

FASHION FACTORY OF TOMORROW

creating a healthy and comfortable work environment
for factory workers of the fashion industry

INTRODUCTION

the fashion industry

problem statement

context

research

objective

DESIGN

site

guidelines

layout

construction

conclusion

INTRODUCTION

THE FASHION INDUSTRY

problem statement

context

research

objective

DESIGN

site

guidelines

layout

construction

conclusion

THE FASHION INDUSTRY



THE FASHION INDUSTRY

some numbers:

about **60.000.000** to **75.000.000**

people work worldwide in the textile, clothing
and footwear manufacturing

80% WOMEN
throughout the supply chain

2nd highest polluter:
responsible for **10%** of
the global carbon emissions

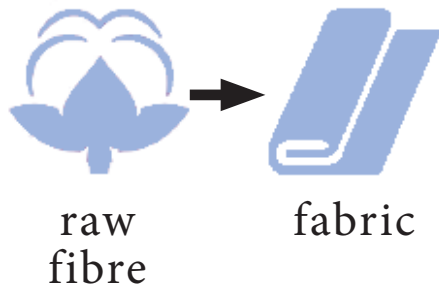
1 in 6 people in the world
work in fashion & related industries

\$3.000.000.000 / year industry

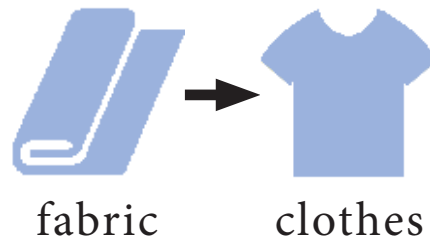
2nd highest user of water

THE FASHION INDUSTRY

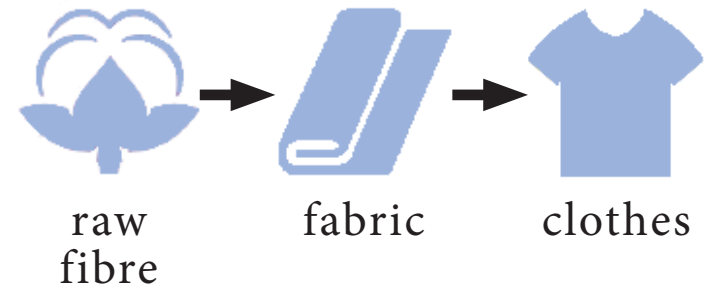
textile factory



garment factory



vertically integrated factory



INTRODUCTION

the fashion industry

PROBLEM STATEMENT

context

research

objective

DESIGN

site

guidelines

layout

construction

conclusion

PROBLEM STATEMENT



environmental pollution



poor working conditions



very low wages



lots of waste / little recycling



lots of pesticides



unsafe factory buildings

PROBLEM STATEMENT



environmental pollution



poor working conditions



very low wages



lots of waste / no recycling



lots of pesticides



unsafe factory buildings

PROBLEM STATEMENT

AlterNet | December 31, 2010 | Lauren Kelley

*“Deadly Accidents, **Inhumane Conditions***

*-- Why We Must Fight to Stop Abuse of the
World’s Sweatshop Workers”*

In These Times | June 15, 2015 | Erik Loomis

*“In the Global Apparel Industry,
Abusive and **Deadly Working**
Conditions Are Still the Norm”*

GlobalPost | March 22, 2015 | Patrick Winn

*“The **slave labor** behind your
favorite clothing brands: Gap,
H&M and more exposed”*

The Guardian | April 22, 2015 | Jason Burke

*“Bangladesh garment workers suffer **poor**
conditions two years after reform vows”*

PROBLEM STATEMENT



PROBLEM STATEMENT

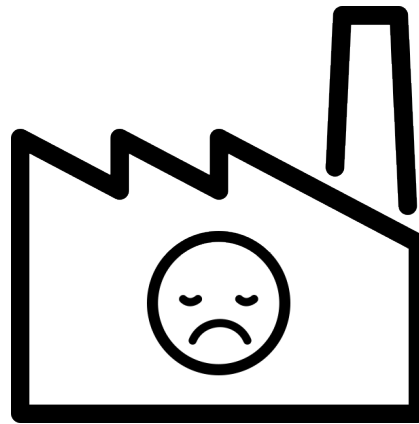


PROBLEM STATEMENT

VIDEO

PROBLEM STATEMENT

Existing textile and garment factories are often **unsafe, unhealthy** and **uncomfortable** workplaces.



INTRODUCTION

the fashion industry

problem statement

CONTEXT

research

objective

DESIGN

site

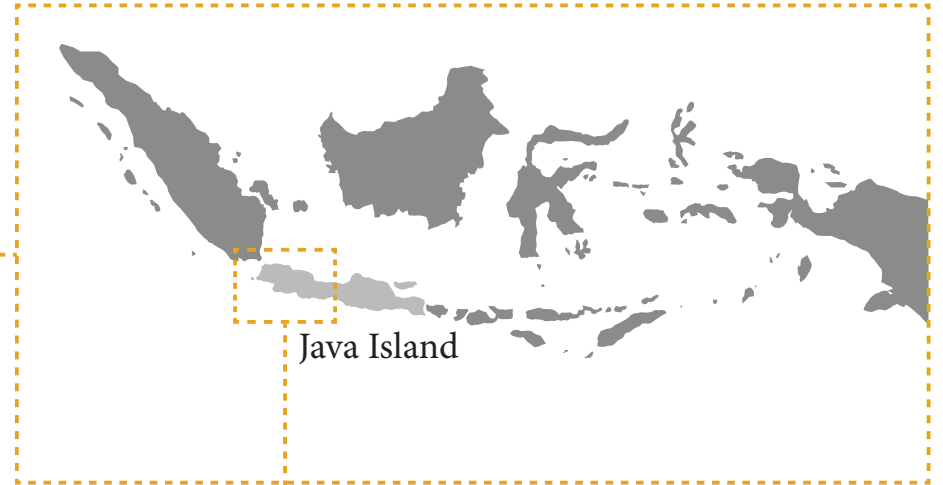
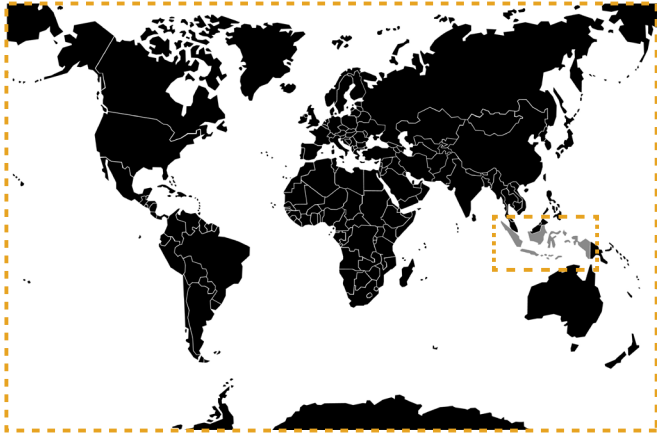
guidelines

layout

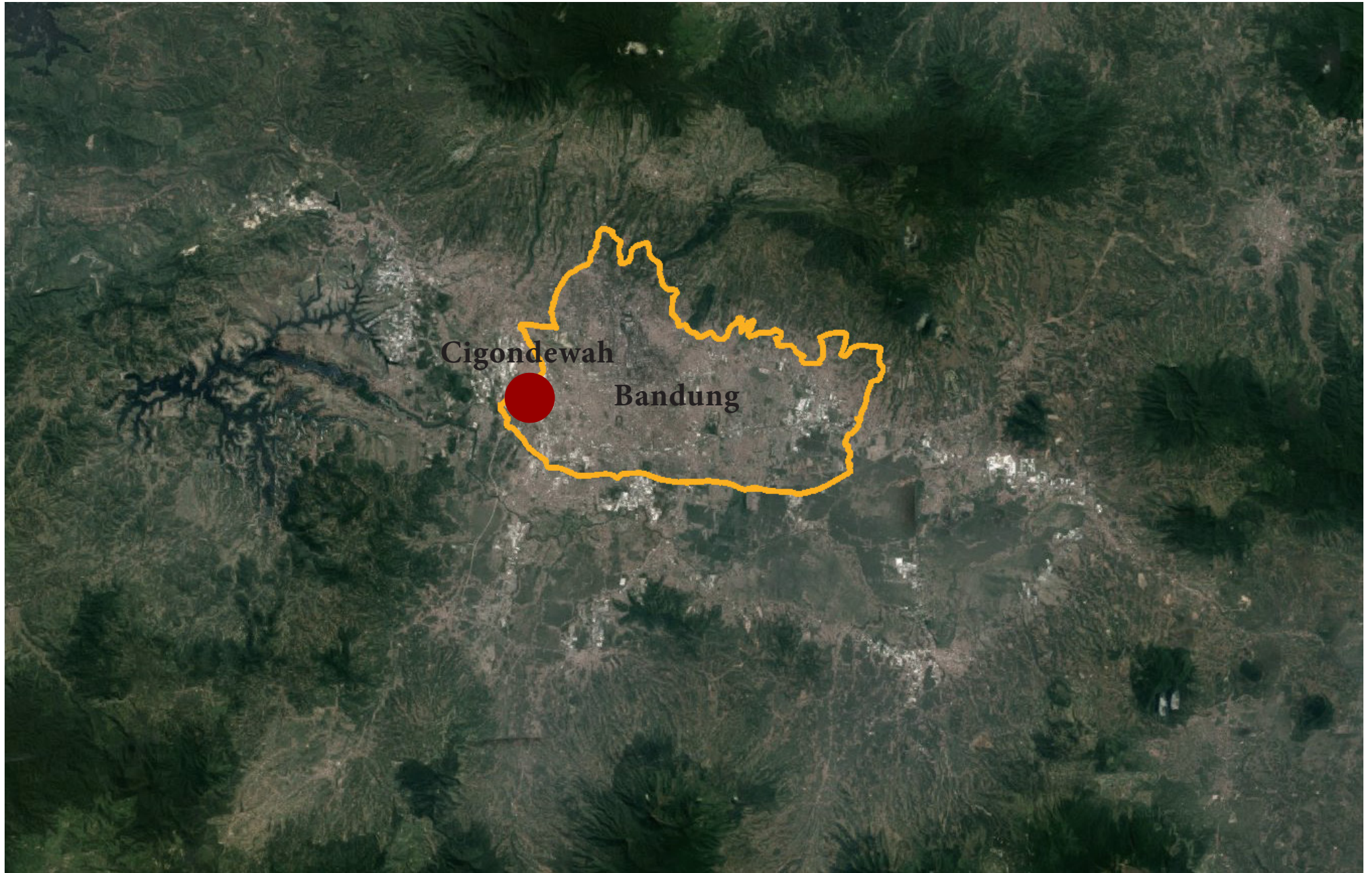
construction

conclusion

CONTEXT



CONTEXT



CONTEXT



(picture source: "Home at Work", COCOCAN 2016)

CONTEXT



RW 02 & 12

CONTEXT



(picture source: “Home at Work”, COCOCAN 2016)

CONTEXT



INTRODUCTION

the fashion industry

problem statement

context

RESEARCH

objective

DESIGN

site

guidelines

layout

construction

conclusion

RESEARCH

INDOOR ENVIRONMENT

lighting

indoor air quality

thermal comfort

acoustics

RESEARCH



RESEARCH



RESEARCH



LIGHTING

PROBLEMS

absence of daylight

uncomfortable artificial lighting

no view to the outside



INDOOR AIR QUALITY

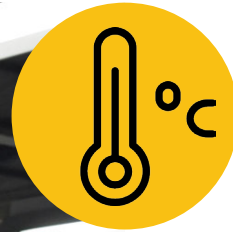
PROBLEMS

lack of (natural / mechanical) ventilation

dusty air

chemical air pollutants

RESEARCH



THERMAL COMFORT

PROBLEMS

high indoor air temperatures

high relative humidity levels

lack of indoor air movement

RESEARCH



ACOUSTICS

PROBLEM

loud and continuous noise throughout the whole factory

INTRODUCTION

the fashion industry

problem statement

context

research

OBJECTIVE

DESIGN

site

guidelines

layout

construction

conclusion

OBJECTIVE

To design a sustainable **vertically integrated clothing factory** in Bandung,
by making optimal use of passive building design strategies
to create a **healthy and comfortable indoor environment** for the workers.

INTRODUCTION

the fashion industry

problem statement

context

research

objective

DESIGN

SITE

guidelines

layout

construction

conclusion

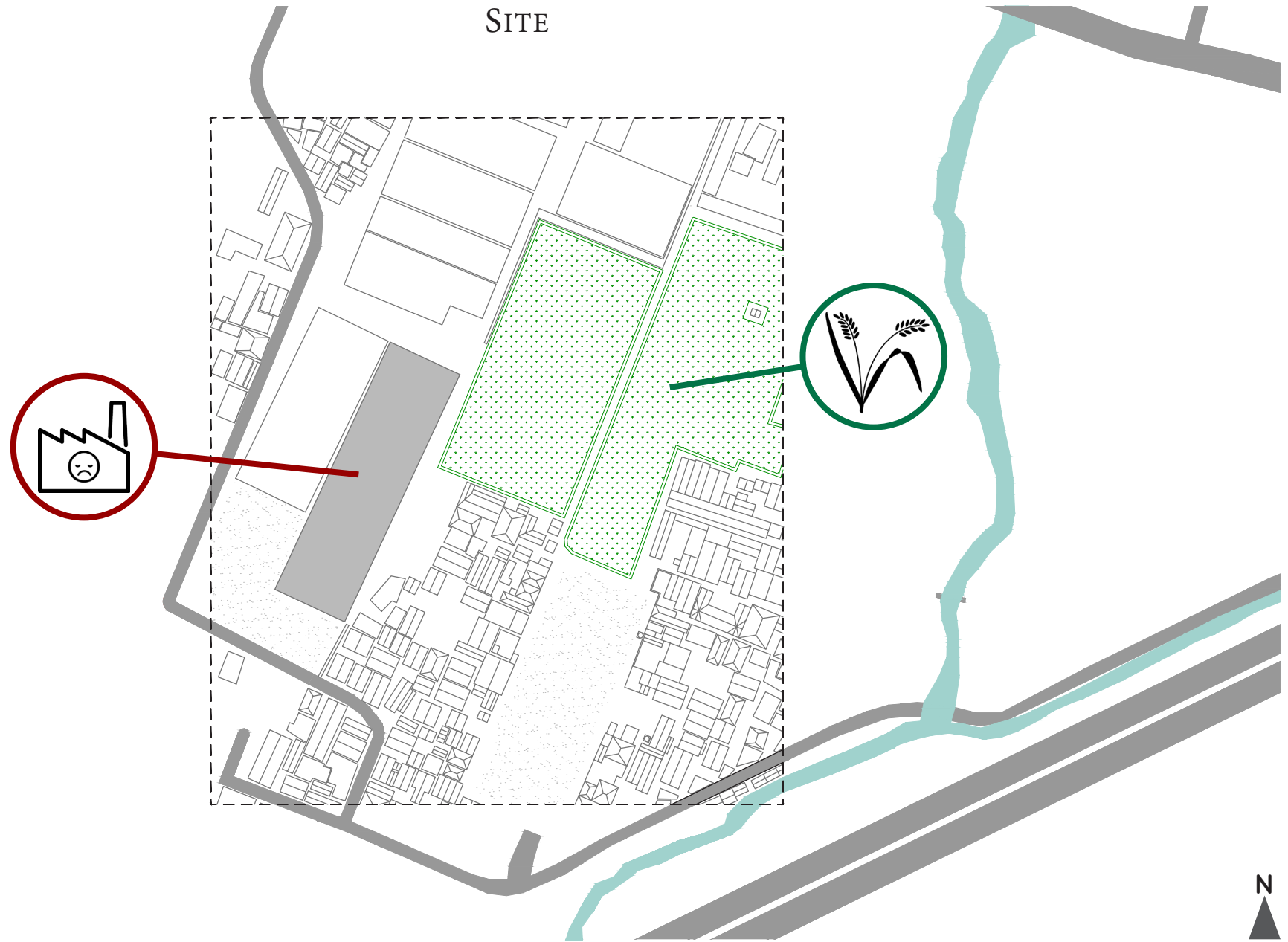
SITE



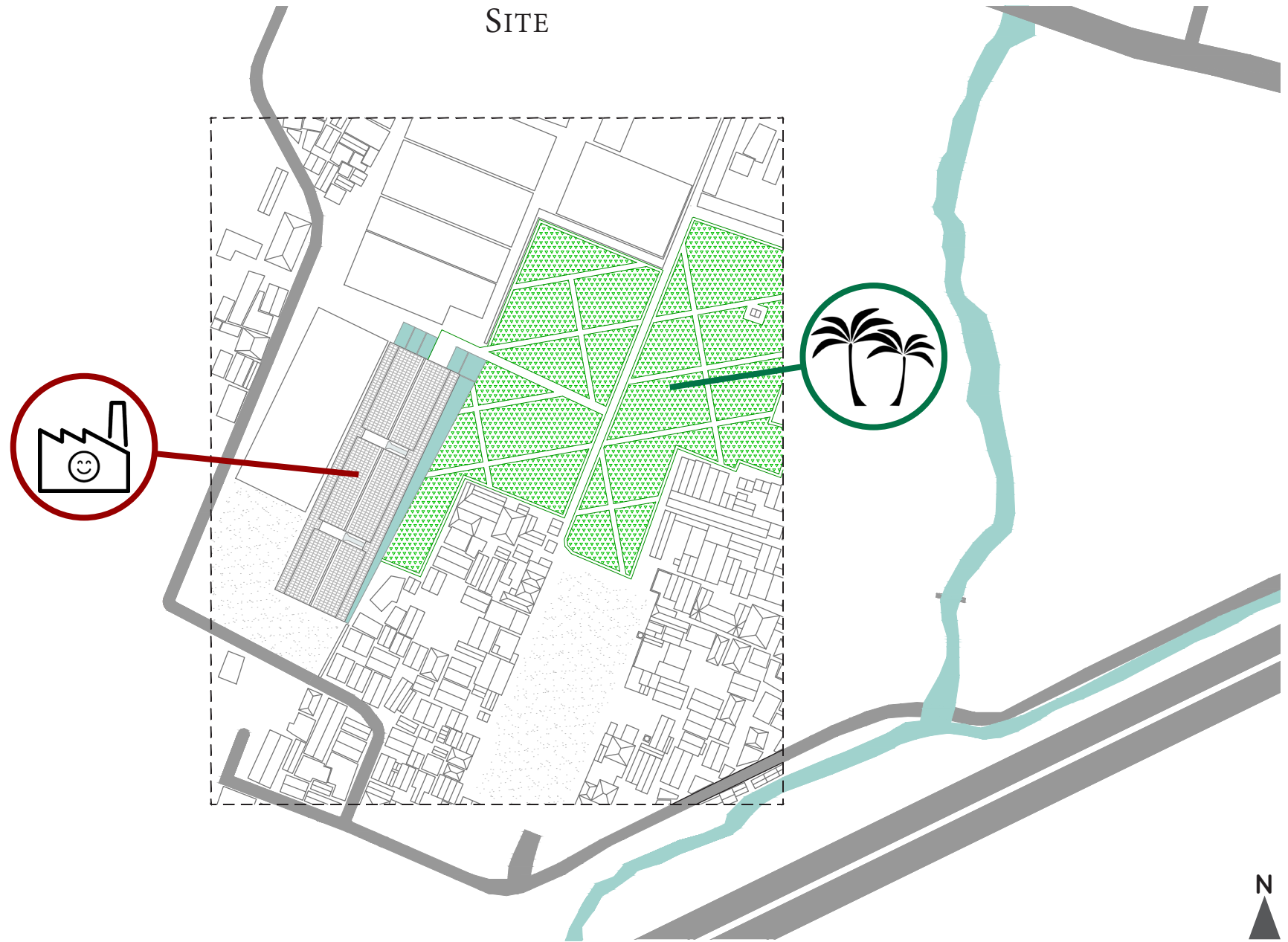
(picture source: “Home at Work”, COCOCAN 2016)

