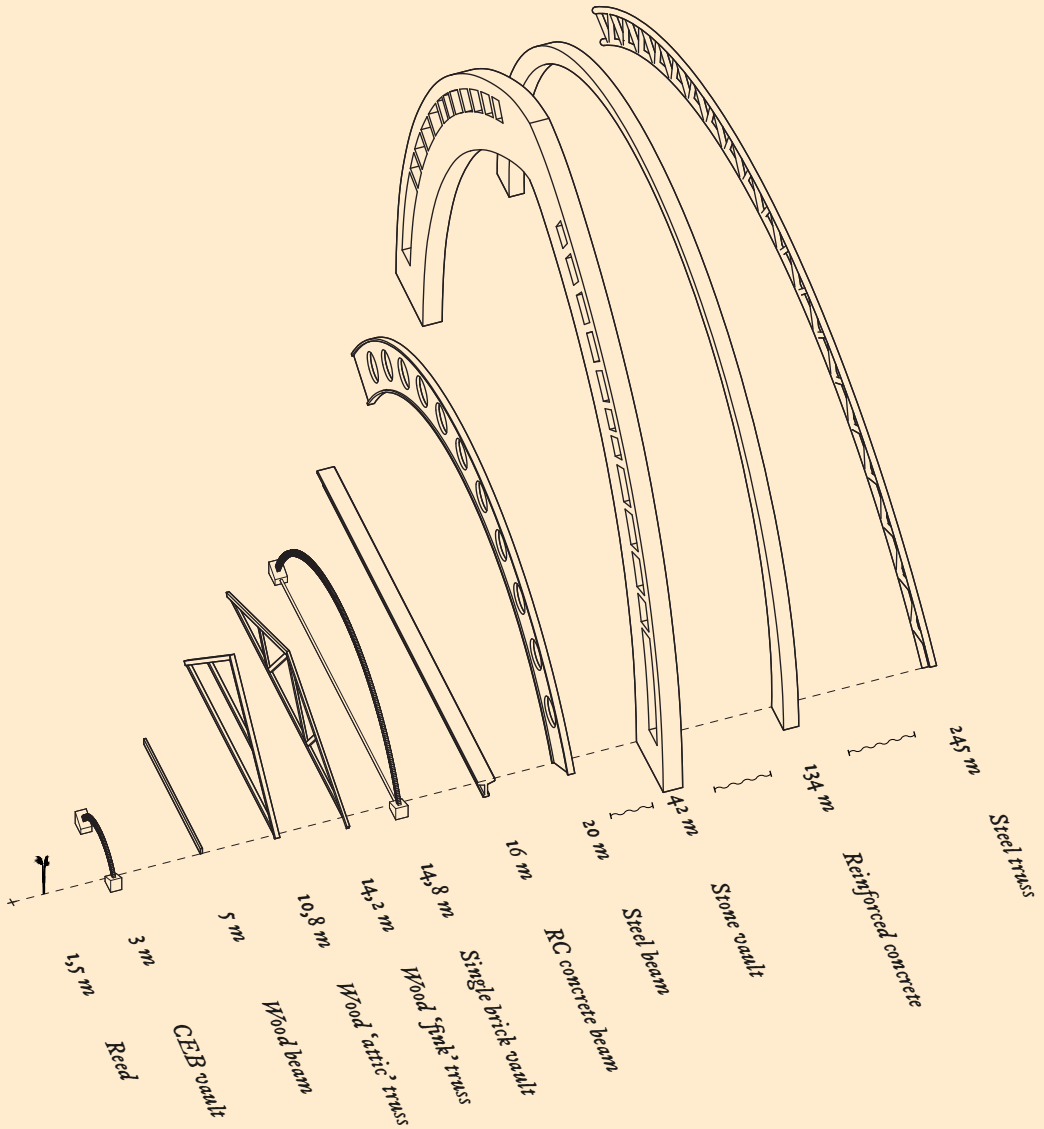
Clay
Ceramics



Stone
Masonry

Architectons diagram.
By author.

Material spanwidths.
By author.



Appropriate material

All materials have bound sizes and scales in which they can manifest. 'There is a limit to the height of a tree, the length of a straw, the weight of a brick and the span of an arch.' As architects we follow the intrinsic properties of the materials we choose to work with. The materials thus have an appropriate scale in which it operates and instinctively we know of the materials proportions. We can use these assumptions to artistically create an awe by shattering the expectations of the materials scale and surprise the observer.

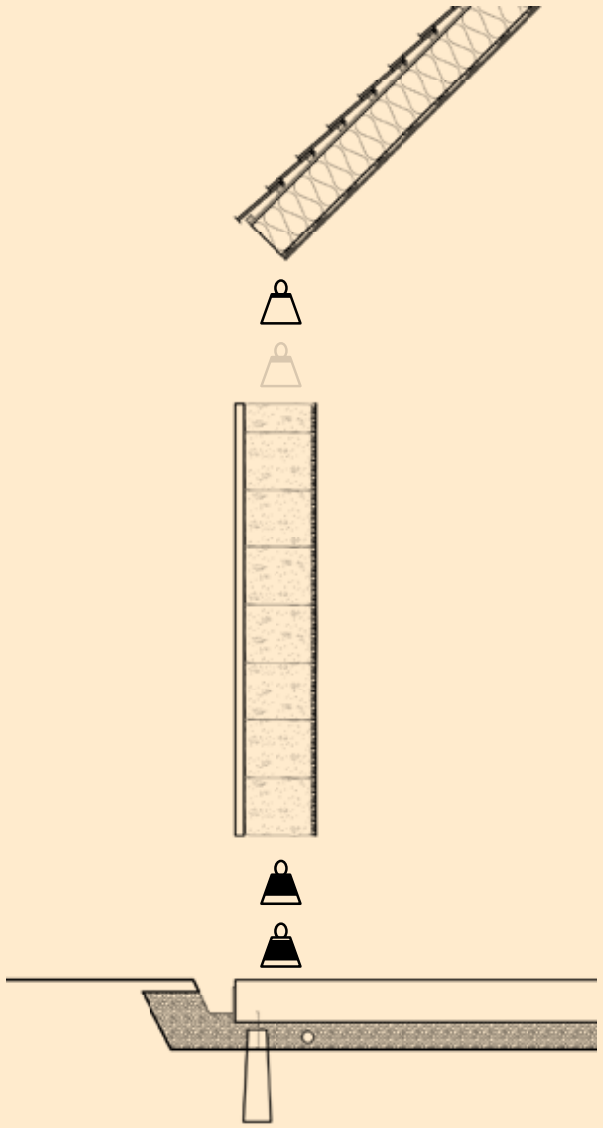
Typically, however architectural expression benefits from these prior assumptions to create material feelings of ease and balance in the observer. By having the architecture mimic the laws of nature and of our own intuition. Therefor some constructions are appropriate for a given scale and best conveys a message of harmony by subjecting the choice of materials to the size of the construction.

Fig. 13

13. *El Lissitzky.*
Horizontal Skyscrapers.

left *Thinking structural. By author.*

right *Construction catalogues. By auther.*



Thinking structure

When undertaking an architectural assignment, the project's structure should be thought of as a series of vertical loads that work to stabilize the whole - while seeking to the ground. In this reasoning we sometimes face that; as span widths increase so does the point of transference and with it, the structural requirements of the underlaying element.

By examining different structural system through a series of catalogues I discovered a correlation between the structural properties, the price, and the environmental impact of different systems. Which future states the notion that some constructions are 'appropriate' for a given scale and some are not. This is the reason you don't see many playhouses constructed in reinforced concrete or iron rivets.

See 'construction catalogue' in appendix, p. 66-71.

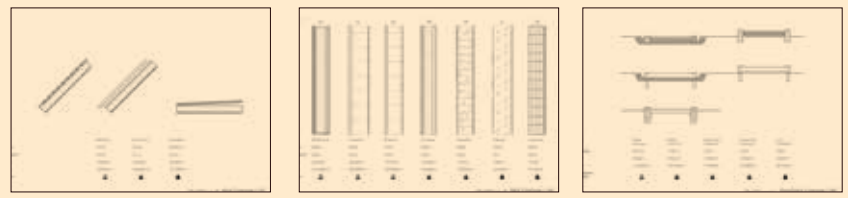
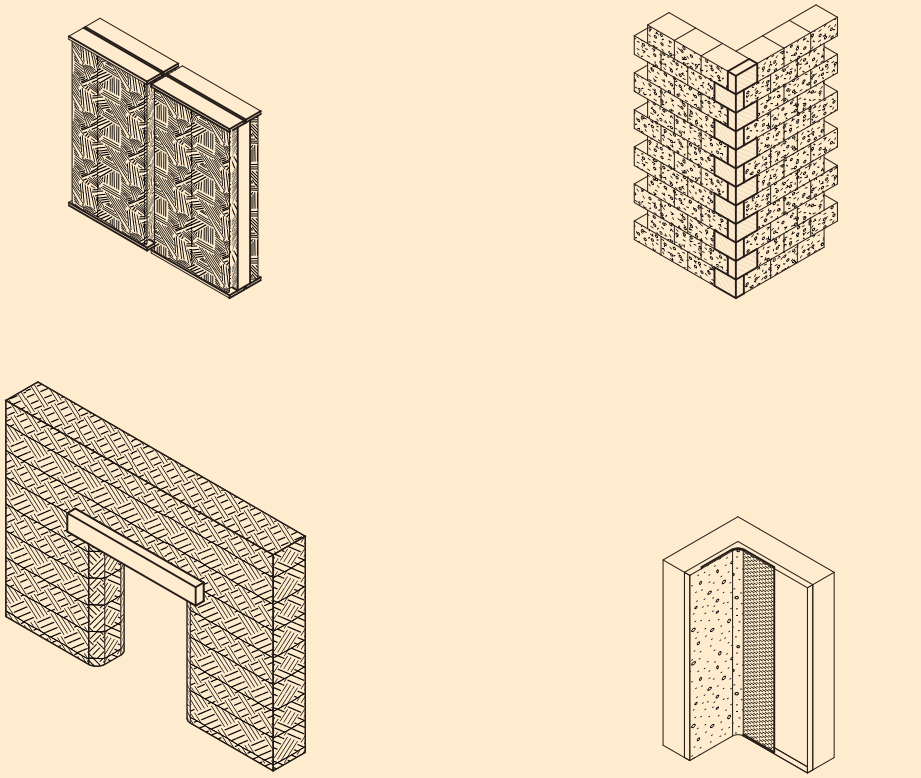
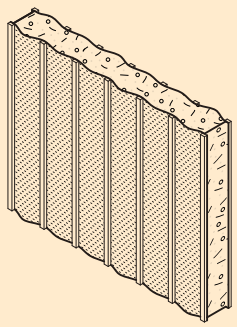
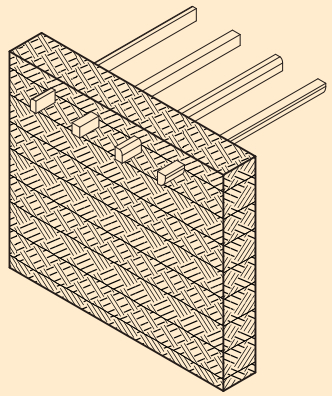
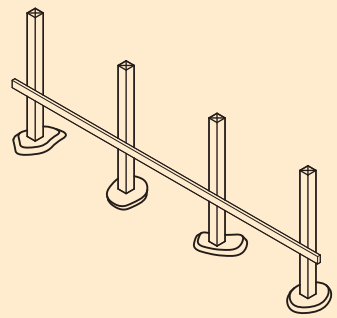


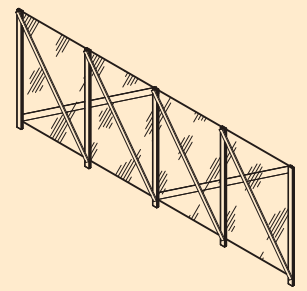
Diagram of material synergies.
By author.











