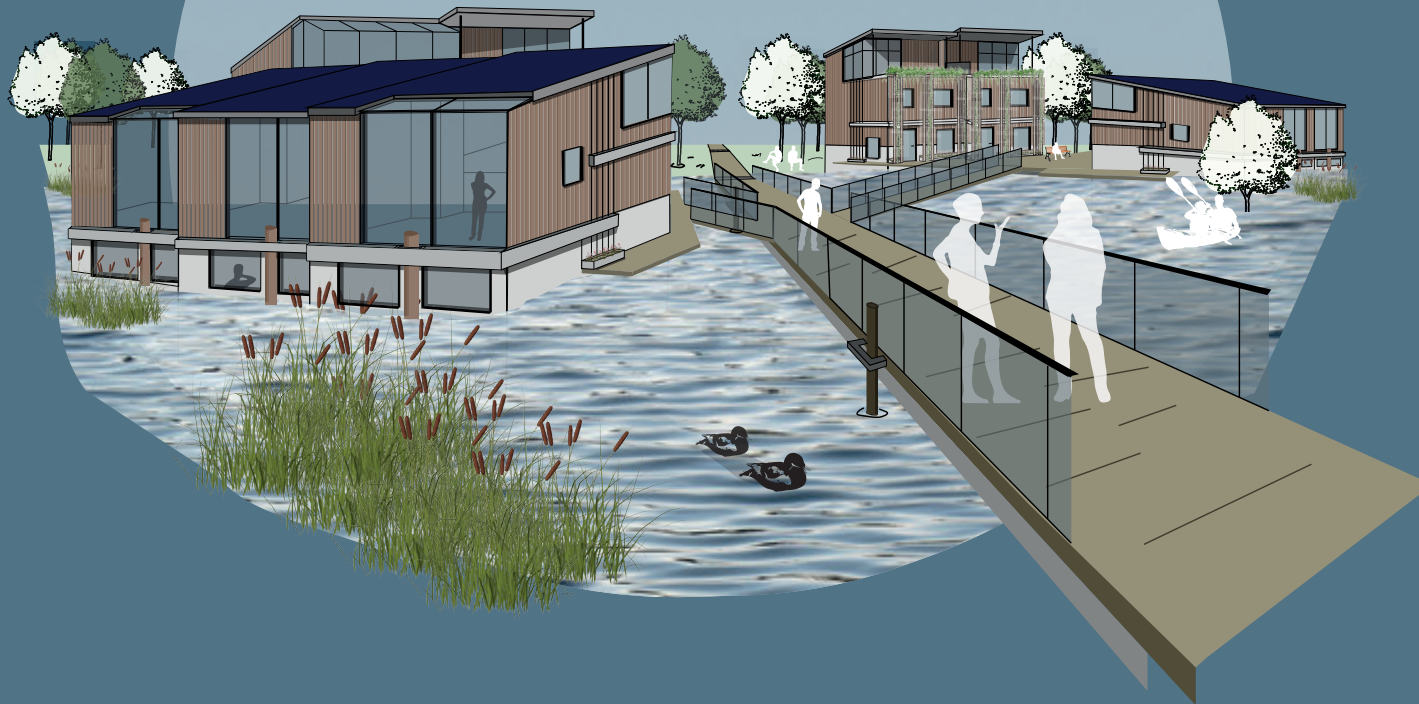


Flood-proof living at the riverside

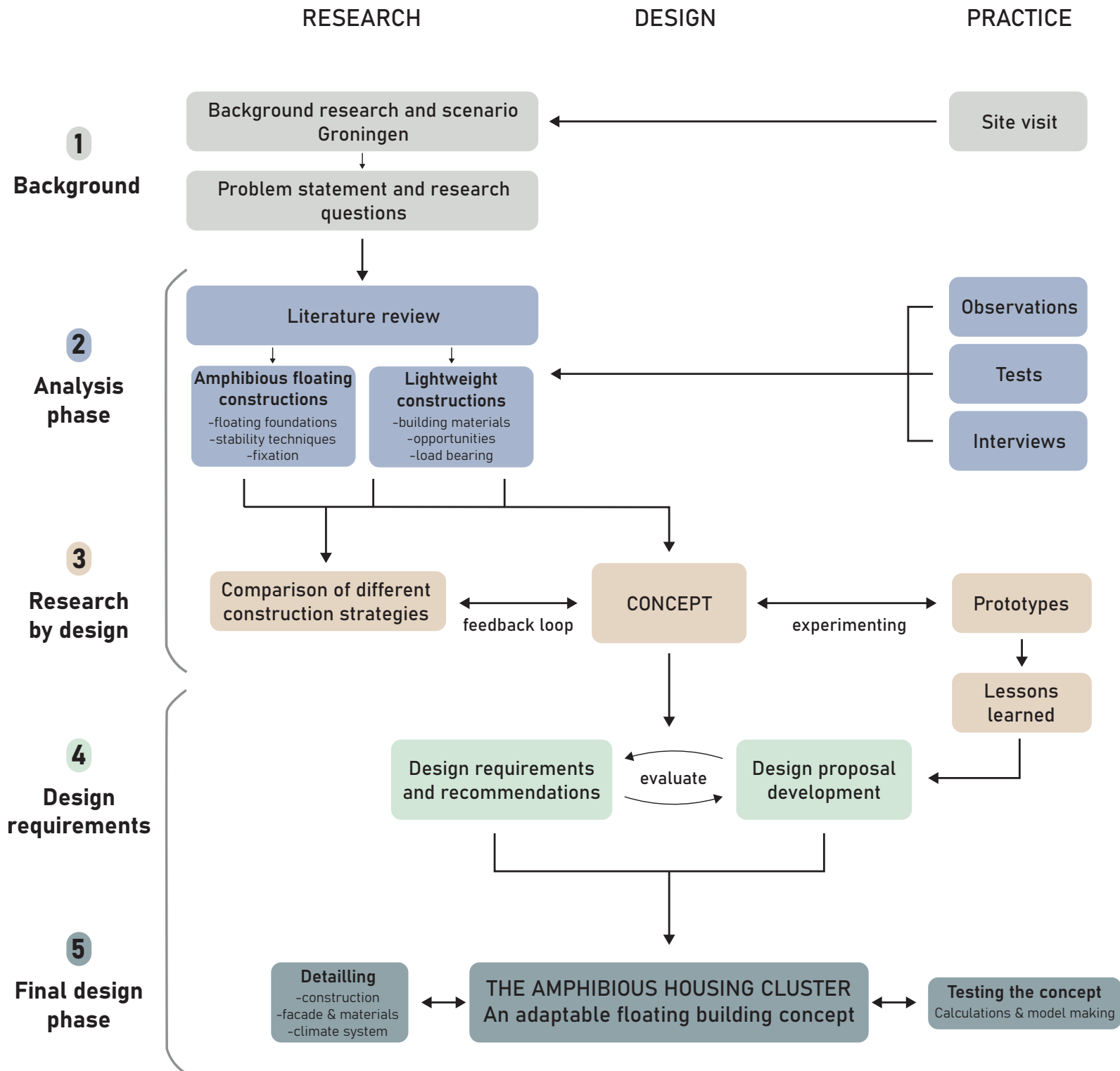
The future of amphibious housing in adaptive and dynamic neighborhoods





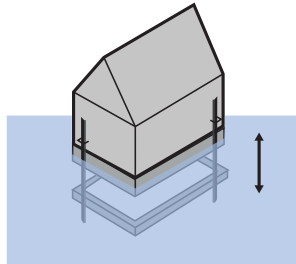
📍 Dordrecht, NL
Source: Knobbe, C., 2020





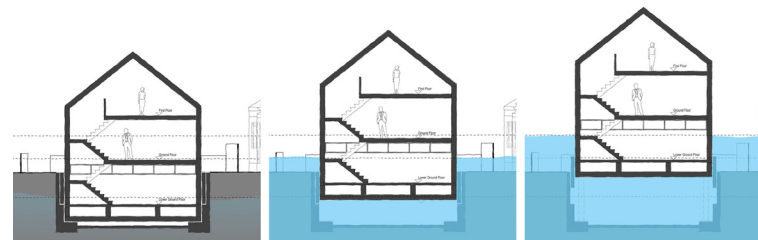
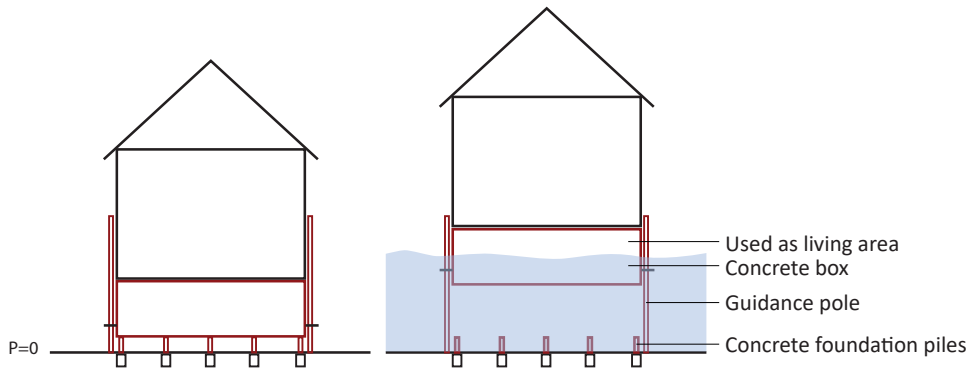
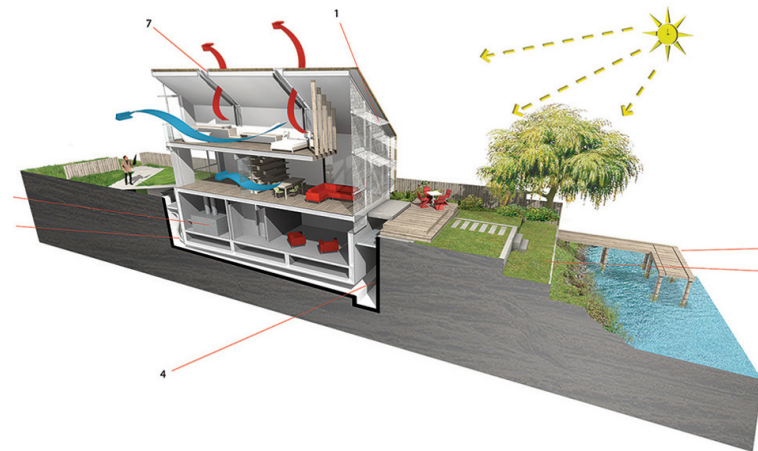
“How can buildings effectively adapt to fluctuating water levels in Dutch polder landscapes by incorporating an amphibious foundation and a lightweight construction?”

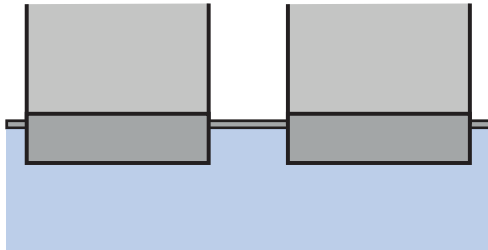
The solution for living in riverside areas



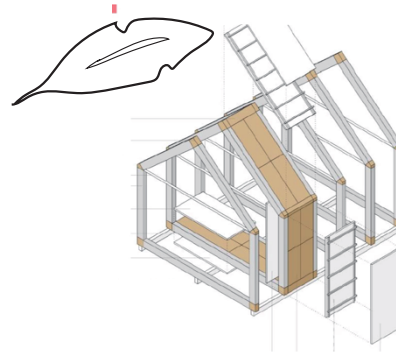
Amphibious building;
only floats during floods

Reference of amphibious house in UK





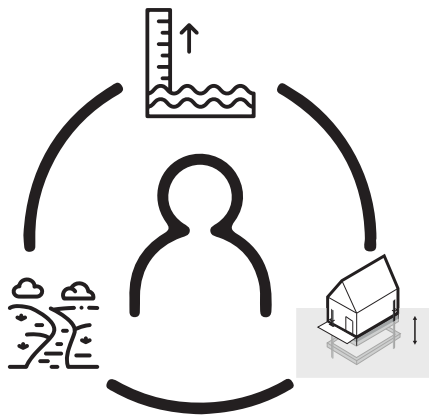
Floating pontoon basement



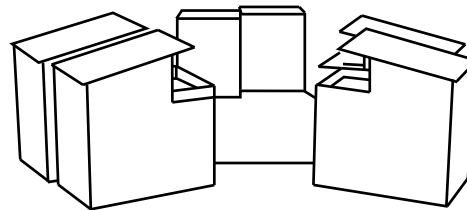
Lightweight building material



Accessibility



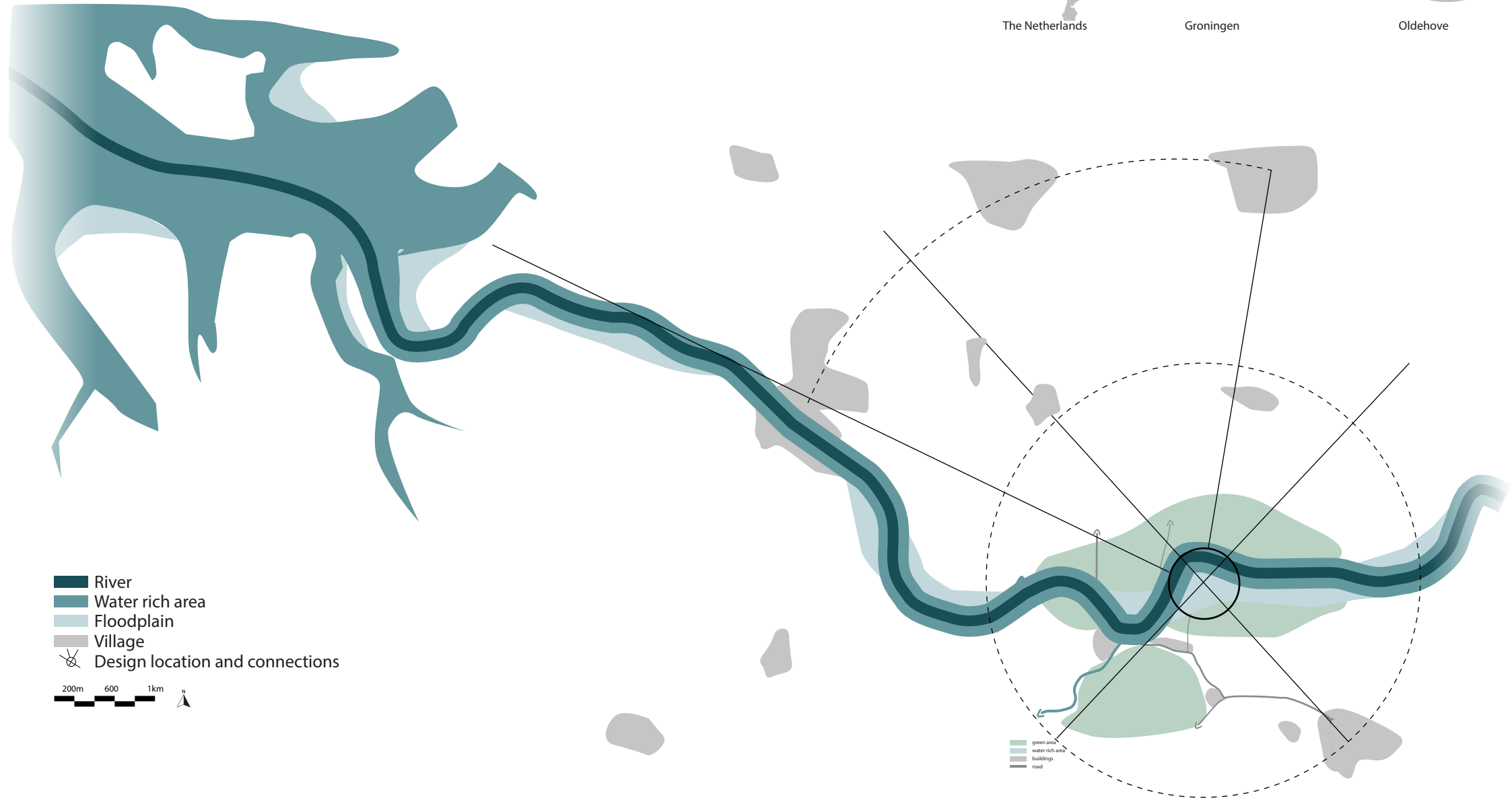
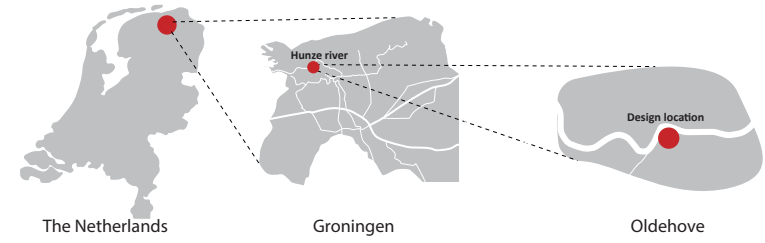
Experience water level fluctuations