SITE





existing factory and rice plantation



new factory and banana plantation

INTRODUCTION

the fashion industry

problem statement

context

research

objective

DESIGN

site

GUIDELINES

layout

construction

conclusion

DESIGN GUIDELINES

INTRODUCTION

the fashion industry

problem statement

context

research

objective

DESIGN

site

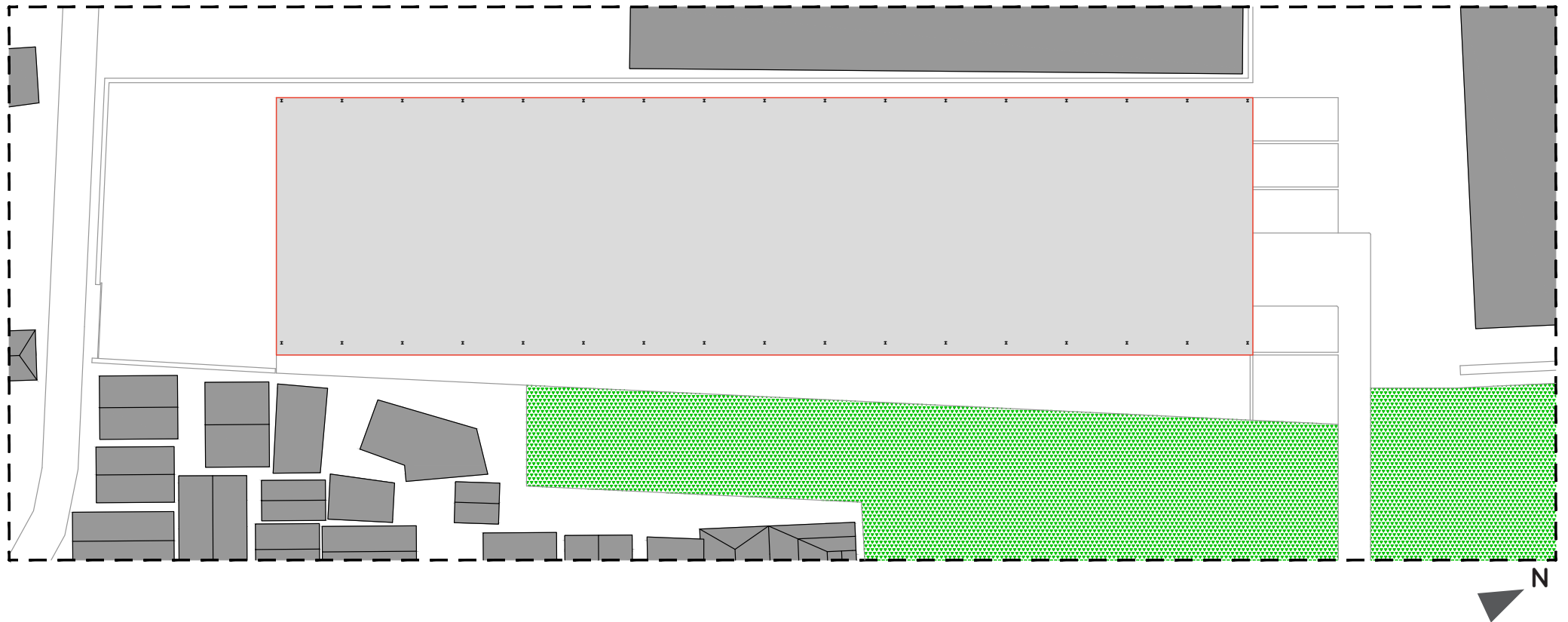
guidelines

LAYOUT

construction

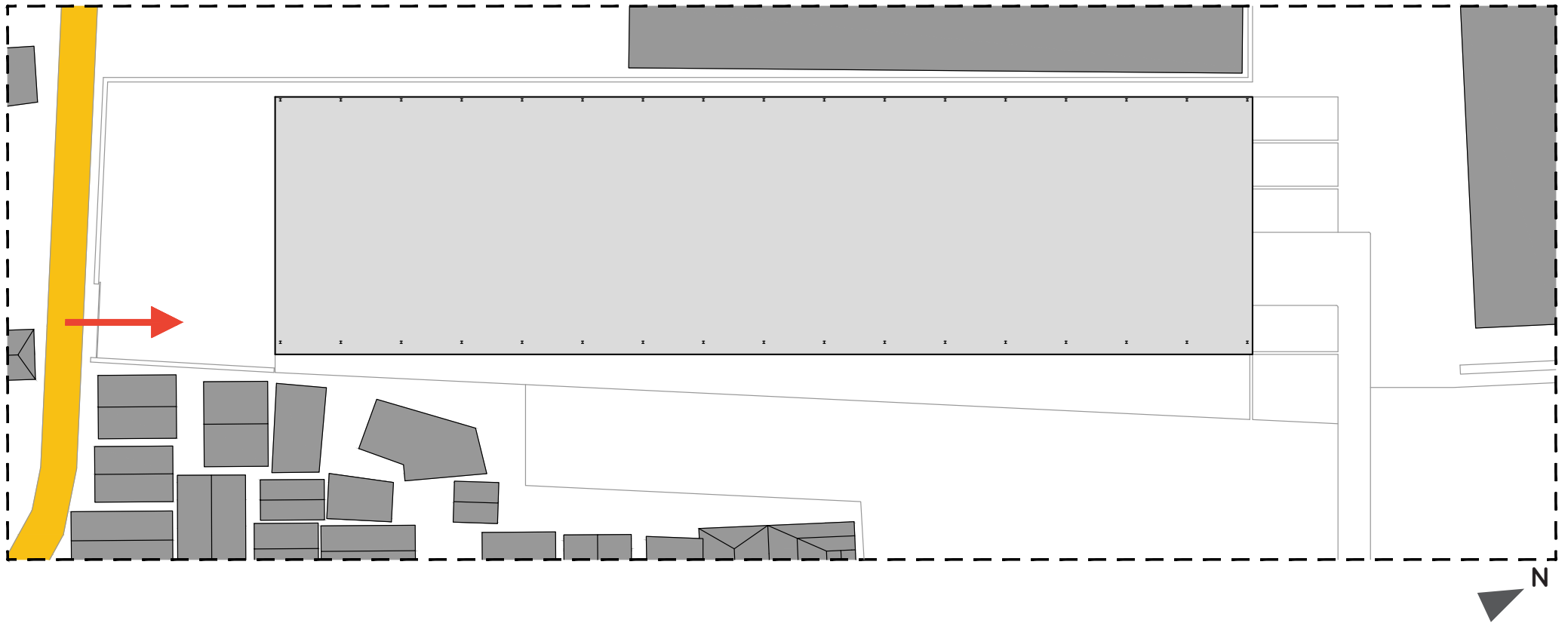
conclusion

DESIGN LAYOUT



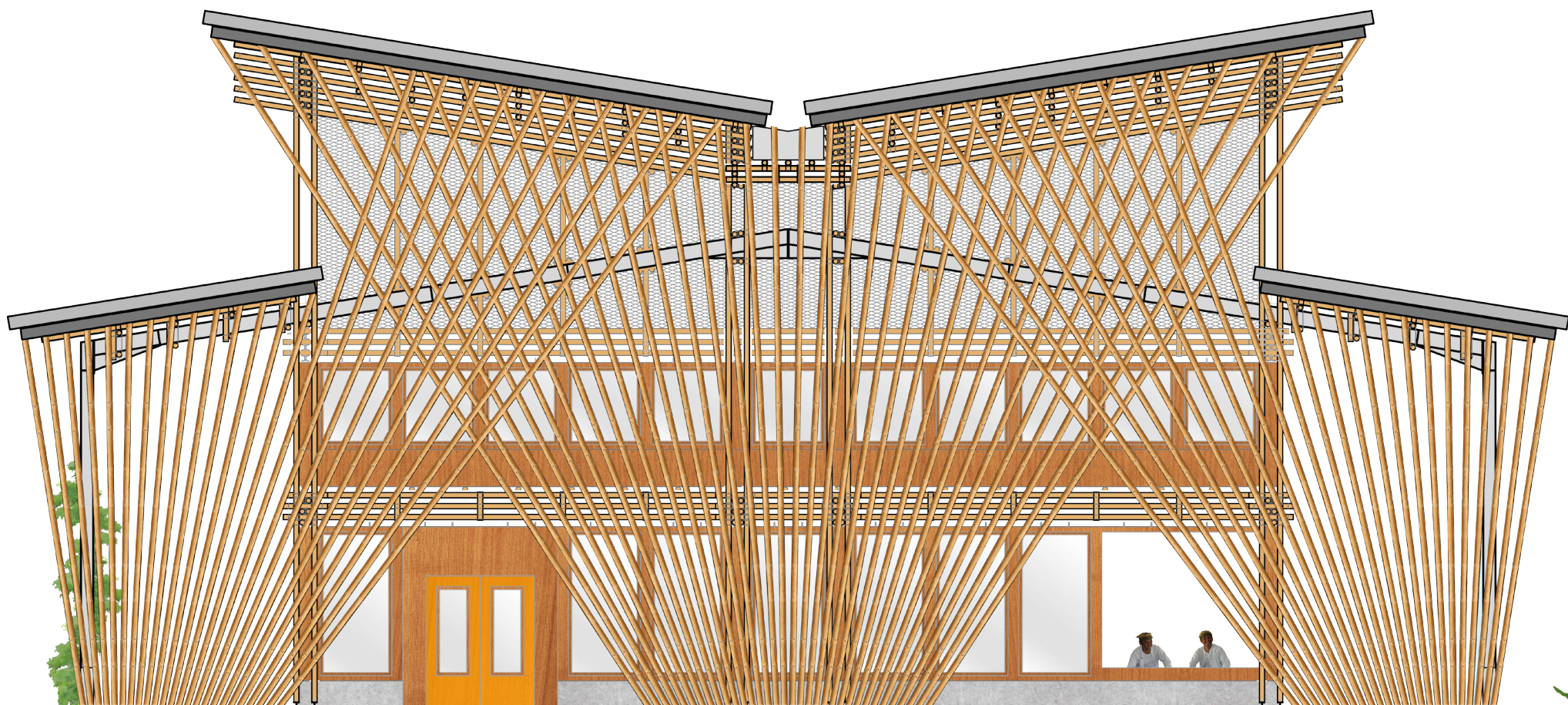
plantation

DESIGN LAYOUT

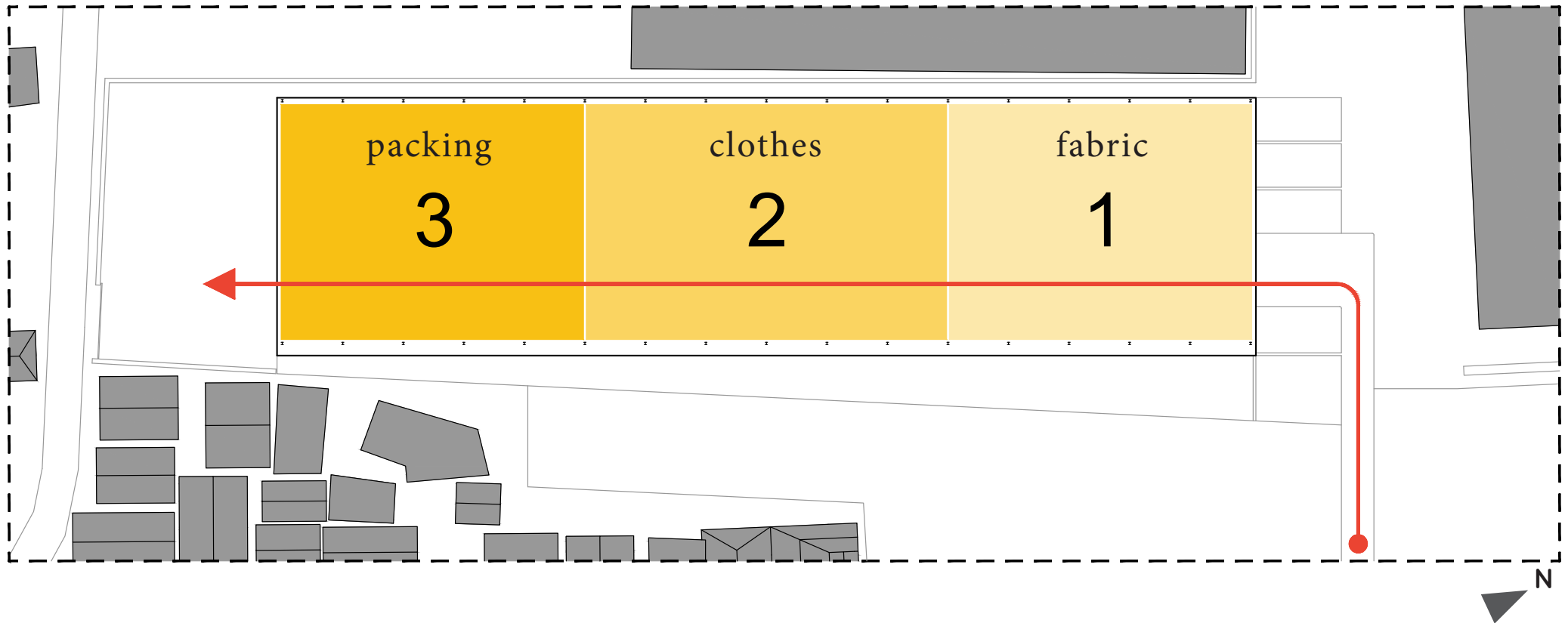


acces

picture model - van voor, schuin van boven (weg zichtbaar)

