Building a bio-based workshop

Architectural Engineering
P5 presentation

Mees Hehenkamp

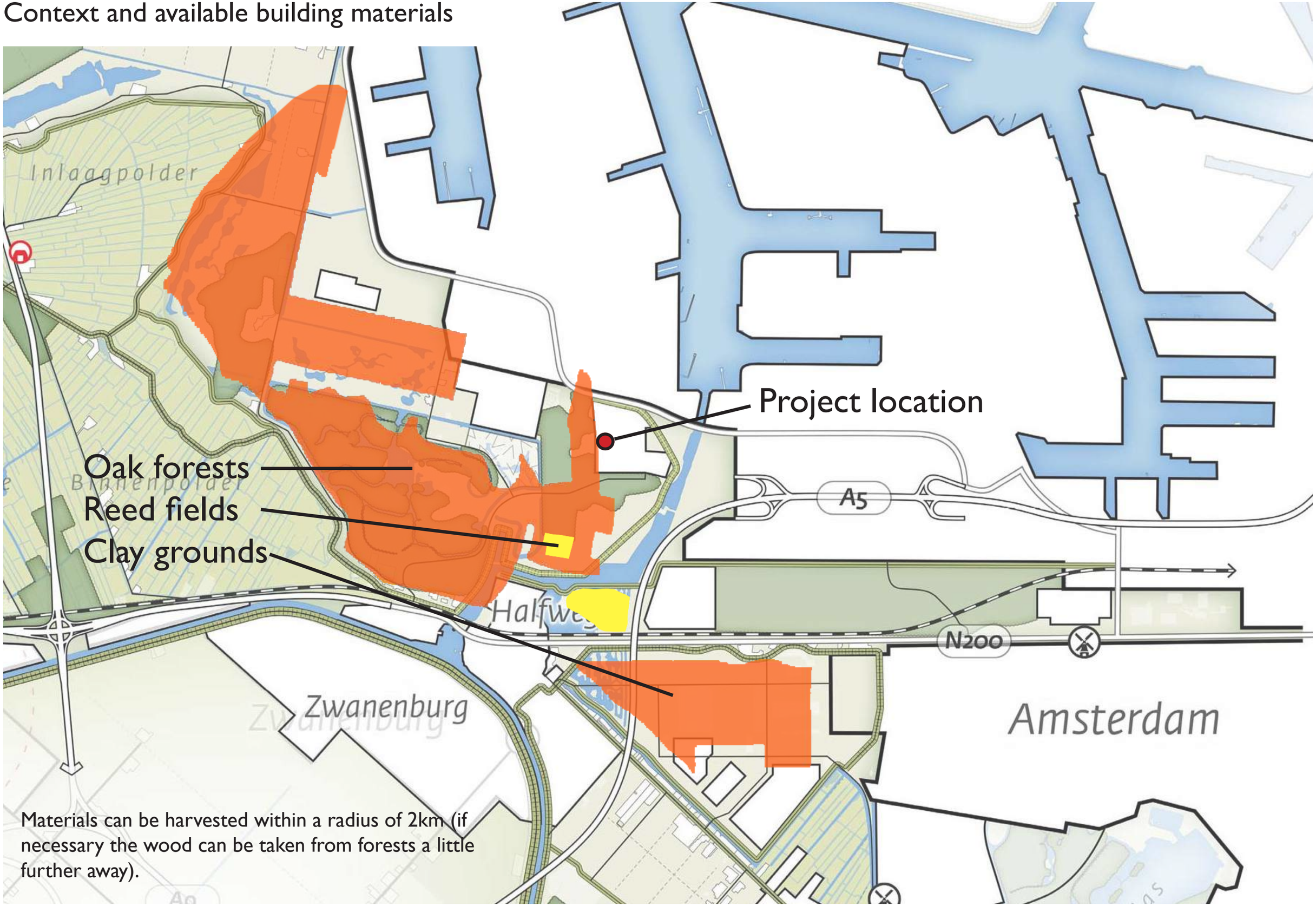
Part 1: project info

Project aims

1. Reduction of CO2 emissions by the building industry in The Netherlands by means of using local building materials (straw, clay and wood).

2. Teaching the woodcraft and straw building by making a workplace where knowledge is exchanged.

Context and available building materials



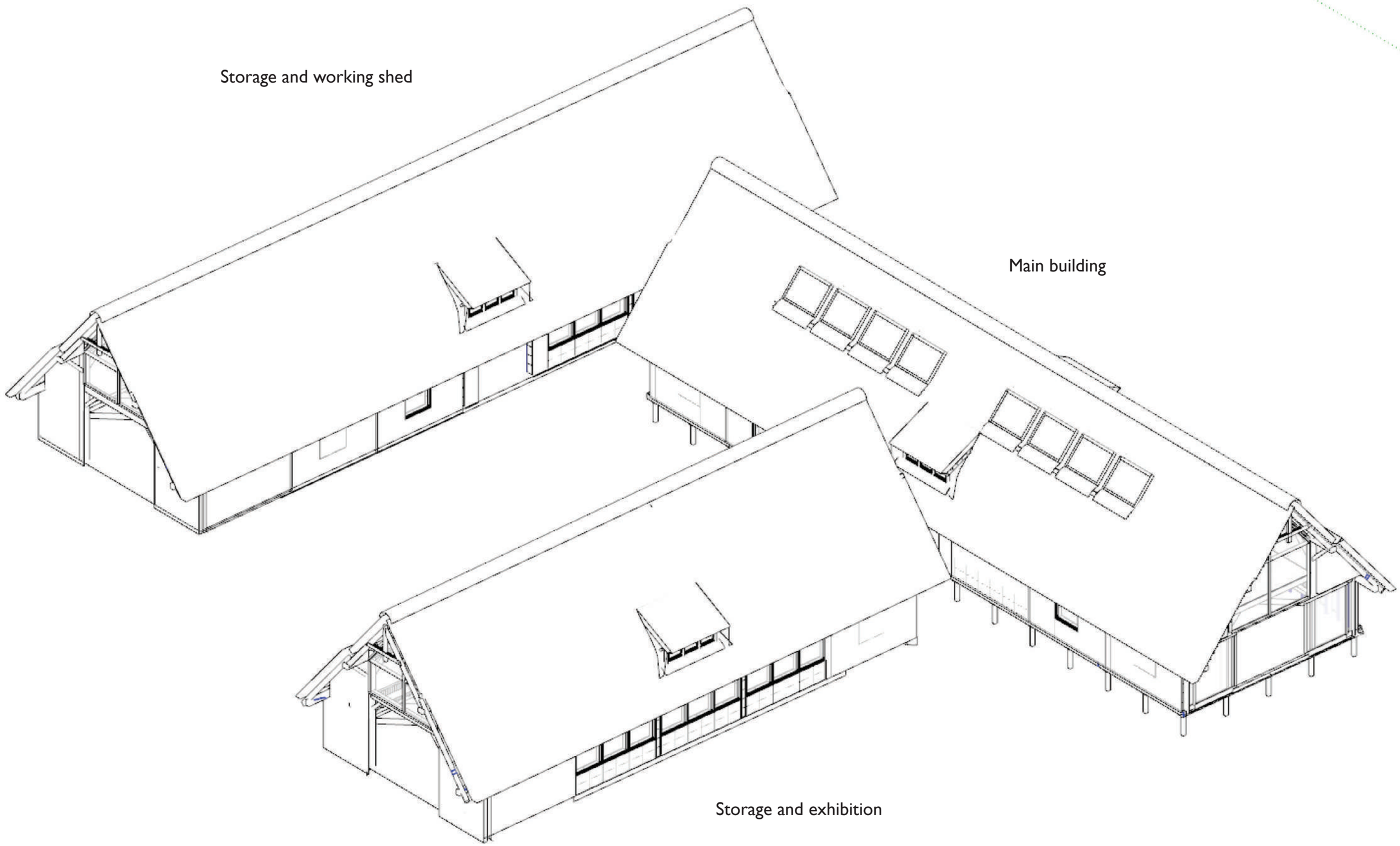
Materials can be harvested within a radius of 2km (if necessary the wood can be taken from forests a little further away).

50m

80m

1:200

Programm

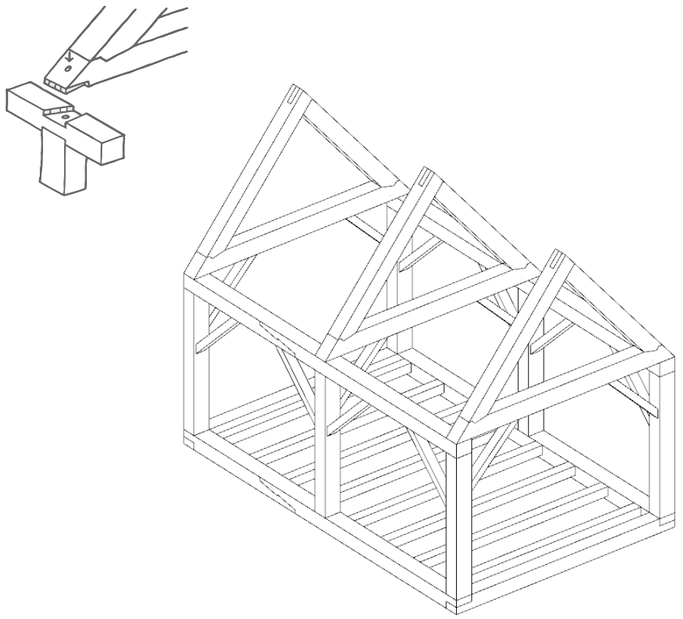

Storage and working shed
Main building
Storage and exhibition

Part 2: building technology research

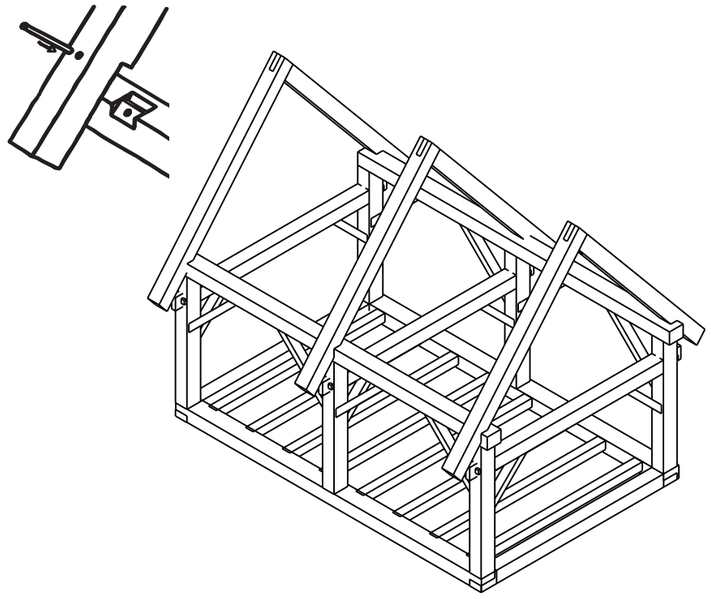
Traditional configurations for timber frames

