



BAMBhOuse



Seismic proof laminated bamboo structures
an architectural and socio-economical restart in the Groningen area

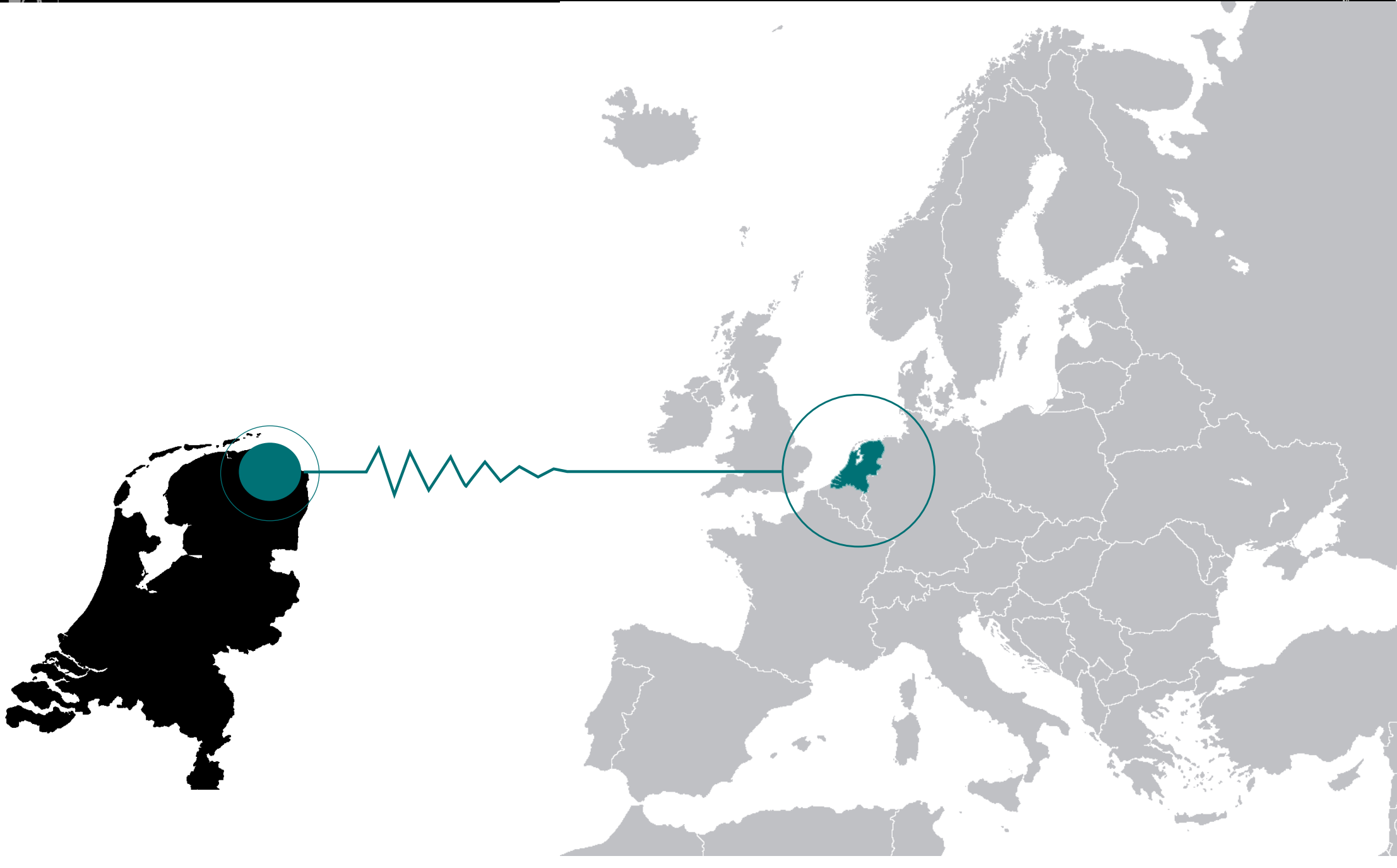


Delft
University of
Technology





Earthquakes in the Netherlands



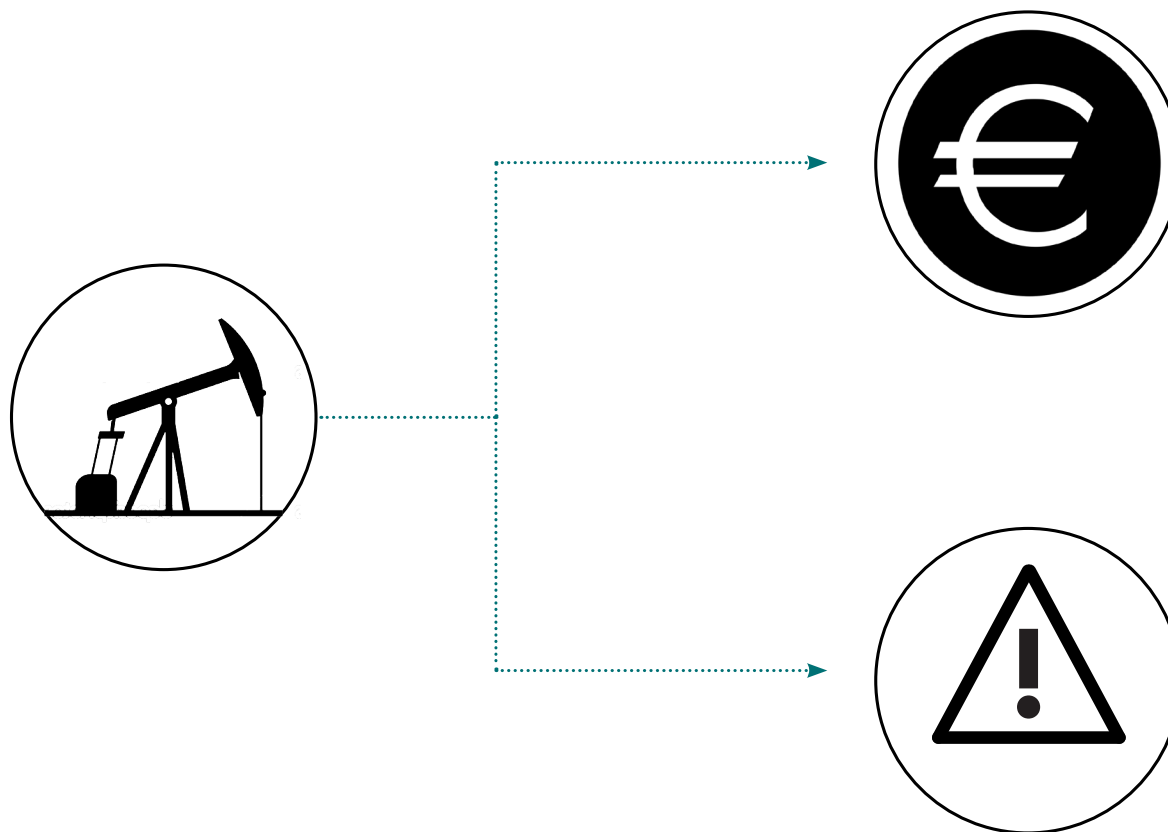


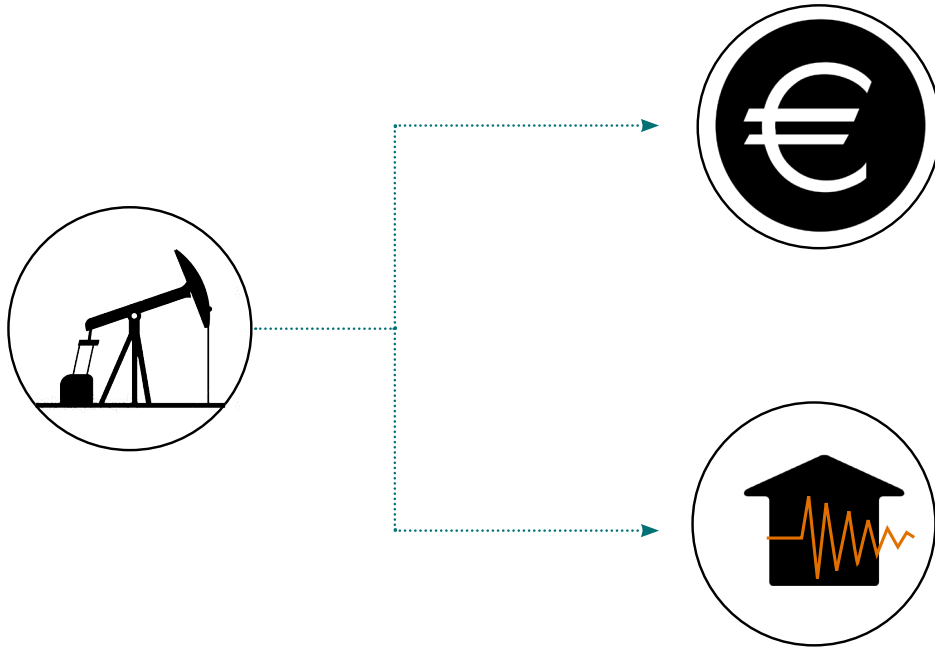
"The role of science has been defined in terms of dominating and manipulating nature for the pursuit of man's well being"
F.Bacon

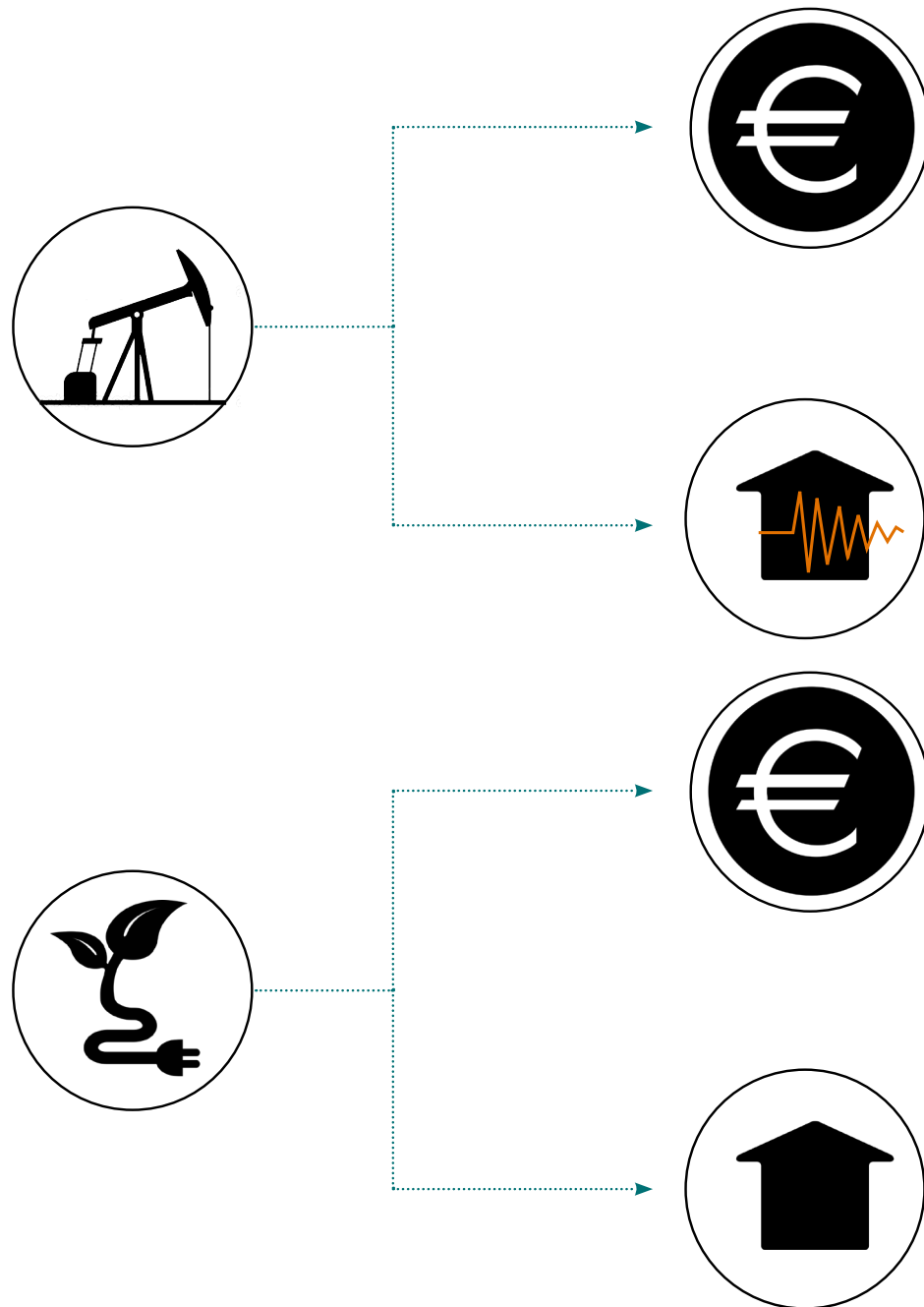


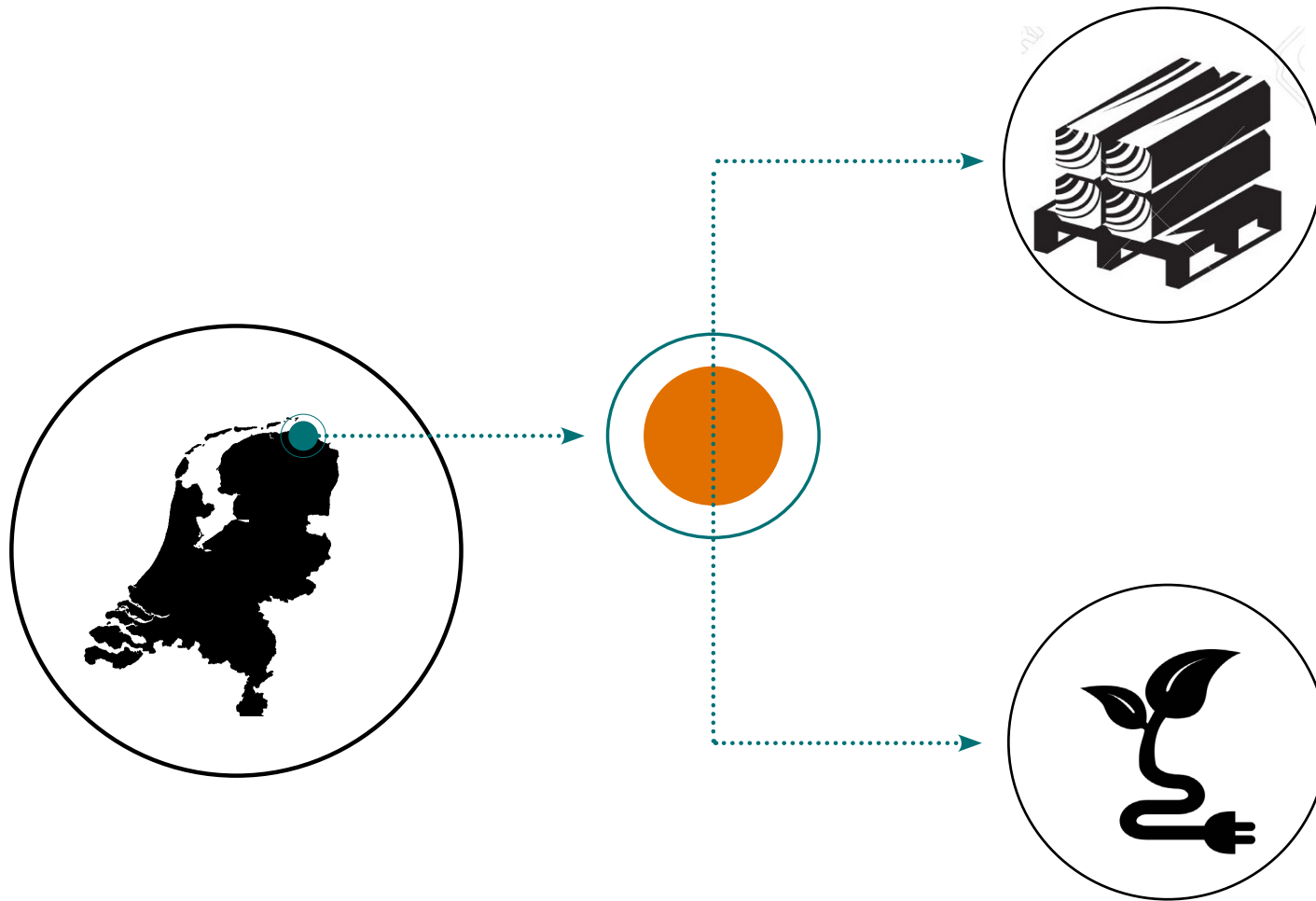




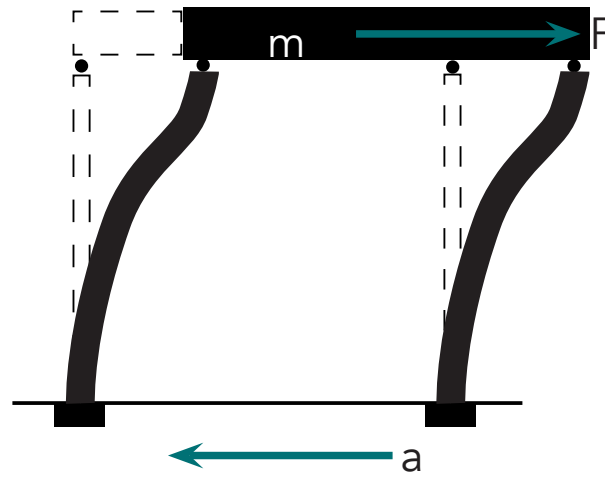
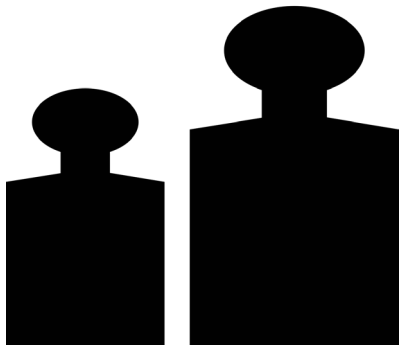


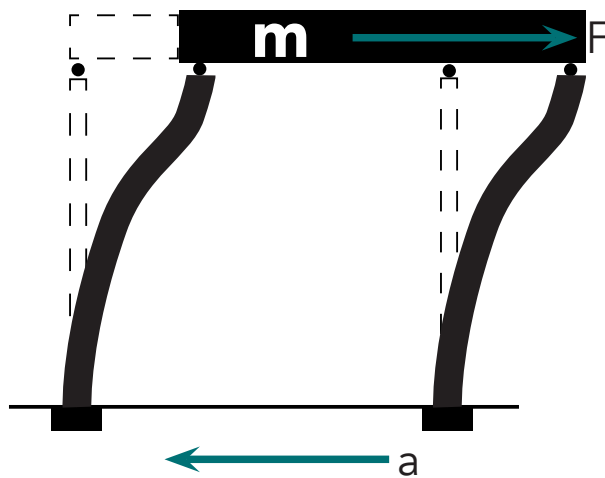
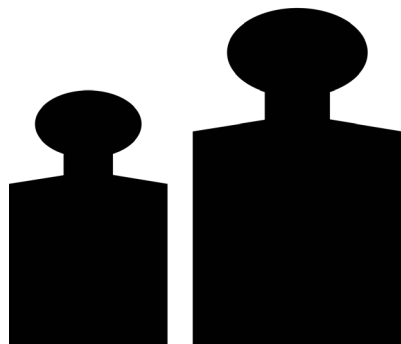






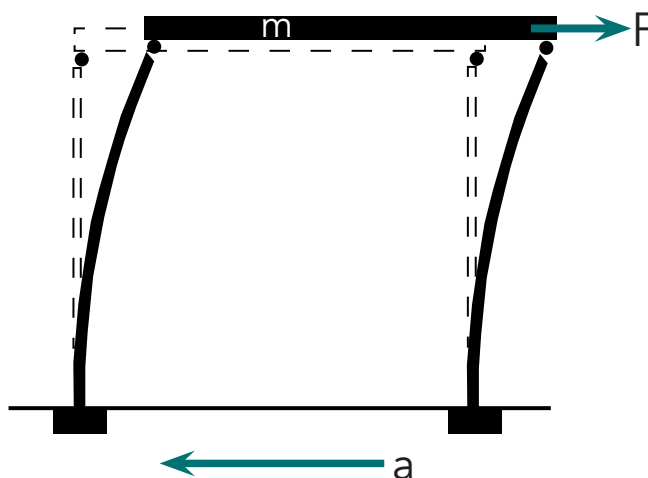
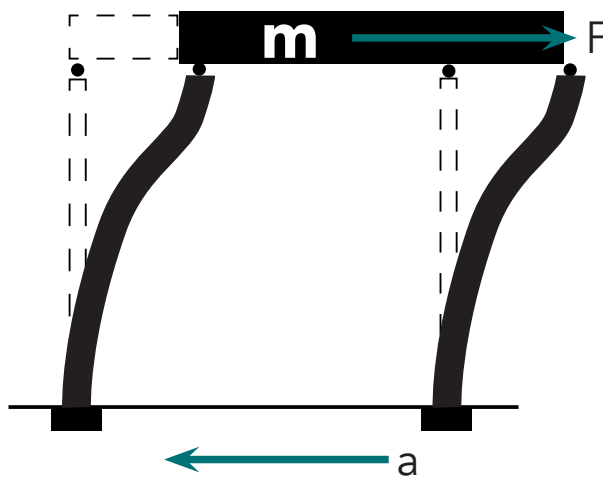
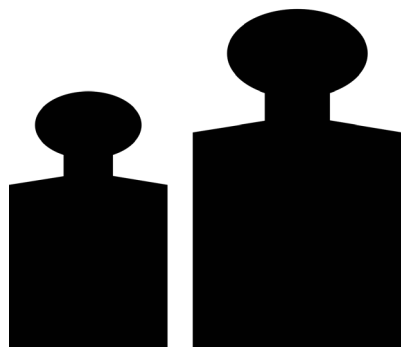
The objective is to come up with a new and **locally implemented solution** for a recent and unexplored problem in the Netherlands, seeing this as an **opportunity** rather than a threat for the **sustainable energy production** and for the **new antiseismic building industry**.





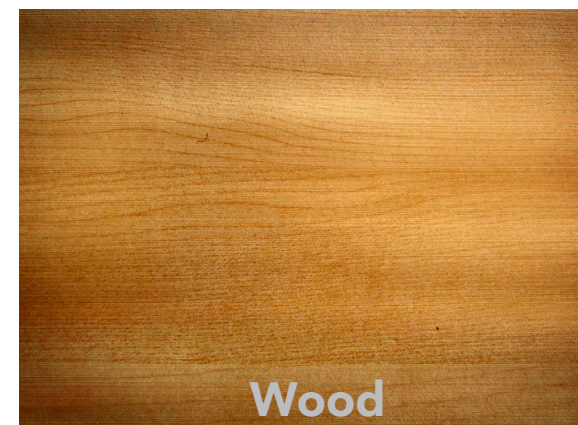
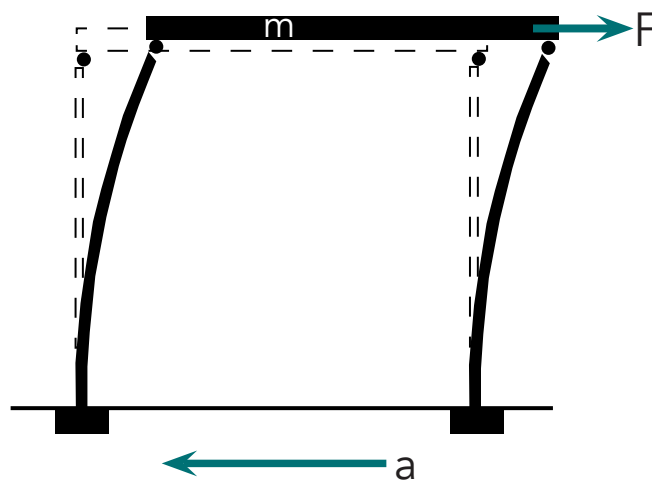
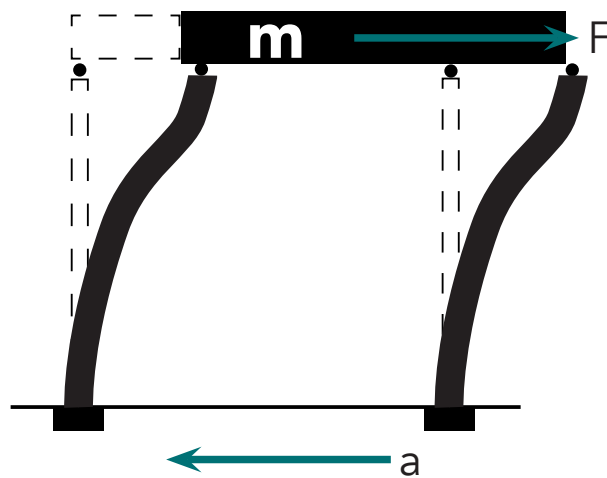
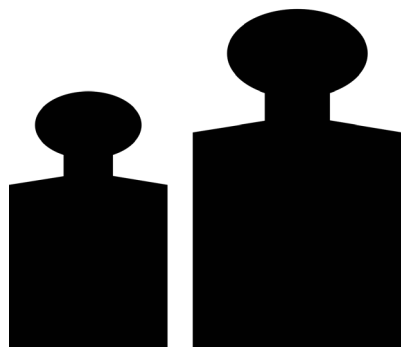


High mass structures vs Lightweight



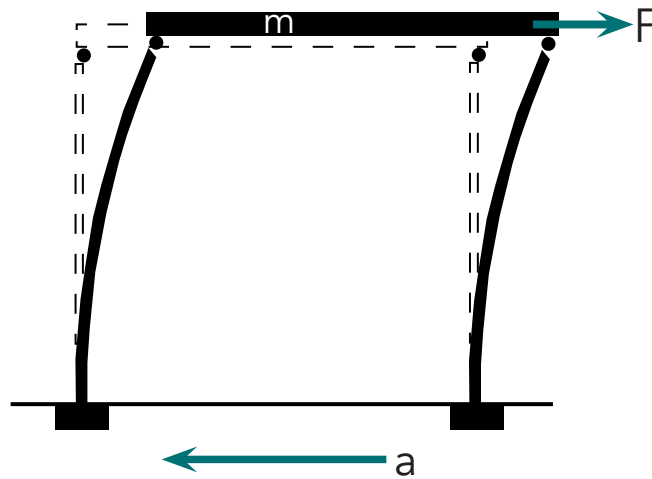
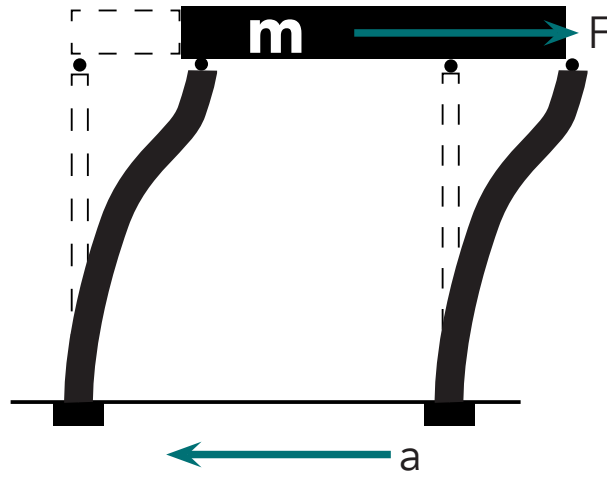
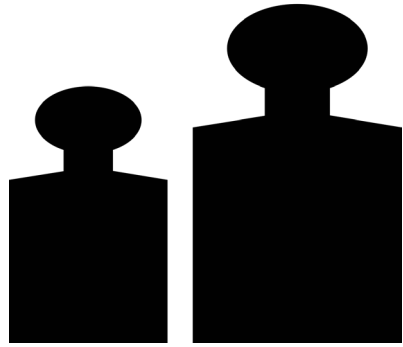