Material synergies

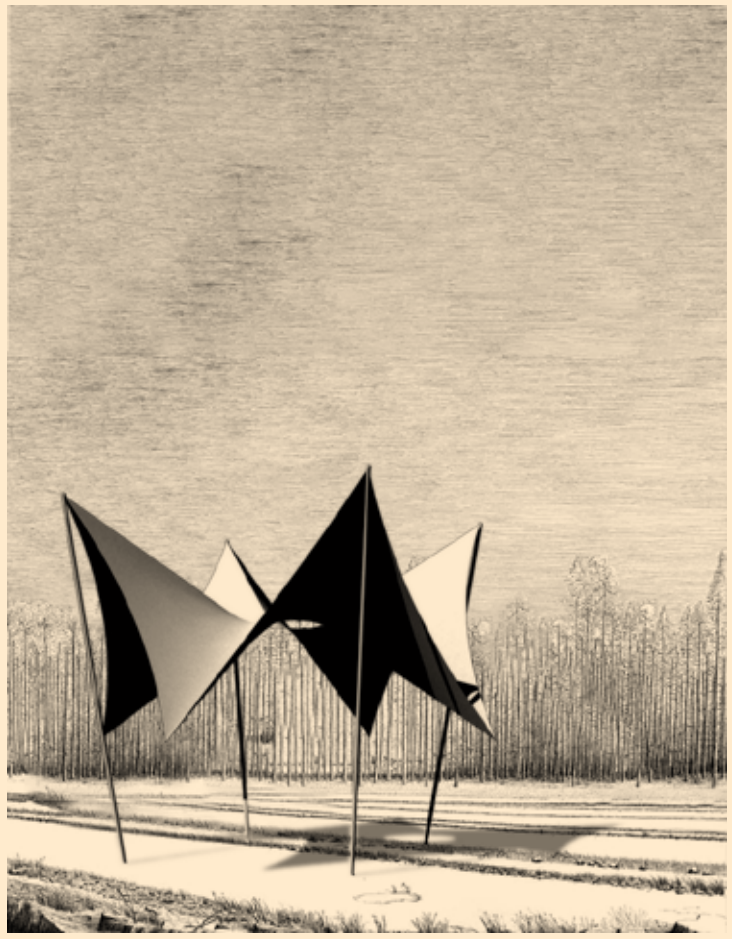
Because there are limiting structural properties to materials some materials are having difficulties manifesting in a building on their own. So, in order to have the material preform a higher function than on its own we need to start investigating material synergies. Synergies in which the logics of materials 'elite performance' starts to unify and support each other. Through the joining of materials.

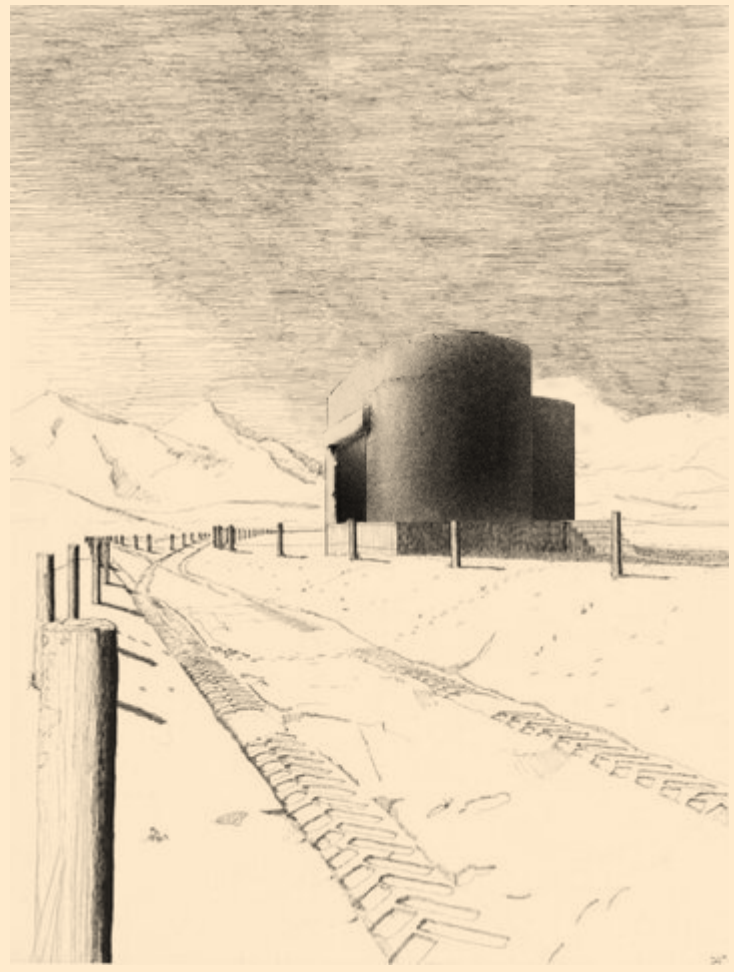
top left *Weaving architecton.*
By author.

b. left *Masonry architecton.*
By author.

top right *Carpentry architecton.*
By author.

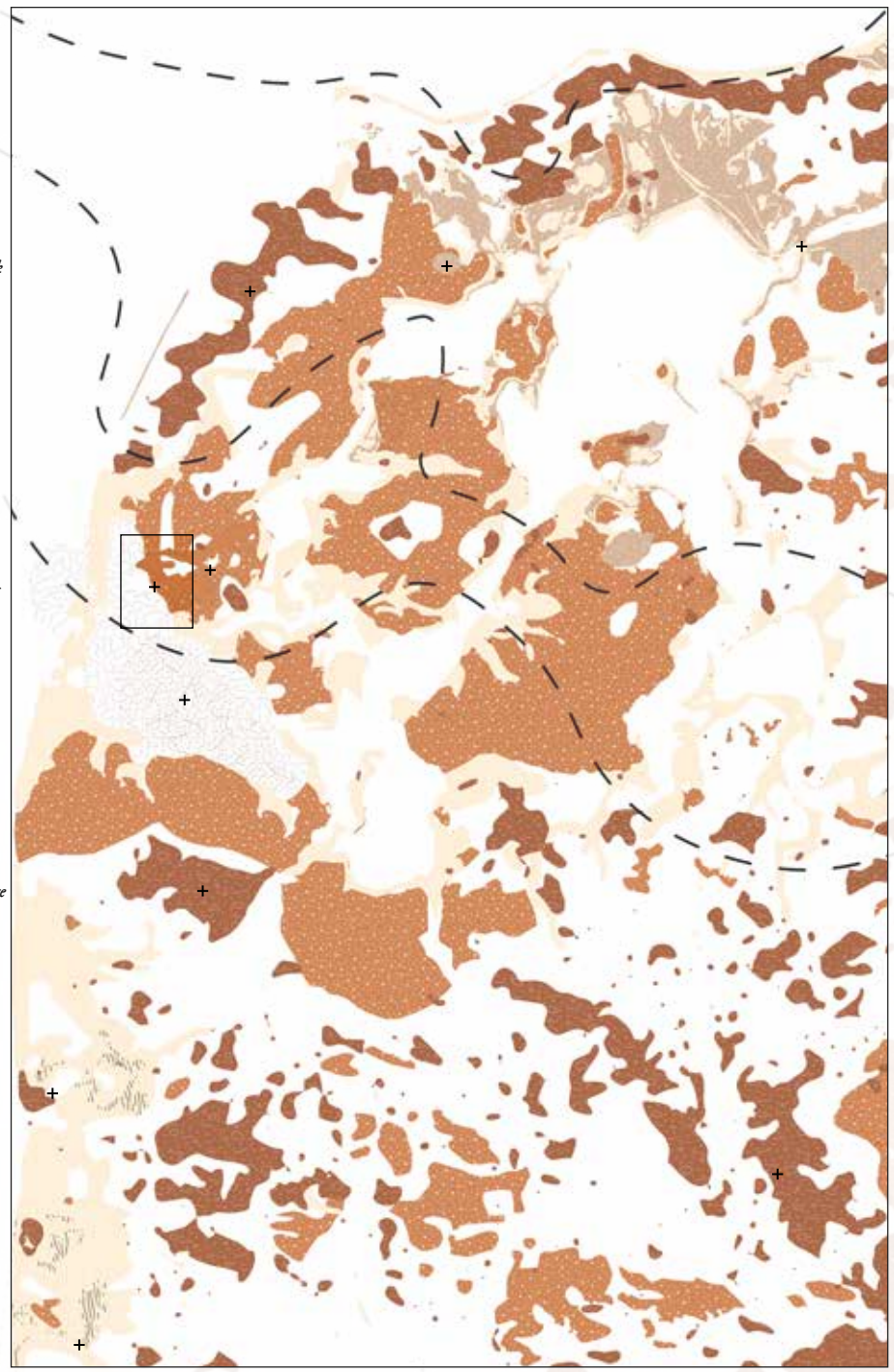
b. right *Ceramics architecton.*
By author.





Thatch architecton.
By author.

Material Analysis



Material convergence in Thy

In the cartography exercise of mapping resources, I discovered a convergence of natural resources in the north-western part of Denmark. Thy is a place which consists of multiple geological and ecological factors, which all attribute to a varied landscape alternating from harsh sea to protected cove. Here can be found multiple industries of primary resource productions such as farming, excavation/quarrying, and livestock.

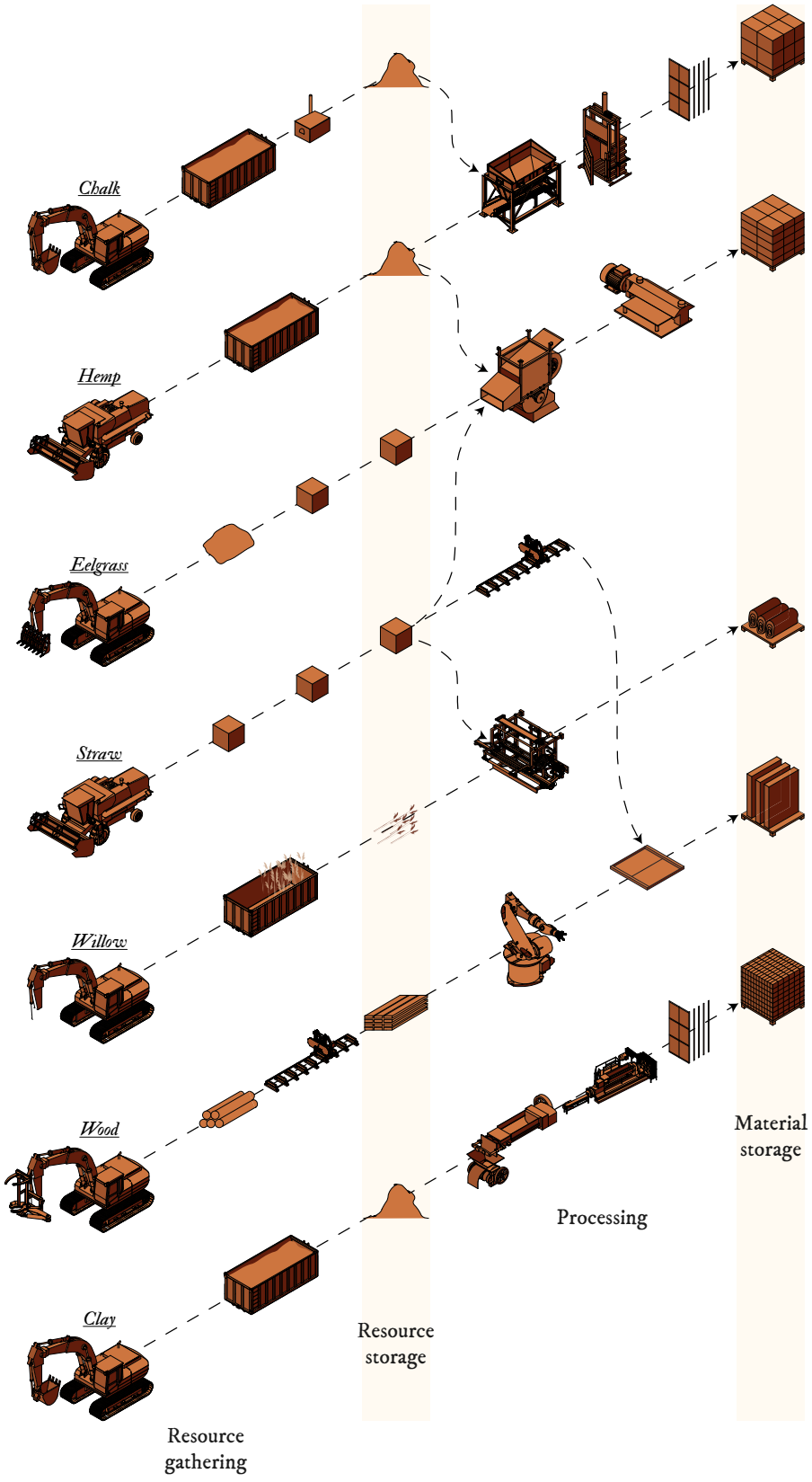
Industries creating timber, chalk, straw, and mussels are already in the area.