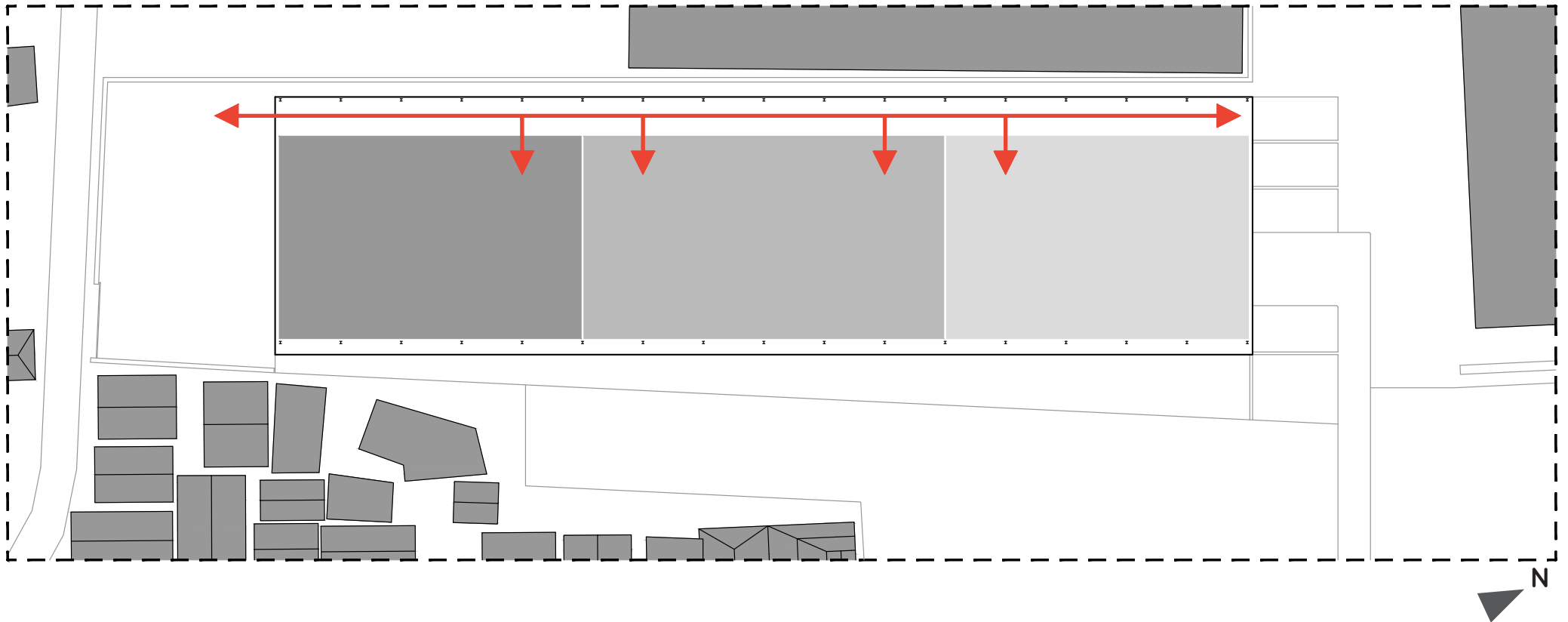


DESIGN LAYOUT



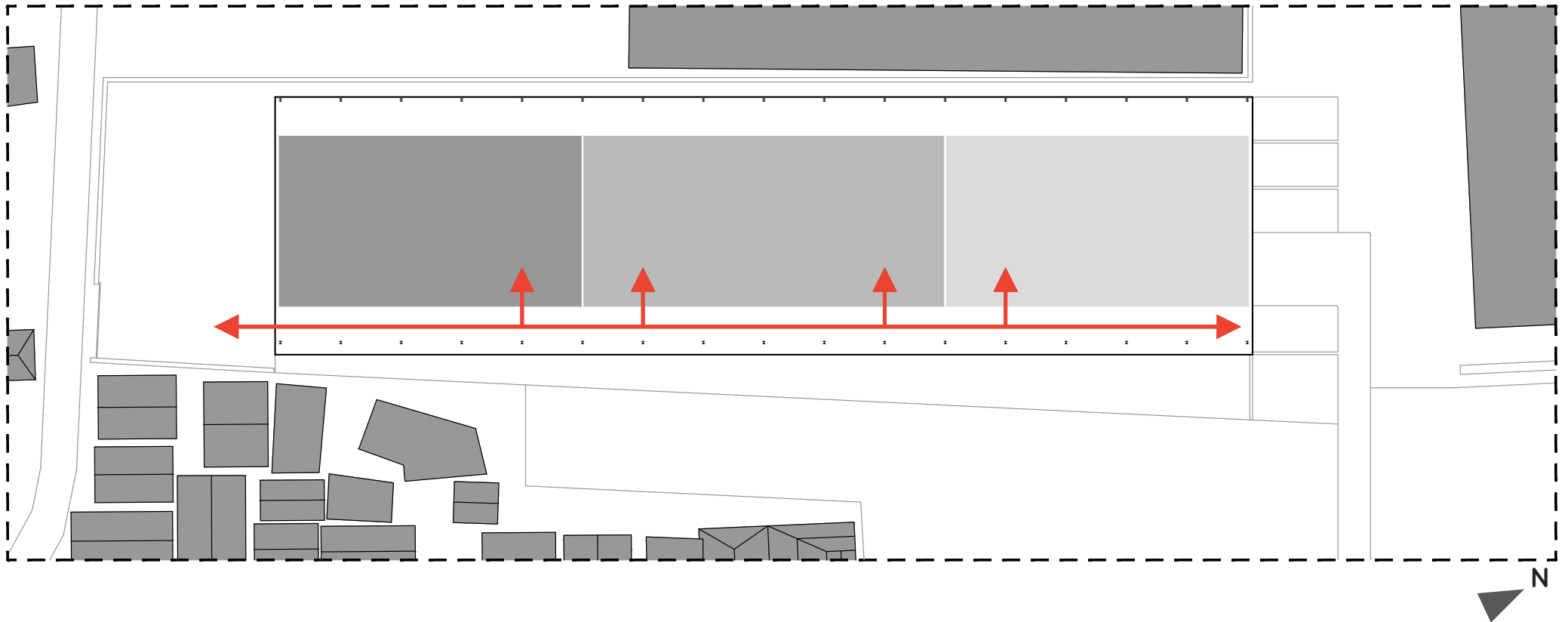
production flow

DESIGN LAYOUT



routing products

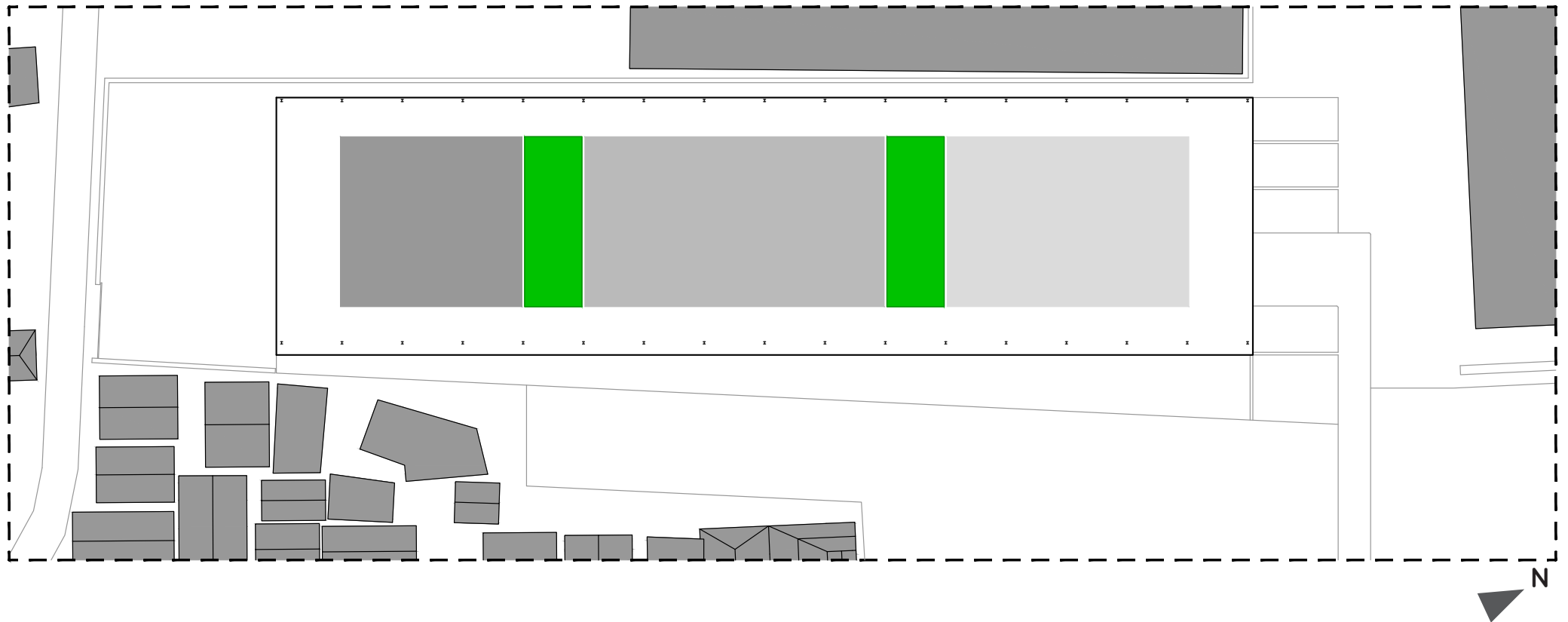
DESIGN LAYOUT



routing workers



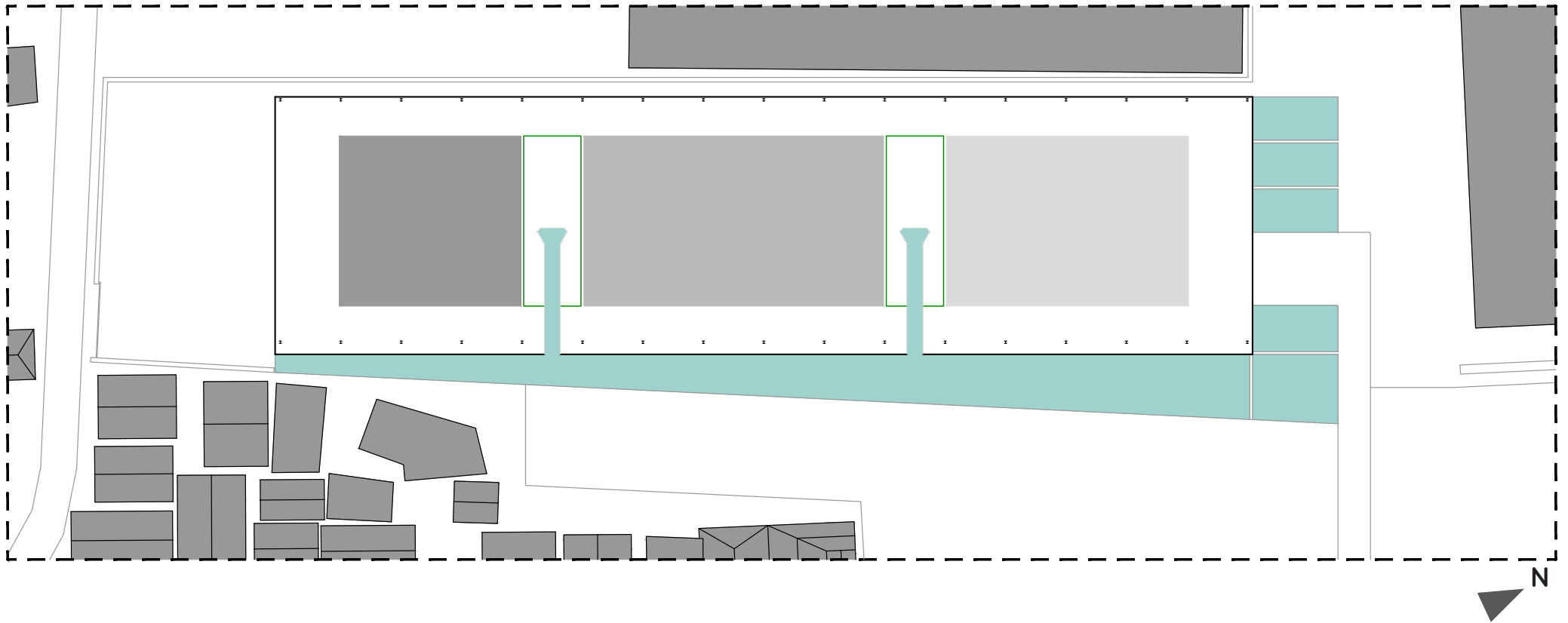
DESIGN LAYOUT



patio's

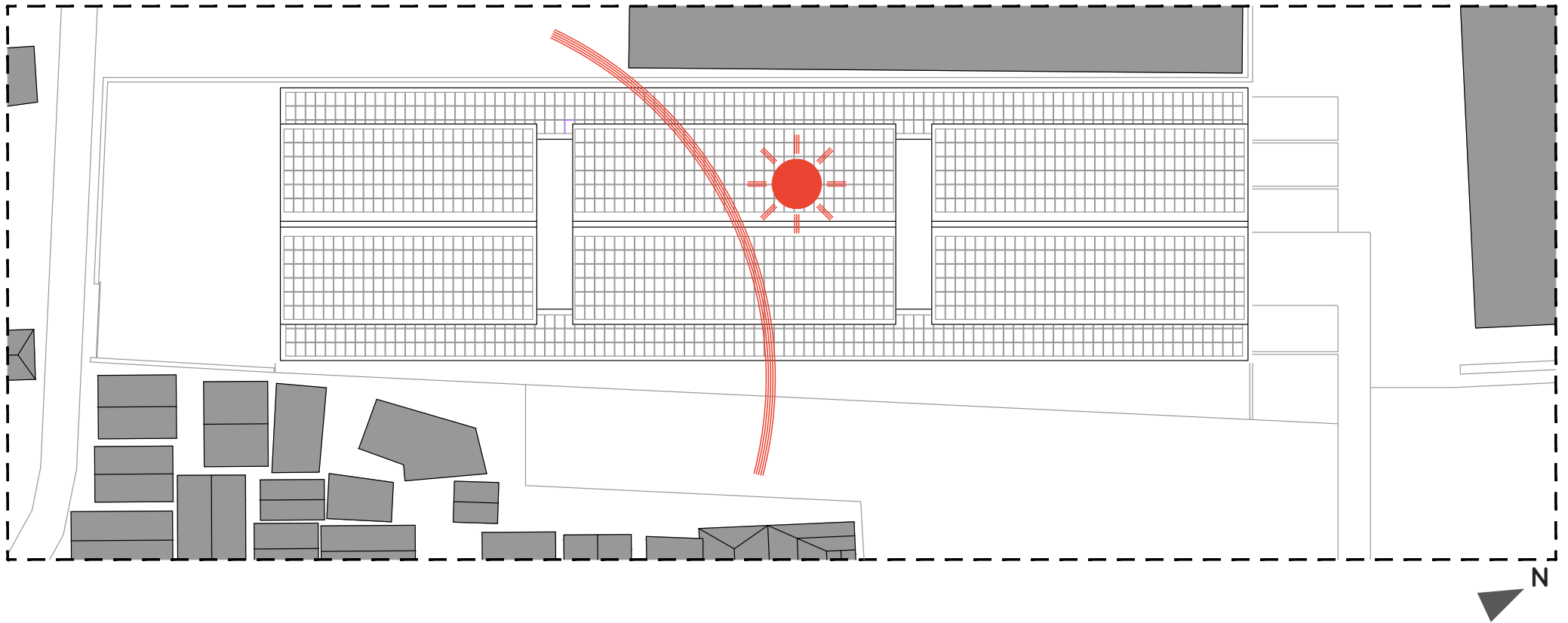
picture model - roofshape 3 parts and split by patio's

DESIGN LAYOUT



water basins

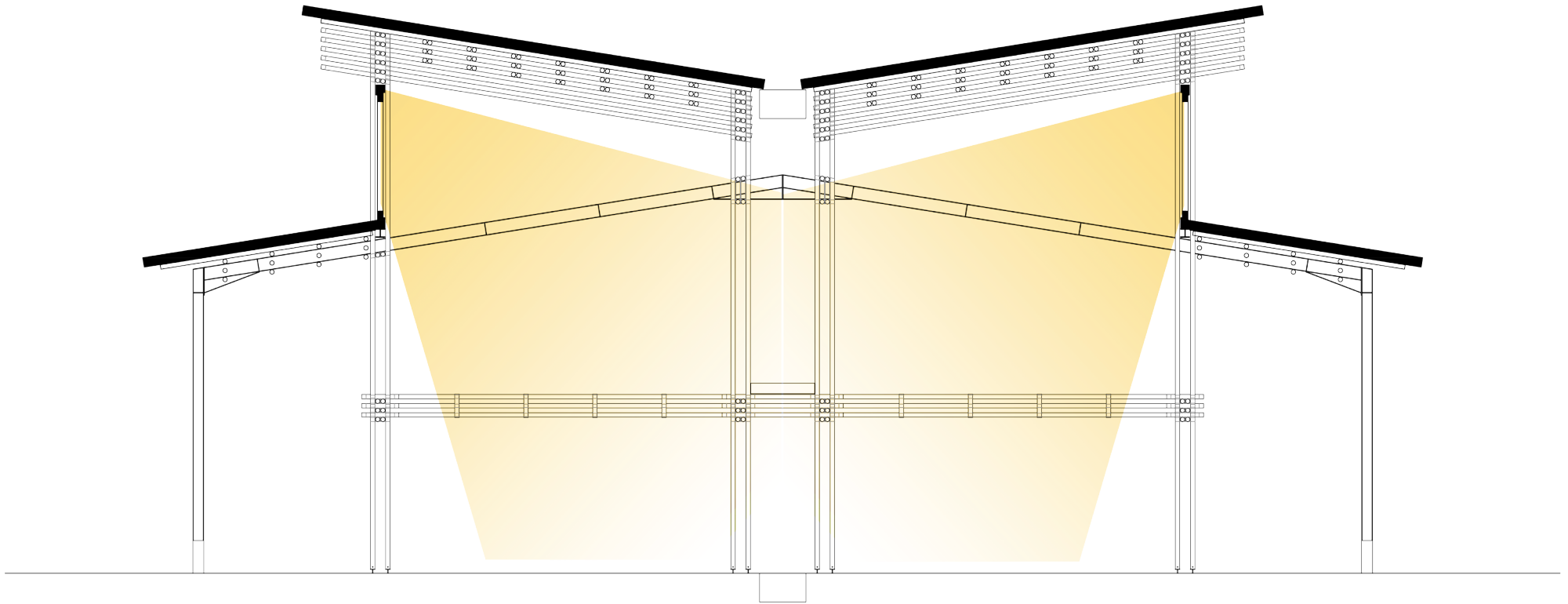
DESIGN LAYOUT



orientation indoor space - sun path

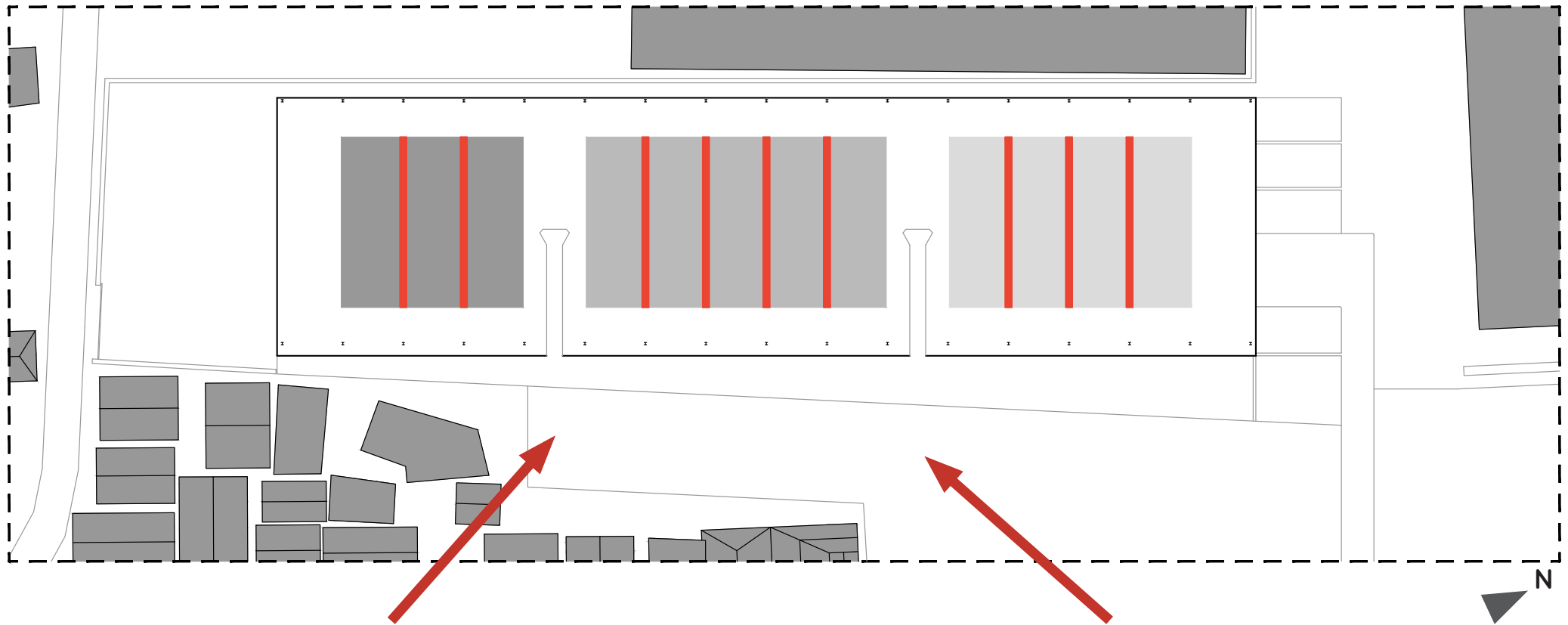
picture model - roof from side (roof windows)

DAYLIGHT

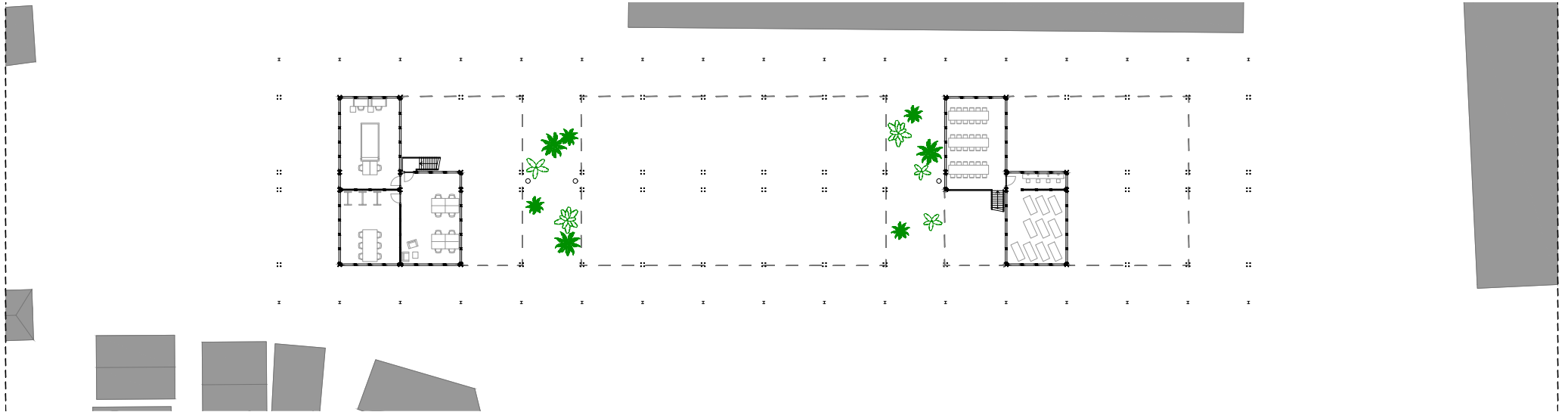


roofwindows

DESIGN LAYOUT



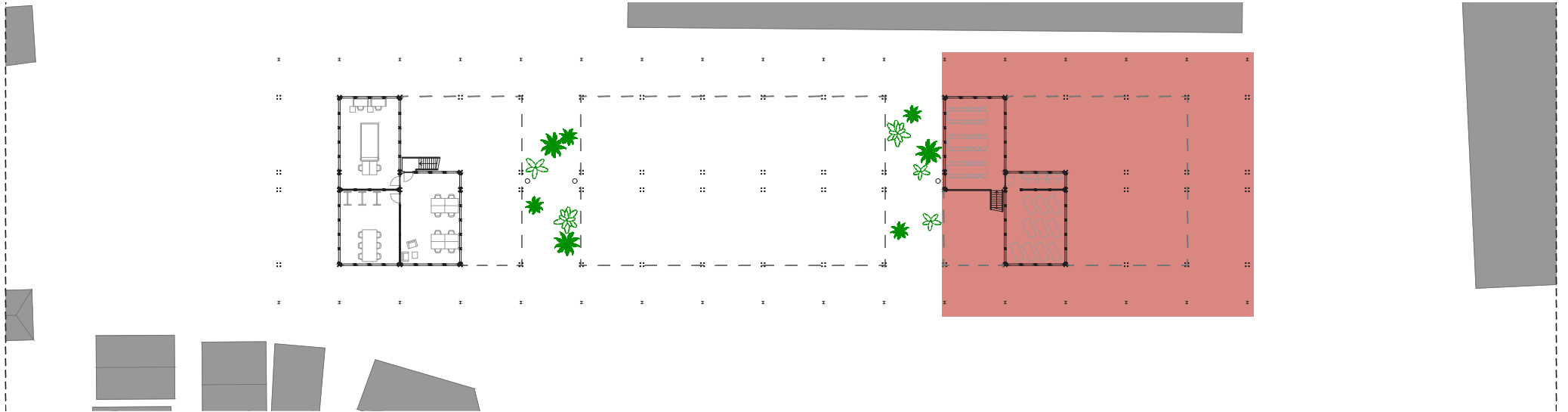
orientation indoor space - prevailing wind directions