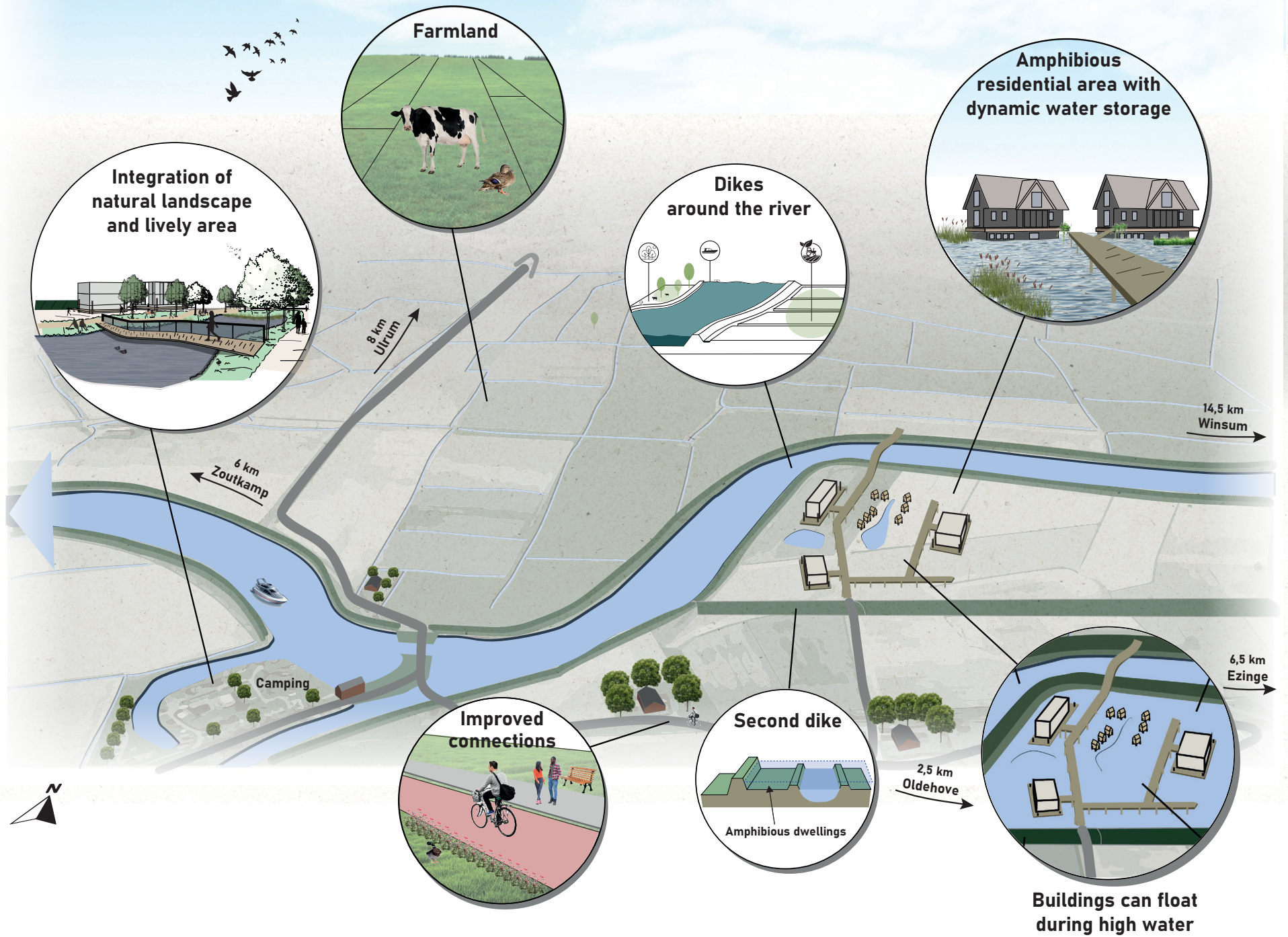


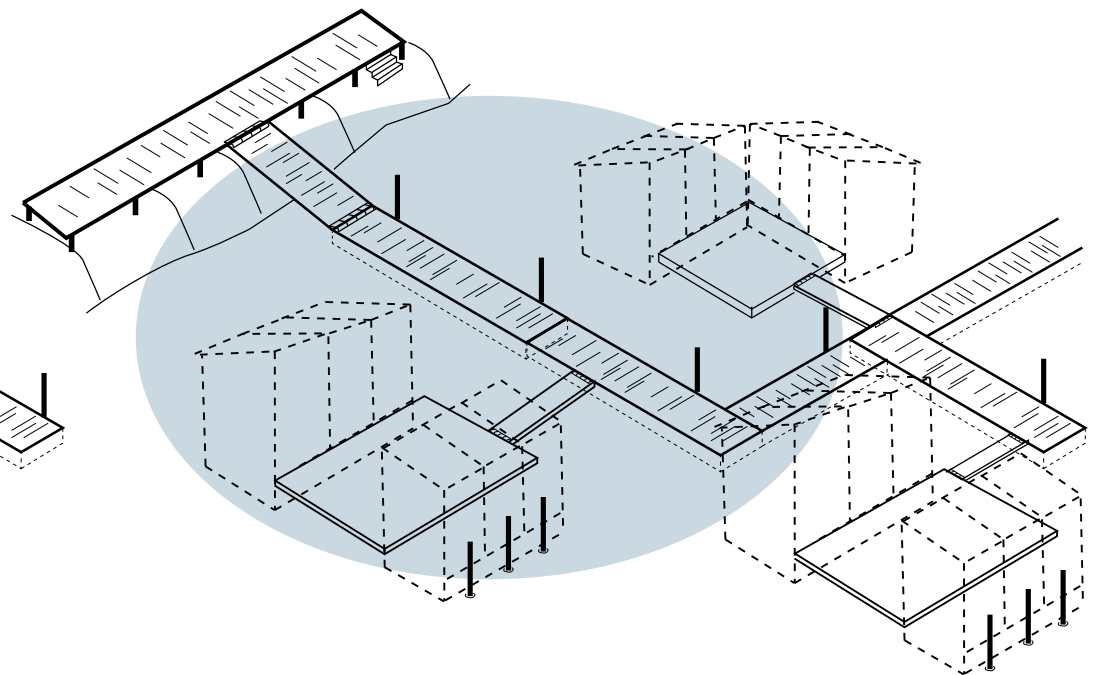
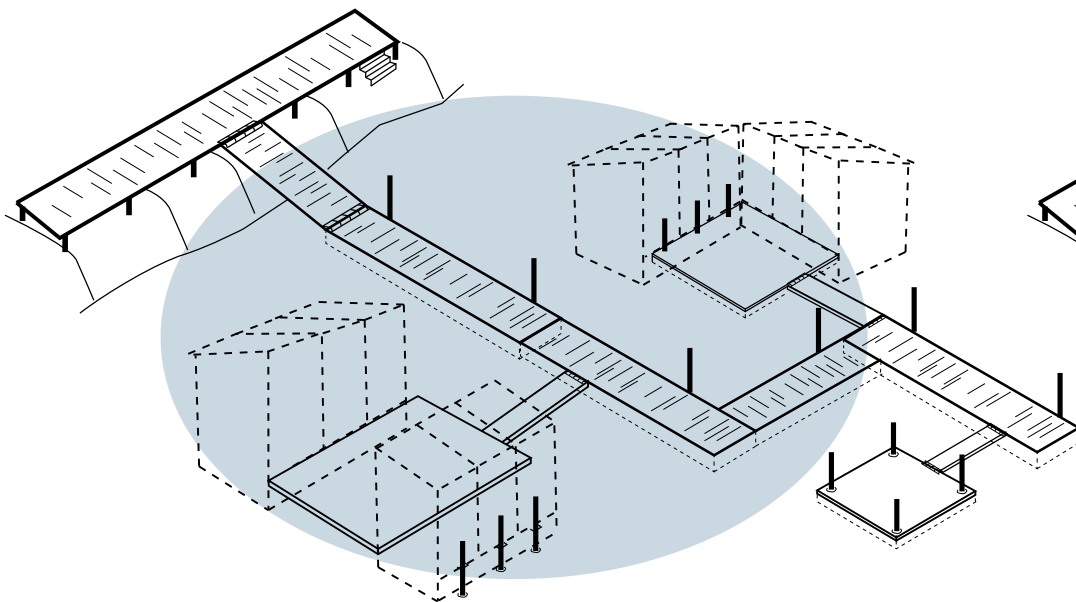
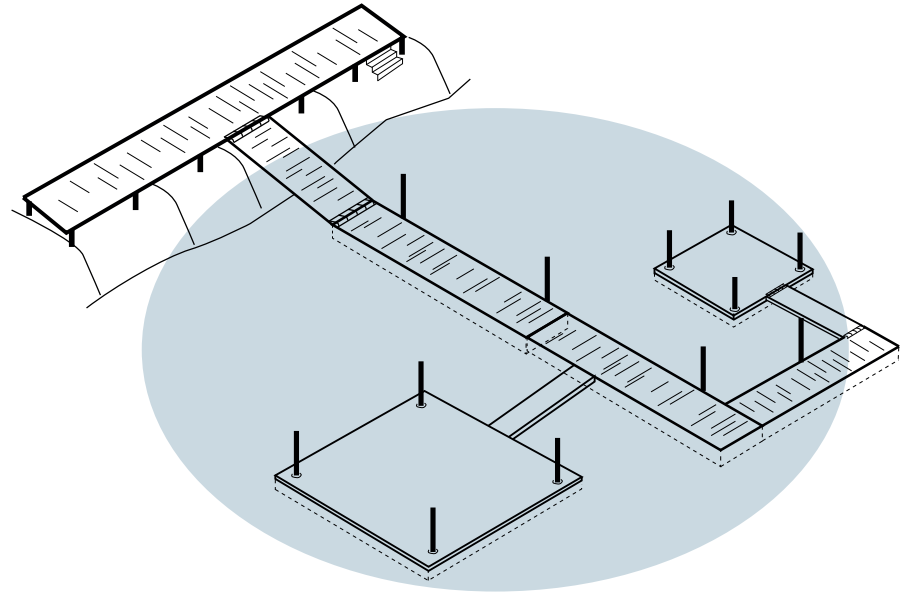
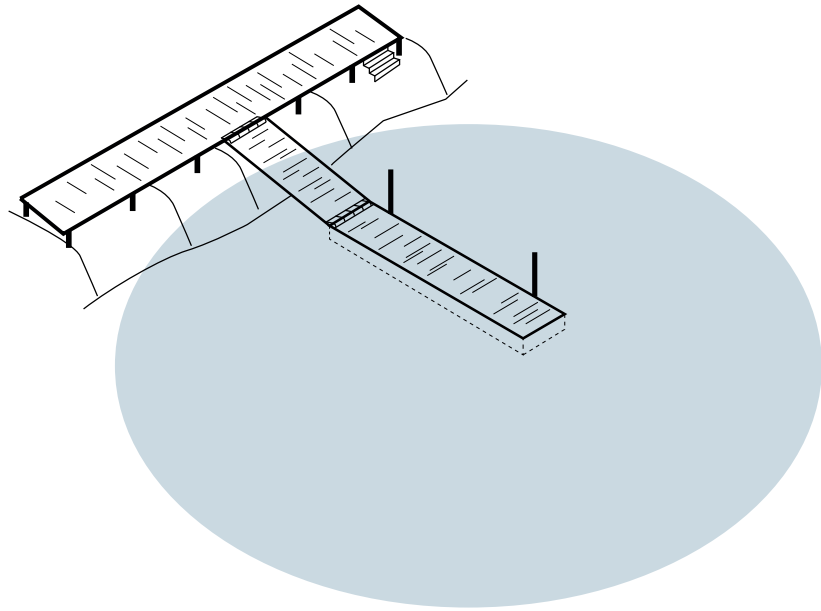
Housing clusters

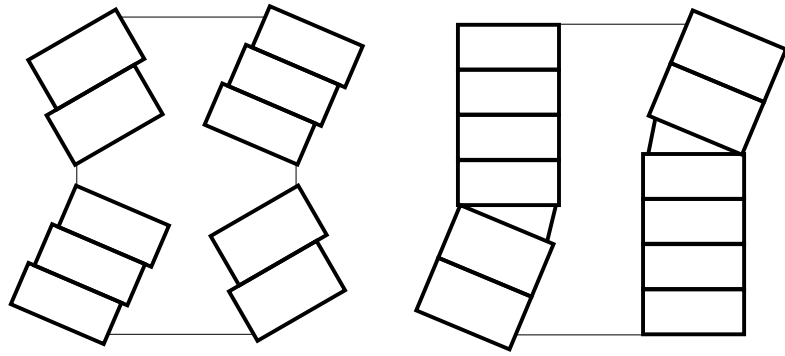


Off-grid buildings on a large scale

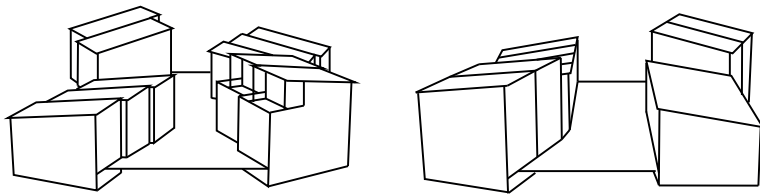
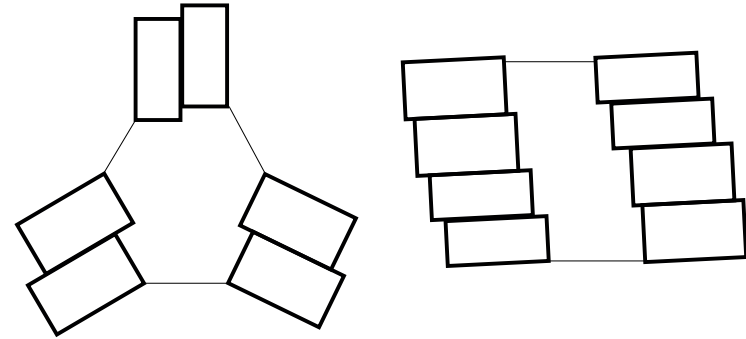




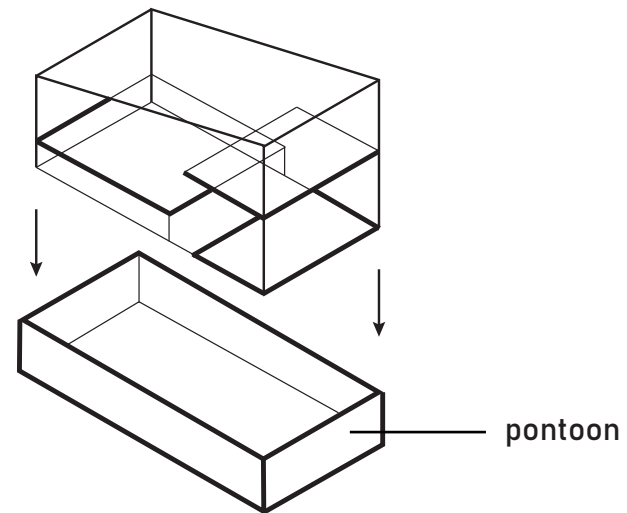
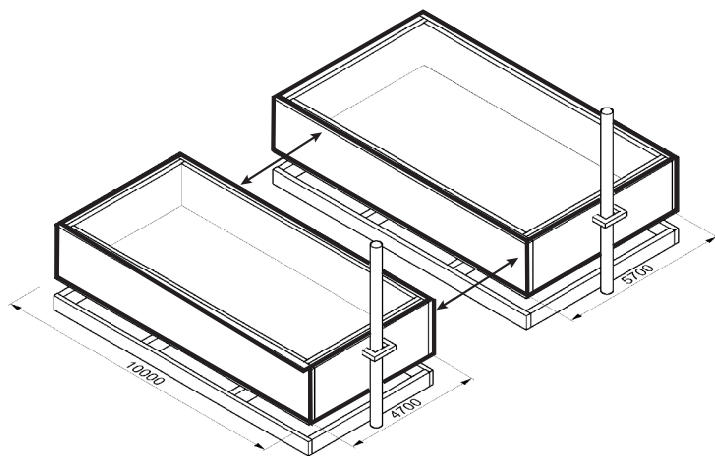
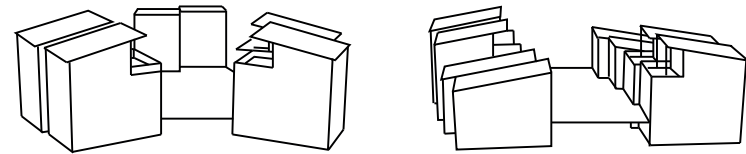




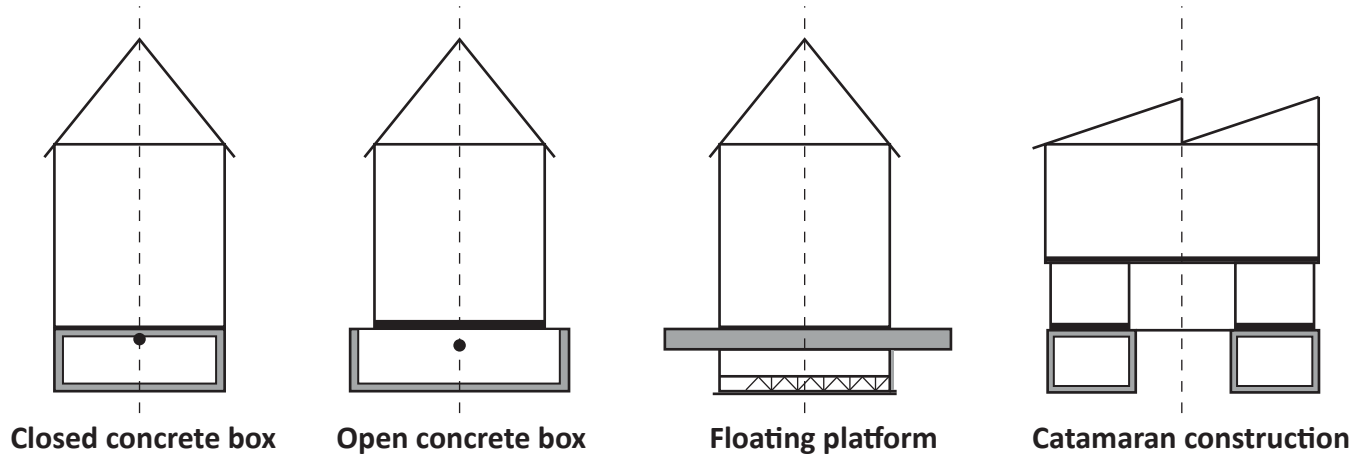
Floorplans



3D views

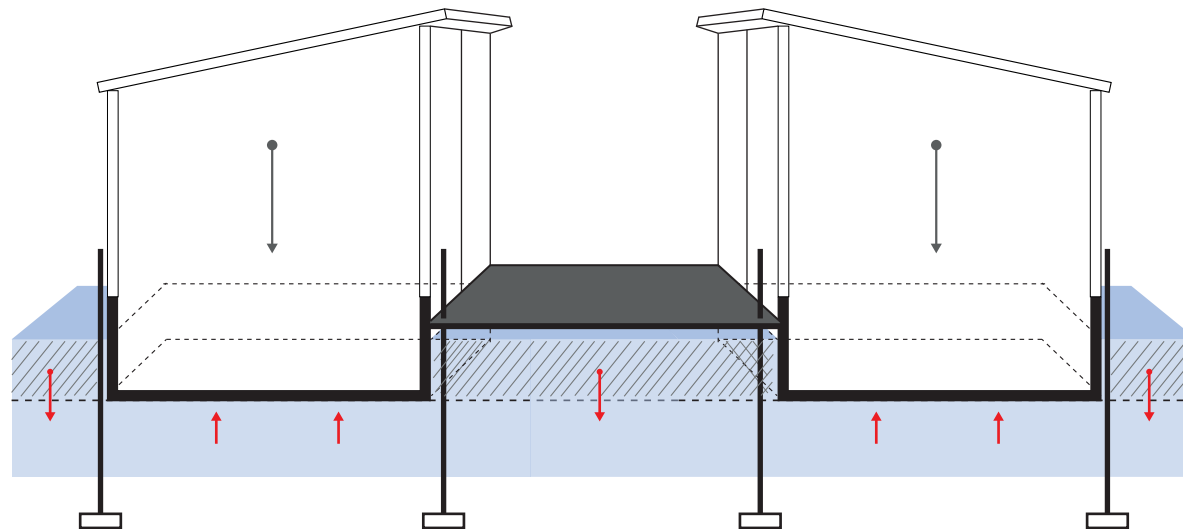
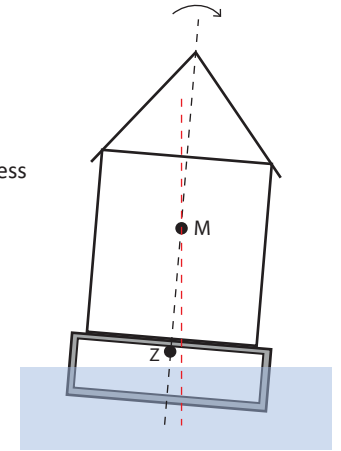


Conclusions from research:



● = core of stability
Higher core of stability means possibility for a heavier building, but a less stable construction

$$F_{\downarrow} = F_{\uparrow}$$

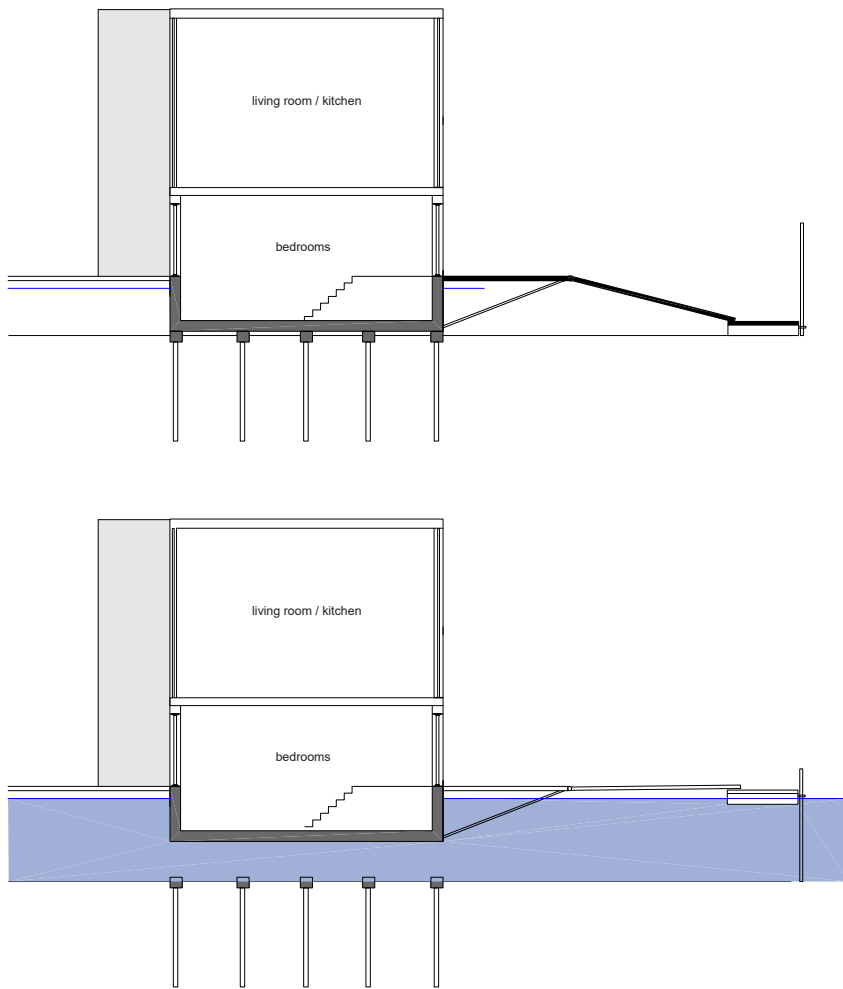


Final design

Combination of catamaran construction and open concrete boxes for maximum stability