Building a wooden timber frames in the Netherlands is done according to the "pole and truss frame" method. These frames can be used to make 1-storey houses, with a width of 3.6-5m. There are three configurations:

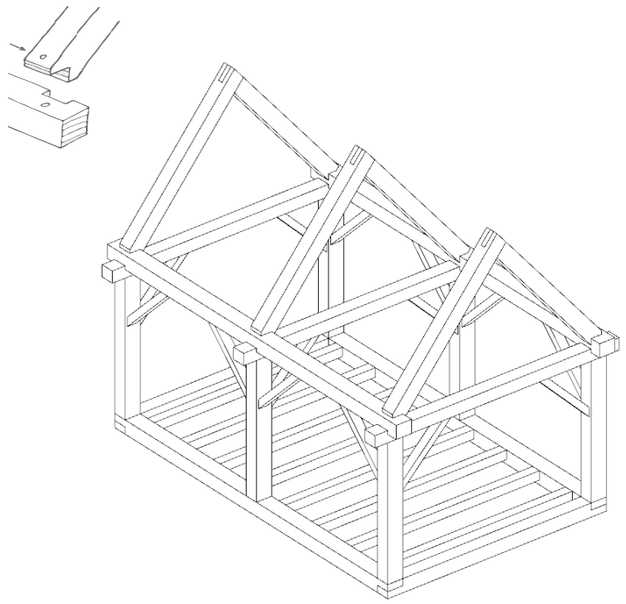
Normal assembly



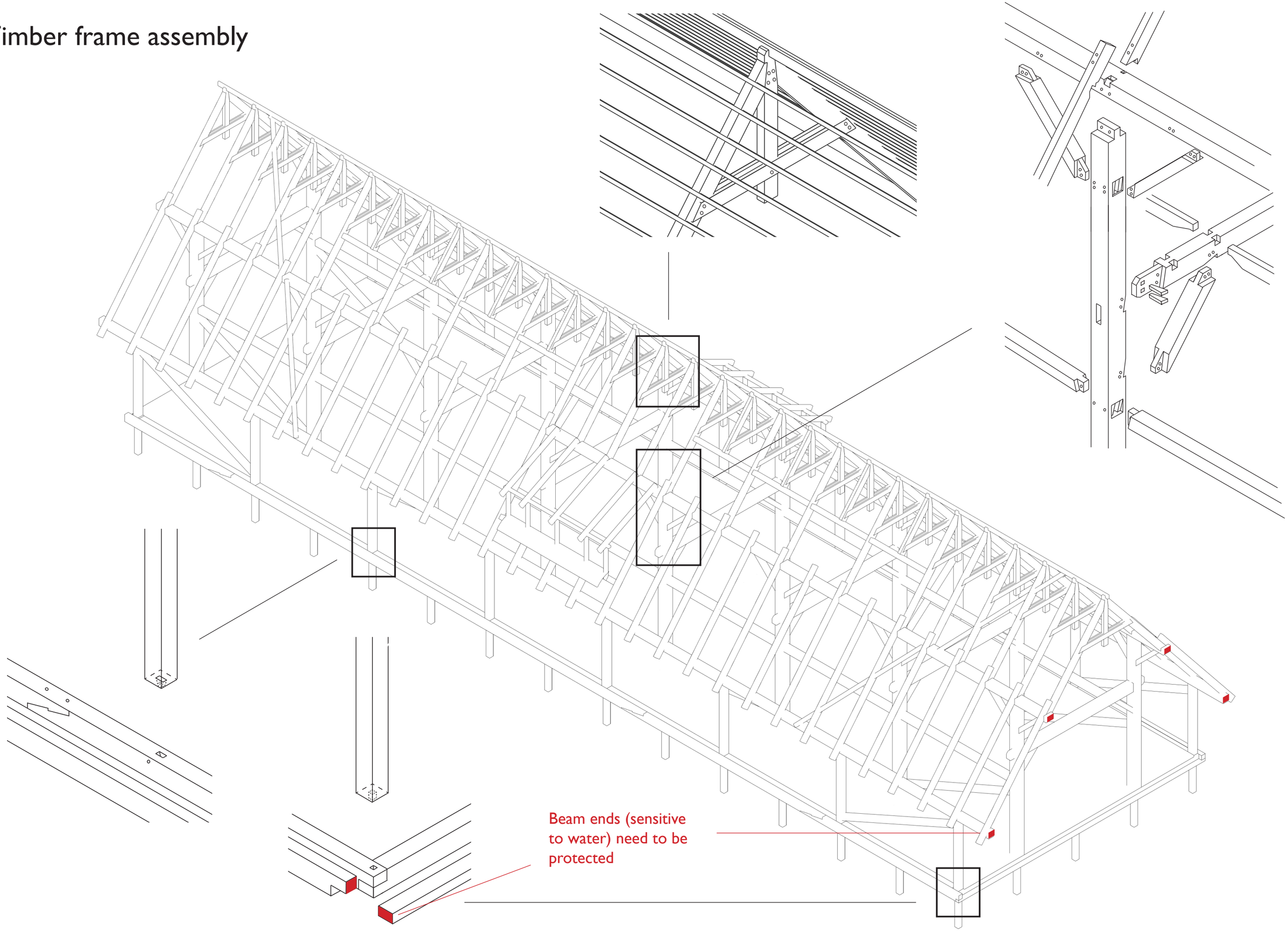
Raised header assembly



Reversed assembly



Timber frame assembly



Timber frame assembly

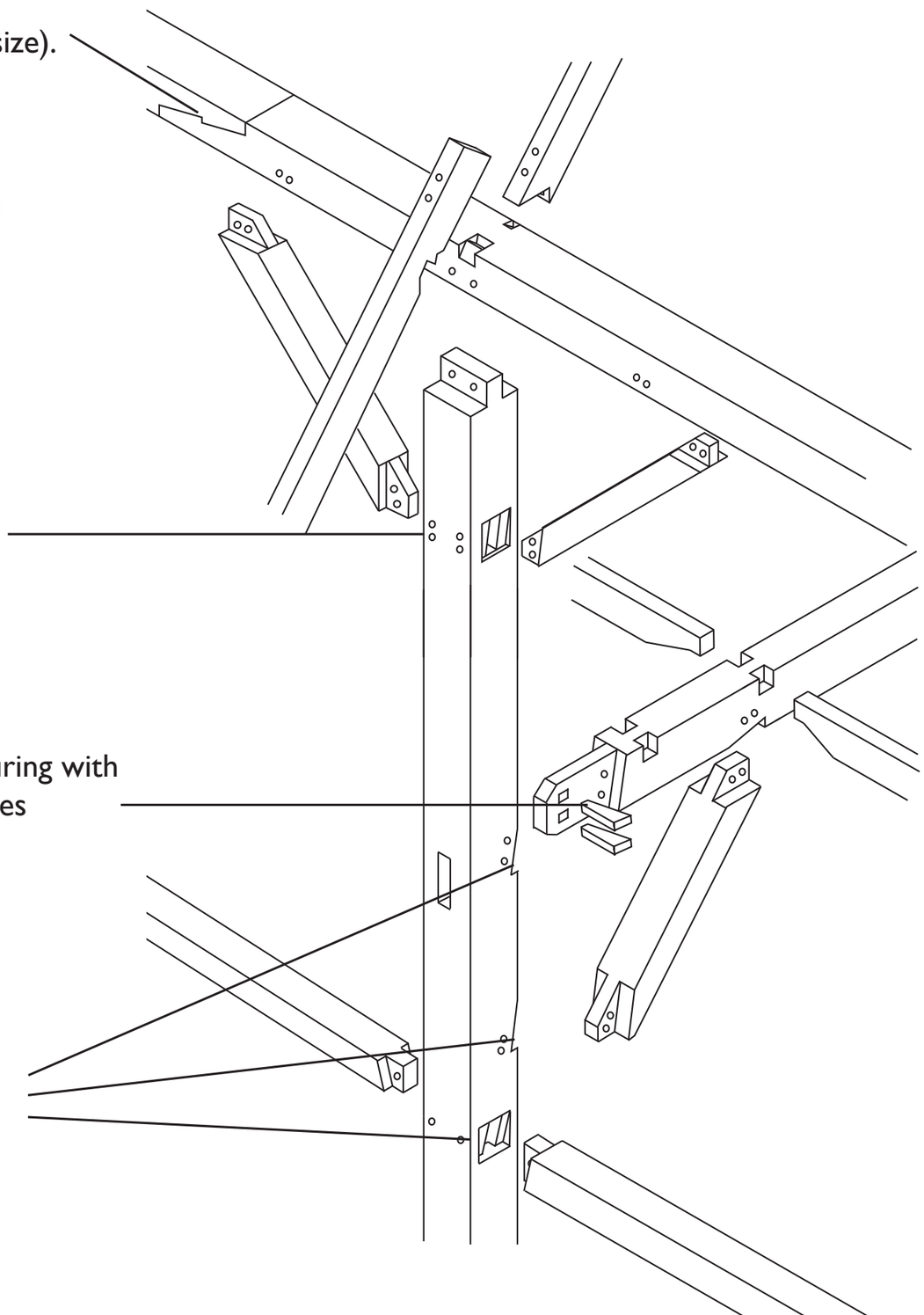
Scarf joints are used to extend beams (of any size).