Fig. 24

left *Resource mapping closeup. By Author.*

right *Closeup placement. By author.*

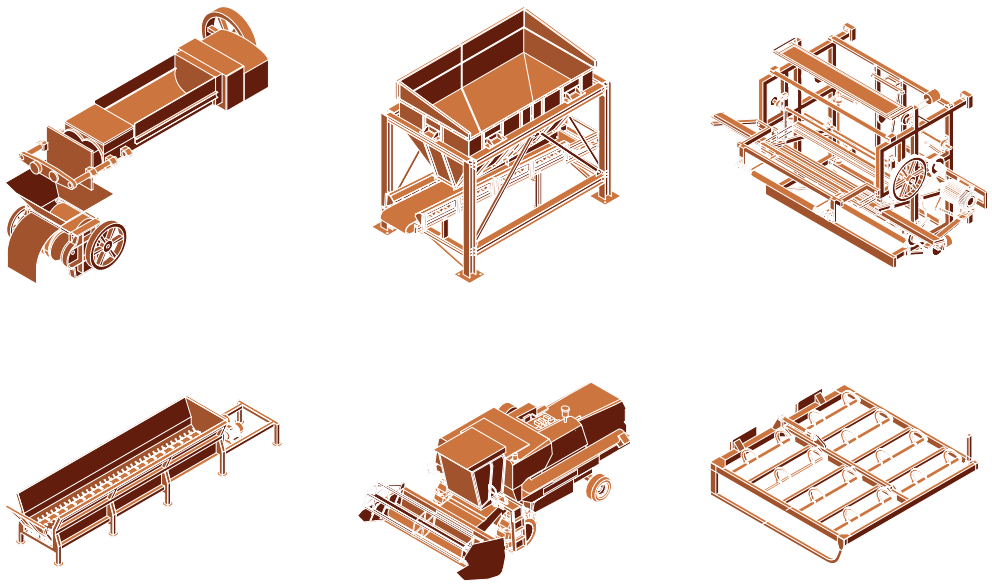
24. *Thy nationalpark logo.*



Material production process

Investigating the production process steps of sustainable materials is a useful way of discovering programmatic potentials. Manufacture concludes of a series of transformative processes in which resources are treaded through compressing, mixing, weaving, shredding, drying, cutting, and moving. Here different treatments require curtain spatial configurations in order to work properly and be safe for the workers. Requirements such as heat, shelter, controlled humidity, etc. all make inquiries towards the building and can inform the built architecture.

See all 'fabrication elements' in appendix, p. 72-81.



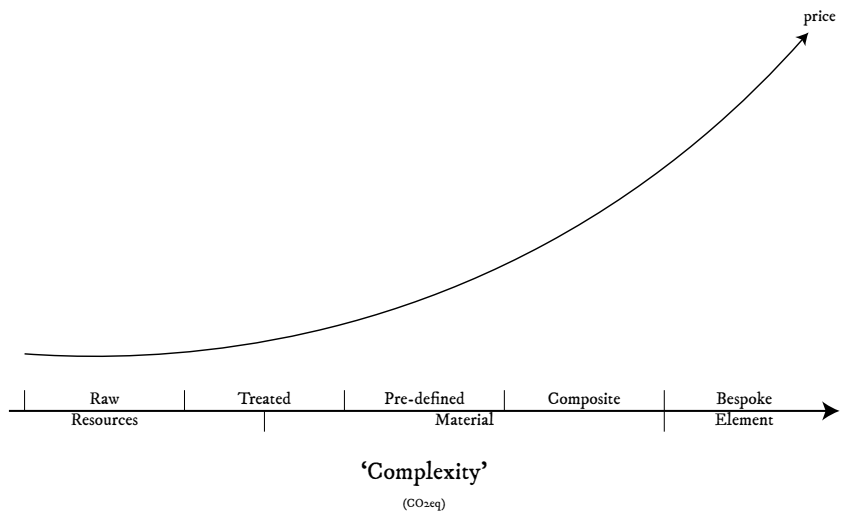
left *Production mapping. By Author.*

right *Production elements. By author.*

Material complexity

The treatment of raw resources has a gradual increase in complexity parallel to its demanded properties. But as requirements goes up so does both price and environmental impact. The demands happen for a multitude of reasons such as expanded properties, durability and controlled appearance.

We see raw resources initially being treated - then shaped into pre-defined standards or being mixed with other resources to create composites that has even more properties. Finally, we have bespoke elements of which our building culture is flooded with today.



Surroundings Helligsø brickworks

The brickworks is situated at the foot of the sloping moraines landscape where a small valley meets the fjord. To the south wetlands mitigates the landscape from hill to fjord. A public road converges with the valley, penetrates the site, and follows the shoreline on a built-up road.

The rural town of Helligsø is surrounded by commercial farmland and grazing areas for livestock. It mostly consists of detached farmhouses and industrial structures located on the higher plateau. Historically the lower wetlands have been periodically flooded but in recent years it occurs more often. The shoreline consists of larger pebbles and during fall it is draped with a layer of seaweed from the fjord. In front of the brickworks there is constructed 5 wave breakers perpendicular to the coast. They were built in 1990 after a storm surge eroded the road in the south.

Fig. 28.

1. moraines landscape
2. public road
3. stone beach
4. pond
5. site
6. wave breakers
7. wetlands
8. wave instrument

28. Flooding 1990. Thylands avis.

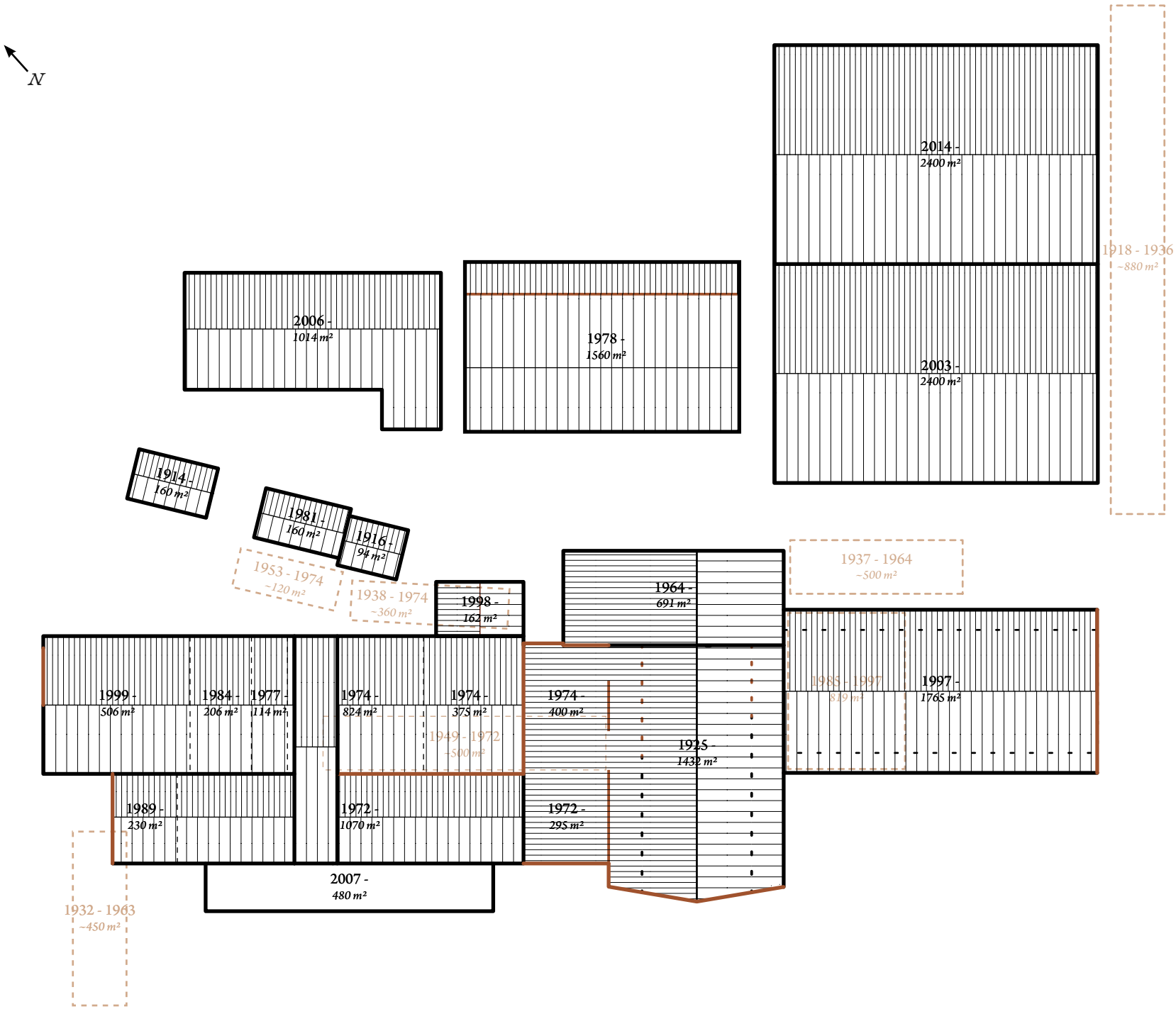
right Context plan 1:5000. By author.

History of the complex

The brickworks have existed since 1874 and was originally founded by local farmers. It has since seen many developments and modifications. In 1925 a 'ring oven' was built, and it was later superseded by a 'tunnel oven' in 1973. The main structure still stands but other building has since been removed - most during a fire in 1963. Previously the clay was sourced directly from the moraine hill to the north - but today it is hauled from a quarry in Ydby 1,3 km away.

The city of Ydby had its own brickworks but it has been put out of use (2009). The same has happened periodically in recent year for Helligsø brickworks. [9]

Fig. 30.



30. Aerial photograph 1951. Sylvest Jensen Luftfoto.

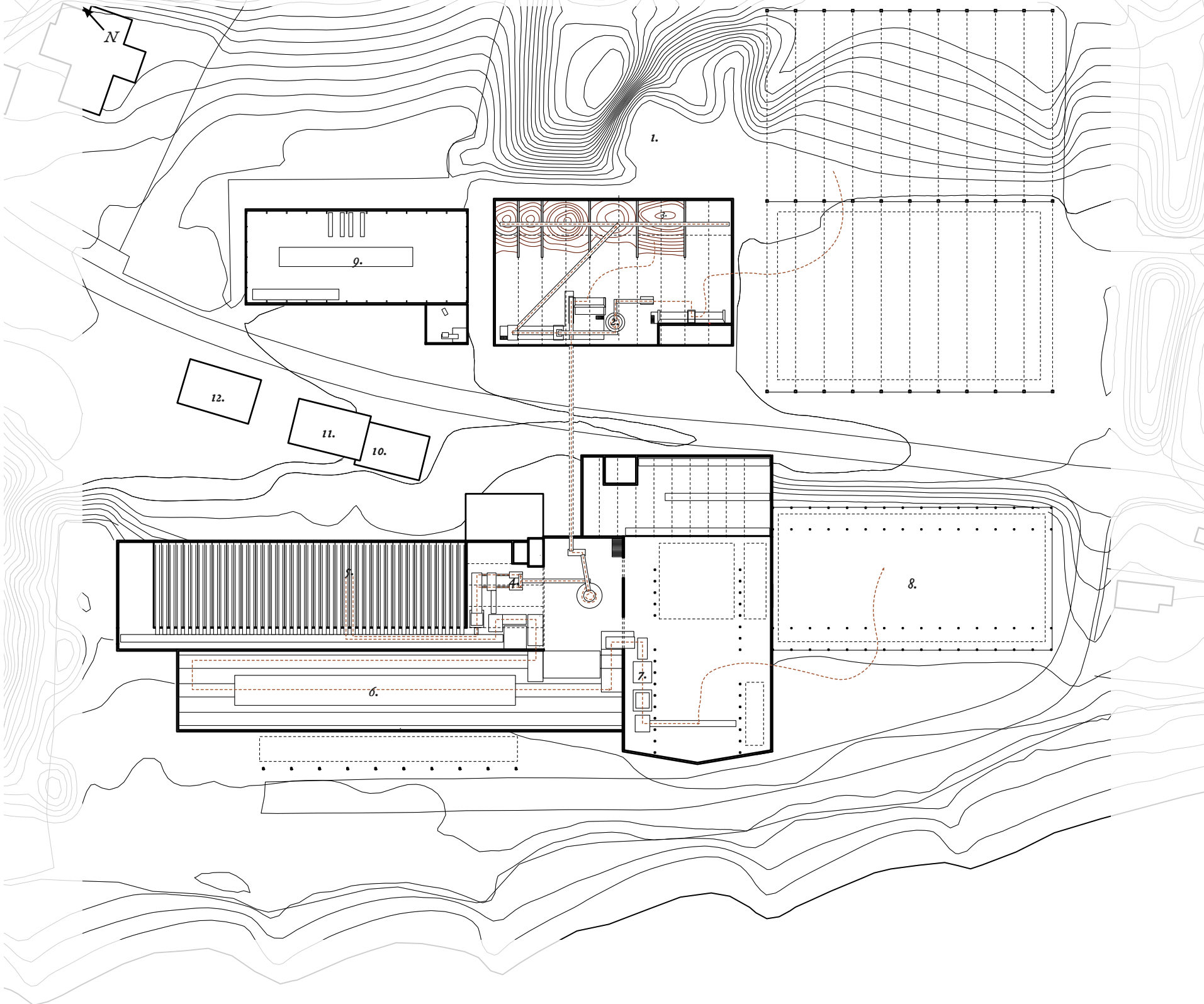
right Development & condition diagram 1:1000. By author.