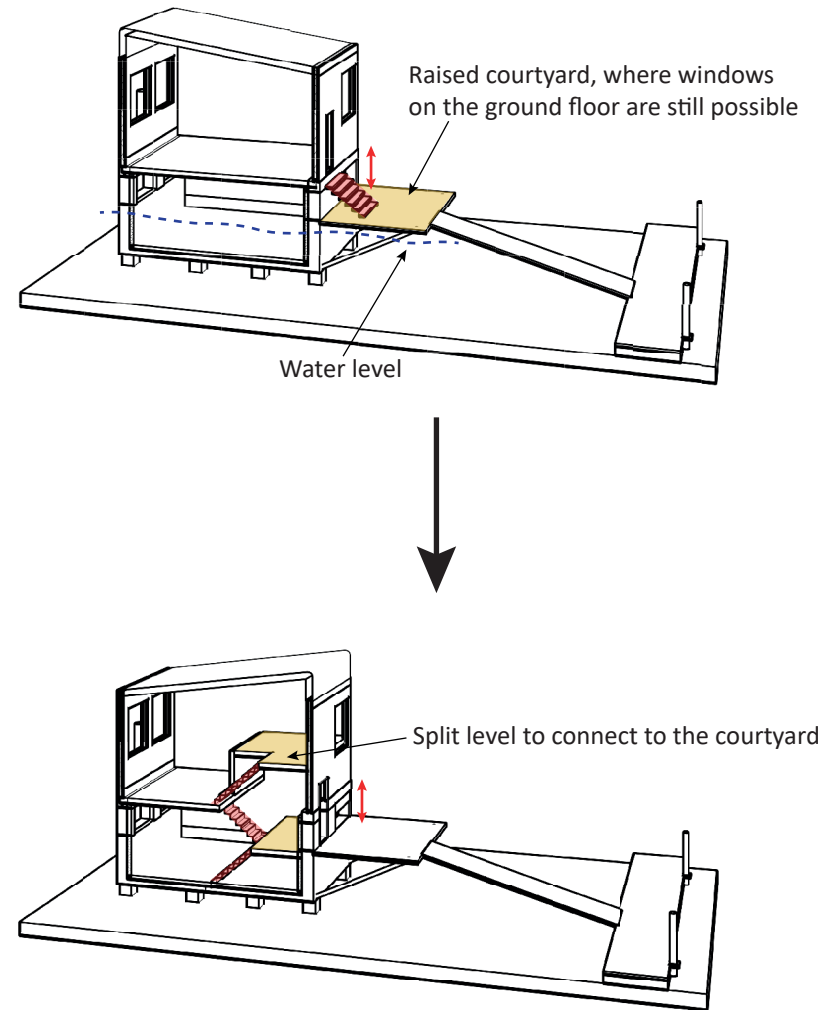
Reverse living --> bedrooms in the pontoon

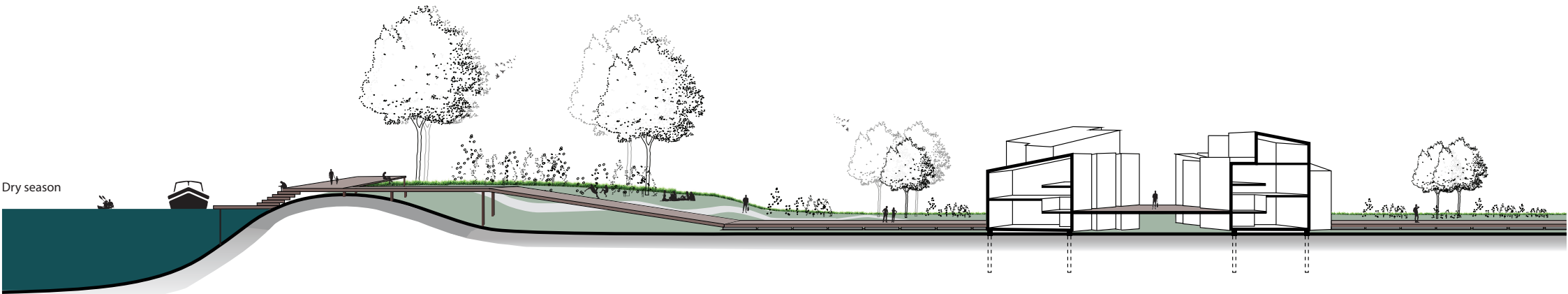
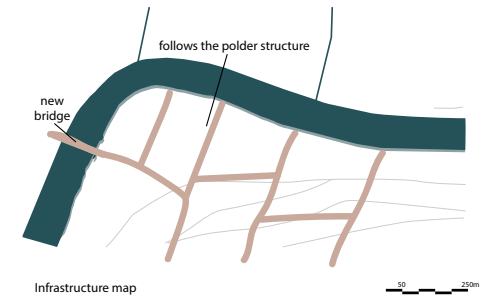
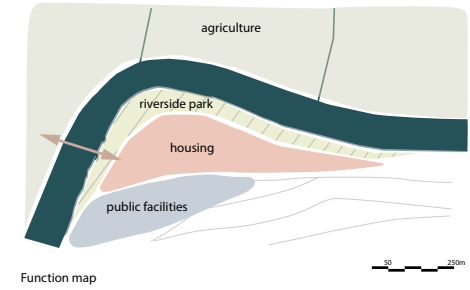
Decking will float along by high water

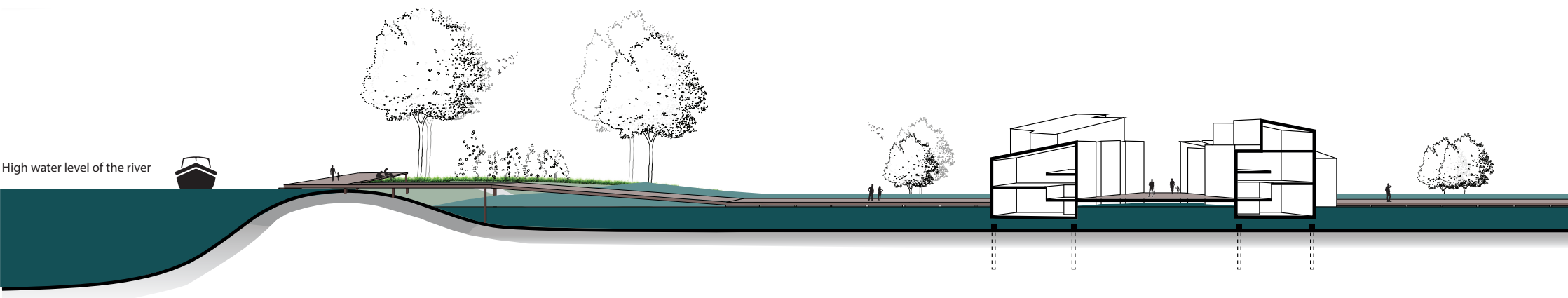
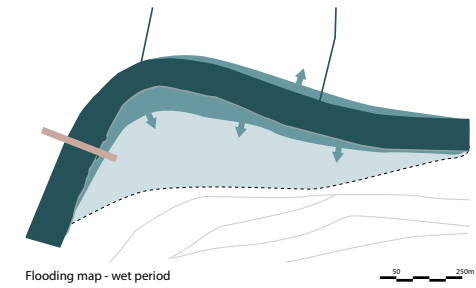
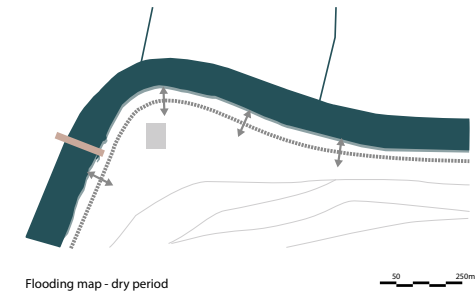
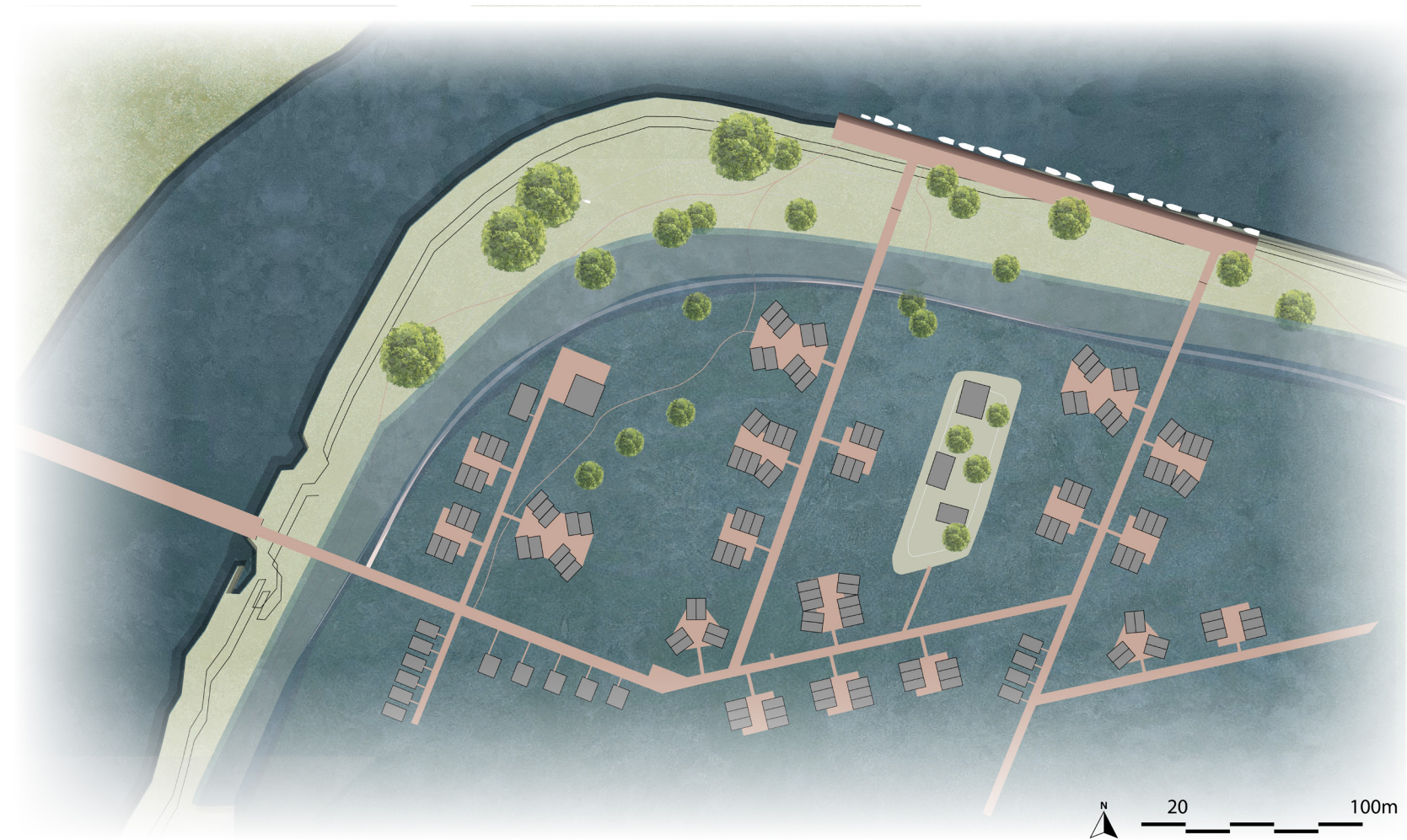


Amphibious housing --> split-level design

Overcoming the height difference inside vs outside the house










Let's have a walk through this amphibious village...
We start at the Reitdiep river!

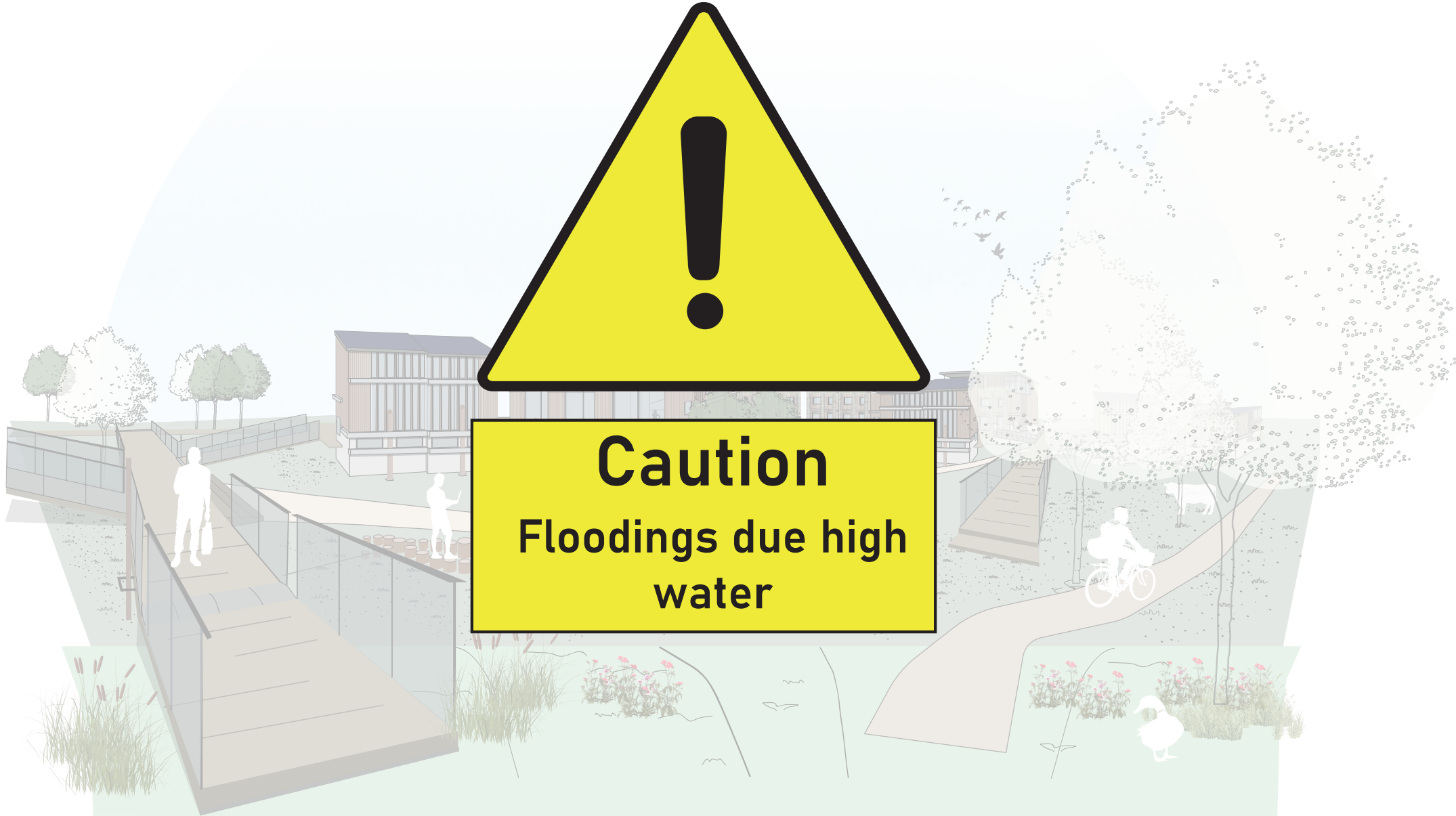



 The houses here clearly integrate as guests in the landscape
But why do these houses have elevated entrances and inner courtyards?





Caution
Floodings due high
water



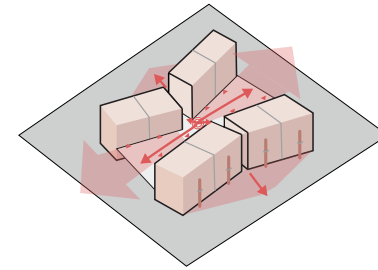
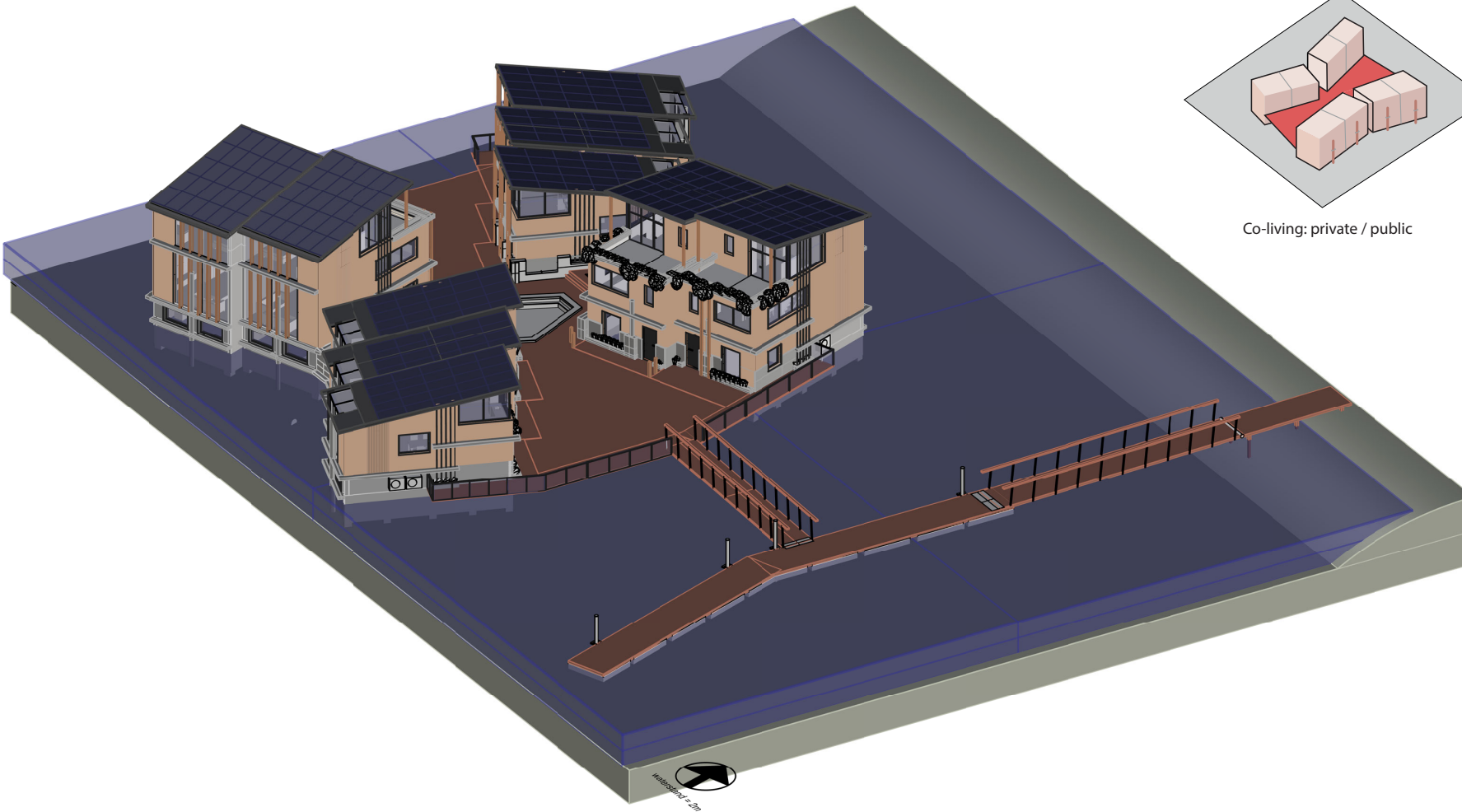
 ... no problem! That's what the neighborhood is intended for!
The buildings and deckings start to float and a whole new landscape arises



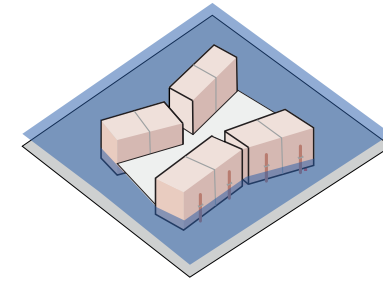


Fortunately, our cluster has a courtyard which also started to float, so we can still sit outside in our dry garden and enjoy the view over the water!