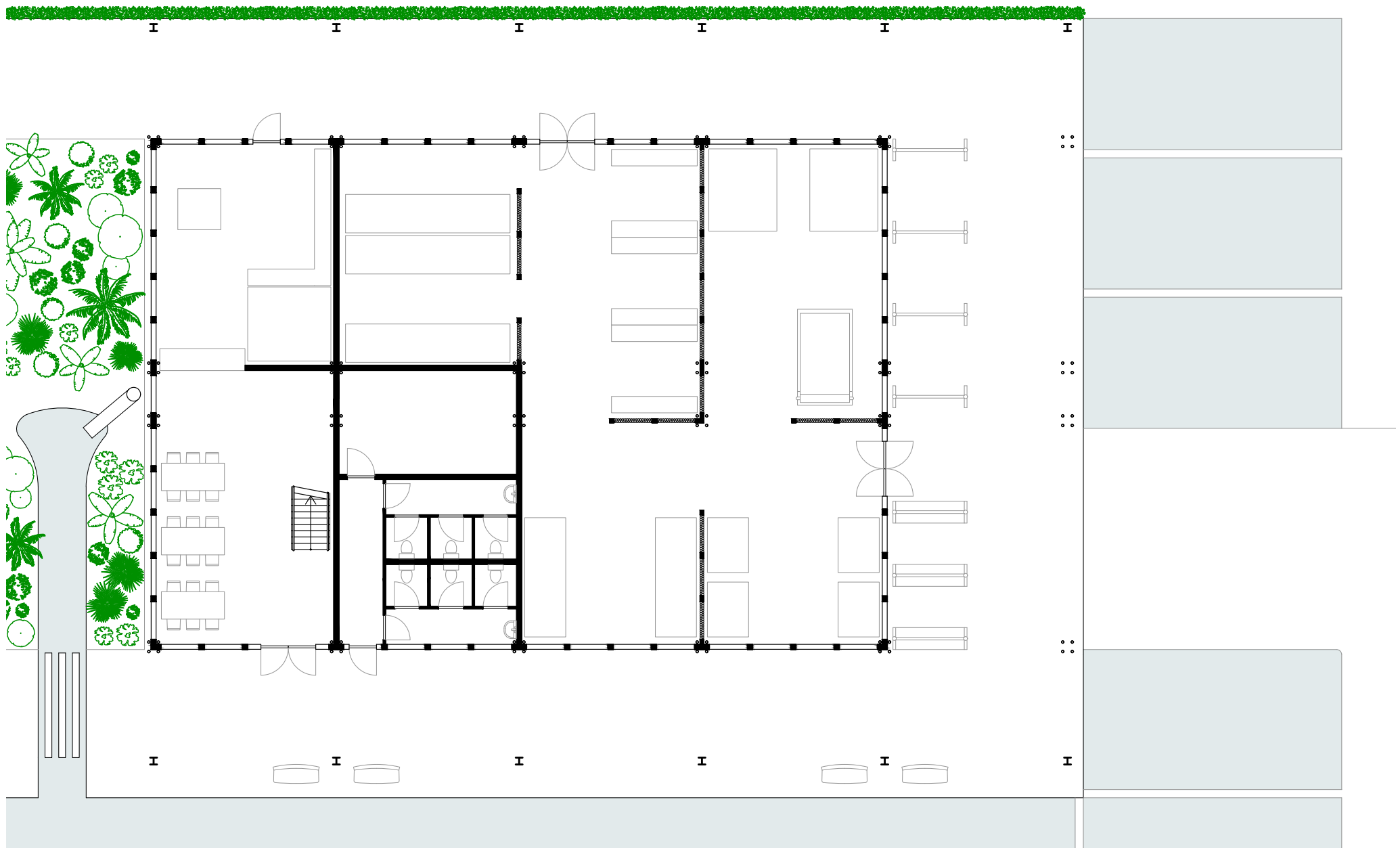
floorplan - first floor



floorplan - ground floor



building part 1 - production of the fabric

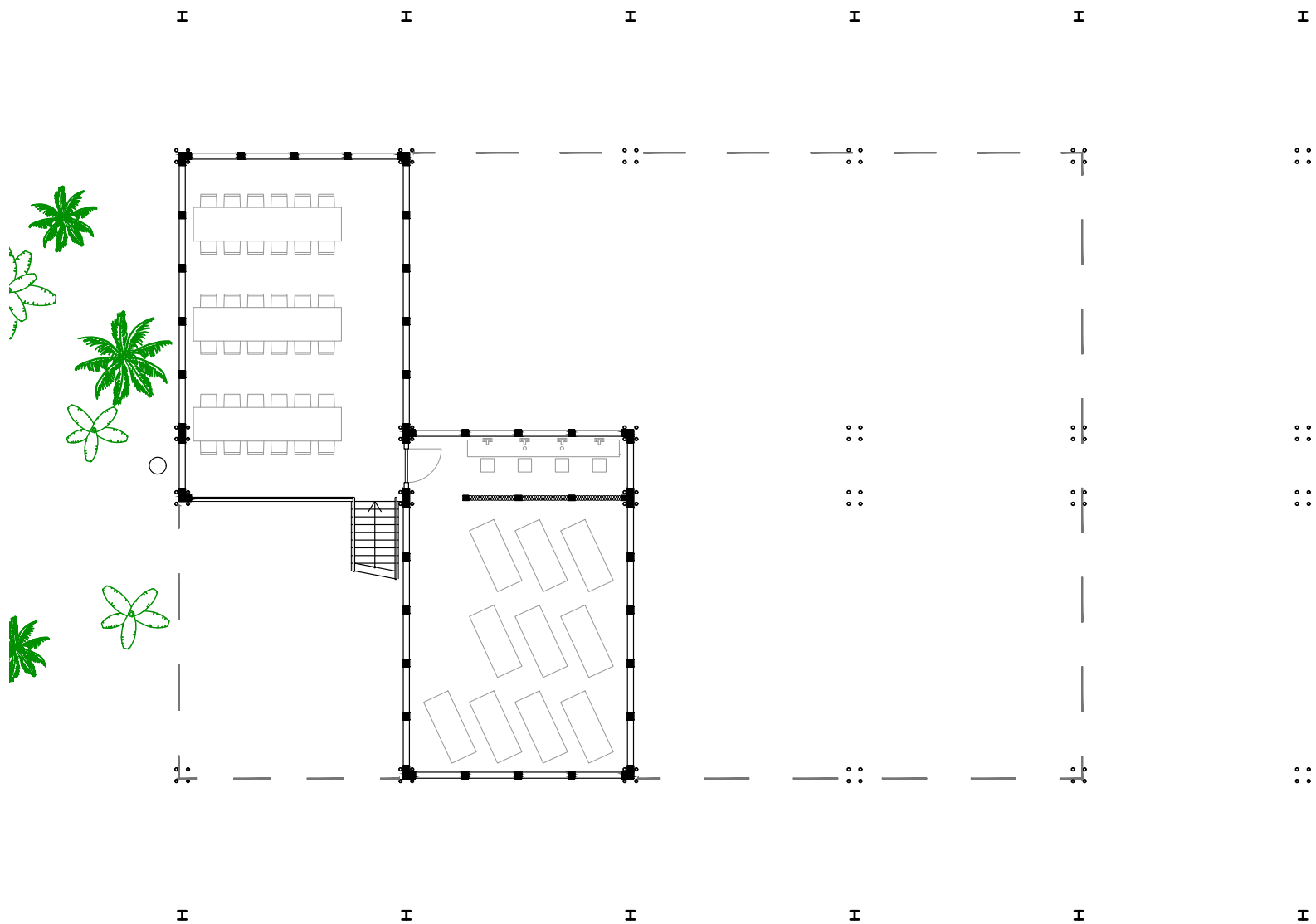


building part 1 - ground floor



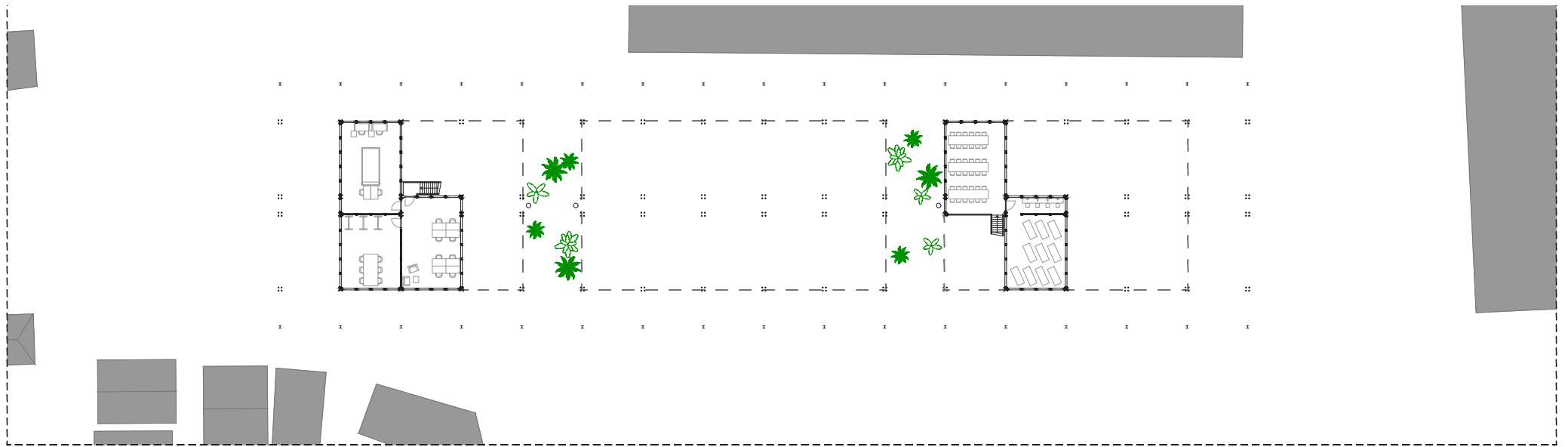






building part 1 - first floor





building part 2 - production of the clothes

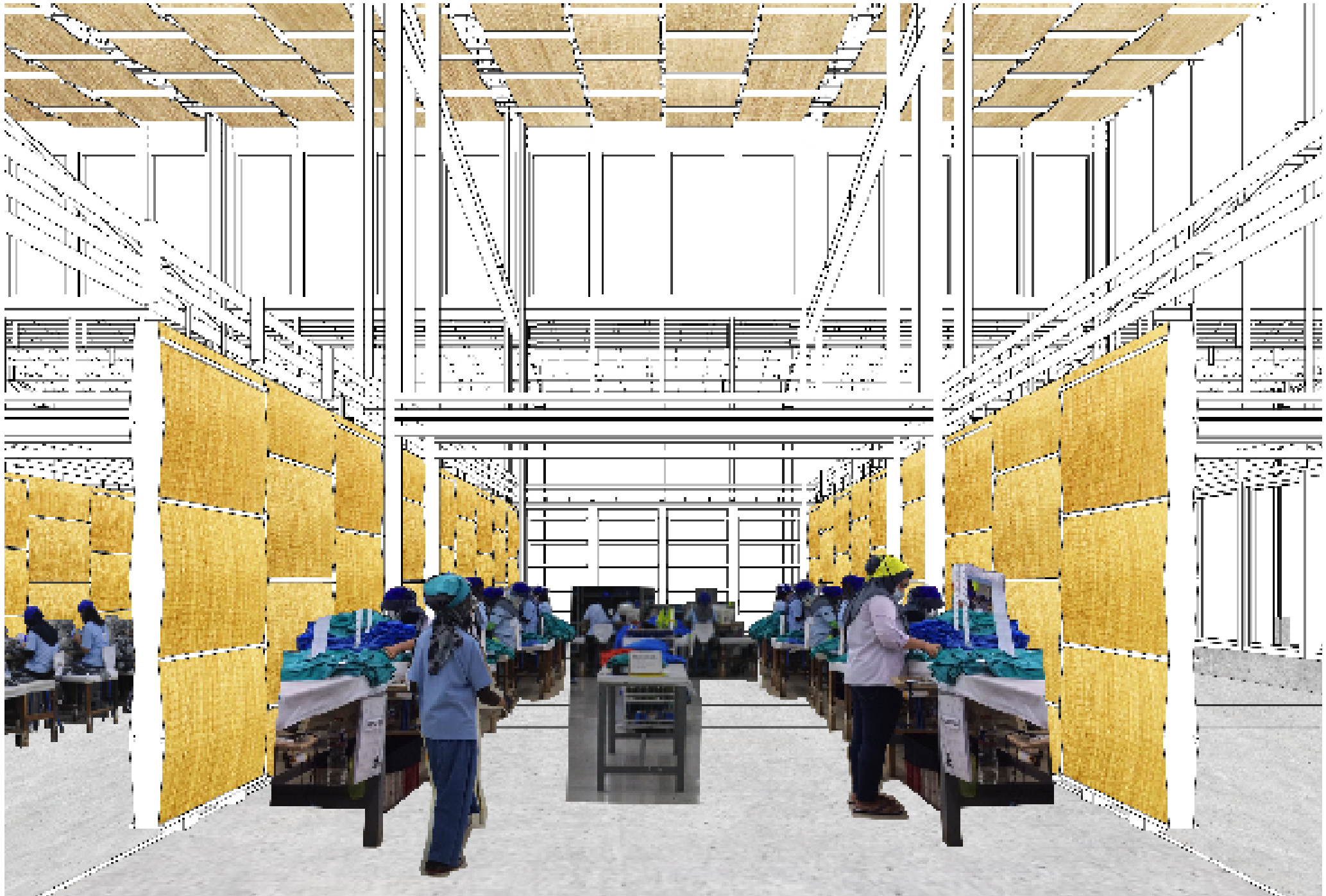


building part 2

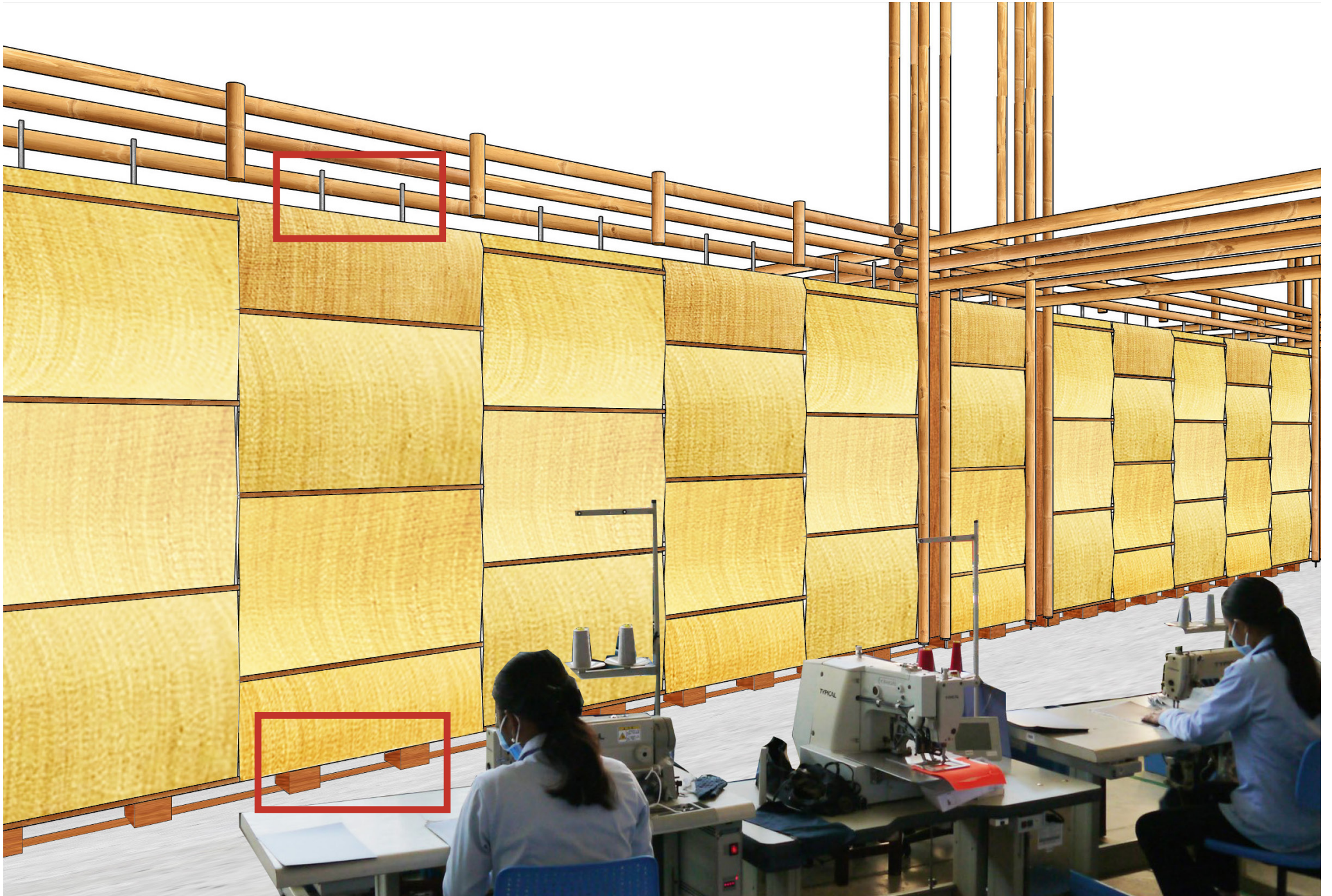




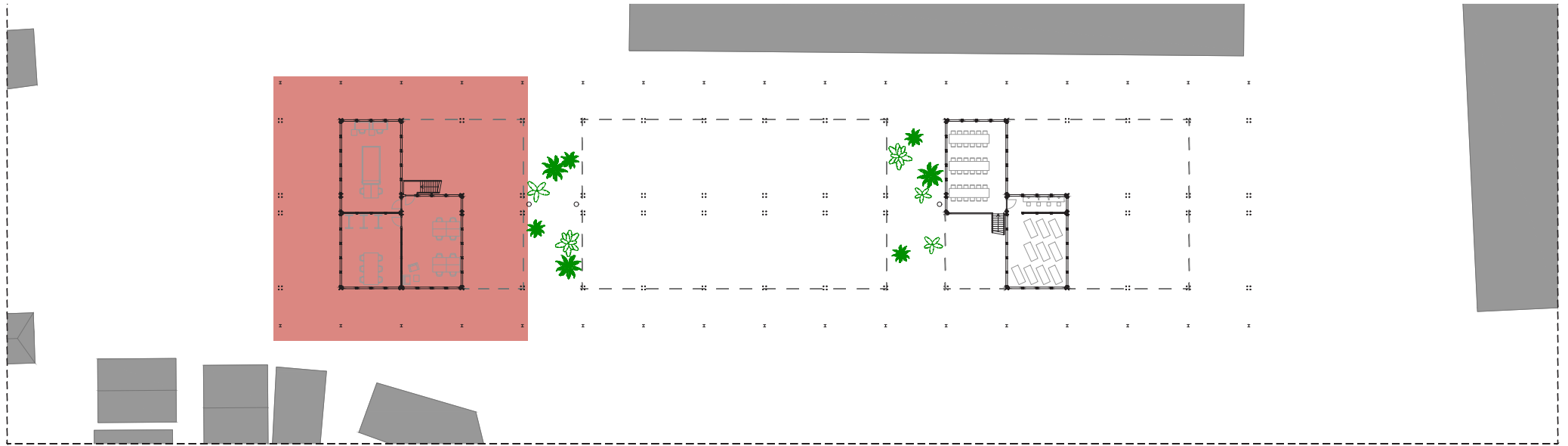






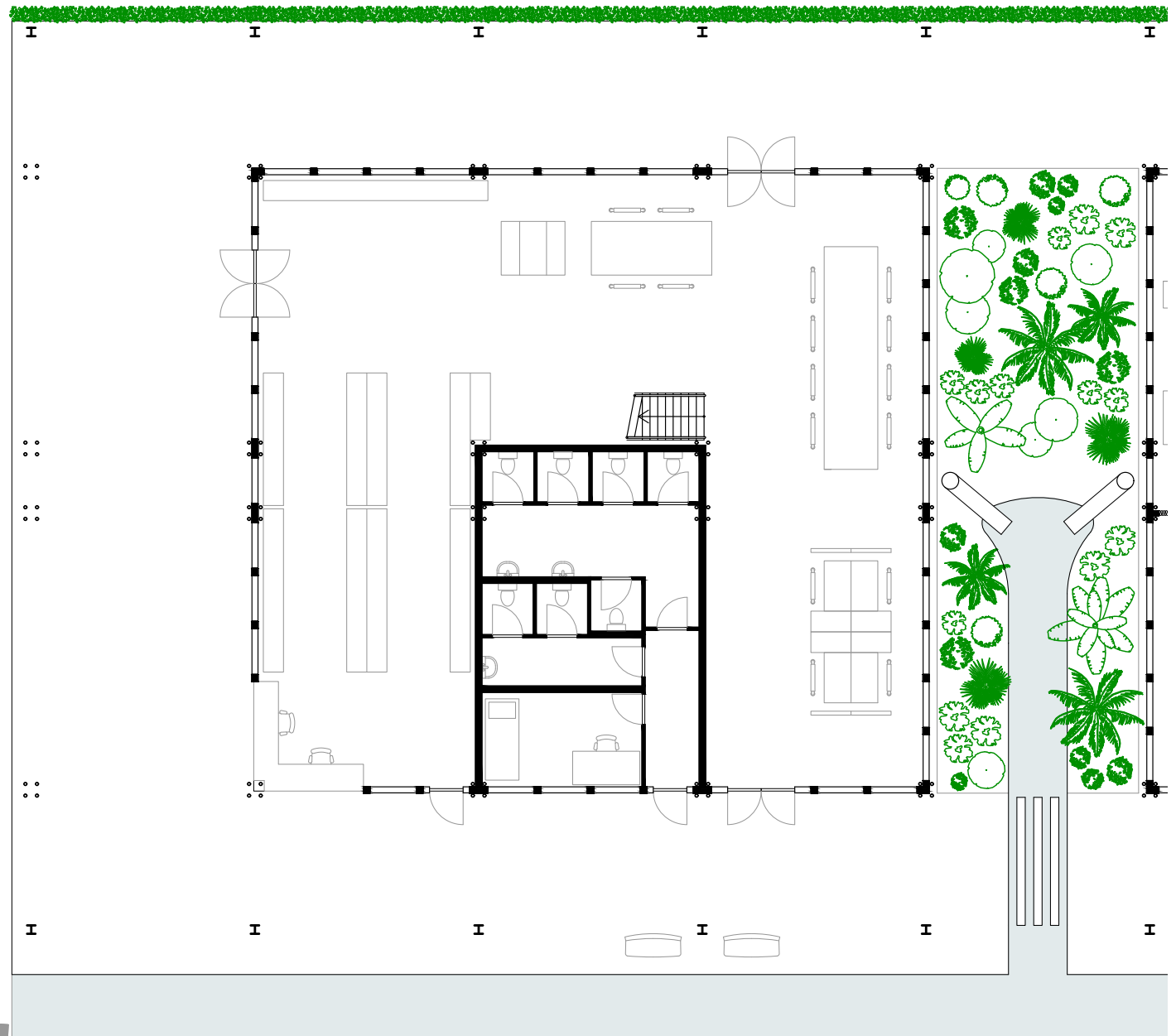