Production process

The current production setup consists of initial sorting, milling and storage of the clay on the northern side of the road. It is then transported underground to the southern side where it is extruded, dried, burned and packaged.

1. raw clay
2. clay mill
3. storage
4. extruder
5. drying
6. furnace
7. packaging
8. storage
9. special production

10. office
11. kitchen
12. common room



Production flow diagram 1:1000. By author.

Phantom

The project seeks to transform an industry building through new production. It opens up – invites in. New ideas and people, to change their perception of what commercial building culture can be. Replacing long and energy intensive processes with shorter, varied once.

It becomes a seed for expanding a regenerative material thinking, where biogenic materials are not just a mere substitute for the current building materials. But instead replacing them AND their intrinsic thinking with ideas focusing on individual material performances. This should be demonstrated in the scales of the building's transformation.

Schemata

Like in a cityscape, the historic presence of the brick, the steel and the concrete shouldn't necessarily be torn down to make way for the new. Instead, they shall become actors partaking in the new biogenic material synergies. Bearing patina, history, and structural properties.

New additions to the site shall be designed with the intend to support the new production workflows. But most importantly the additions shall bring the visitors closer to the manufacturing experience by curating the composition, views, and haptics of the factory. While connecting it with the spatial requirements of the different production stages.

The goal of the building is to educate craftsmen, constructors and the general public in the different renewable constructions and workflows. In a sense the building becomes an exhibition of what it produces.

Spatial Estimate

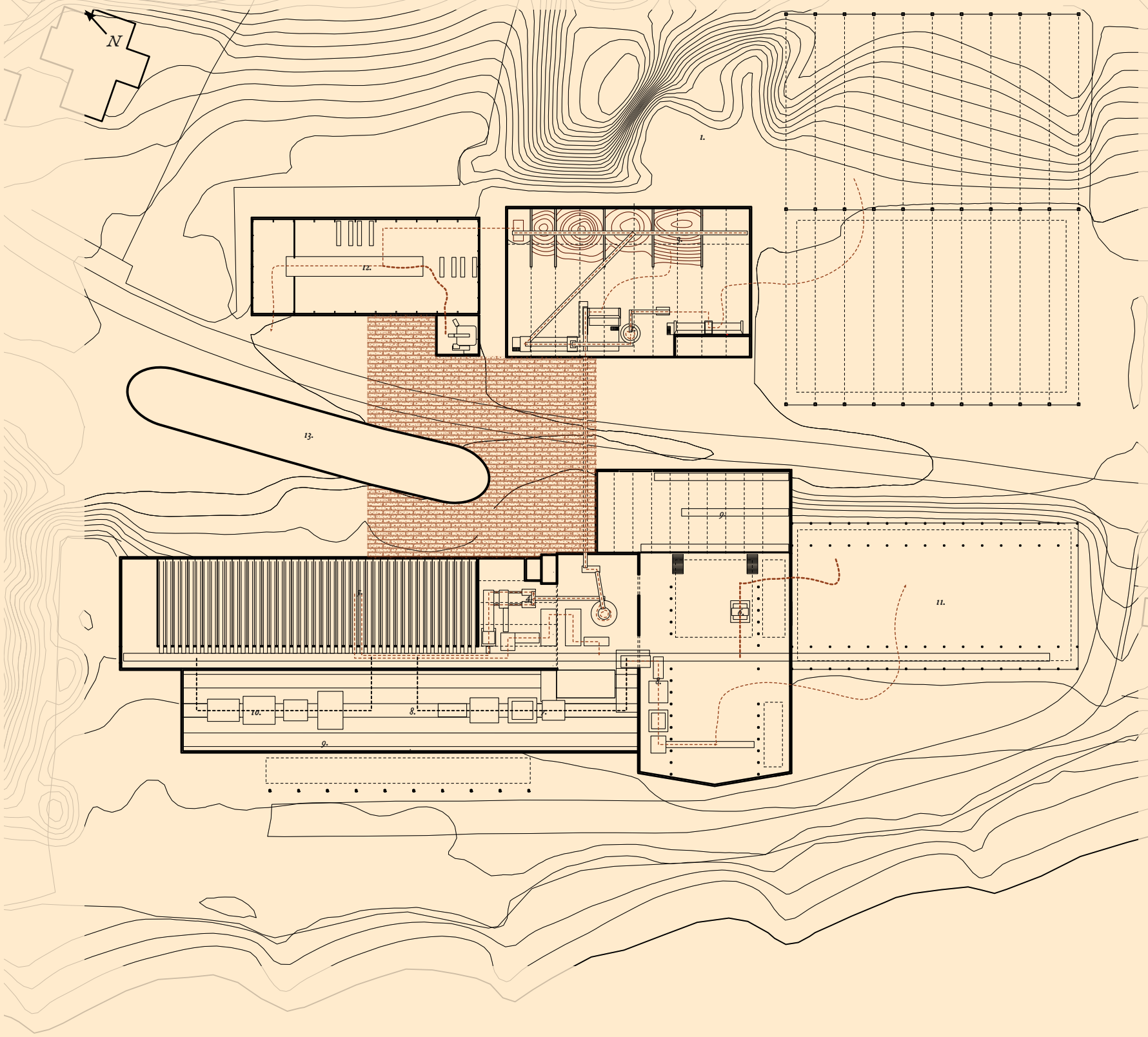
2335 sqm.	Clay process	Factory
1015 sqm.	Wood process	
1650 sqm.	Hemp process	
1430 sqm.	Weaving process	
1300 sqm.	Compression process	
695 sqm.	Halls and walkways	
6650 sqm.	Sheltered storage	
14975 sqm.	Total	
30 sqm.	Arrival	Visitor center
70 sqm.	Exhibition	
35 sqm.	Kitchen	
85 sqm.	Canteen	
75 sqm.	Conference room	
50 sqm.	Bathrooms	Service facilities
25 sqm.	Walkways	
110 sqm.	Courtyard	
120 sqm.	Office	Administration
85 sqm.	Depot	
20 sqm.	Sales room	
50 sqm.	Research and development	
755 sqm.	Total	

New production and zoning

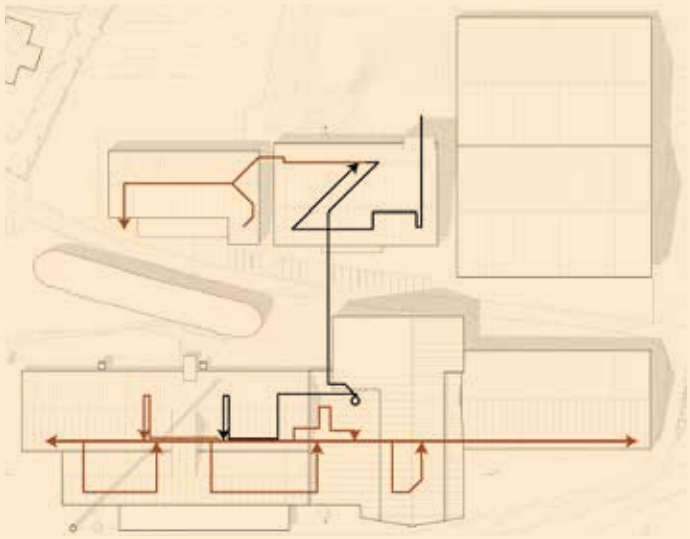
The repurposing of the facility maintains the parallel positioning of the straddle roof buildings, while strengthening the bend axis of the service and office buildings. Some of these are repurposed to accommodate the visitors. A central square is highlighted and attaches to the southern volumes. A public flow is established to curate the visitors through the production process.

1. raw clay
2. clay mill
3. storage
4. extruder
5. drying
6. weaving
7. sheeting
8. shredding
9. mixing
10. compressing
11. storage
12. assembly

13. new axis

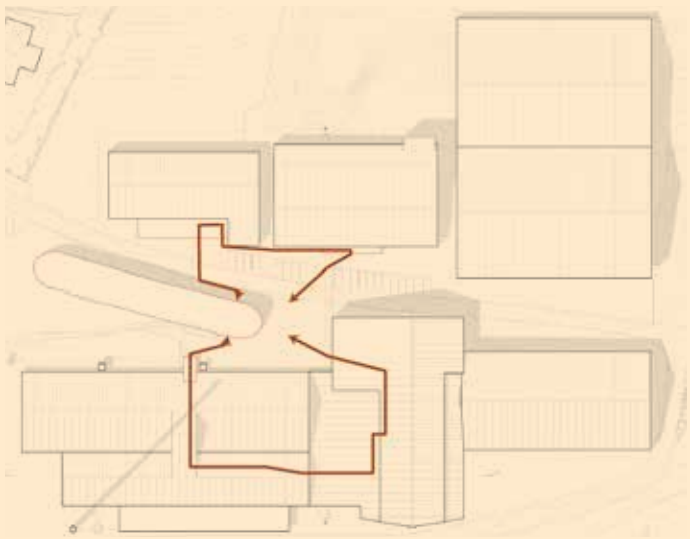


New production and flow
1:1000. By author.



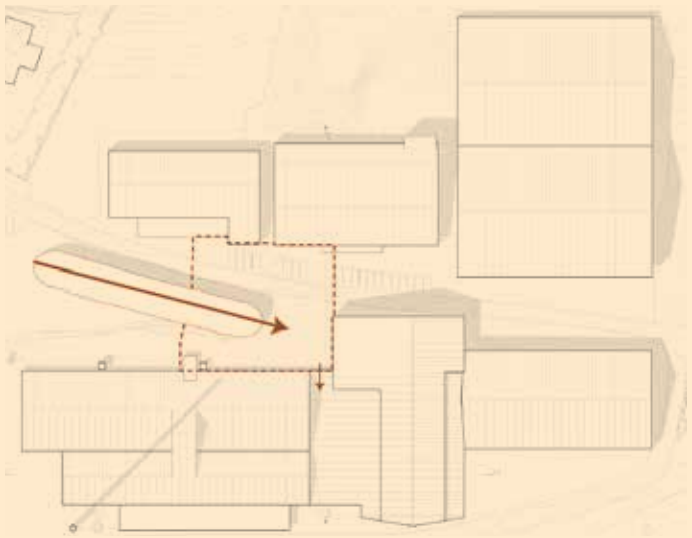
New production

The production is rearranged to allow more types of productions to happen in the southern production hall. The former 'tunnel oven' is removed, while keeping the linear production flow.



New loop

A public loop is introduced through and over the production line to provide access to visitors. At the northern halls the visitors can look from the outside in. In the south they can have an immersive tour through the production facilities.



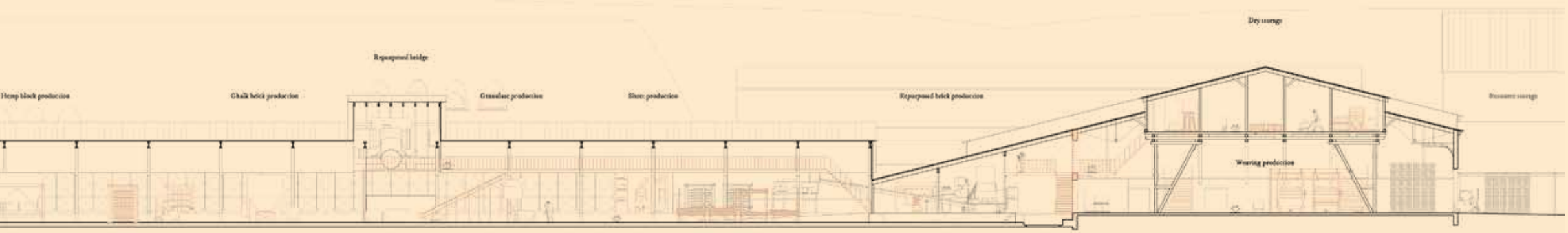
Strengthened axis

The bend axis of the former administration building is highlighted by the transformed building volume. Uniting the volumes under one roof structure pointing towards a central square. In here the new service, exhibition and administrations functions are placed. The square stretches between the buildings tying the volumes together and providing a look above the roofs unto the sea.

