

THE INTEGRATION OF FOREST ECOLOGIES INTO THE URBAN ENVIRONMENT

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Architectural Engineering
Urban Forestry



Personal Information

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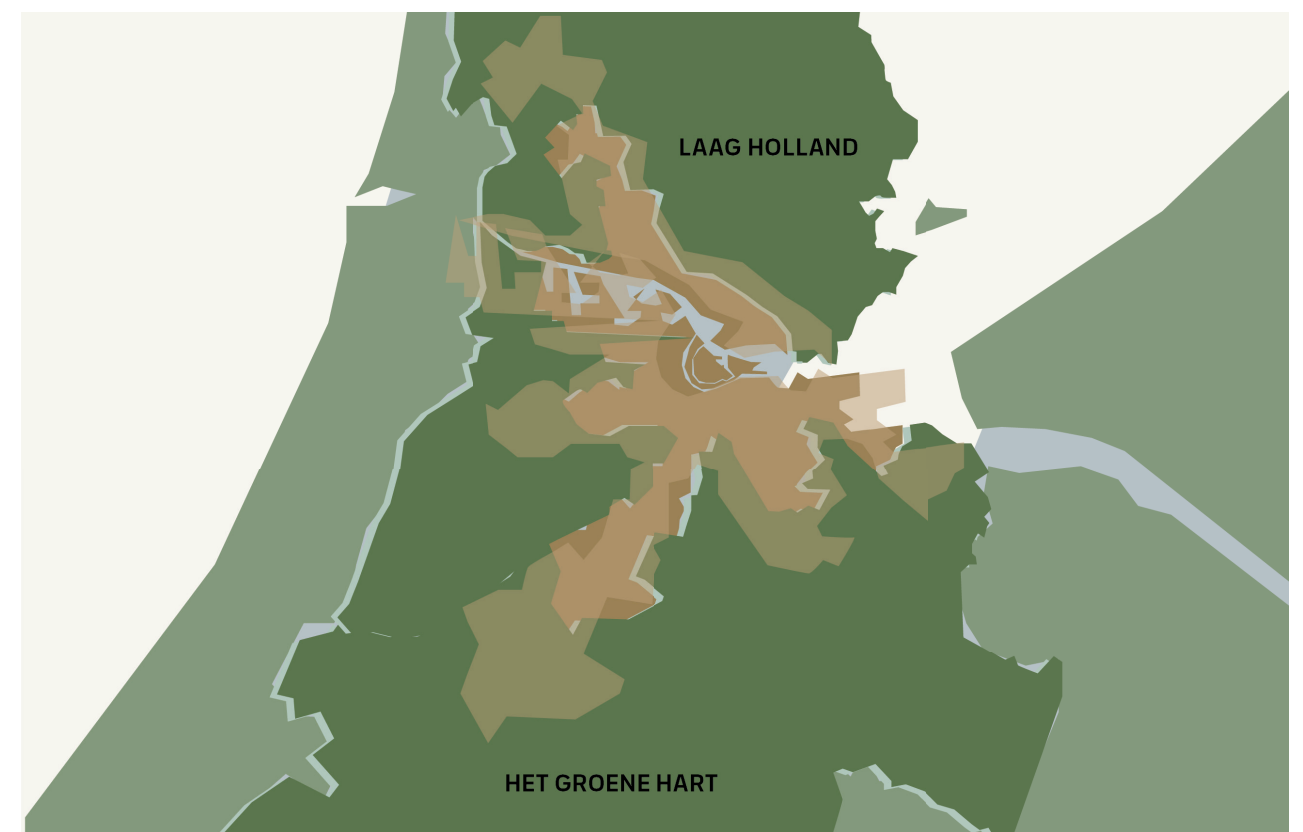
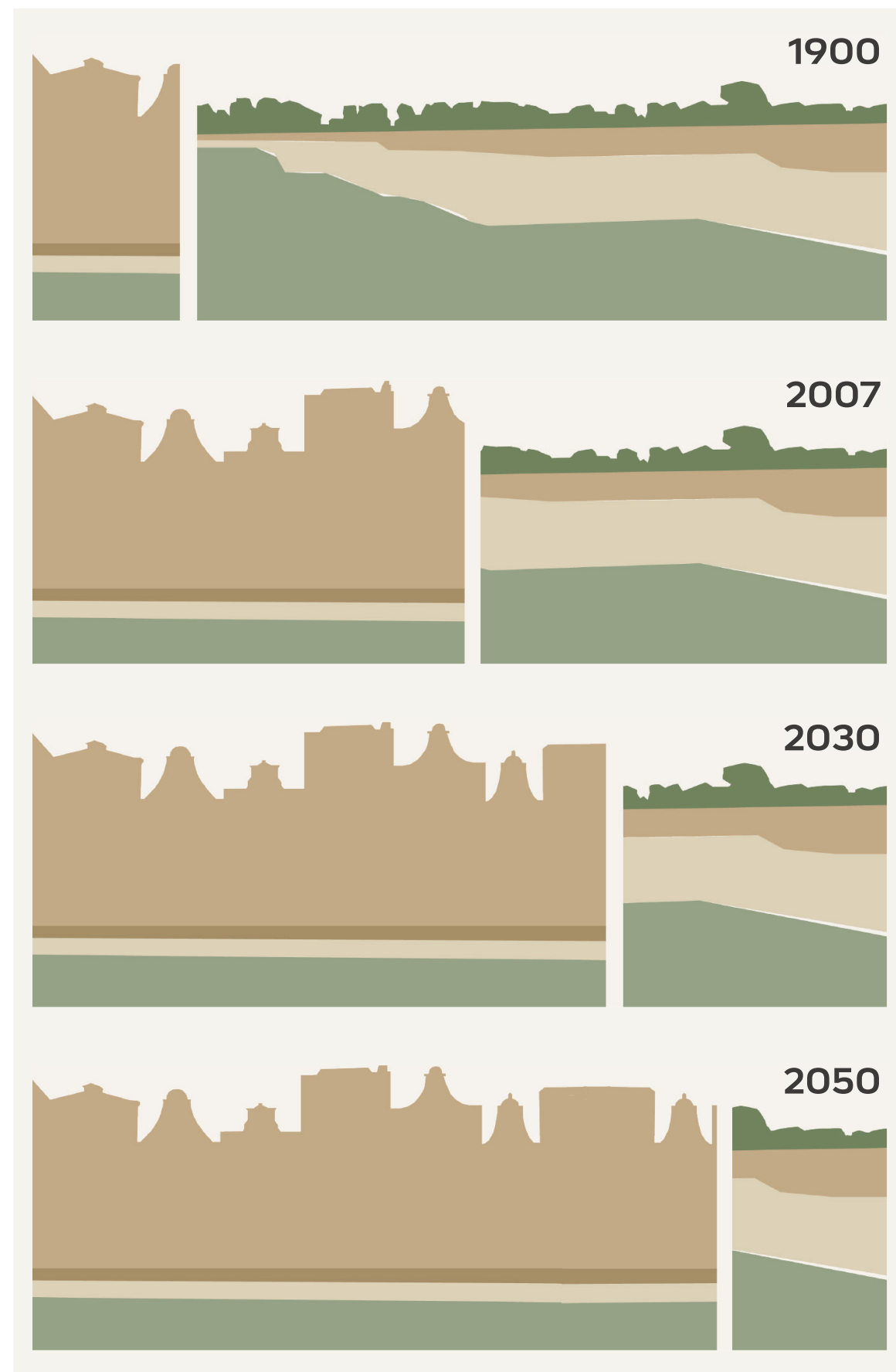
Studio

Name of studio: Architectural Engineering
Design tutor: Mo Smit
Research tutor: Pierre Jennen
Buidling technology tutor: Gilbert Koskamp
Delegate examiner: Andre Mulder

Title

The integration of forest ecologies into the urban environment.

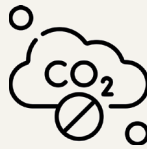
PROBLEM STATEMENT



THE CONTINUOUS CITY



Lack of biodiveristy



CO₂ and dust pollution



Noise pollution



Stormwater flooding



Heat stress



Lack of identity



Less availability of fresh water



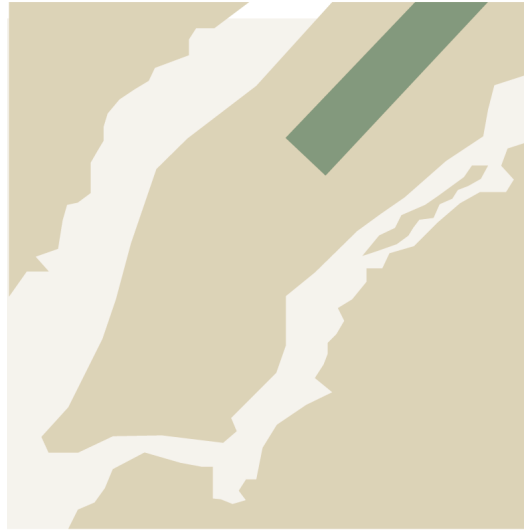
Psychological problems
Integration problems



(RIVM, 2010)

To design an ecological and integrated neighbourhood in a wetland forest landscape, where both landscapes are benefitting from each other's ecosystem services

Thematic research question: "How can urban ecologies and forest ecologies be integrated?"



Centralised planting



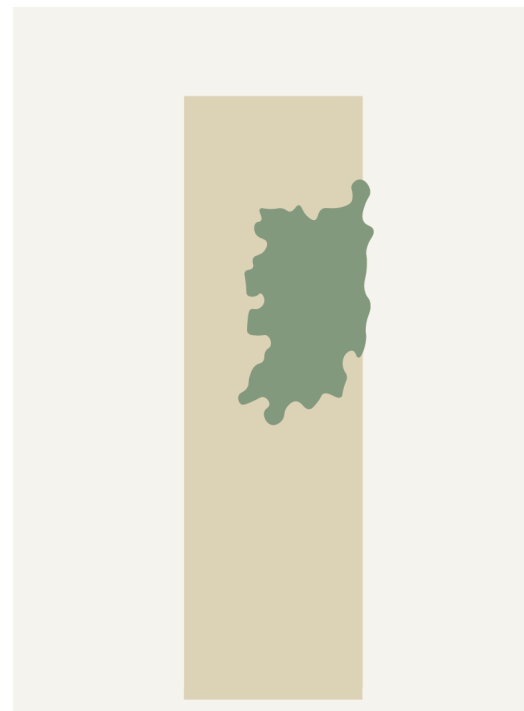
Dispersed planting
"spotty" pattern



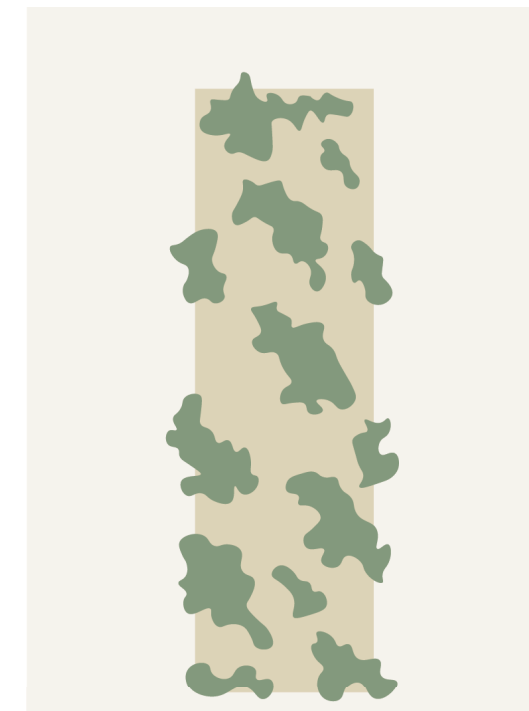
"Stepping stones"



Link existing natural corridors
Continuous planting
"corridors and fingers"