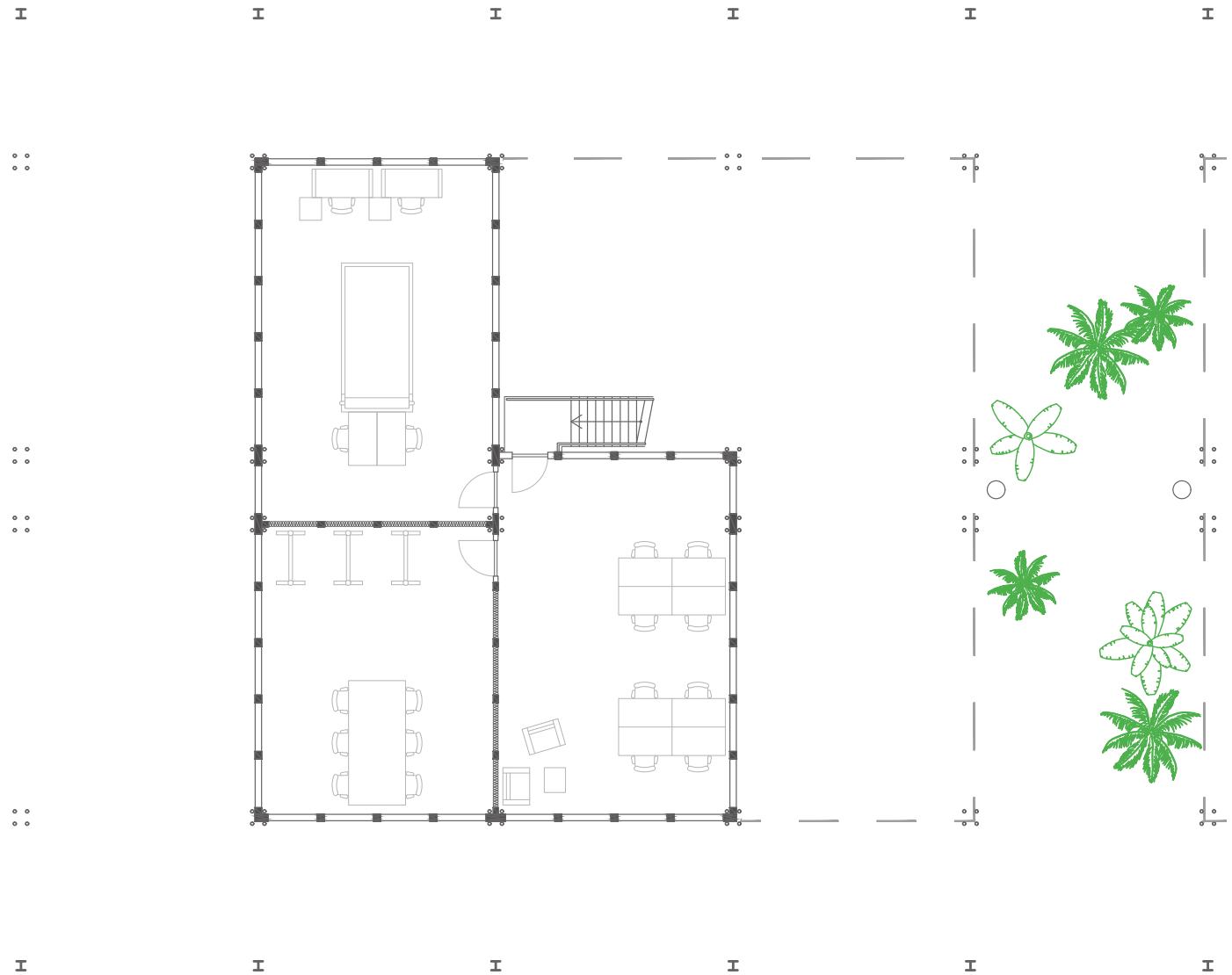


building part 3 - final check & packing





building part 3 - ground floor



building part 3 - first floor







concrete



steel

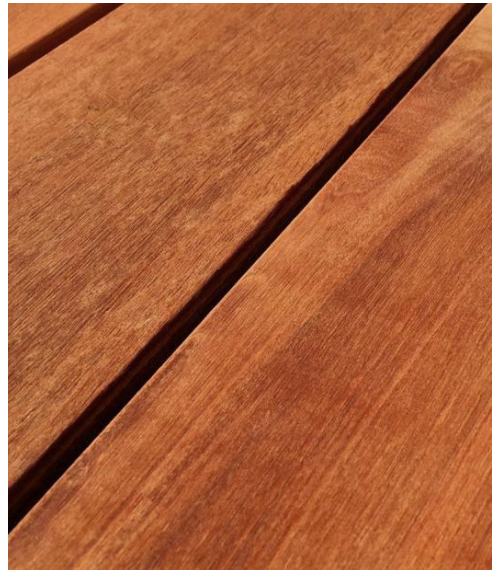


metal sheets

existing materials



bamboo



Bangkirai wood



natural coconut fiber



banana fabric

new materials

INTRODUCTION

the fashion industry

problem statement

context

research

objective

DESIGN

site

guidelines

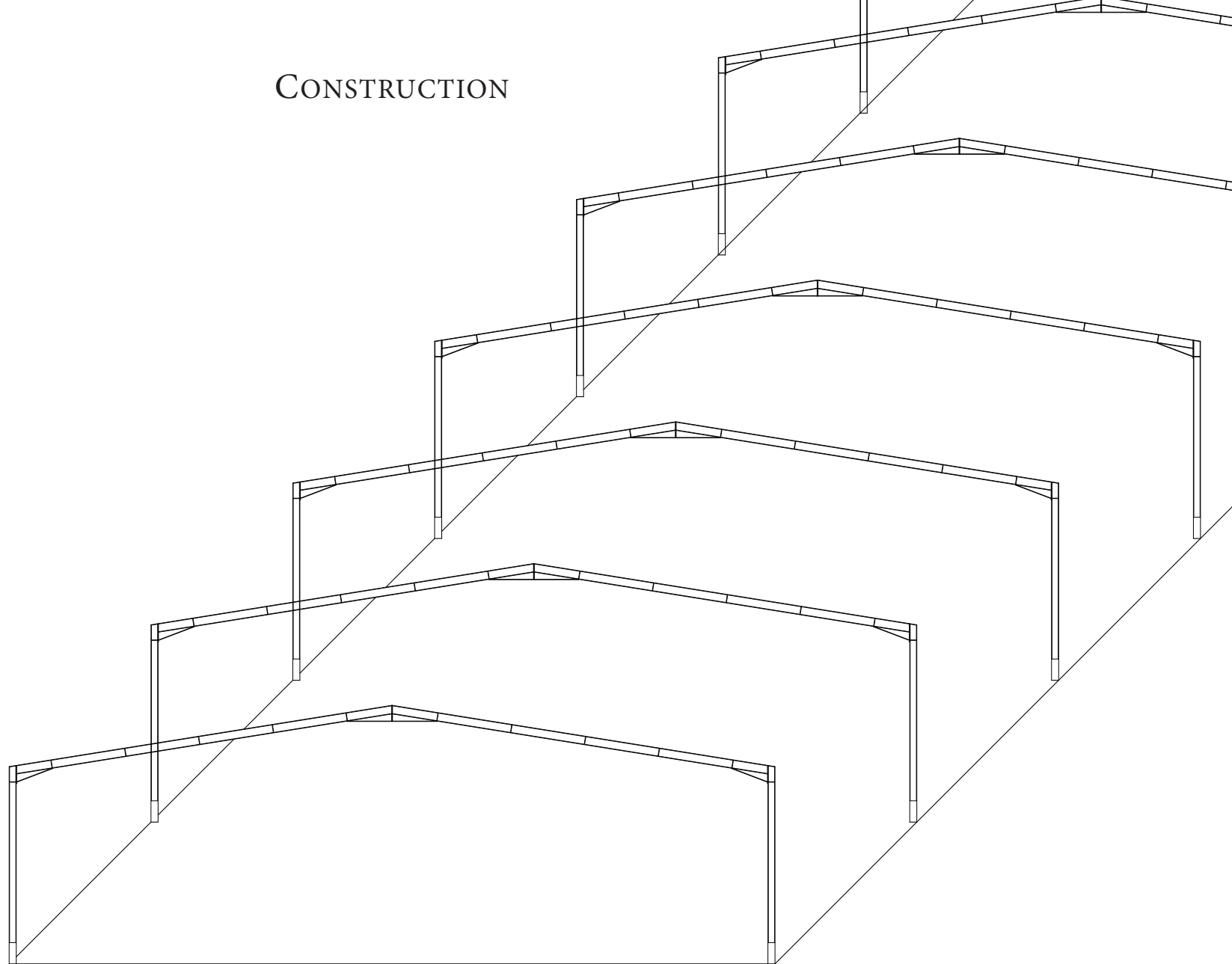
layout

CONSTRUCTION

...