Curated production and visit

The former heat vent of the 'tunnel oven' is being repurposed to allow the visitors a path through the building, connecting to a suspended bridge above the new production. From here the visitors can access the central platform of the factory and onto another bridge with access to both the repurposed dry loft and a pathway to the square.

Cutout of section CC.
By author.



Production halls

Removing the extensive burning and management of the clay bricks frees up space for multiple productions to happen. Processes such as weaving, sheeting, shredding, mixing and compressing.

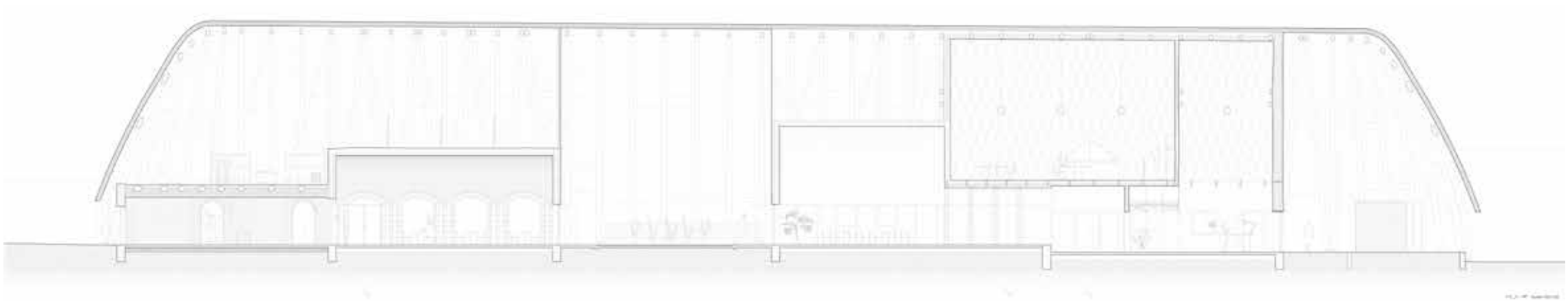
left *Production hall render.*
By author.

right *Weaving hall render.*
By author.

Full bleed Exterior render

top *Section DD.*
By author.

b. *Plan drawing.*
By author.

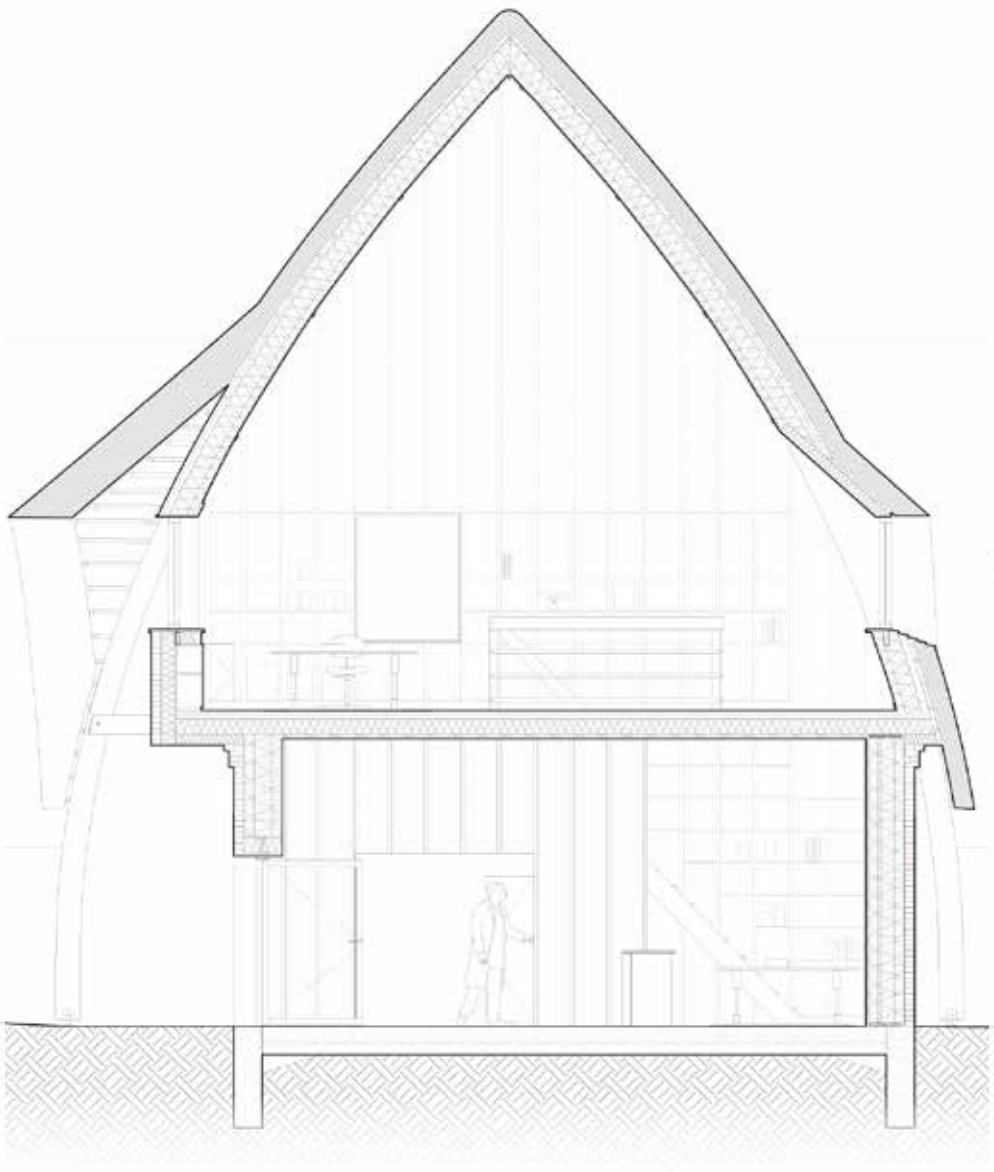


left *Cutout, section GG.*
By author.

right *Interior render.*
By author.

43. *'Studie til Parti at udkanten fra Tisvilde Skov'. 1843-1845.*
By P.C. Skovgaard.

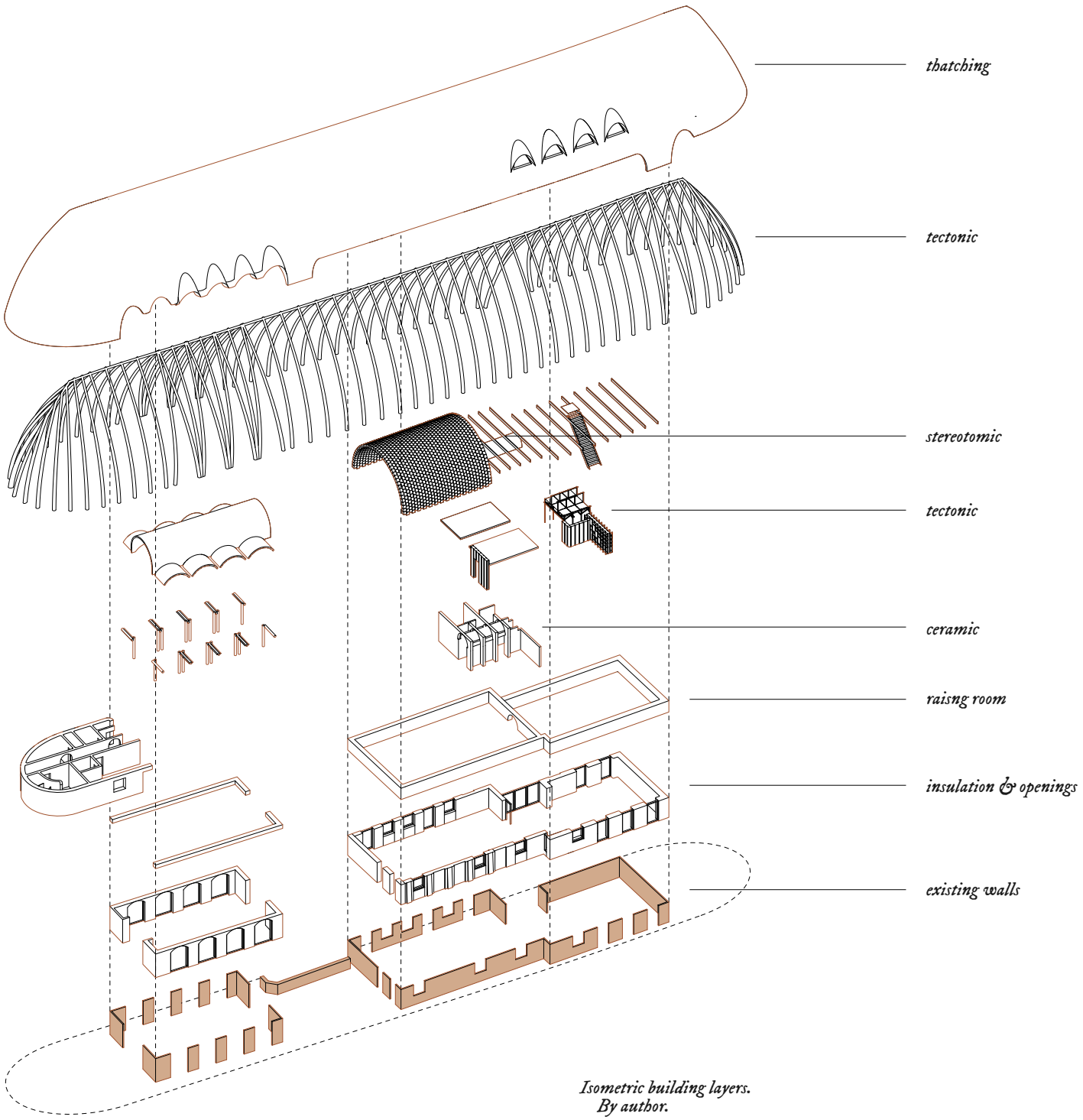
Fig. 43



Transforming the axis

The former administration and service buildings are transformed to accommodate the new and expanded program. The jagged compositions of the volumes are emphasized as the old bricks and the facade openings are kept. The roof and interior however are transformed with extra insulation and new aesthetics. Focusing on the 'elite performance' of the materials to curate the rooms specific to their requirements. Sometimes a large room is required, sometimes a compressed sensation and sometimes the new aesthetic sparks completely new layers in the building - as the cantilevered roof makes new outdoor sheltered spaces.

Interior rendering



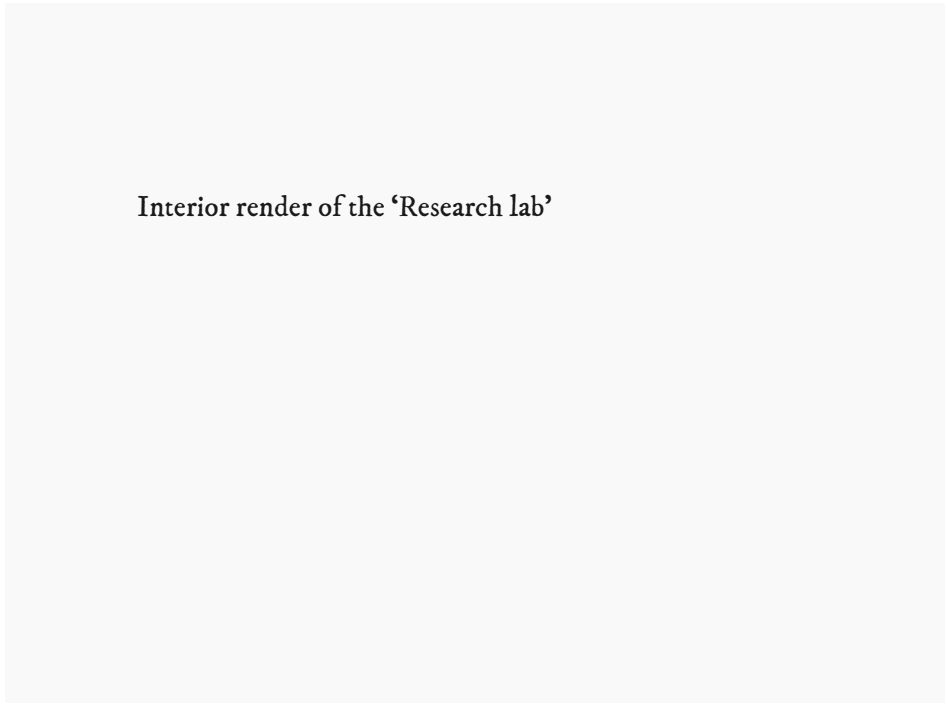
Isometric building layers.
By author.