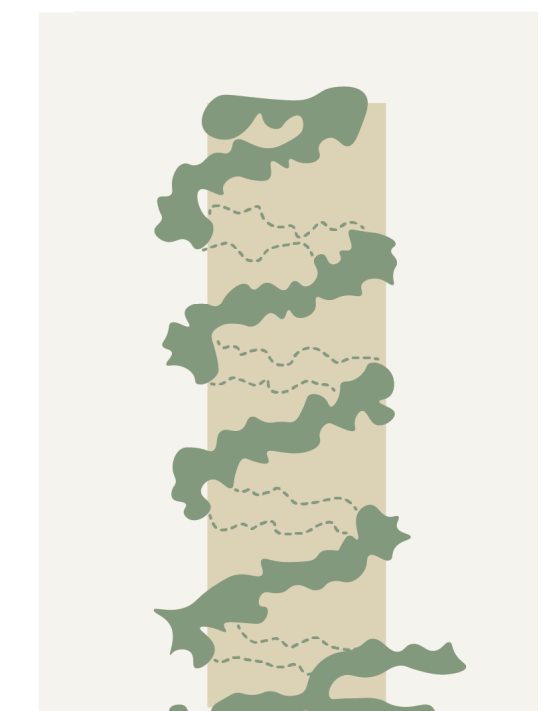
Juxtapositioning



Intermixing

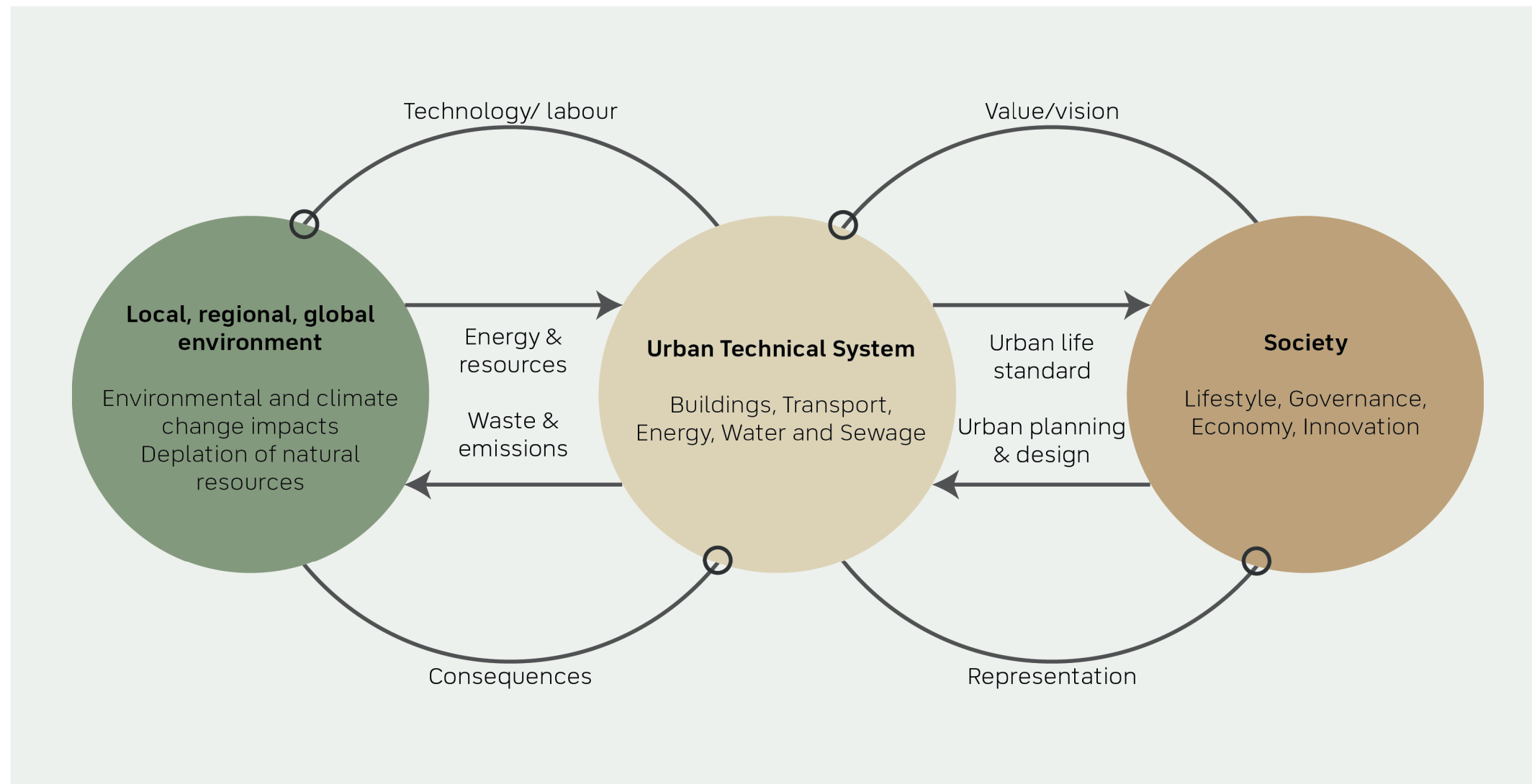


Enhanced intermixing

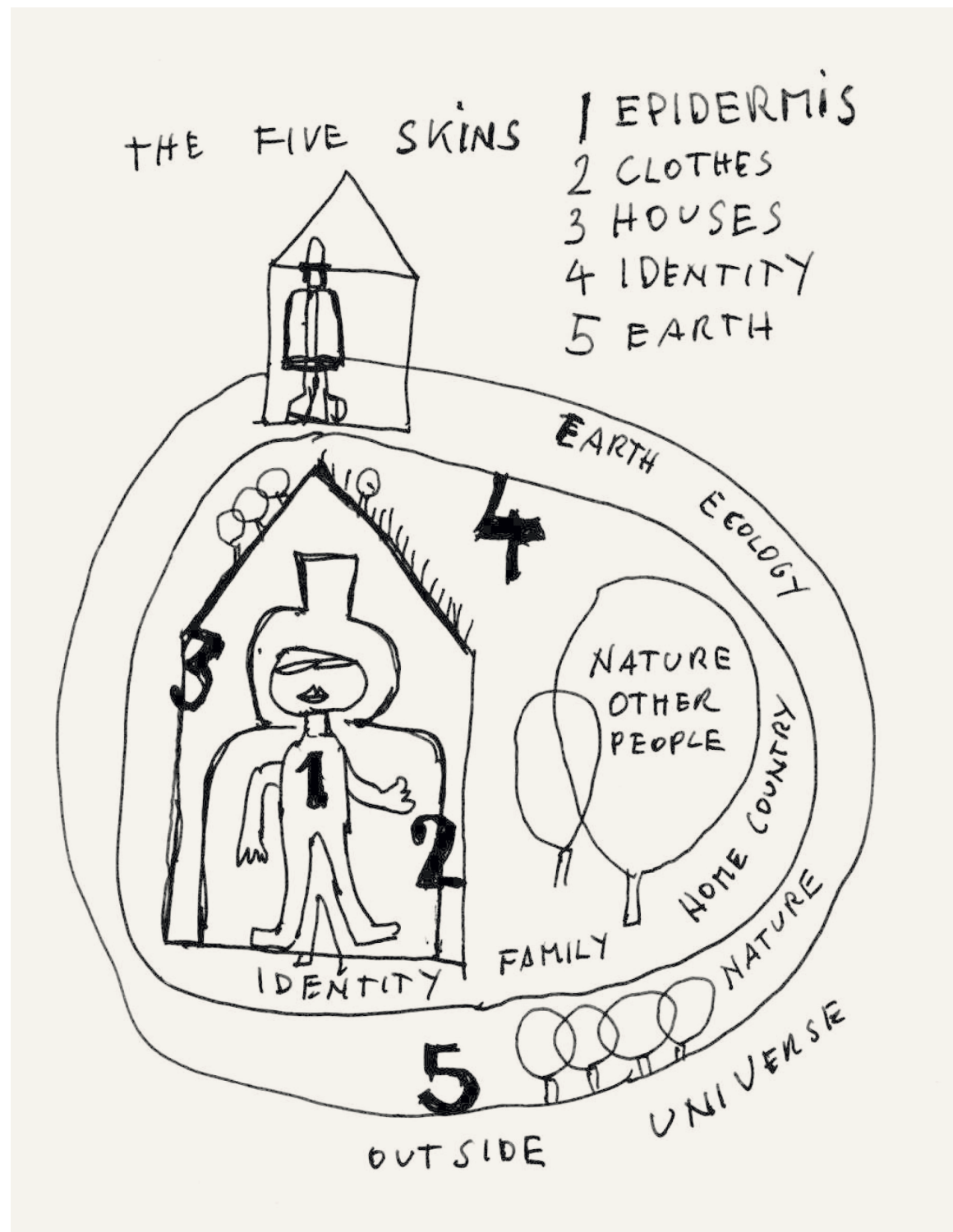


Integrating

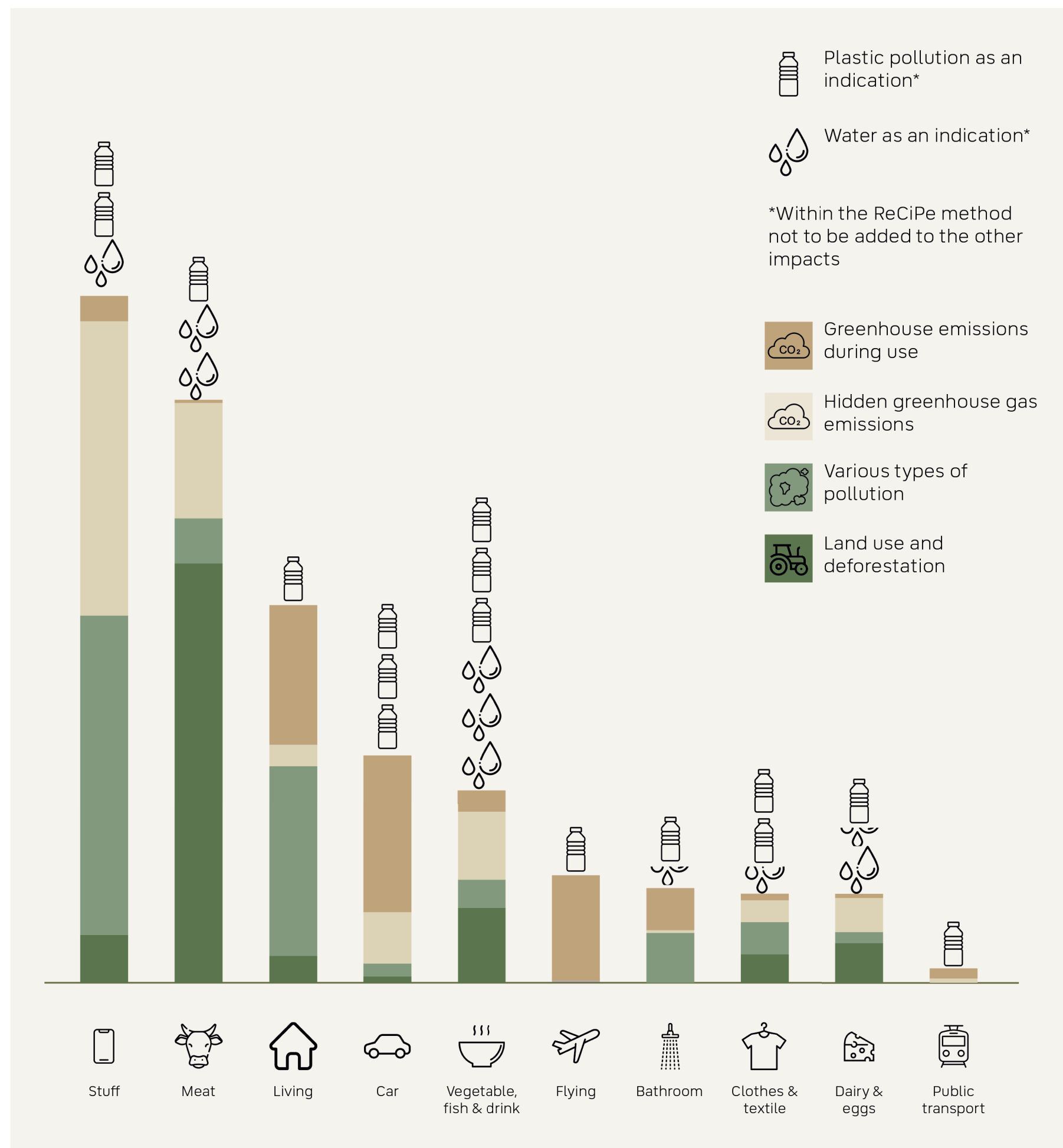
(Yeang, 2018)



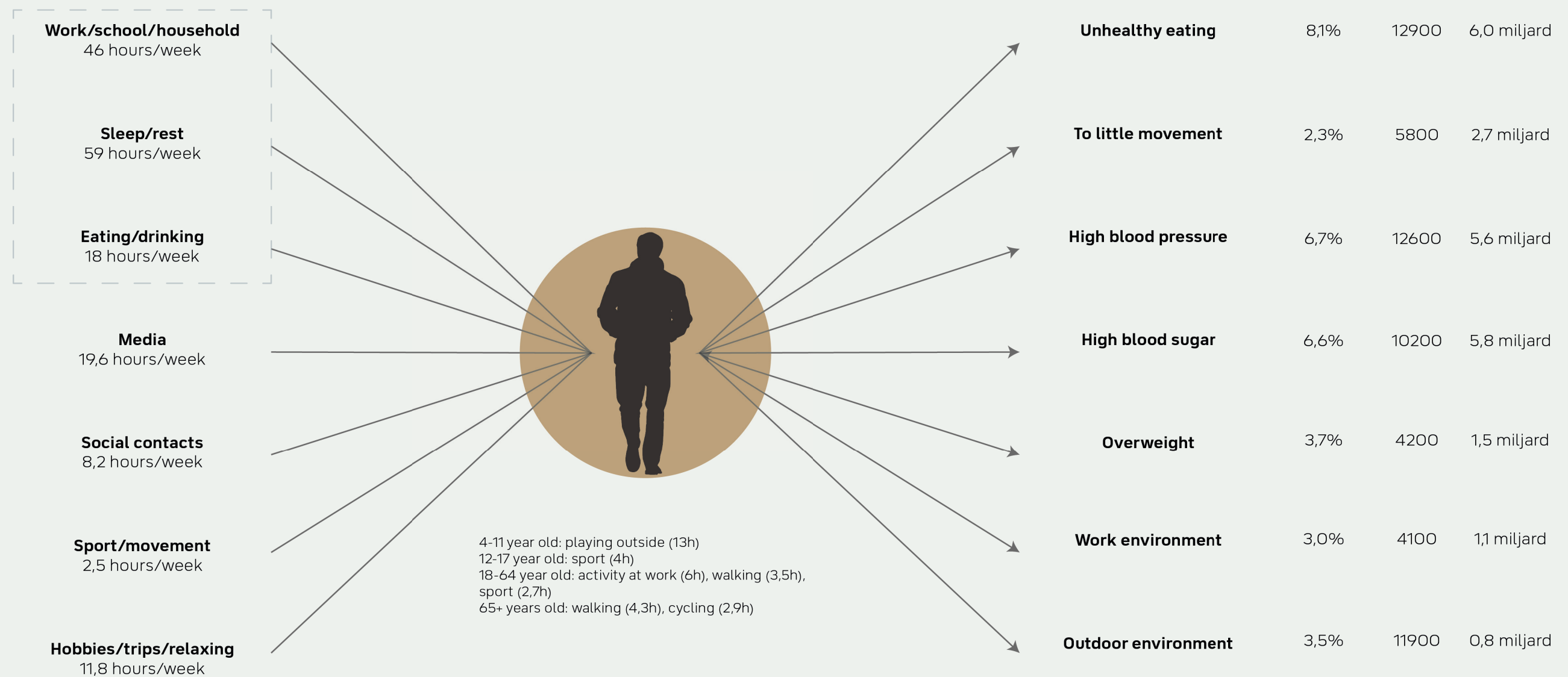
(European Environment Agency, 2020)



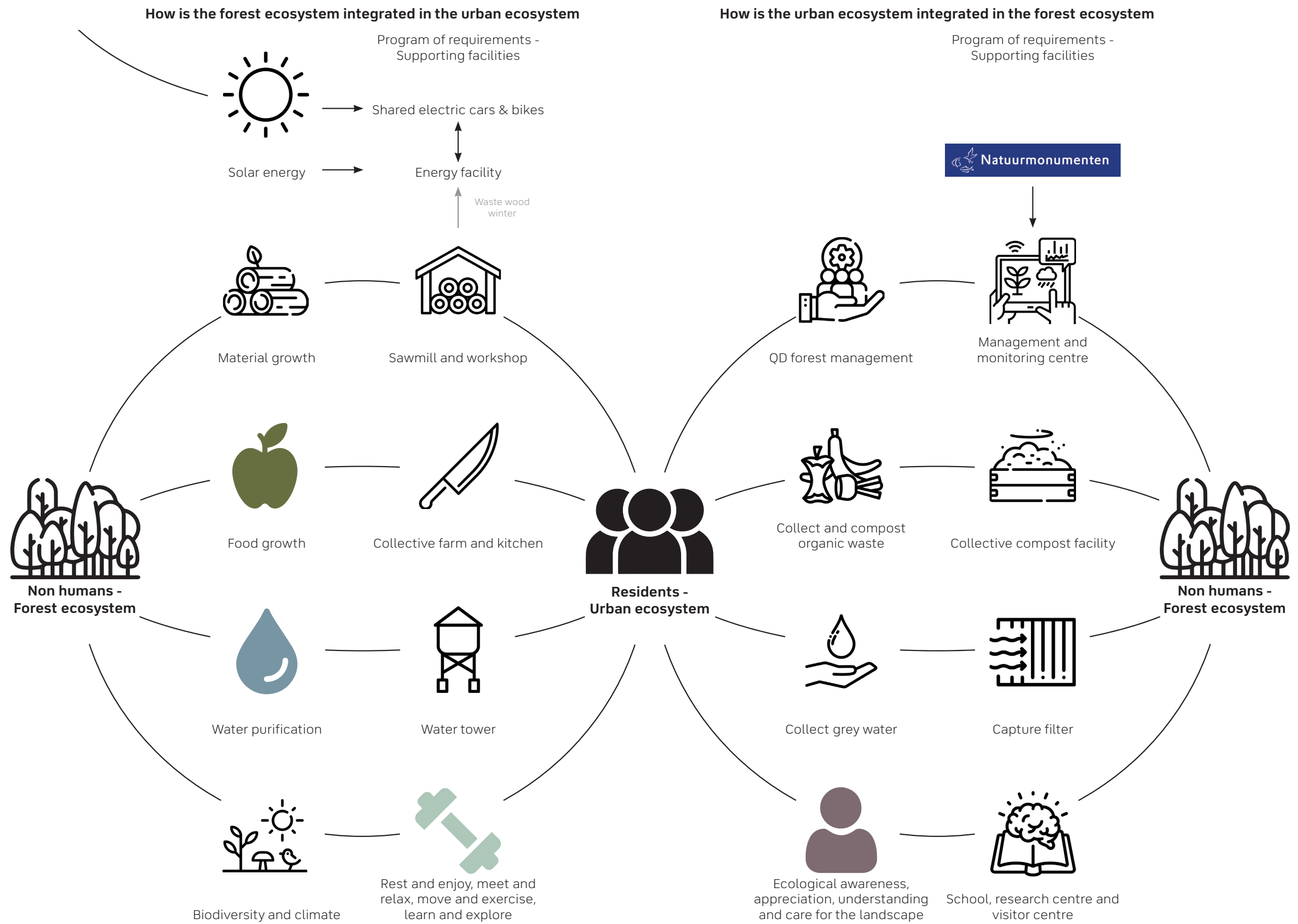
(Hundertwasser, 1980)



(Porcelijn, 2016)