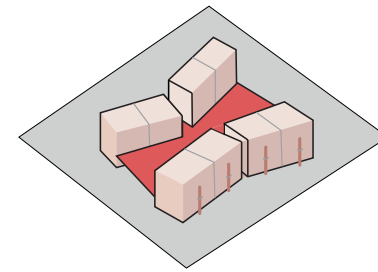




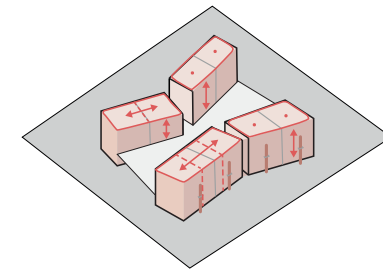
Flows and sightlines



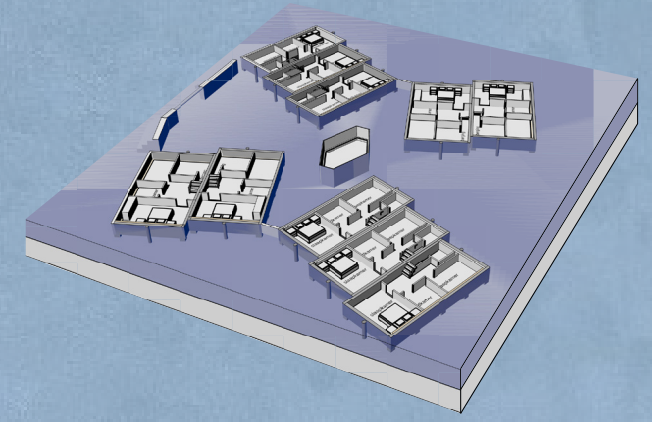
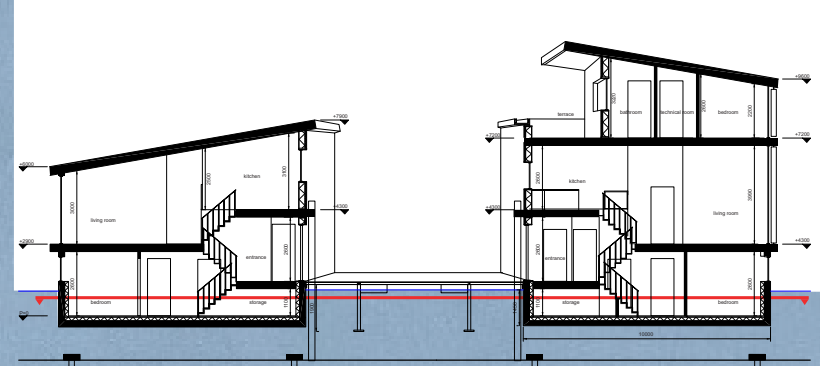
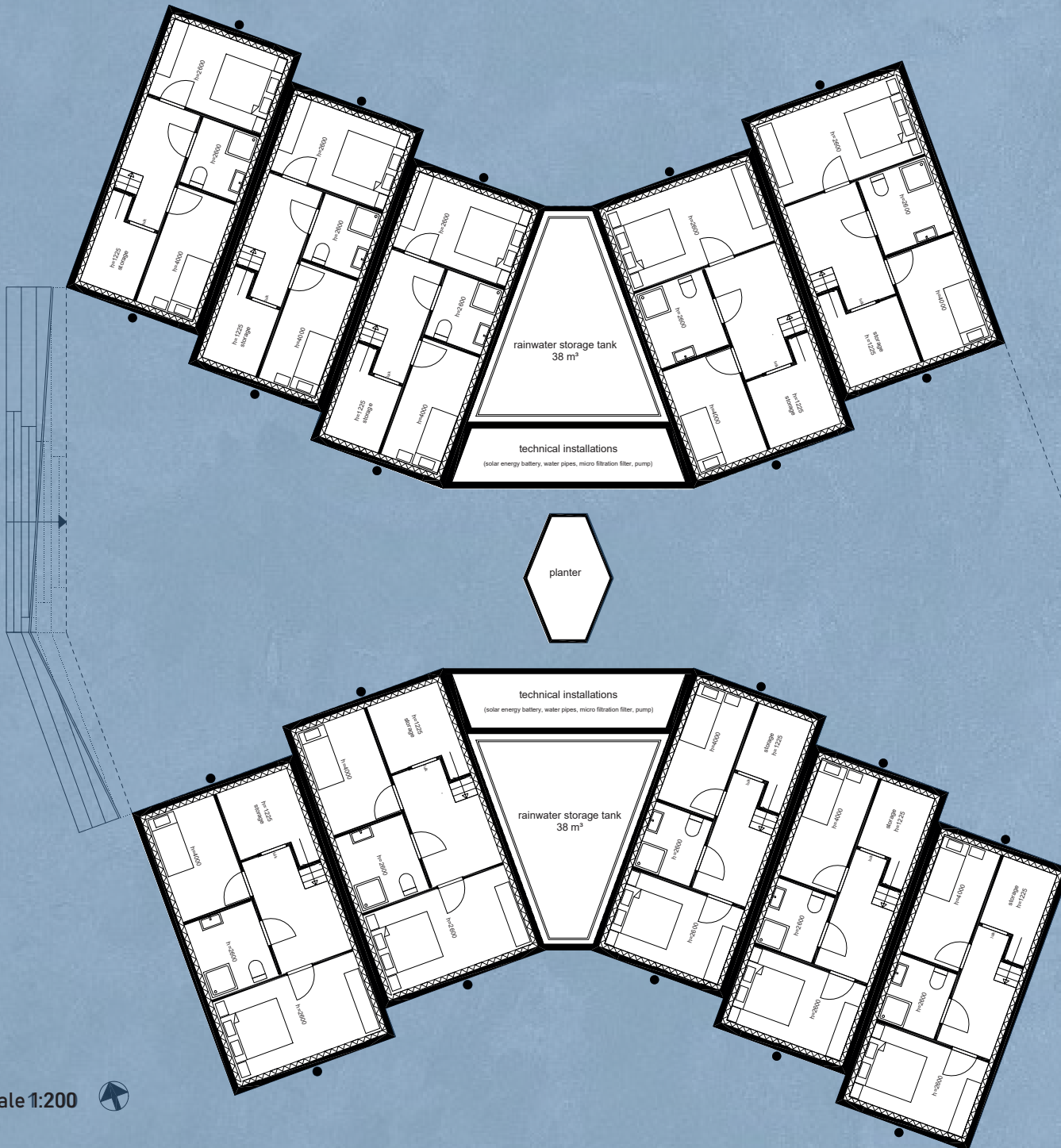
Flood adaptive

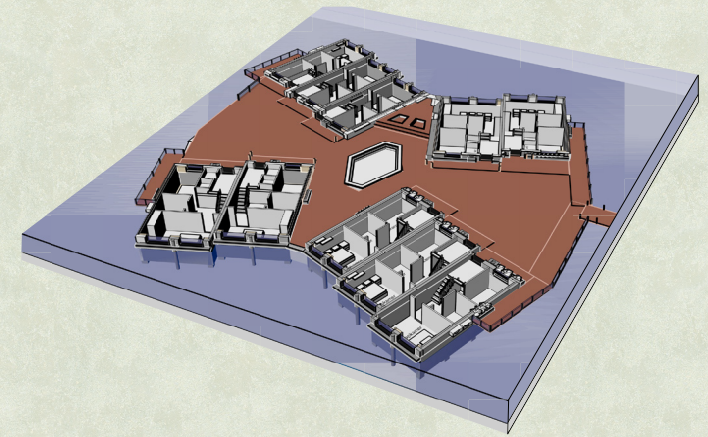
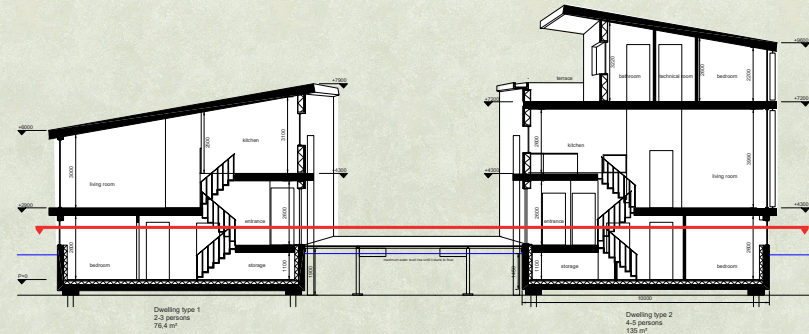


Co-living: private / public



Flexibility

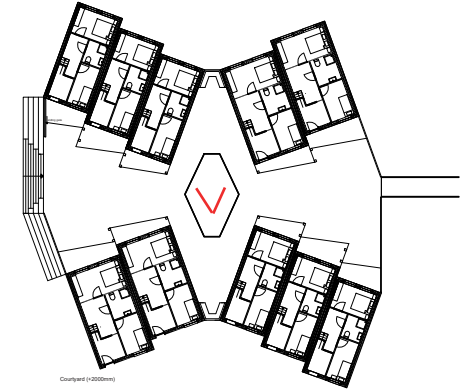
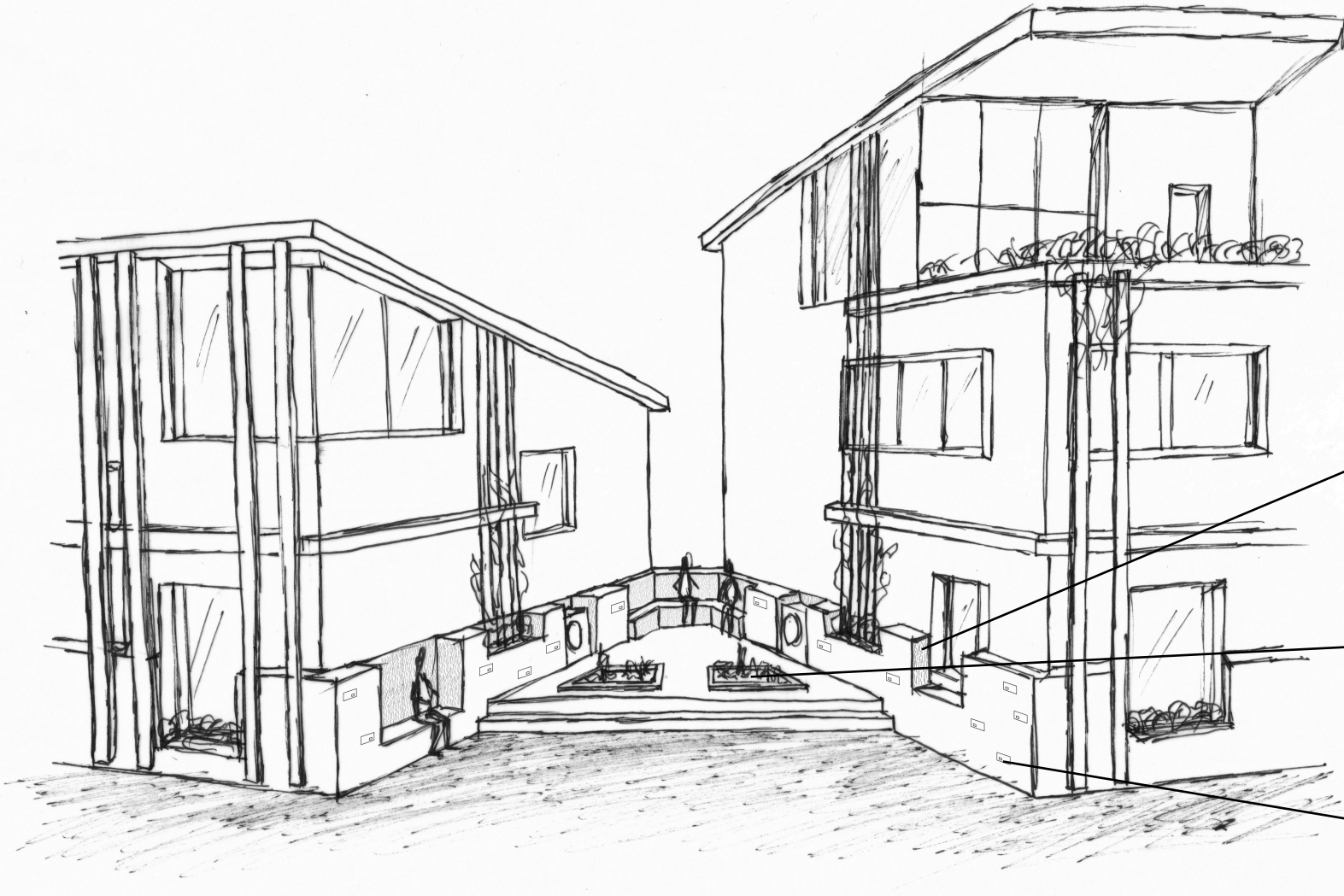




Courtyard level (+2000mm)

1:200





Different concrete structures



Gardening



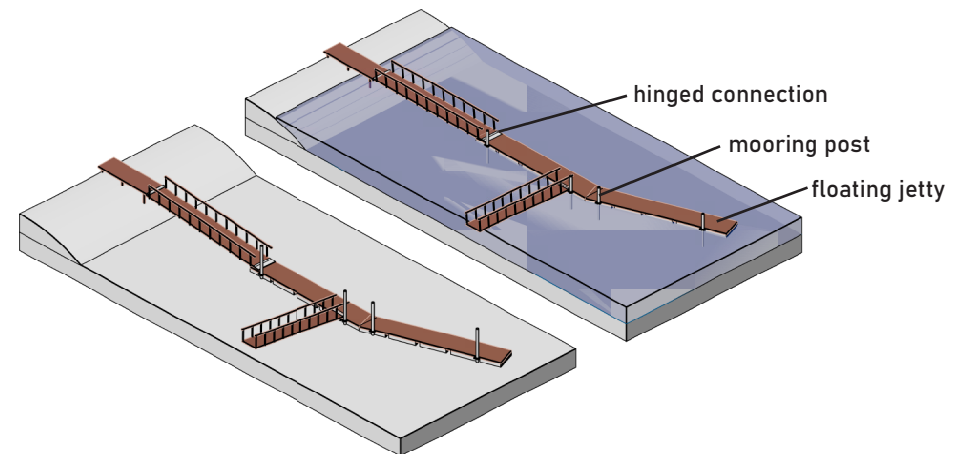
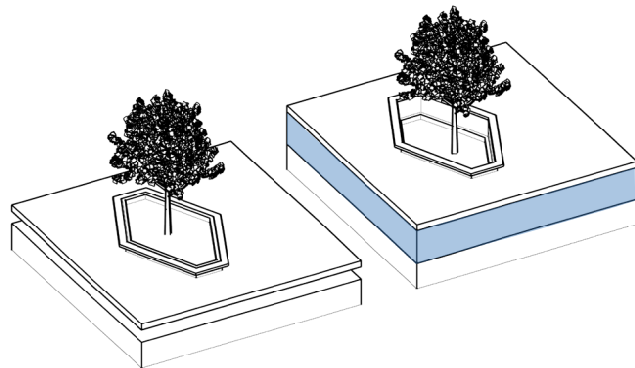
Holes for birds



Fixation vs Movable



Changing views



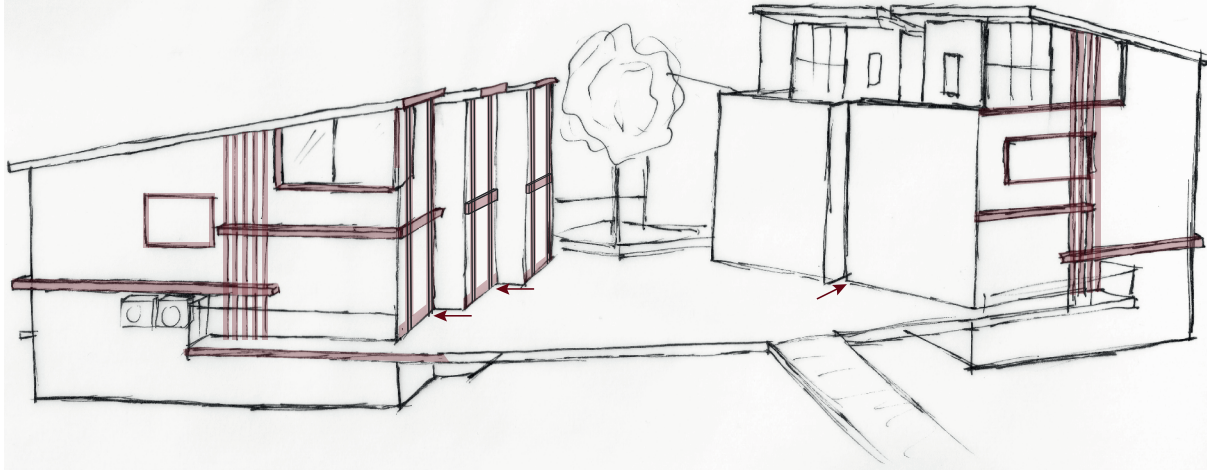


TYPE 1
2-3 persons
76,4 m²

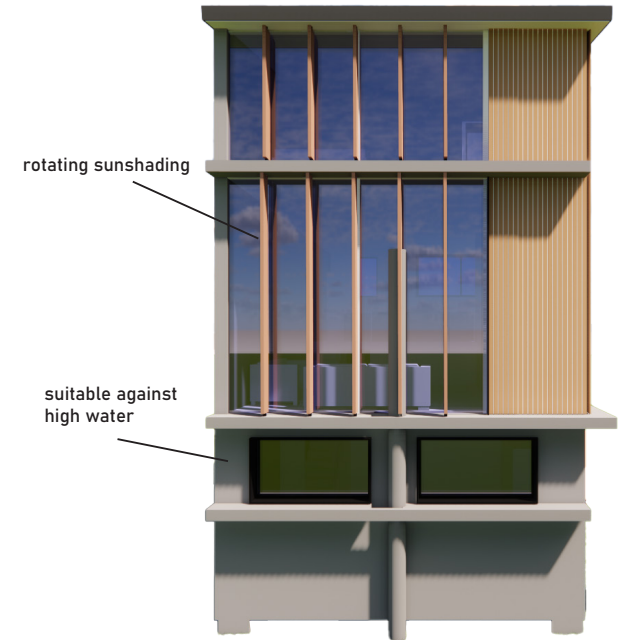
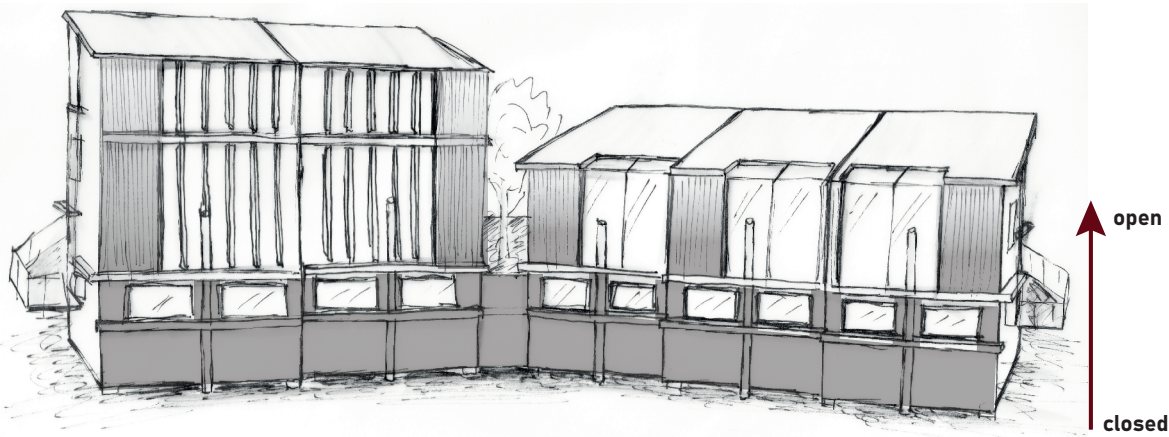


TYPE 2
4-5 persons
135 m²

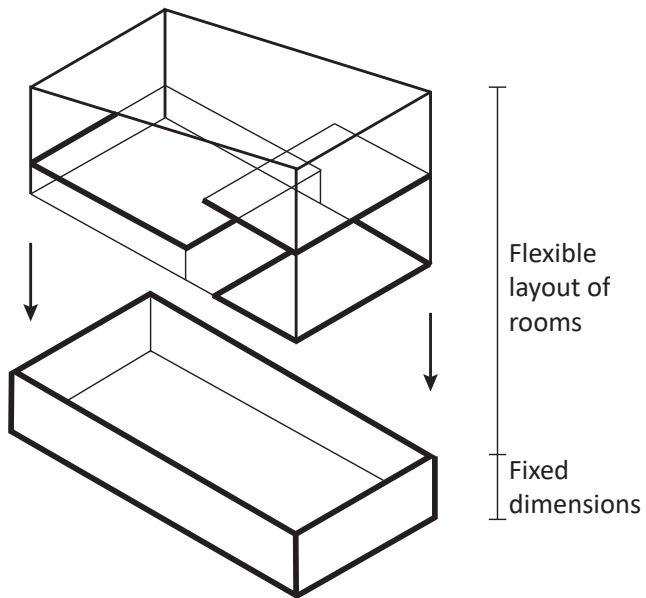
Vertical and horizontal facade accents --> enhance the readability of the houses