'Elite performance'

The materiality of the rooms seeks to broaden the varied experiences of moving through spaces and functions. From a sheltered exhibition area where the thatch and wooden pillars creates a thick vertical canopy. Through the research and administration where a mix of light tectonic spatial dividers and furniture, compliment rounded facade openings of clay plaster.

Moving towards the conference room the rammed earth walls thickens and compresses the space before revealing a large, vaulted ceiling of hemp blocks. The tactile surface of the hemp blocks cushions the sound and makes for great conversations and knowledge sharing.

Opposite the courtyard another vaulted ceiling structure creates a different atmosphere. Here the pillars and vaults subdivide the room in smaller niches while the hardened surface reflects sounds to create a casual soundscape. Moving future through to the additional building we are meet by a synergy between free standing rammed earth and a suspended seaweed-paneled ceiling. This is made possible by vertical wood trunks - that also facilitates an attic space above.



Interior render of the ‘Research lab’

Developing a new building culture

If we are to implement new ways of constructing sustainable buildings, we also require a place for developing new materials. A place to learn and understand the intrinsic properties of the resources. Testing and developing new products on par with the conventional materials of today. Understanding what the resources can and cannot do. Defining the limits of its scale. Only then can the sustainable building material be certified and used in the commercial erection of buildings. This knowledge can be researched in the buildings laboratory and shared just outside in the exhibition.

AR 1:5

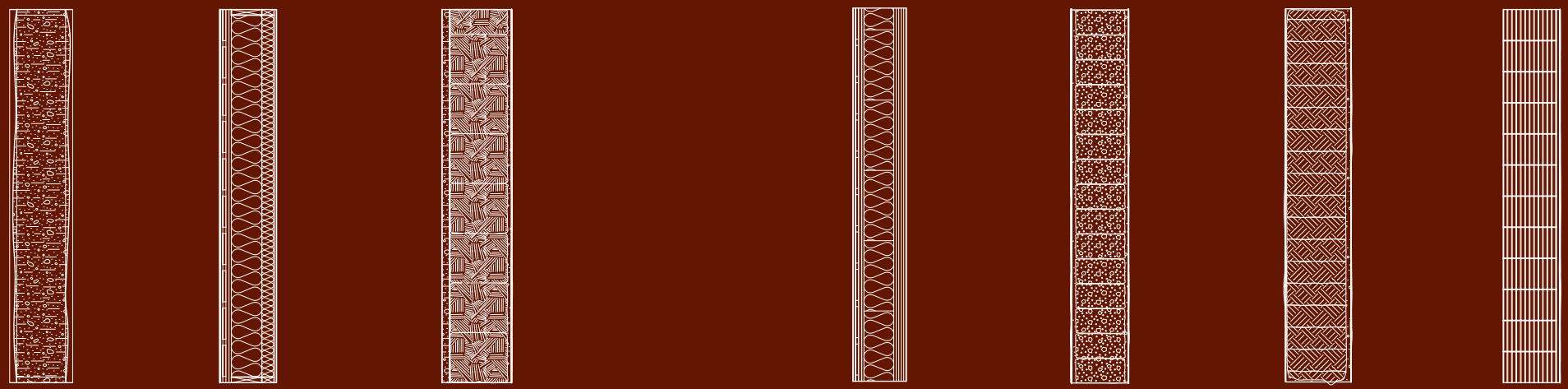
Manufactoring a new building culture

On the topic of new productions, I also think it is worth exploring the relationship between the digital and the analog. As there resides a permanent split between the complex digitized facilities of mass production and the manual labor of the crafts.

This duality in technique can potentially meet in the manufacturing system of less processed biogenic materials. Materials in which a margin of impression is to be expected. Here the computational power to grasp complex geometries and datasets can be married with the human hand-to-eye motoric and empiric knowledge of crafting with the body.

Perhaps this is one way of supporting both the traditional craftsmanship of the past, while exploring the sustainable materials of the future. To make use of the intrinsic qualities of varied renewable materials and their 'elite performance' to develop the aesthetics of a new architectural period.

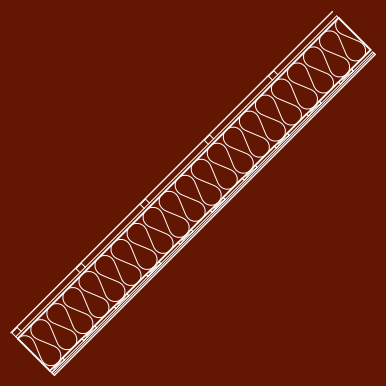
Appendices

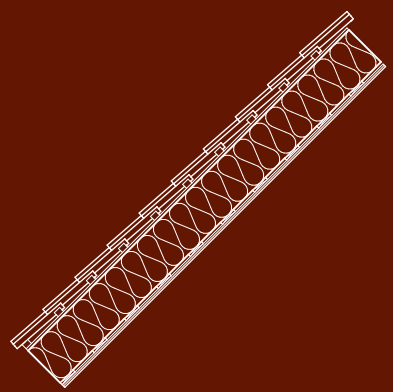


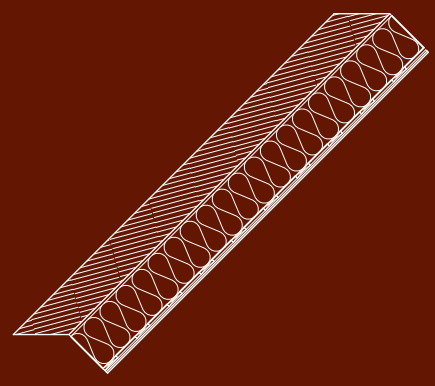
Type	Hessian wall	Timber frame	Straw bale	CLT 100mm	Hempcrete	Rammed earth	Calyblocks
Width	460 mm	460 mm	560 mm	434 mm	468 mm	538 mm	485 mm
Insulation	0,154 μ	0,154 μ	0,143 μ	0,166 μ	0,169 μ	0,2 μ	0,158 μ
GWP	-66,4 kg/m2	-66,4 kg/m2	-48,6 kg/m2	-123,8 kg/m2	1,9 kg/m2	11 kg/m2	72 kg/m2
Price	557,6 DKK/m2	557,6 DKK/m2	398,8 DKK/m2	1332 DKK/m2	1350 DKK/m2	381 DKK/m2	877 DKK/m2
Weight							

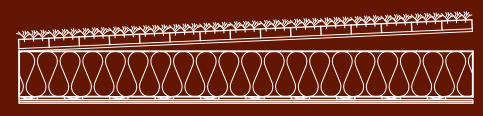
0 0,2 0,5 1 2m

1:50



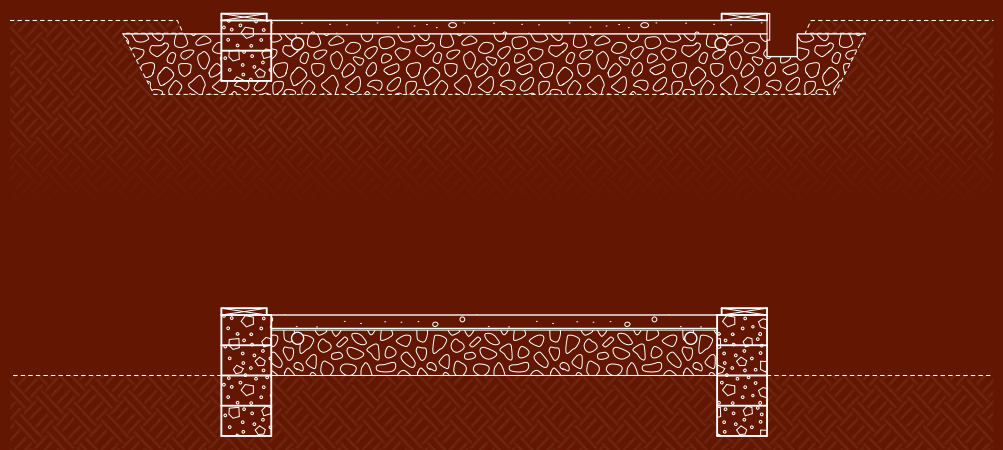






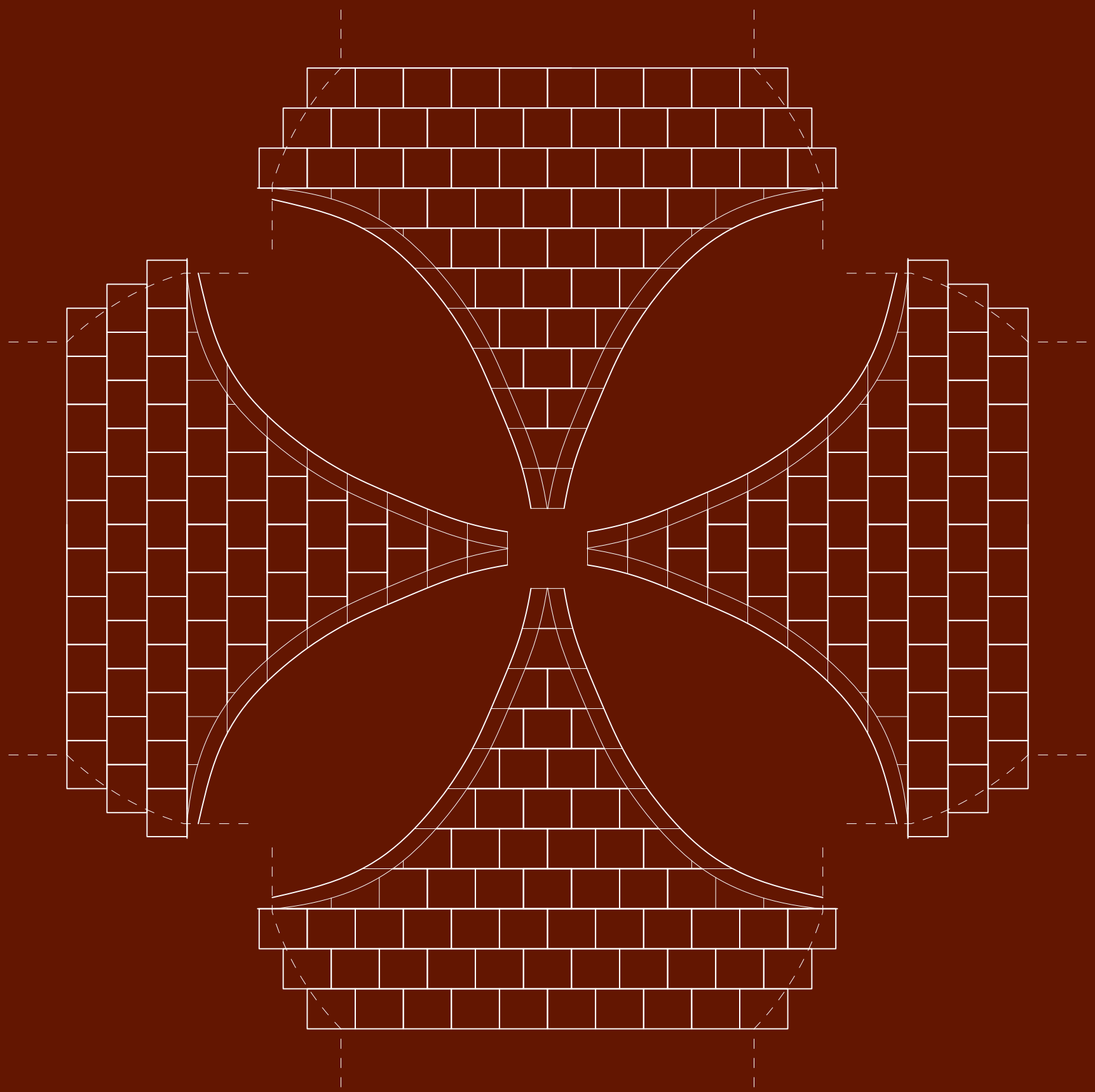
Type	Sheet roof	Slate roof	Thatch roof	Sedum roof
Width	435 mm	475 mm	610 mm	465-605 mm
Insulation	0,137 μ	0,137 μ	0,11 μ	0,135 μ
GWP	-27,9 kg/m^2	-25,2 kg/m^2	-88,7 kg/m^2	-48,7 kg/m^2
Price	745 DKK/m^2	876 DKK/m^2	1228 DKK/m^2	1132 DKK/m^2
Weight				