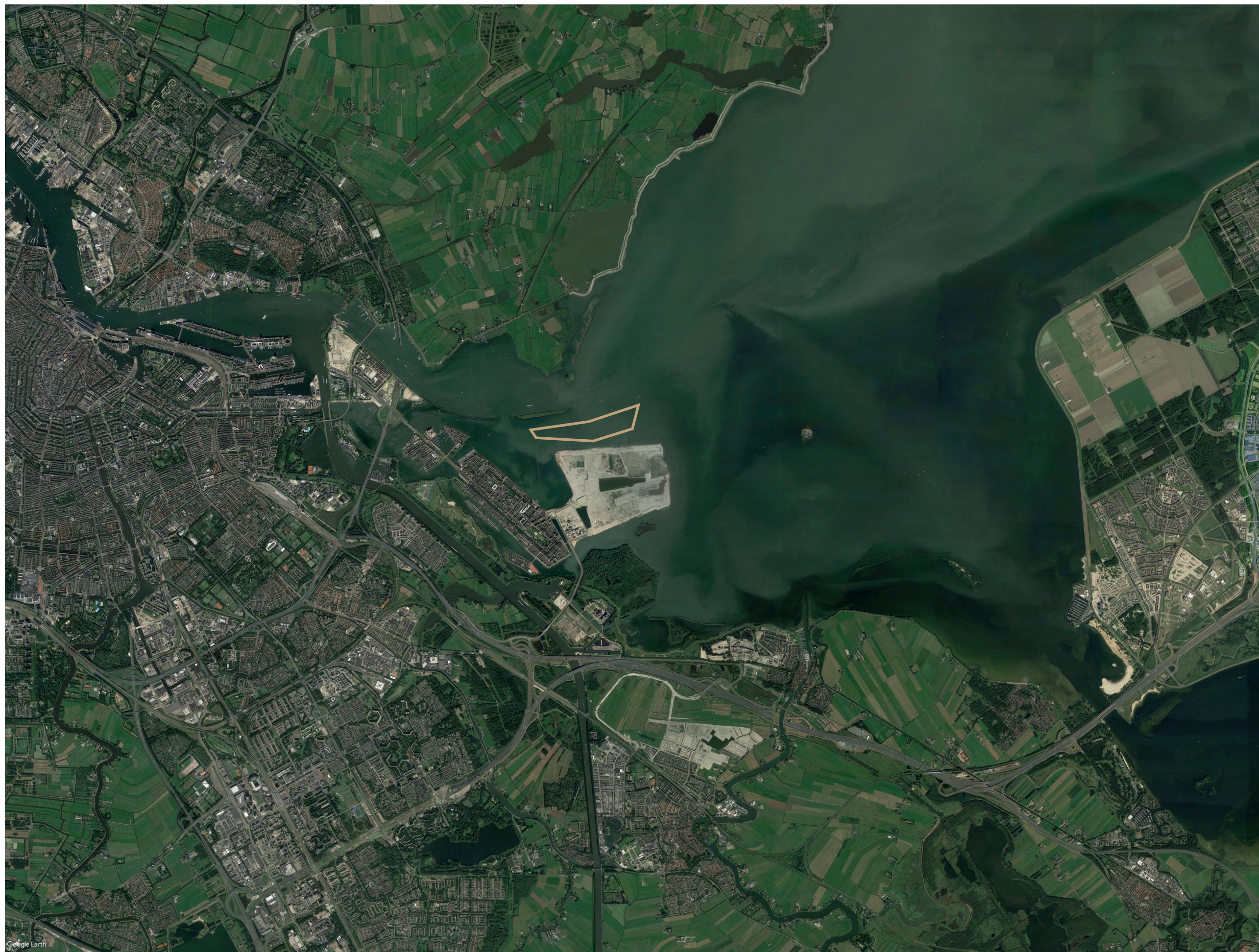


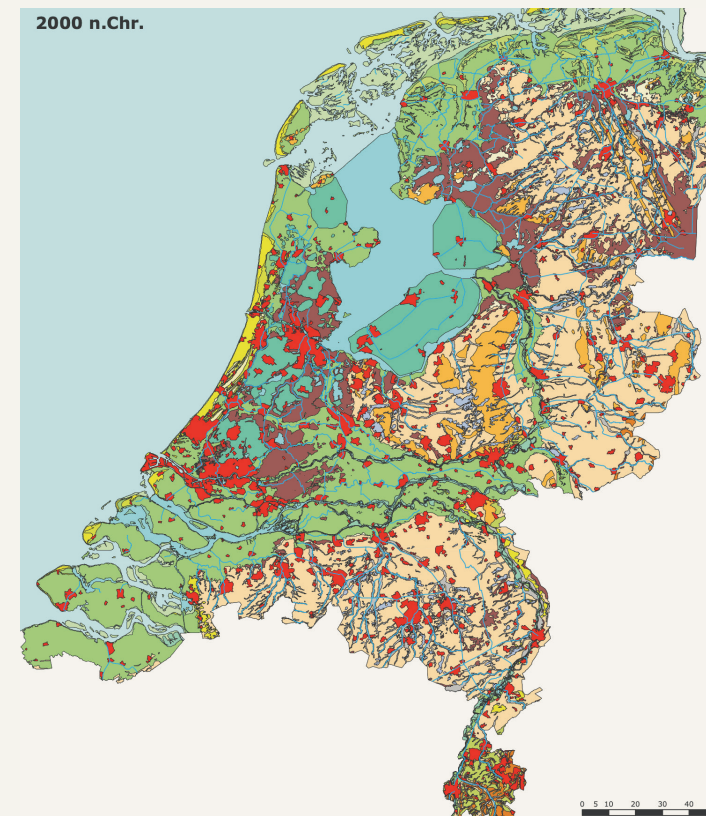
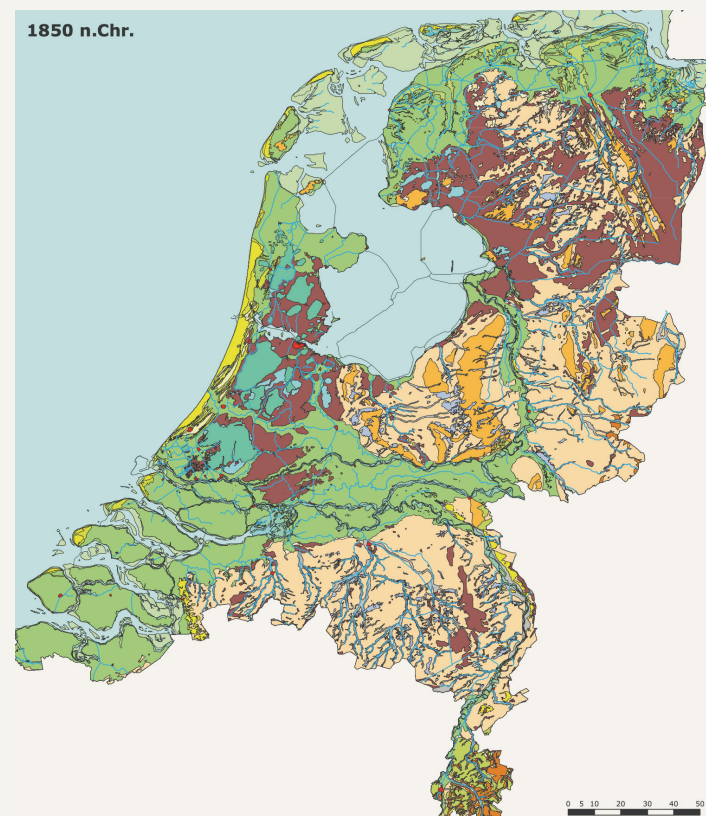
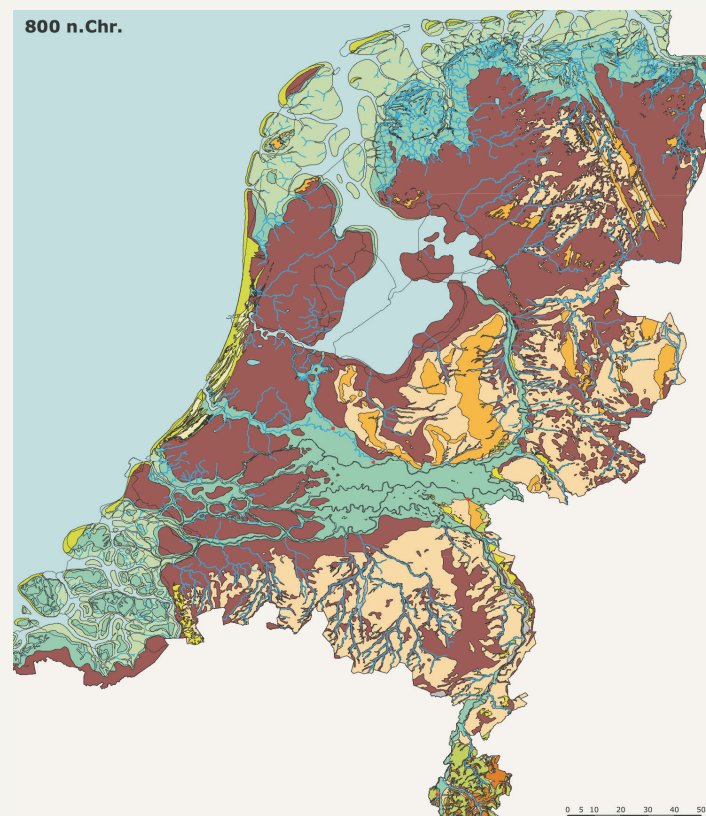
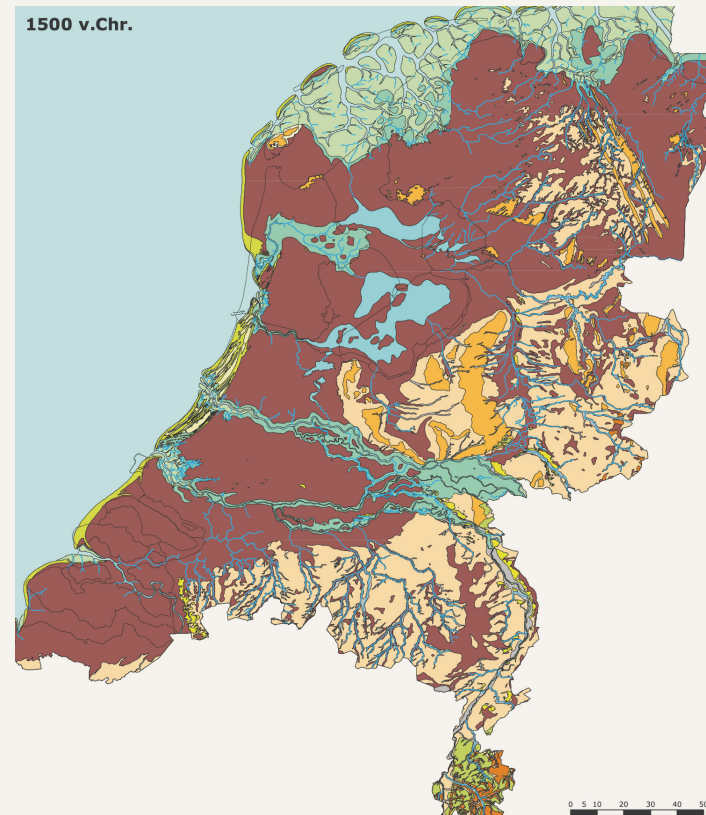
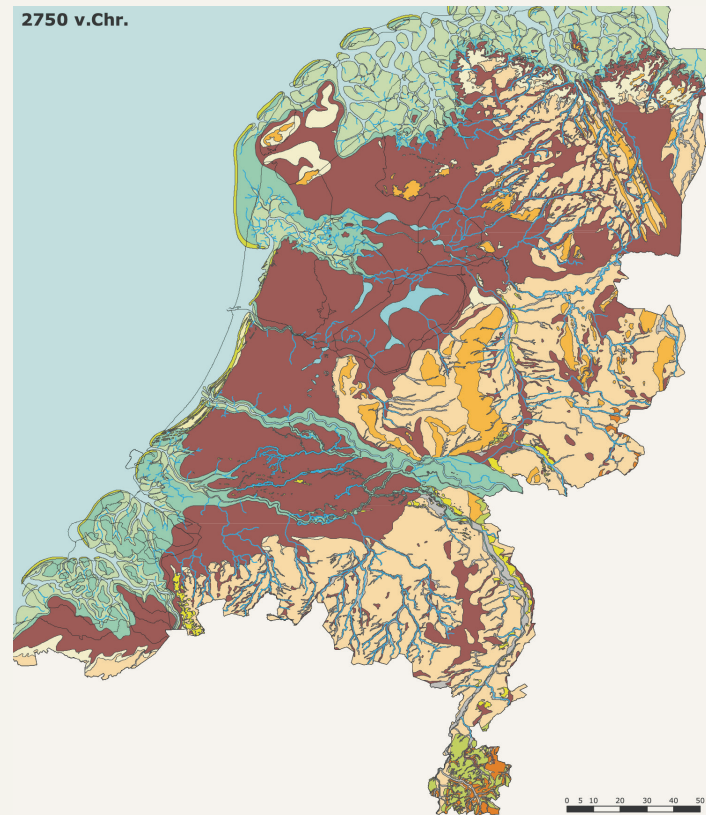
(Sociaal en Cultureel Planbureau & Roeters, 2018, Rijksinstituut voor Volksgezondheid en Milieu, 2018)



SITE AMSTERDAM IJBURG BUITENEILAND







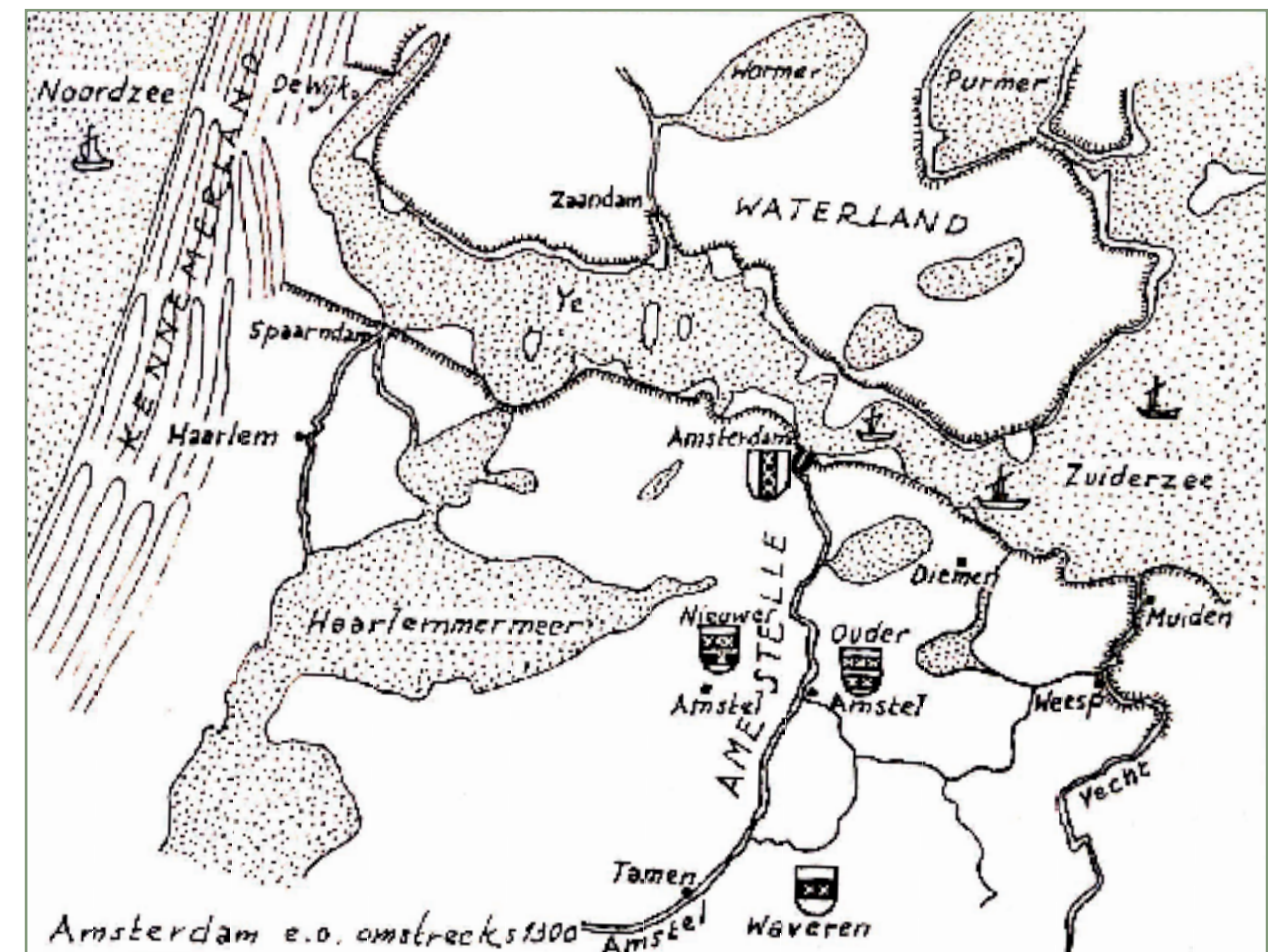
Holocene landscape

- High dunes
- Beach ridges and long dunes
- Beach plains and dune valleys
- Tidal flats and mudflats
- Salt marshes and river plains
- Areas with salt marshes and ridges
- Peatland area
- Embanked salt marshes and river plains
- Droogmakerij
- Urban area

Pleistocene landscape

- External and internal water
- Pleistocene sandy areas, below 16m. -NAP
- Pleistocene sandy areas, below 16 and 0m. -NAP
- Pleistocene sandy areas, above 0m. NAP
- River plain and stream valleys
- Riverdunes
- Löss area
- Weirs, pushed boulder clay and ridges and valleys modelled by flowing land ice
- Areas with Tertiary and older deposits
- Drift-sand

(Rijksdienst voor het Cultureel Erfgoed, TNO, & Deltares, 2020)



(Janse, 2016)





Various wetland species: ronde zonnedauw, gele lis, koekoeksbloemen, veenpluis, koekoeksbloem, moeraskartelbald, orchideeën, zegge, waterzuring, watermunt, riet, watergentiaan, kikkerbeet, krabbenscheer, waterlelie.



Various wetland species: lepelaar, kwak, bruine kiekendief, roerdomp, woudaapje, porseleinhoen, blauwborst, kleine karekiet, bosrietzanger, blankvoorn, modderkruiper, snoek, otter, dwergmuis, boommarter, libellen, ruggenzwemmers, kokerjuffers, oranjetipje, zilveren maan.



North elevation forest dwelling
(Royal HaskoningDHV, 2017, Wageningen University & Didde, 2020)



Wetland as local food forest



Wetland forest crops:

Trees:

- Birch (Berk)
- Walnut (Walnoot)
- Pecan

Large Shrubs:

- Hazel (Hazelaar)
- Elder (Vlier)

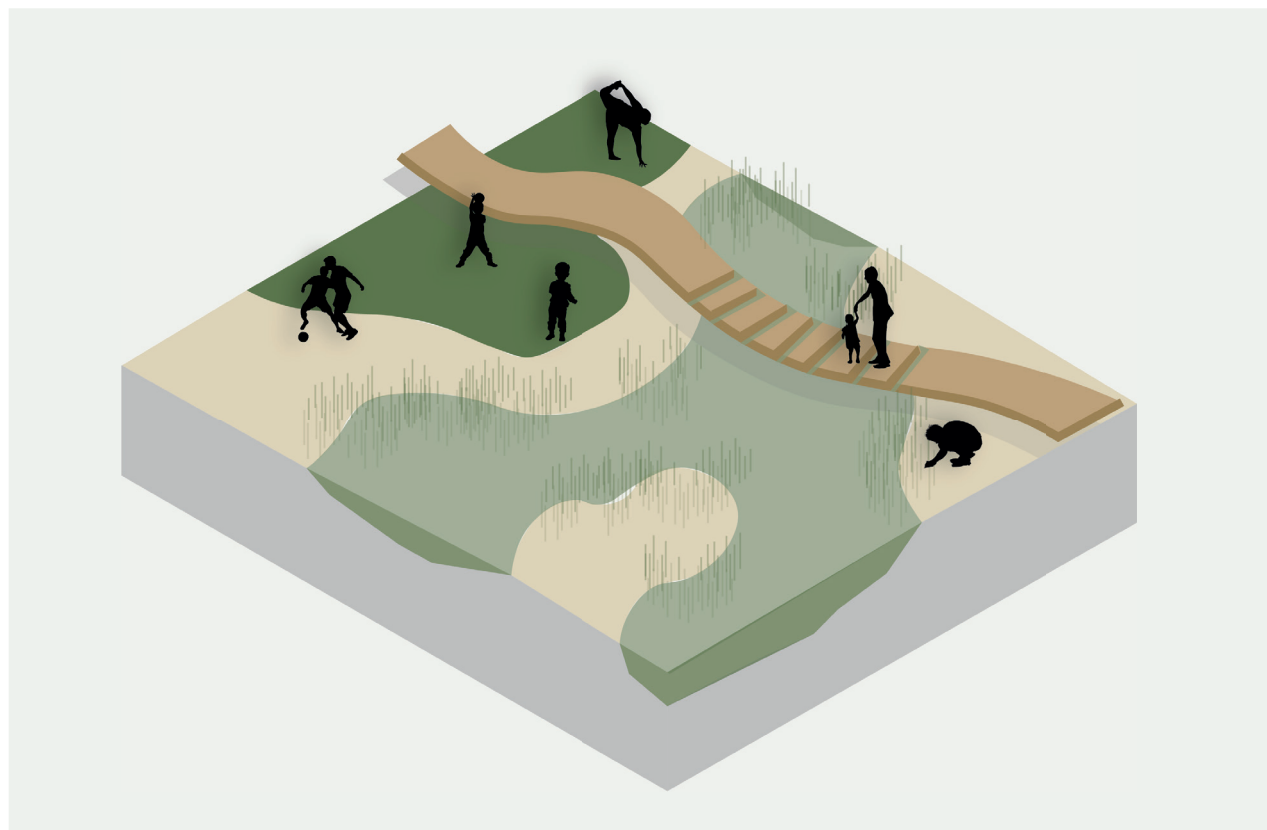
Small Shrubs:

- Honeyberry (Honingbes)
- Cranberry
- Chokeberry (Appelbes)
- Blackberry (Zwartebes)

Herbaceous layer & swamp plants:

- Common cattail (Lisdodde)
- Azolla
- Angelica root (Engelwortel)
- Water spinach
- Chives (Bieslook)
- Pickerelweed (Snoekkruid)
- Indian rhubarb (Indianen rabarber)
- Water mint
- Horseradish (Mierikswortel)
- Roman chervil (Roomse kervel)
- Black chervil (Zwart moes kervel)
- Common Bistort (Adderwortel)
- Giant rhubarb (Mammoetblad)
- Narrow leaved cattail (Kleine lisdodde)
- Broad leaved cattail (Grote lisdodde)
- Water-archer (Pijlkruid)
- Calamus (Kalmoes)
- Horse Mint (Hertsment)
- Purple loosestrife (Kattenstaart)

East elevation wetland dwelling
(Voedselmoeras Den Haag, 2021)



Play and discover



Rest and enjoy



Swimming and sunbathing



Eating and meeting

How to develop a new wetland forest ecosystem on a 'manmade' sandy island?

Breeding areas



-0,7/-1,0m NAP
calm water areas

Food supply



0,0--0,4m NAP
variable water level
wetland

Resting areas



0,0/+1,0m NAP
Riparian forest

Year 0 - Start construction island by raising sand ridges

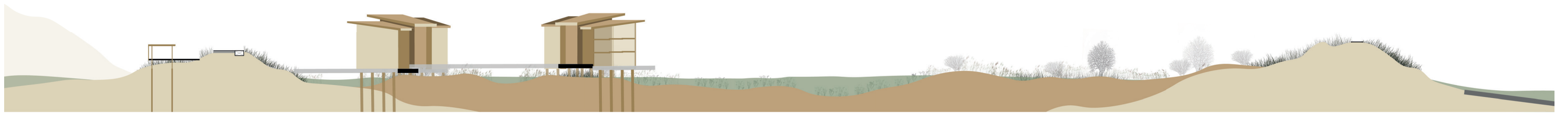


Year 0 - 3 - Anchor the sandridges with stones and vegetation. Fill the area between the sandridges by spraying on excessive silt from the bottom of the IJmeer.