High mass structures vs Lightweight



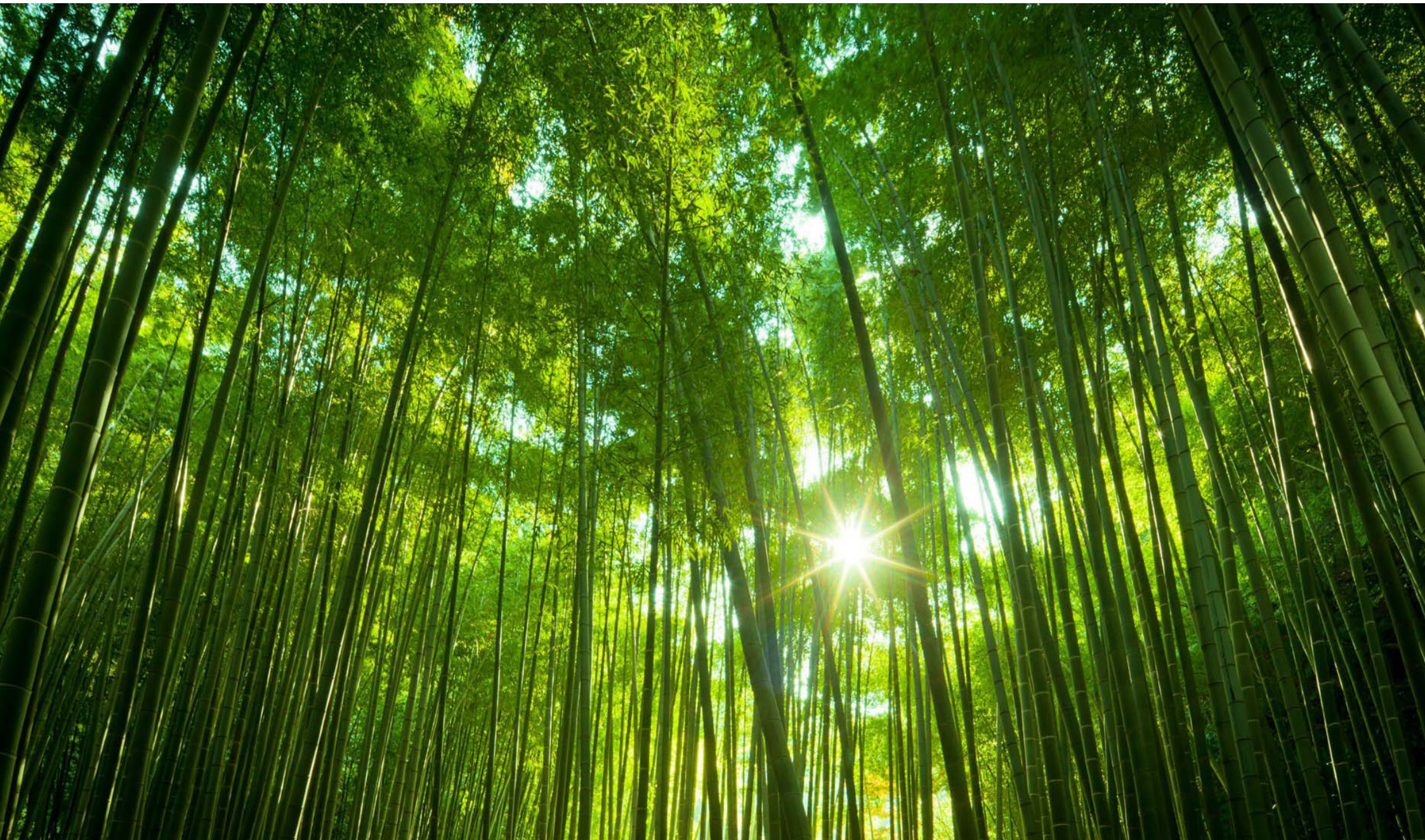


High mass structures vs Lightweight





Bamboo



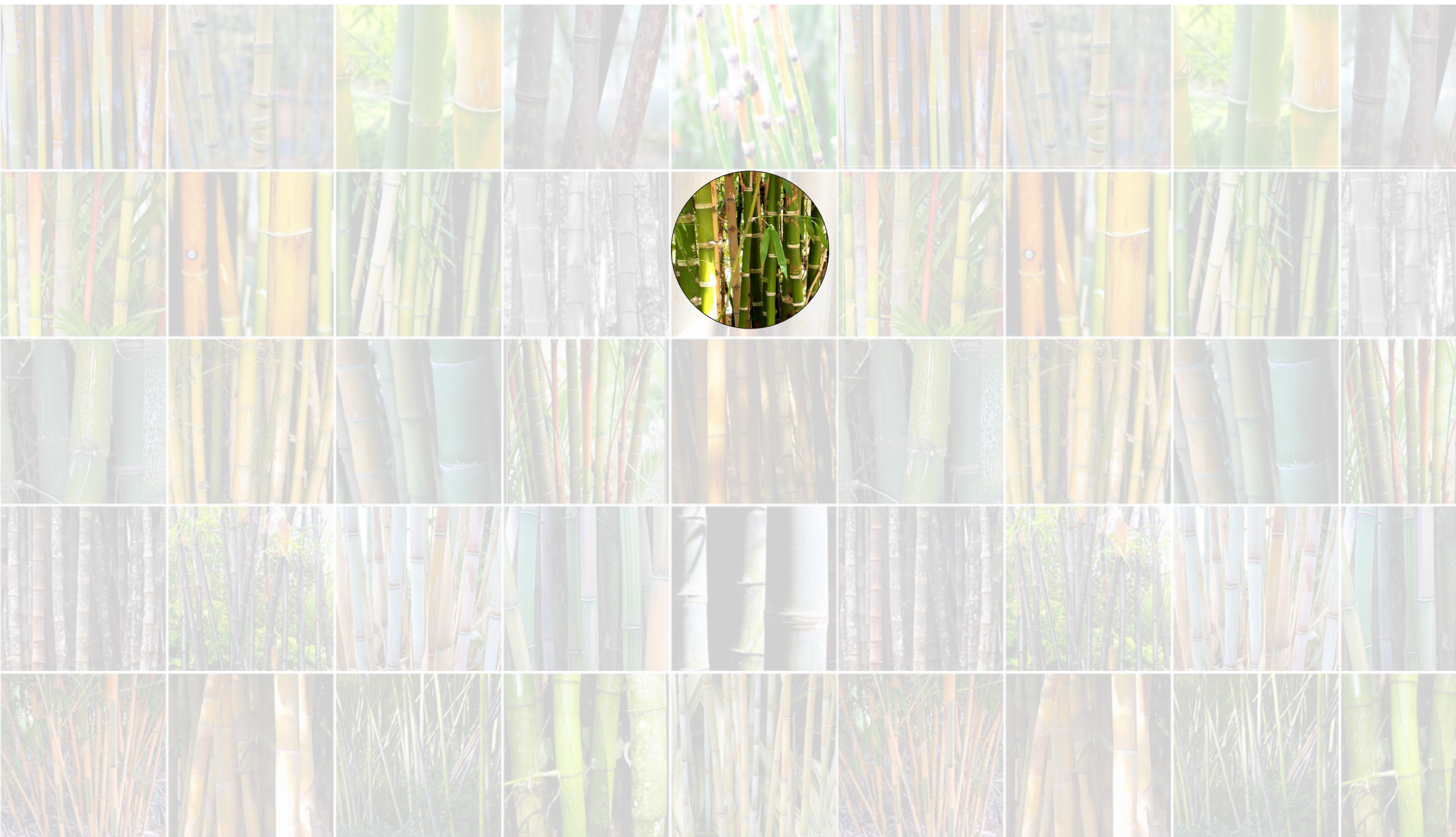


More than 1000 bamboo species...

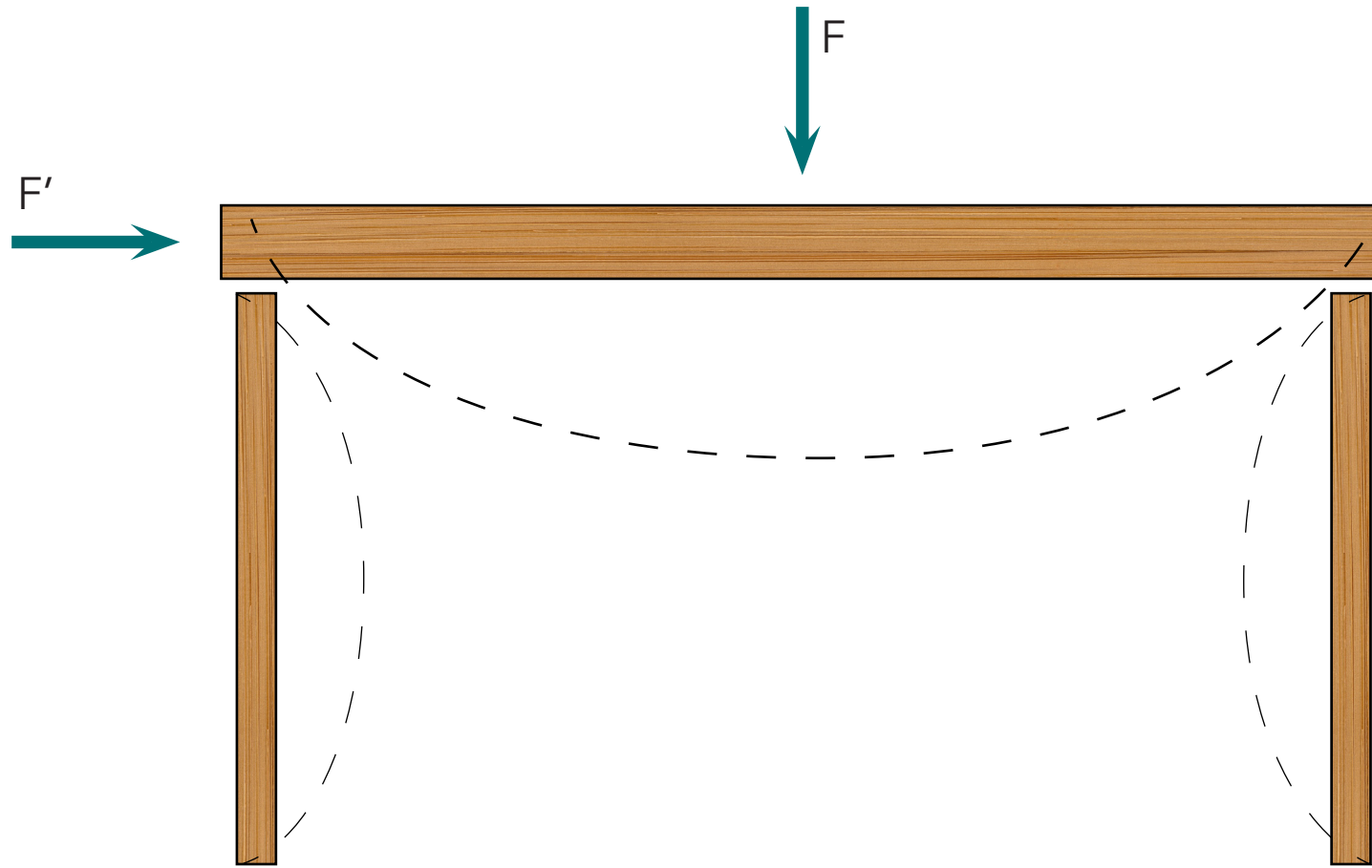




Guadua Angustifolia Bamboo



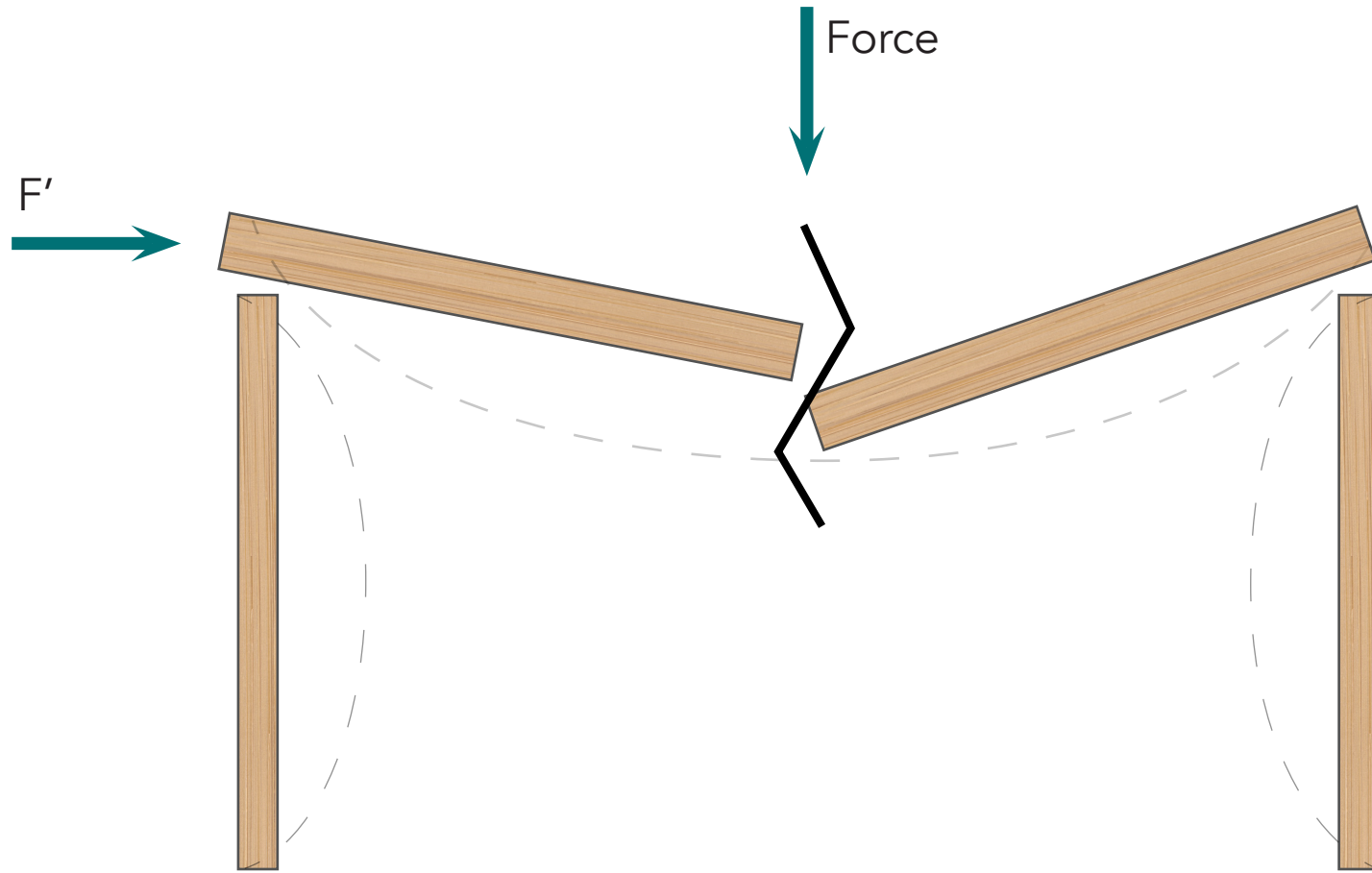
4 times stronger!



$$f_m = 80\text{N/mm}^2$$

$$E = 19000\text{N/mm}^2$$

**Laminated
Bamboo**

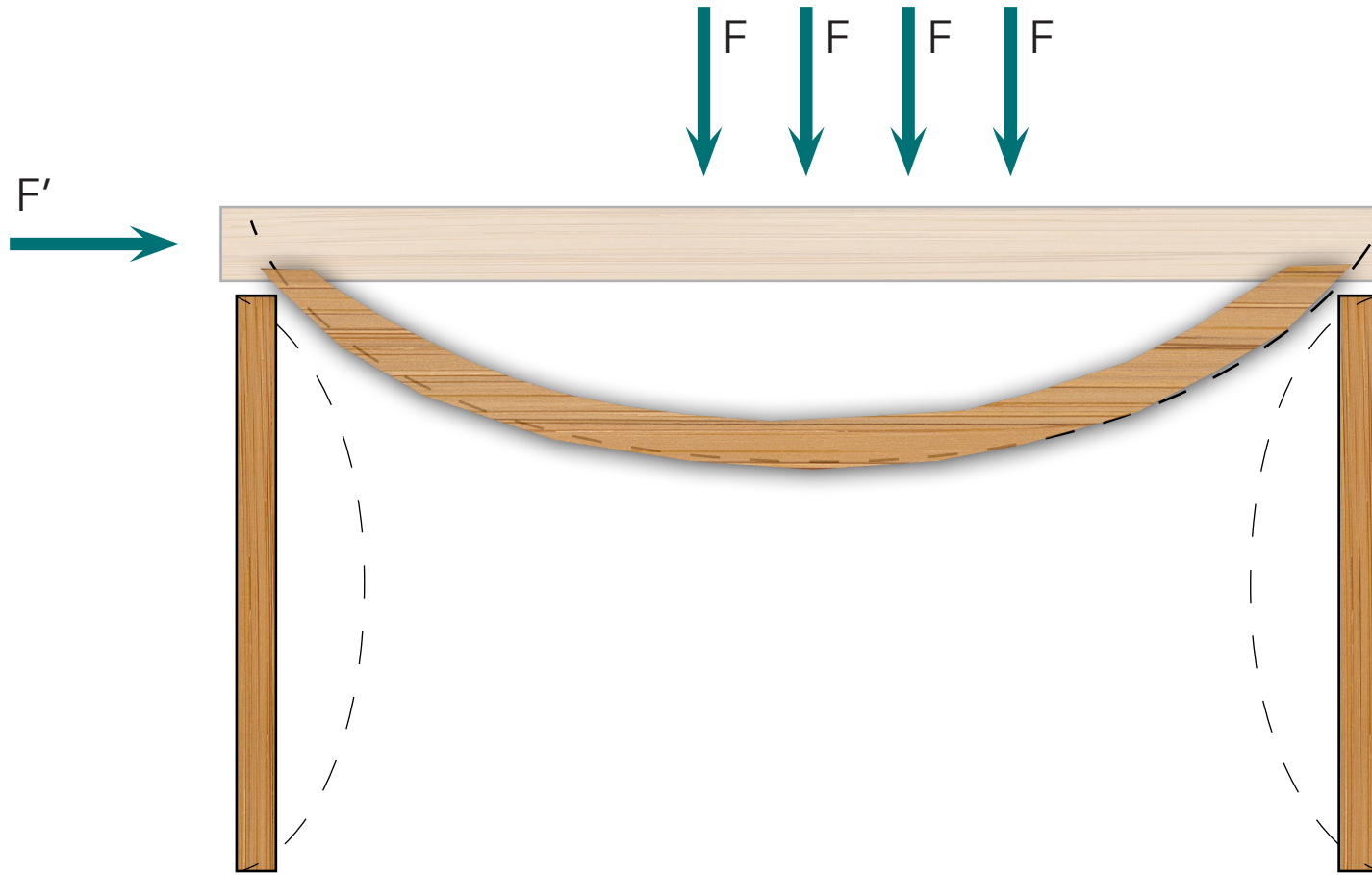


$$f_m = 15\text{N/mm}^2$$

$$E = 8000\text{N/mm}^2$$

Wood

...bamboo will keep bending!



$f_m = 80\text{N/mm}^2$
 $E = 19000\text{N/mm}^2$

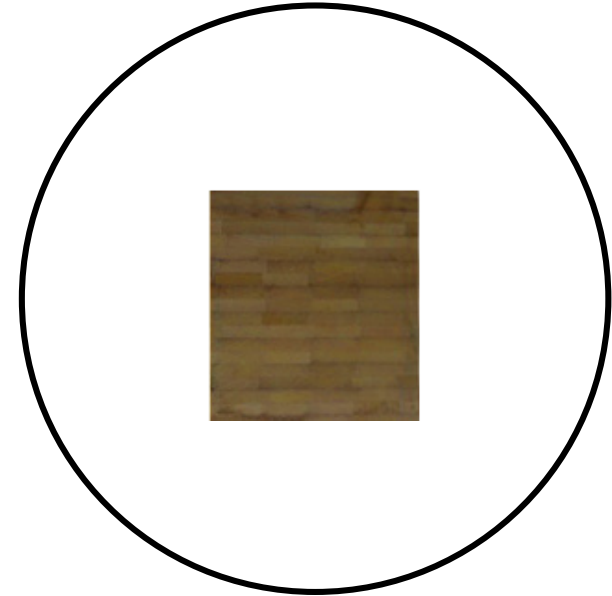
Laminated Bamboo

Wood



$h=1/20L$

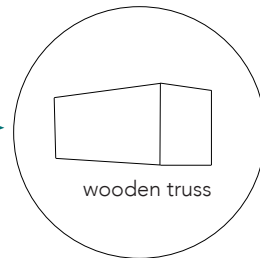
Laminated Bamboo



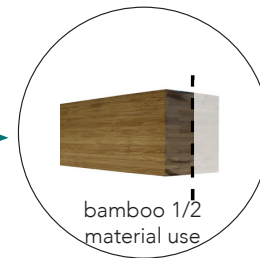
$h=1/40L$



€ € € €



€ €



€ €

1/2!



1,00 m
in 30 days





1,00 m
in 30 days

2,00 m
in 40 days





1,00 m
in 30 days



2,00 m
in 40 days



20,0 m
in 8 months





1,00 m
in 30 days



2,00 m
in 40 days



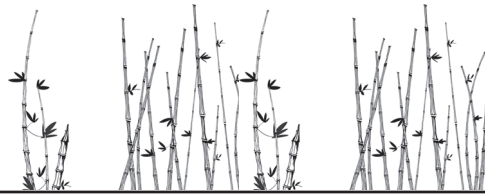
20,0 m
in 8 months



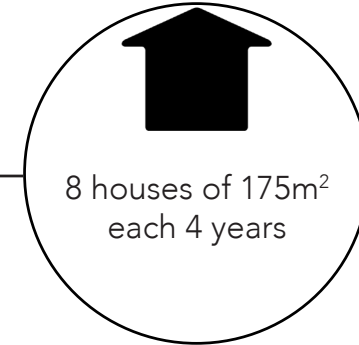
1-2-3 y
hardening



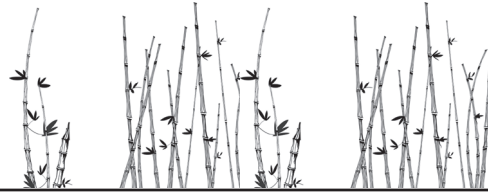
GUADUA




1 hectare



GUADUA

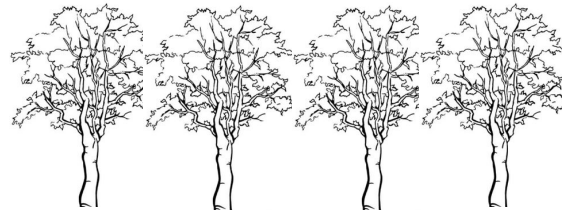


1 hectare




8 houses of 175m²
each 4 years

LUMBER



1 hectare



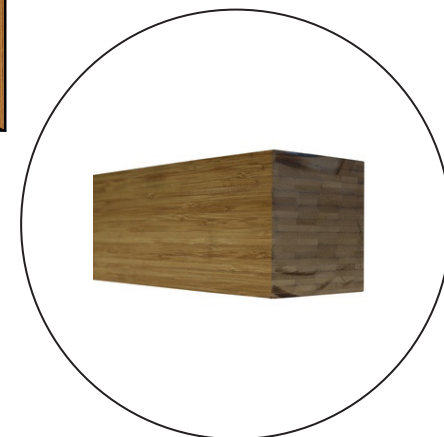
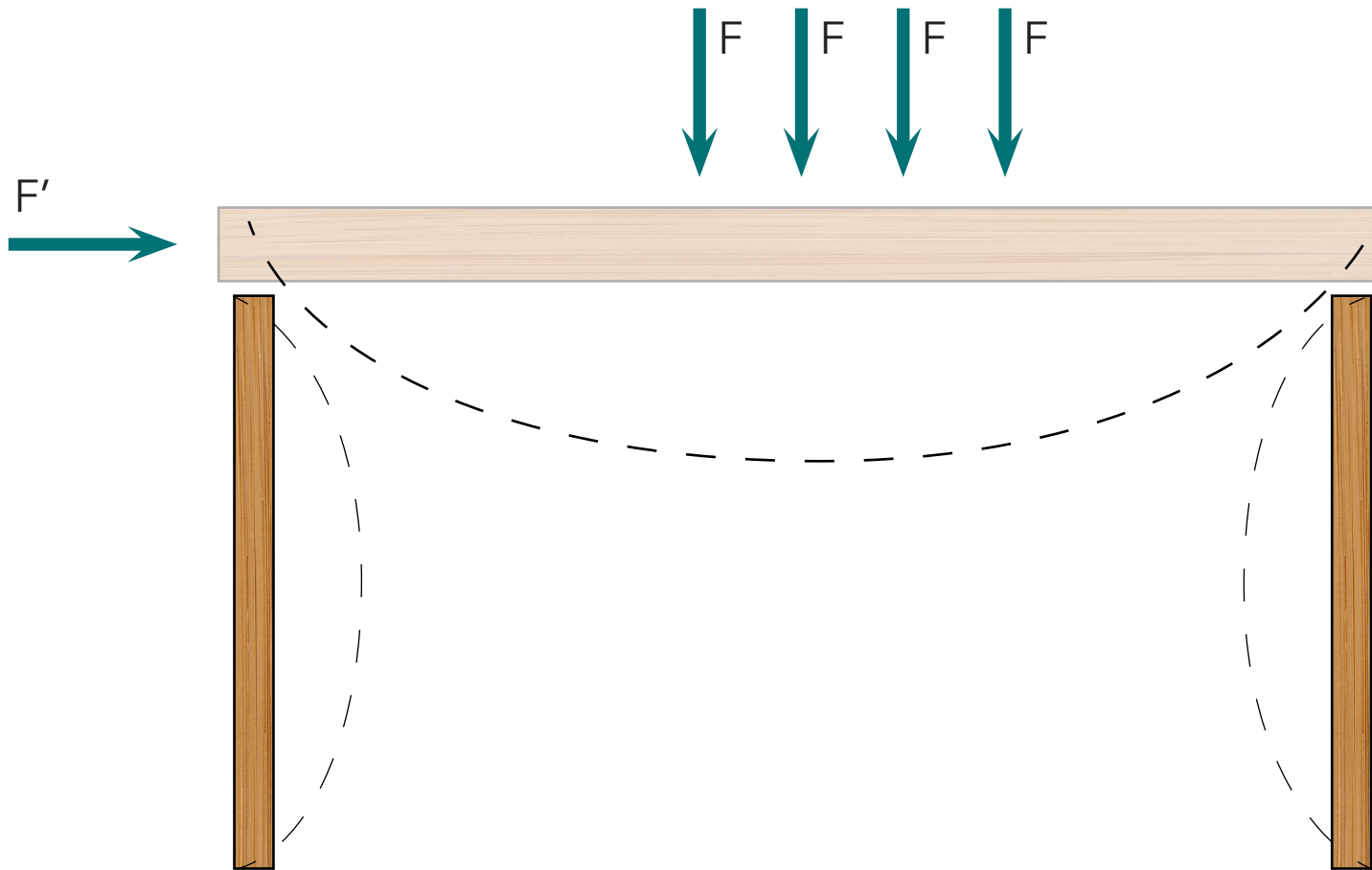
1 house of 175m²
each 4 years

1:8!