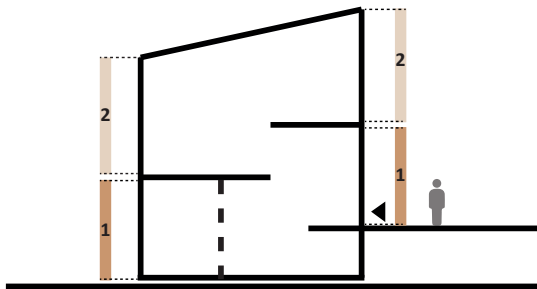
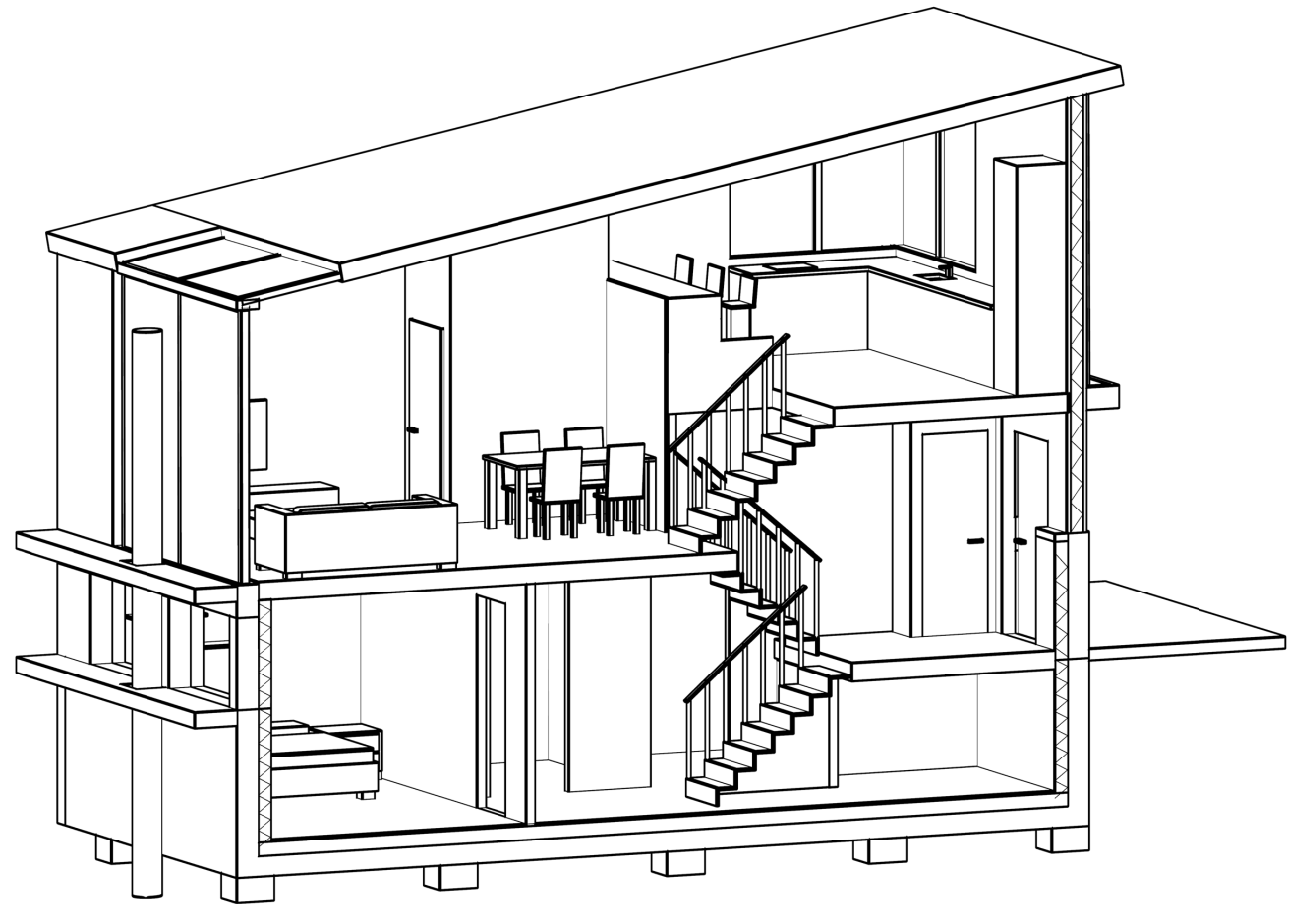
Closed to open facade



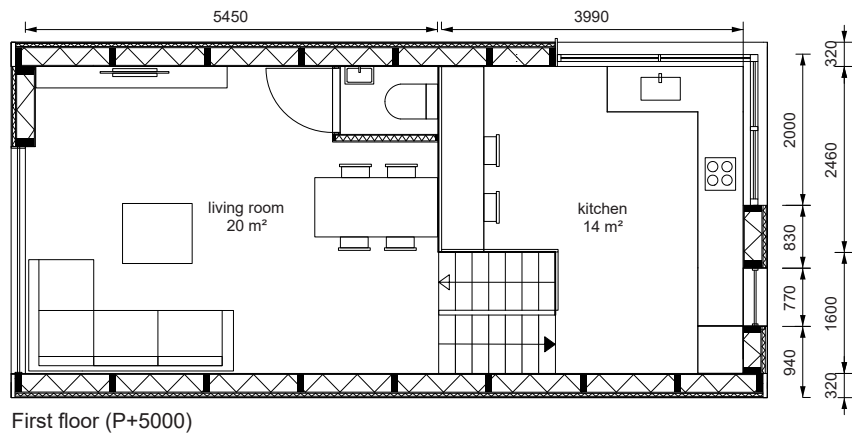
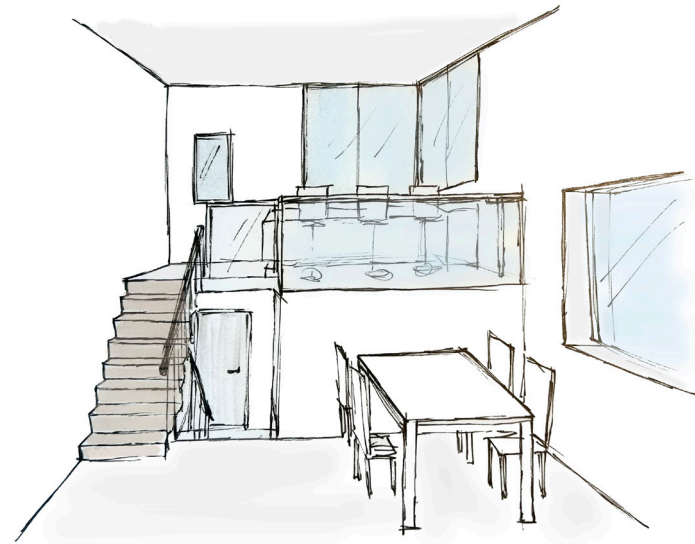
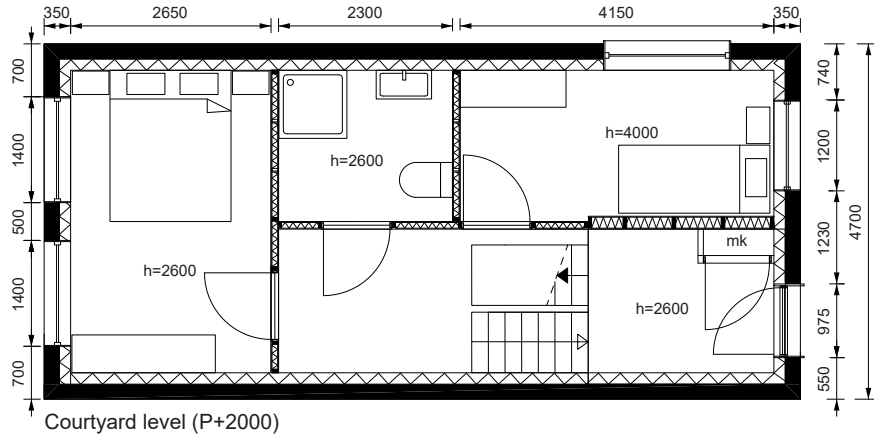
TYPE 1
2-3 persons
76,4 m²



-Starters
-Empty nesters



Conceptual section - Type 1

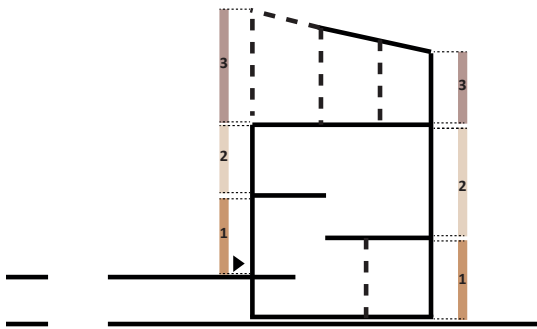
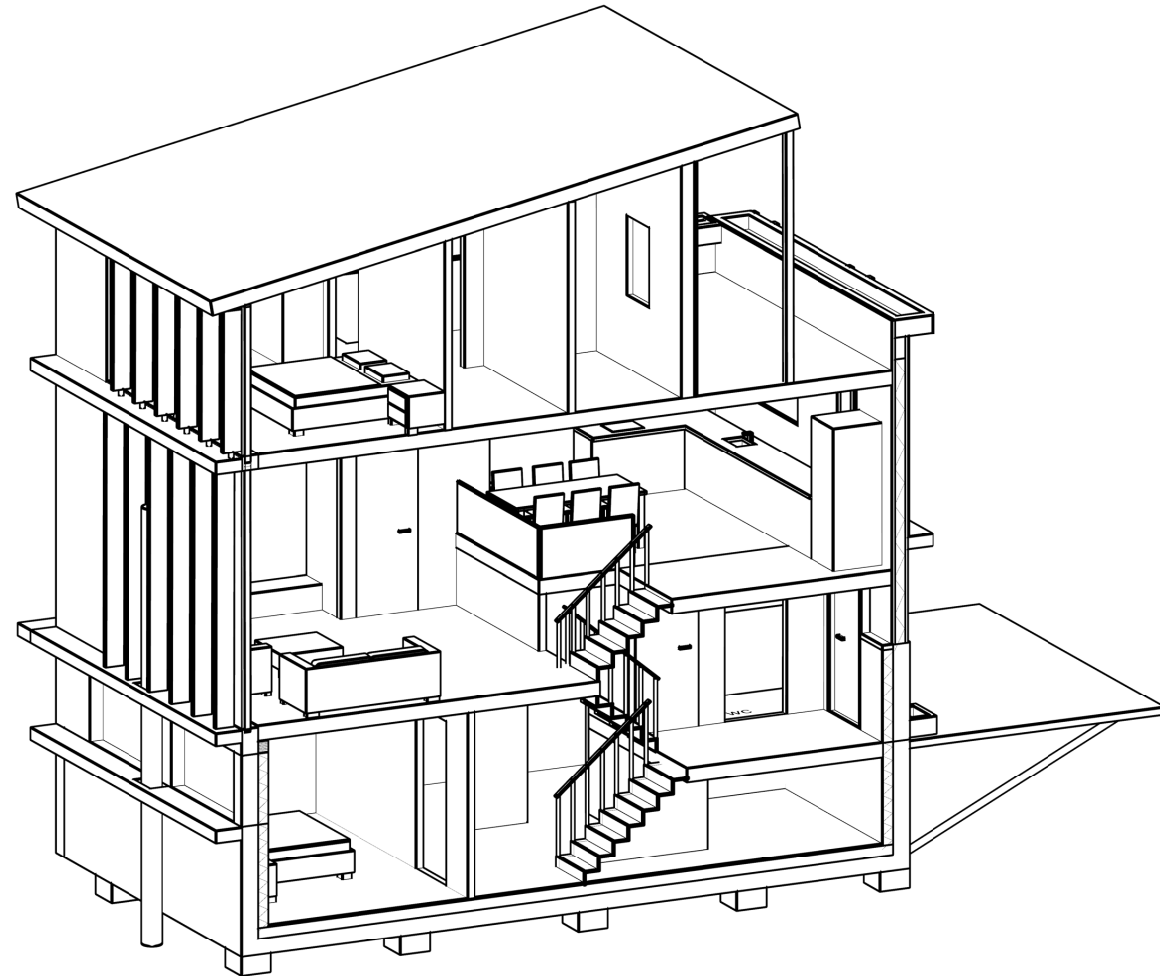
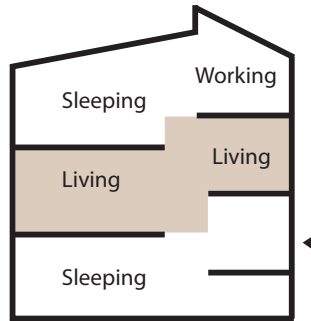
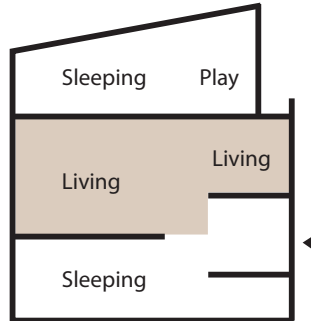
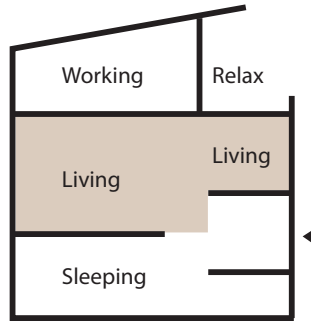
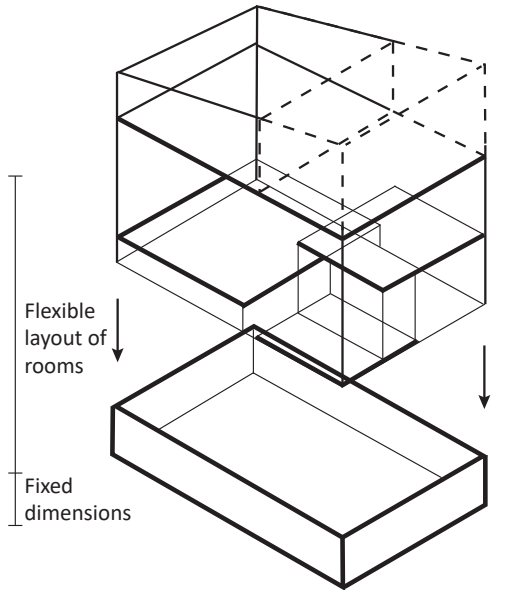


scale 1:100

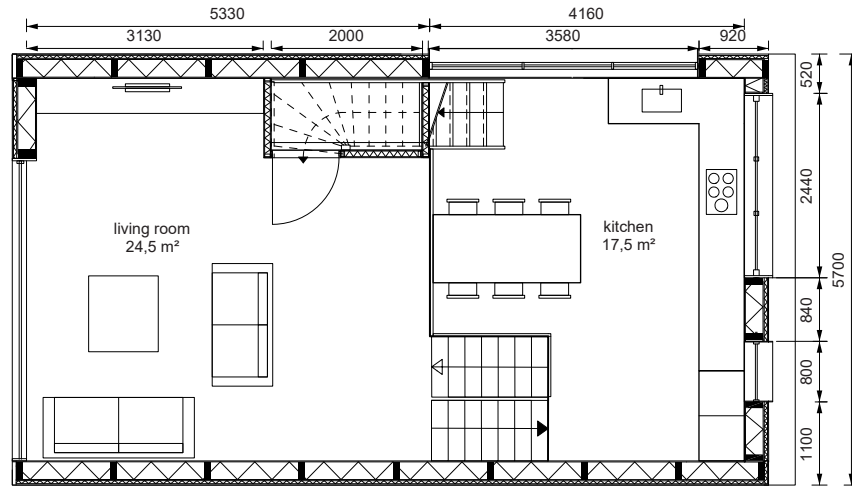
interior impressions

TYPE 2
4-5 persons
135 m²

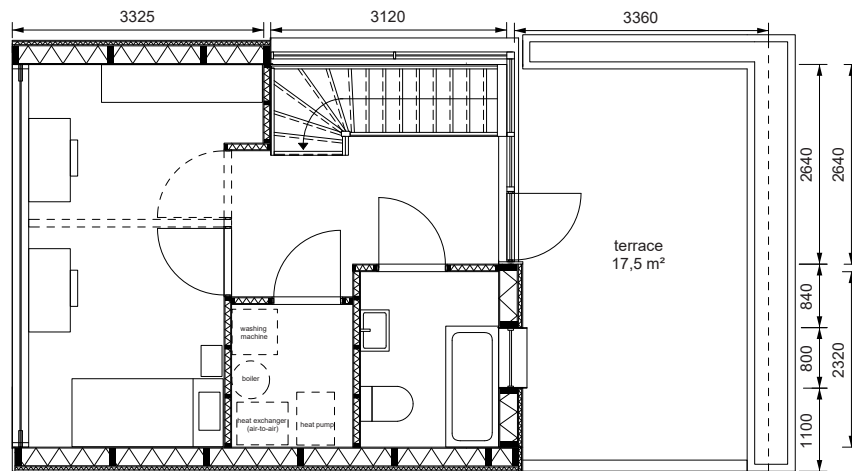
Roof constructions
Customizable



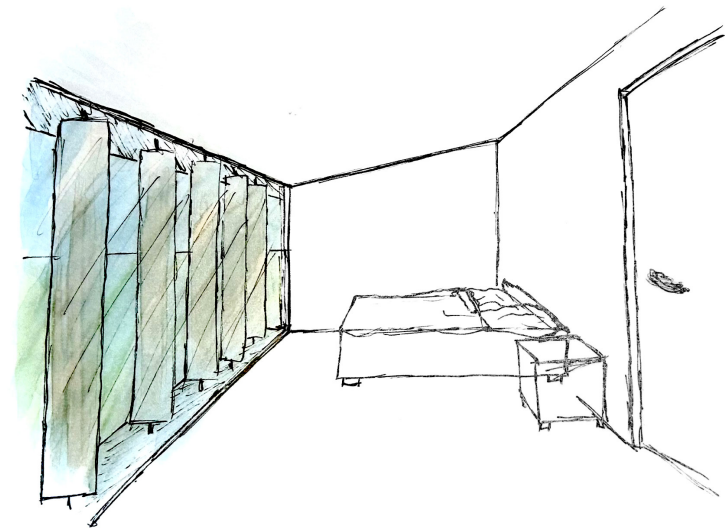
Conceptual section - Type 2



First floor (P+5000)

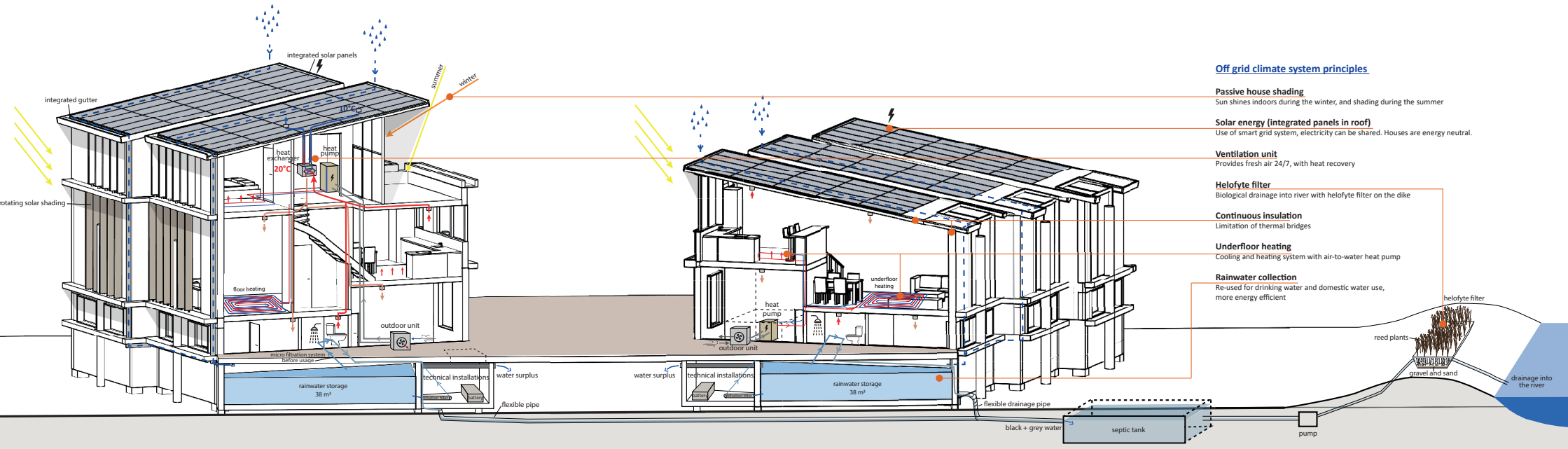


Second floor (P+8500)