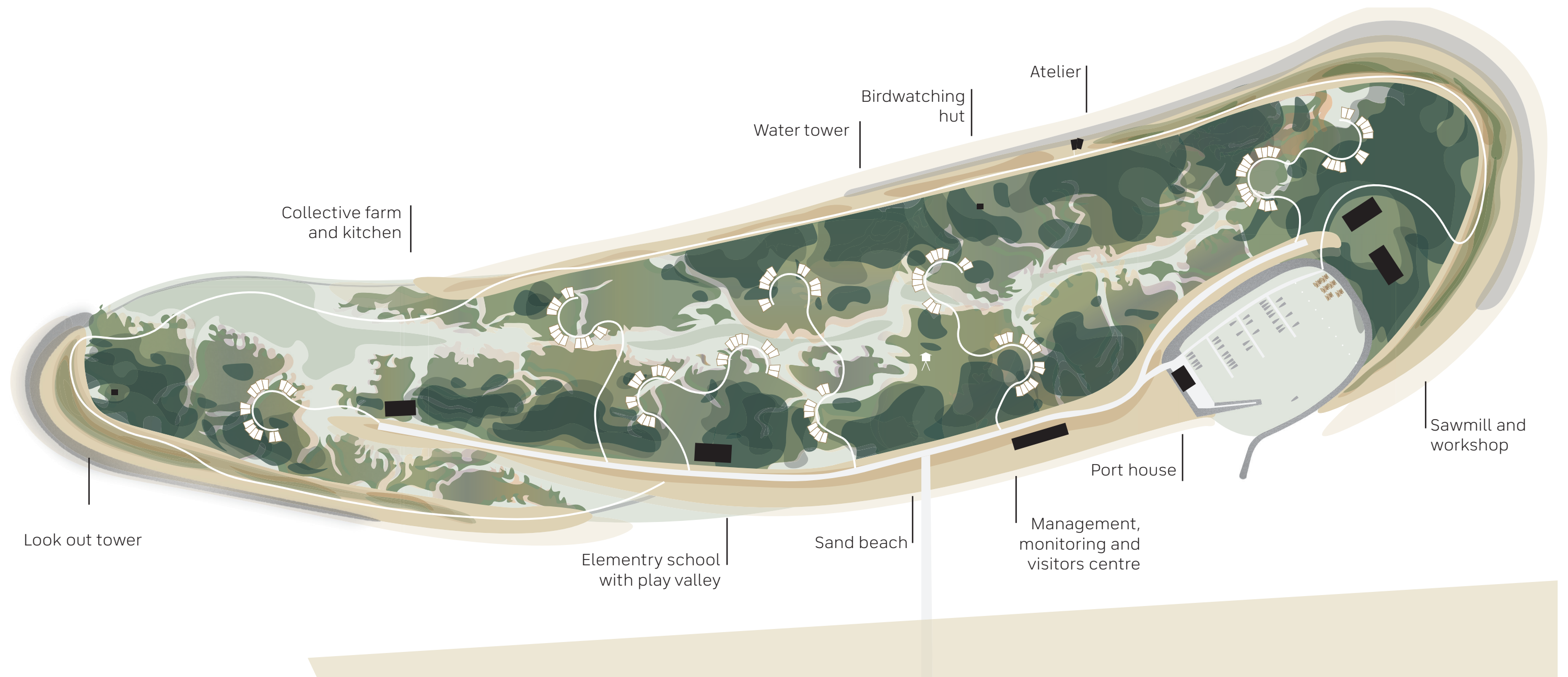
Year 5 - Plant diverse underwater plants, grasses and shrubs to start the first ecological processes by attracting, insects, birds and fishes.



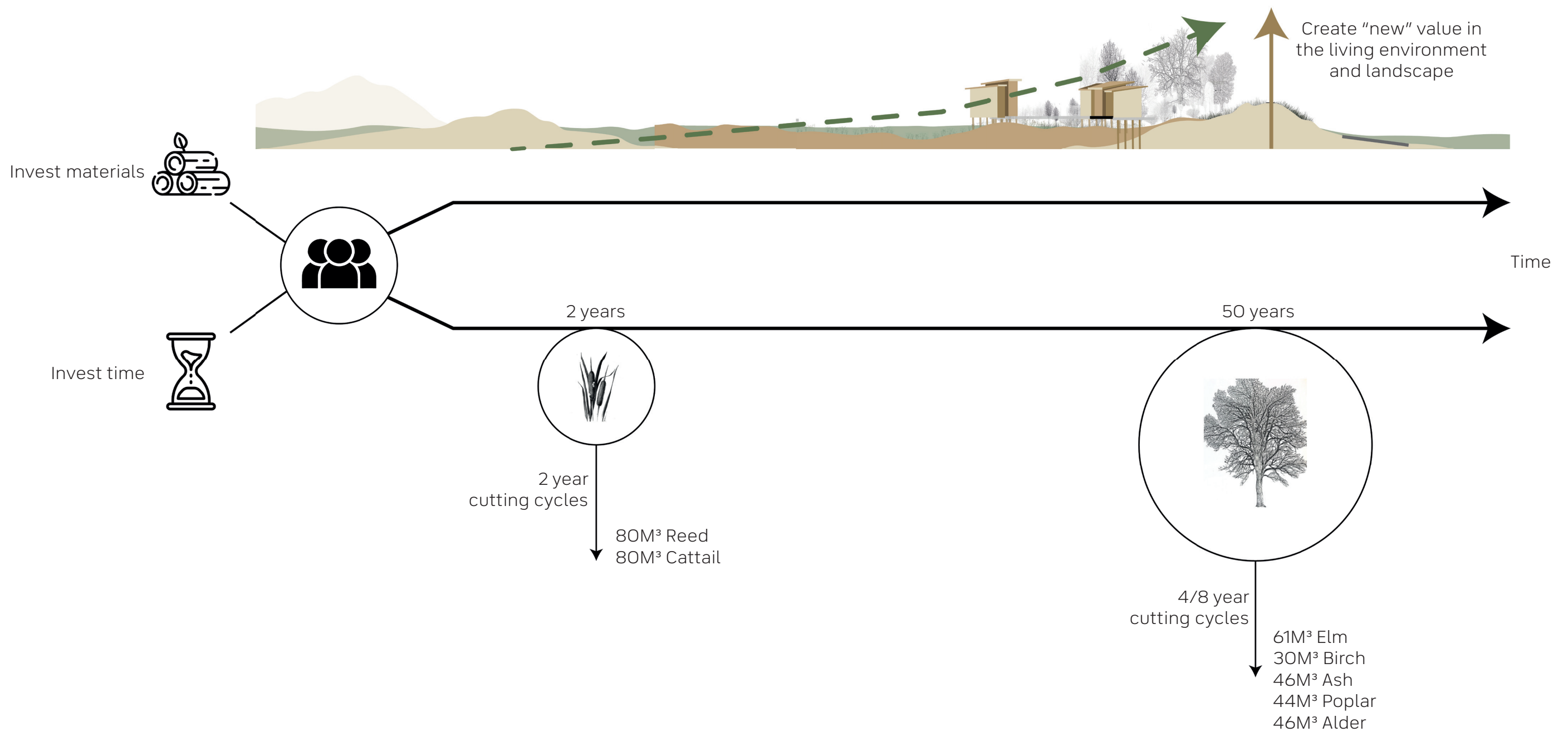


Year 7 - 8 - Plant the first trees close to each other according to the miyawaki reforestation method. To create a self sustaining forest ecosystem within 10 years.





>30 years



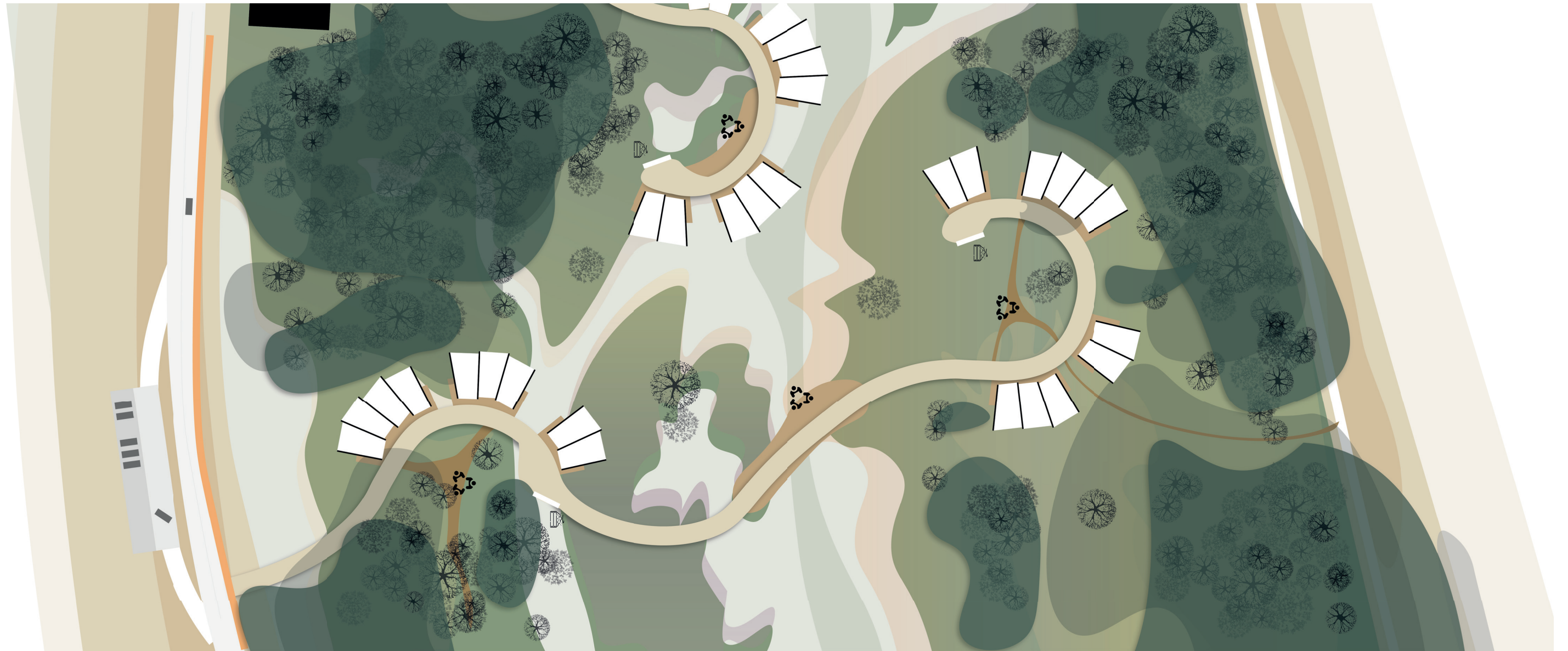












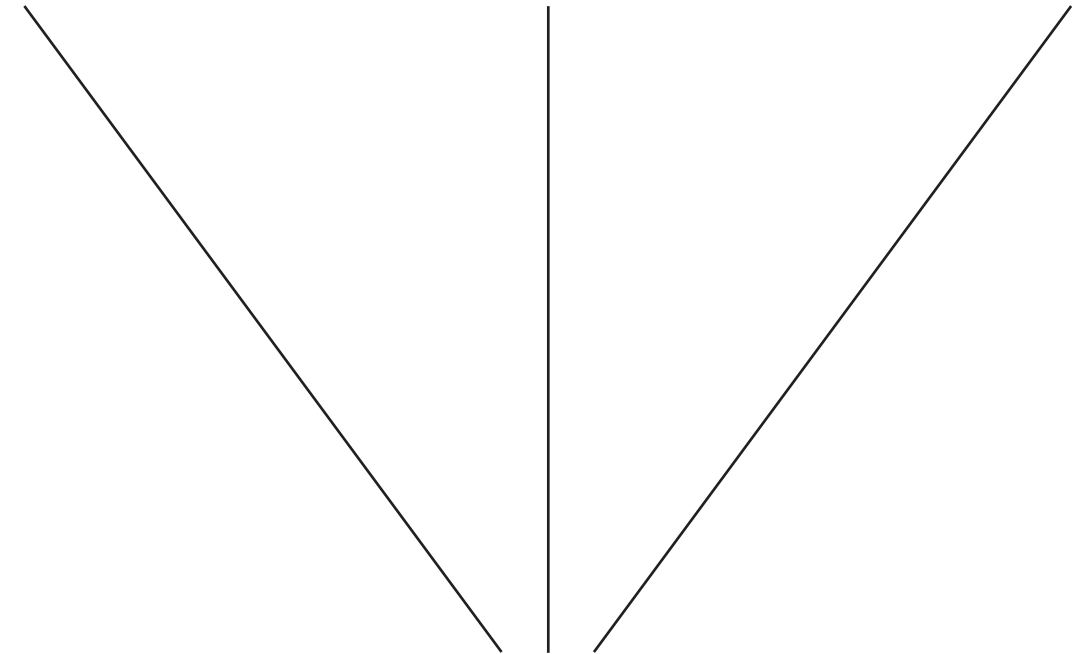




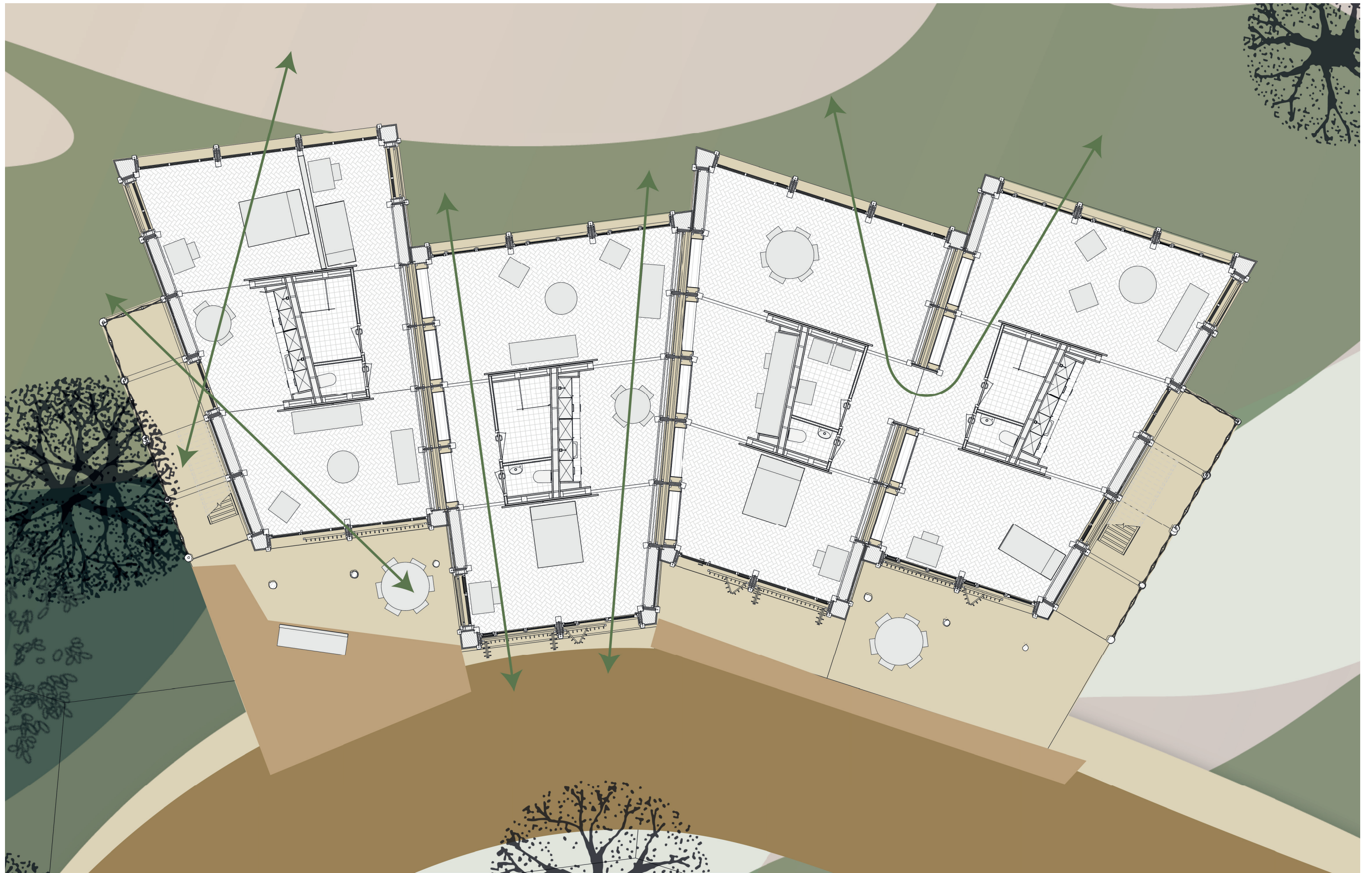
Foundation of residents and
initiators

Management foundation

Foundation activity energy and
mobility



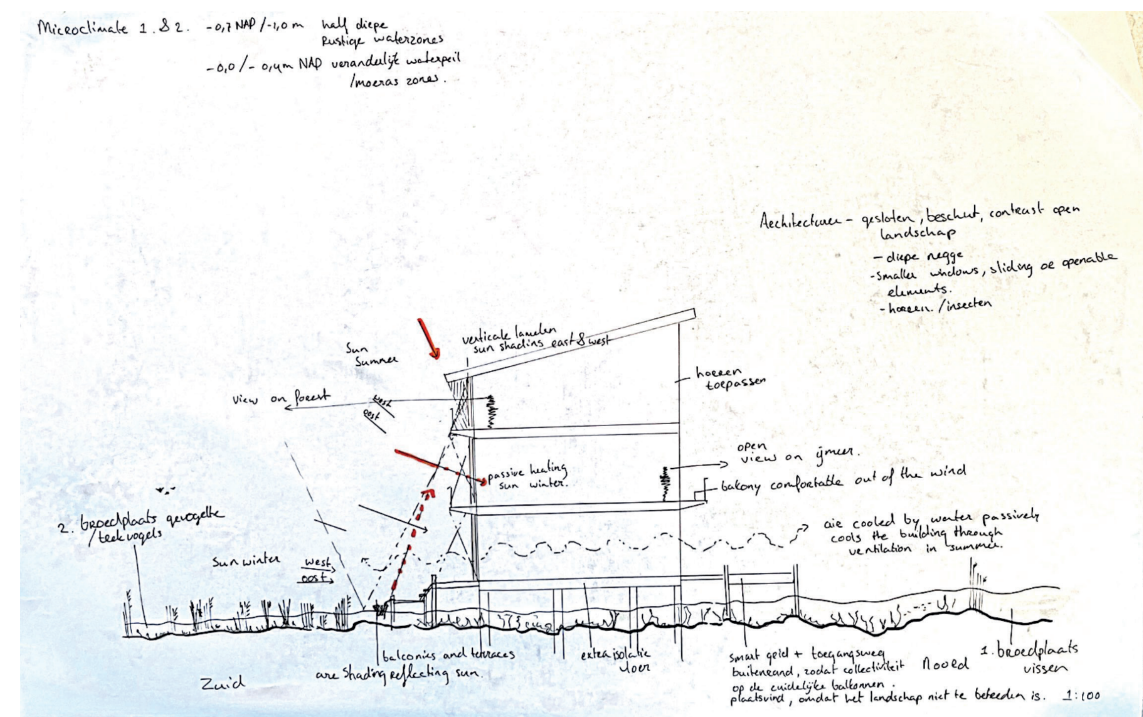
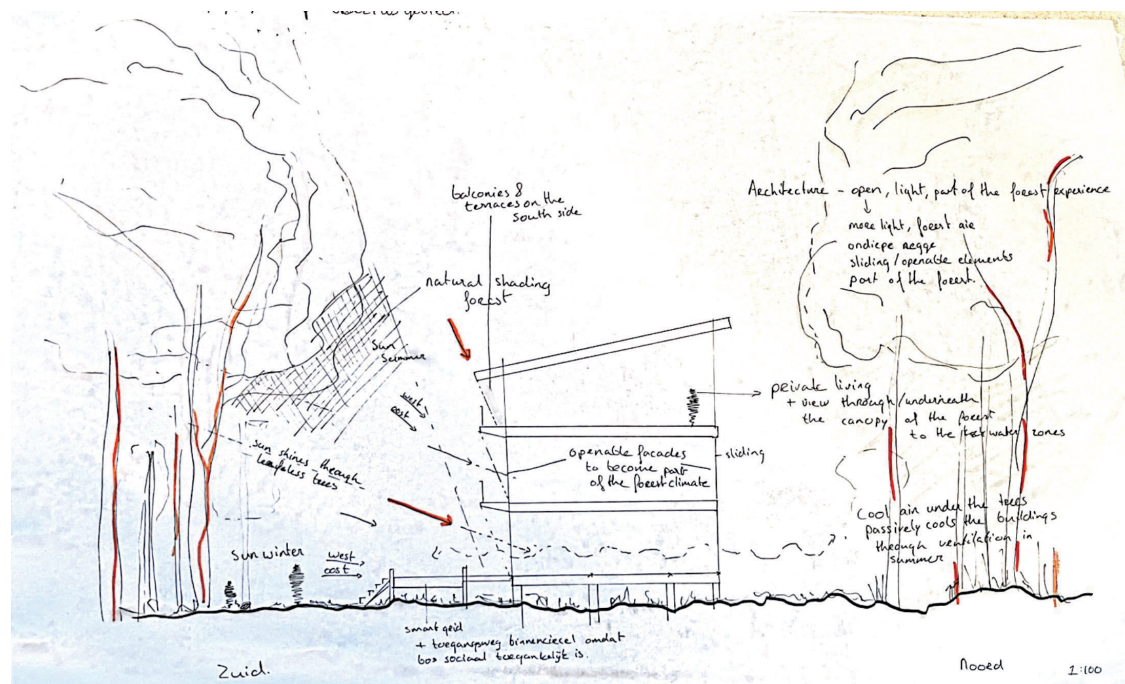
3 chosen residents per street
represent the interests of the
whole street