20,0 m
in 8 months



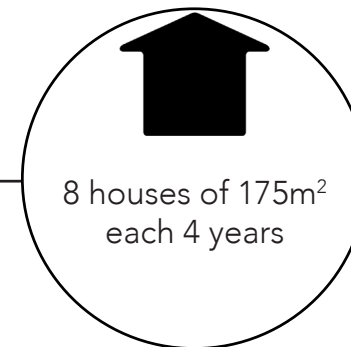




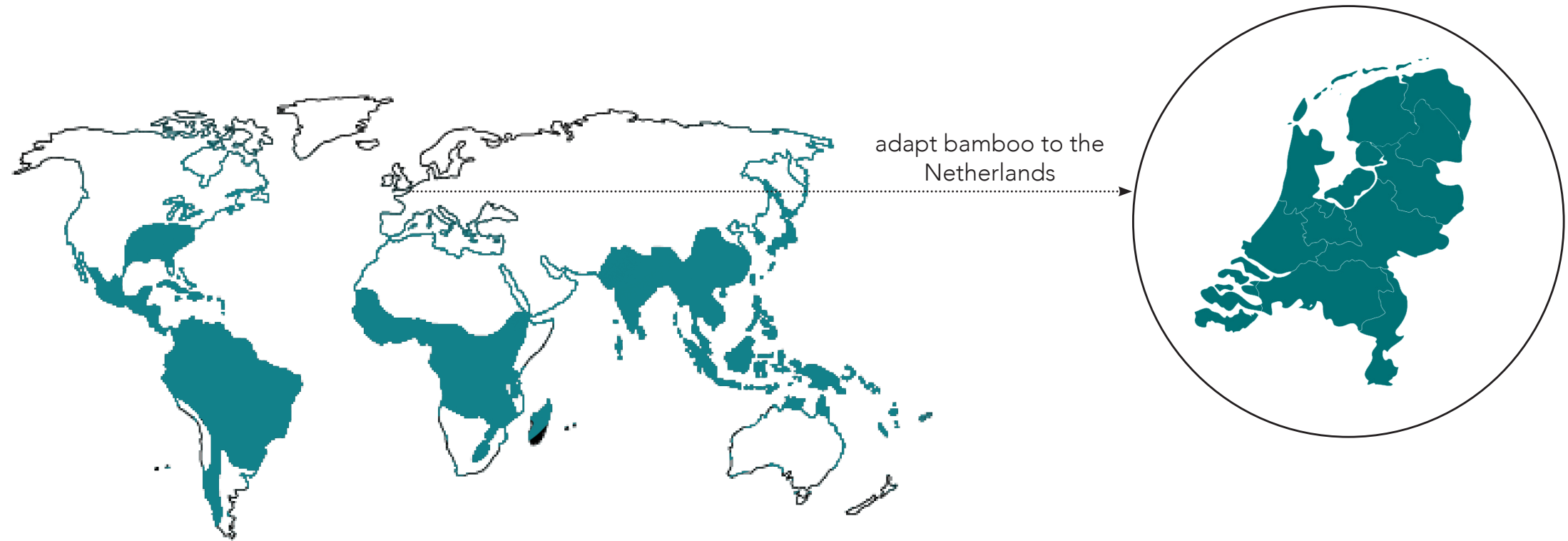
GUADUA



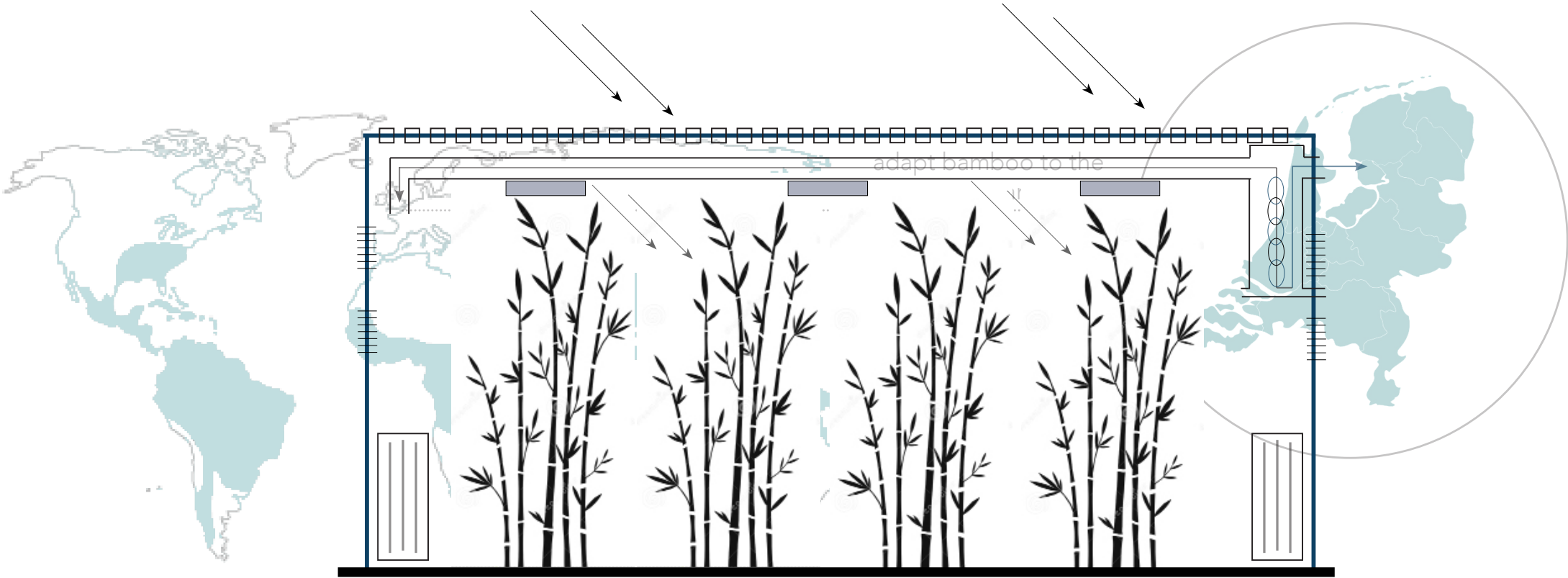
1 hectare

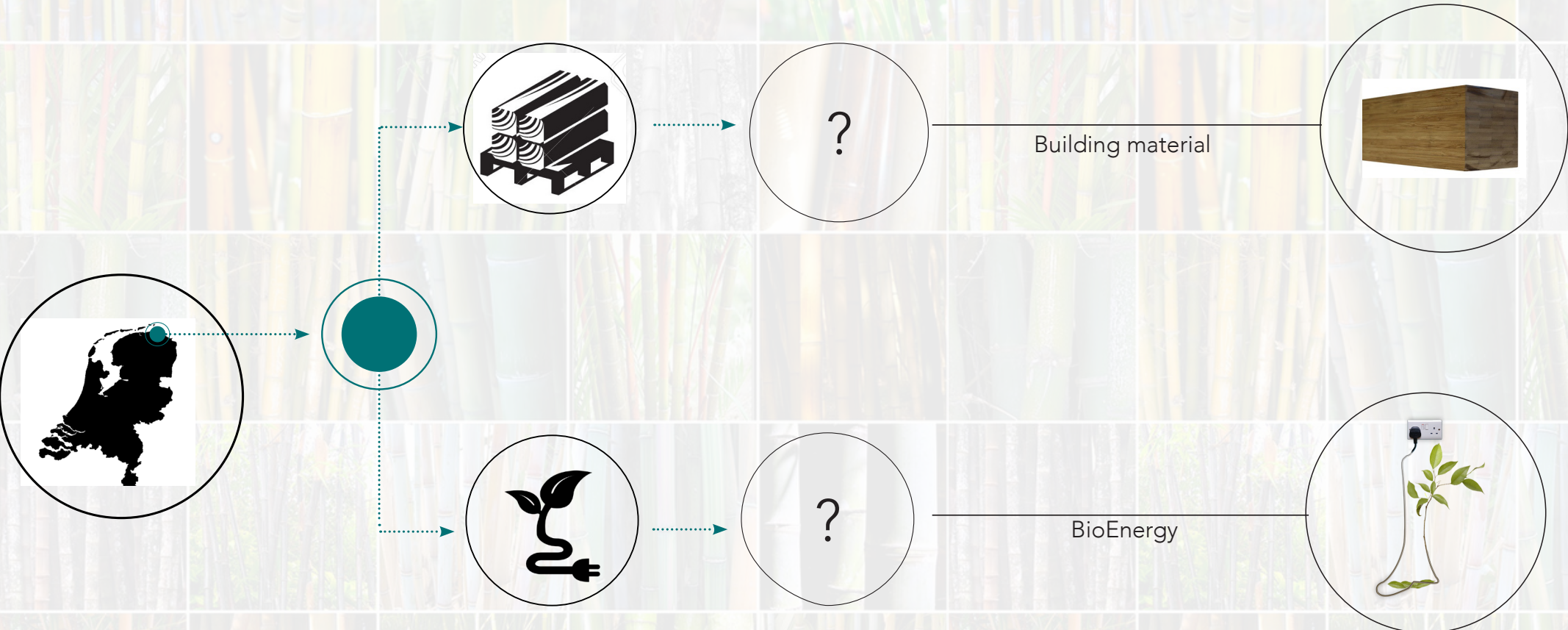


1:8!



The challenge

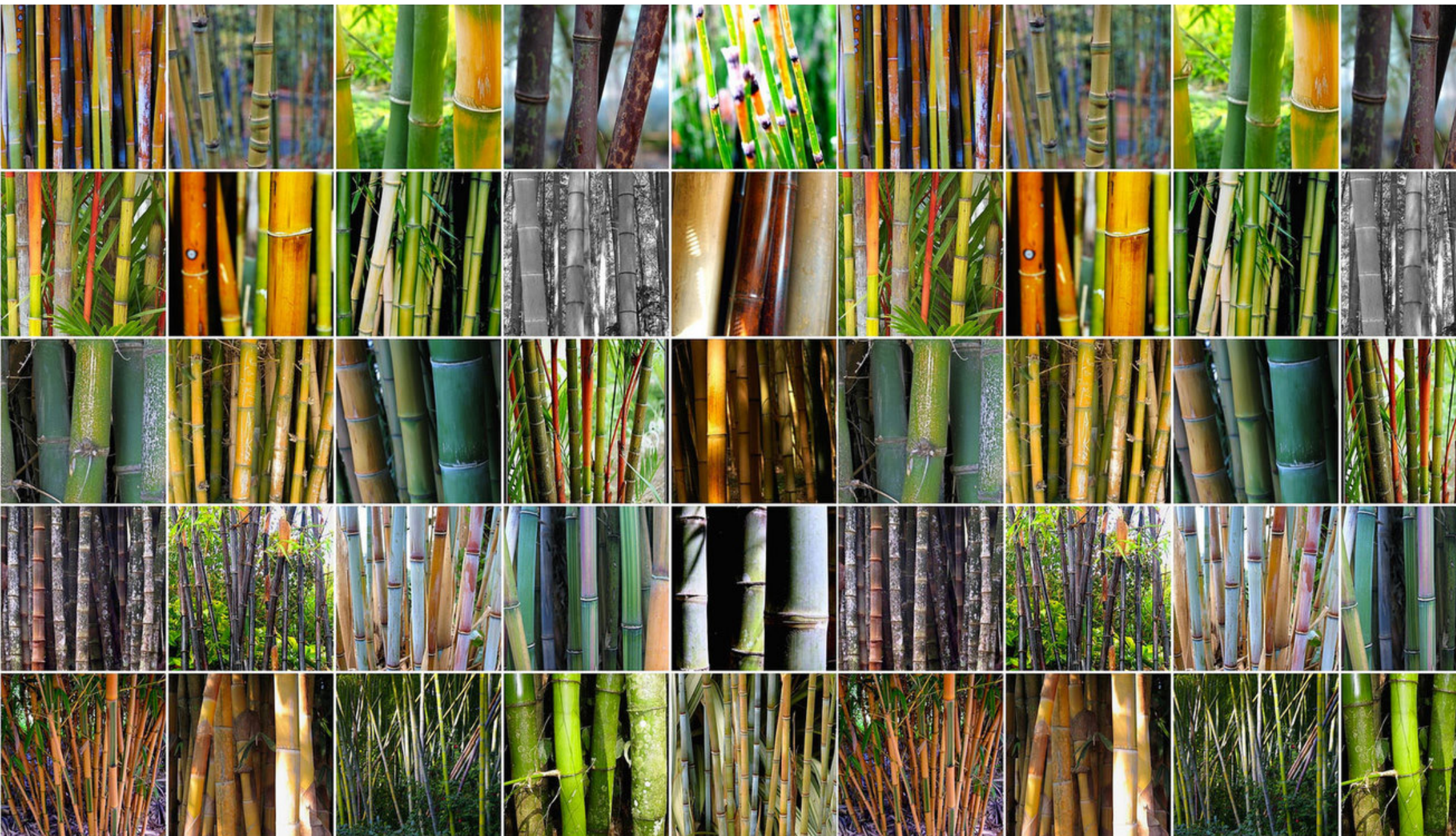






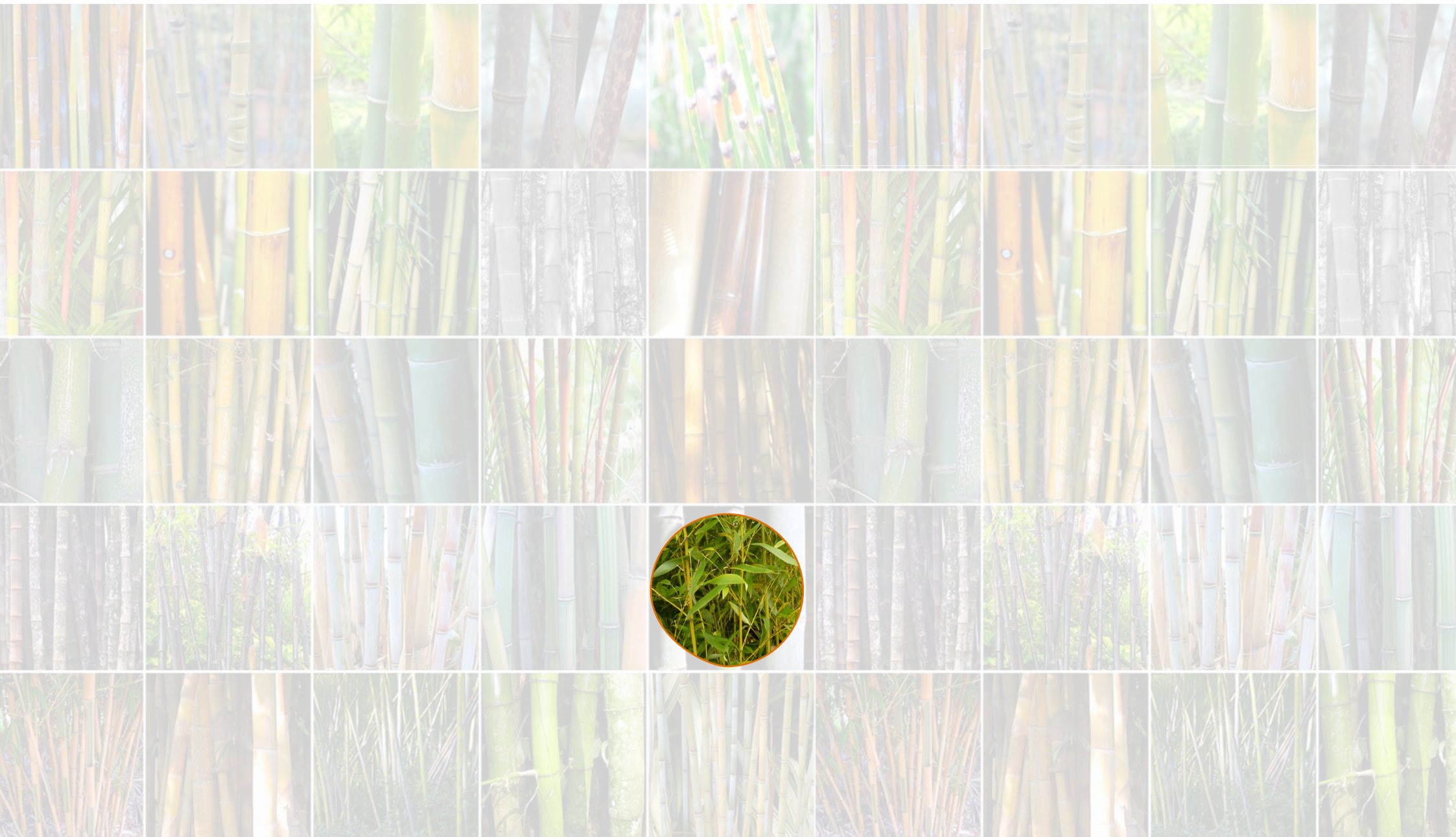


Species





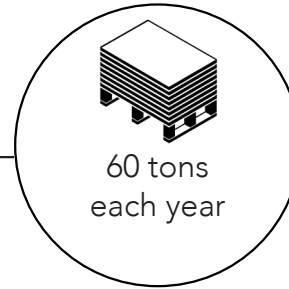
Phyllostachys Aurea Bamboo



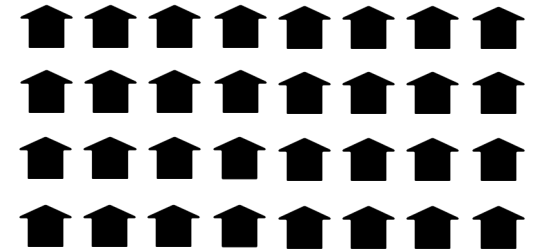
PHYLLOSTACHYS



1 hectare plantation

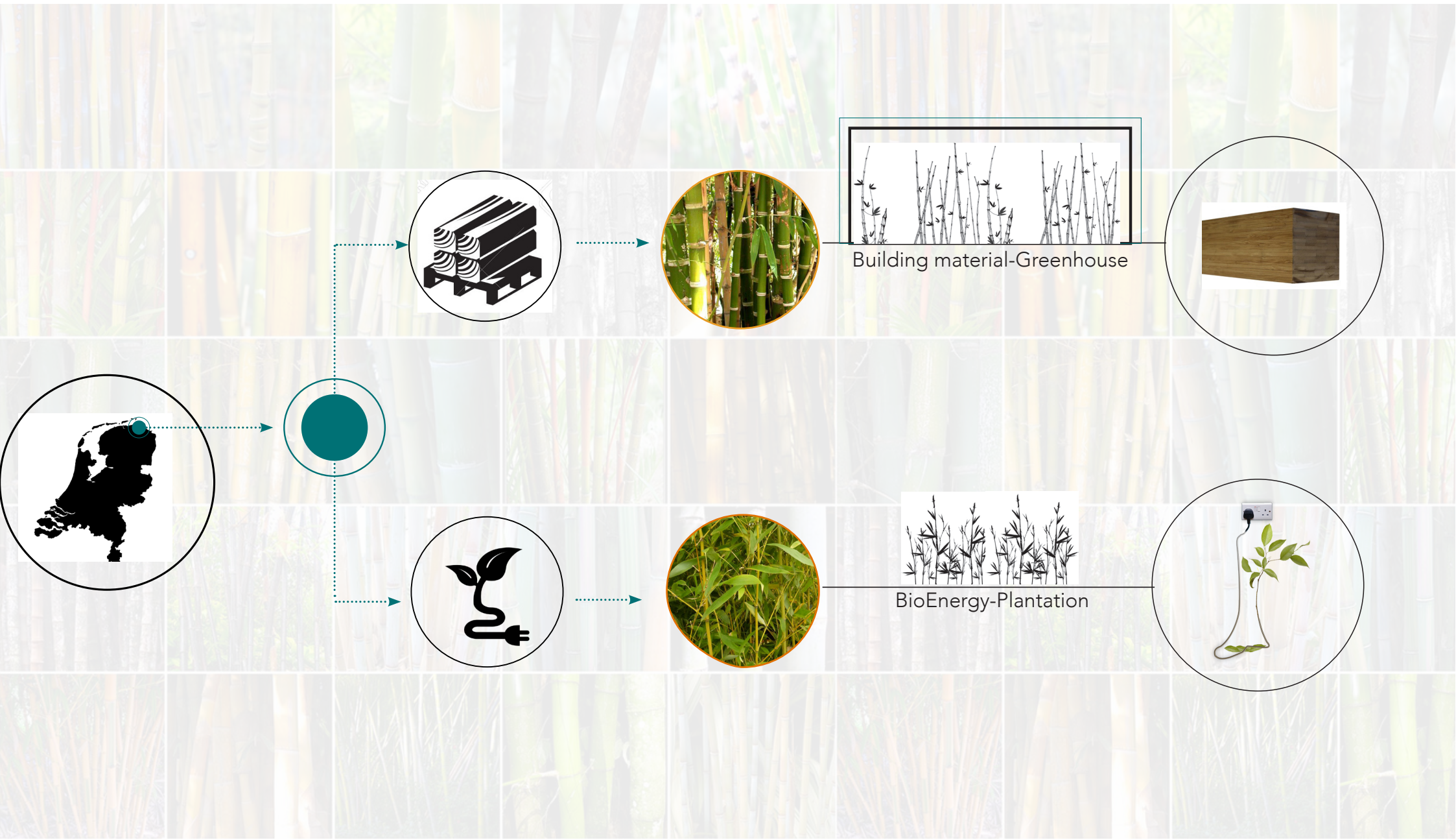


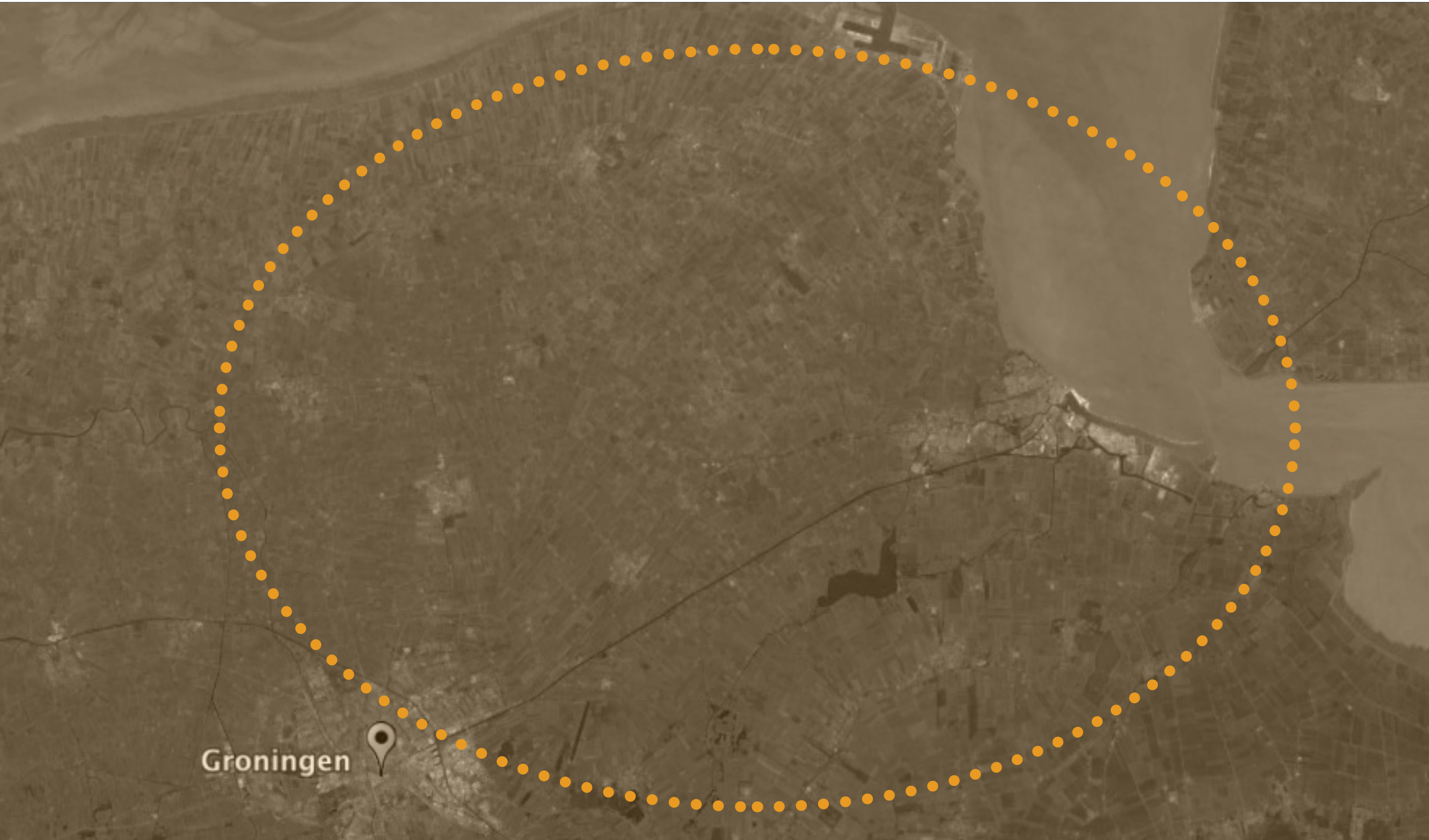
• energy for 32 houses



ENERGY

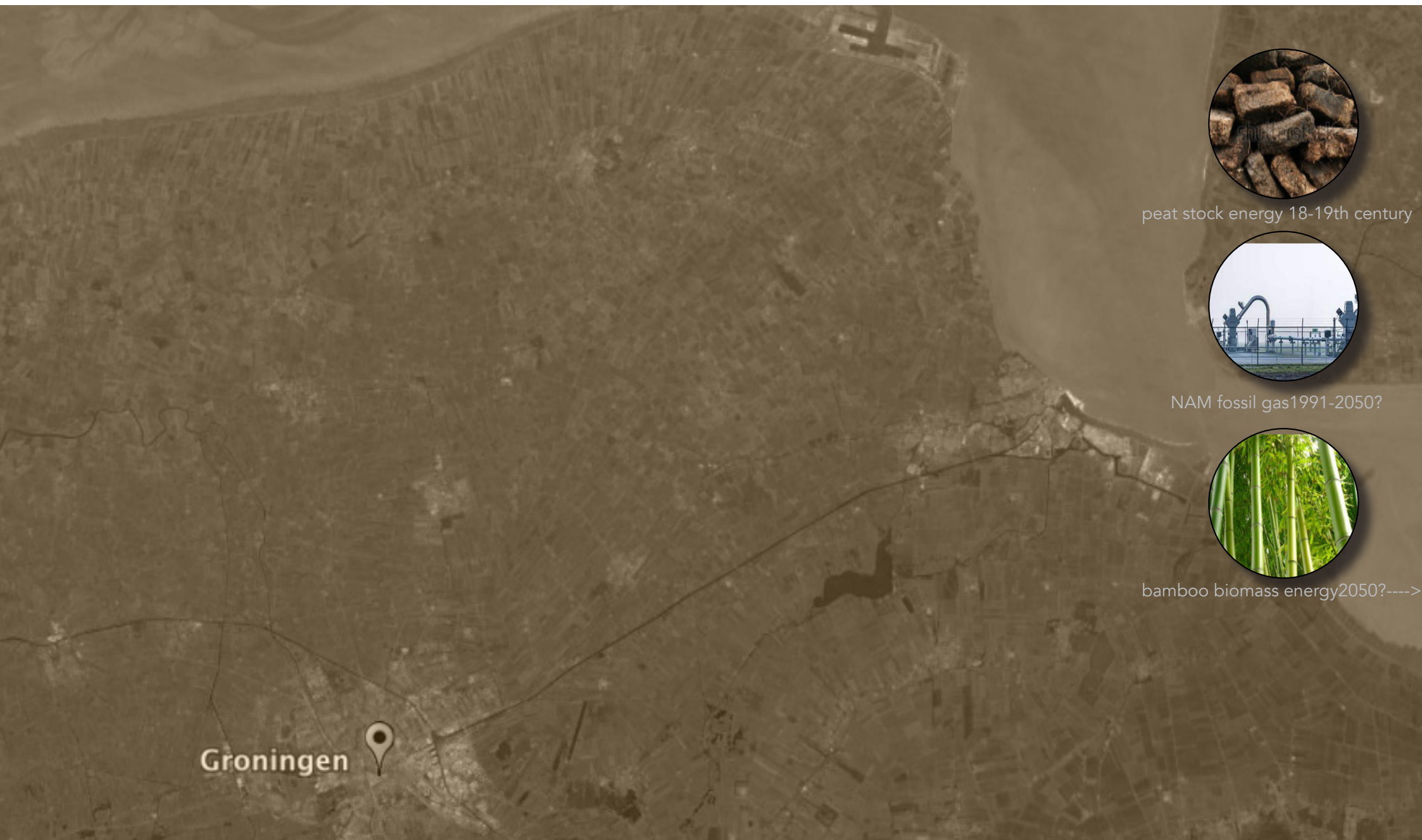
- 70% less CO₂ emissions than gas
- no need of replanting
- low ash content and alkali index compared to other herbaceous species







An energy producing area



peat stock energy 18-19th century



NAM fossil gas 1991-2050?



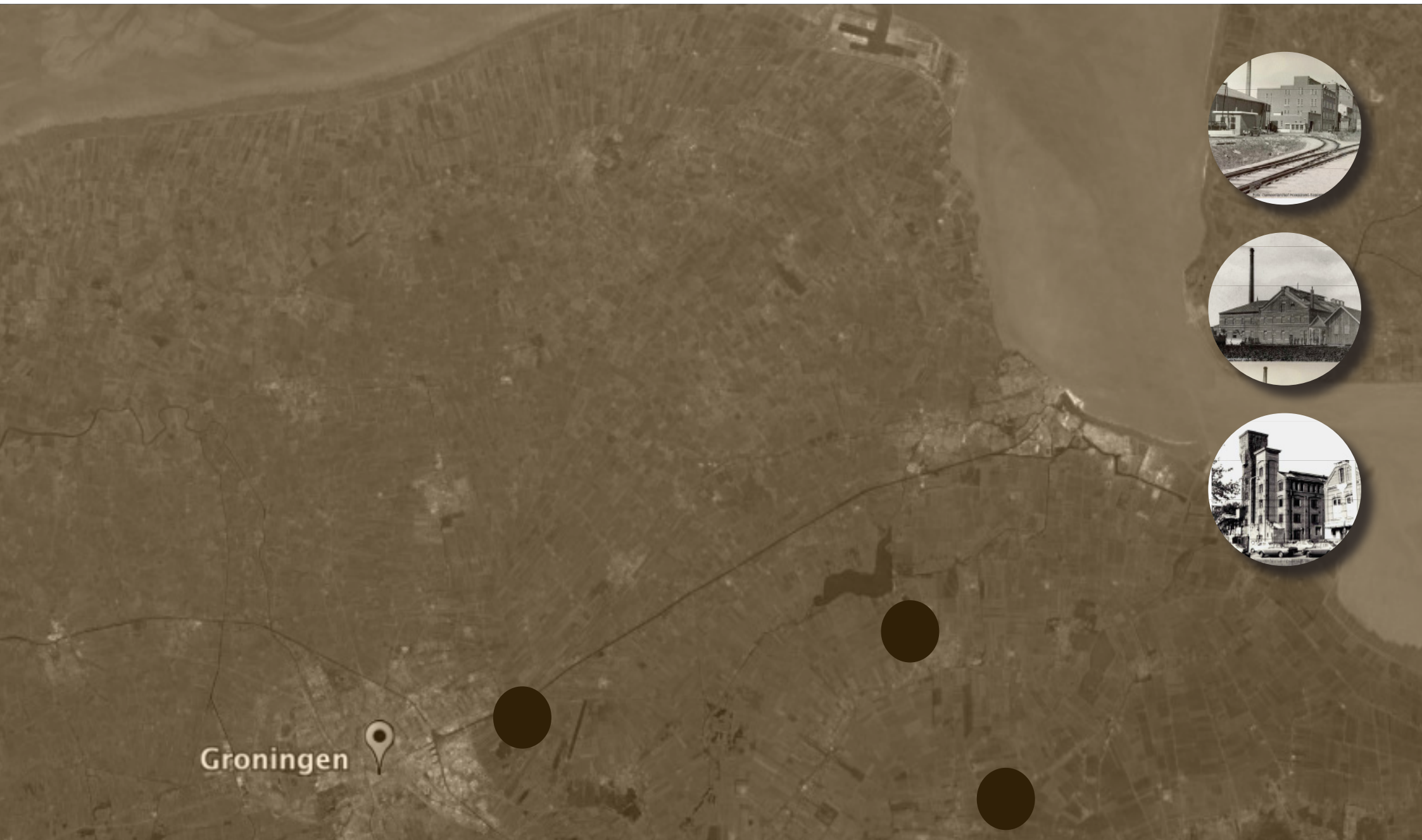
bamboo biomass energy 2050?---->

Groningen





An industrial area



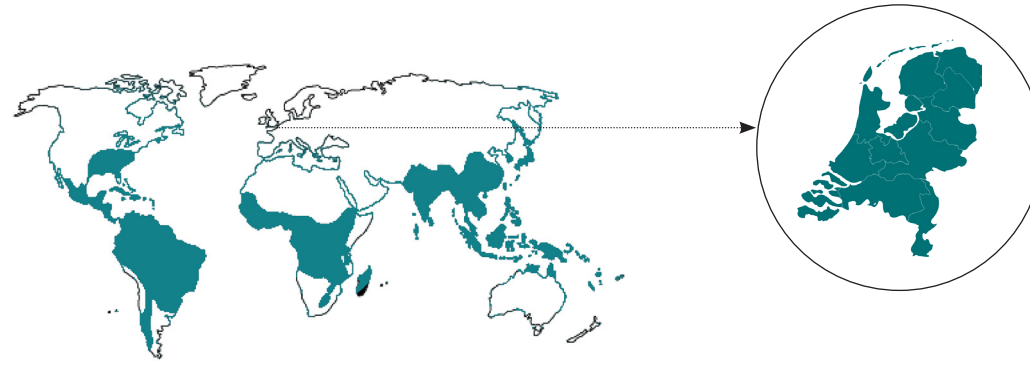


Opportunity for now?