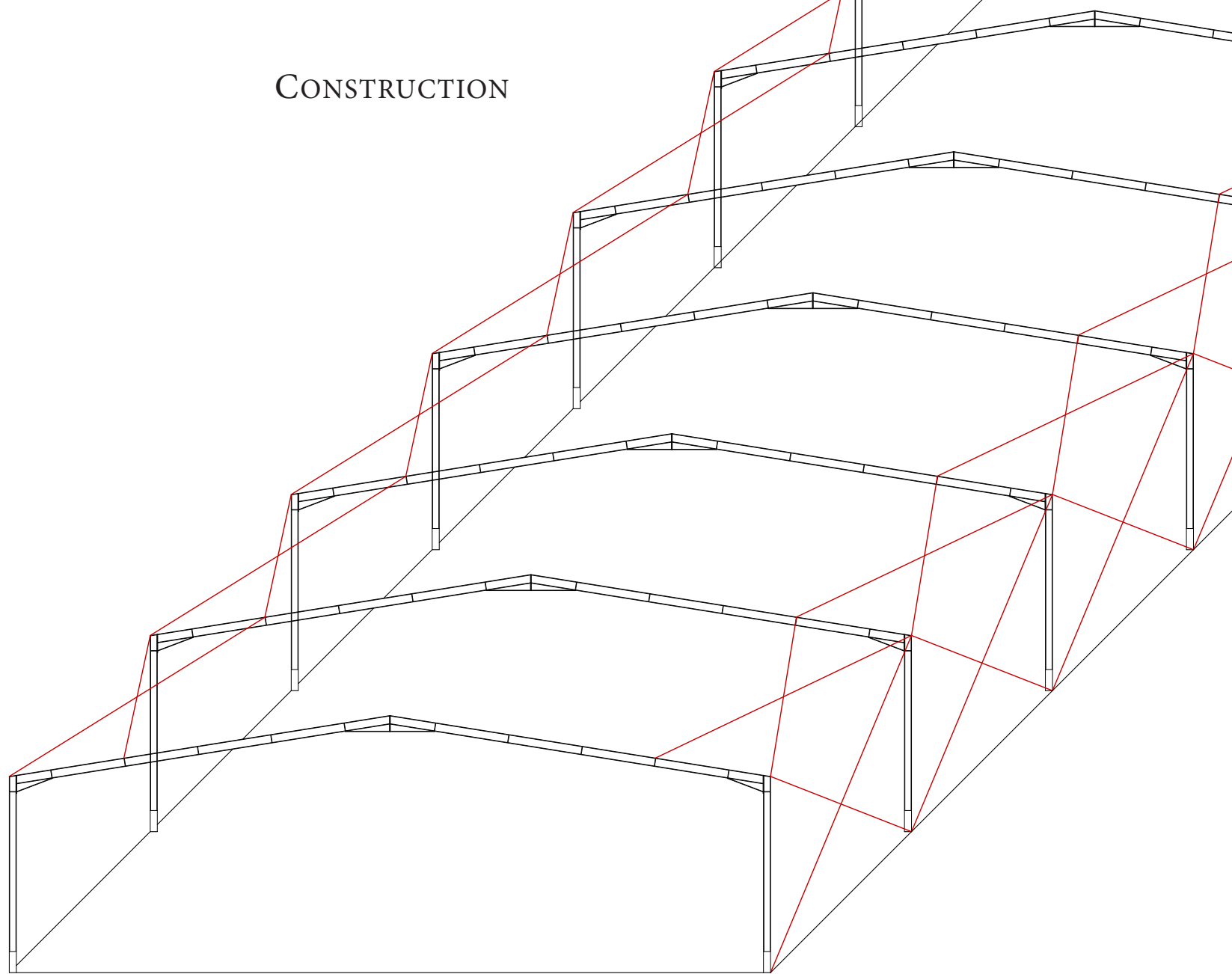
conclusion

CONSTRUCTION



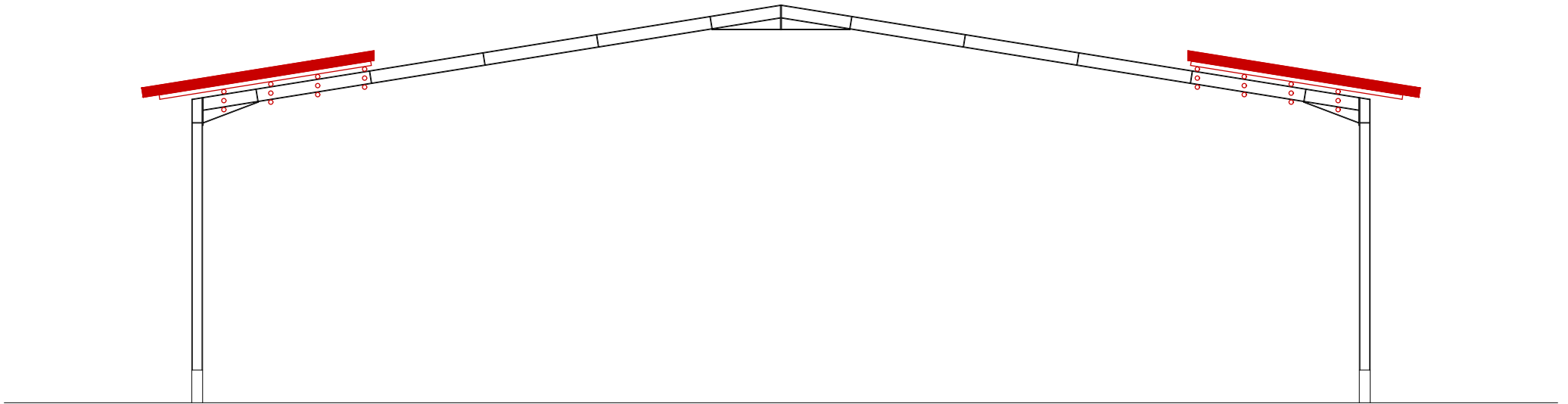
existing steel frame

CONSTRUCTION



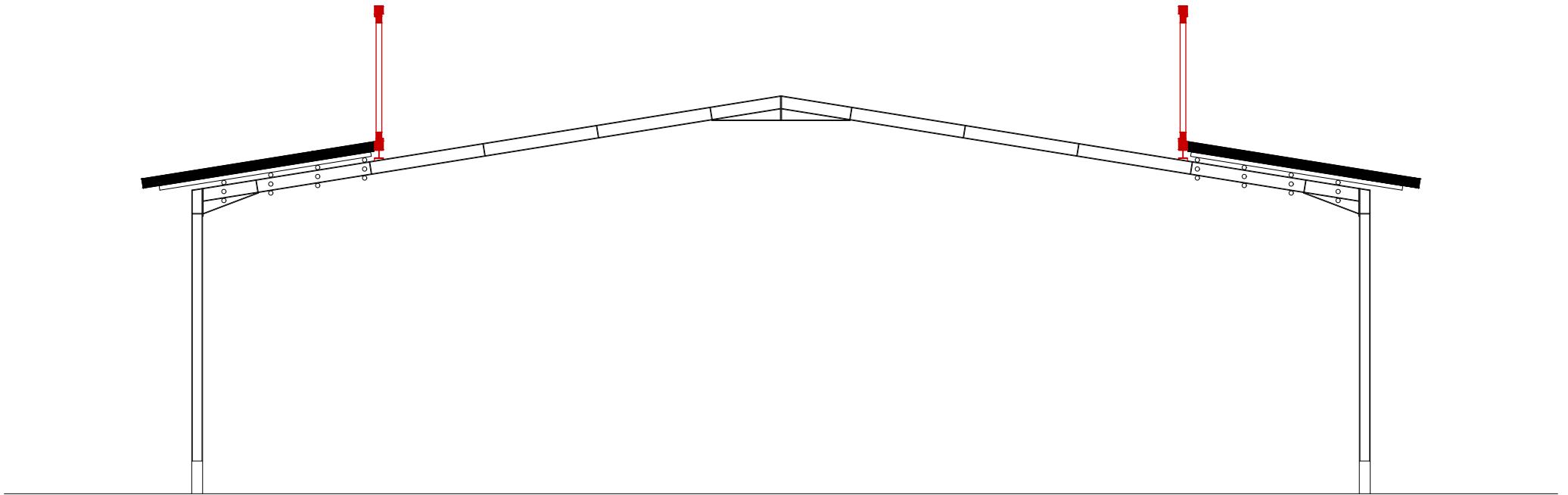
bracing

CONSTRUCTION



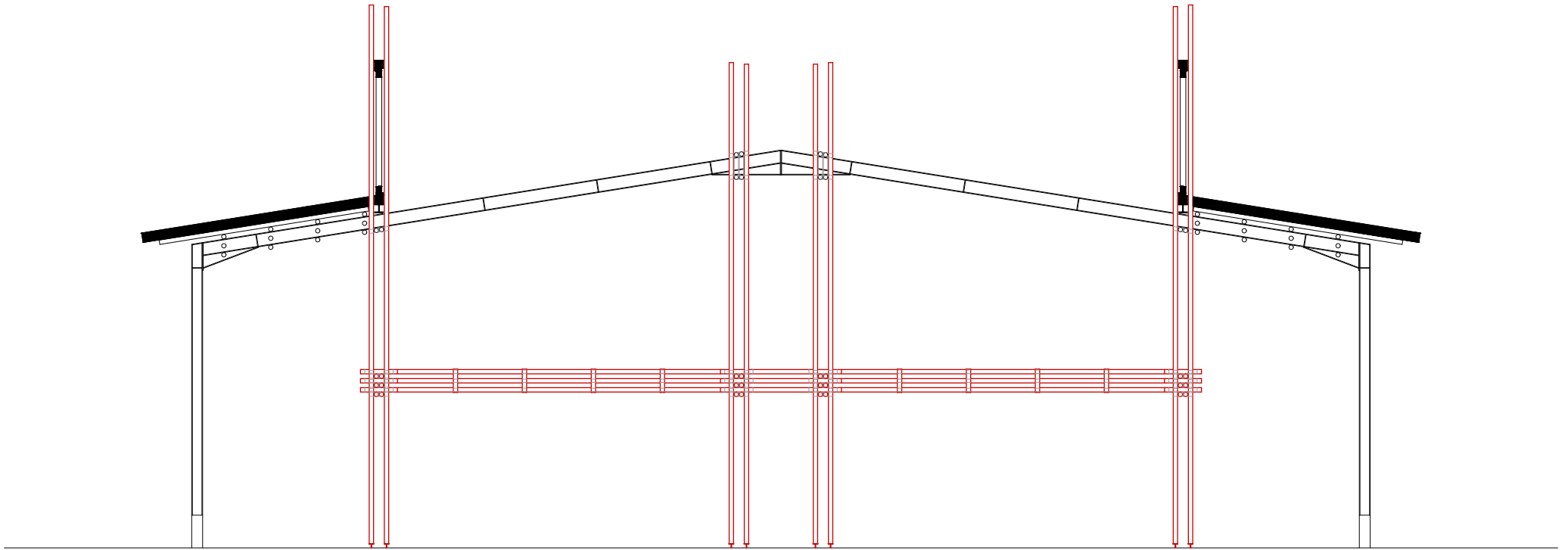
lower roof parts

CONSTRUCTION



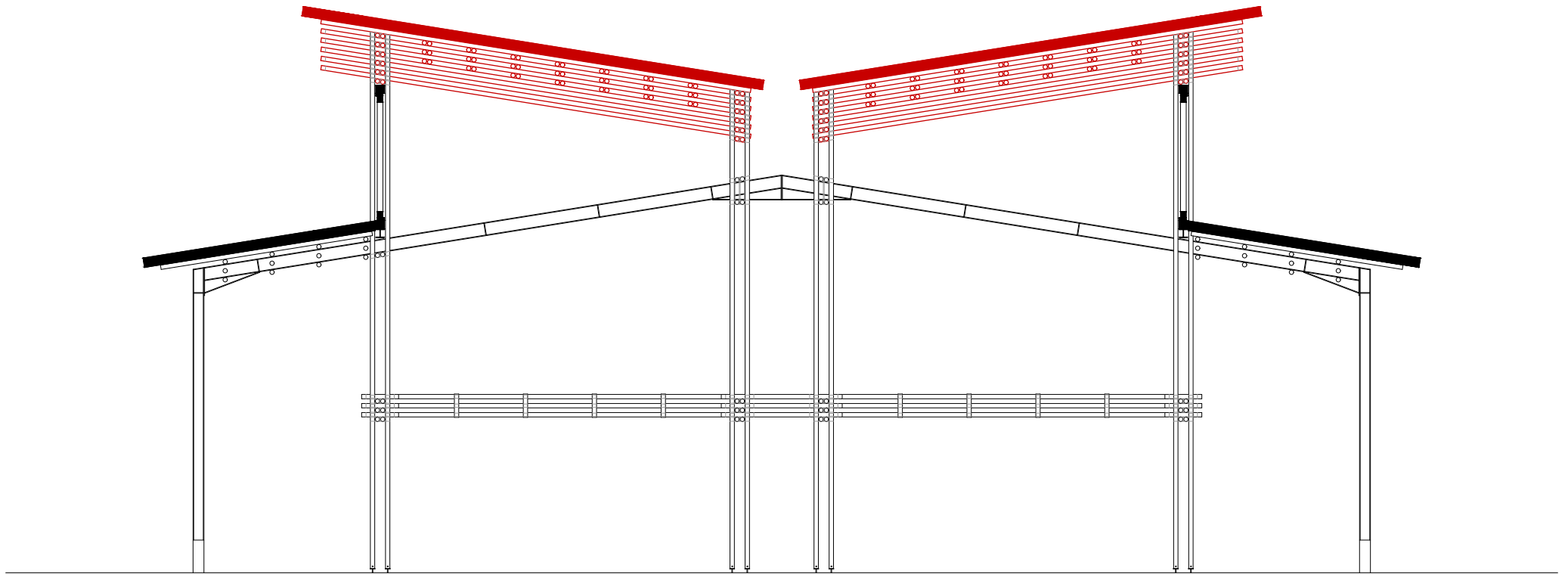
roof windows

CONSTRUCTION



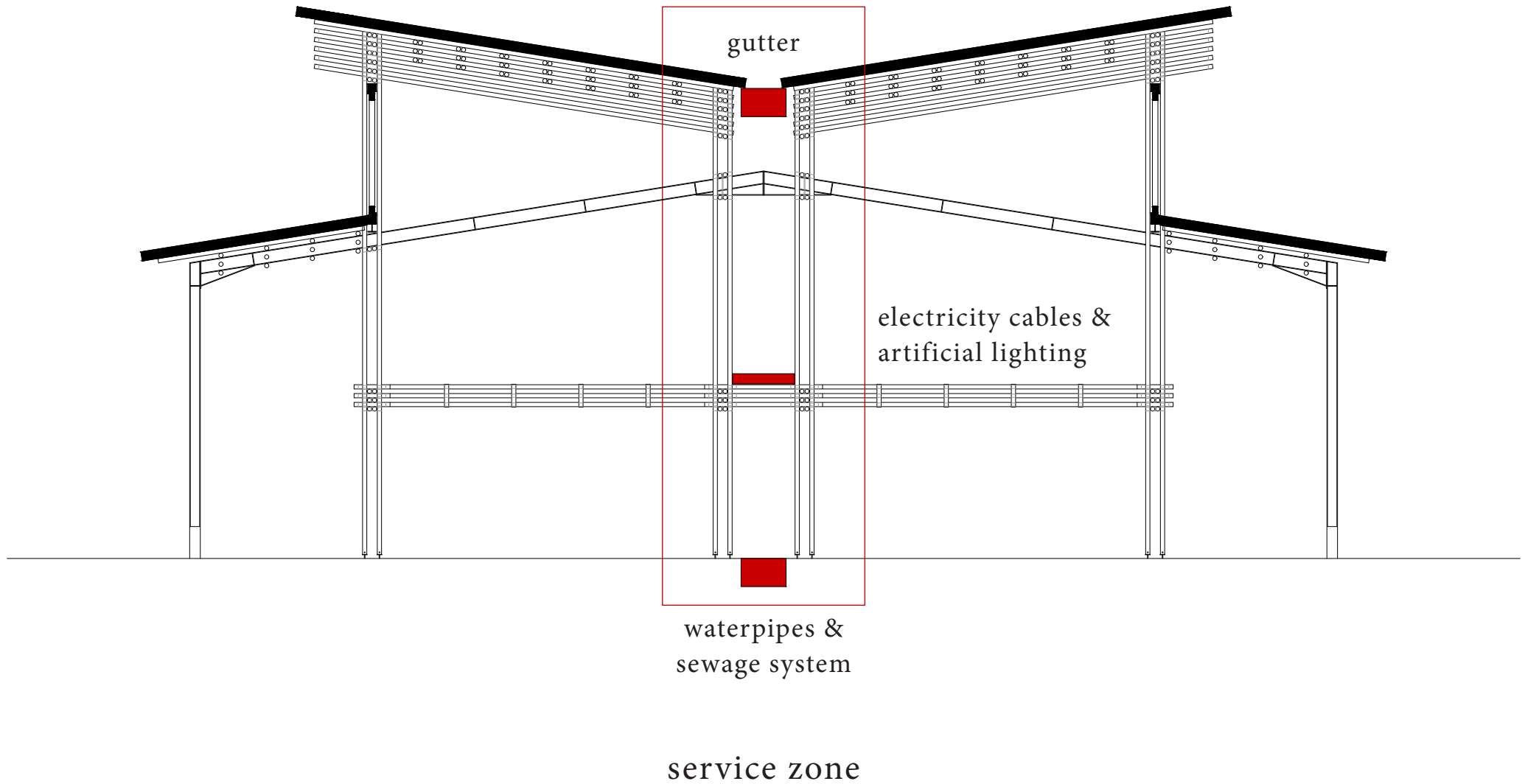
bamboo construction

CONSTRUCTION

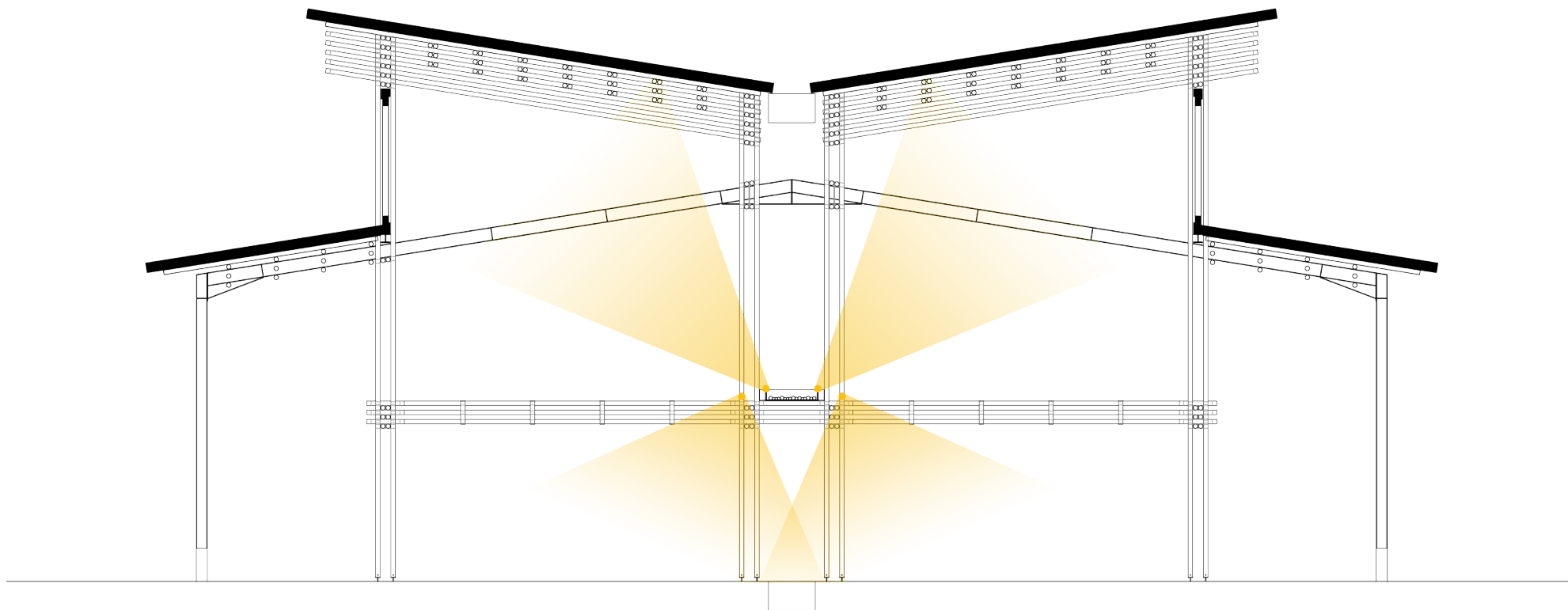


upper roof parts

CONSTRUCTION



CONSTRUCTION



service zone | artificial lighting

INTRODUCTION

the fashion industry

problem statement

context

research

objective

DESIGN

site

guidelines

layout

construction

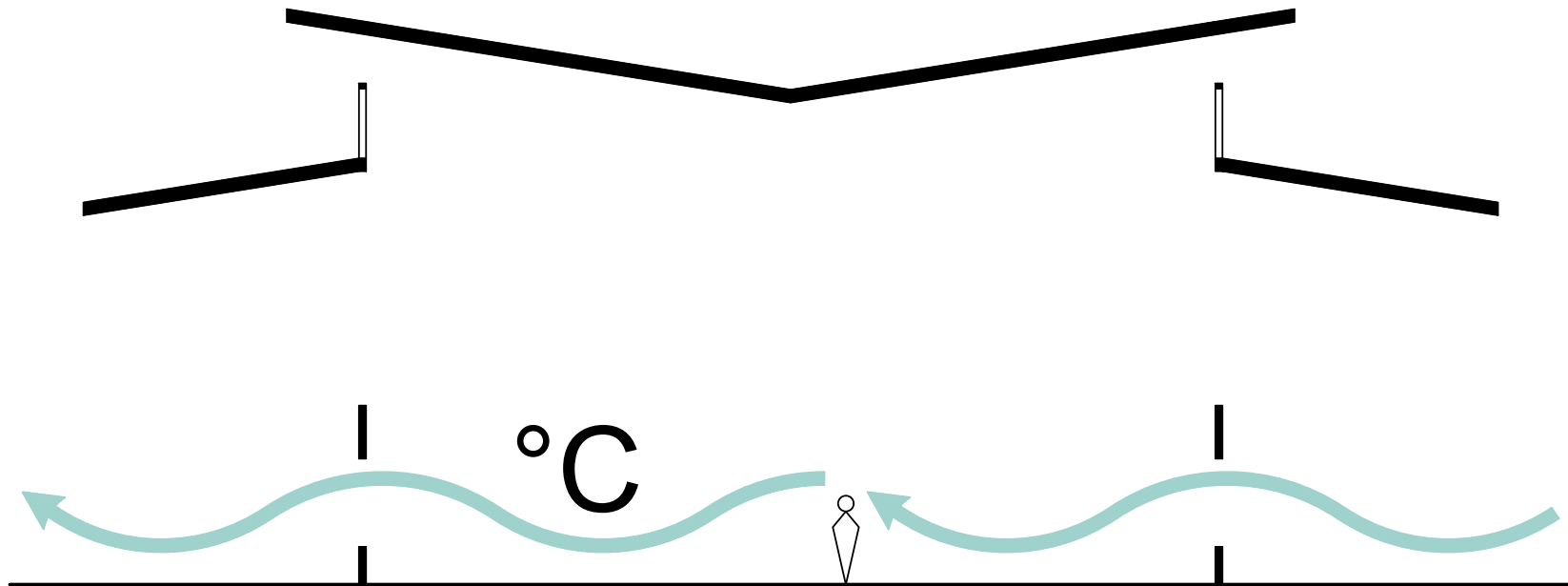
...

conclusion

picture model - facade from side (mesh and windows)
two different window-types (openable and closed)