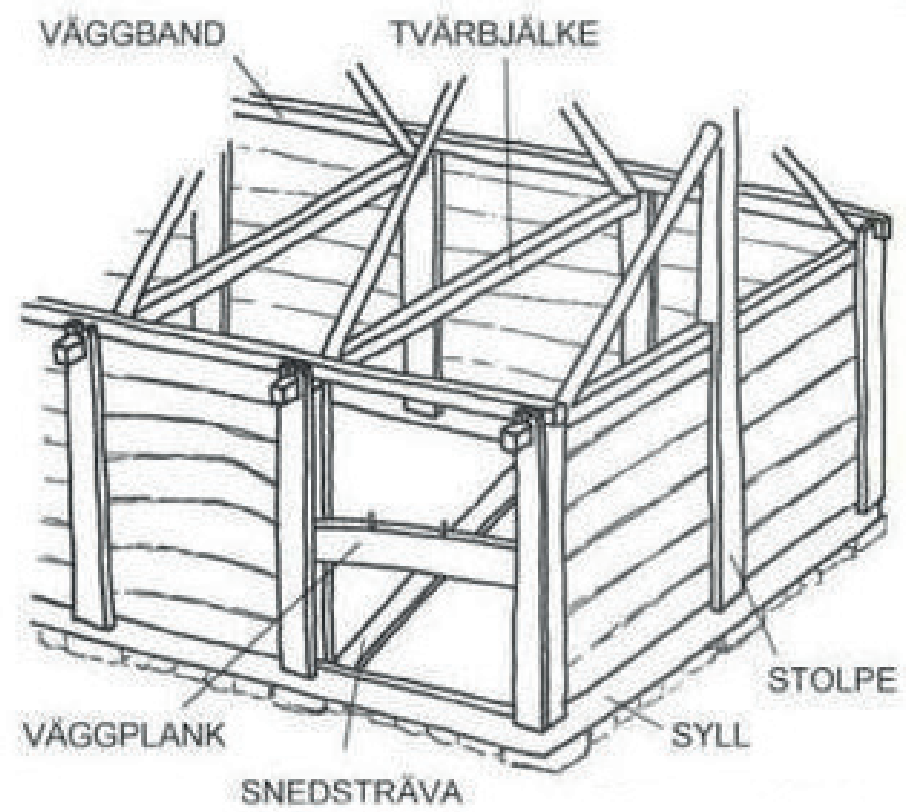


The flexibly useable rooms enable creating different spatial conditions and views
 ↑ N 1:100



The dancing floors create different positions and views in relation to the landscape 1:100



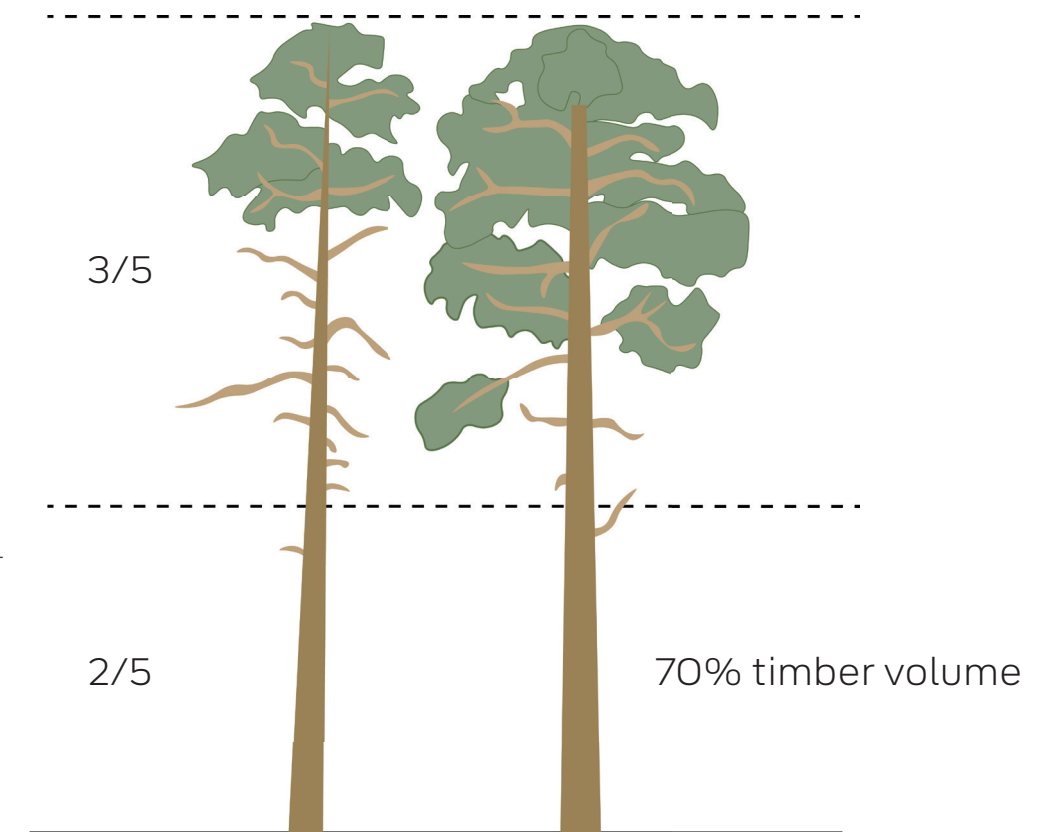
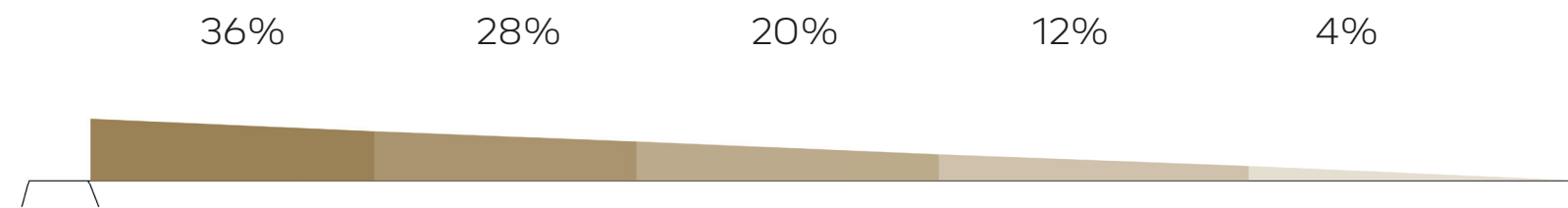


Traditional post-plank, Skiftesverk or Ständerbohlenbau construction method



Bålehus: The farm consists of two farmhouses, the first built in 1688, the second in 1737.





Dosse hout



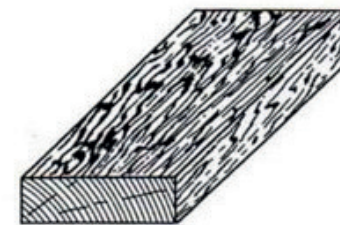
werking van dosse hout



kwartiers hout



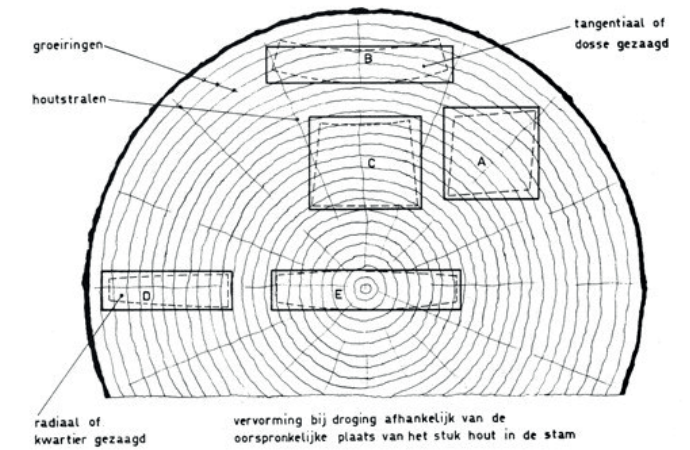
werking van kwartiers



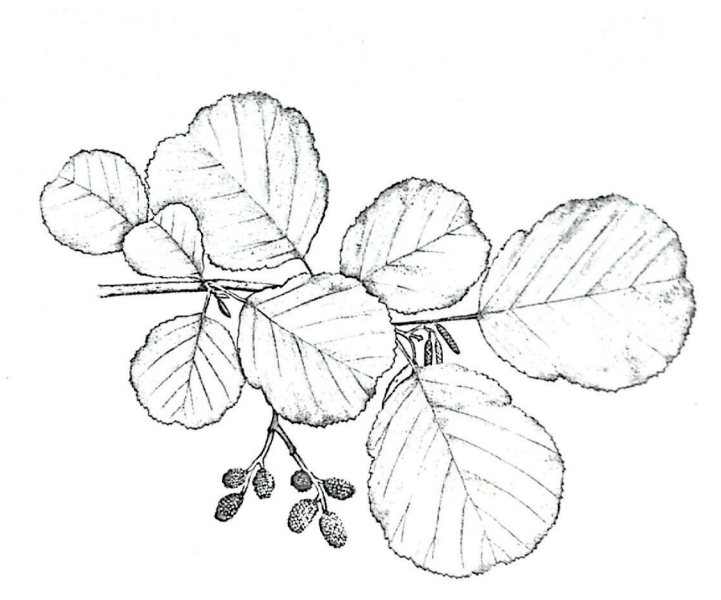
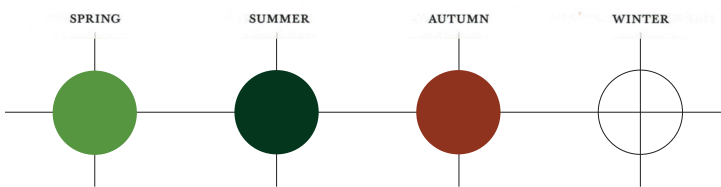
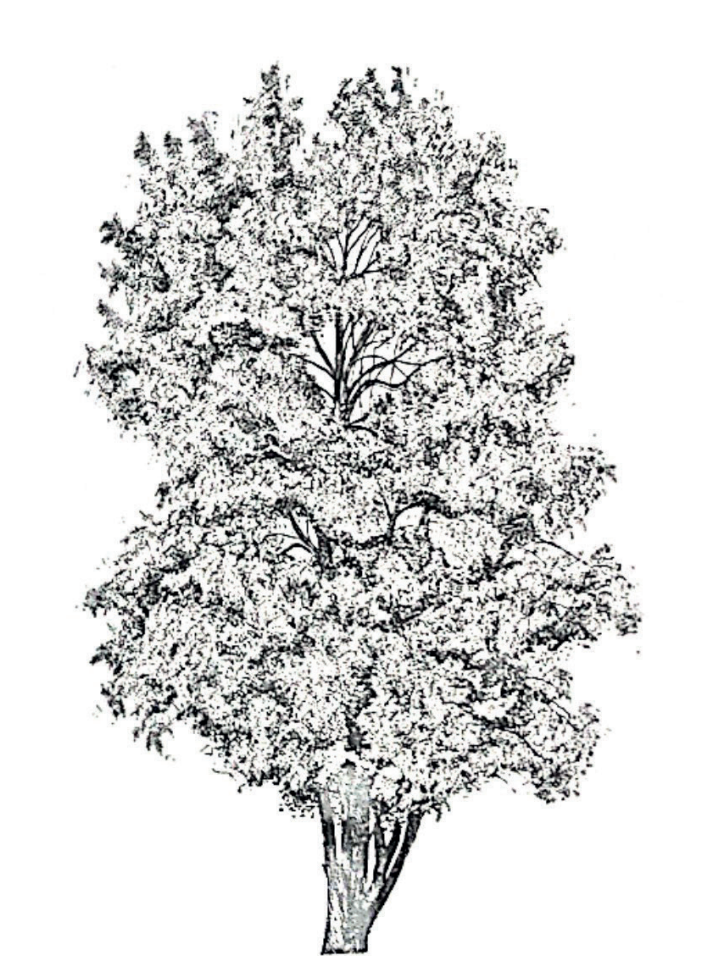
half kwartiers hout



werking van half kwartiers



Material - Black Alder (Zwarte Els) - Alnus glutinosa



Tree hight 10-20m
Branch-free stem 6-12m
Diameter 0,3-1,2m

Tree species Deciduous
Type of timber Alder is soft, tough and moderately strong.

Appearance The trunks are almost always whole, with sparse branches that are spread assymetrical. The bark is greenisch-brown, smooth and glossy, and with age it cracks into segments. The color of the wood when cut changes from yellow to bright red.

Colour Dark green in colour on the upper pagina and lighter on the lower pagina.

Application Under water foundations

Processing tree into high quality durable timber 1. **Watering the tree trunks for 9-12 months** makes the timber thougher and harder.

- Other reasons to water the trunks are:
- For easier transportation
 - For easier sorting
 - To prevent drying cracks
 - So the wood can't be t affected by insects & fungi
 - To rinse substances affected by insects and fungi out
 - To change its structure so that the wood is easier to debark, easier to saw, dries faster and is better to impregnate

2. Debark the tree, so the wood has less discolouration, the sap wood hardens faster and is less affected by insects.
3. Saw in desired dimensions
4. Dry the timber.
5. Impregnate with linseed oil using the drenching technique.

Estimated lifespan of the timber >100 years - keeps its quality for centuries under water

Black Alder
Tree specifications

Growing time 50 years
Height 20 m
Target diameter 450/600 mm

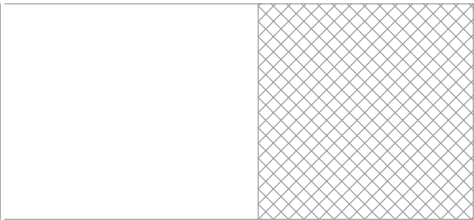
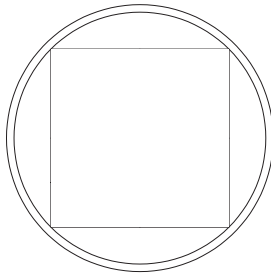
Max. length sawn timber 12,5 m

Architectural appearance

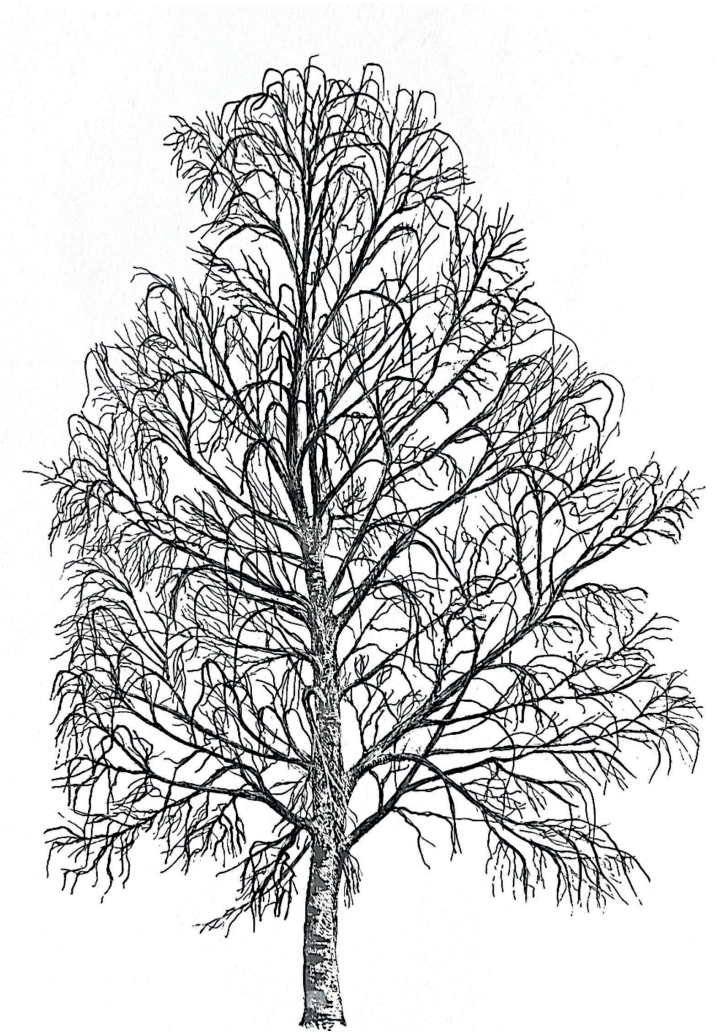


Target diameter & Saw diagram

Length stem - 12,5m
Target diameter - 450mm - 600mm
Gekantrecht timber



Material - Birch (Berk) - *Betula pendula Roth*



Tree hight
Branch-free stem
Diameter

18-21m
9m
0,5-1,0m

Tree species
Type of timber

Deciduous
Birch is soft and can be worked well.

Appearance

It has a erect trunk, ascendant major branches and thin secondary branches that hang downward, a sparse light crown and thin, smooth, white bark that flakes off in horizontal silver-colored strips. Birch forests are not dark and have a dense undergrowth with various grasses and shrubs.

Colour

The upper pagina is intense green and the lower one is paler green; they turn golden yellow in autumn.