The 10 meter roof is spanned by two 5m poles, fastened together with wooden pens

Securing with wooden pens.

Additional securing with wooden wegdges

‘Houses’ are made to make the beam rest on the column

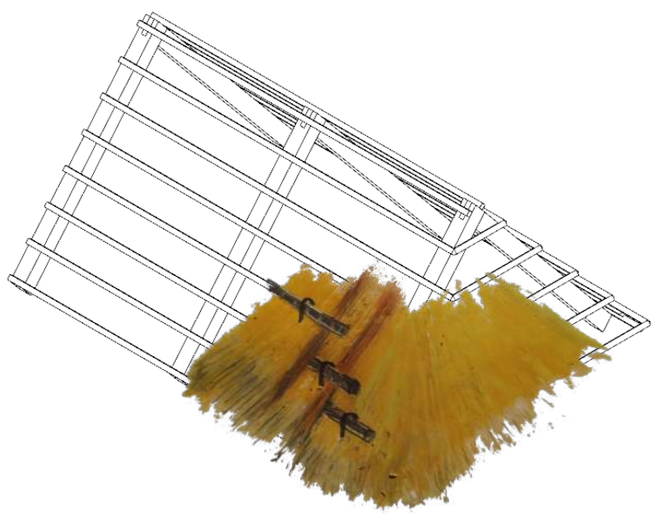


Building element	Measurements (cm)	Heart to heart distance (m)
Roof trusses	10x20	1,2
Columns	30x30	4,8
Truss plate	30x20	
First floor beam	30x30	4,8
Lowered floor beam	20x20	2,4