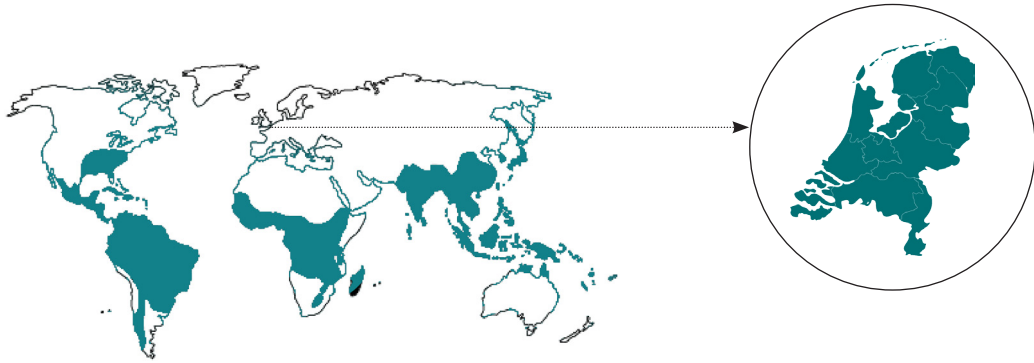


Groningen

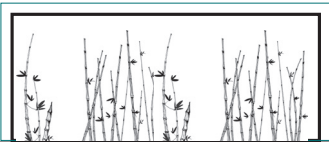




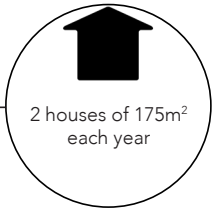
Proposal



GUADUA



1 hectare



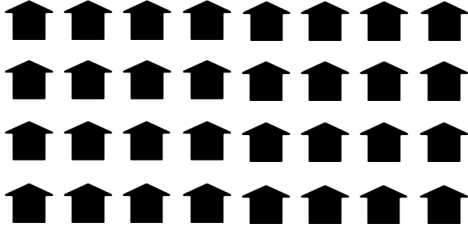
2 houses of 175m²
each year

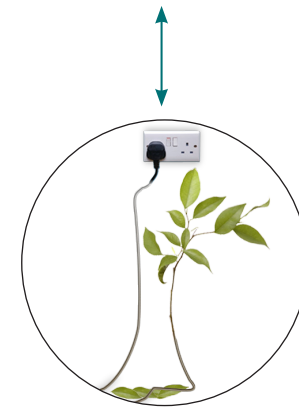
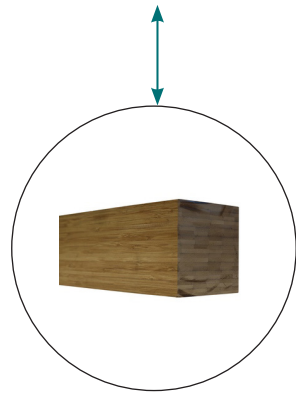
PHYLLOSTACHYS



1 hectare

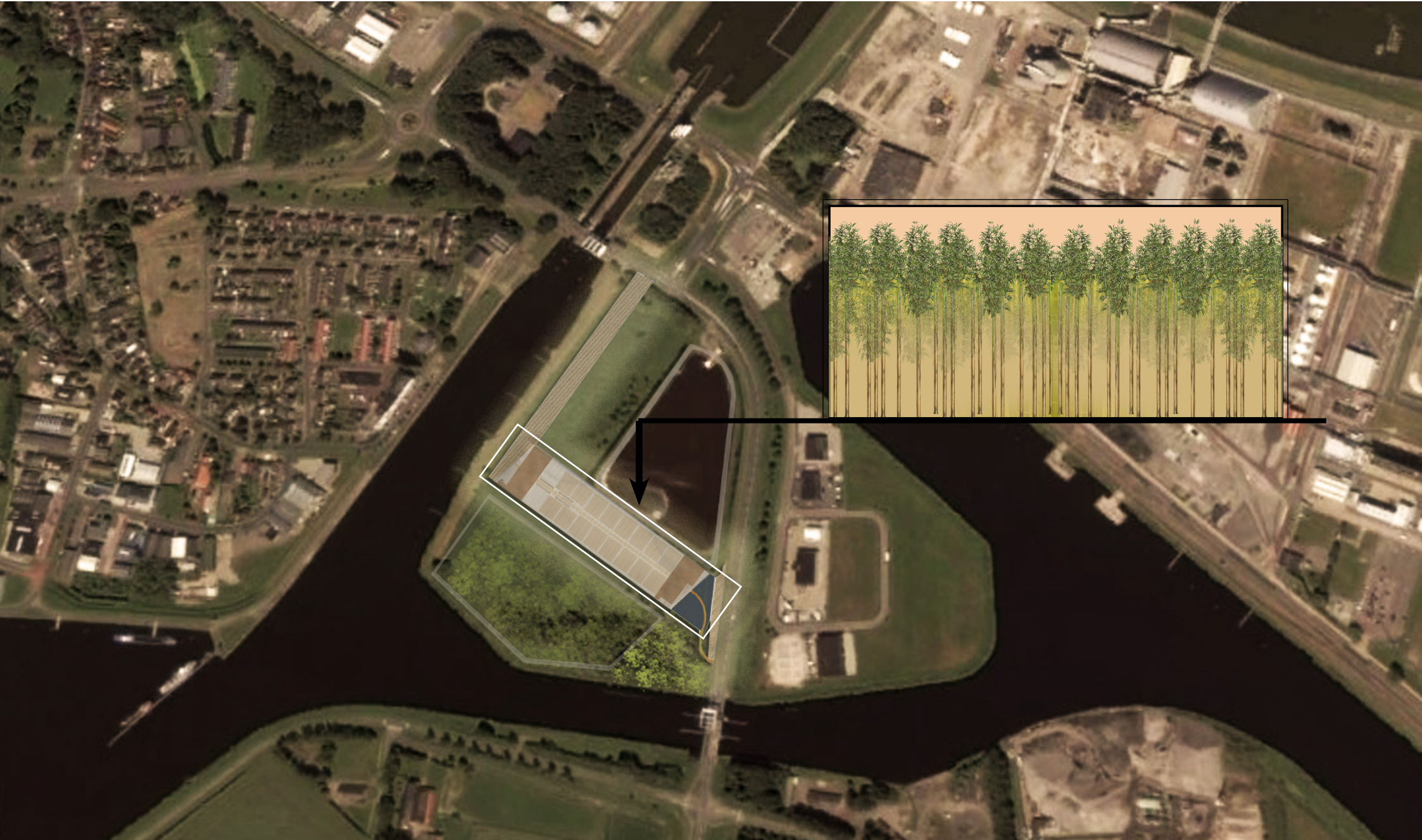
• energy for 32 houses

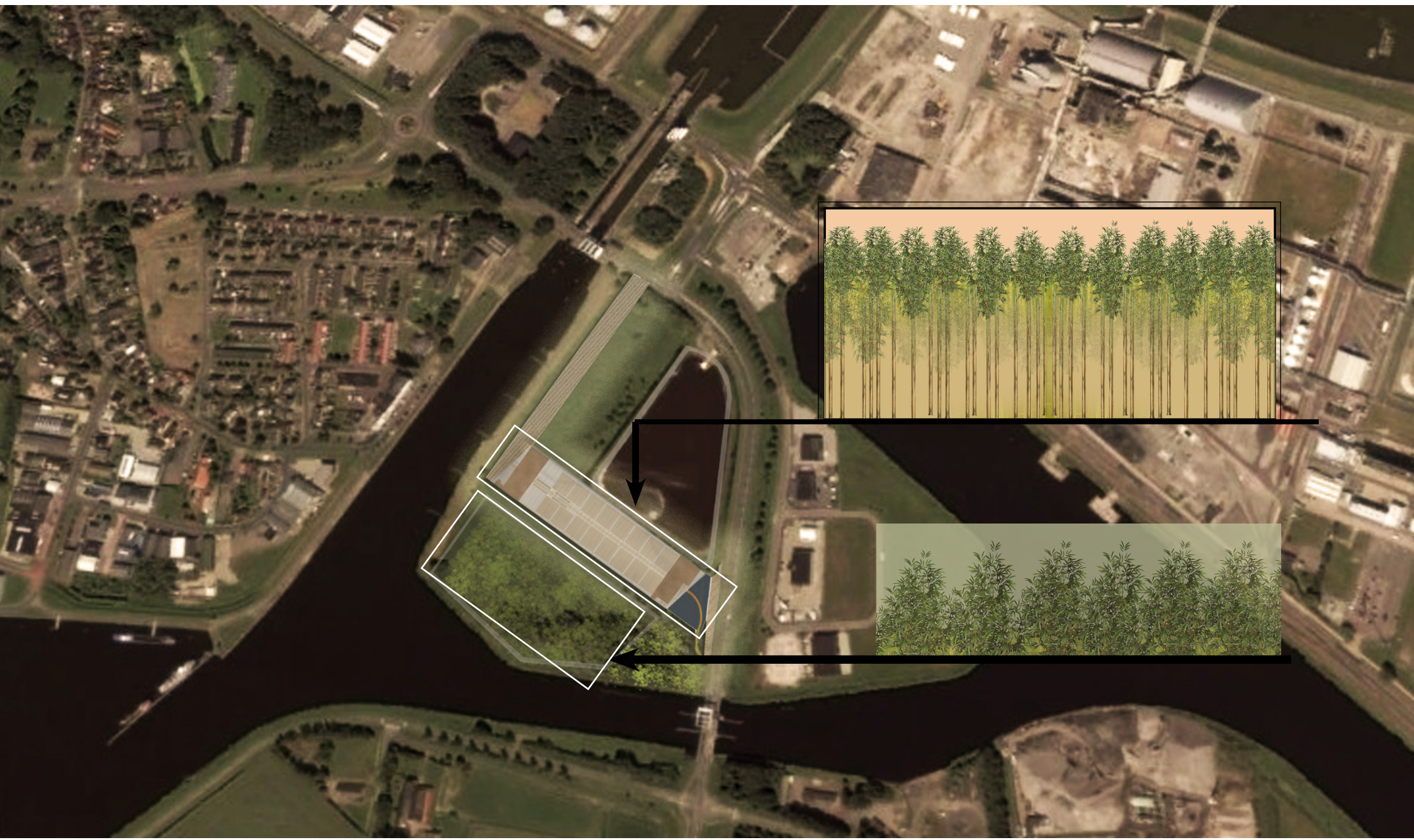


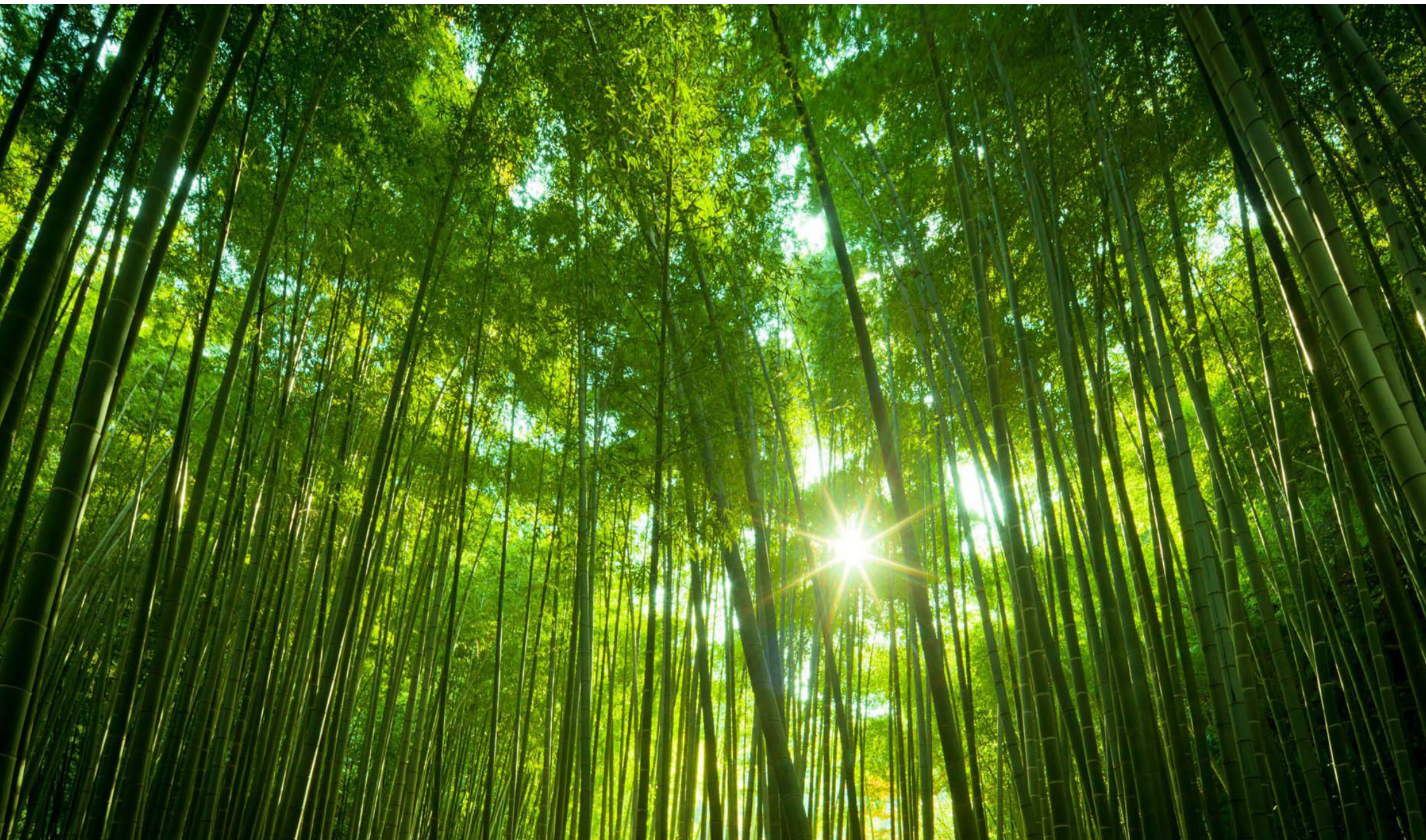






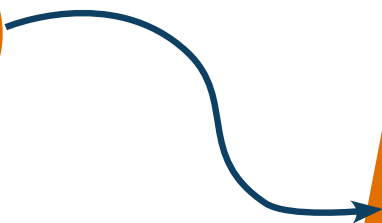
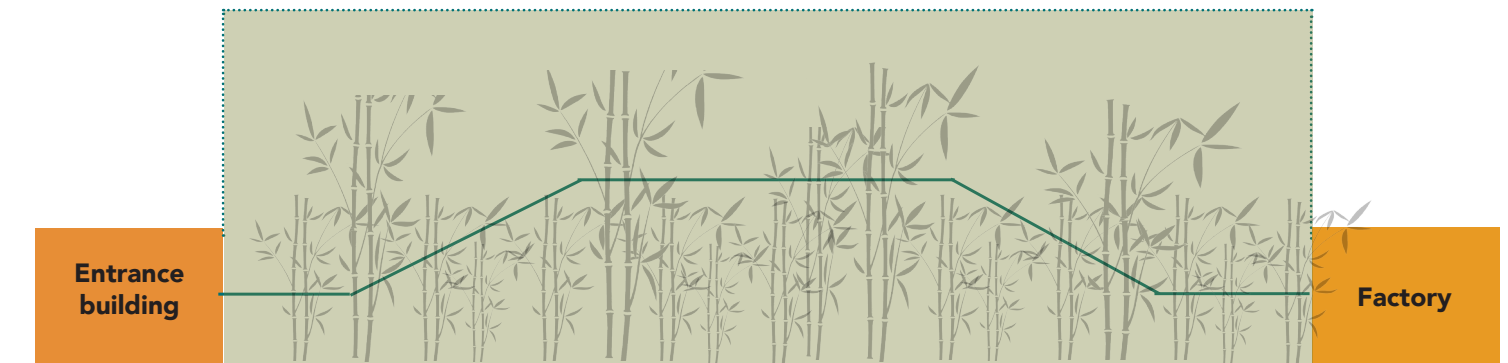




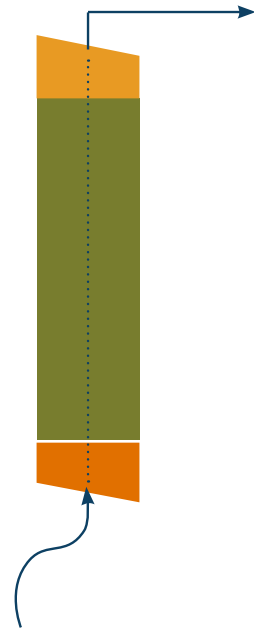
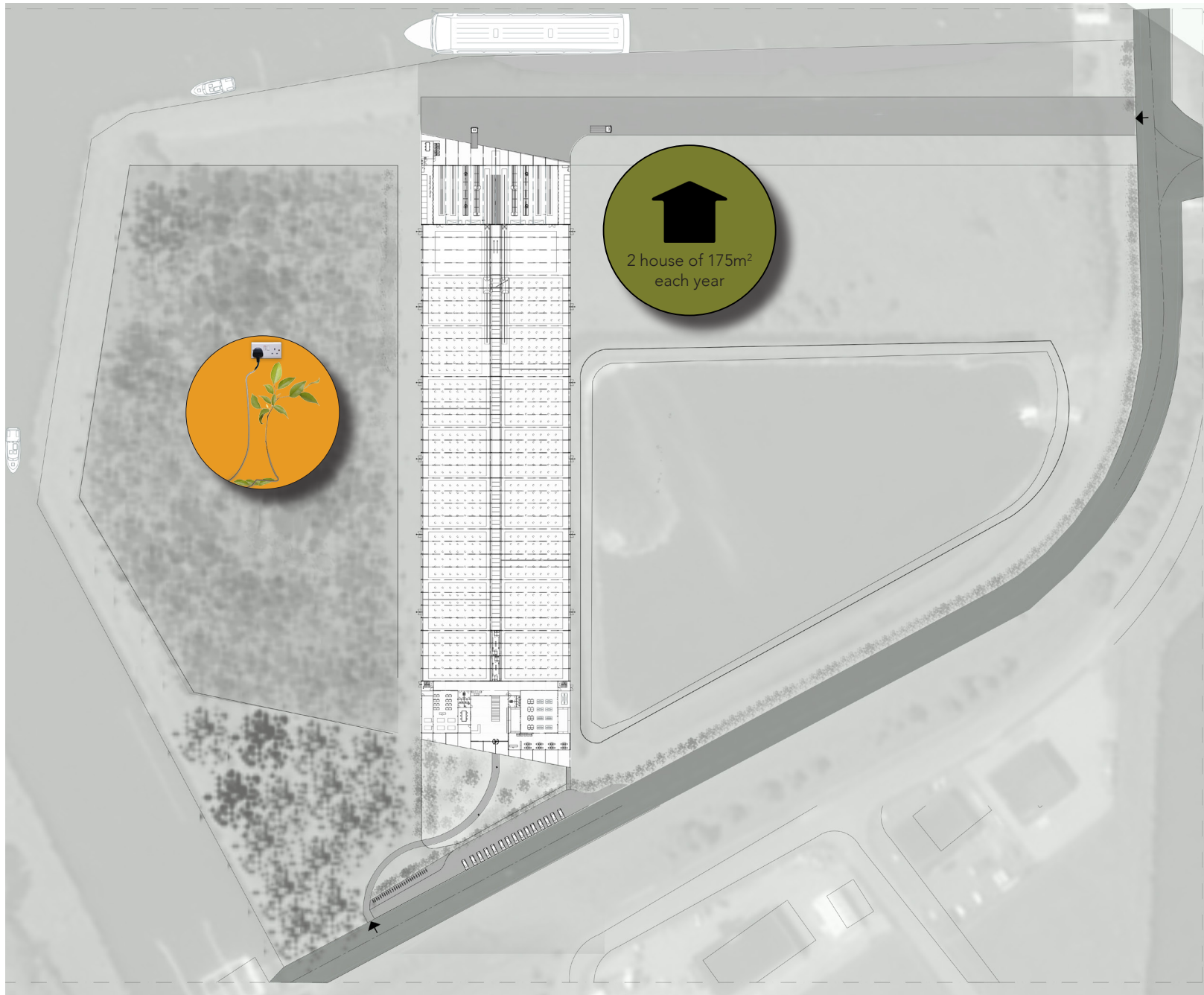




Building diagram

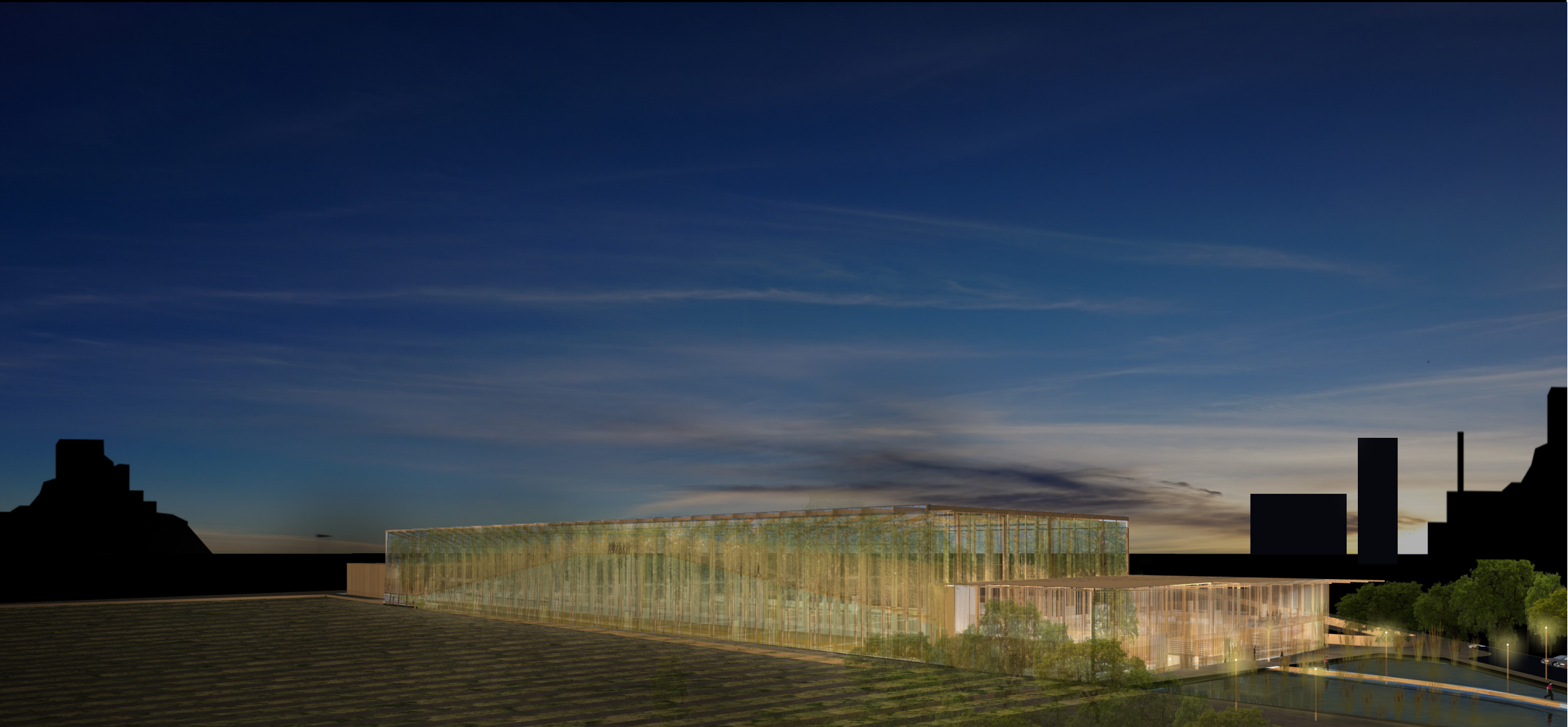


Project on site





The building





Entrance





Plan



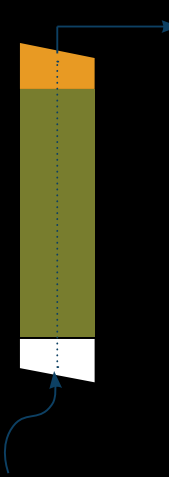
Workshop area

Offices

Labs

Workers changing rooms

Entrance greenhouse





Plan: entrance hall





Welcome to BAMhOuse!





Entrance hall









Entrance hall



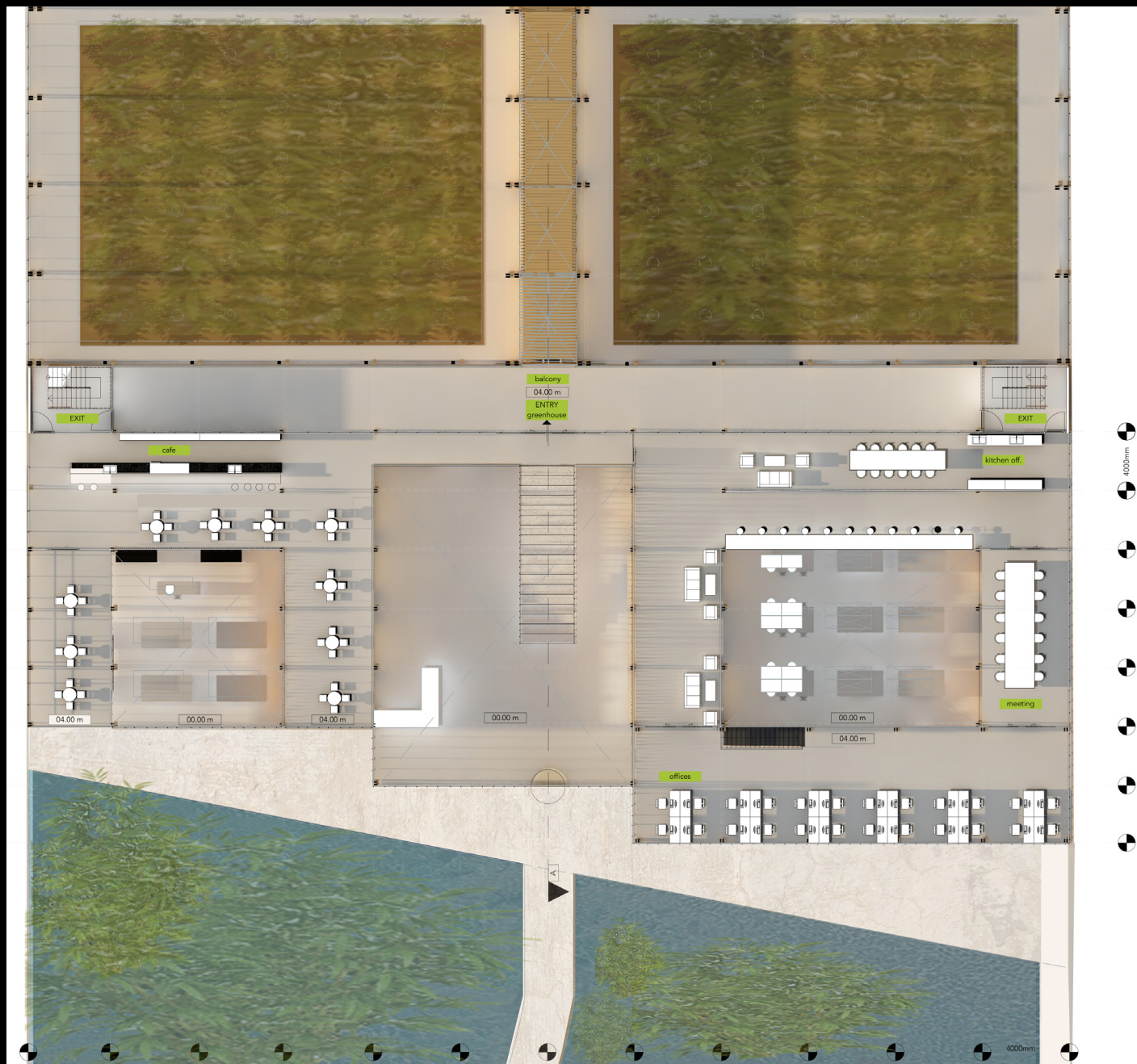


Go upstairs!