Application

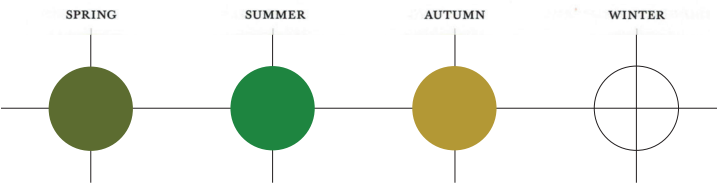
Indoor carpentry, flooring and furniture

Processing tree into high quality durable timber

- 1. Debark the tree, so the wood has less discolouration, the sap wood hardens faster and is less affected by insects.
- 2. Saw in desired dimensions
- 3. Has to be relatively quickly **steam dried** since it is sensitive to blue mould.
- 4. Impregnate with linseed oil using the drenching technique.

Estimated lifespan of the timber

>50 years



Birch
Tree specifications

Growing time >50 years
Height 18-21 m
Target diameter 450/600 mm

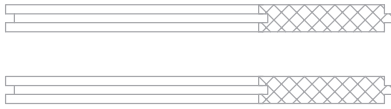
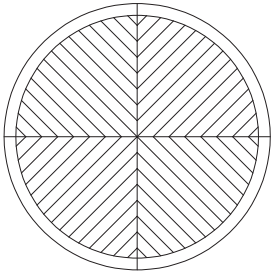
Max. length sawn timber 7,2-8,4 m
2/5 rule

Architectural appearance

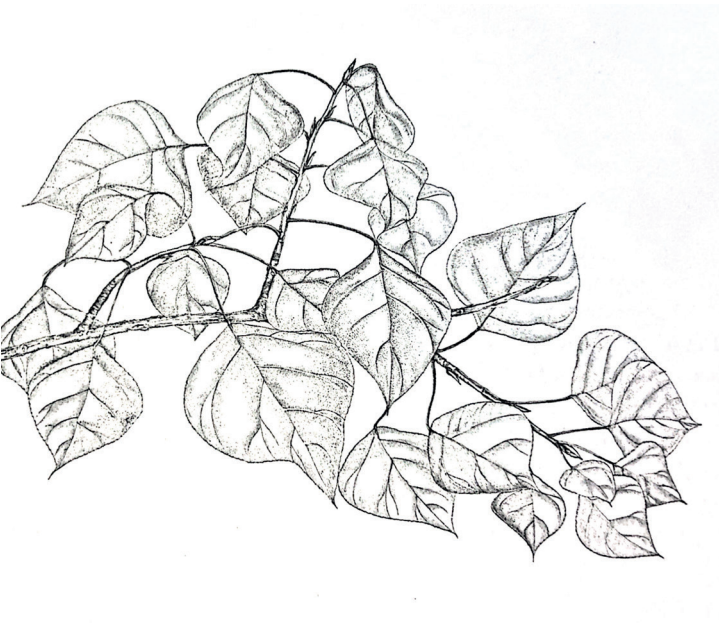
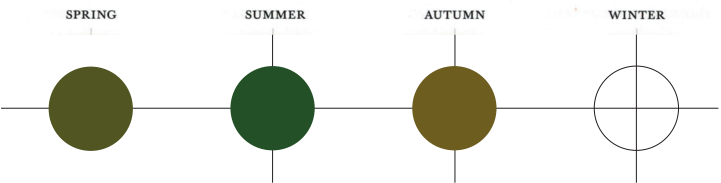
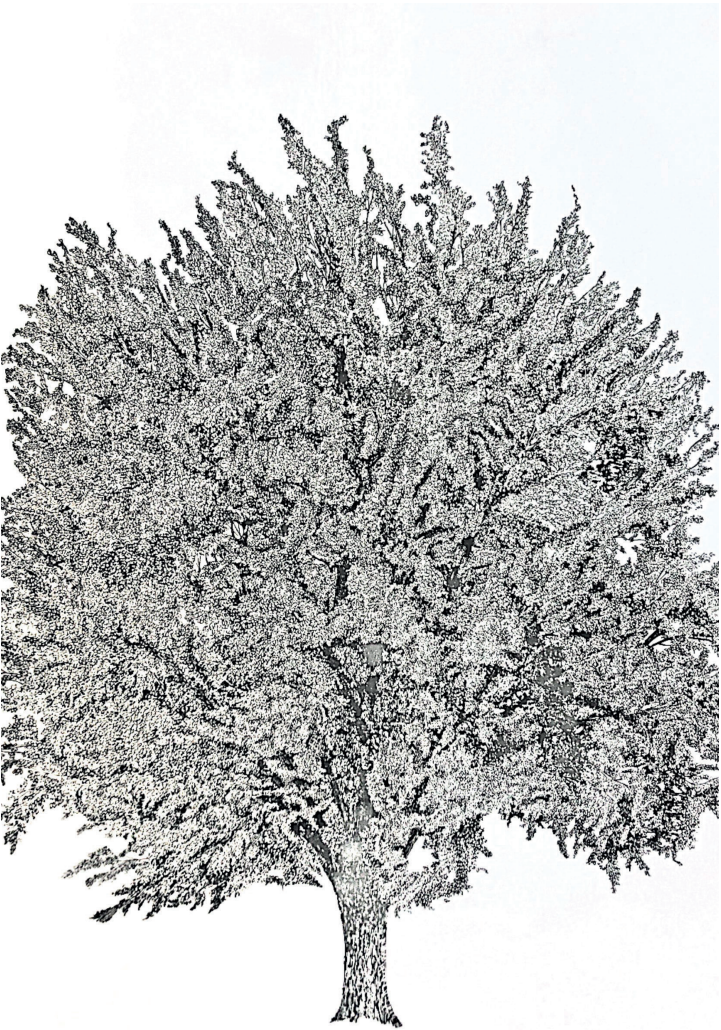


Target diameter & Saw diagram

Length stem - 7,2 - 8,4m
Target diameter - 450mm - 600mm
Kwartiers timber



Material - Black Poplar (Zwarte Populier) - *Populus nigra* L.



Tree hight
Diameter

16-25m
0,2-0,5m

Tree species
Type of timber

Deciduous
Poplar is moderately strong, soft and, for its weight, tough.

Appearance

It has a knotty and heavily ramified trunk, a large and sparse crown, and gray-white bark that turns near-blackened and cracked and is often disfigured in old age.

Colour

The leaves are smooth and shiny dark green on the upper pagina, and duller with raised veins on the lower pagina.

Application

Indoor carpentry, strength class C24.

Processing tree into high quality durable timber

1. The tree trunks should be **watered for the minimum of one year** to improve the quality of the timber.

- Other reasons to water the trunks are:
- For easier transportation
 - For easier sorting
 - To prevent drying cracks
 - So the wood can't be t affected by insects & fungi
 - To rinse substances affected by insects and fungi out
 - To change its structure so that the wood is easier to debark, easier to saw, dries faster and is better to impregnate

2. Debark the tree, so the wood has less discolouration, the sap wood hardens faster and is less affected by insects.
3. Saw in desired dimensions
4. Dry the timber.
5. Impregnate with linseed oil using the drenching technique.

Estimated lifespan of the timber

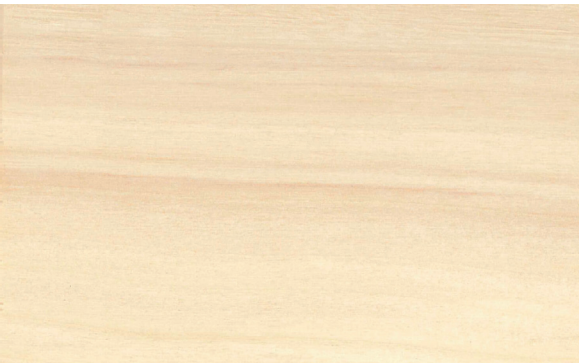
>50 years

Poplar
Tree specifications

Growing time 20 years
Height 18-25 m
Target diameter 400/500 mm

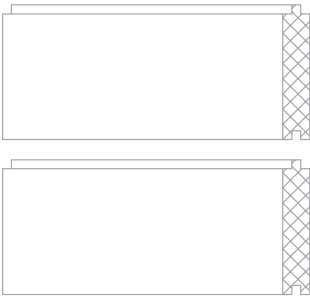
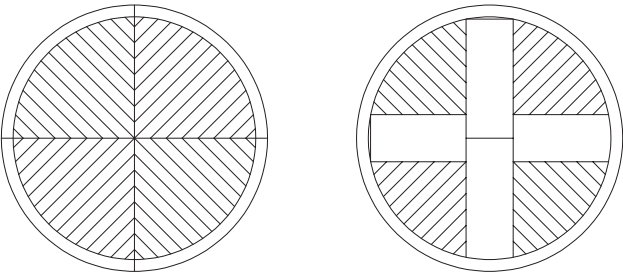
Max. length sawn timber 7,2-10,0 m
2/5 rule

Architectural appearance

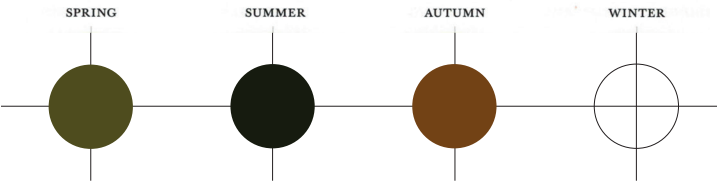
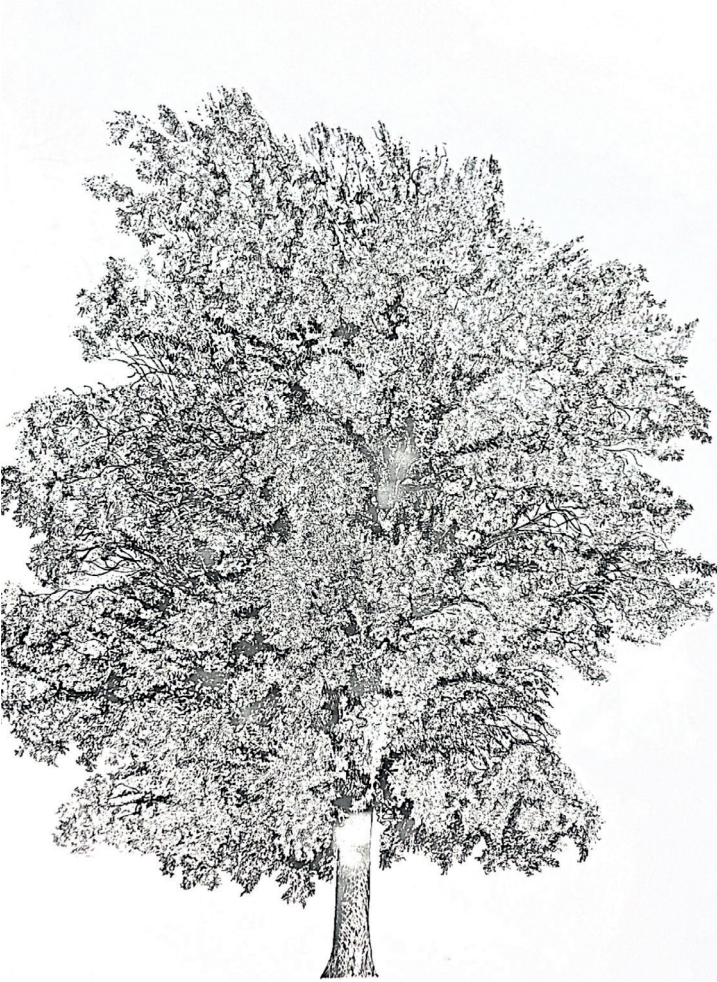


Target diameter & Saw diagram

Length stem - 7,2 - 10m
Target diameter - 400mm - 500mm
Kwartiers timber



Material - Oak (Eik) - Quercus petraea



Tree hight 18-35m
Branch-free stem 15m
Diameter 1,2-1,8m

Tree species Deciduous
Type of timber Oak is generally hard, heavy, solid, strong and coarser in struc-
ture

Appearance It has a sturdy trunk, very knotty branches, an ample crown,
and bark that is smooth when young and later cracked.

Colour The leaves are glossy dark green on the upper pagina and
grayish on the lower one.

Application Exterior load bearing columns and beams

Processing tree into high quality durable timber 1. The tree trunks should be **watered for 3 to 4 years** to impro-
ve the quality of the timber.

- Other reasons to water the trunks are:
- For easier transportation
 - For easier sorting
 - To prevent drying cracks
 - So the wood can't be t affected by insects & fungi
 - To rinse substances affected by insects and fungi out
 - To change its structure so that the wood is easier to debark, easier to saw, dries faster and is better to impregnate
2. Debark the tree, so the wood has less discolouration, the sap wood hardens faster and is less affected by insects.
3. Saw in desired dimensions & de-core the beams and columns.
4. Dry the timber.
5. Impregnate with linseed oil using the drenching technique.

Estimated lifespan of the timber >100 years

Oak
Tree specifications

Growing time 80-120 years
Height 18-30 m
Target diameter 600/700 mm

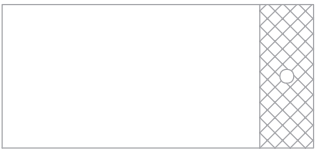
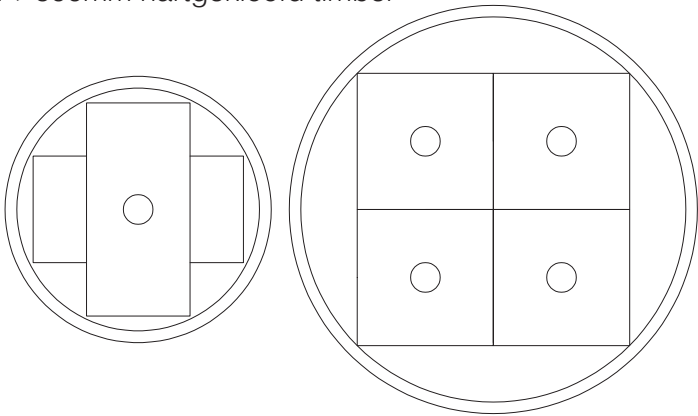
Max. length sawn timber 7,2-12 m
2/5 rule

Architectural appearance

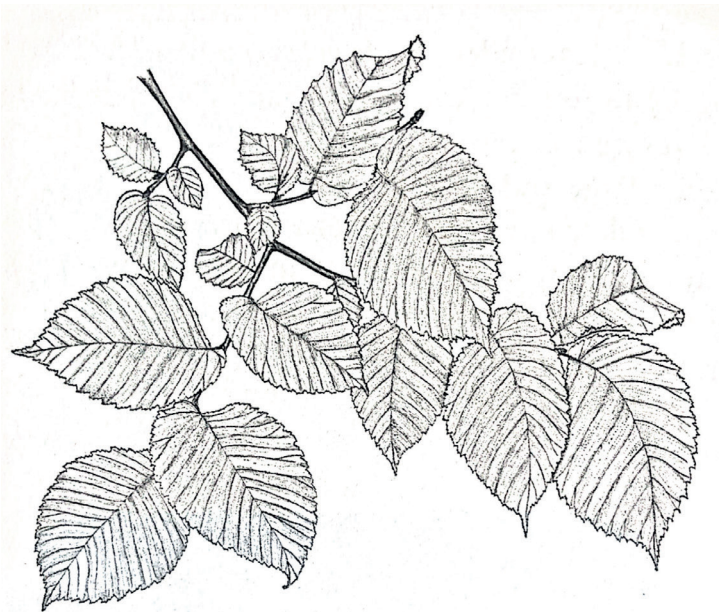
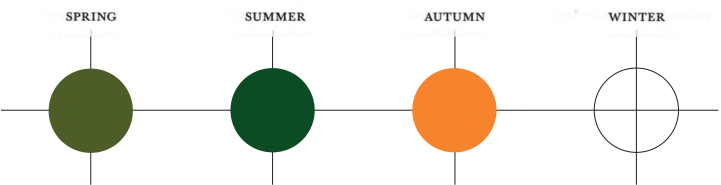


Target diameter & Saw diagram

Length stem - 7,2 - 12m
Target diameter - 450mm - 700mm
450mm gekantrecht timber & de-cored,
or >600mm hartgekloofd timber



Material - Elm (lep) - *Ulmus glabra*



Tree hight 25m
Branch-free stem 10-18m
Diameter 0,9-1,4m

Tree species Deciduous
Type of timber Elm wood is solid, tough, fairly light and usually uniform in struc-ture.

Appearance It has an erect trunk with many branches, an ample and dense crown, and bark that is smooth when young, then cracked.

Colour The leaves are dark green and rough on the upper pagina and lighter coloured and hairy on the lower one, and with a substan-tial number of veins.

Application ***Facade cladding & decking planks.***

Processing tree into high quality durable timber 1. The tree trunks should be **watered for 2 to 4 years** to impro-ve the durability, the hardness, strength, skid resistance and weather resistance.

- Other reasons to water the trunks are:*
- For easier transportation
 - For easier sorting
 - To prevent drying cracks
 - So the wood can't be t affected by insects & fungi
 - To rinse substances affected by insects and fungi out
 - To change its structure so that the wood is easier to debark, easier to saw, dries faster and is better to impregnate

Estimated lifespan of the timber 80-100 years

Elm

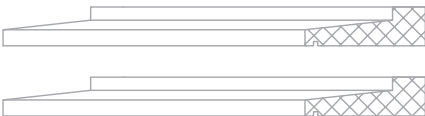
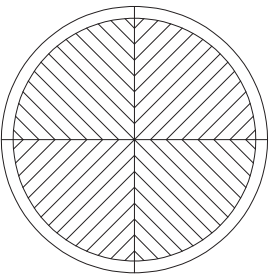
Tree specifications	
<i>Growing time</i>	50 years
<i>Height</i>	25 m
<i>Target diameter</i>	450/600 mm
Max. length sawn timber	10 m
2/5 rule	

Architectural appearance



Target diameter & Saw diagram

Length stem - 10m
Target diameter - 450mm - 600mm
Kwartiers timber



Material - Ash (Es) - *Fraxinus excelsior*



Tree hight
Branch-free stem
Diameter

30m
15-20m
0,4-0,9m

Tree species
Type of timber

Deciduous
Ash is tough, strong, hard and heavy.

Appearance

It has a straight, slender, sparsely ramified trunk, and a round crown that is more dense when it grows in isolation. The trunk's bark is smooth and olive coloured when young, and then turns brown and cracks longitudinally.

Colour

The upper pagina is glabrous, while the lower pagina is lighter in colour and hairy.

Application

Interior loadbearing columns and beams, strength class D40. & window frames

Processing tree into high quality durable timber

1. Debark the tree, so the wood has less discolouration, the sap wood hardens faster and is less affected by insects.
2. Saw in desired dimensions
3. Ash can be air-dried quite easily, ensuring that water does not collect in hollowed sheets (heart side up). To preserve the clear colour, ash should not be artificially dried at too high temperatures (max. 60°C).
4. Impregnate with linseed oil using the drenching technique.