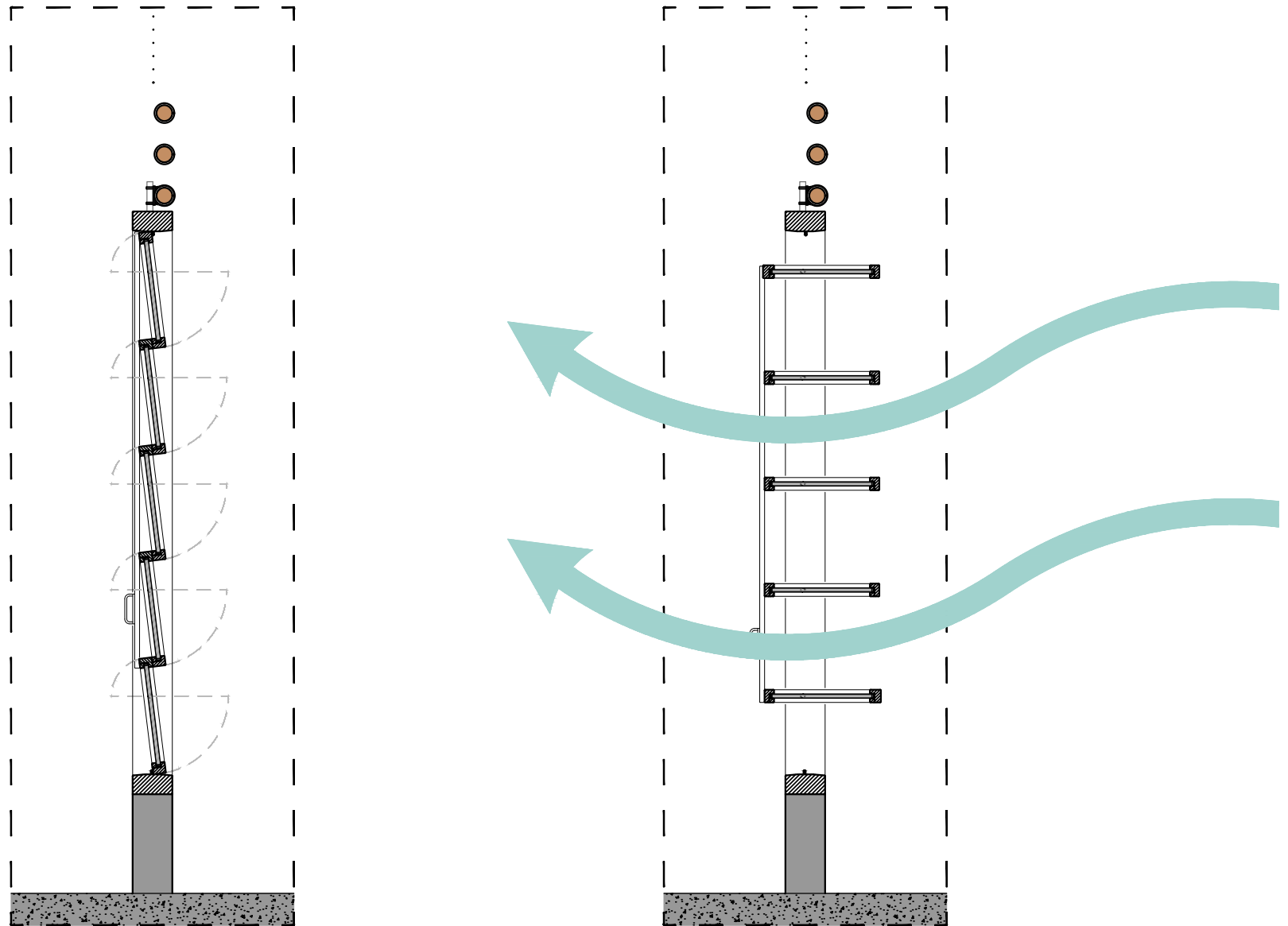


ELEMENTS



facade - operational windows

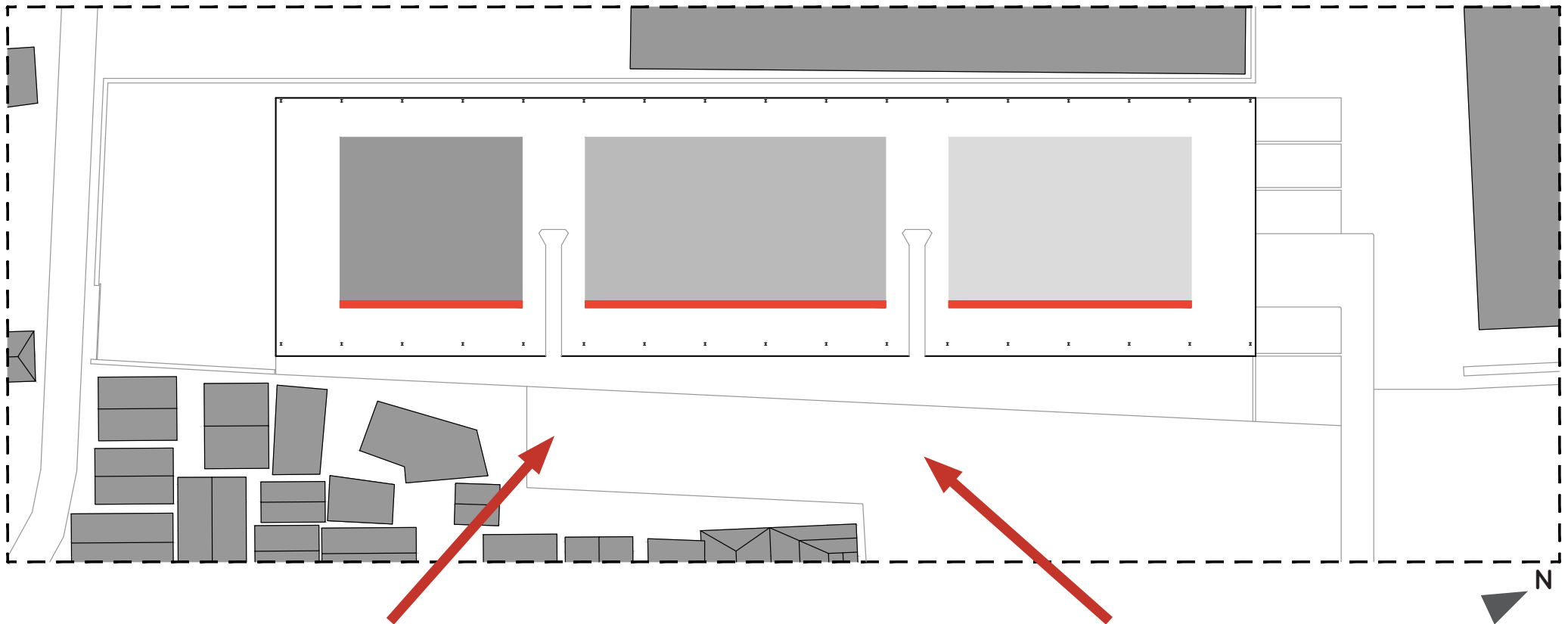
ELEMENTS



facade - operational windows

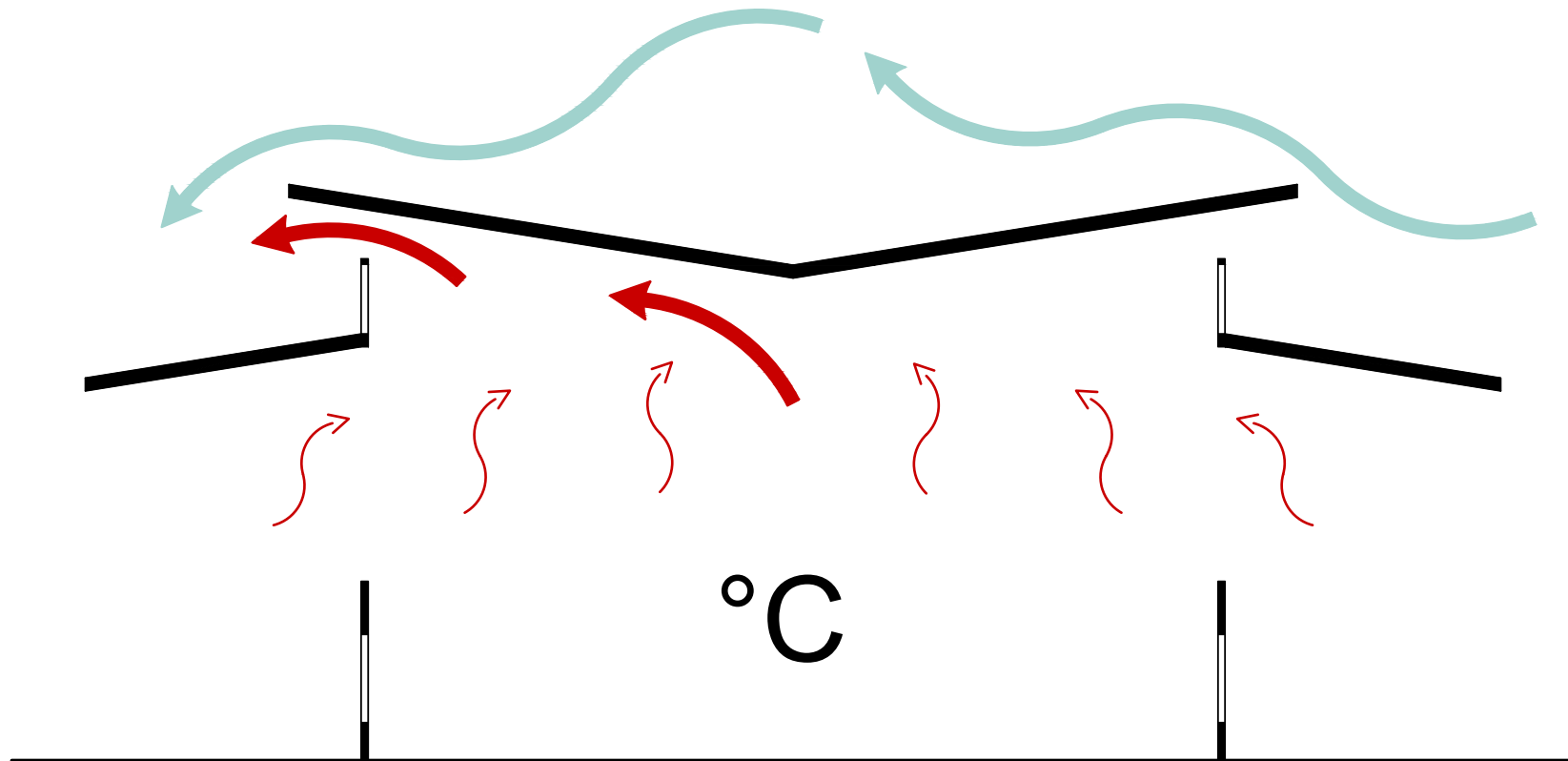
DESIGN LAYOUT

te openen ramen versus dichte ramen!!



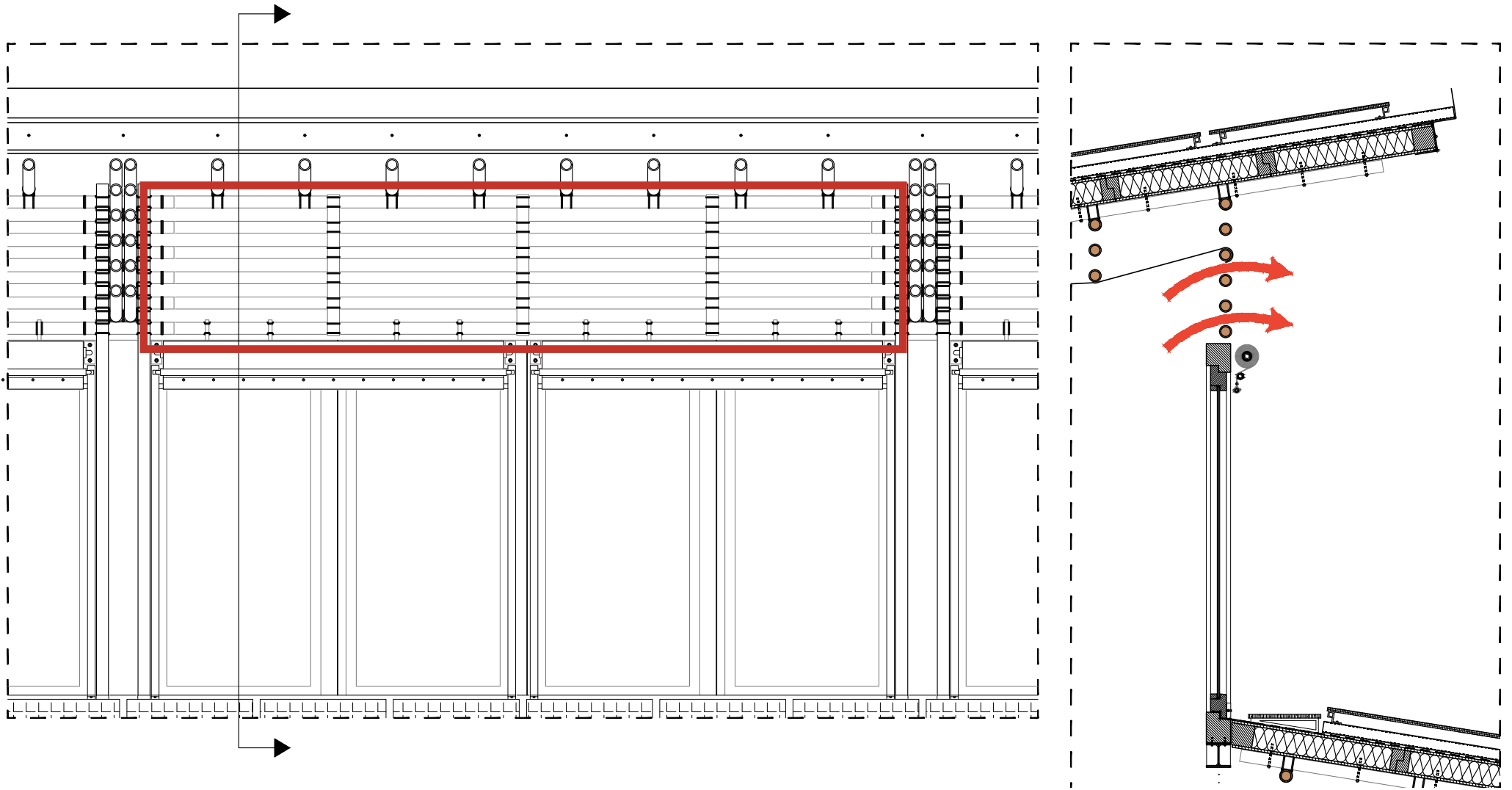
prevailing wind directions in Bandung: SSE and ENE

THERMAL COMFORT



hot air escape via roof openings

THERMAL COMFORT

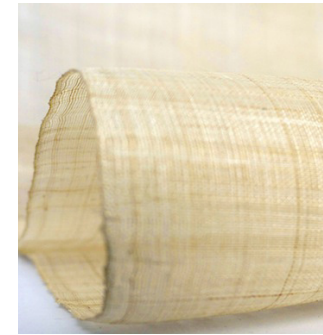
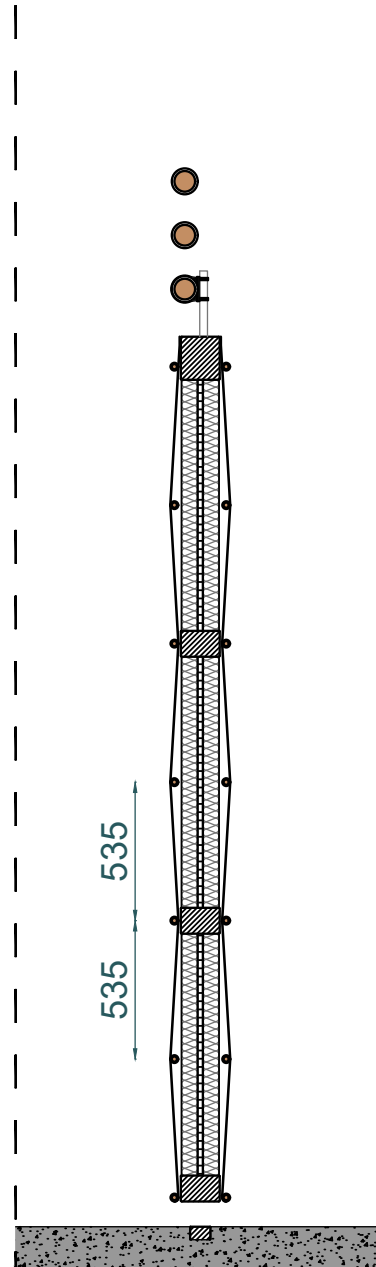