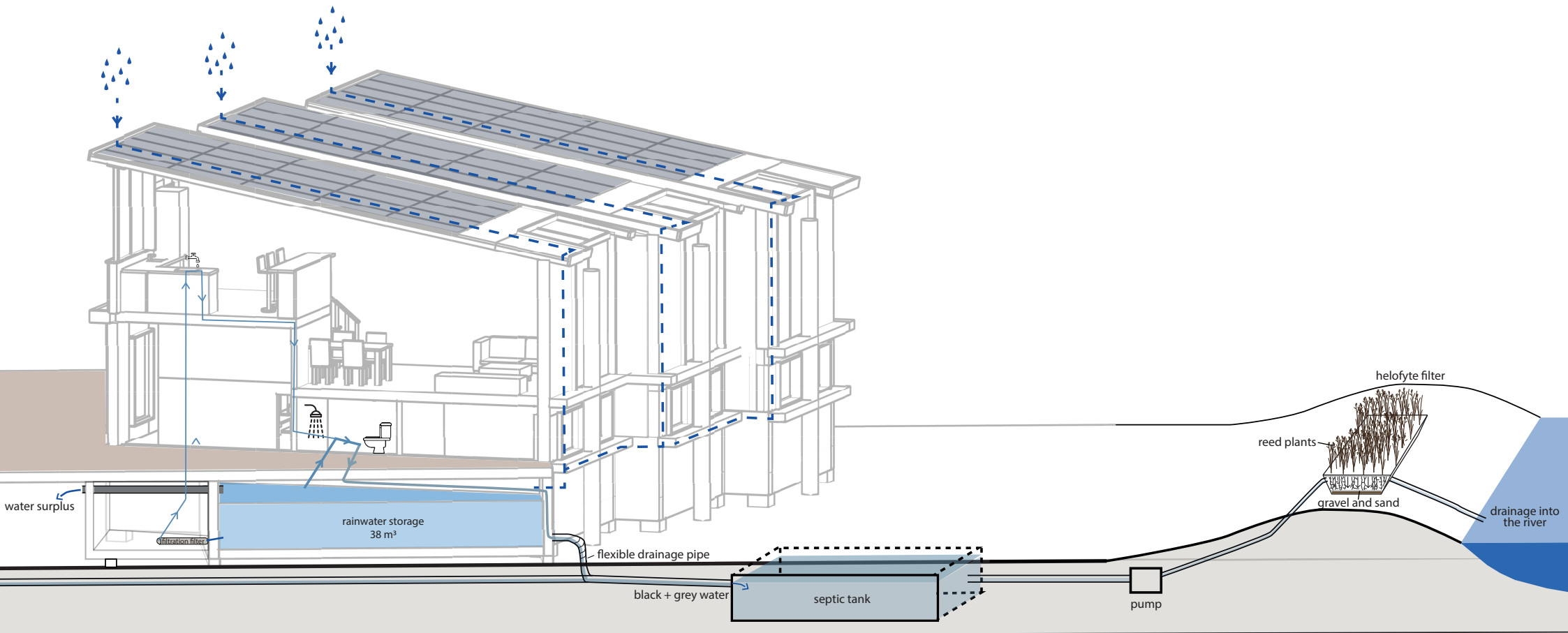
scale 1:100

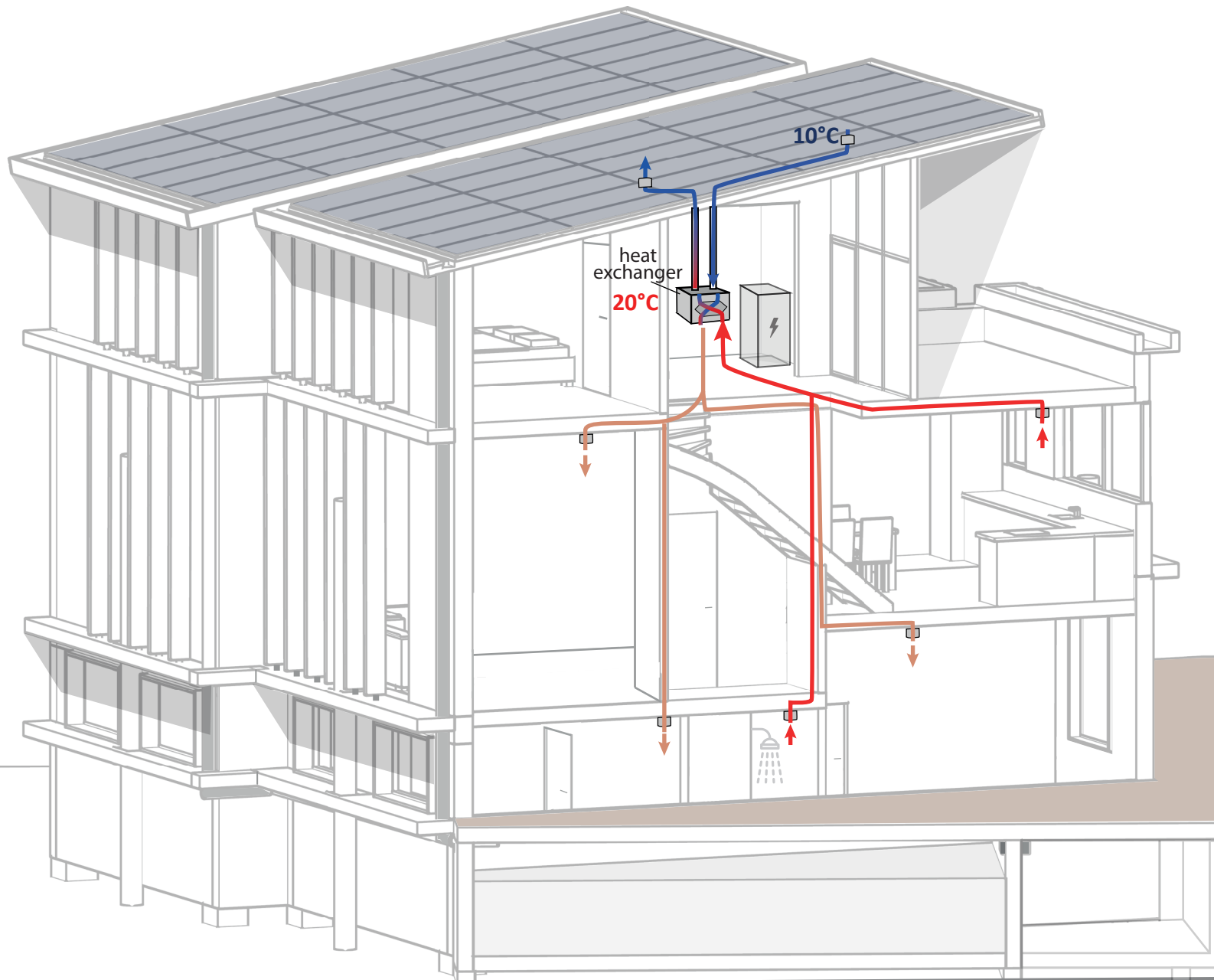
interior impressions

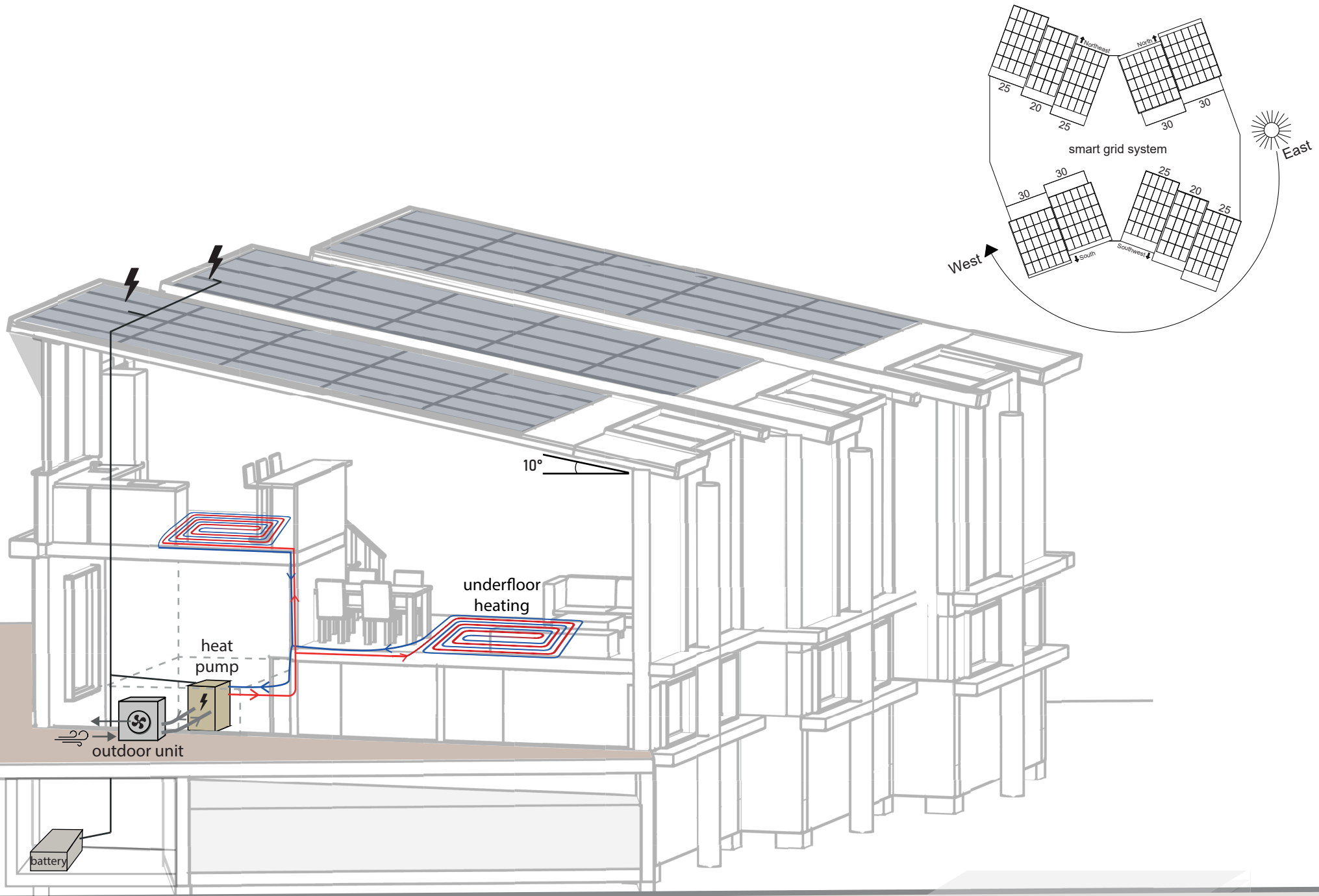


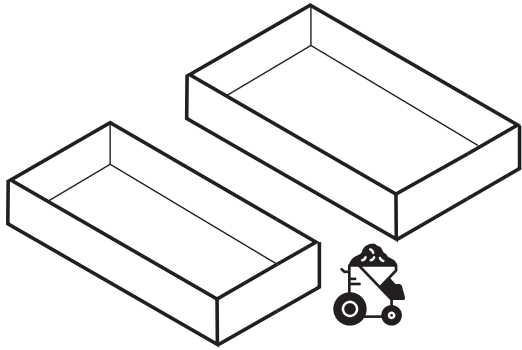
Off grid climate system principles

- Passive house shading**
Sun shines indoors during the winter, and shading during the summer
- Solar energy (integrated panels in roof)**
Use of smart grid system, electricity can be shared. Houses are energy neutral.
- Ventilation unit**
Provides fresh air 24/7, with heat recovery
- Helofyte filter**
Biological drainage into river with helofyte filter on the dike
- Continuous insulation**
Limitation of thermal bridges
- Underfloor heating**
Cooling and heating system with air-to-water heat pump
- Rainwater collection**
Re-used for drinking water and domestic water use, more energy efficient

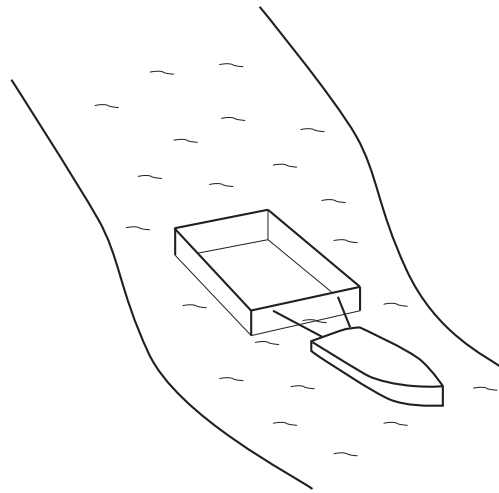




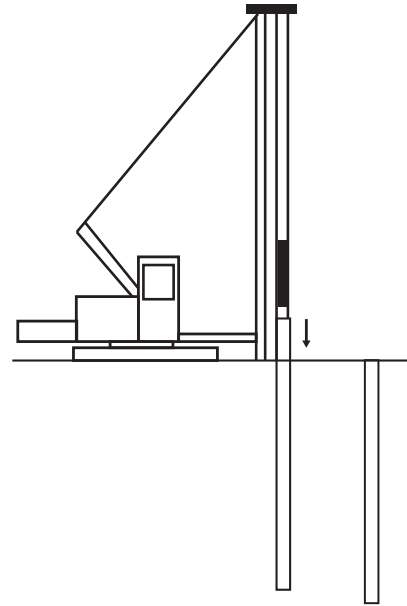




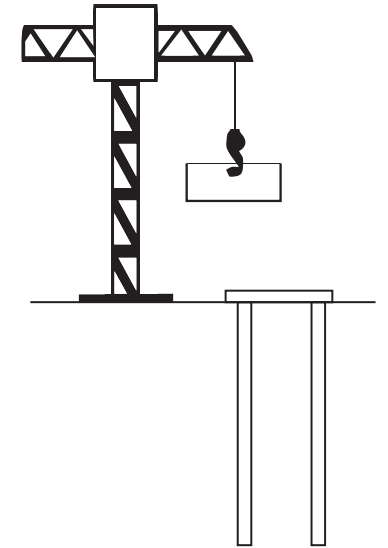
1. Concrete pontoons are manufactured in the factory



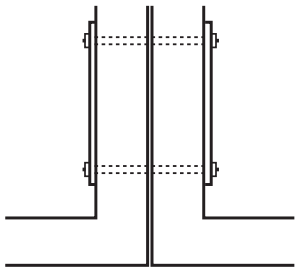
2. Transported via river



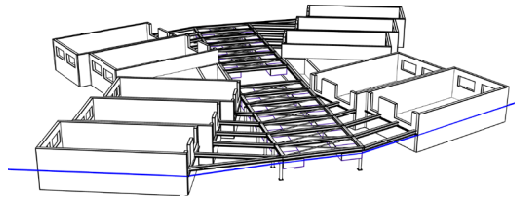
3. Foundations placed on the construction site



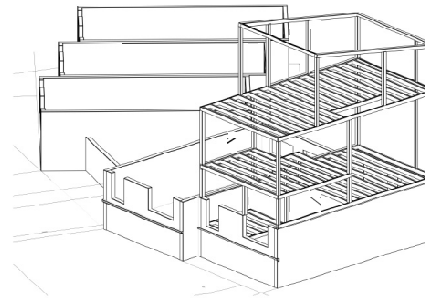
4. Pontoons placed on the foundations with a crane



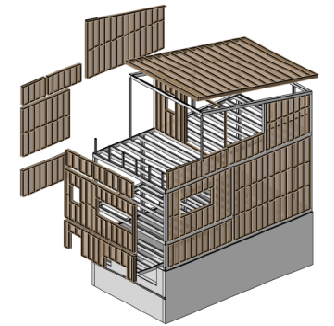
5. Pontoons connected to each other with steel wires



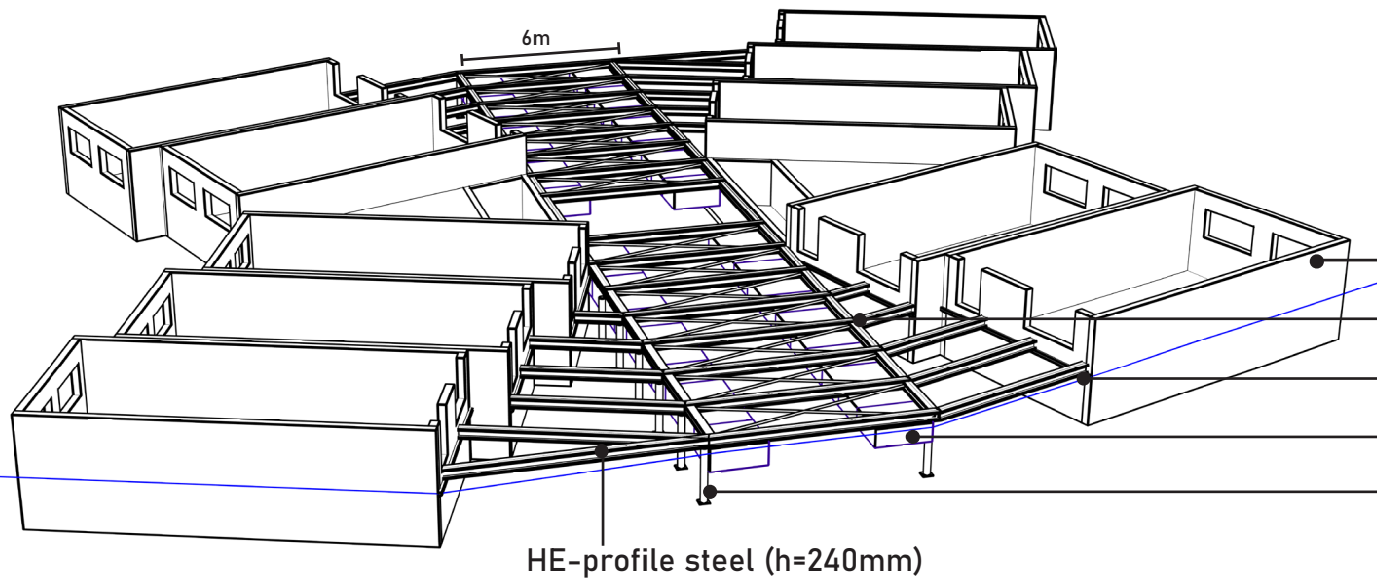
6. Courtyard structure constructed on-site



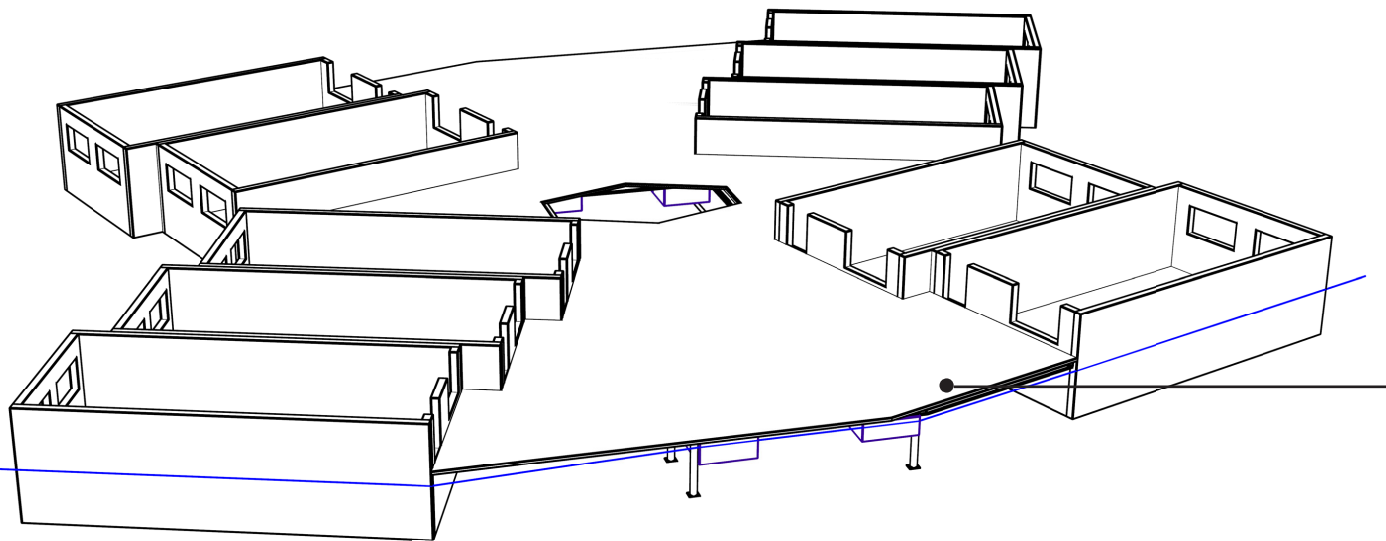
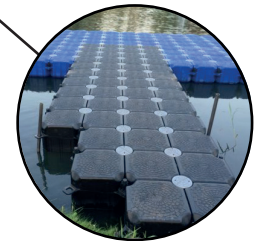
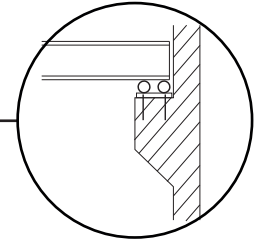
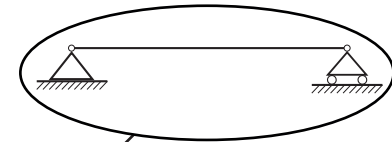
7. Timber frame skelet built on the pontoons on site