Estimated lifespan of the timber

>100 years

Es
Tree specifications

Growing time 50 years
Height 30 m
Target diameter 450/600 mm

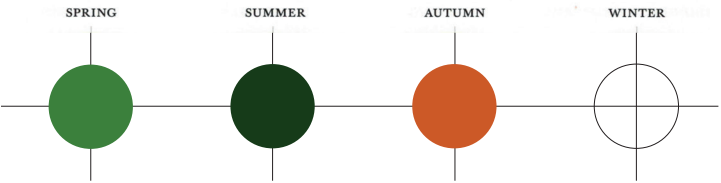
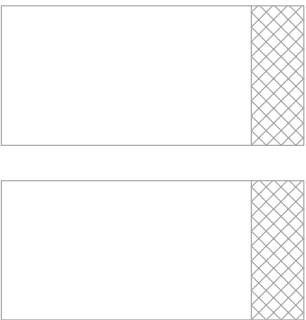
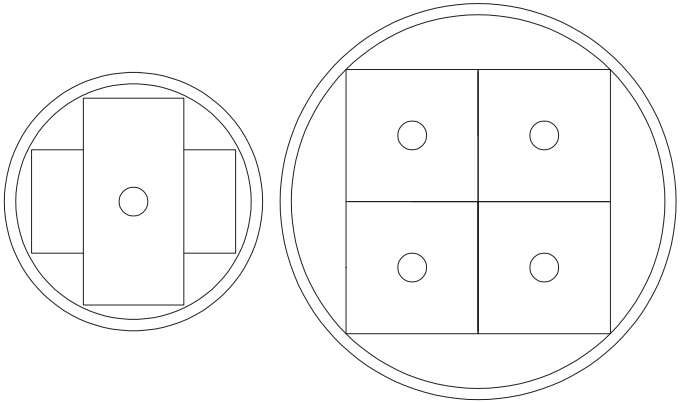
Max. length sawn timber 12 m
2/5 rule

Architectural appearance



Target diameter & Saw diagram

Length stem - 12m
Target diameter - 450mm - 600mm
450mm gekantrecht timber & de-cored,
or >600mm hartgekloofd timber



Material - Willow (Wilg) - *Salix alba* L.



Tree hight
Branch-free stem
Diameter

21-27m
5-8m, often knotted at 2-2,5m
0,9-1,2m

Tree species
Type of timber

Deciduous
Willow is moderately strong, soft and, for its weight, tough.

Appearance

It has a straight trunk, ascending and ramified branches, a large grey crown, and bark that is smooth when young, then cracked.

Colour

The leaves are shiny green on the upper pagina and silver on the lower pagina due to their characteristic sericeous hairs.

Application

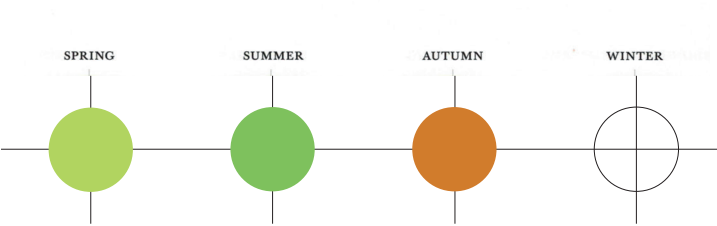
Woven willow (wilgentenen) fencing, sun blinds and slats

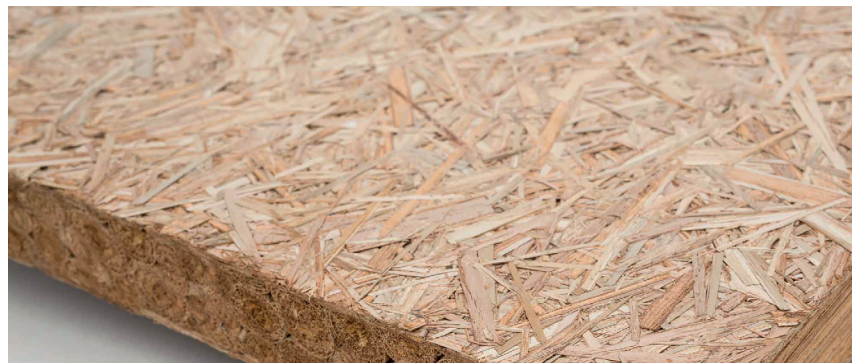
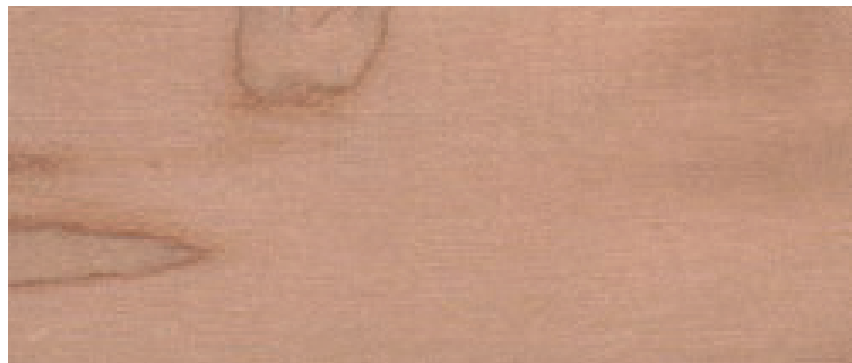
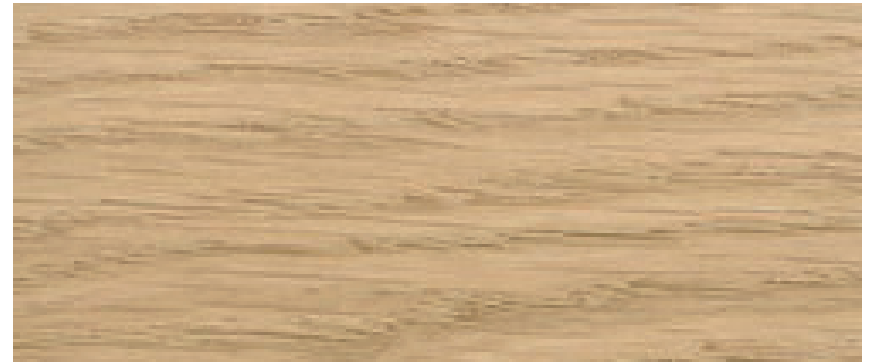
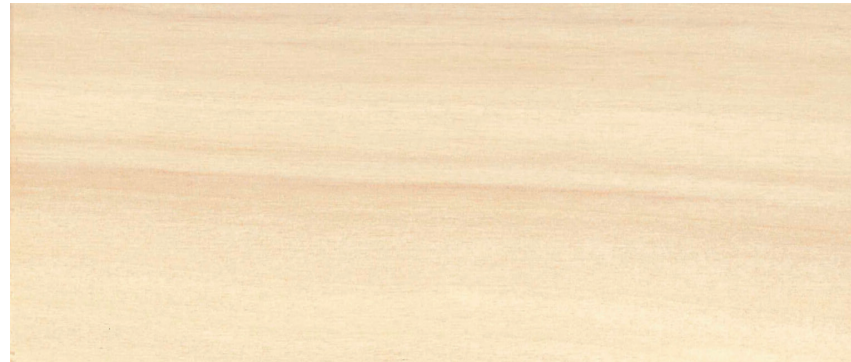
Processing

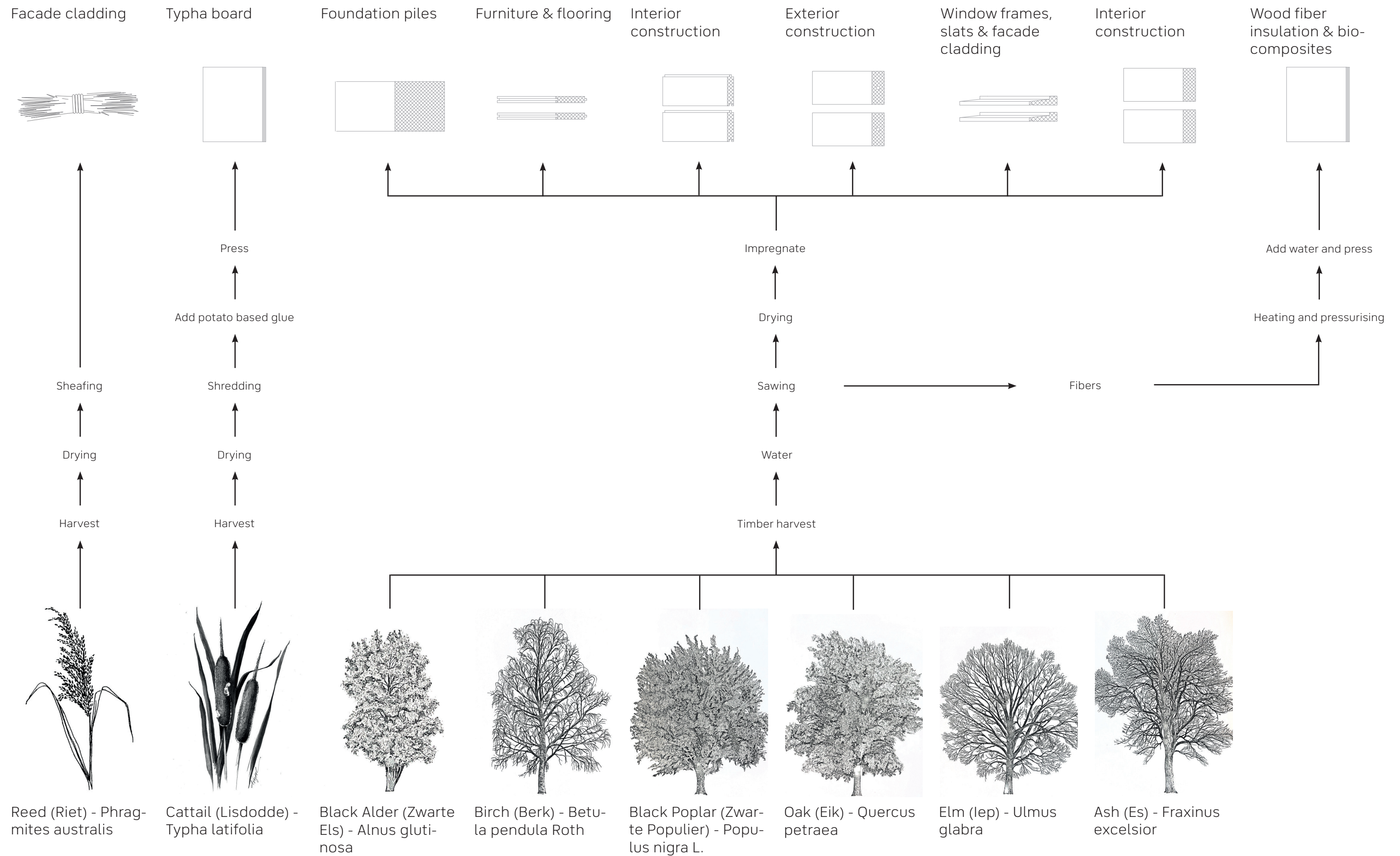
- 1. Knot the tree trunk at 2-2,5m.
- 2. Cut the twigs in the desired lengths.
- 3. Dry the willow twigs.
- 4. Impregnate the twigs with linseed oil using the drenching technique.
- 5. Weave the willow twigs.

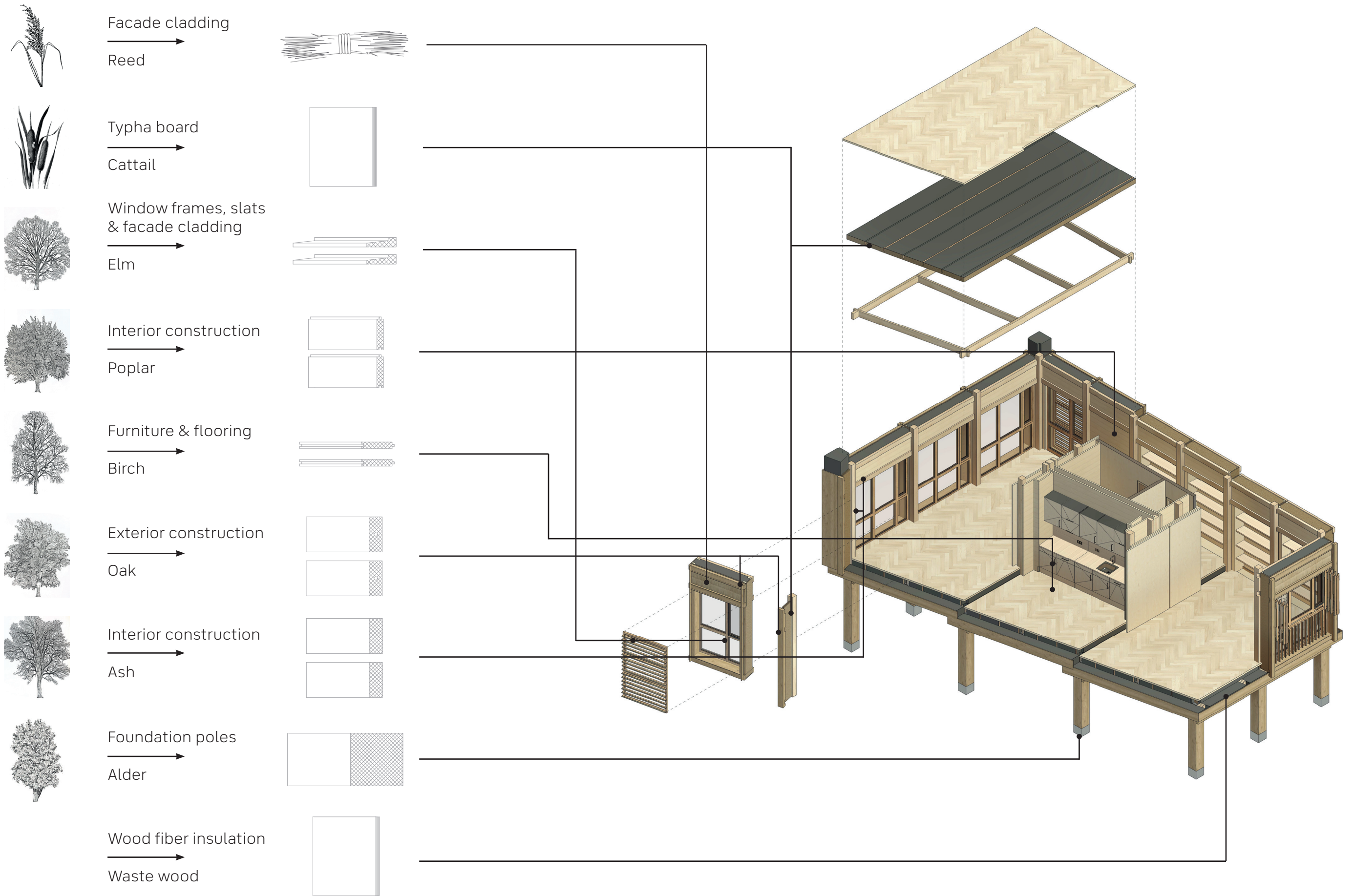
Estimated lifespan of the willow twigs

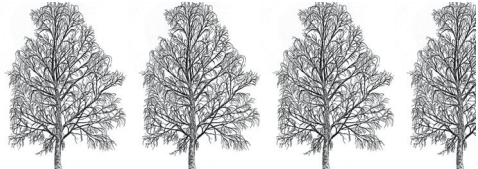
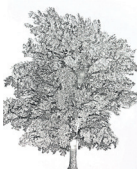
>30 years









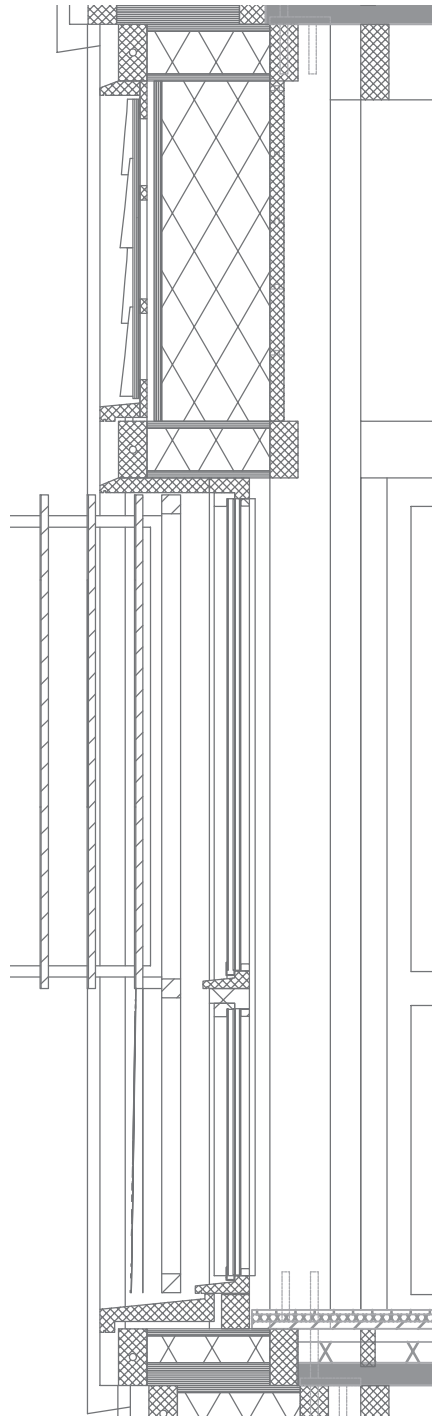
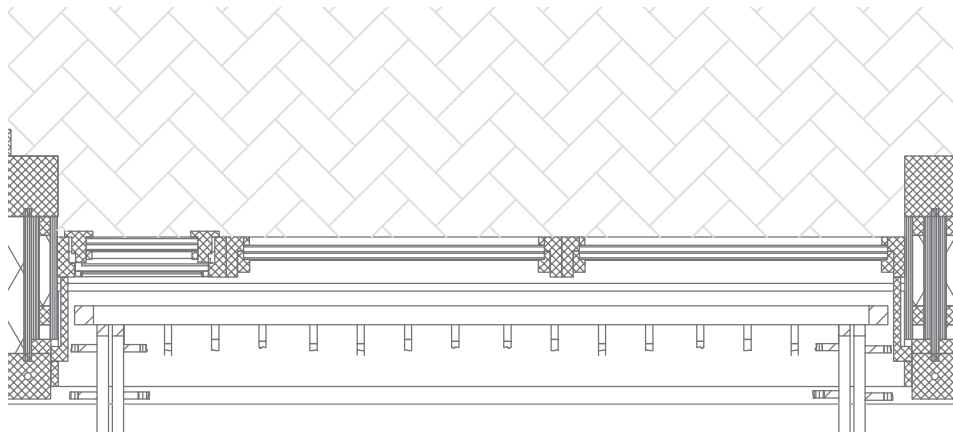
Material necessary for one 60m2 dwelling		M ³ material needed excluding sawing loss	Amount of trees needed including sawing loss (50%)	Growing time
	Facade cladding → Reed	4,6M ³		2 years
	Typha board → Cattail	9,9M ³		2 years
	Window frames, slats & facade cladding → Elm	4,8M ³		>50 years
	Interior construction → Poplar	4,4M ³		>20 years
	Furniture & flooring → Birch	4,9M ³		>50 years
	Exterior construction → Oak	4,2M ³		80 -120 years
	Interior construction → Ash	4,3M ³		>50 years
	Foundation poles → Alder	3,6M ³		>50 years
	Fencing → Willow	0,4M ³		>15 years