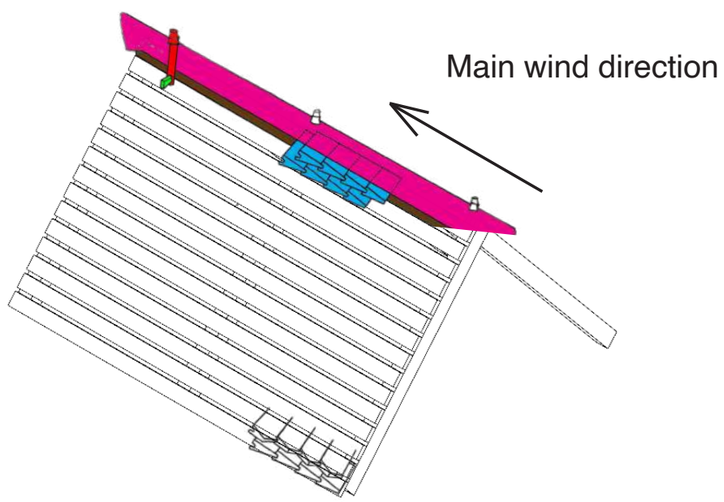
Own practise

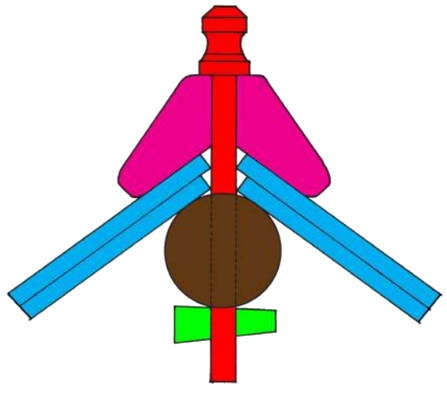
Bio-database

Straw thatched roof, attached
with willow branches



Wooden shakes attached
with nails



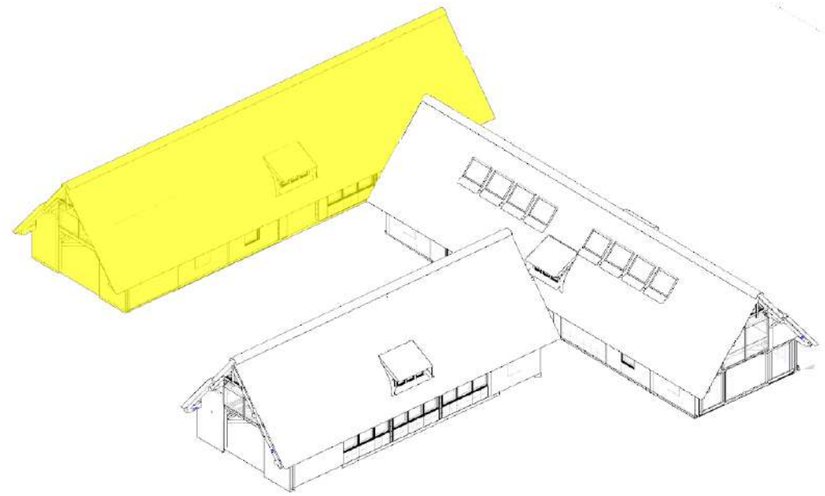


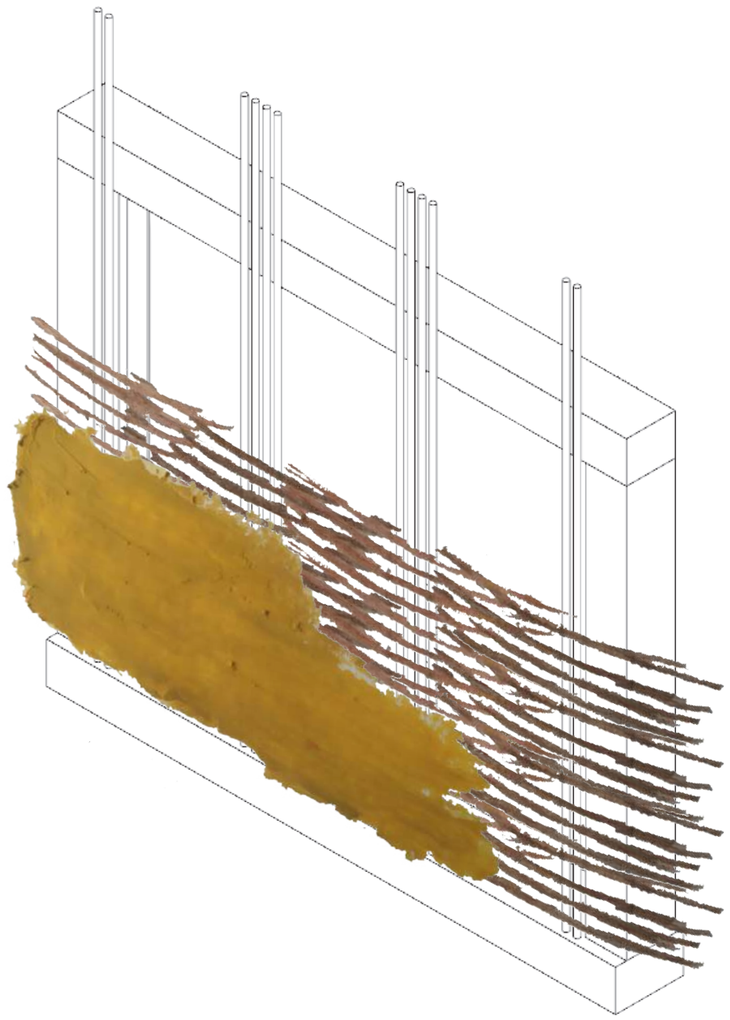
Part 3: design for a bio-based workshop

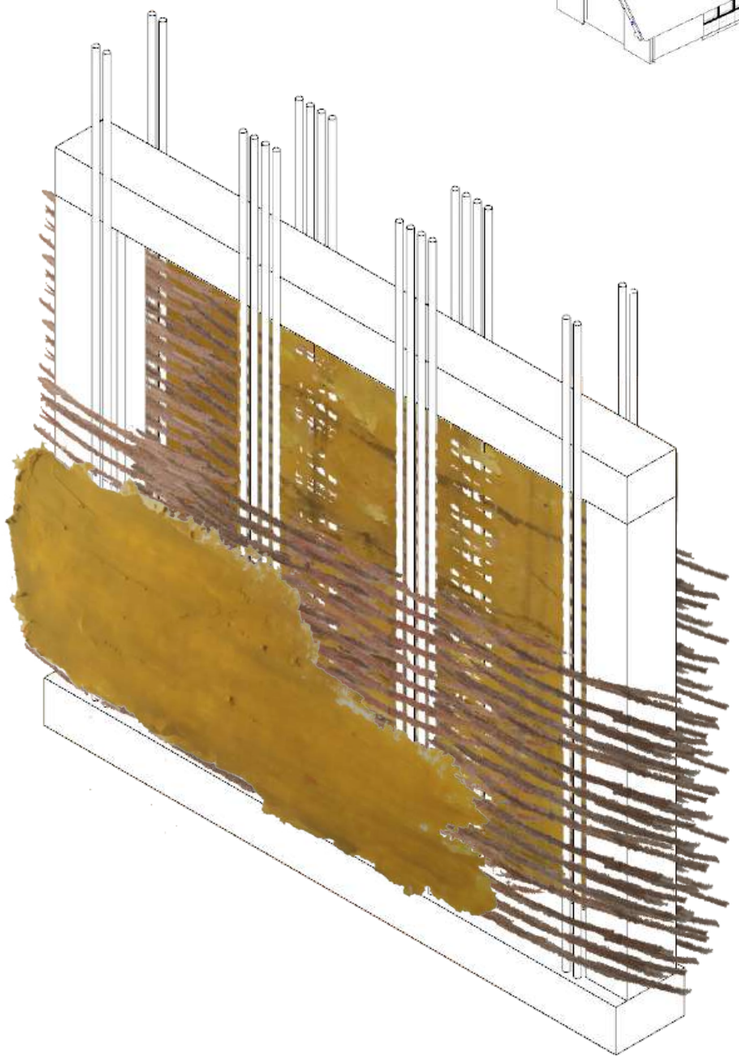
Natural resources

Shed facade: wattle and daub

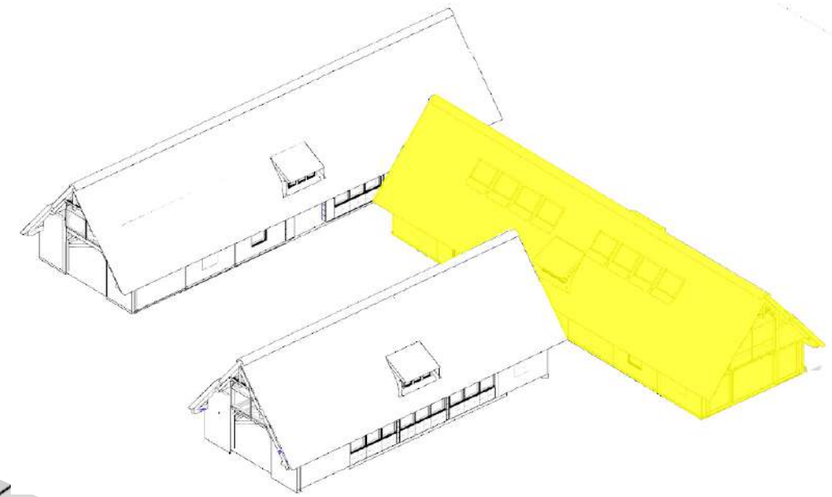
Wattle and daub: strong, durable, with the possibility to add insulation afterwards.