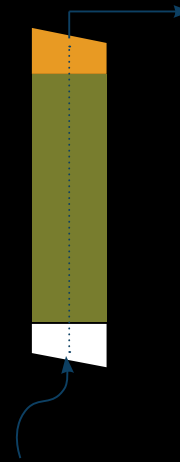




Plan 1st floor



Cafè
Offices
Entrance greenhouse





Plan 1st: Cafè



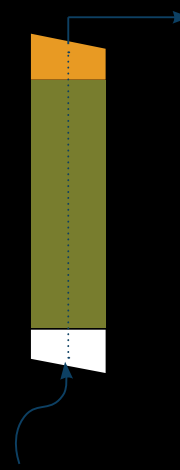
BAMBhOuse cafè

espresso.....	1,50 €
cappuccino.....	2,20 €
caffè lungo.....	2,00 €
americano.....	2,00 €
coca cola.....	1,50 €
fanta.....	1,50 €
bambino water.....	2,00 €





In section





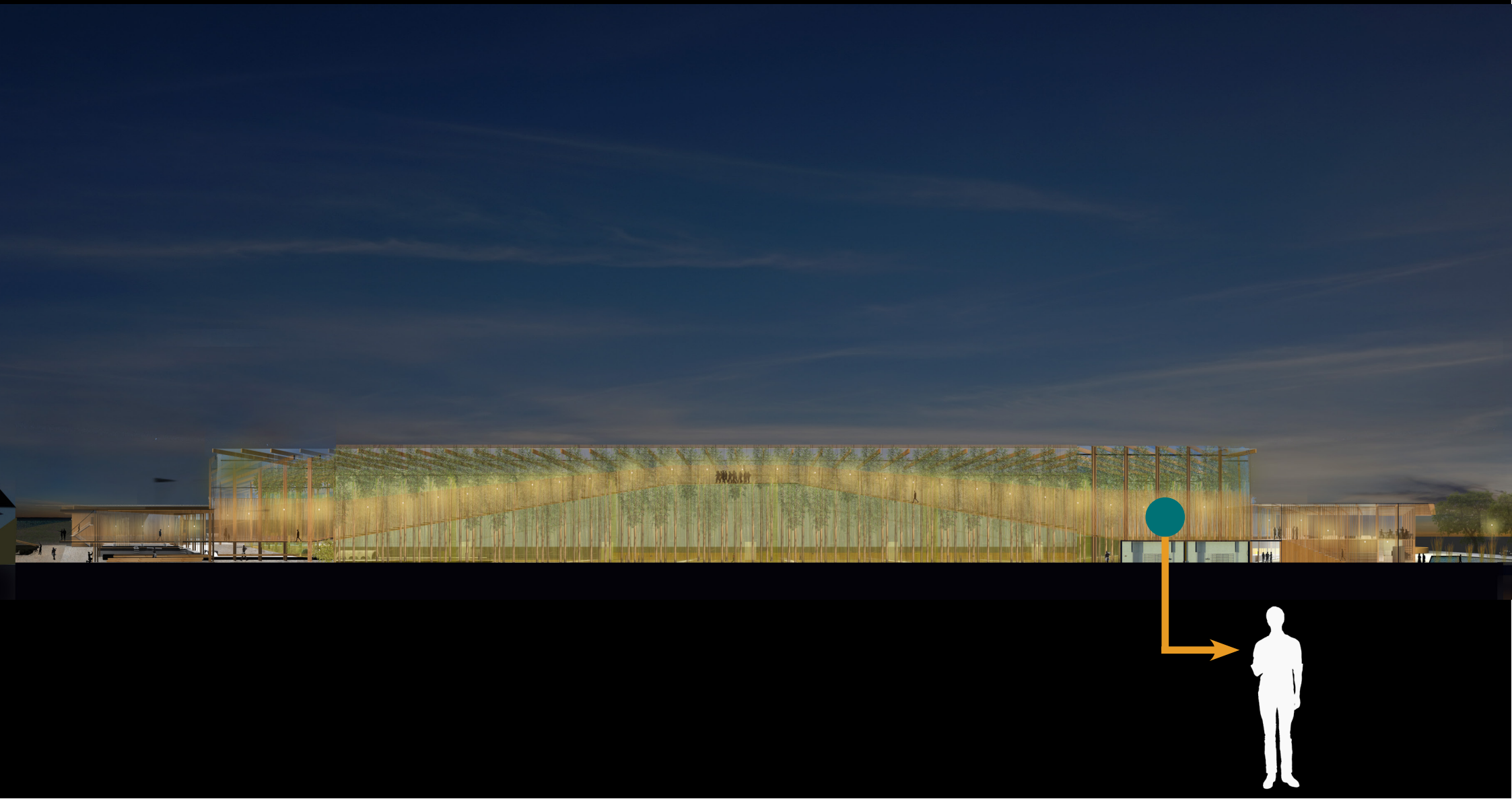
In section





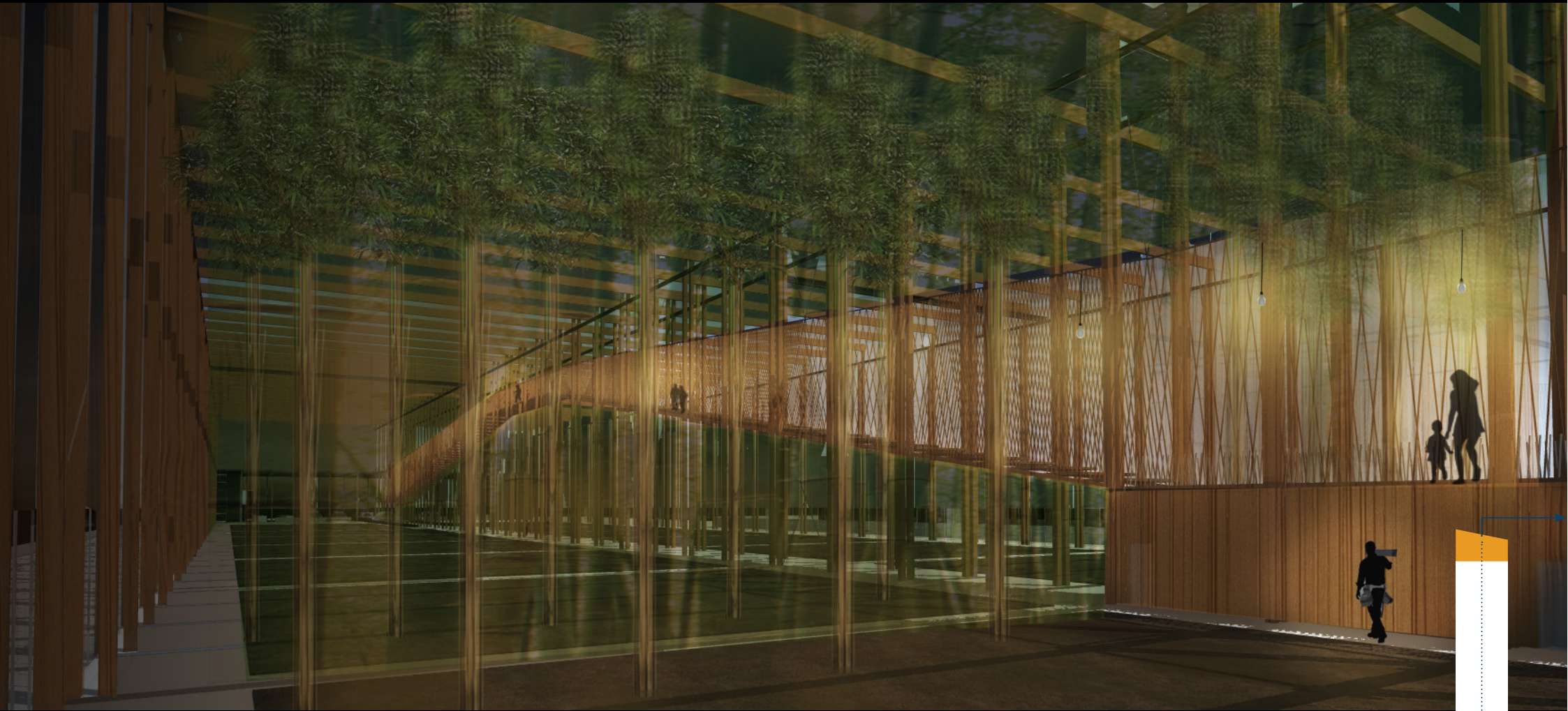
In section





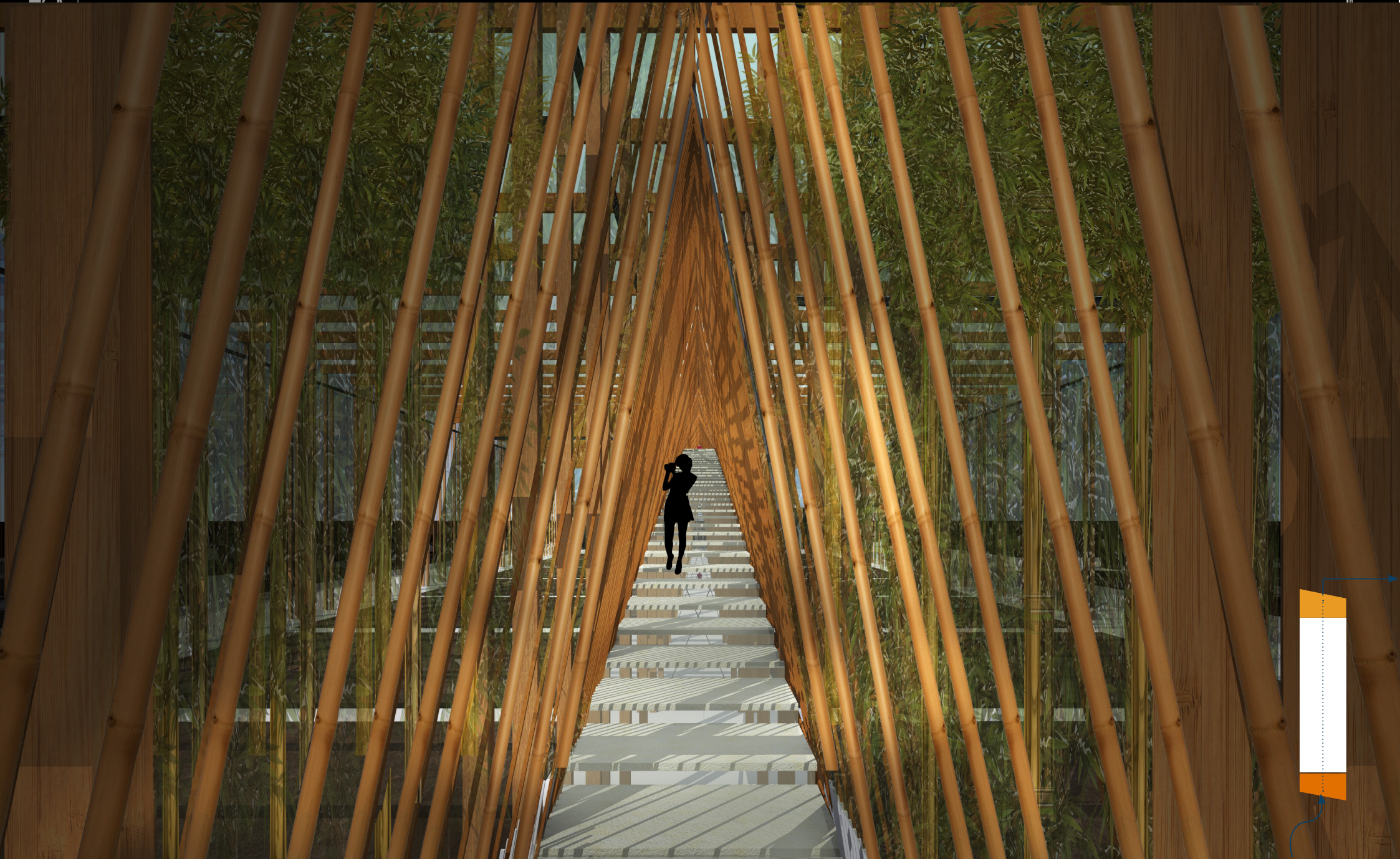


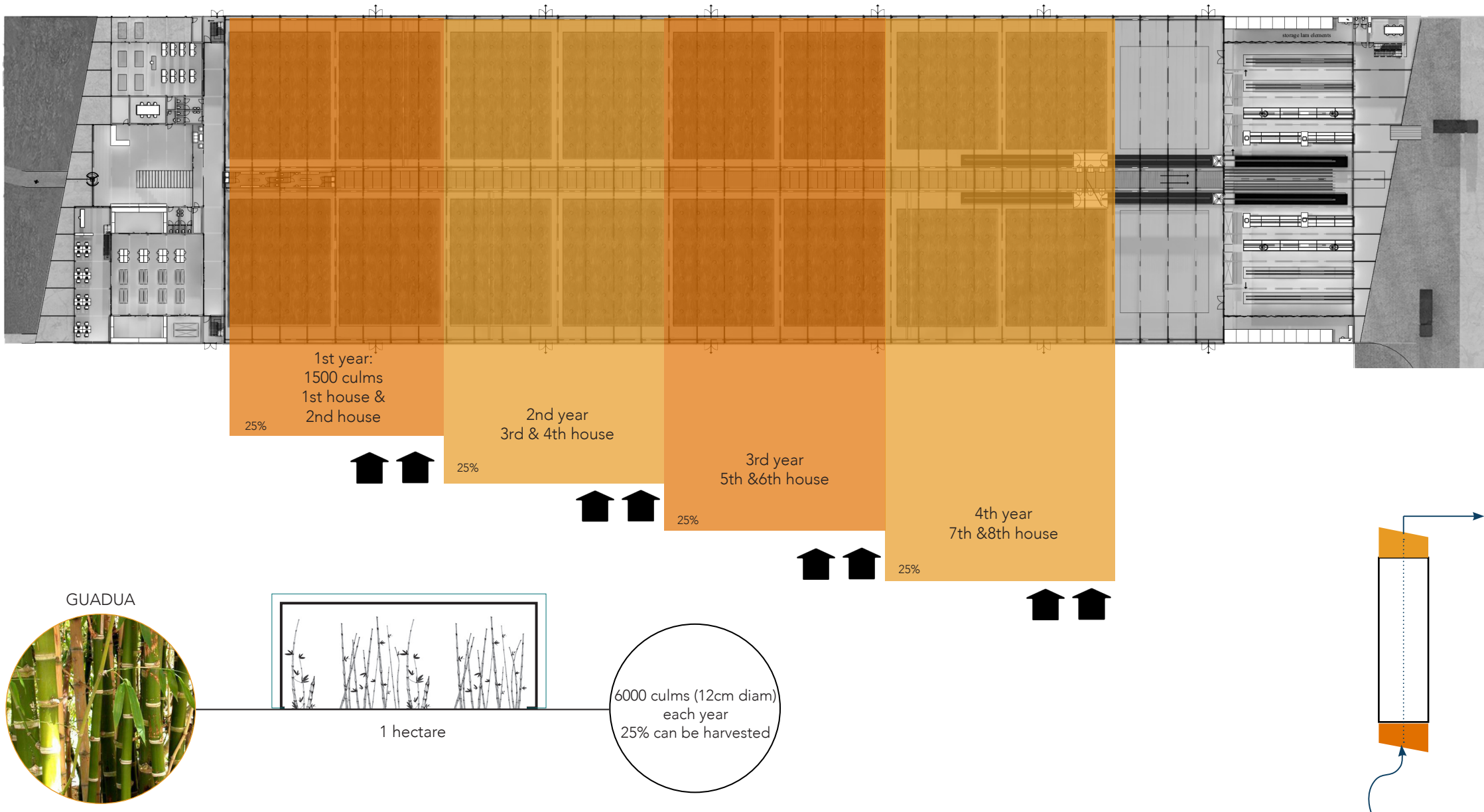
The greenhouse from the balcony





The forest's bridge



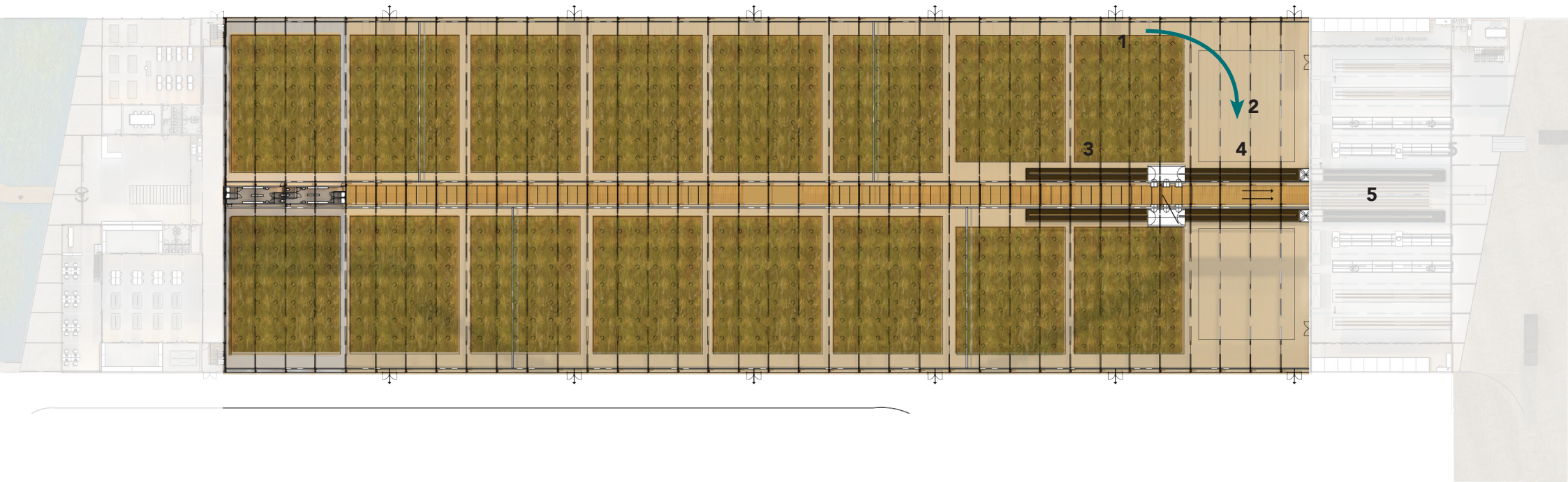
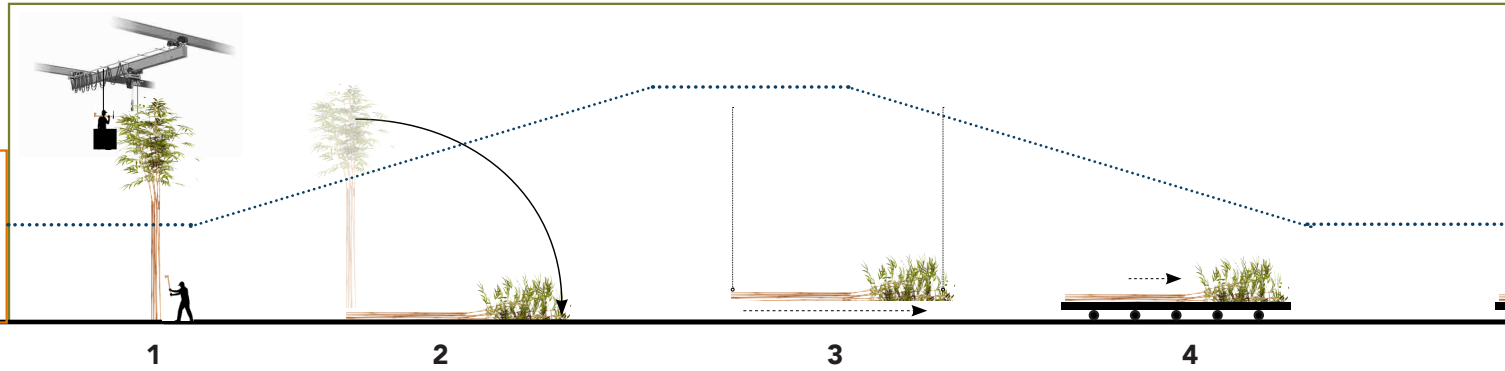