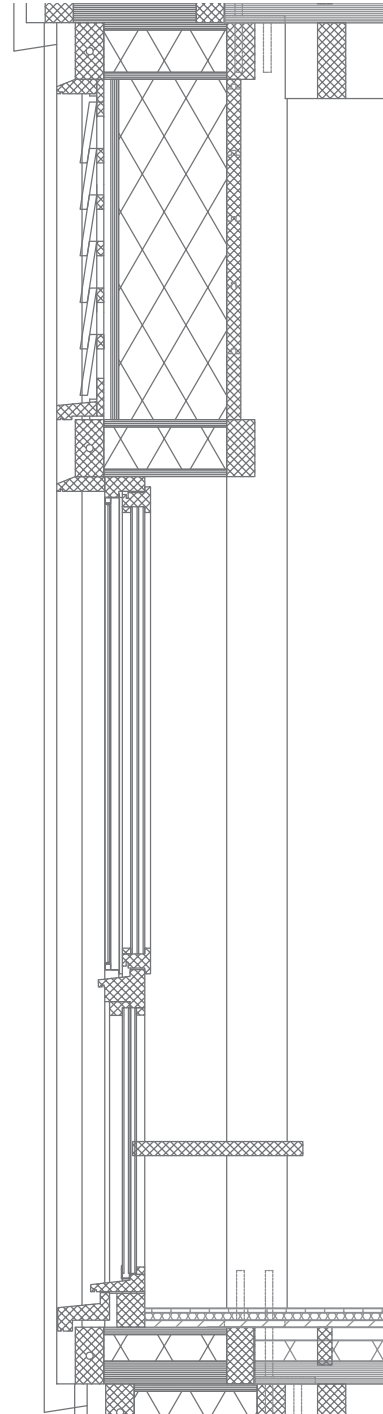
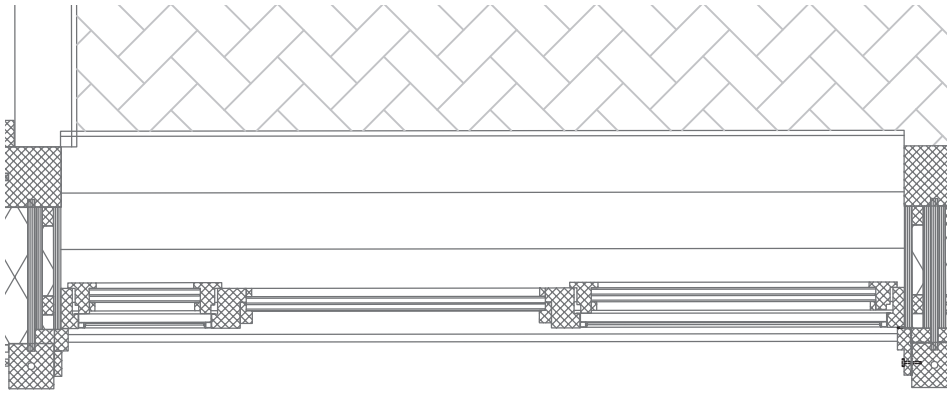


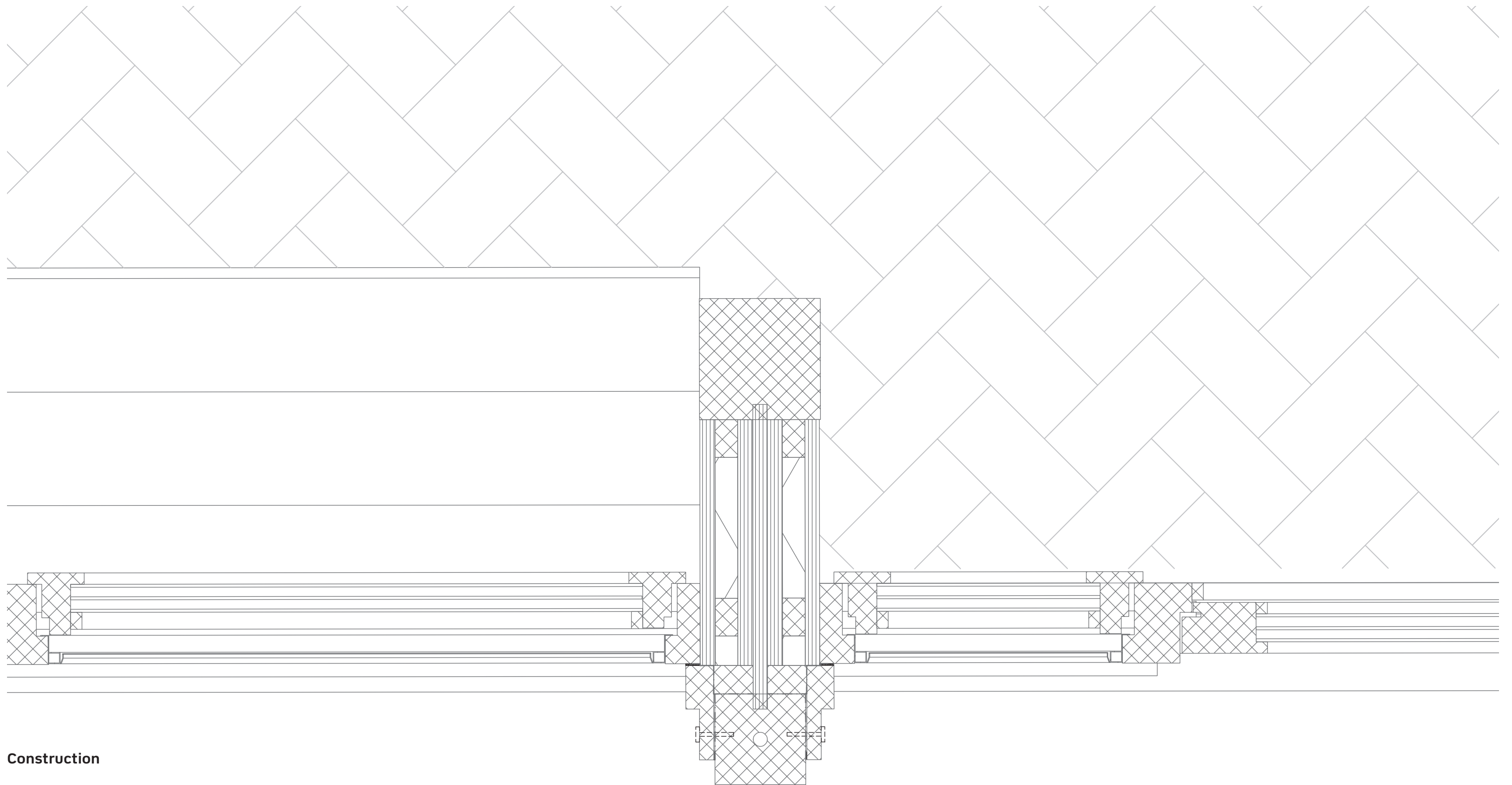
ARCHITECTURAL ENGINEERING RUBEN KOPPES



FREEDOM IN INFILL AND USE - 59





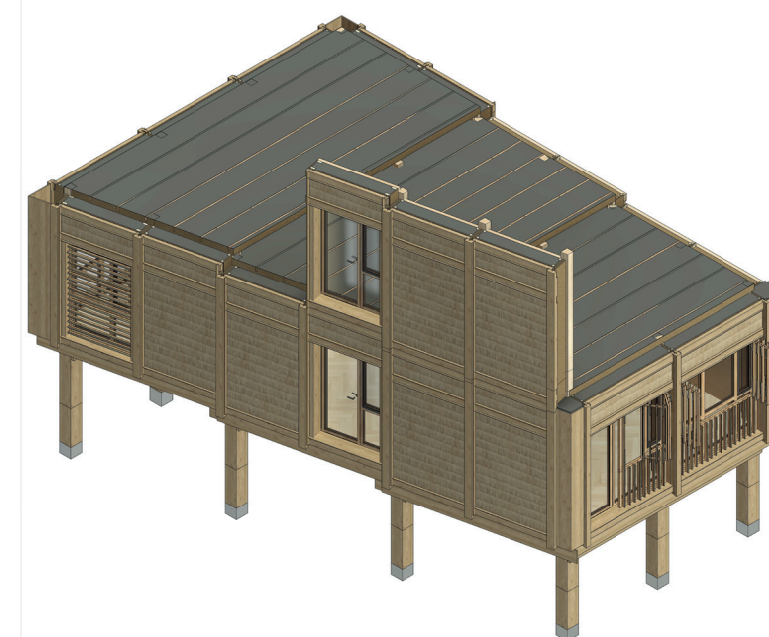
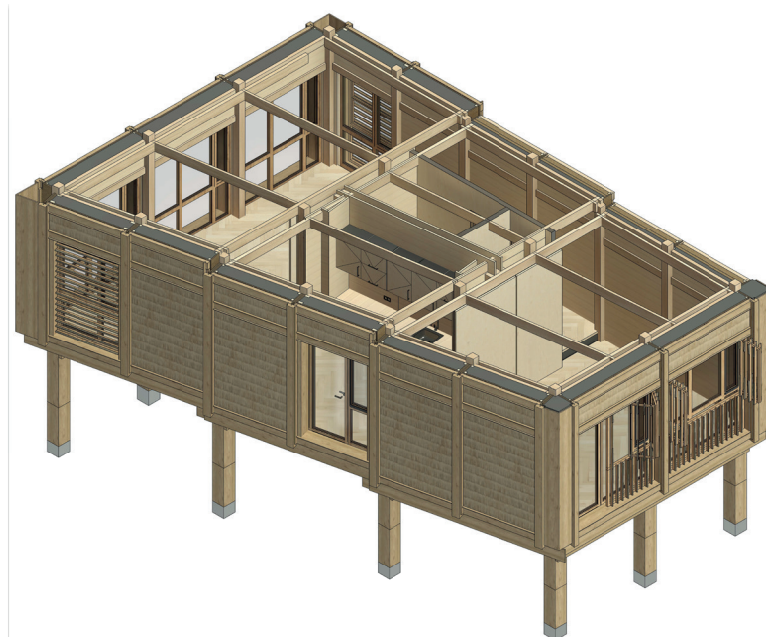
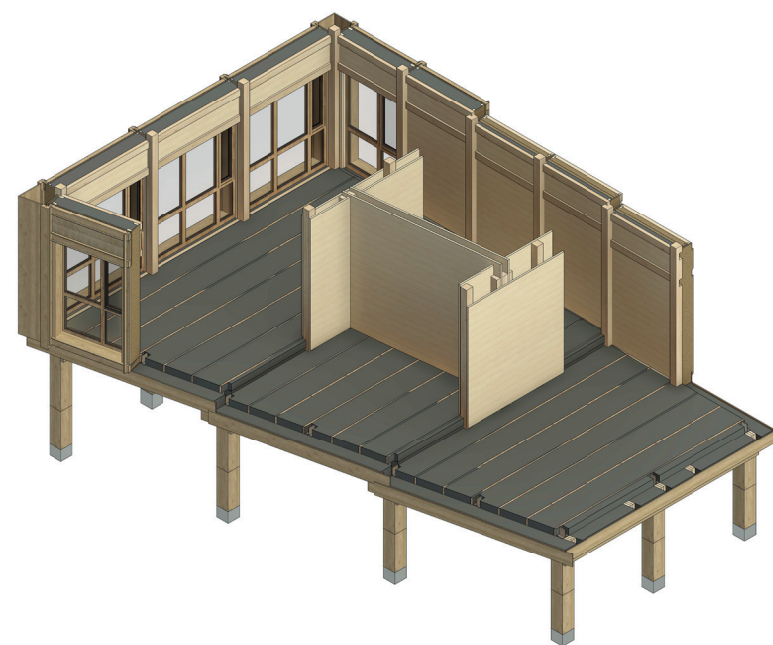
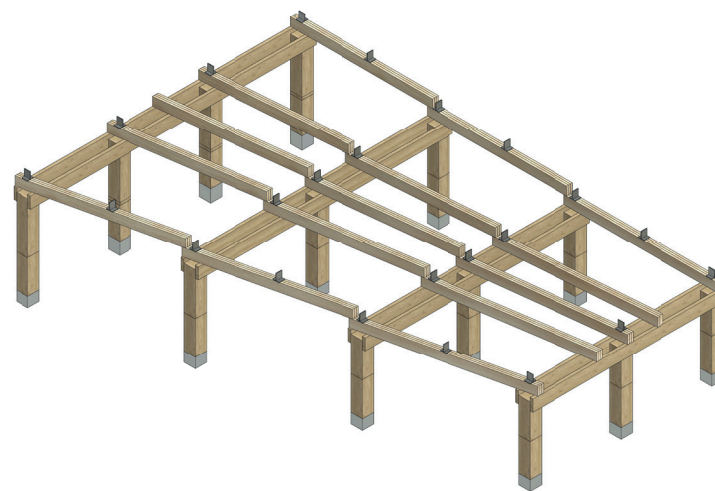
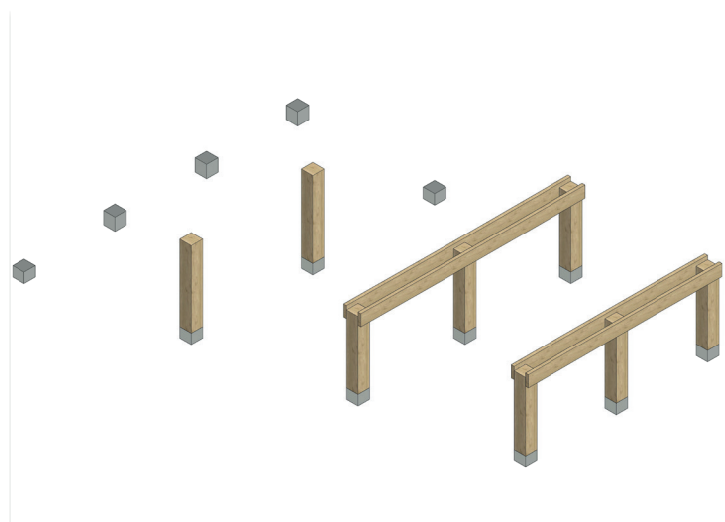


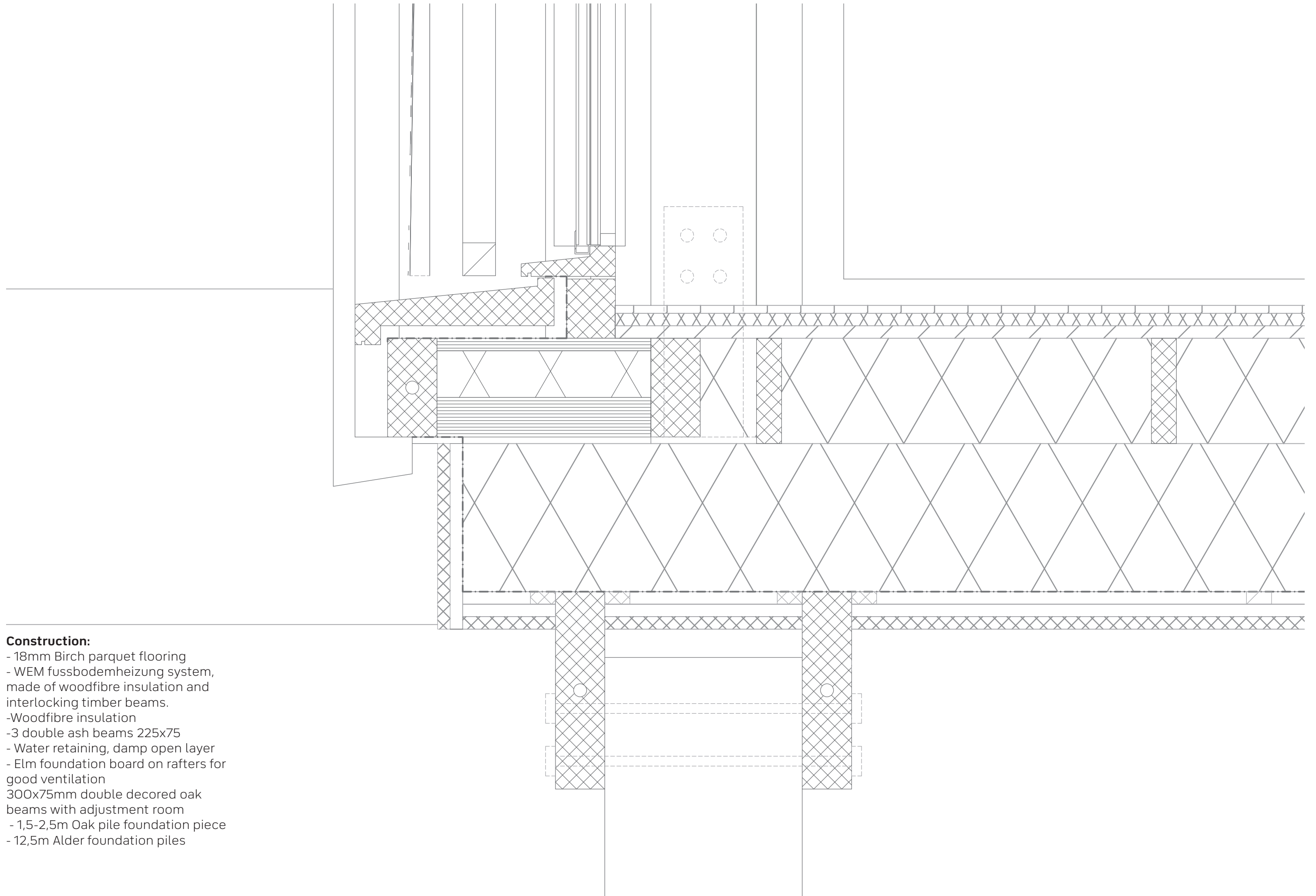
Construction

- 160x160mm interior ash column
- Loadbearing typhaboard middle piece
- 120x120mm exterior decoed oak column

Sandwiched by two facade panels

Elm windowframes





Construction:

- 18mm Birch parquet flooring
- WEM fussbodenheizung system, made of woodfibre insulation and interlocking timber beams.
- Woodfibre insulation
- 3 double ash beams 225x75
- Water retaining, damp open layer
- Elm foundation board on rafters for good ventilation
- 300x75mm double decoed oak beams with adjustment room
- 1,5-2,5m Oak pile foundation piece
- 12,5m Alder foundation piles





Construction

- 75x150mm decored oak beams with dissambleable oak sills (stainless steel screws)
- Reed screwed on a fireresistant typha board
- Elm horizontal and vertical rafters enclosed by oak sills
- Water retaining, damp open layer
- 285mm wood fiber insulation
- Vapour barrier
- 38x175mm poplar planks
- 75x150mm ash beams





40^{m2} average living area

0.6^{m2} purify water use

77^{m2} energy use

58^{m2} material use

53^{m2} collective space (shared garden, roads
& parking)

228.6^{m2}

:

125.6^{m2}

→ 0.6^{m2} wetland landscape

→ 67^{m2} willow forest landscape

→ 58^{m2} forest landscape

**Does this ratio define the maximum ecological
density of the island?**

1300 residents : 16 ha landscape



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