Main building facade: wood, straw and clay

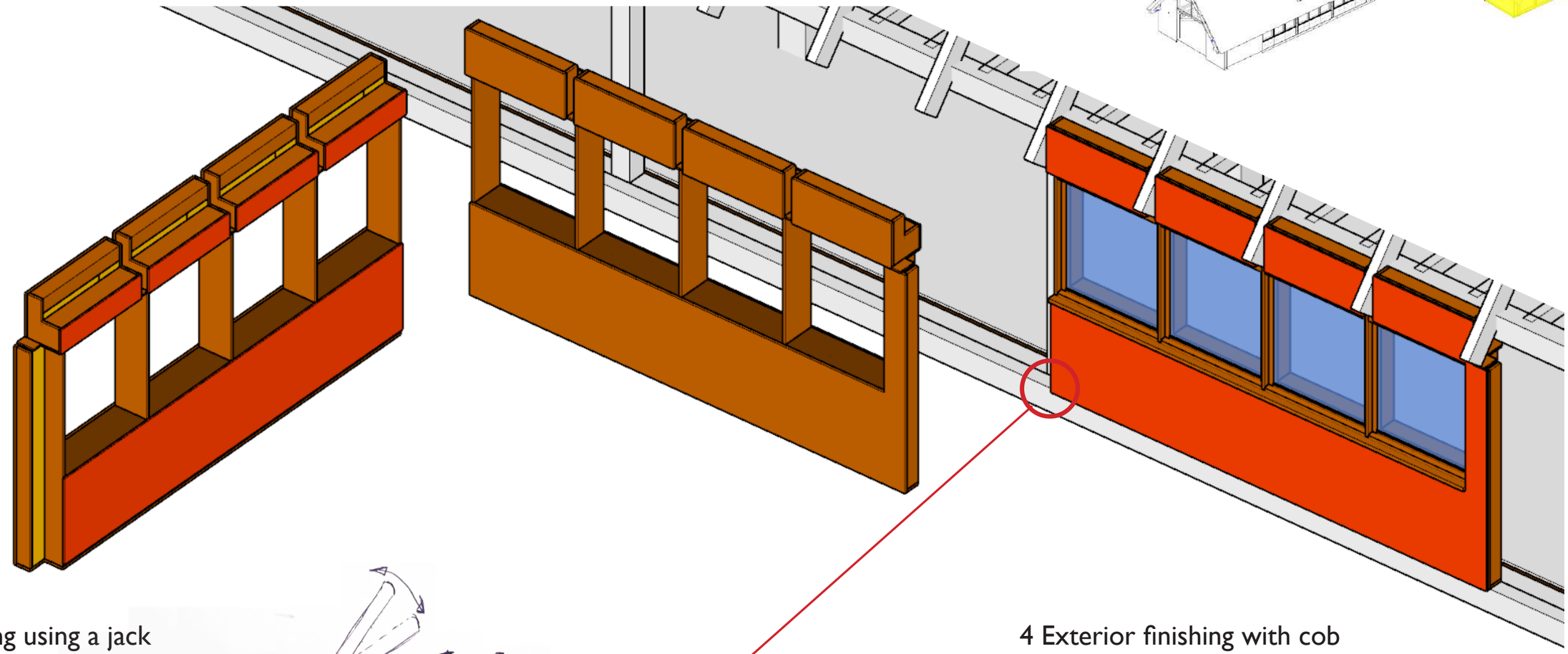


1 Prefabrication in the workshop

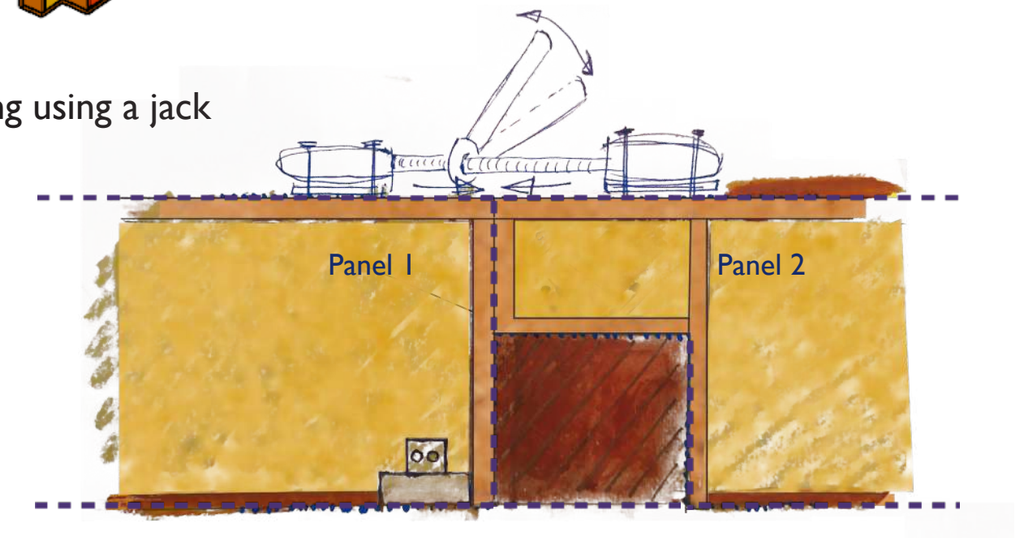
Wooden panel on the exterior side

Cob on the interior side

2 Mounting the panel

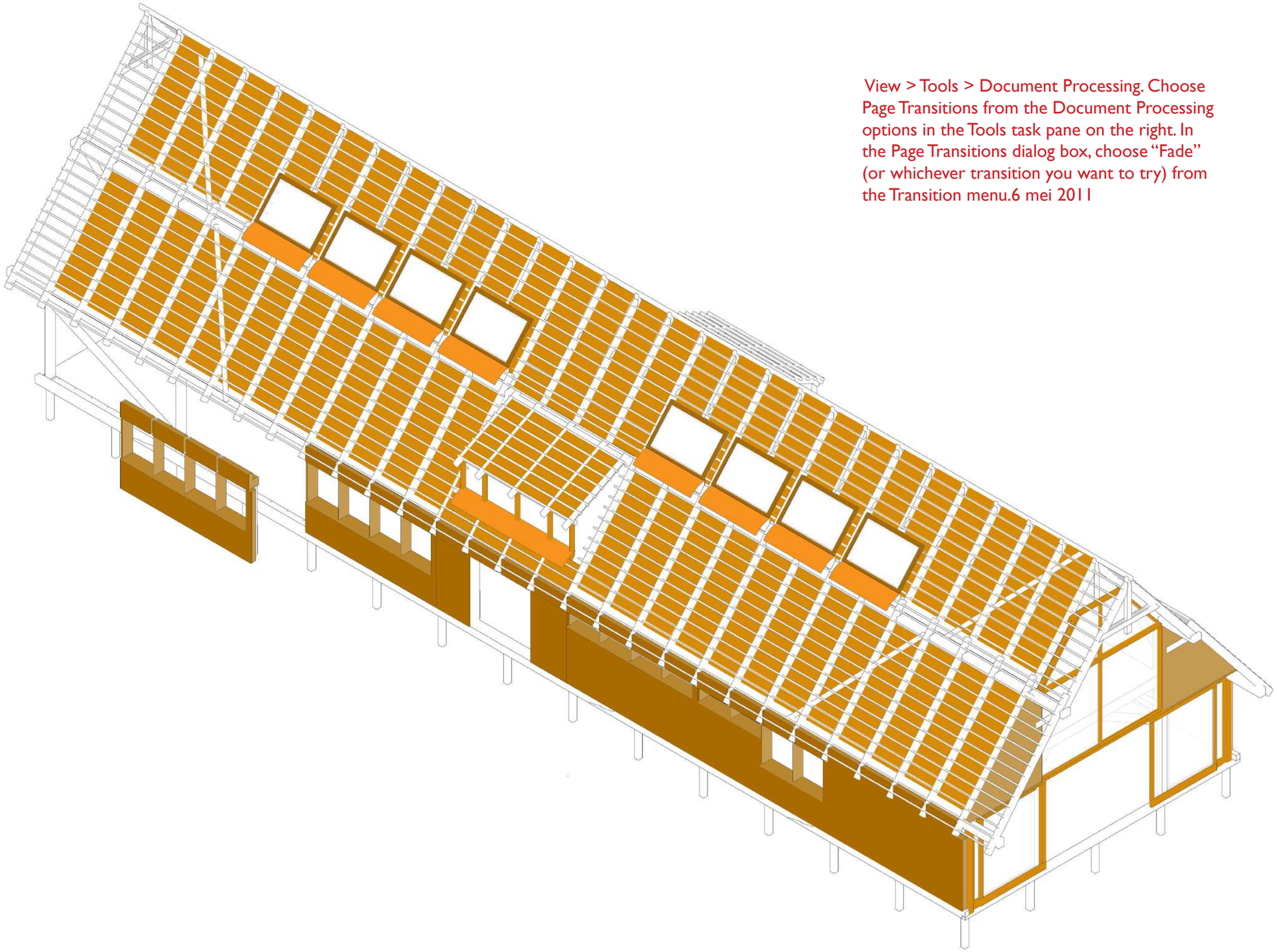


3 Fastening using a jack



4 Exterior finishing with cob

Floors, facade, roof panels



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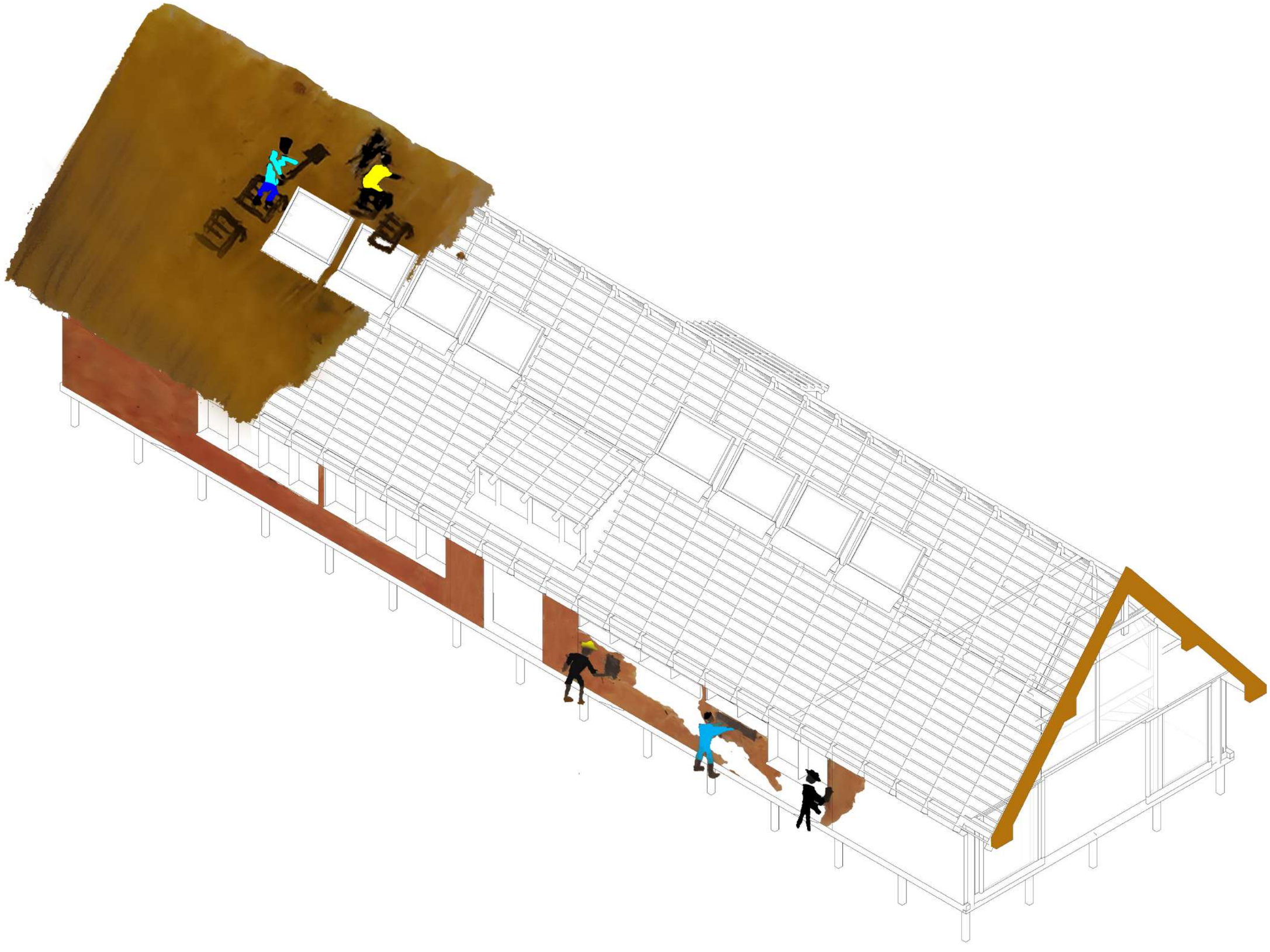
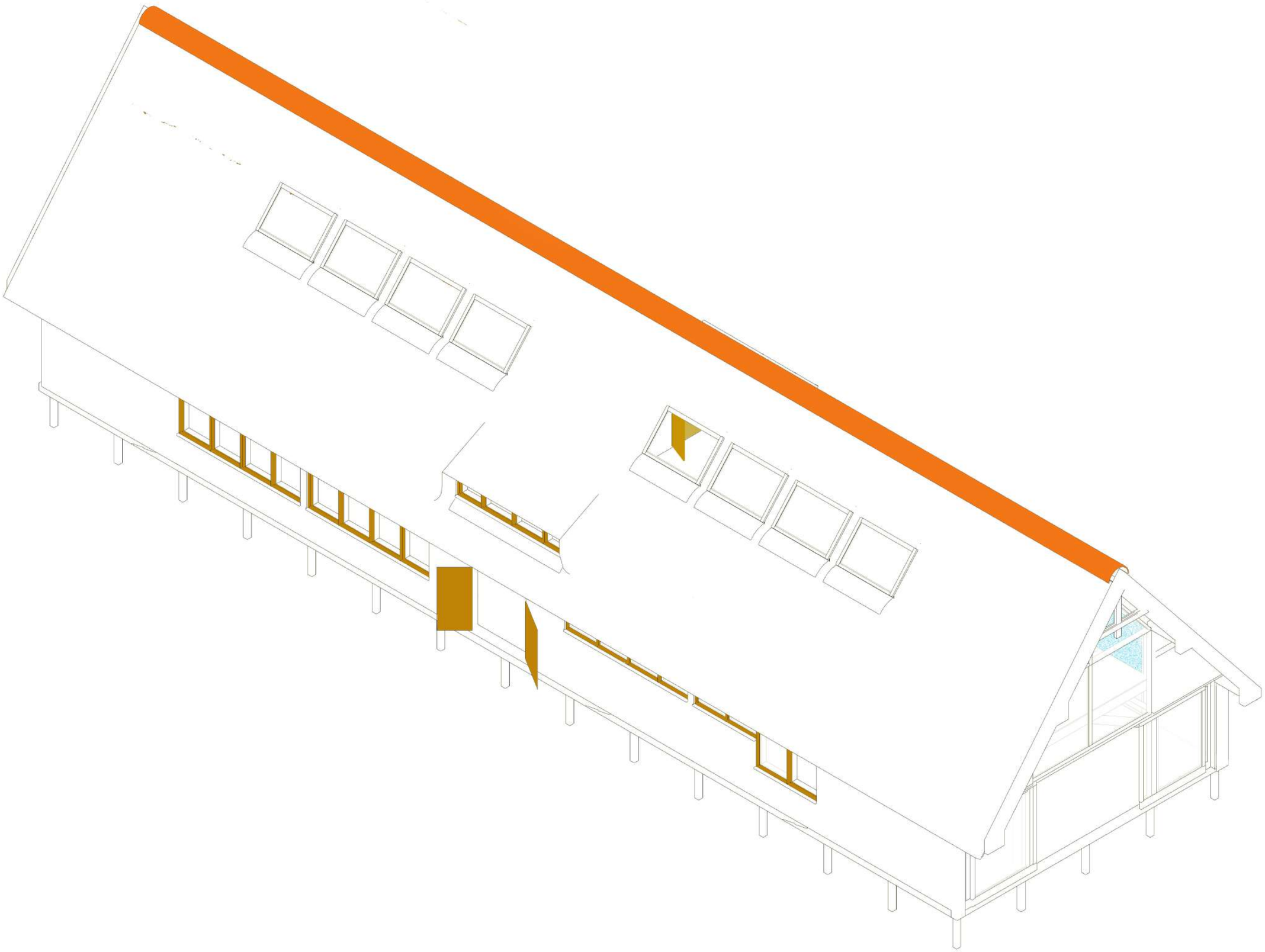
Reed thatching and facade finishing