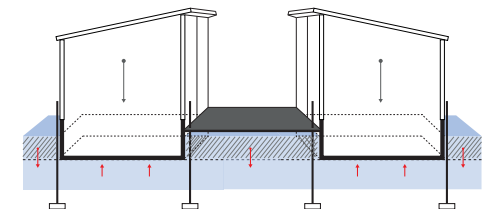
8. Prefab facade elements are mounted

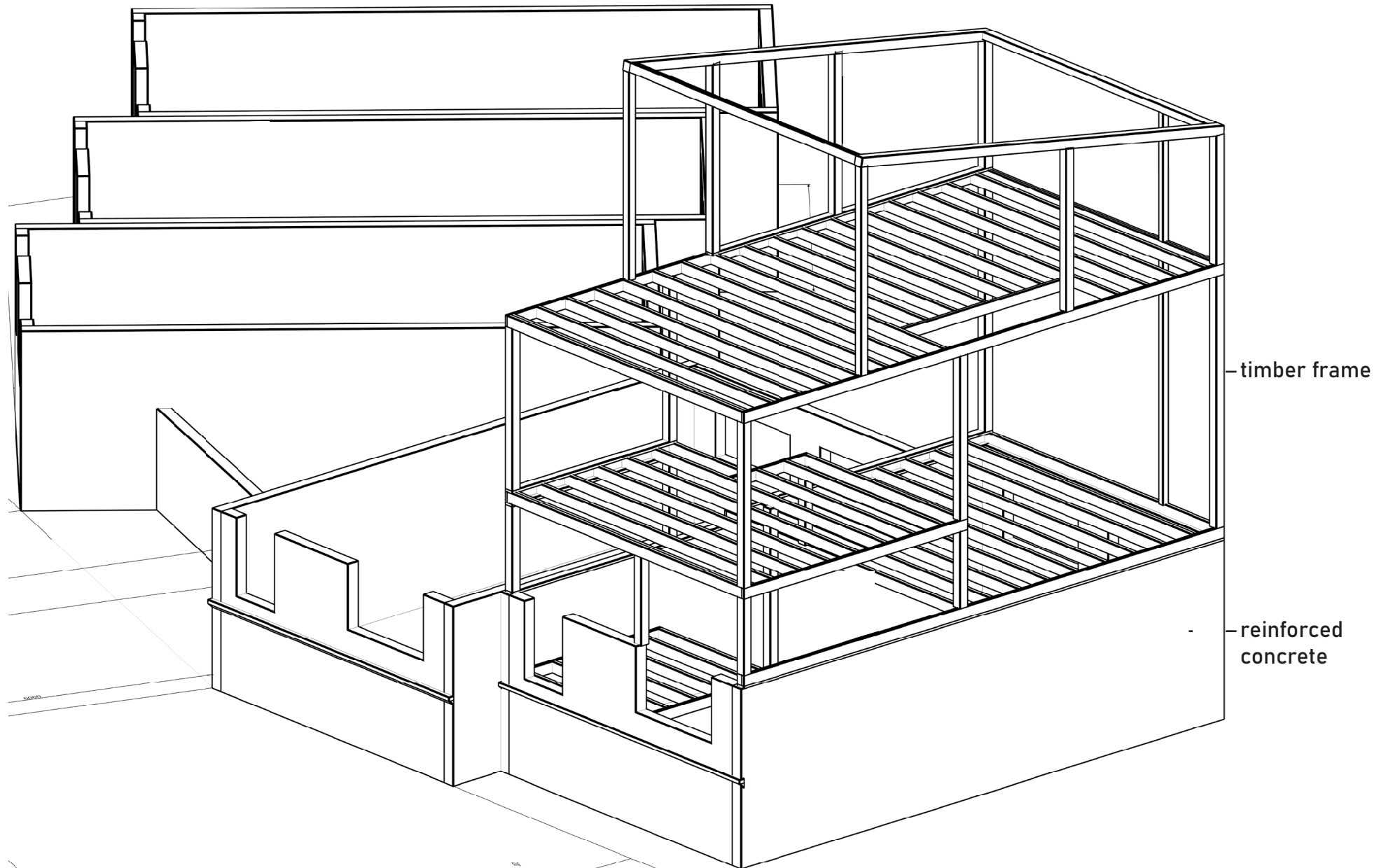


- reinforced concrete
- hinged steel connection
- roller bearing
- connectable pontoons
- concrete columns

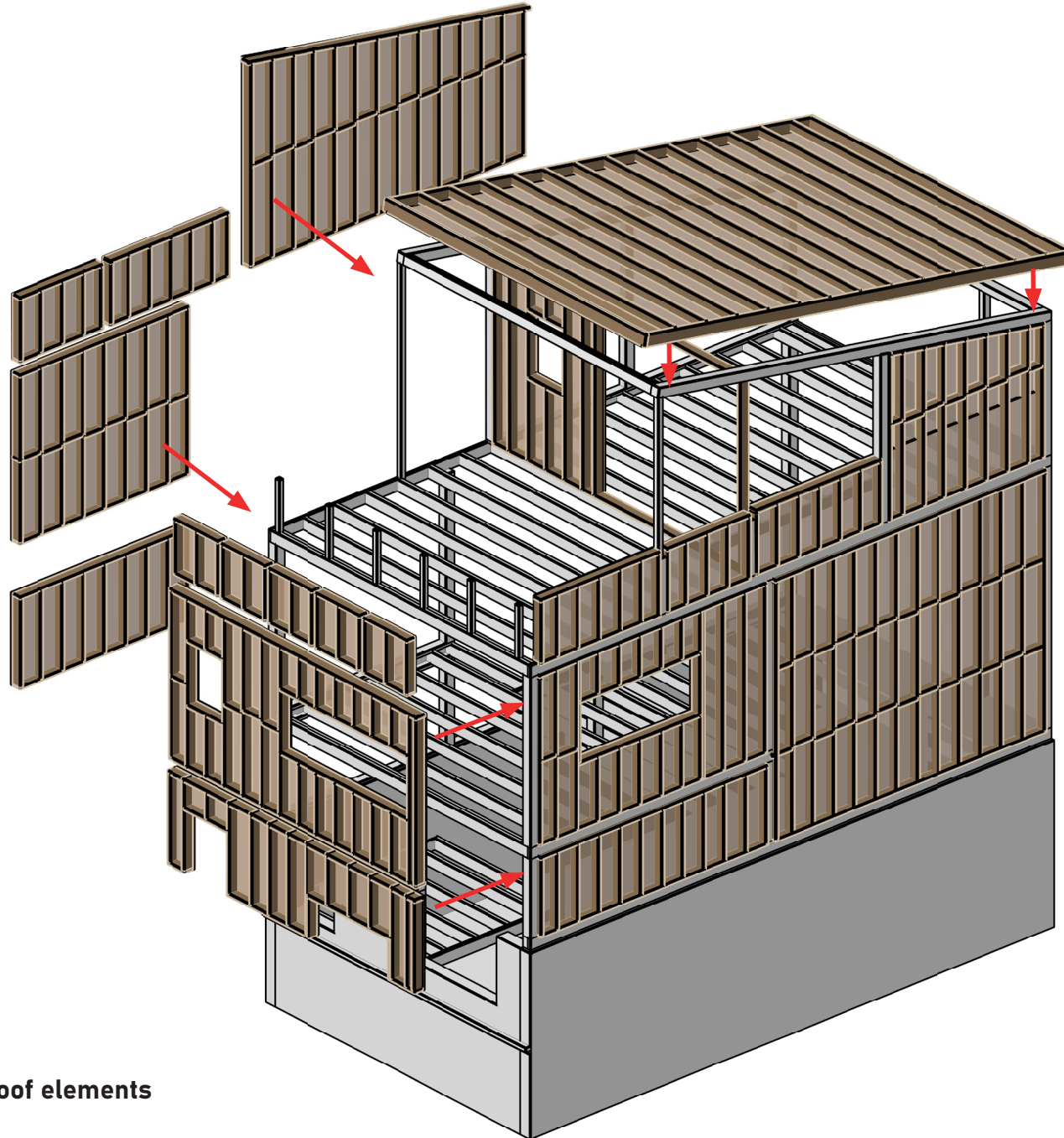


Flexible pole system with connectable pontoons



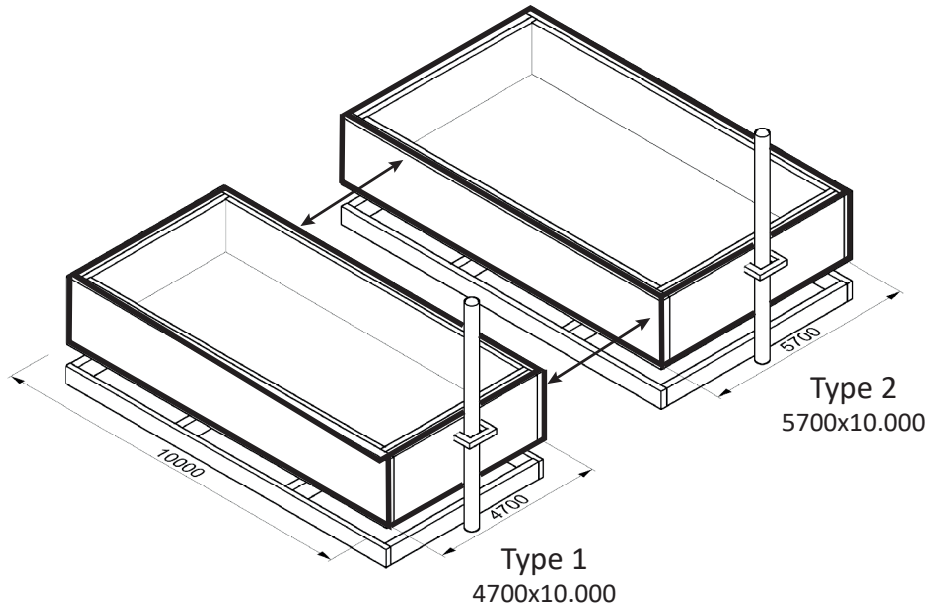


Timber frame skelet on concrete base

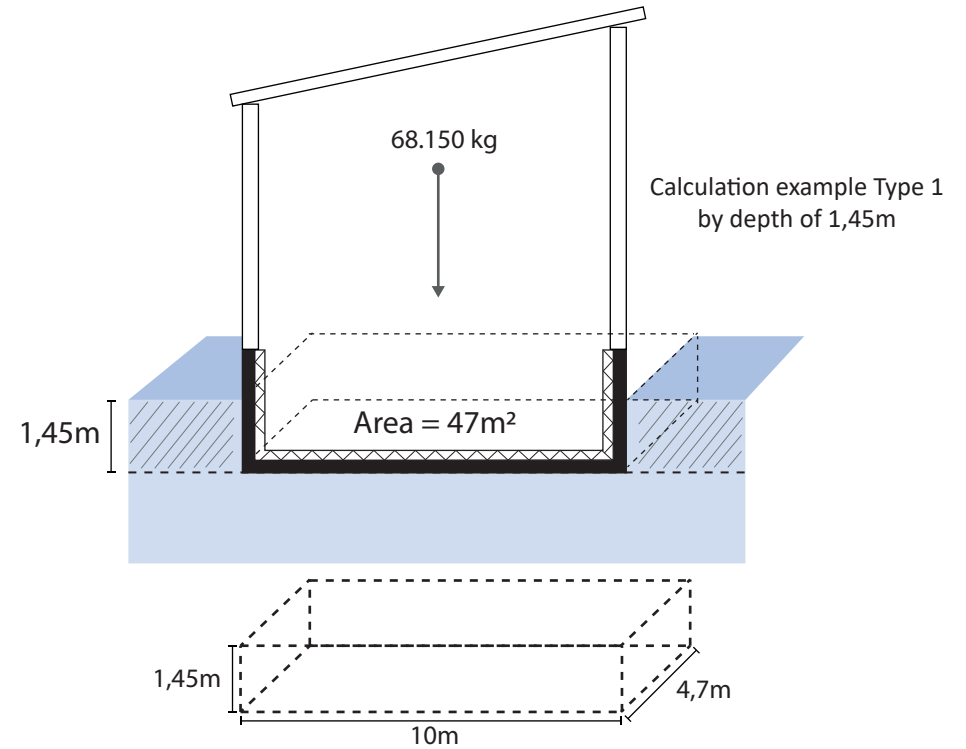


Prefab facade and roof elements

The two concrete box sizes



Archimedes' principle



Acceptable **depth** of the building is **1,4-1,5m**, this means the following max building weights:

- The weight of **dwelling 1** may vary between **66.000 kg** and **70.500 kg**
- The weight of **dwelling 2** may vary between **80.000 kg** and **85.500 kg**

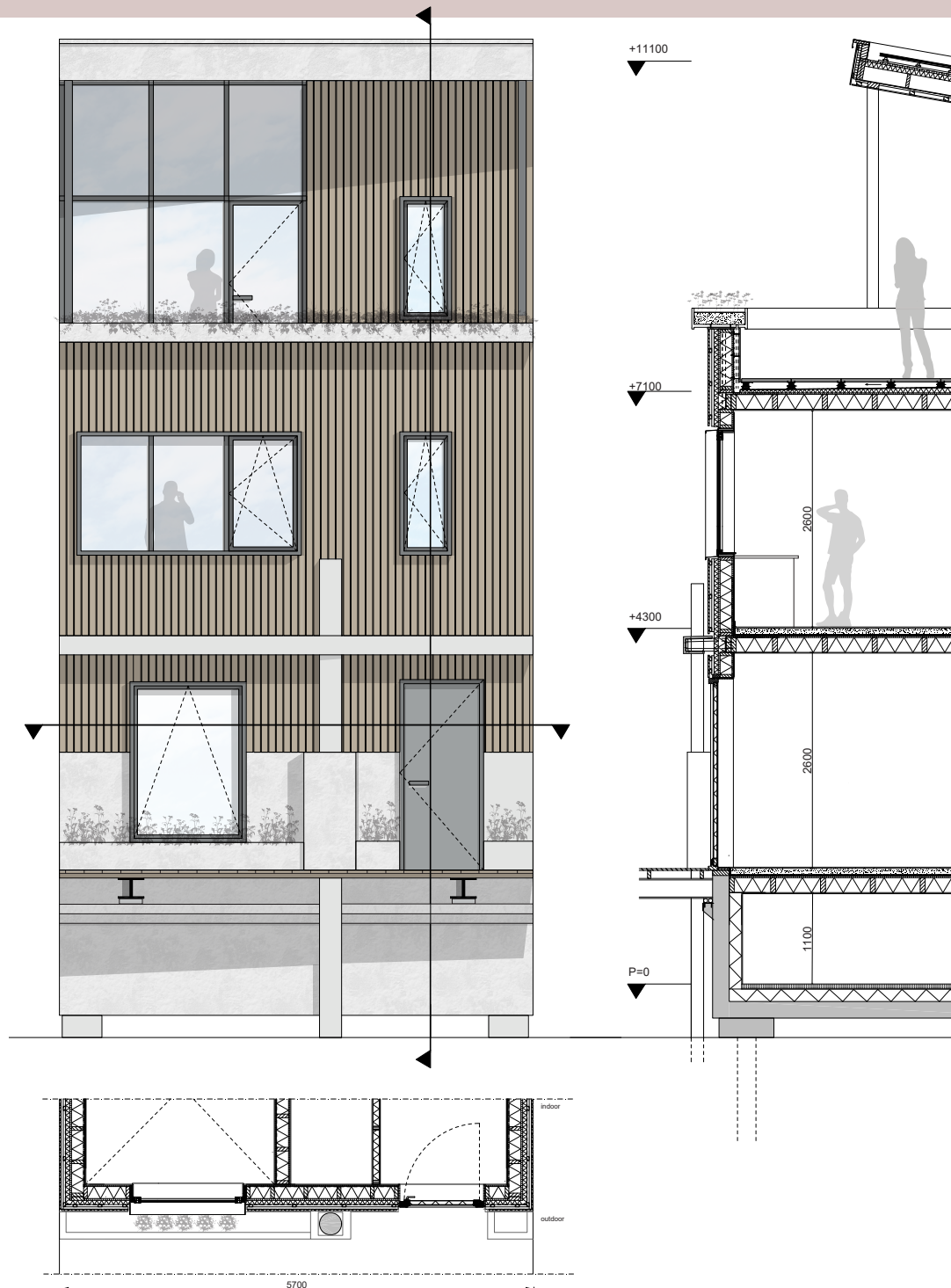
$$V_{\text{displaced water}} = A * h_{\text{depth}}$$

$$V = 47\text{m}^2 * 1,45\text{m} = 68,15 \text{ m}^3$$

$$F_{\downarrow} = F_{\uparrow}$$

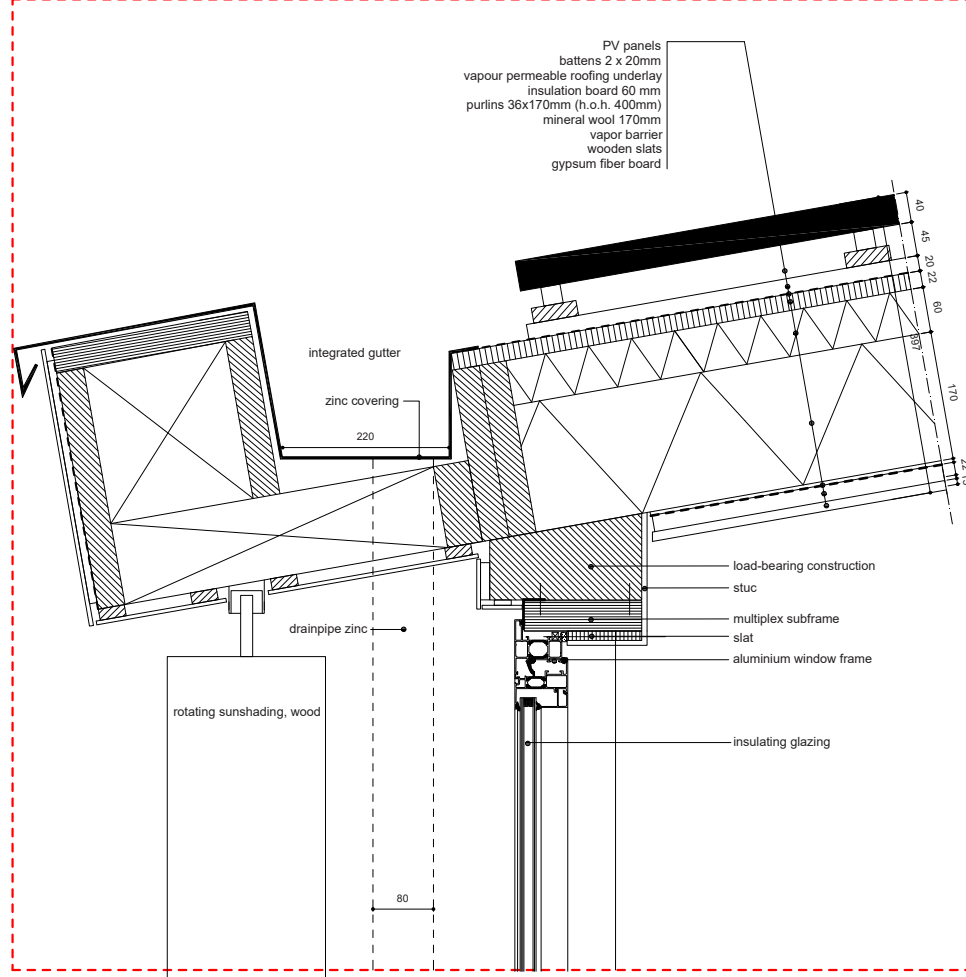
$$M_{\text{pontoon+building}} [\text{kg}] = V * 1000 [\text{m}^3]$$

$$M = 68,15 * 1000 = 68.150 \text{ kg}$$



1:20 (Scaled to 1:80)