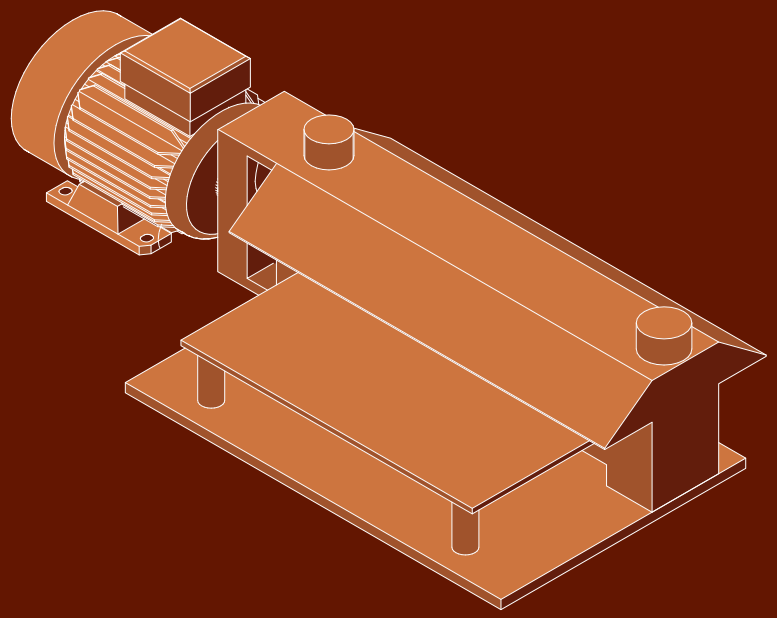
1:50



Type	Buried granulate foundation	Raised granulate foundation	Buried point foundation	Raised point foundation	Slab foundation
Insulation	0,14-0,2 μ	0,14-0,2 μ	0,142 μ	0,142 μ	0,134 μ
GWP	8,2 kg/m2	23,9 kg/m2	-57,6 kg/m2	-58,5 kg/m2	34,9 kg/m^2
Price	174,3 DKK/m2	262,3 DKK/m2	735 DKK/m2	681 DKK/m2	845 DKK/m^2
Compression strength					

1:50





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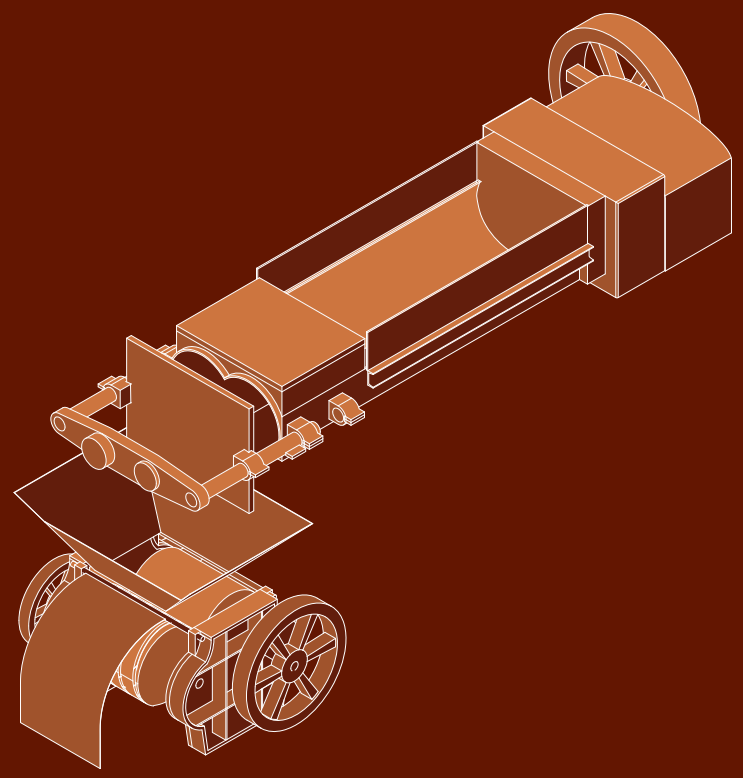

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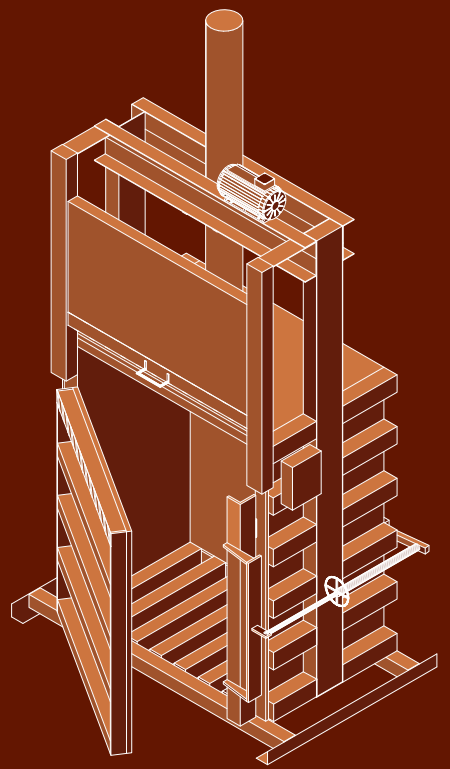

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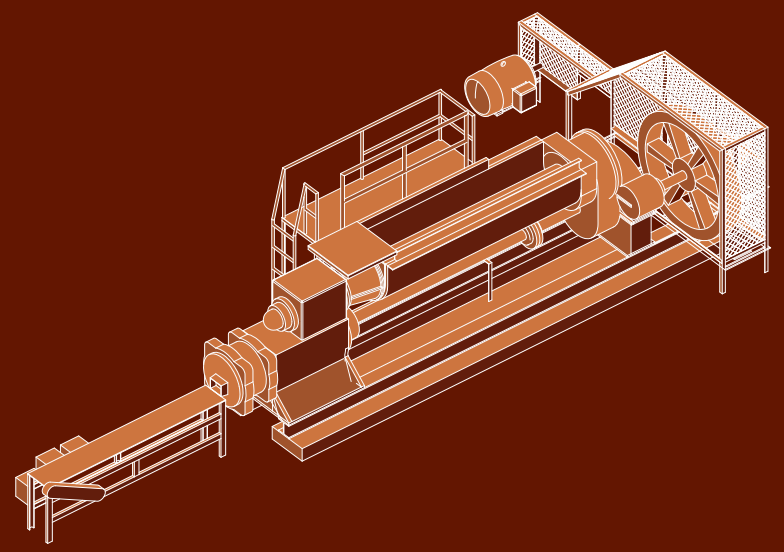

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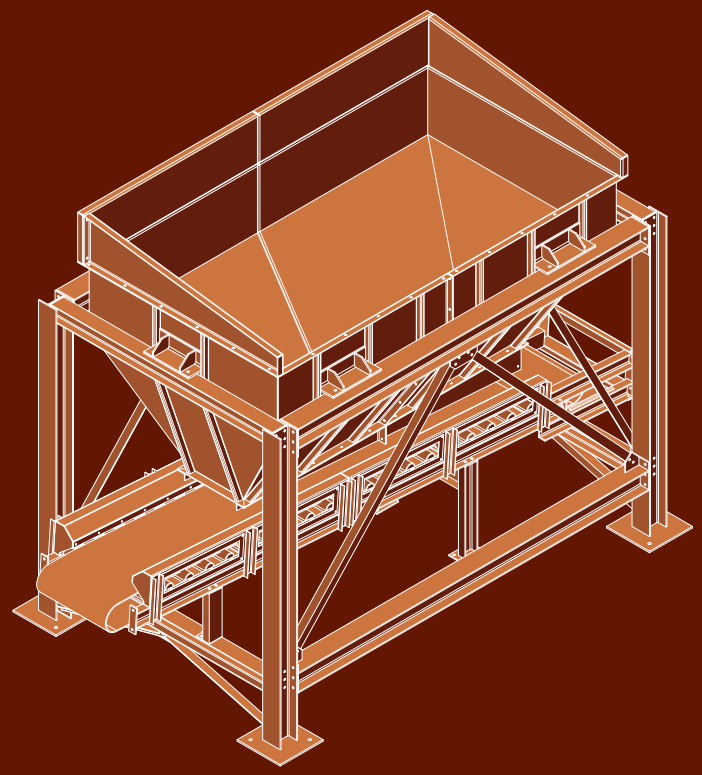

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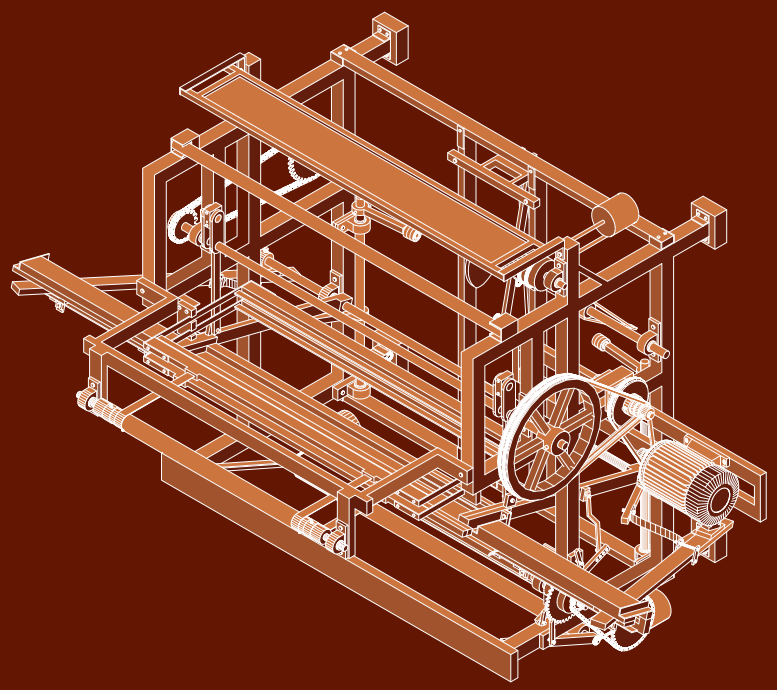
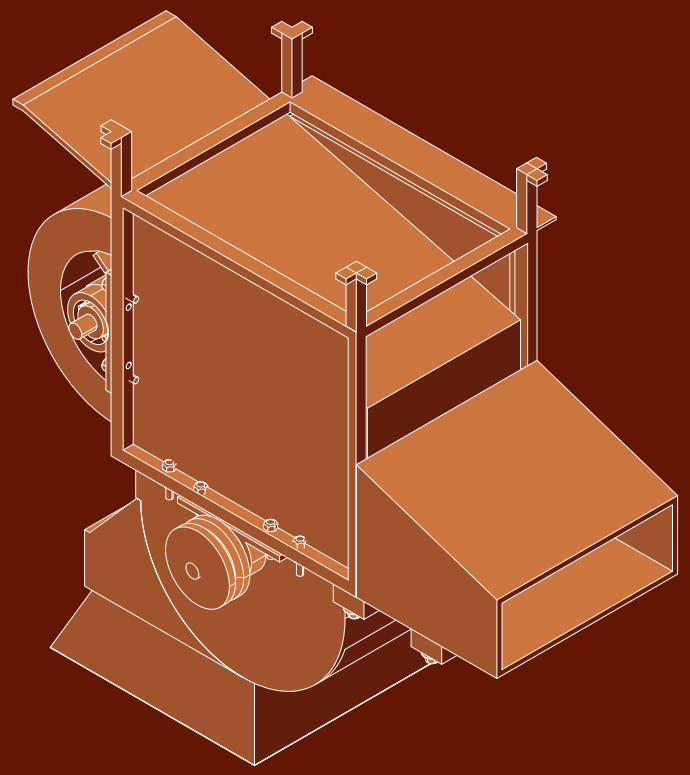
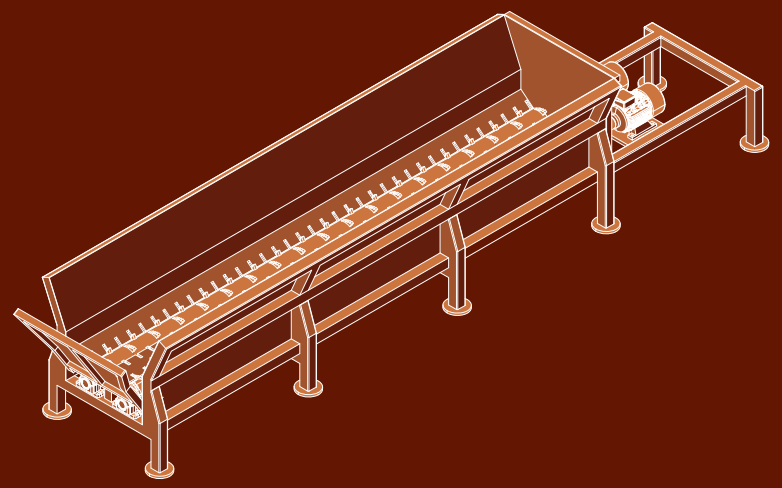