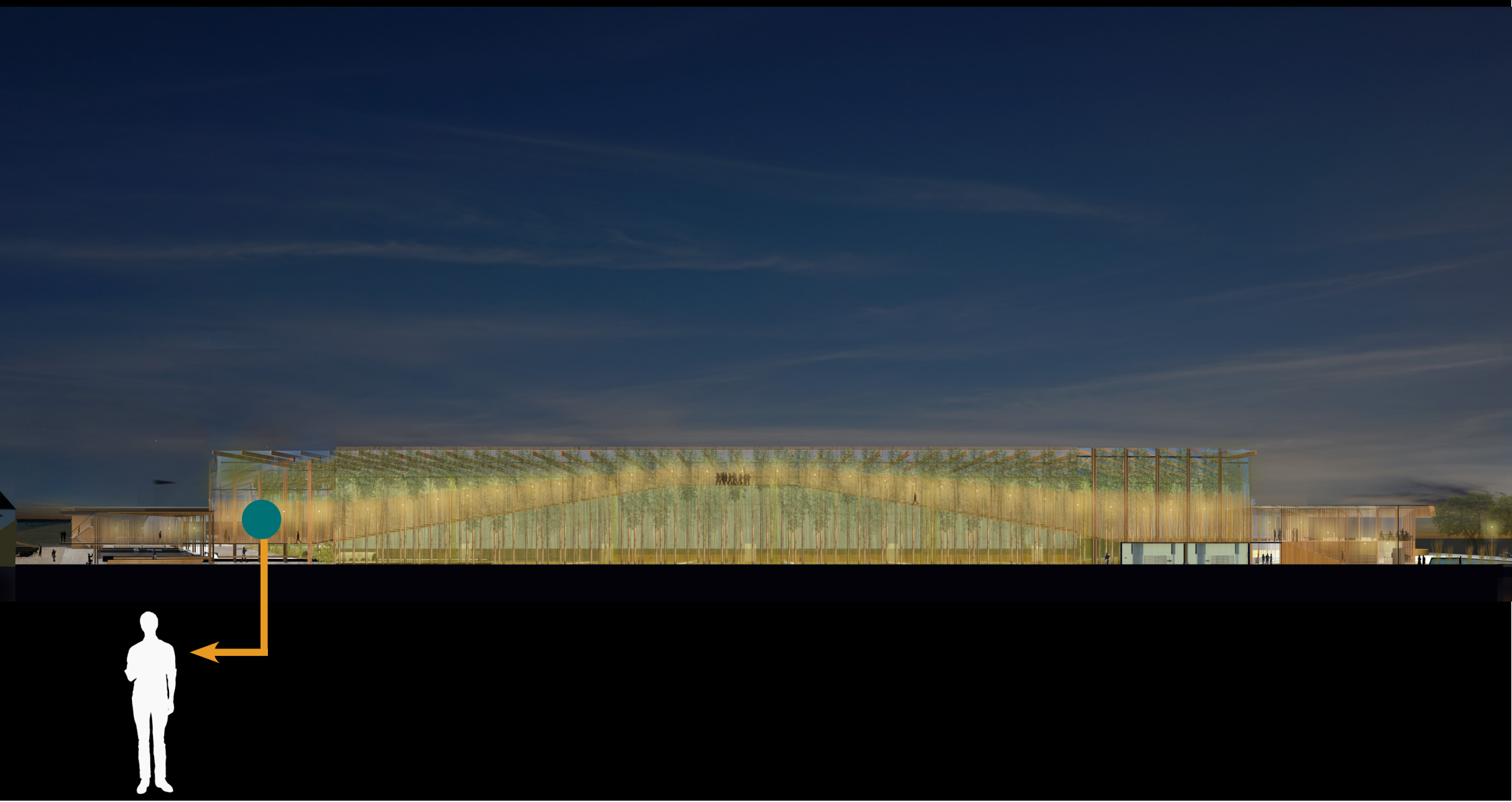


Greenhouse

Entrance volume

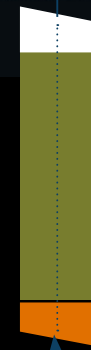
Fabrication space





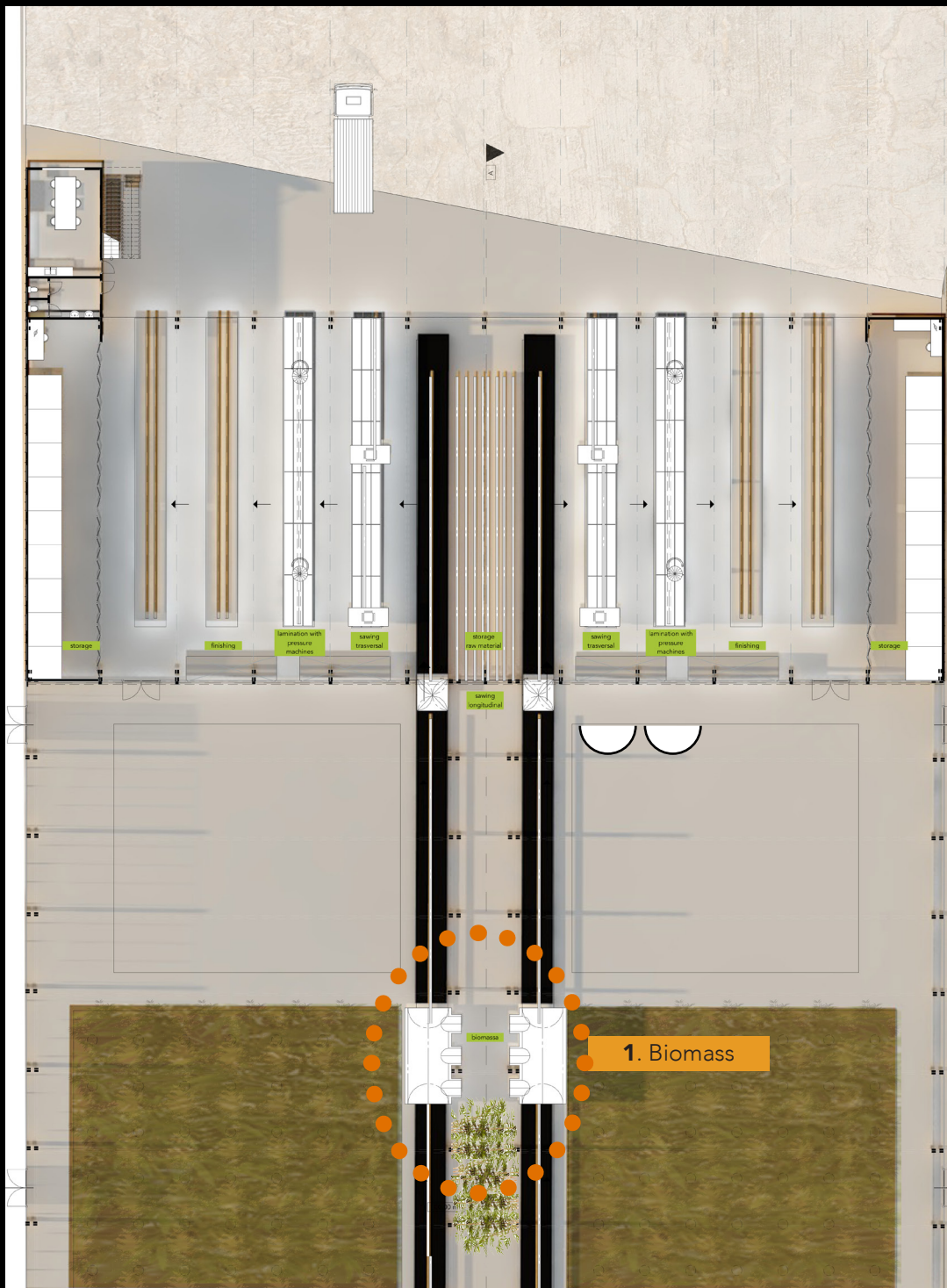


BAMBhOuse Factory

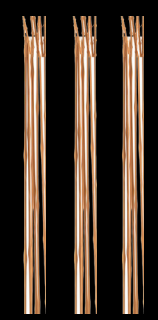




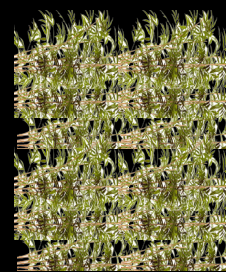
Fabrication chain



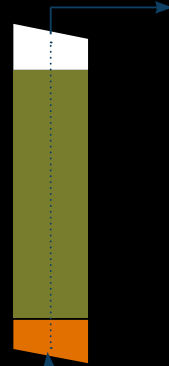
1. Biomass



Building Material

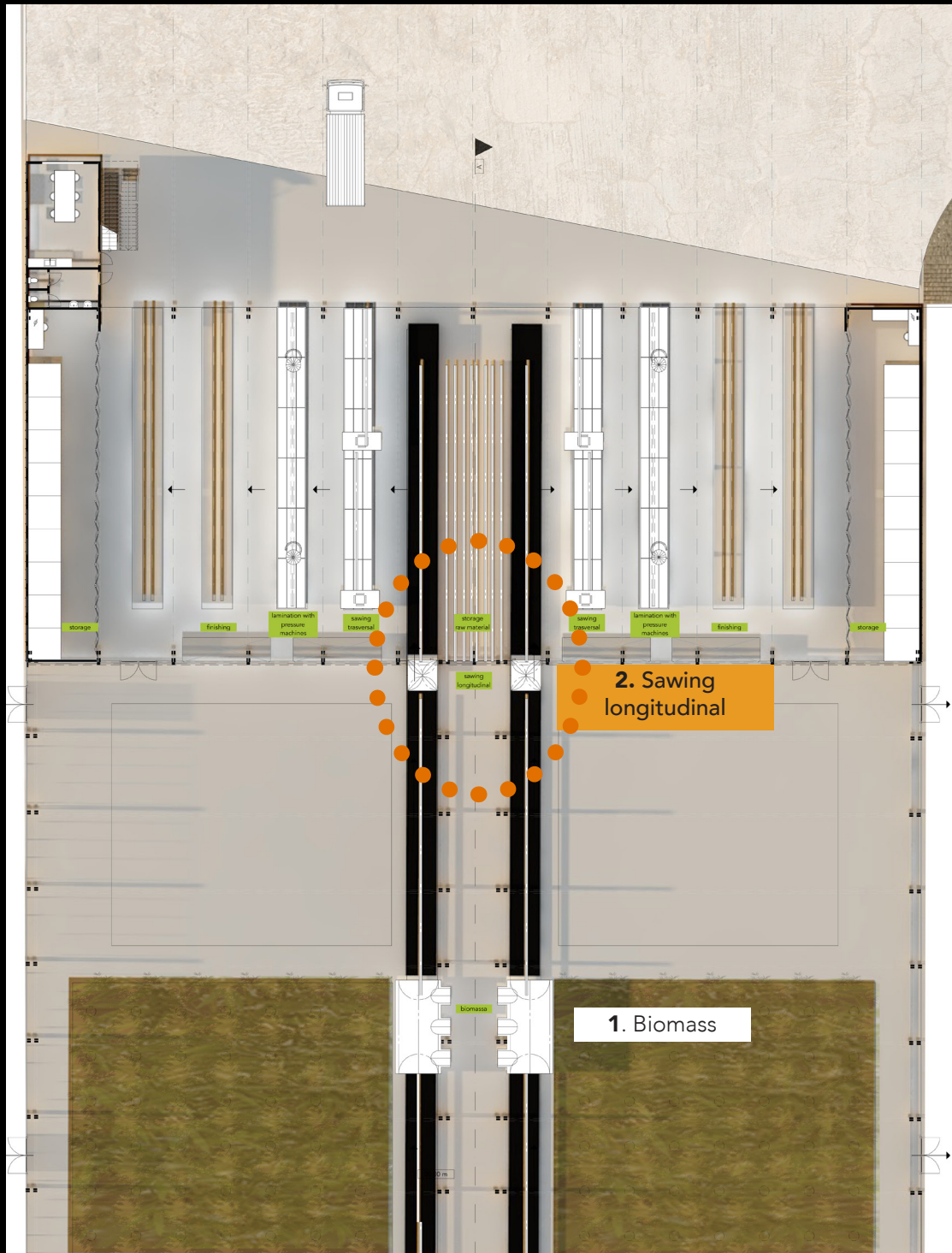


Biomass

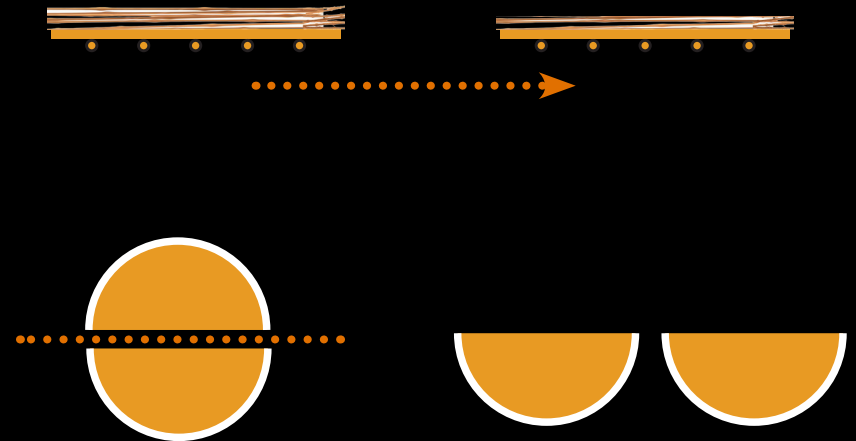




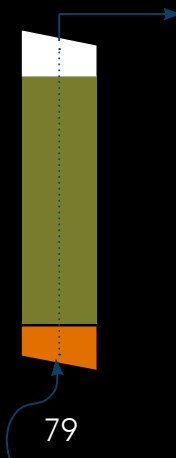
Fabrication chain



2. Sawing longitudinal

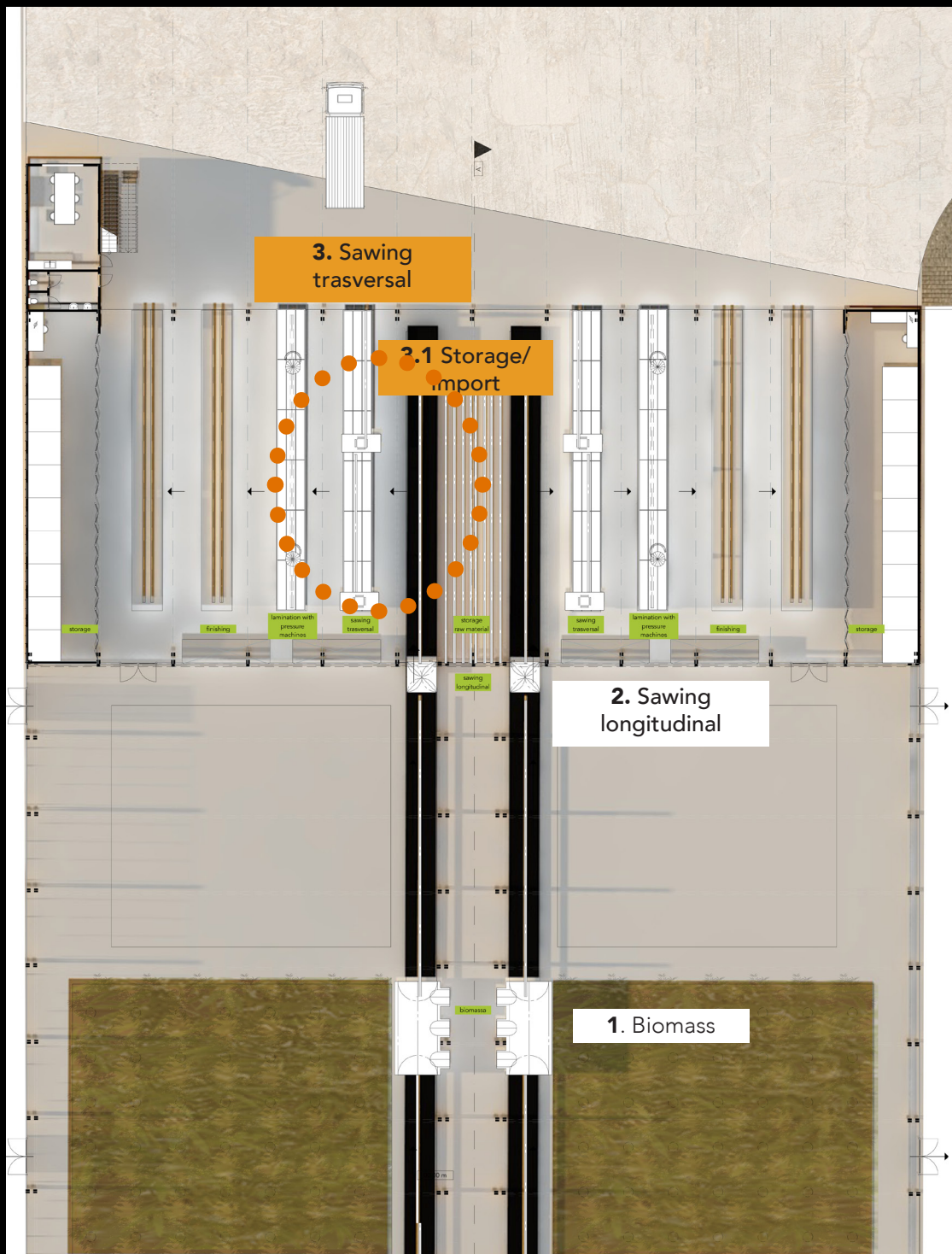


1. Biomass

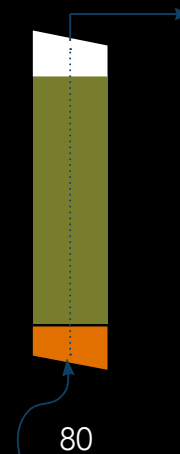
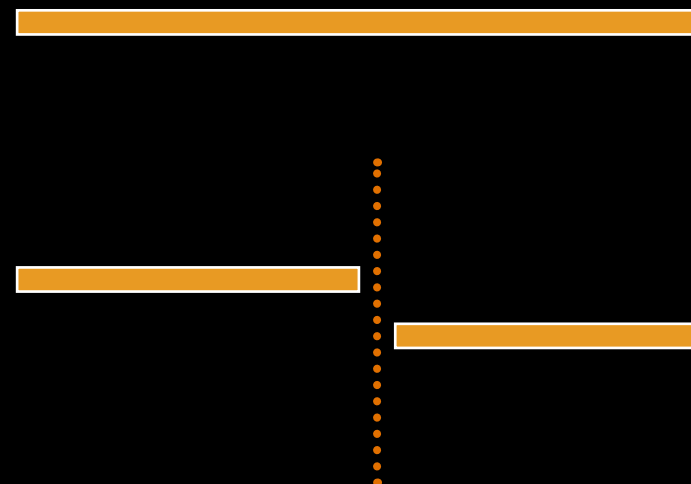




Fabrication chain

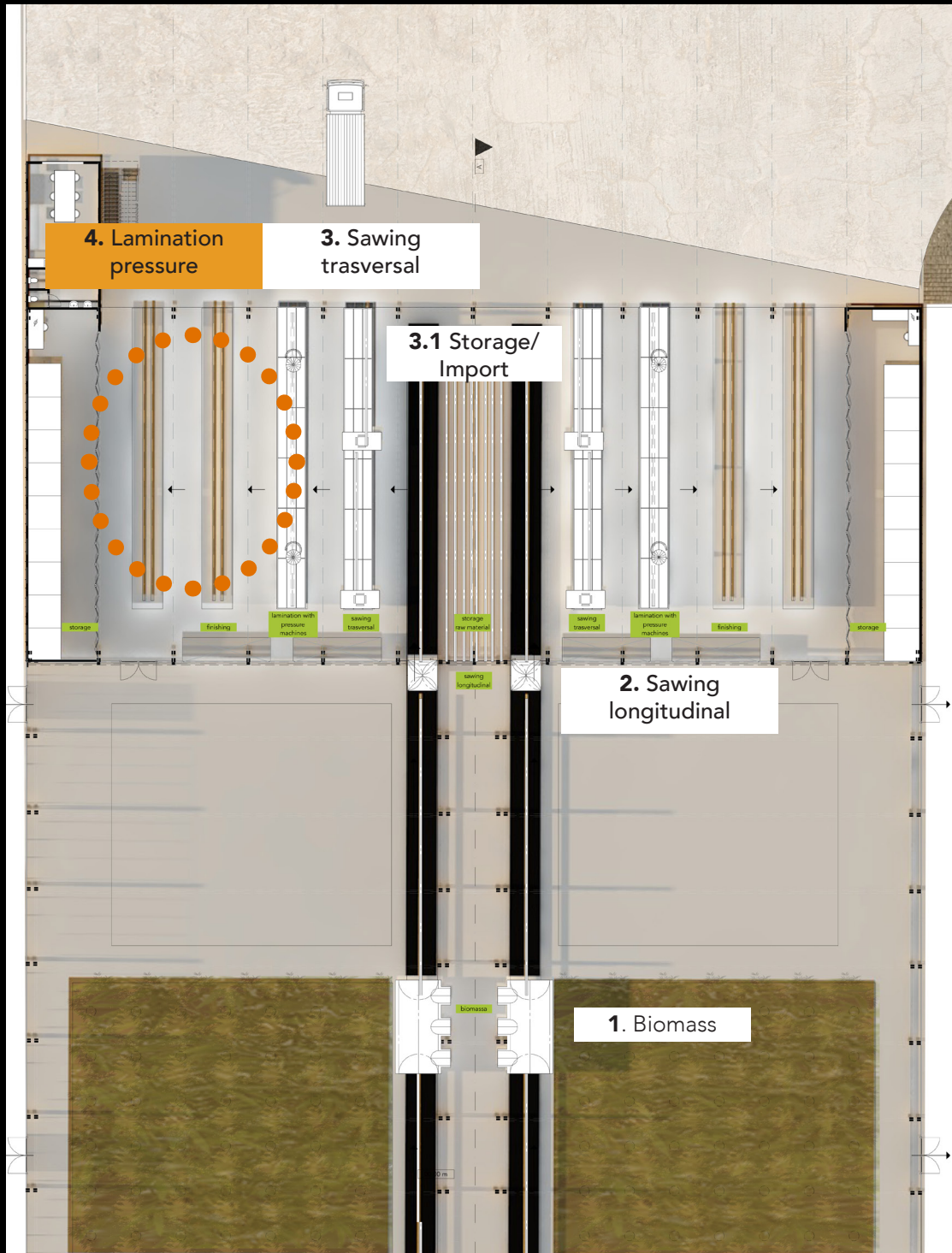


3. Sawing trasversal

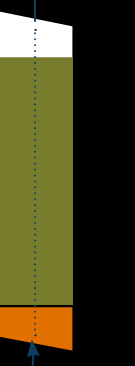
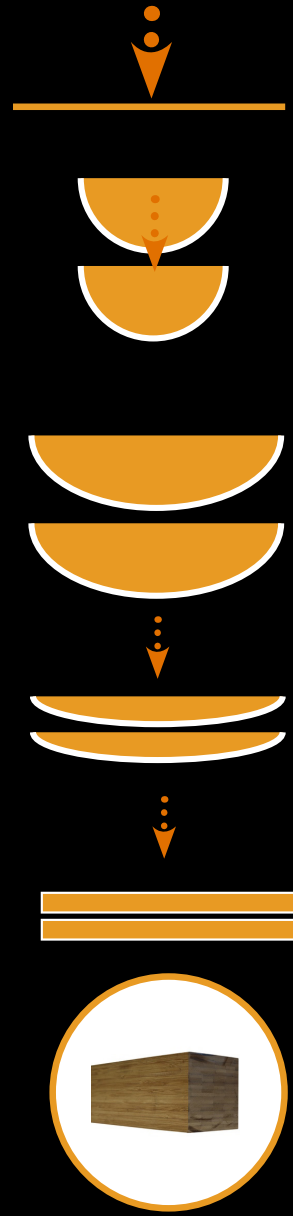




Fabrication chain

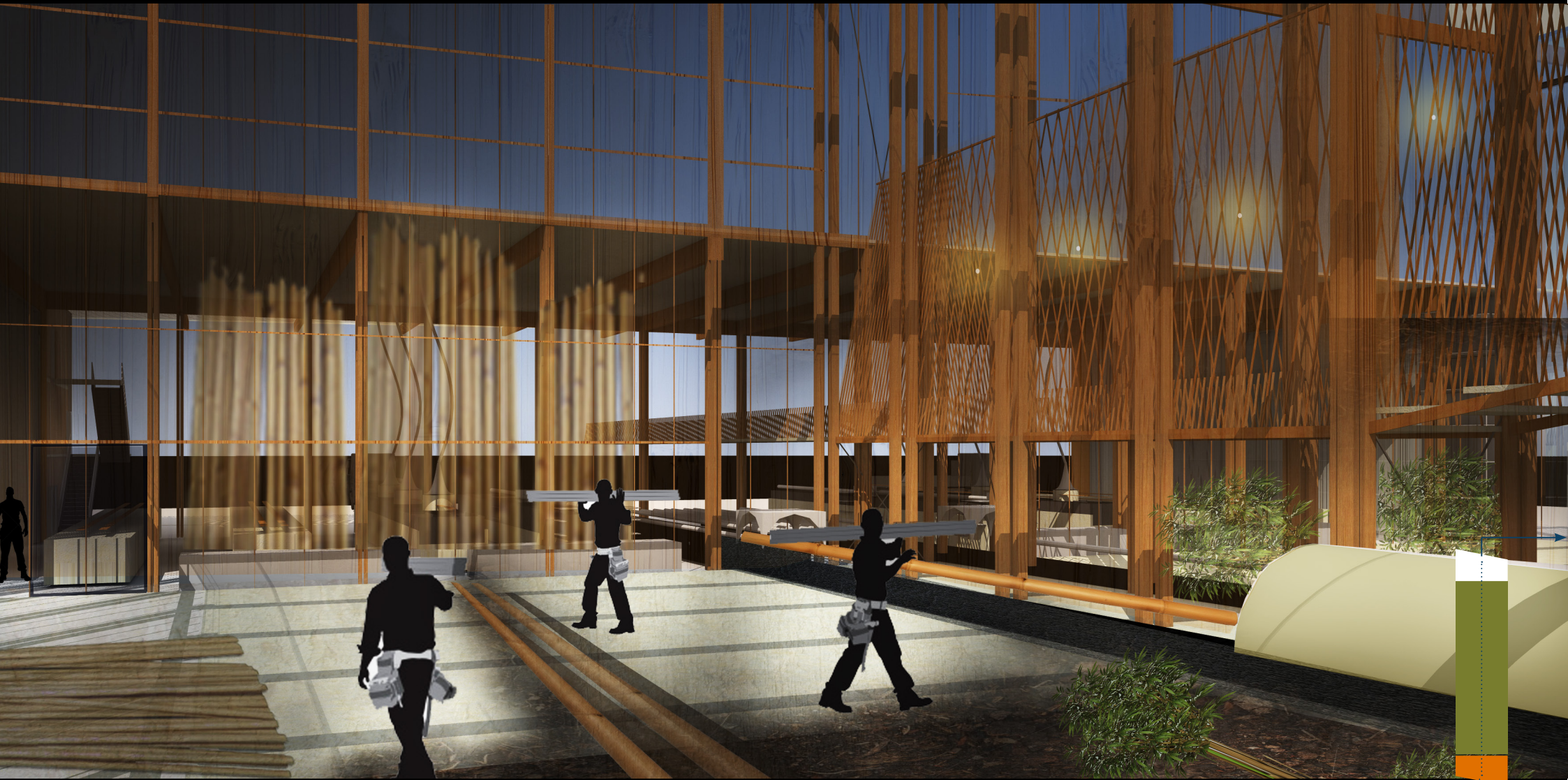


4. Lamination pressure





The factory



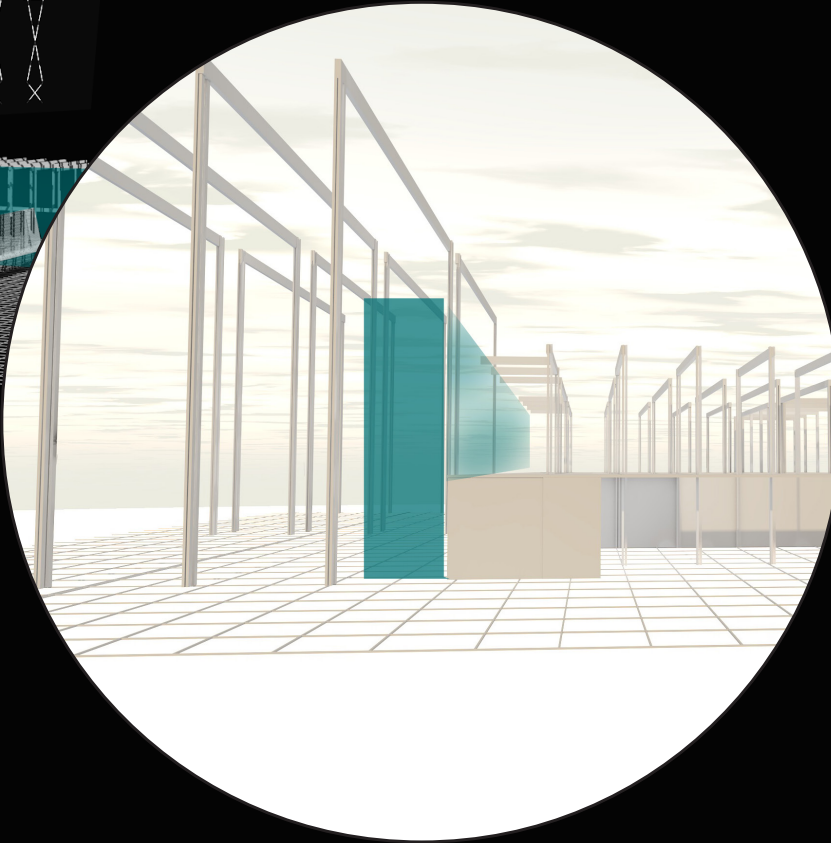
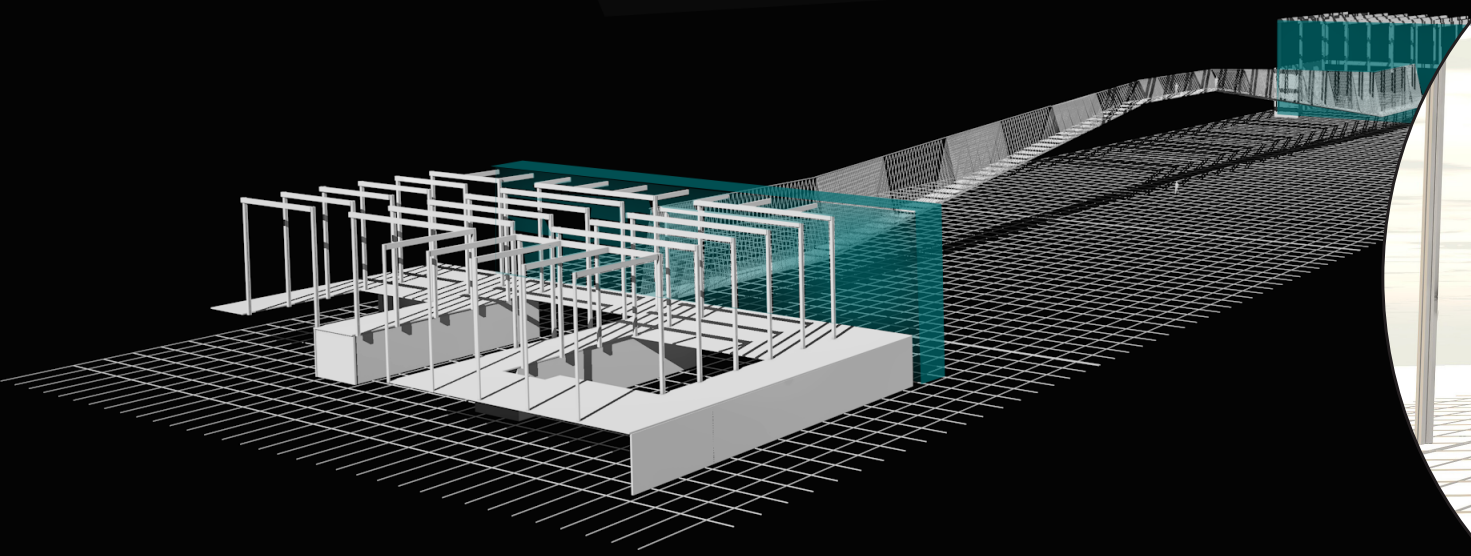
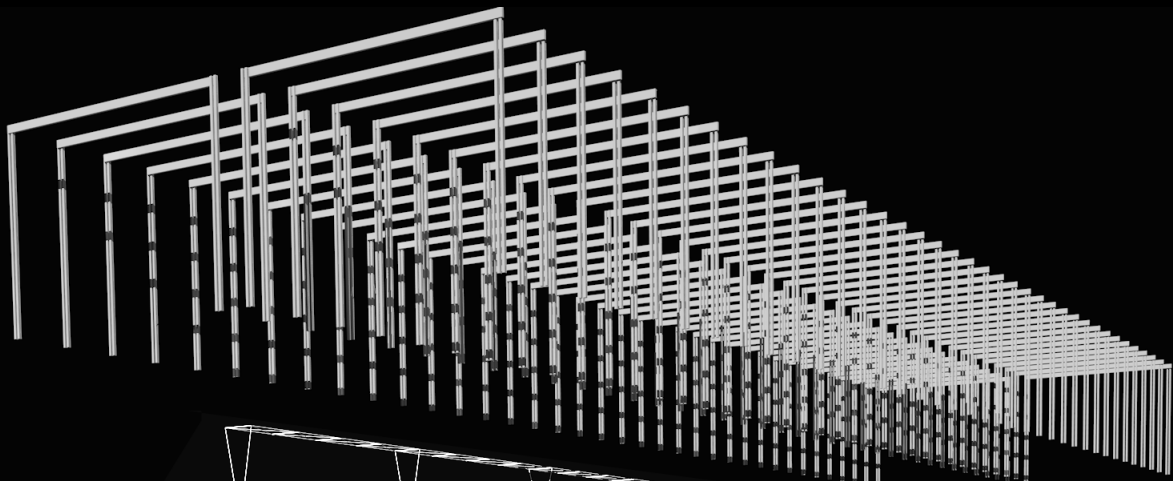


The factory



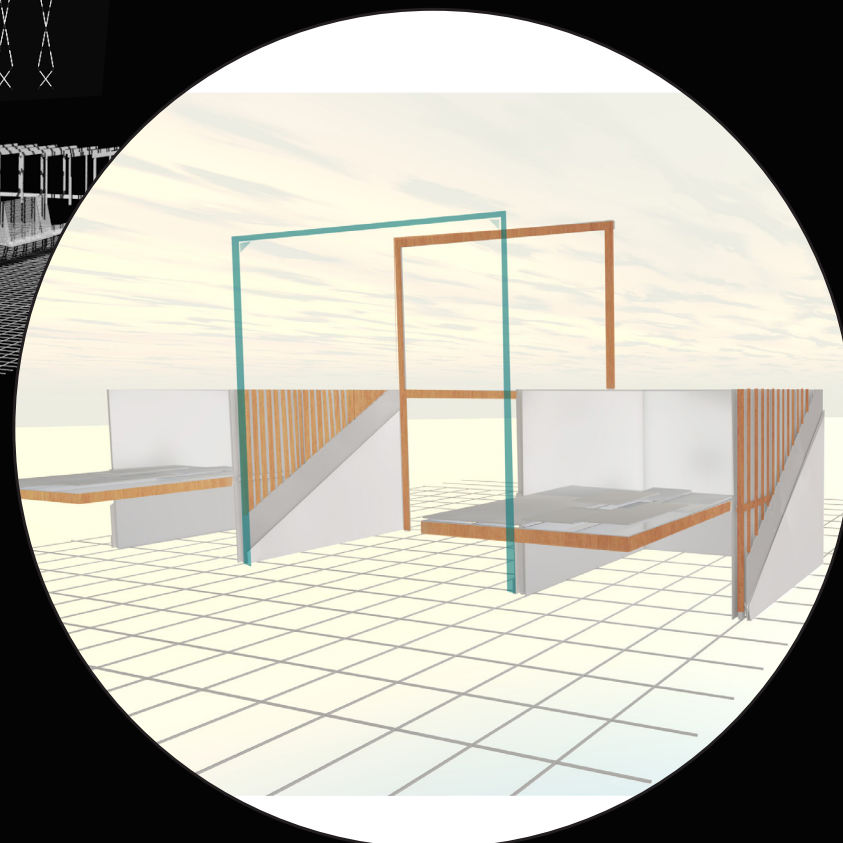
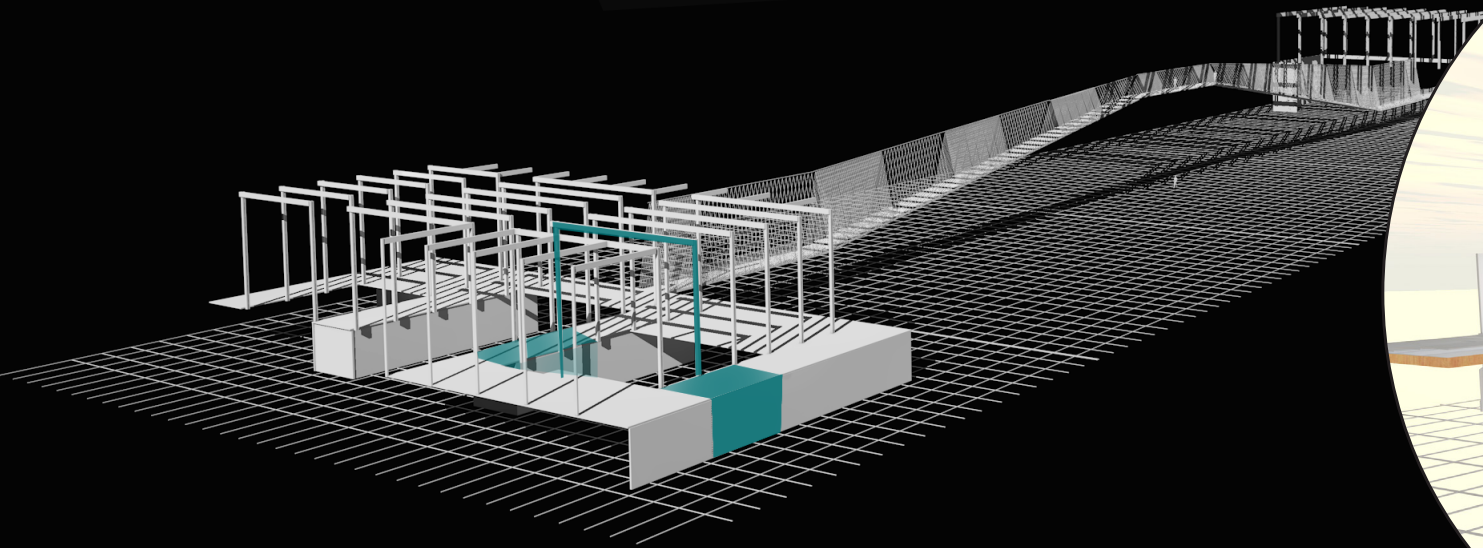
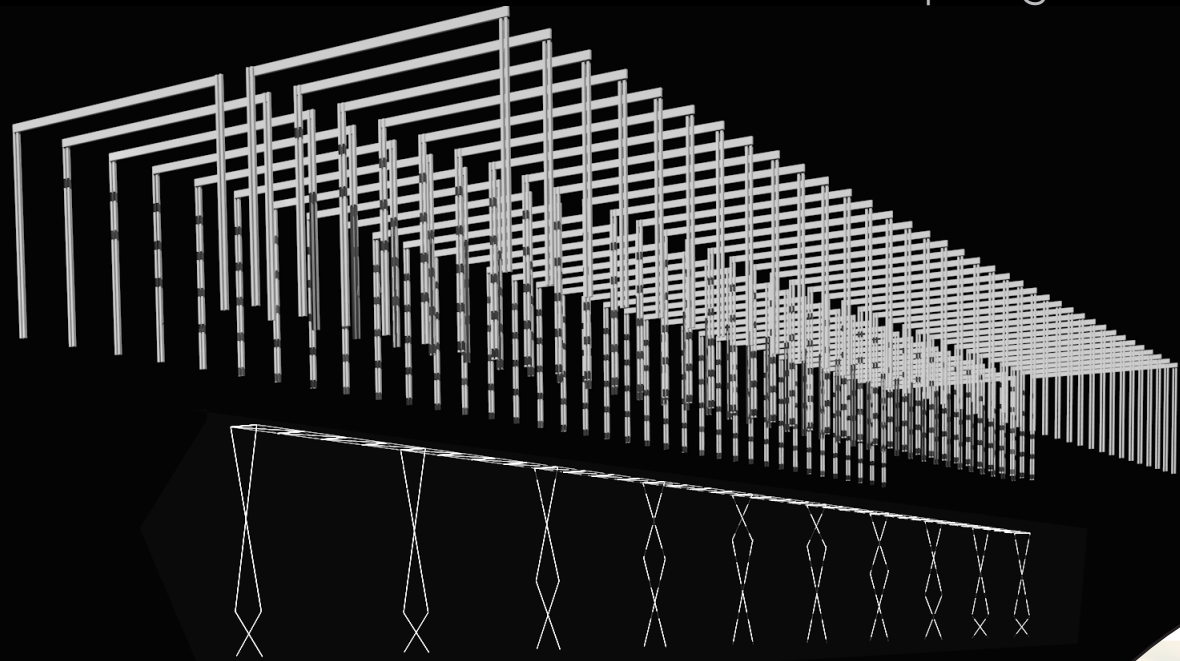