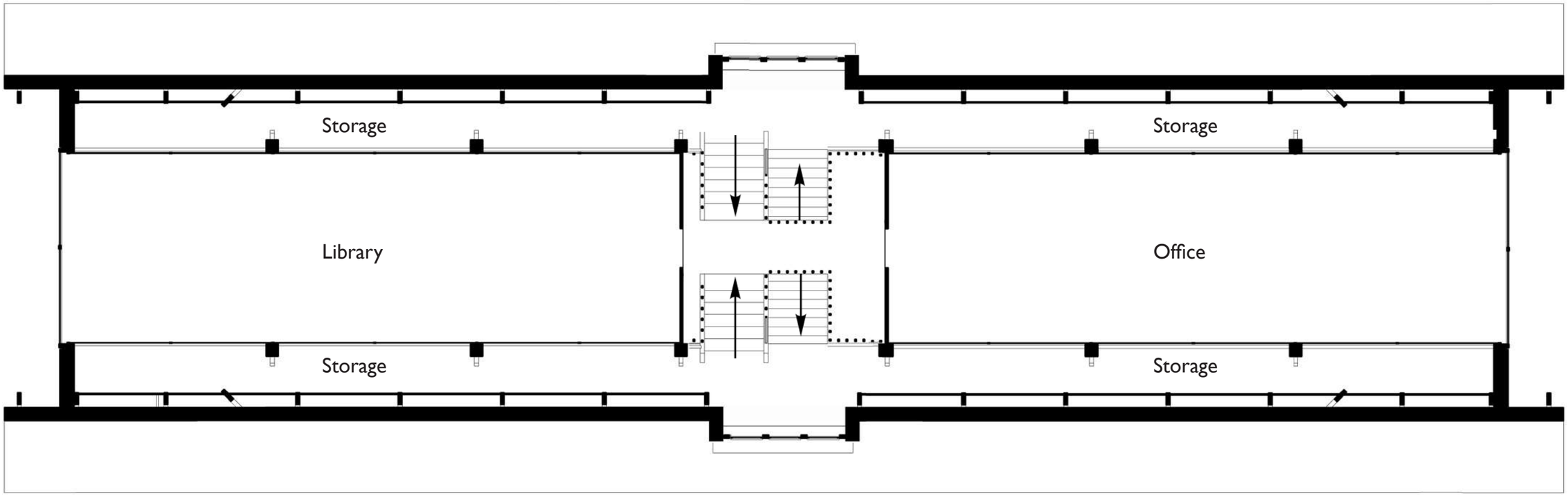


Interior walls, window frames



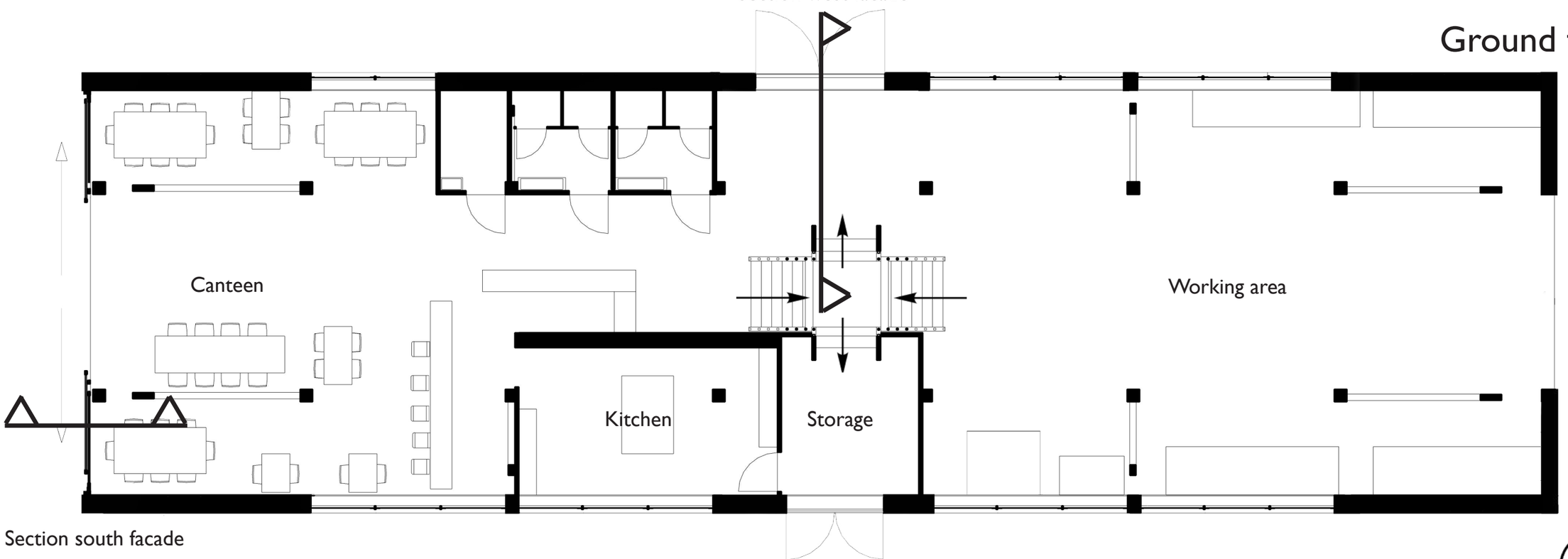
Floor plans

First floor



Section west facade

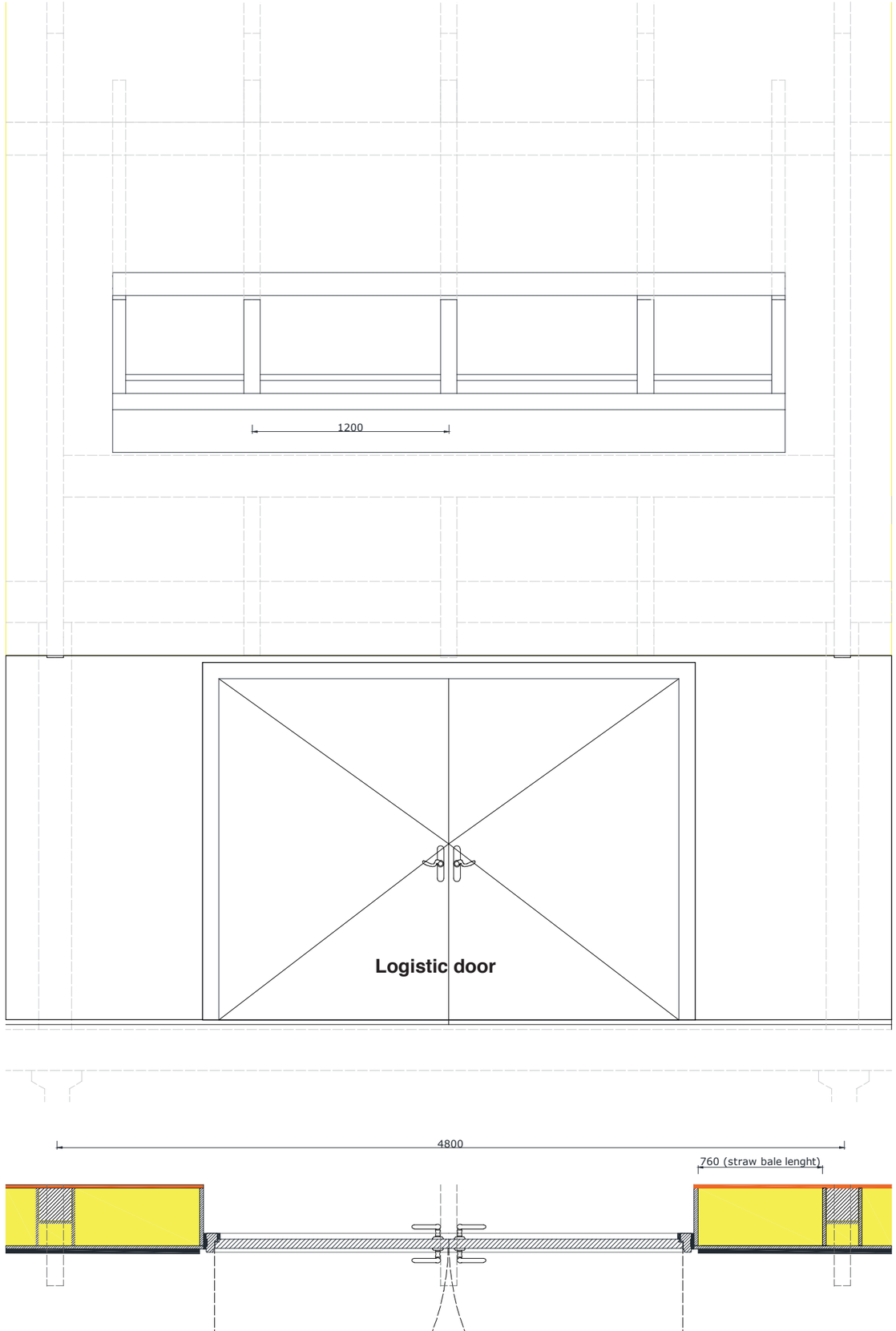
Ground floor

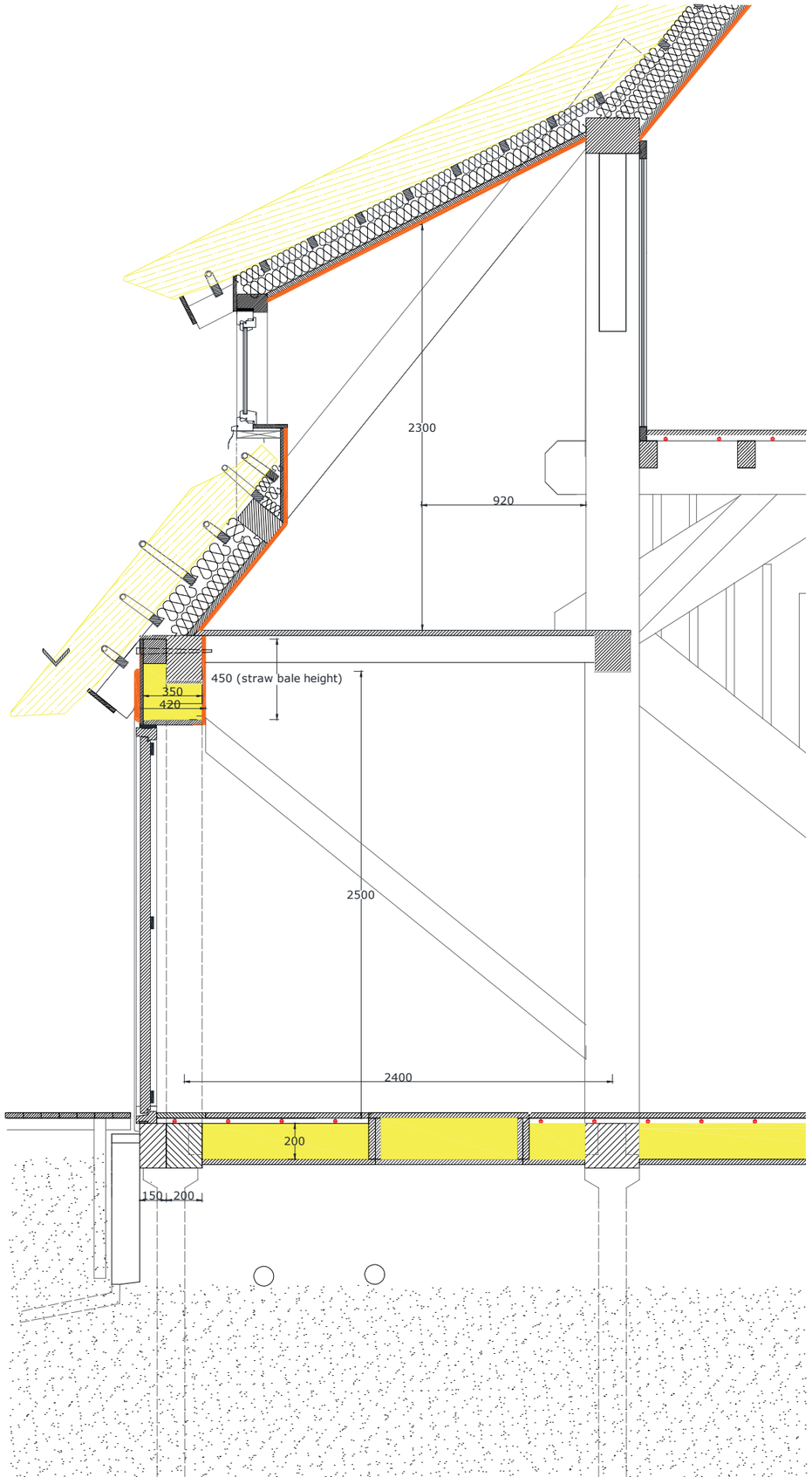