Weaving



Shredding



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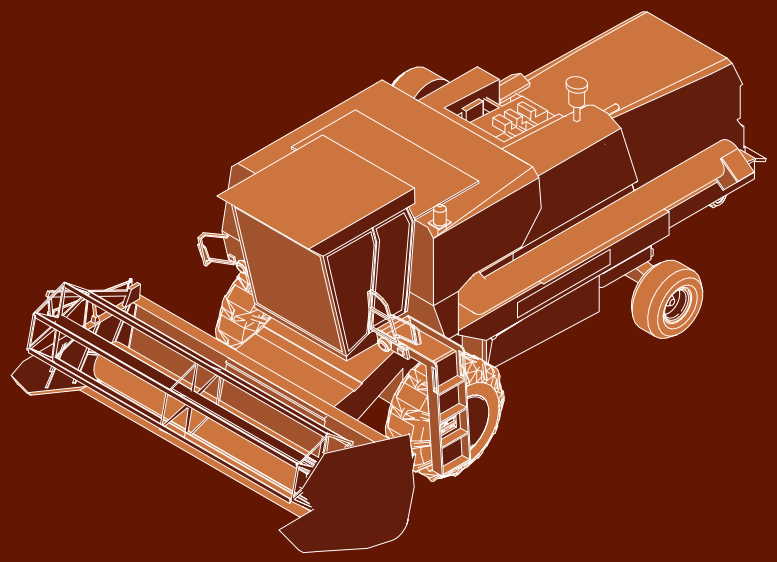

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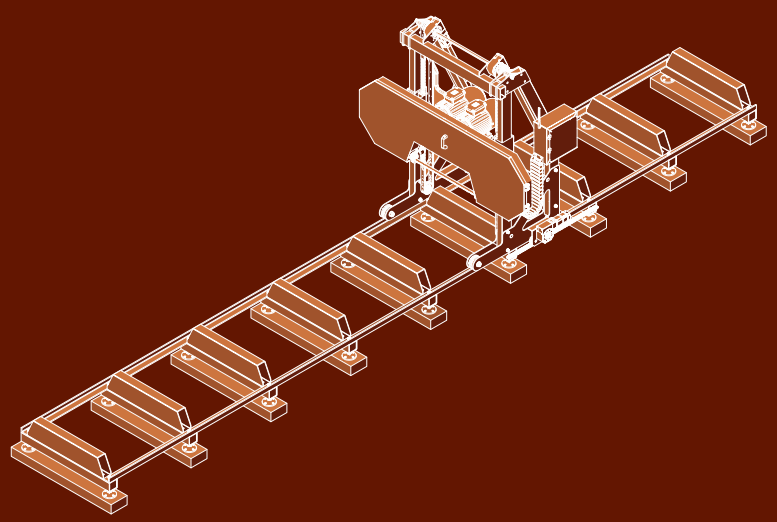

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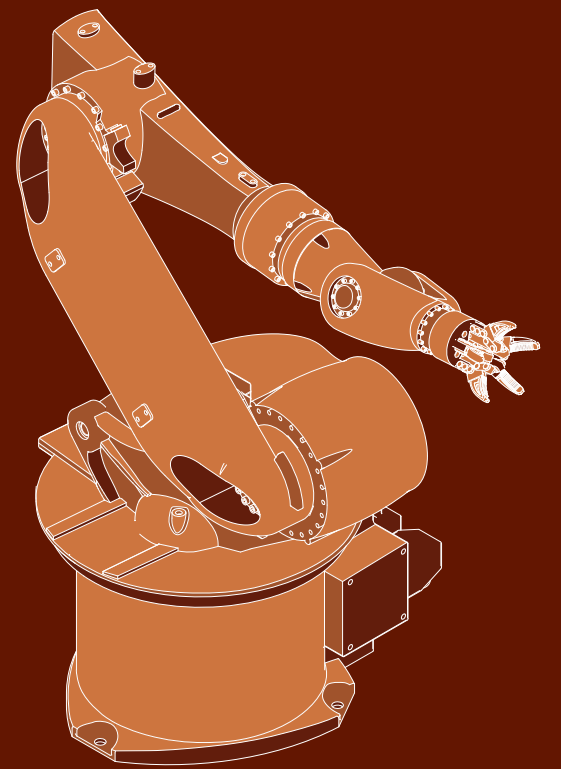

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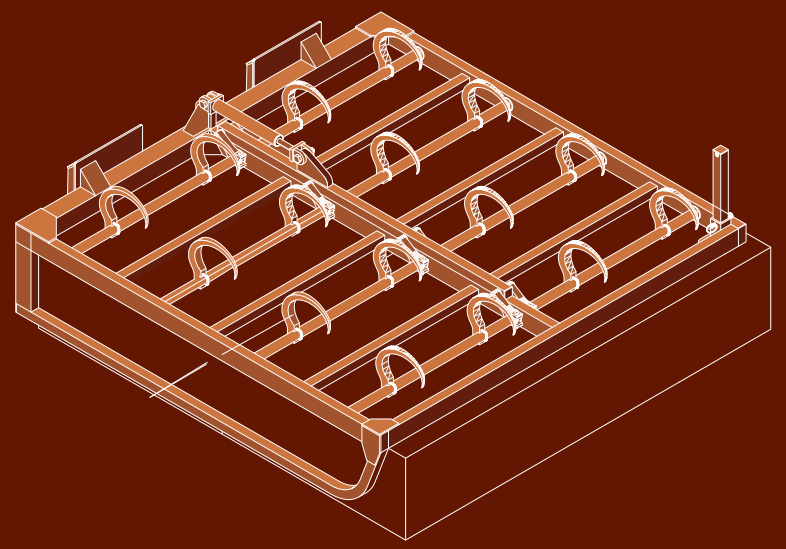

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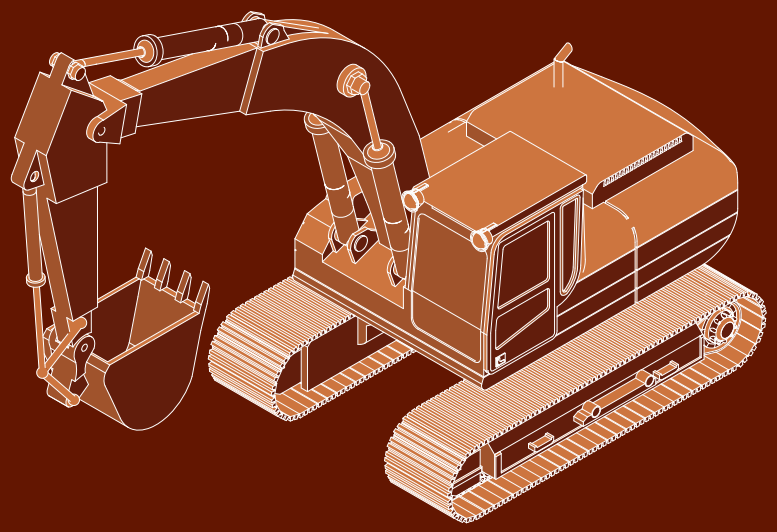

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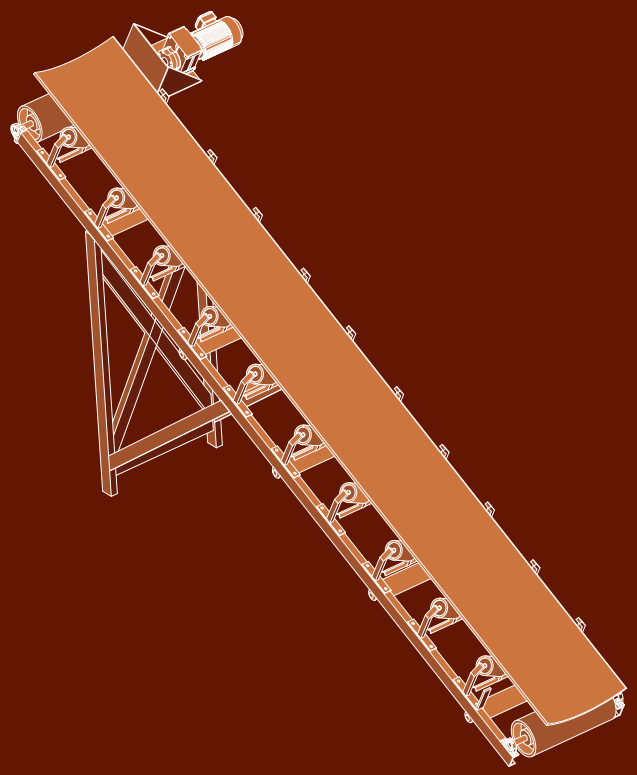

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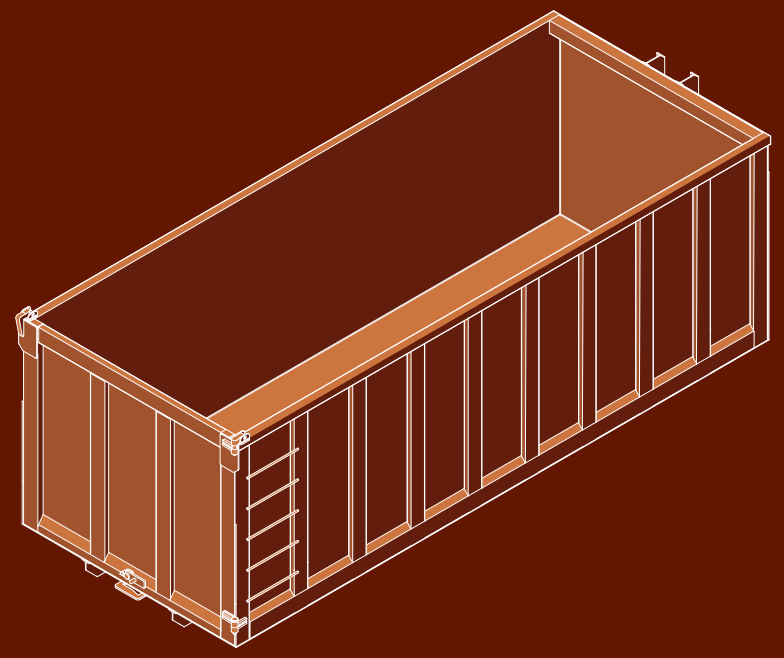

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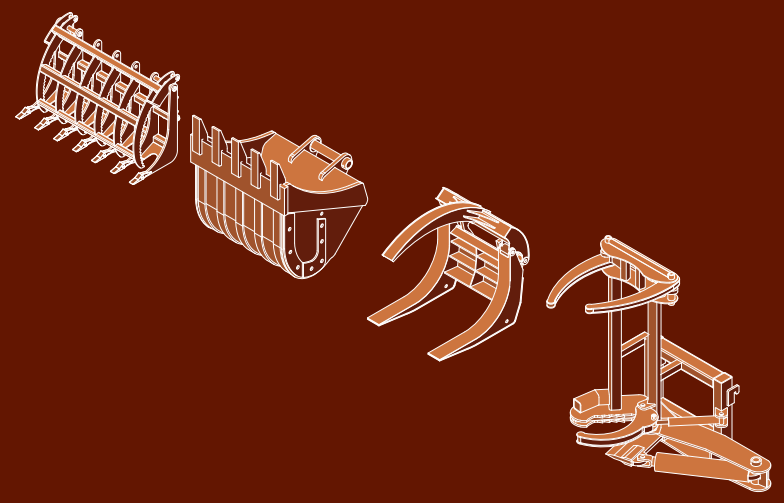

Moving

Figures

All images by the author unless listed below

03 Semper, Gottfried
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28 'oversvømmelse'.
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Colophon

Master of Arts in Architecture RIBA Part II

AAA,

Studio 2C , 10th semester (fall 2022)

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