Structure: dilatations



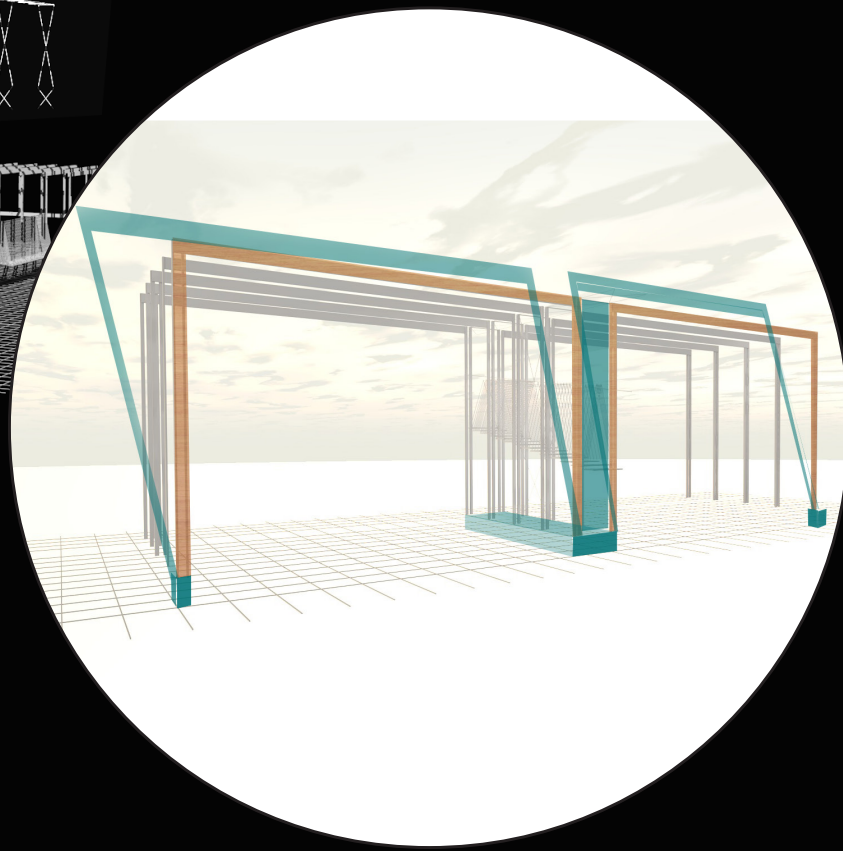
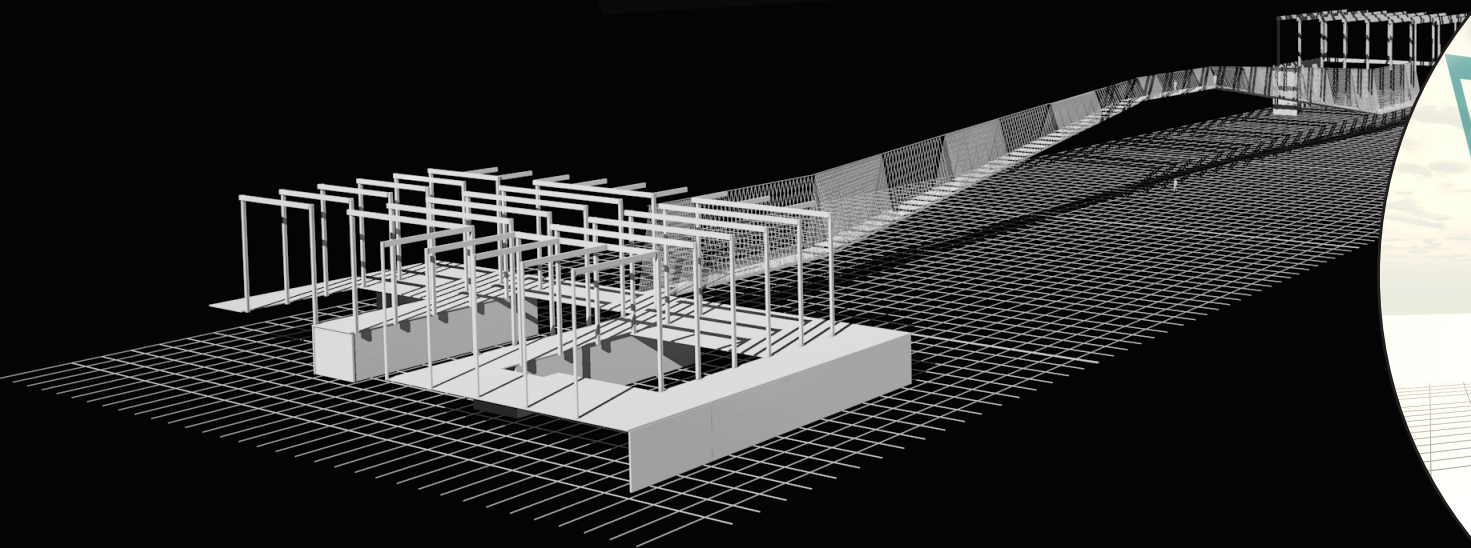
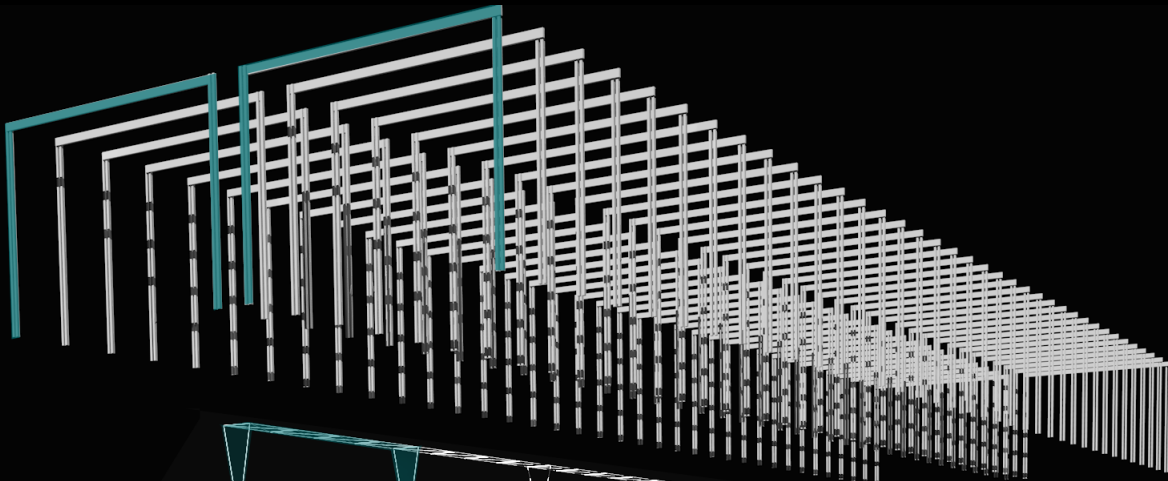


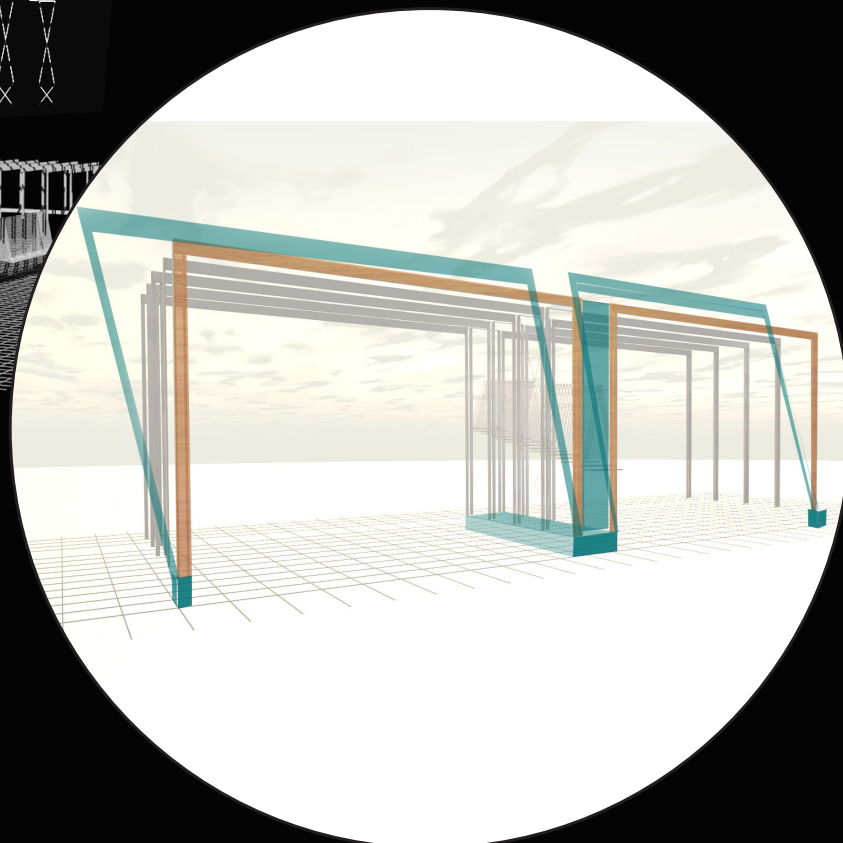
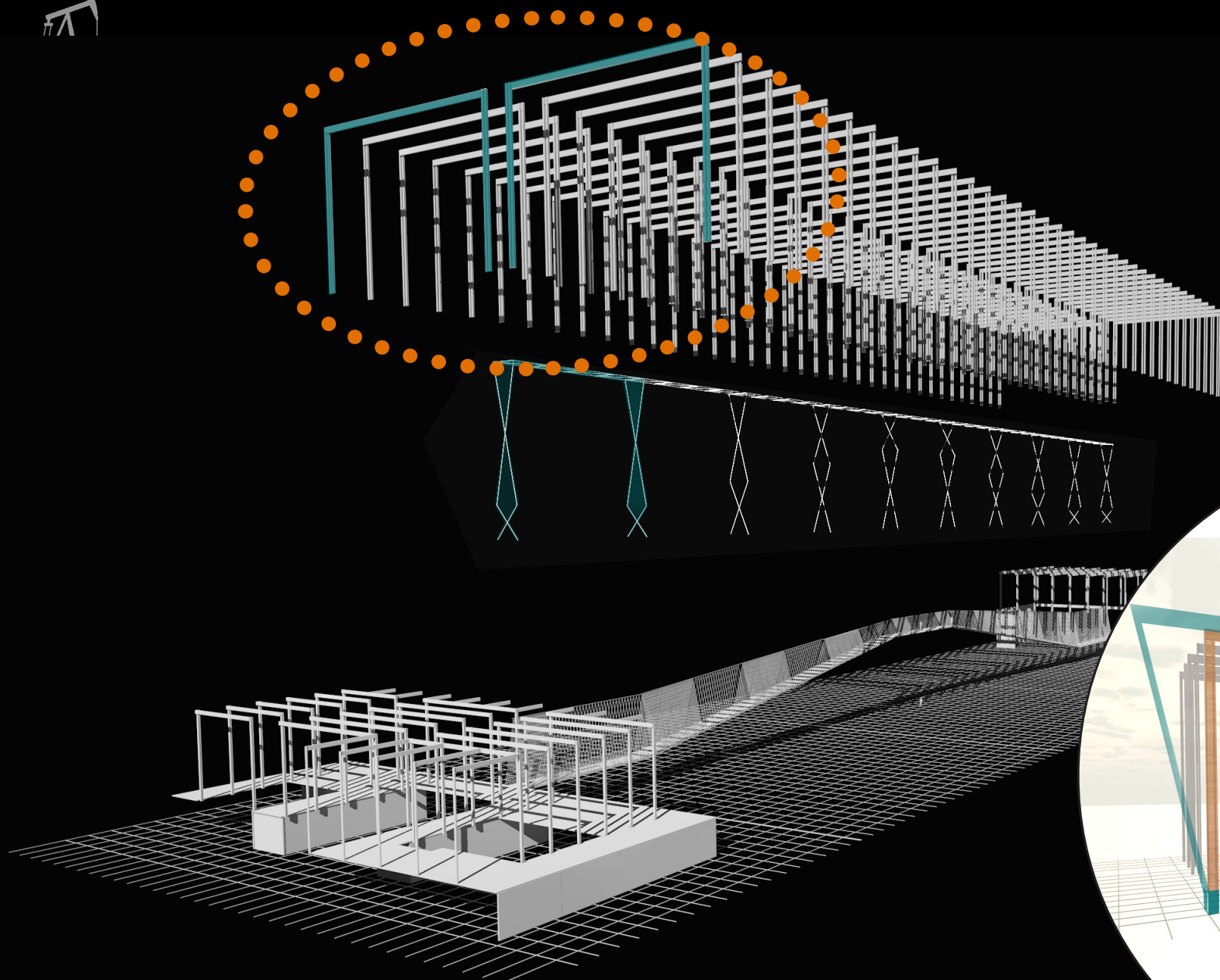
Structure: shear walls and diaphragms