Section south facade

1:100

West facade





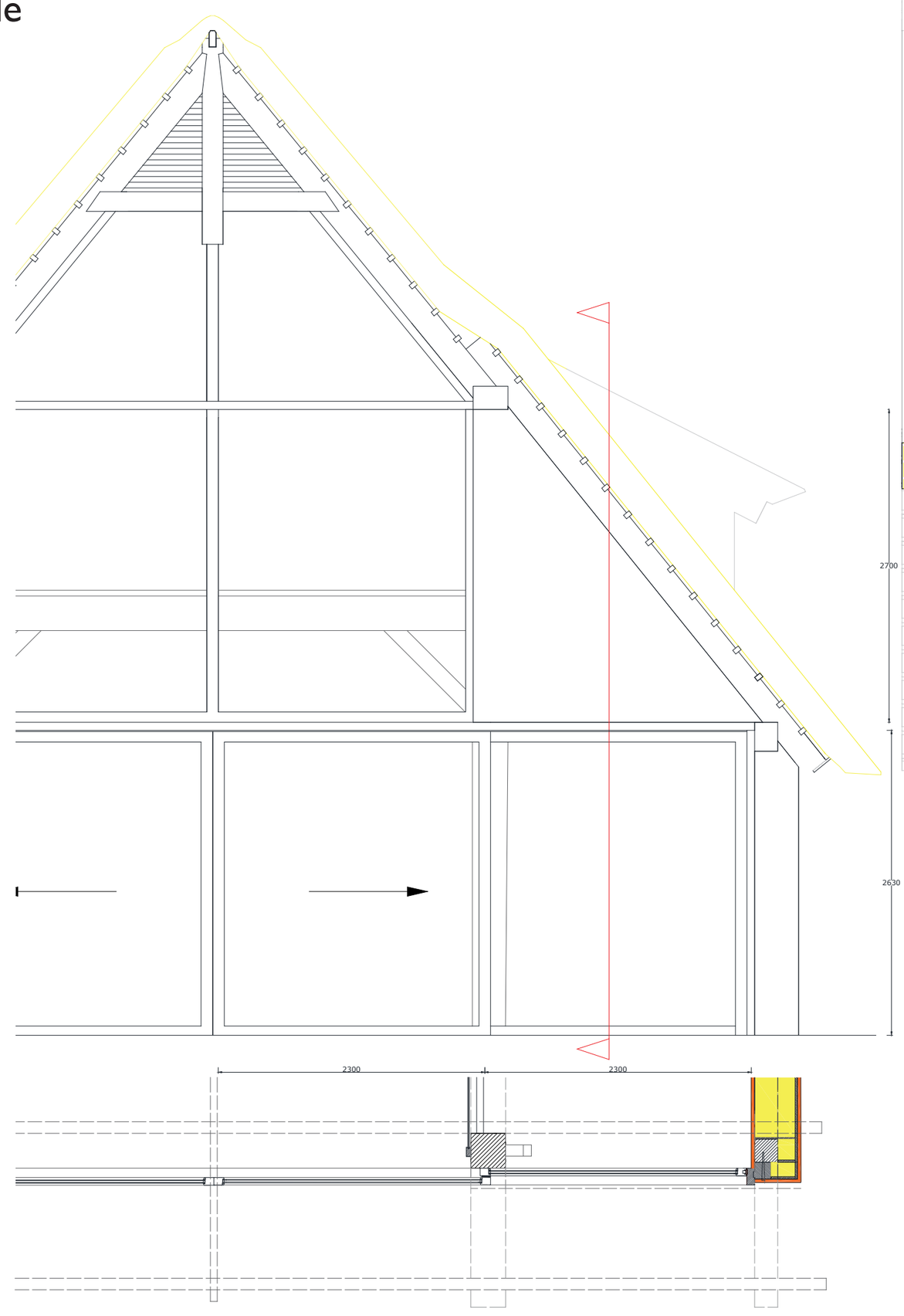
Roof (from outside to inside)

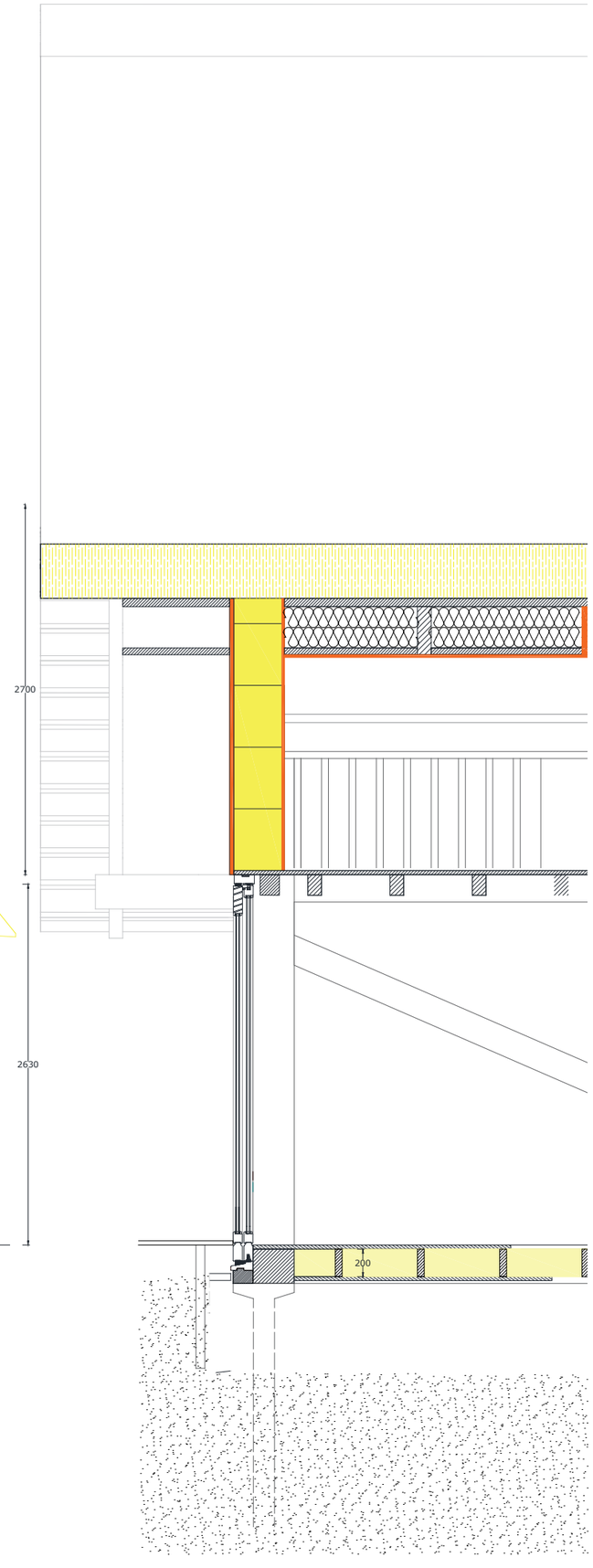
- Reed
- Wooden purlins
- Sheep wool insulation
- Wooden planks
- Clay cover