D.1 Roof edge, integrated solar panels and rain drainage

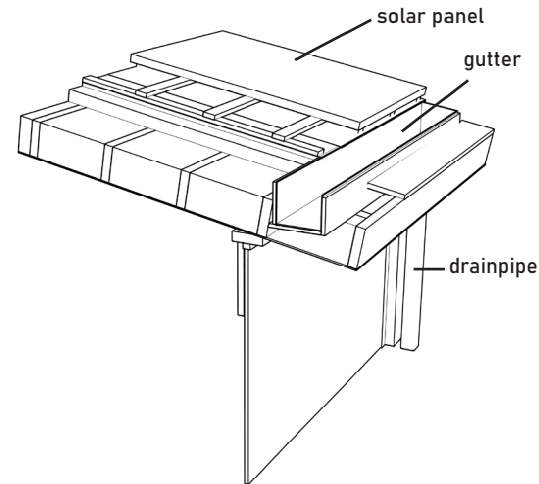


Scaled to 1:10

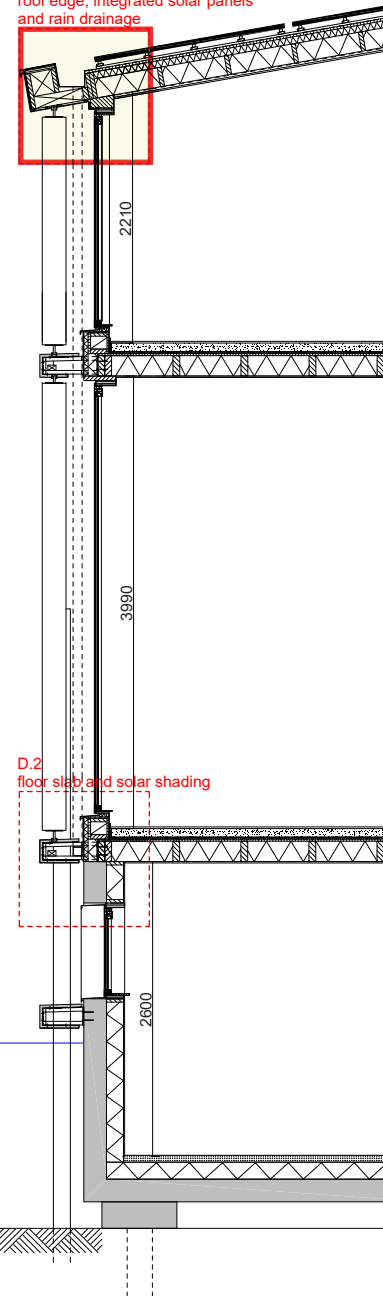
- Structure for integrated solar panels



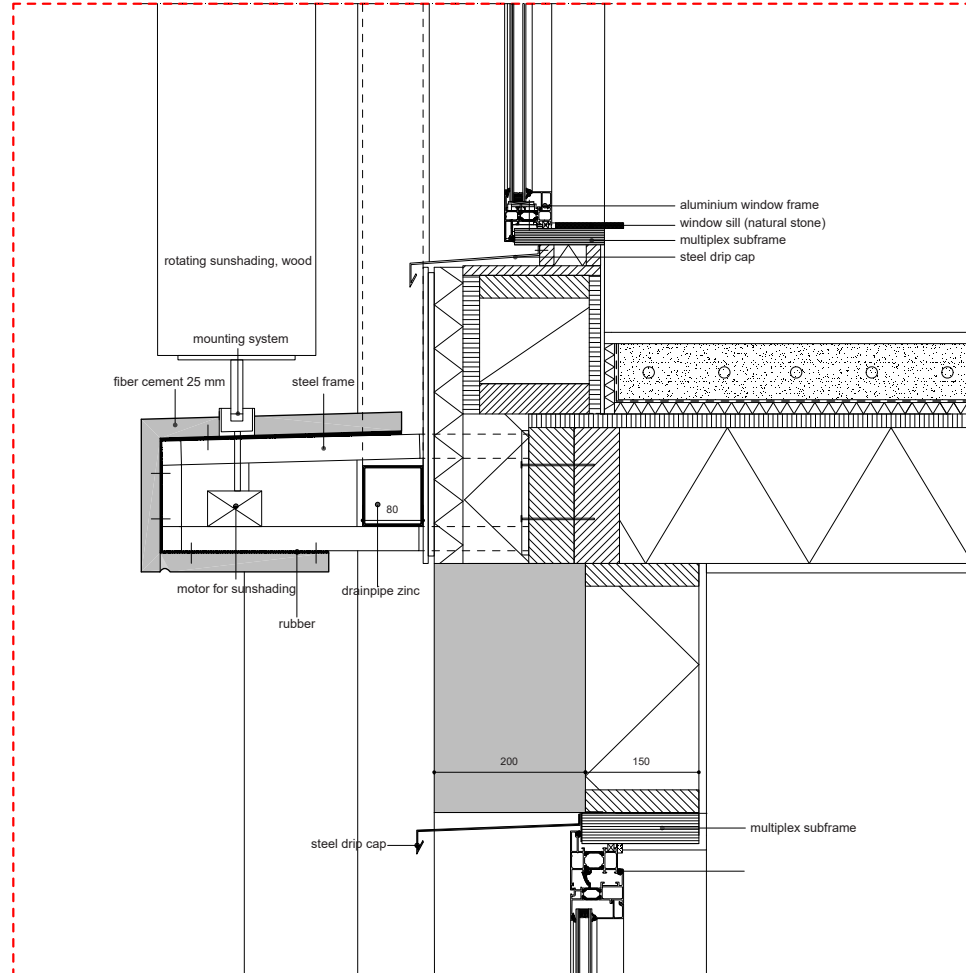
- Integrated / hidden gutter



D.1
roof edge, integrated solar panels
and rain drainage

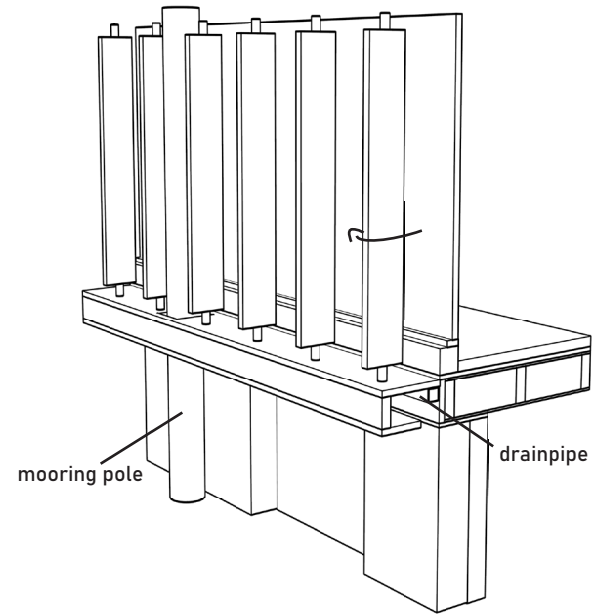


D.2 Floor slab and solar shading

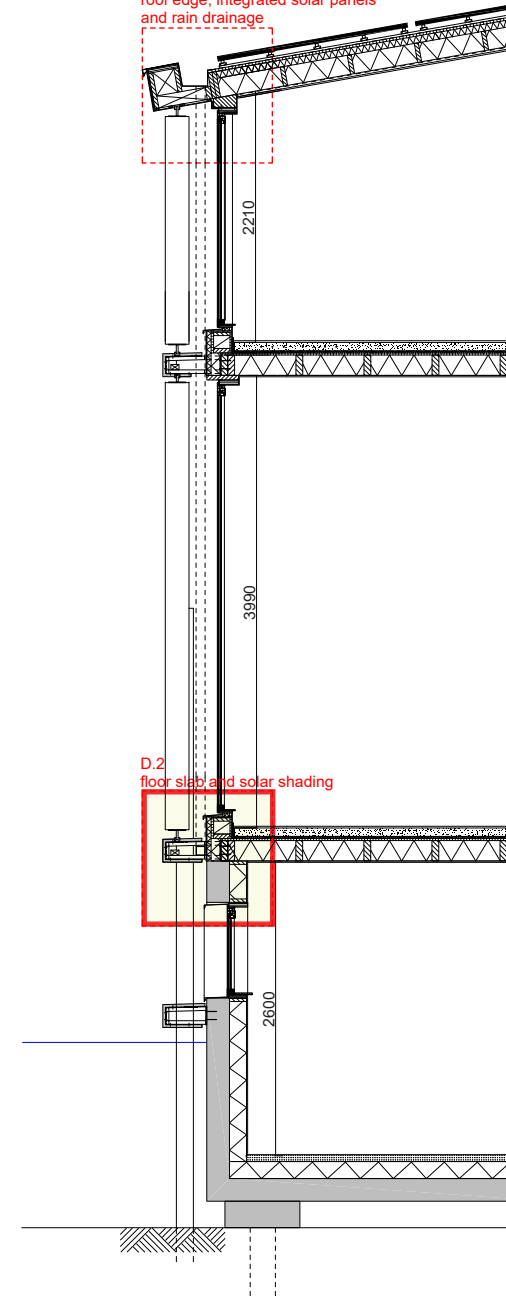


Scaled to 1:10

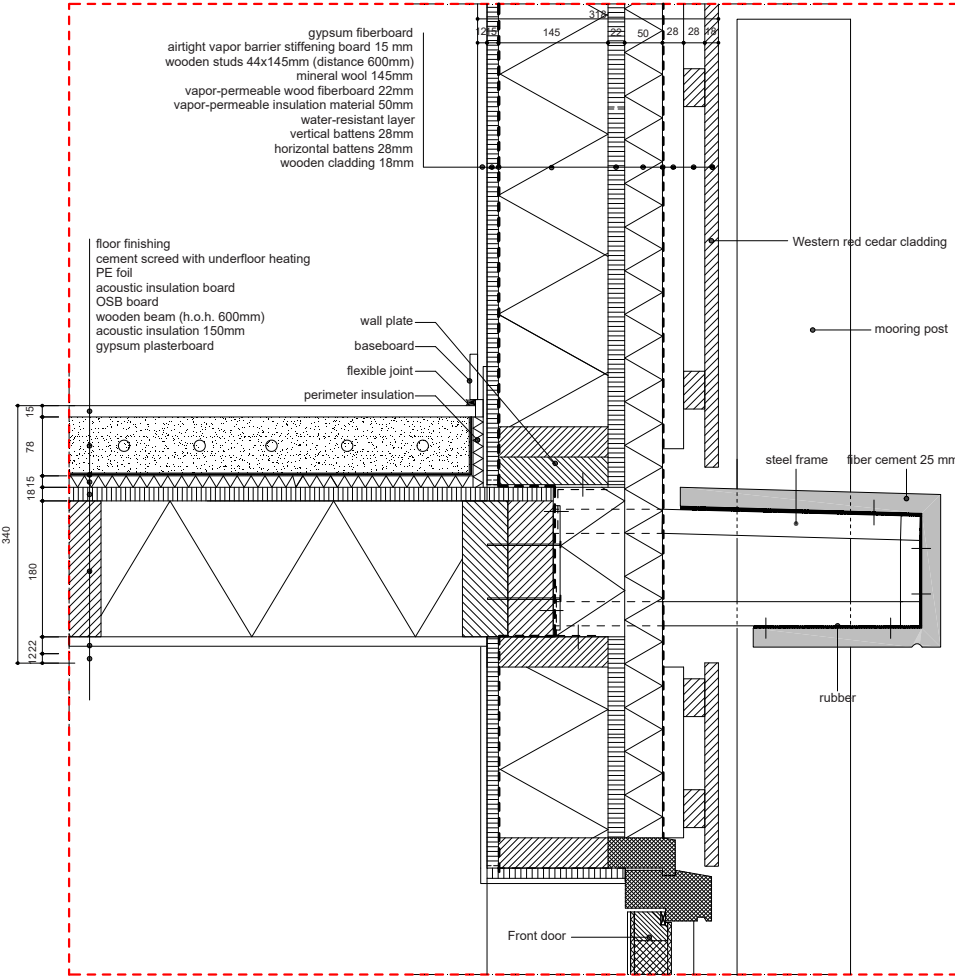
- Rotating sun shading and multifunctional concrete edge



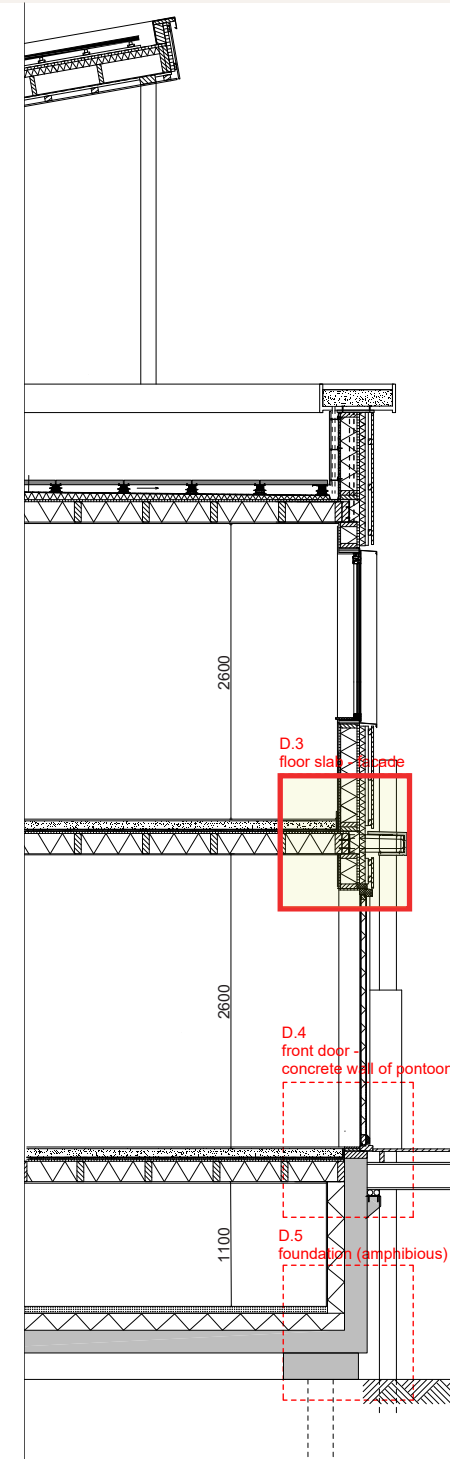
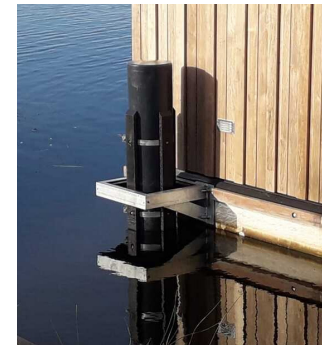
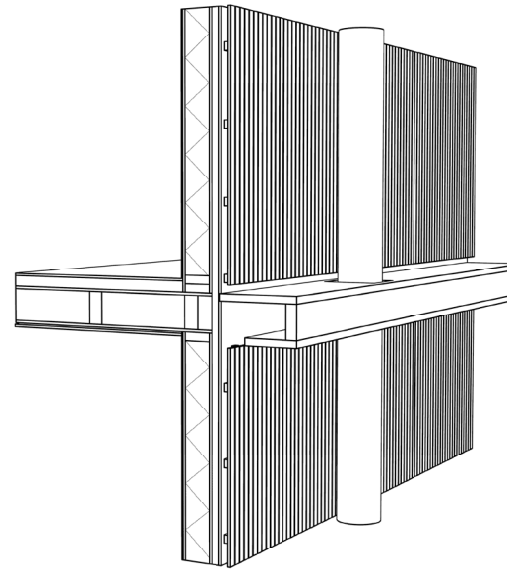
D.1 roof edge, integrated solar panels and rain drainage



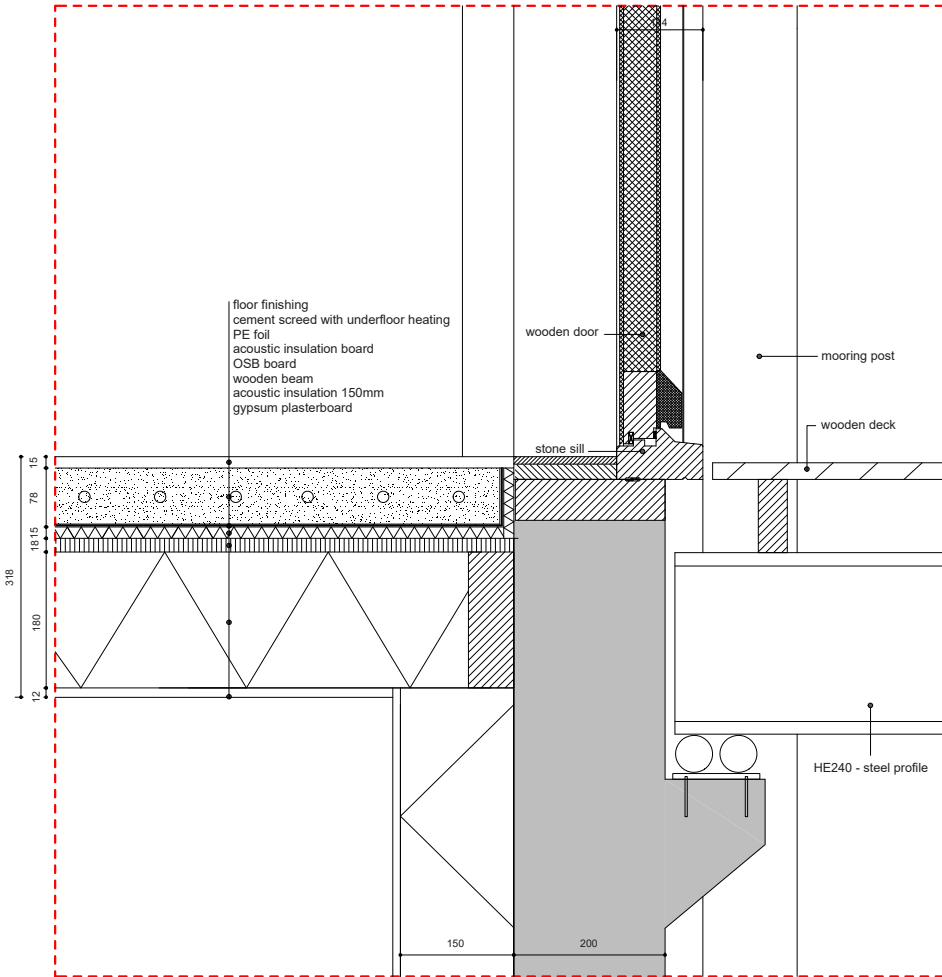
D.3 Floor slab - facade timber frame construction



Scaled to 1:10

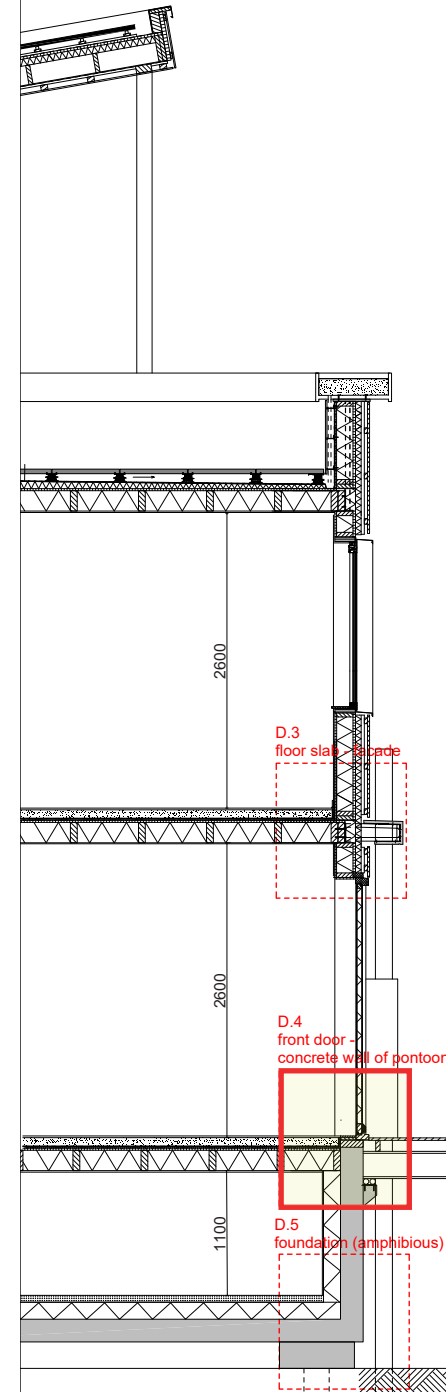
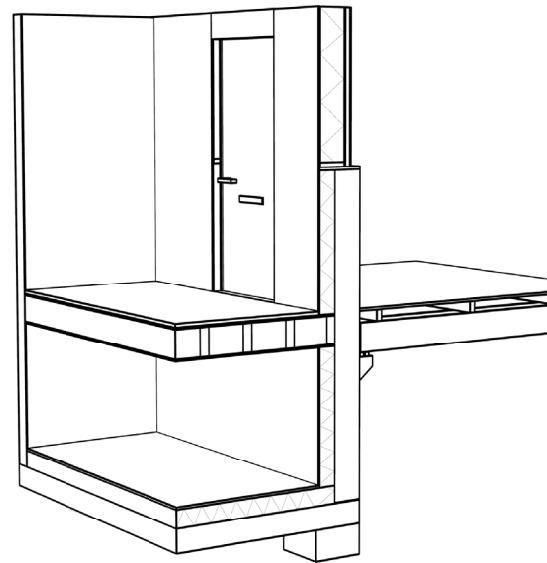


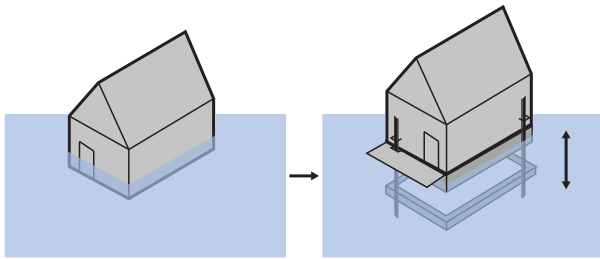
D.4 Front door - concrete wall of pontoon



Scaled to 1:10

- Connection concrete construction and timber frame construction



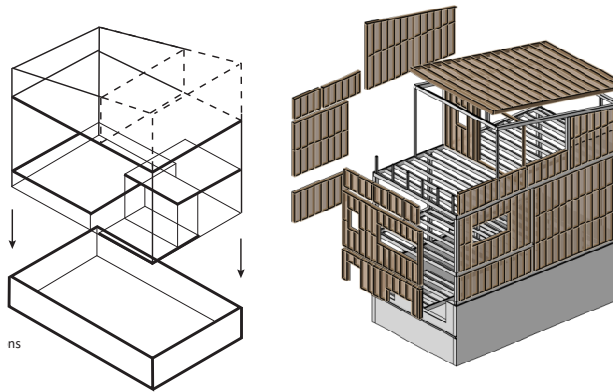


Living in wetland areas without worries



Prevents areas from becoming unliveable due to flood risk

1

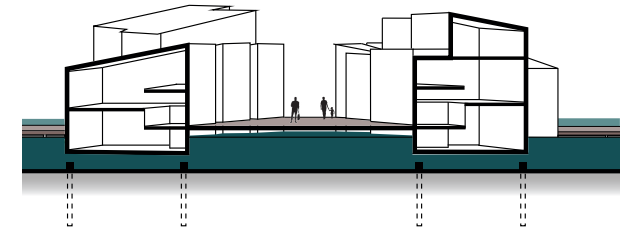


Flexible, self-sufficient and demountable building concept



Can be applied anywhere and is adaptable to user wishes

2



Pleasant way of living with the water



Awareness of water level changes and a good relationship of interaction and private life

3



THANK
YOU

FLOOD-PROOF LIVING
AT THE RIVER SIDE