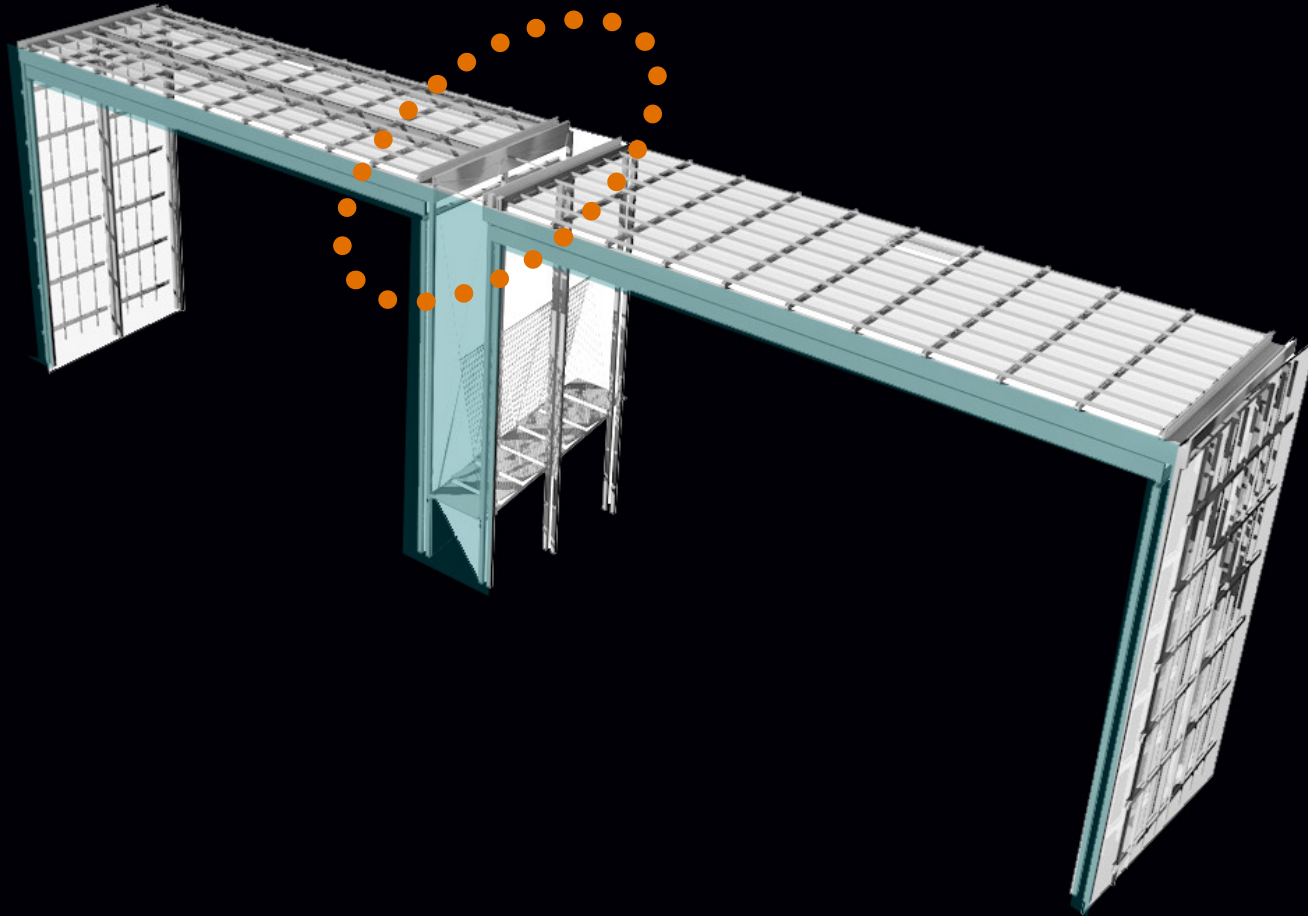




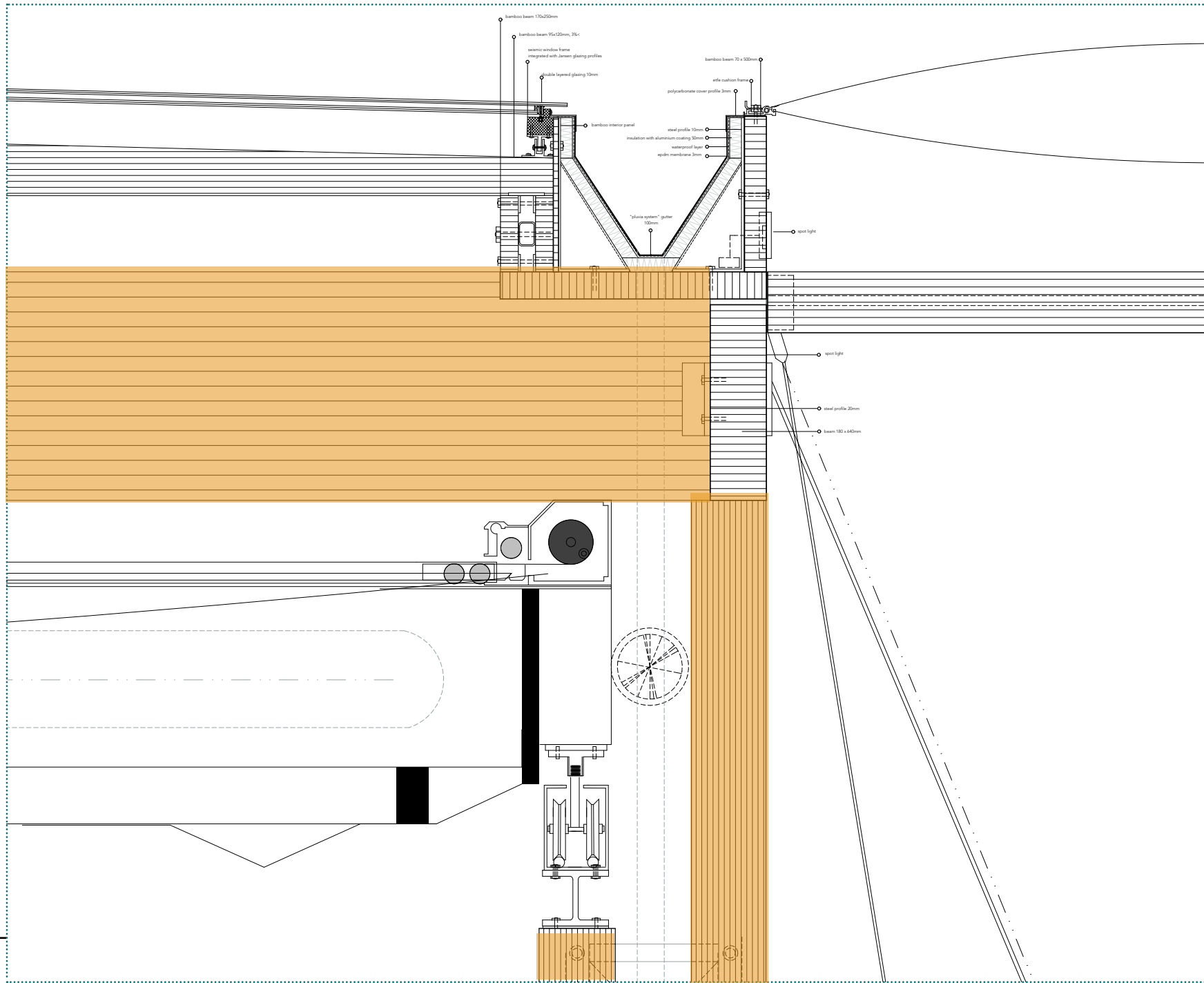
Structure: greenhouse frames



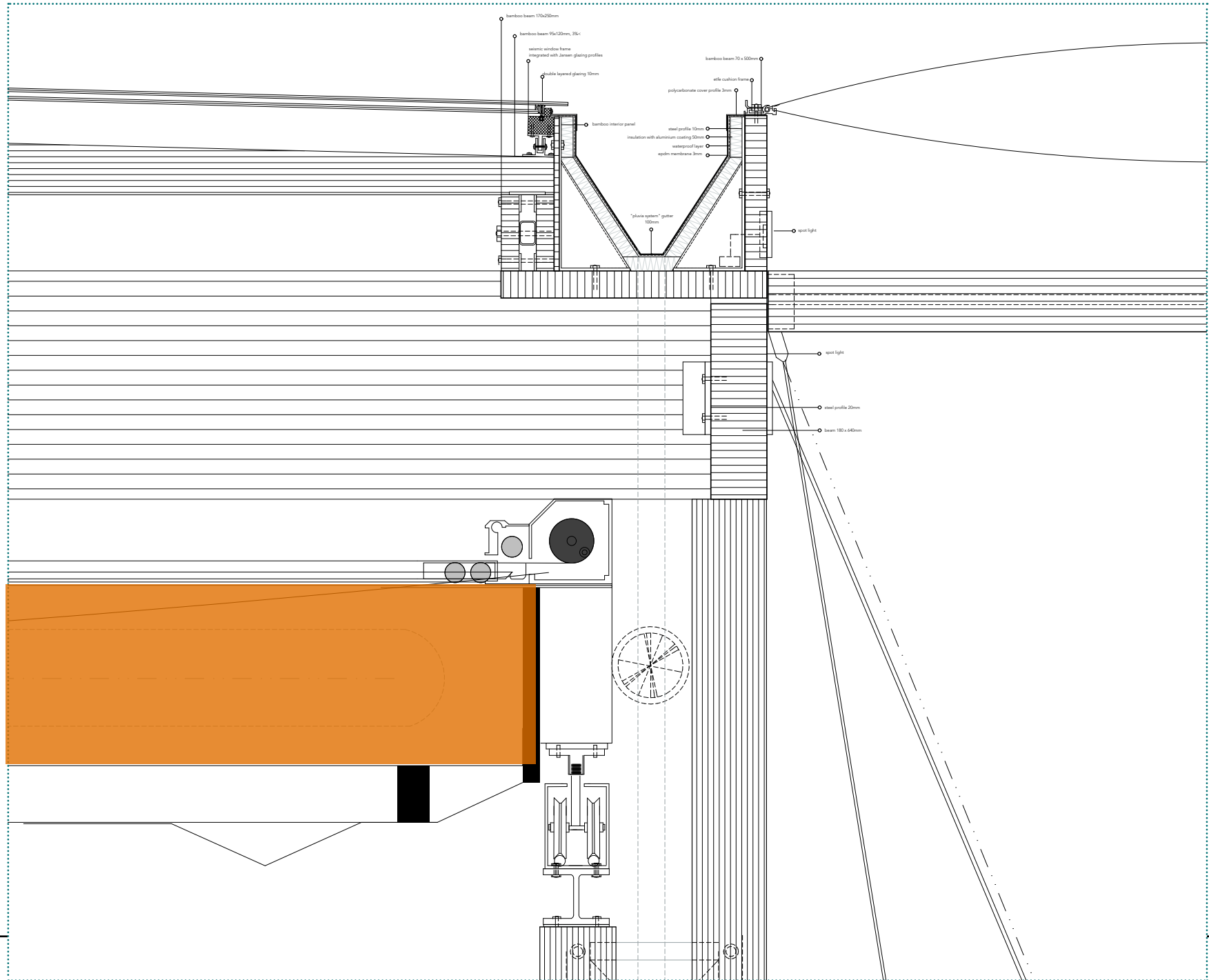




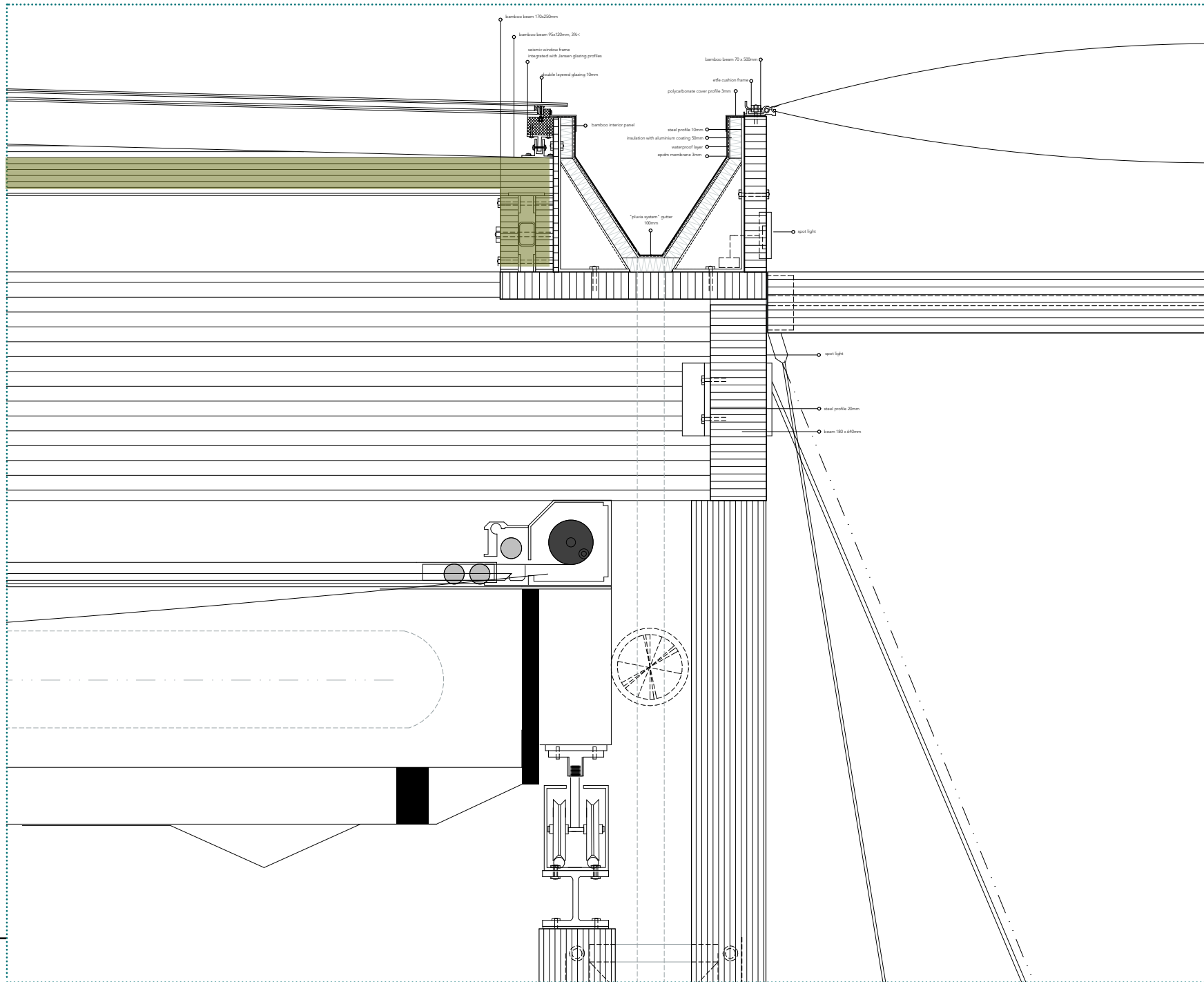
Roof detail 1



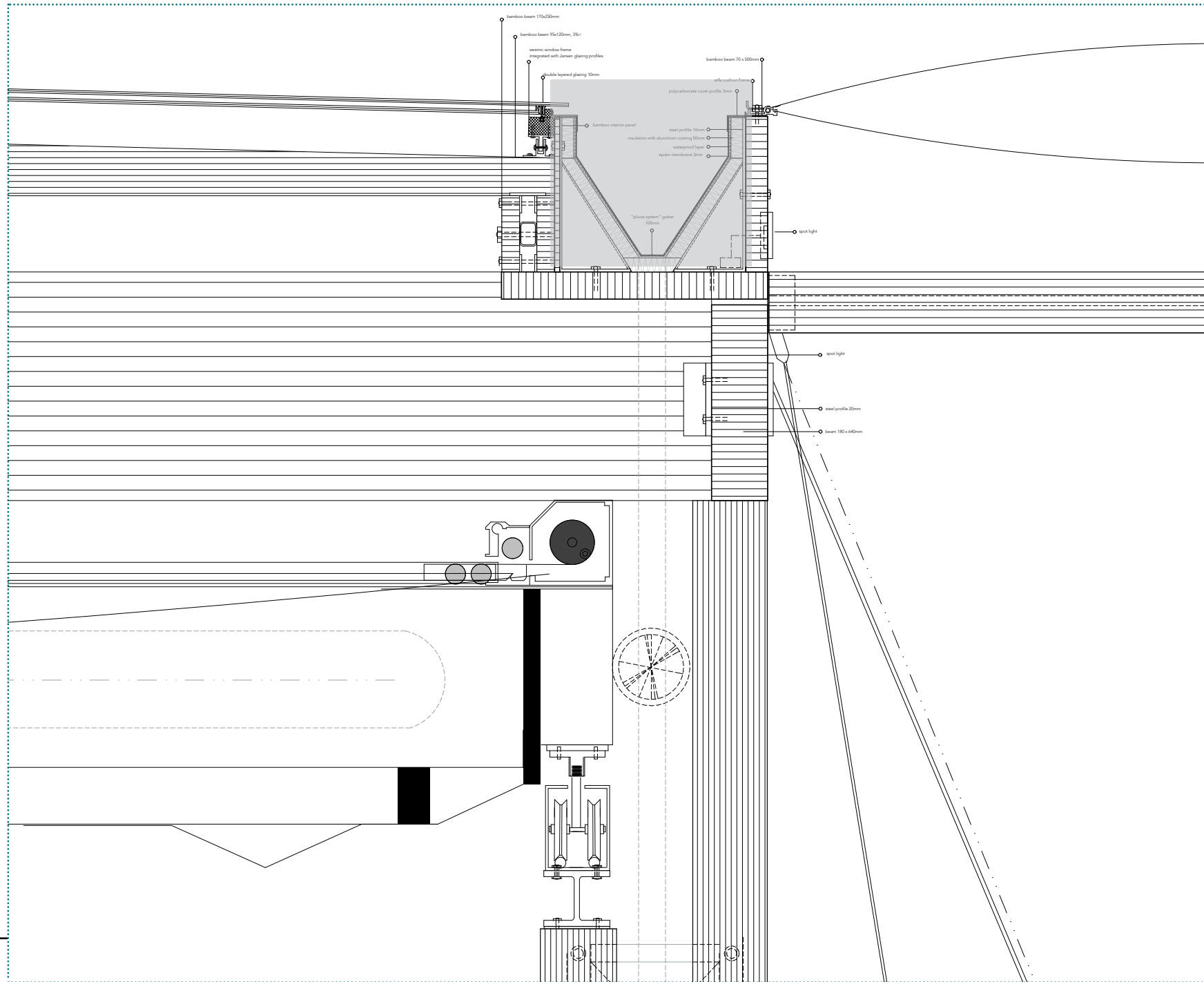
Roof detail 1



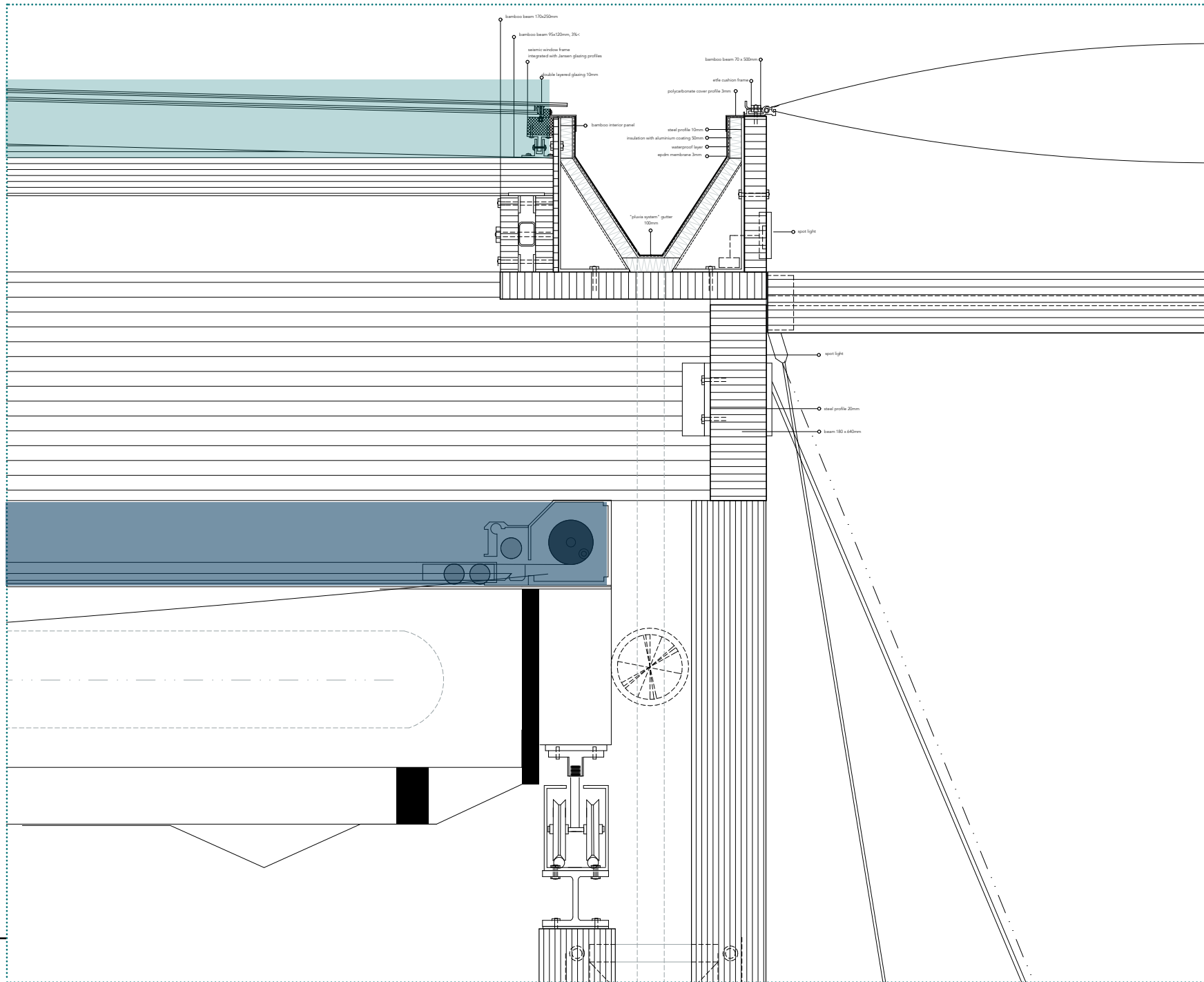
Roof detail 1

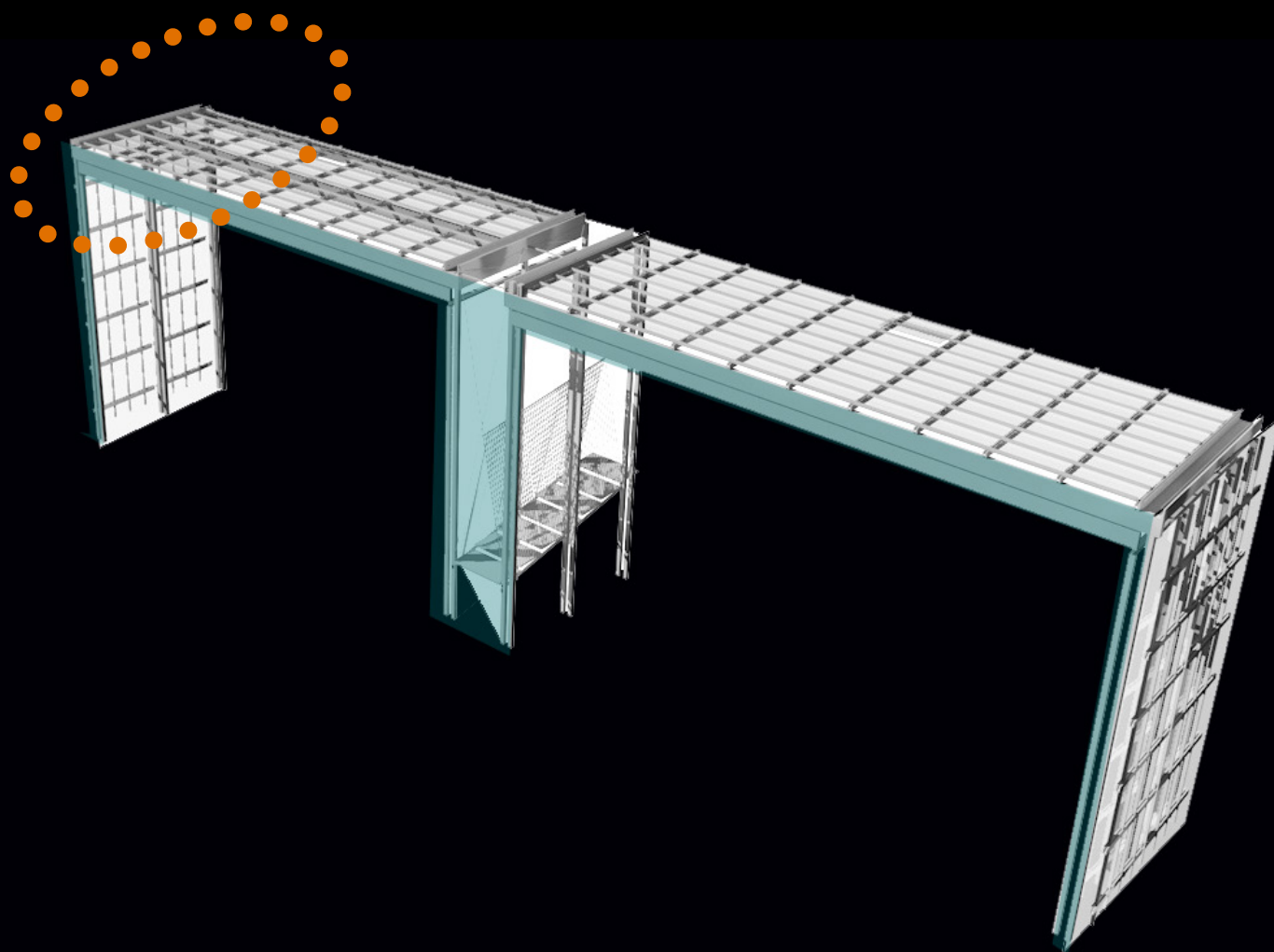


Roof detail 1



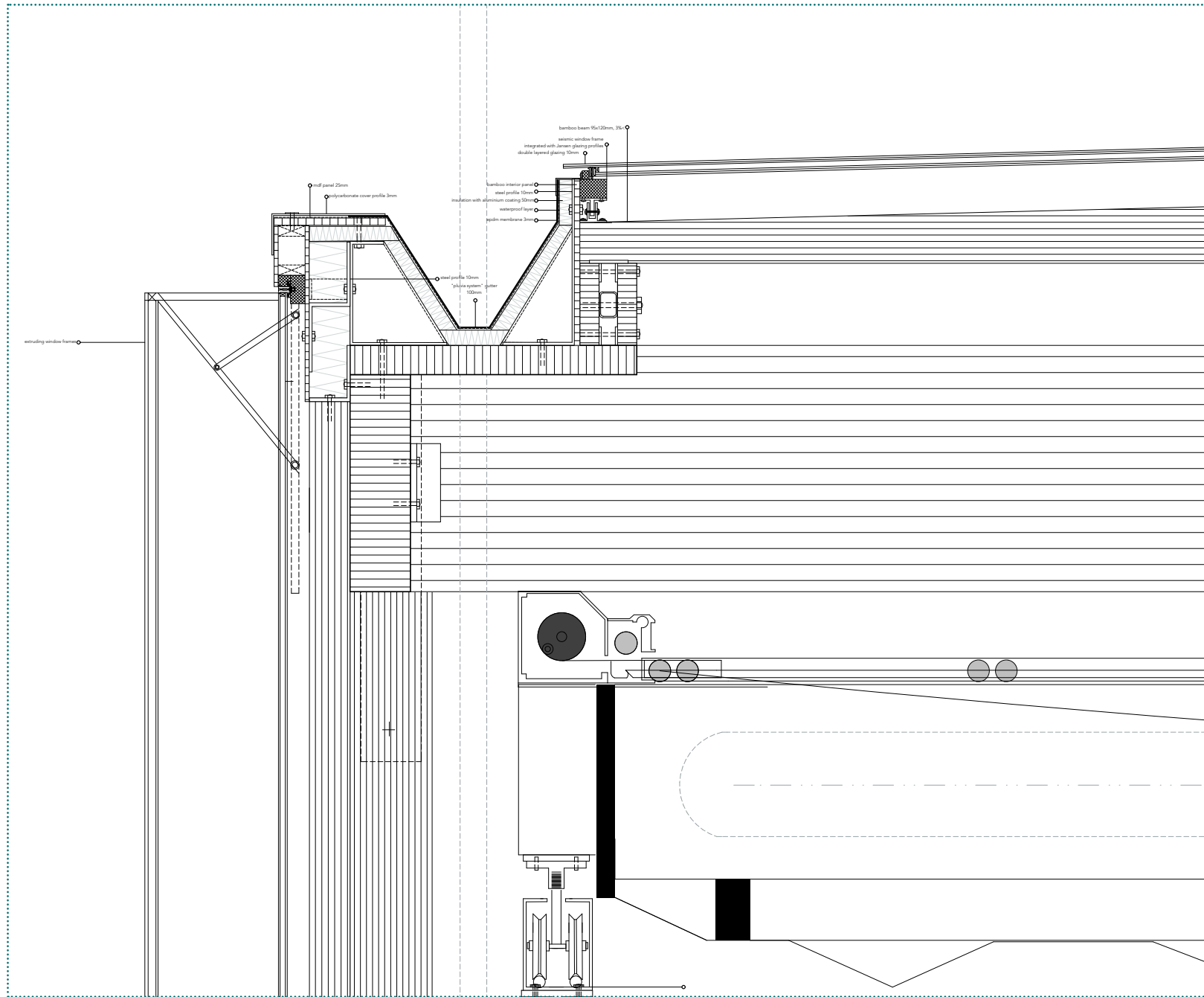
Roof detail 1



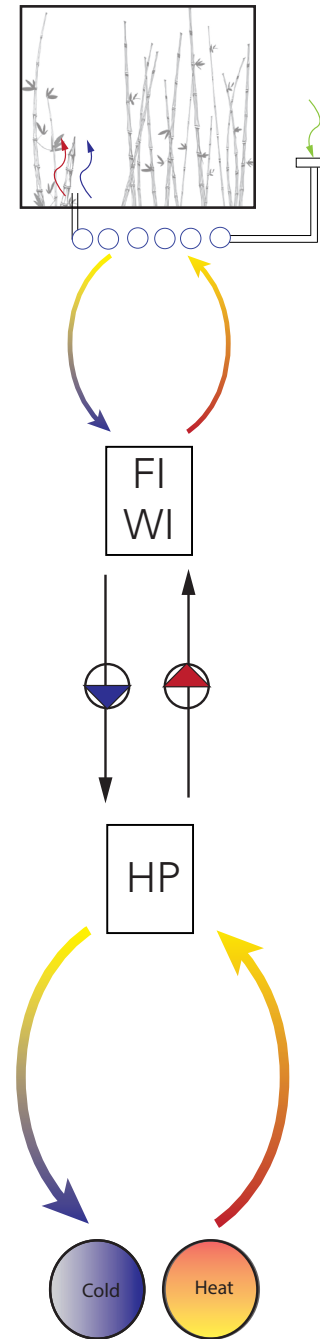


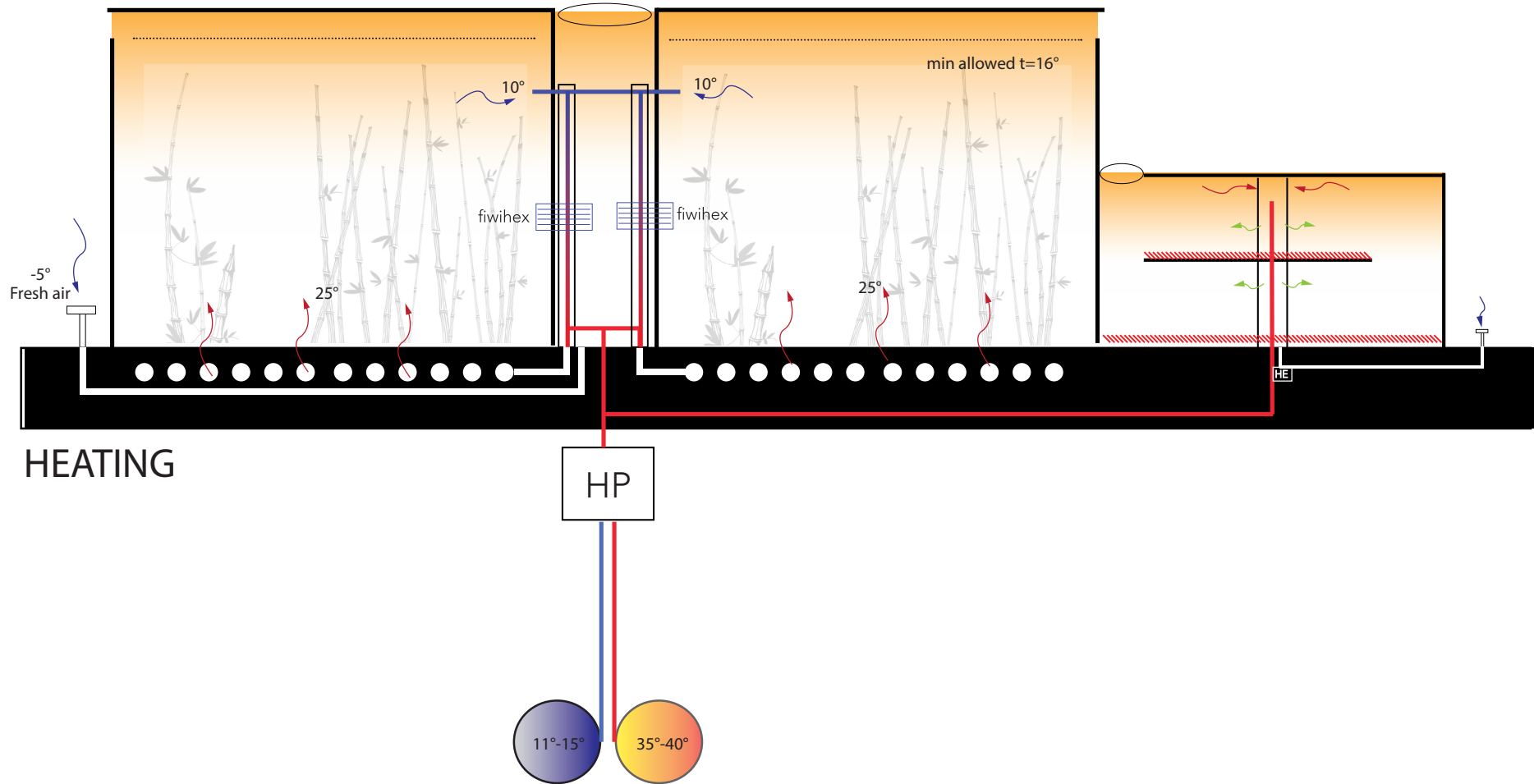


Roof detail 2



Climate control

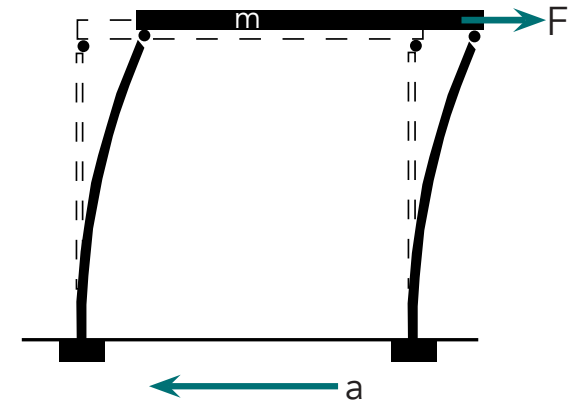






ENERGY

- 70% less CO₂ emissions than gas
- no need of replanting
- low ash content and alkali index compared to other herbaceous species

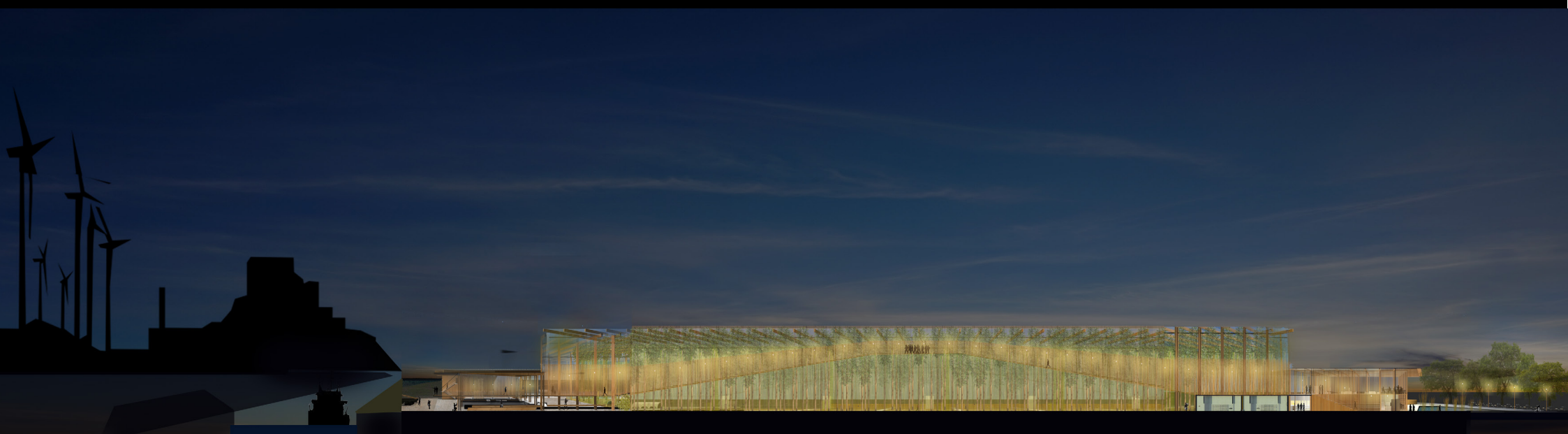


1,00 m
in 30 days

2,00 m
in 40 days

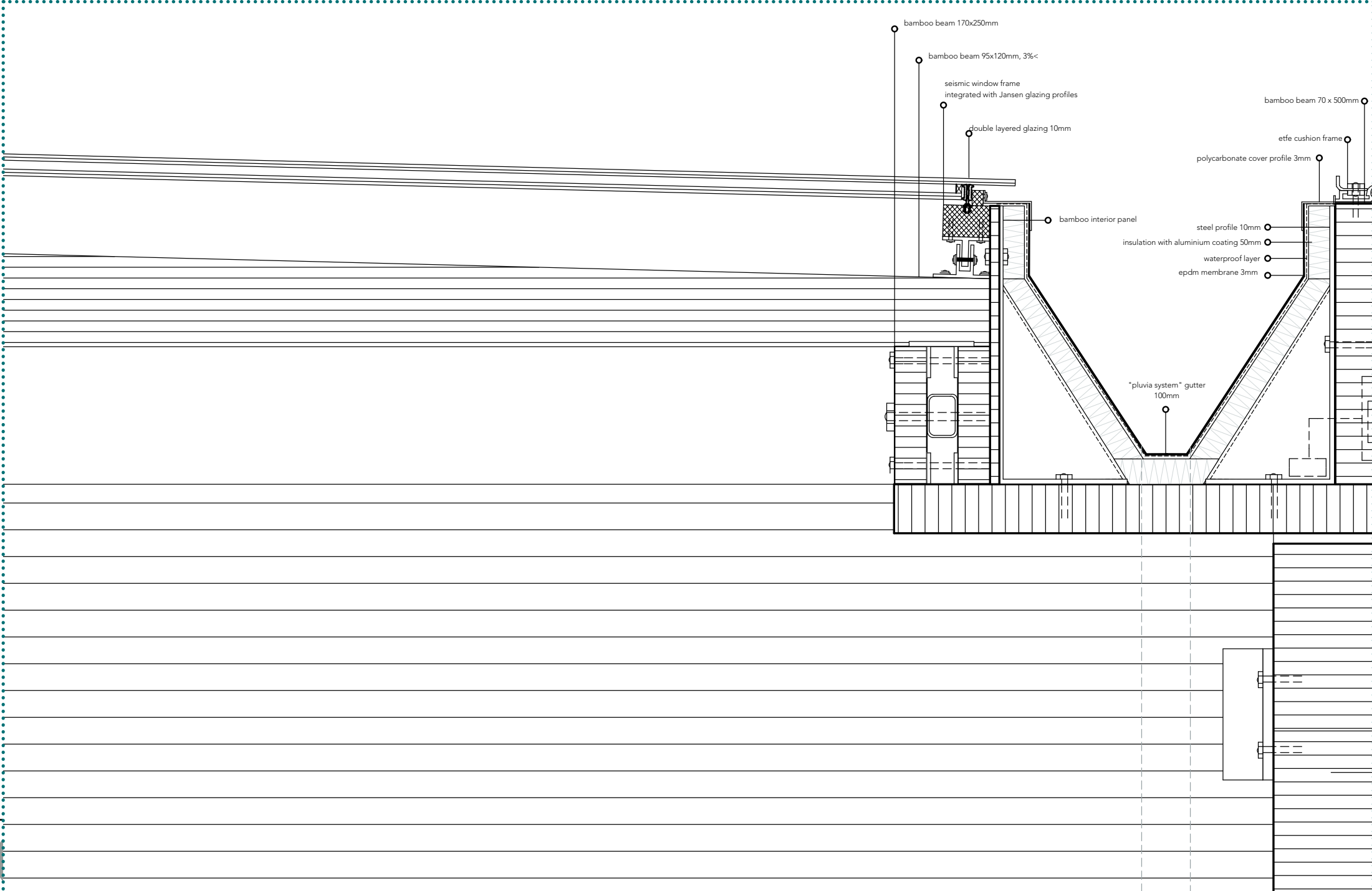


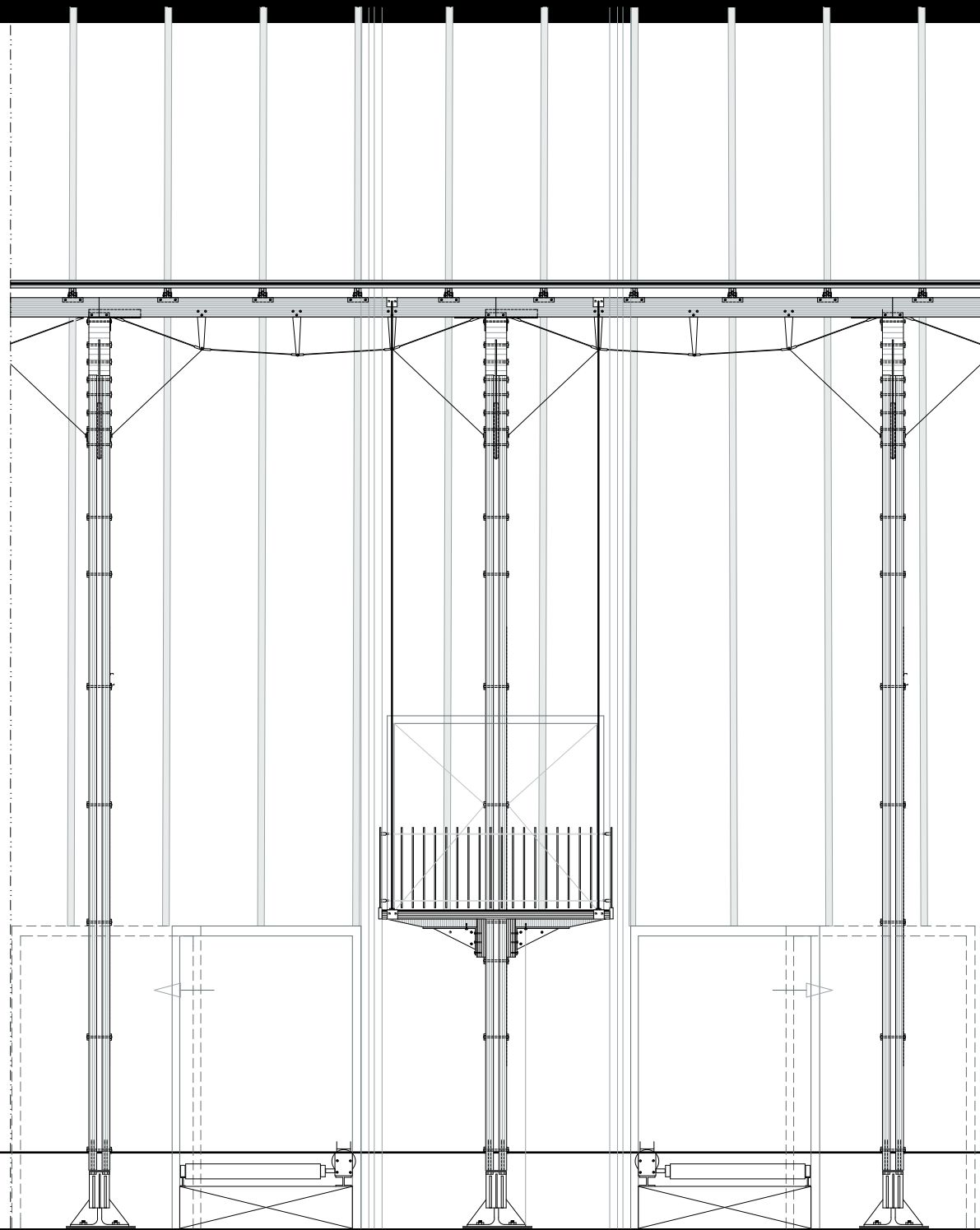






thank you







ARCHITECTURE
GRAPHISOFT