Floor (top down)

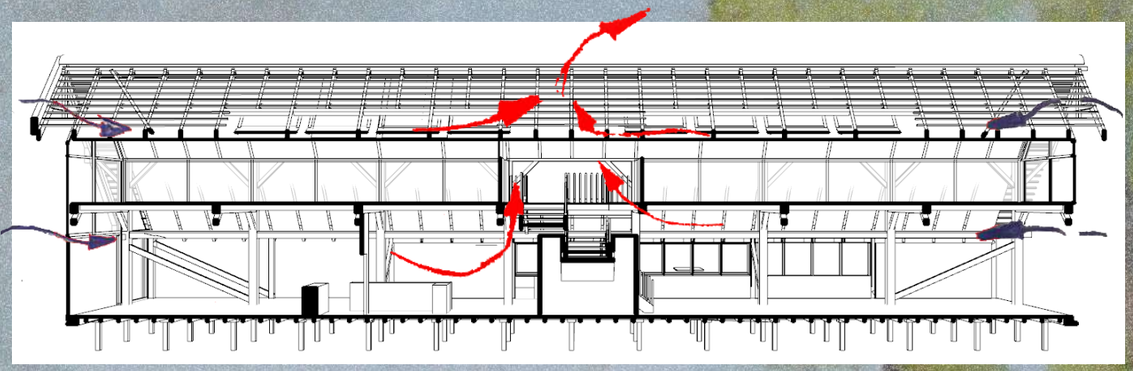
- Wooden planks
- Floor heating
- Floor panels (wooden planks, straw infill)
- Shutter
- Cawl space (water, electricity)

South facade





Climate section



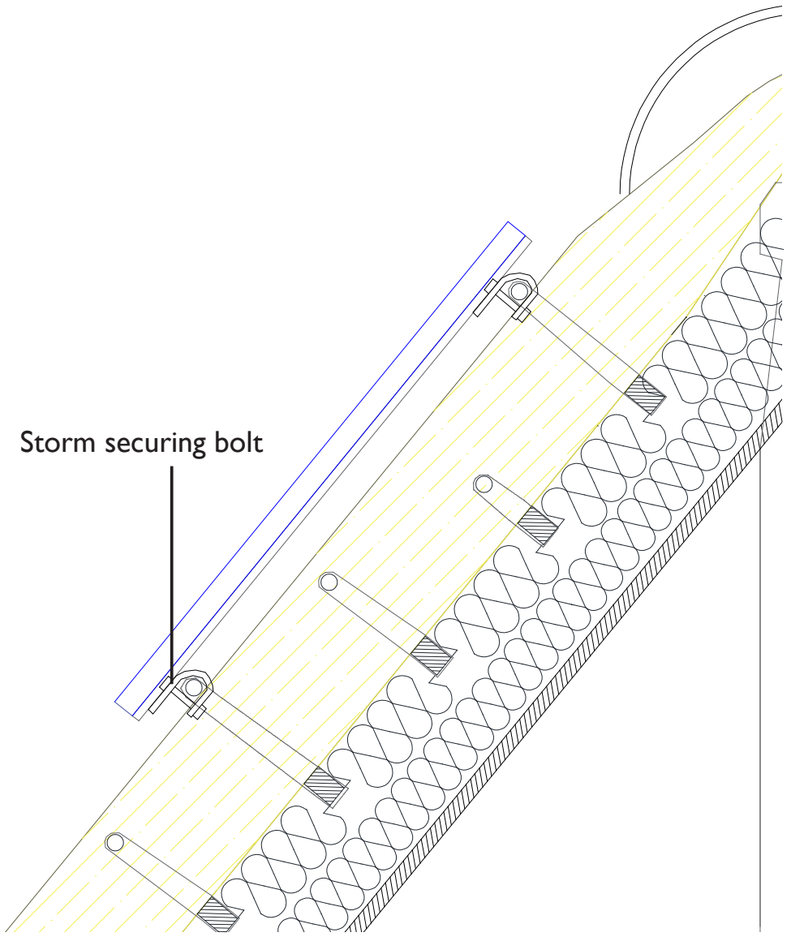
Wood working machines (mainly in use during daytime) and the kitchen are powered by solar panels (94 m2). During the evening the machines are powered by the net.

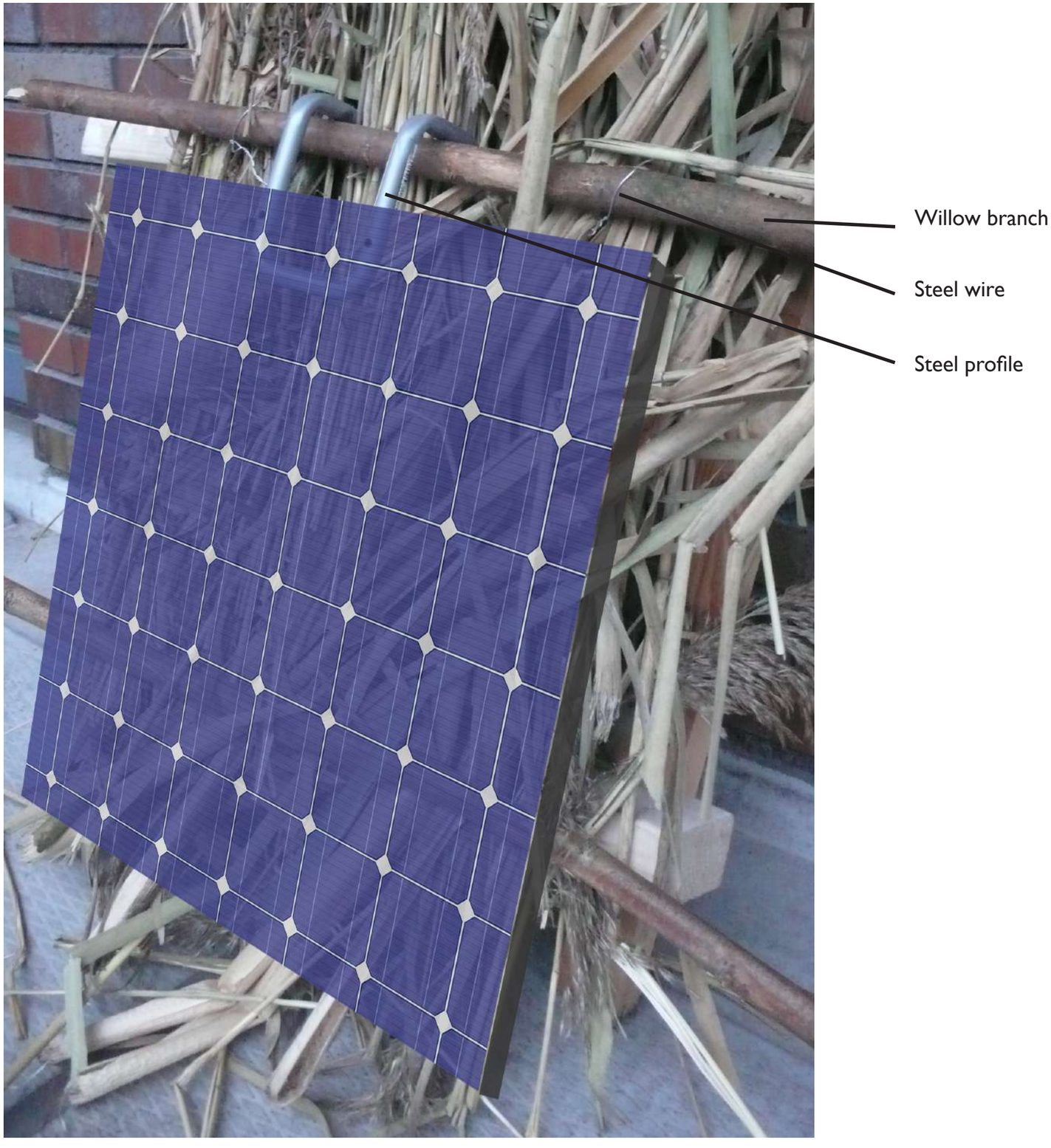
Floor heating is driven by a wood stove (30kW) that makes use of waste wood of the workplace.

Wastewater is stored beneath the building to infiltrate in the ground. Too much water can be disposed into a helofytes filter. Toilet water is harvested from this system.

Integration of solar panels

Solar panels are fastened using a demountable securing system.
Water is disposed in the same way as the rest of the roof.





Use of building materials

Wood

- **Heartwood** is used for all structural parts in the building, floors, stairs, the bottom part of the facade, and window frames.
- **Sapwood** is used for non-structural purposes: interior walls and roof finising panels.

Earth

- **Cob** is a mixture of clay, sand, water and reed. It is spread over floors of the usage spaces (integrating floor heating) as well as used for finishing the roof panels and interior walls. Before application the mixture needs to be tested. For making facade exterior finishings cow dung is added for better cohesion.

Straw

- **Reed** is harvested once a year and is on the roof and facades. Harvested reed on the building site is sufficient to suply maintainance to the roofs. Reed is also used for facade and ground floor insulation. Roof insulation can be made from rolls of reused coton which are easier to apply, but if not available straw packed in wooden boxes can be used as well.

Material use wooden frame vs CLT (m3)

	Wood	Straw	Clay
Frame	210	654	15
CLT	431	400	15

Overview


Straw storage
Builder's workplace
Workplace
Library
Wood storage
Public workplace
Main building
Office
Storage building
Canteen

Impression plot use

Impression south facade

Conclusion

Producing the buildings on the site itself,
With materials very close by,
And a fast production by using machines and making prefab panels