hot air escape via roof openings

ACOUSTICS

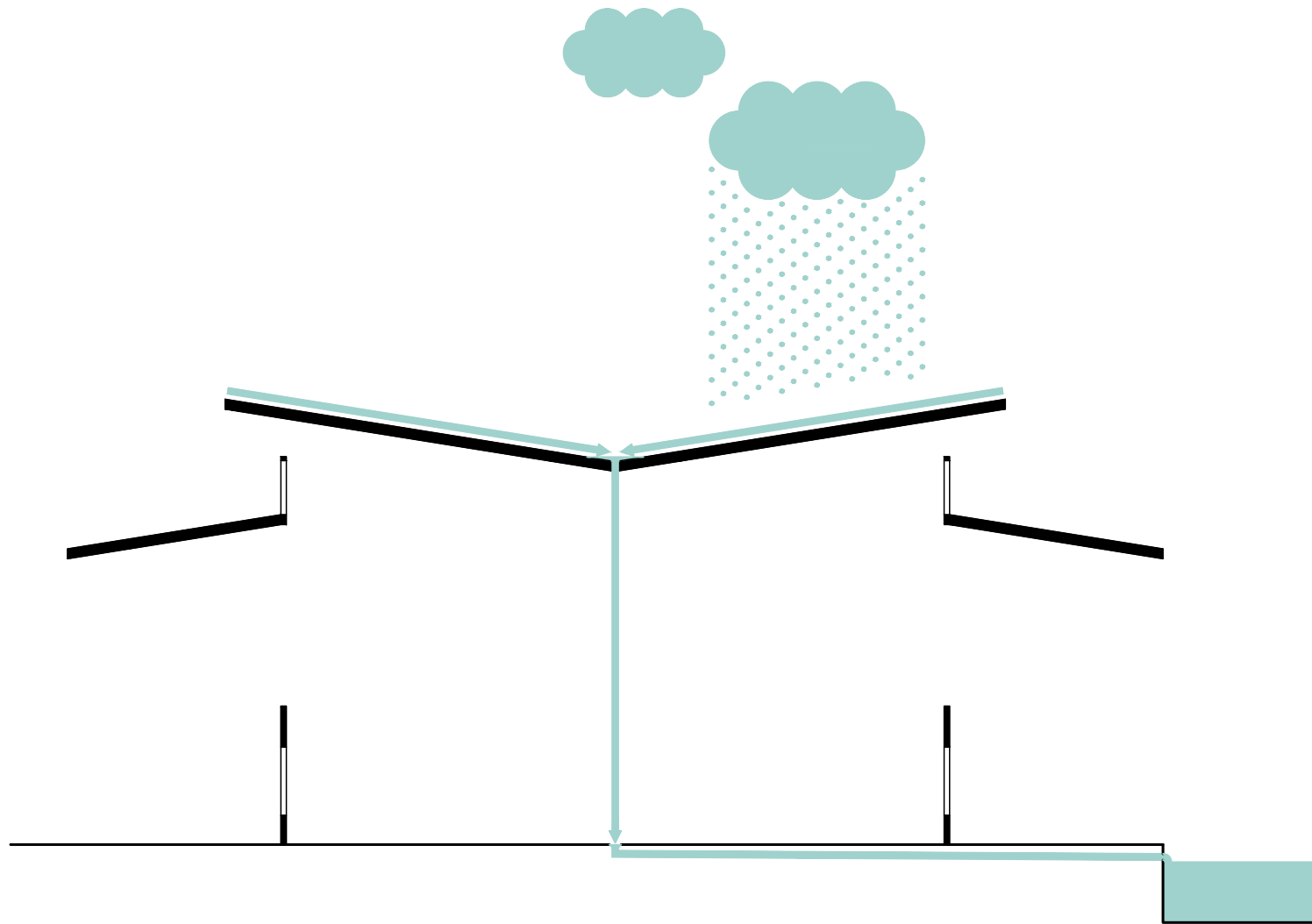


insulation - natural coconut fiber



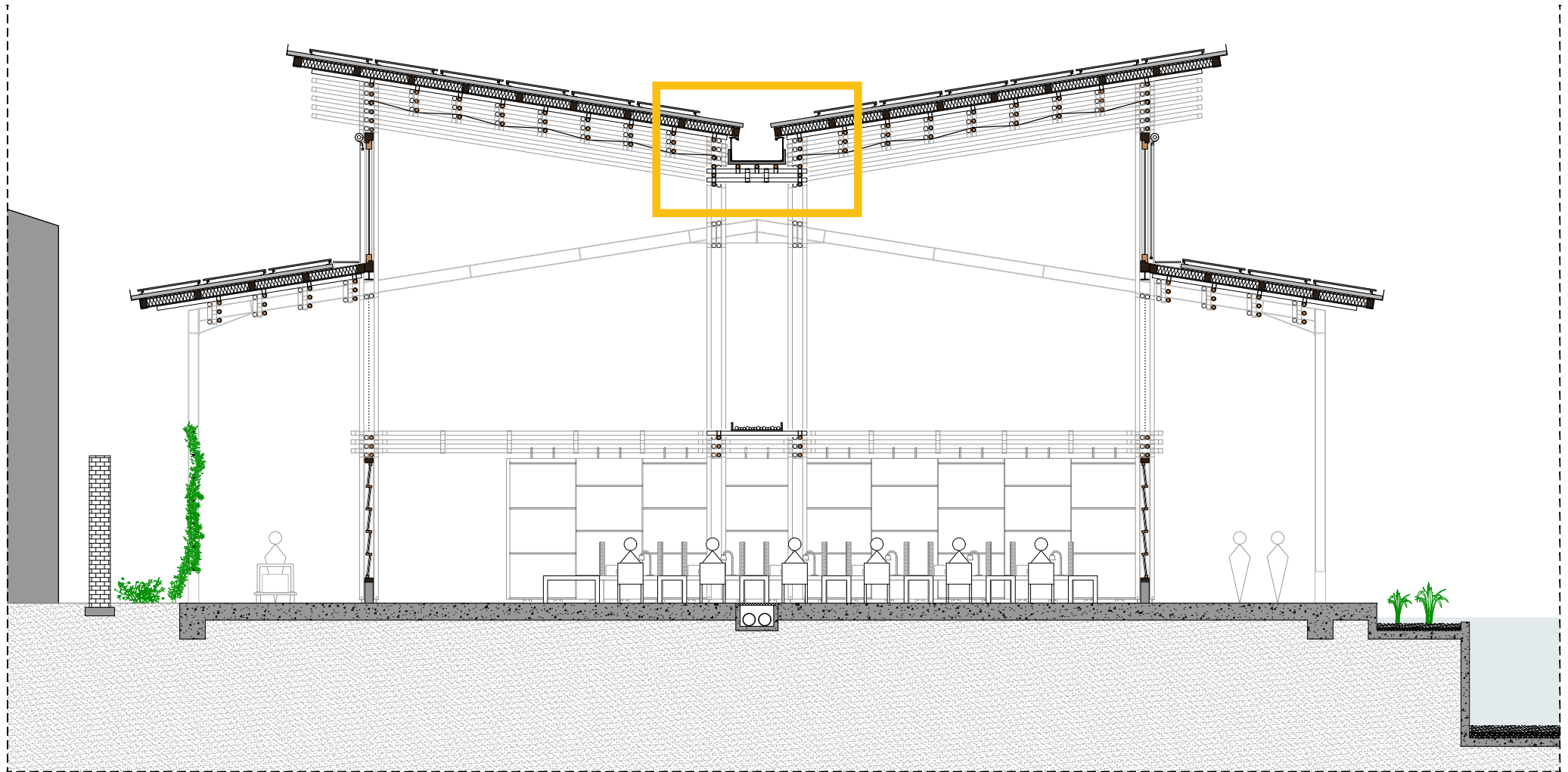
banana fabric, dyed with turmeric

HARVESTING RAINWATER



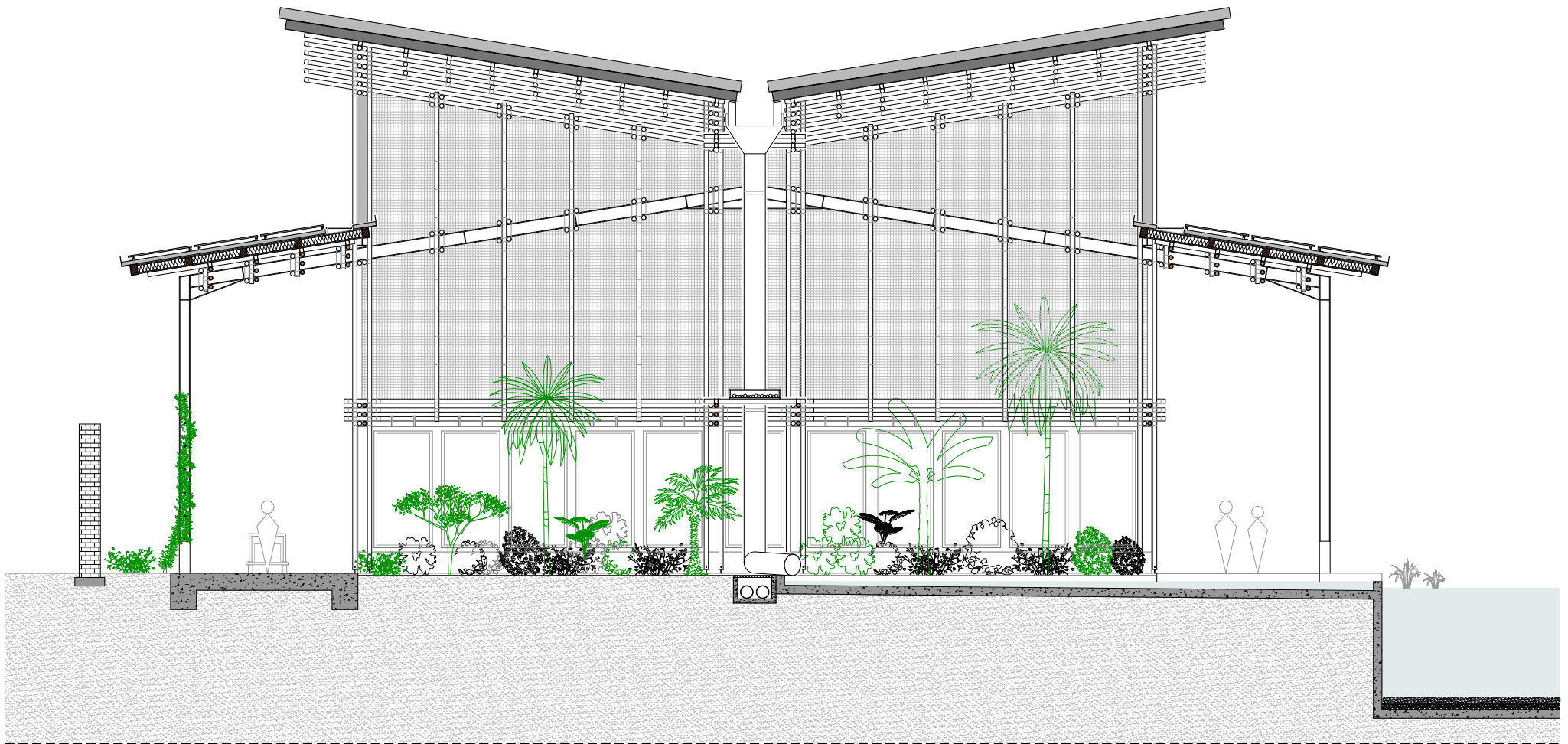
collecting rainwater

HARVESTING RAINWATER



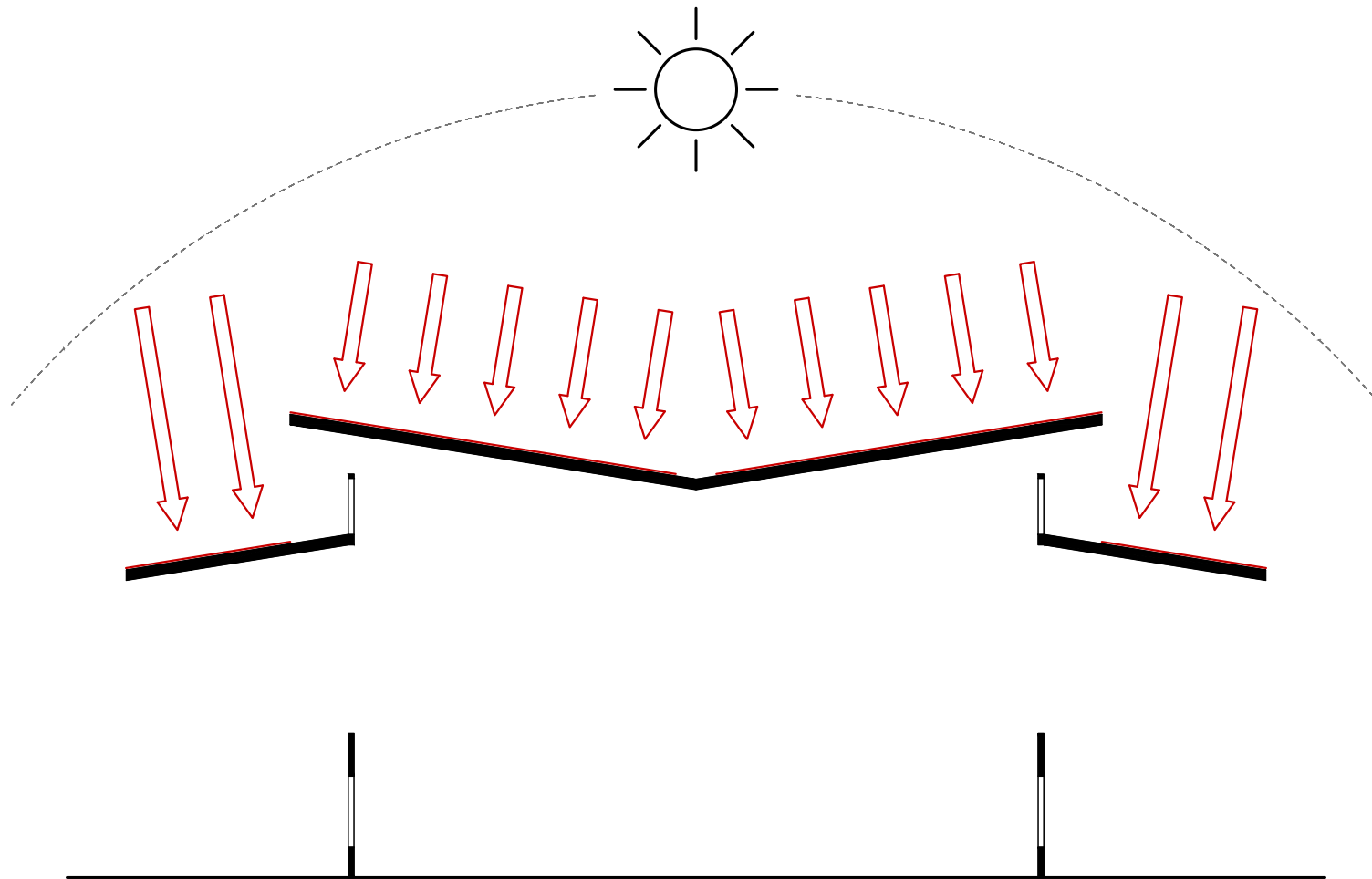
service zone | gutter

HARVESTING RAINWATER



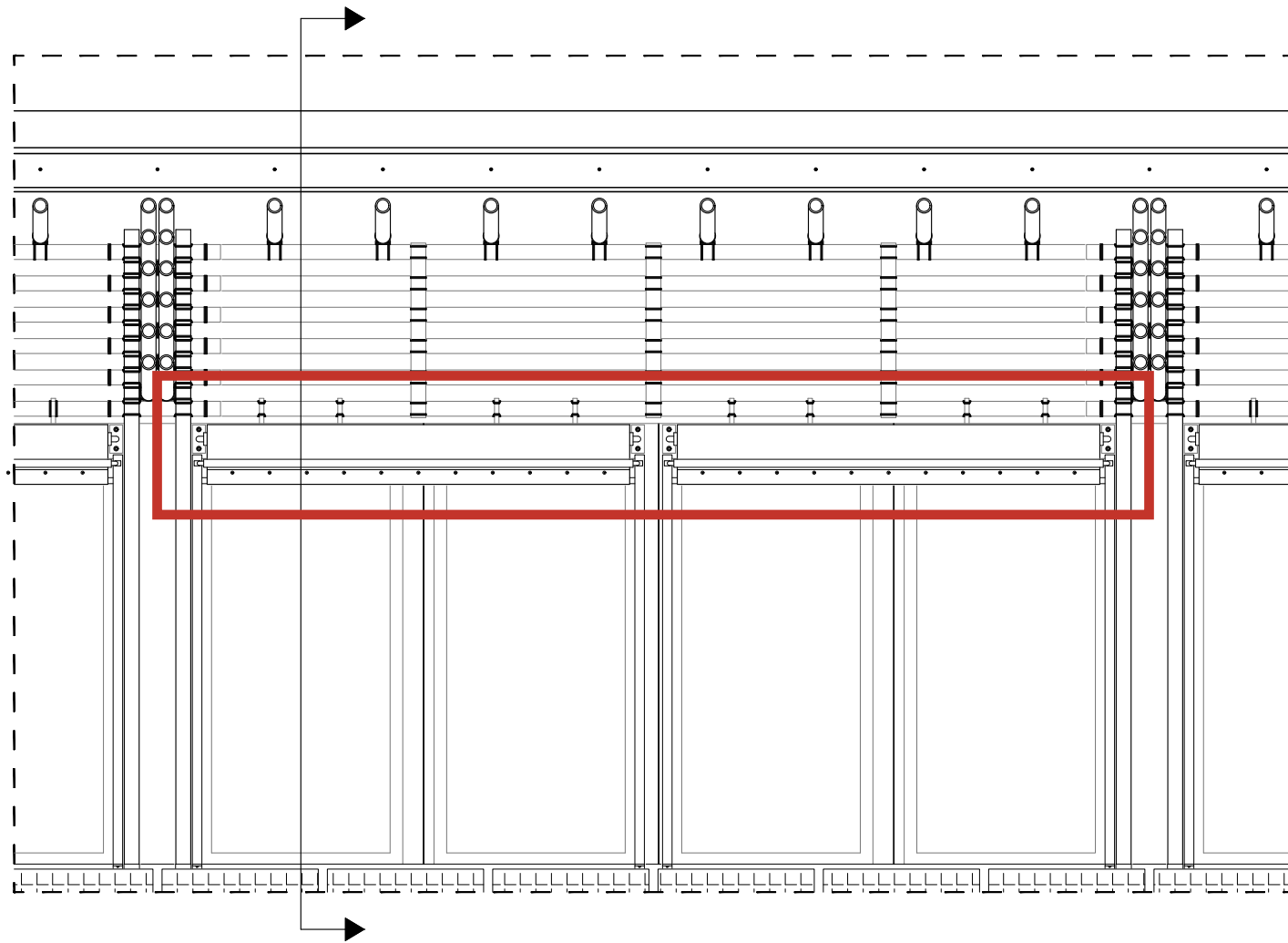
drainage via patio to water basin

ENERGY PRODUCTION

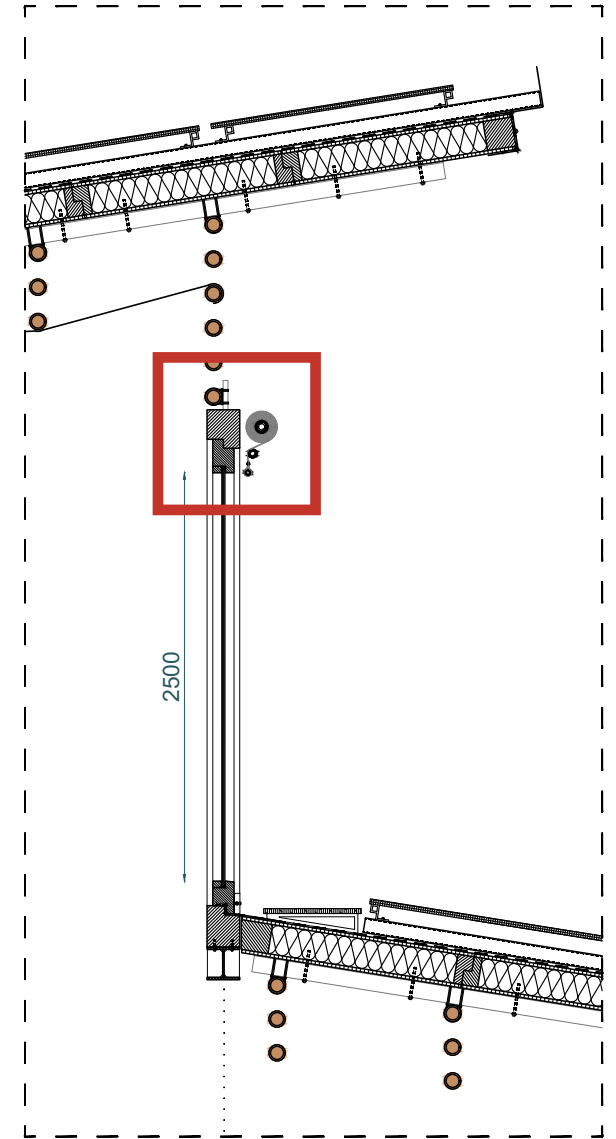


pv-panels give 316455 kWh/year (= 47 Dutch households)

LIGHTING



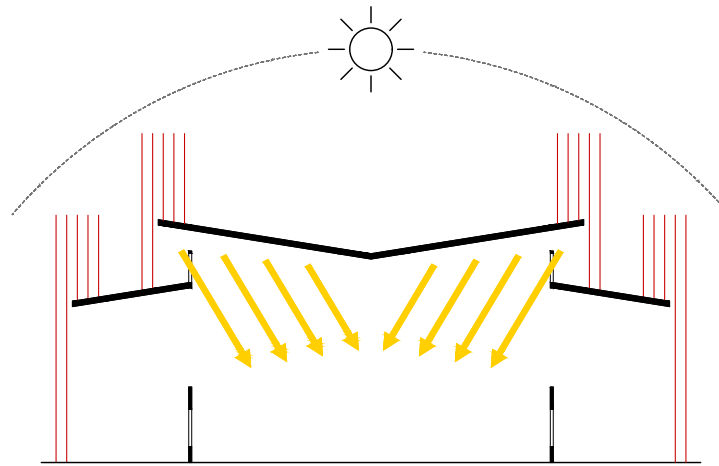
sunshading system



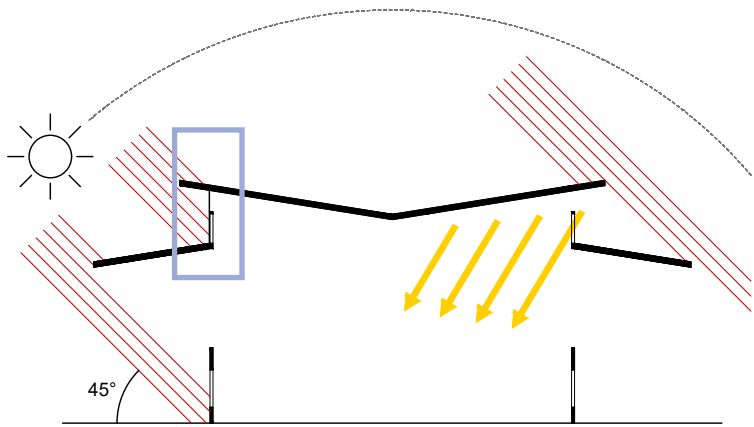
ACOUSTICS

acoustic ceiling panels

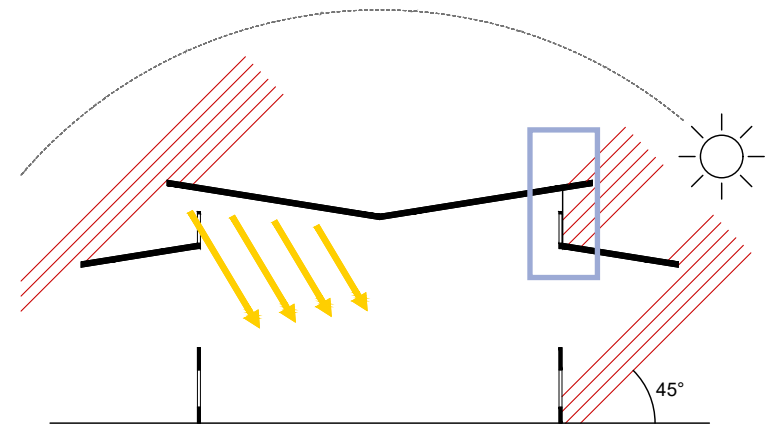
DAYLIGHT



13.00 p.m.



16.00 a.m.



10.00 a.m.

sunpath

INTRODUCTION

the fashion industry

problem statement

context

research

objective

DESIGN

site

guidelines

layout

construction

elements

CONCLUSION

CONCLUSION

Where would you like to work?

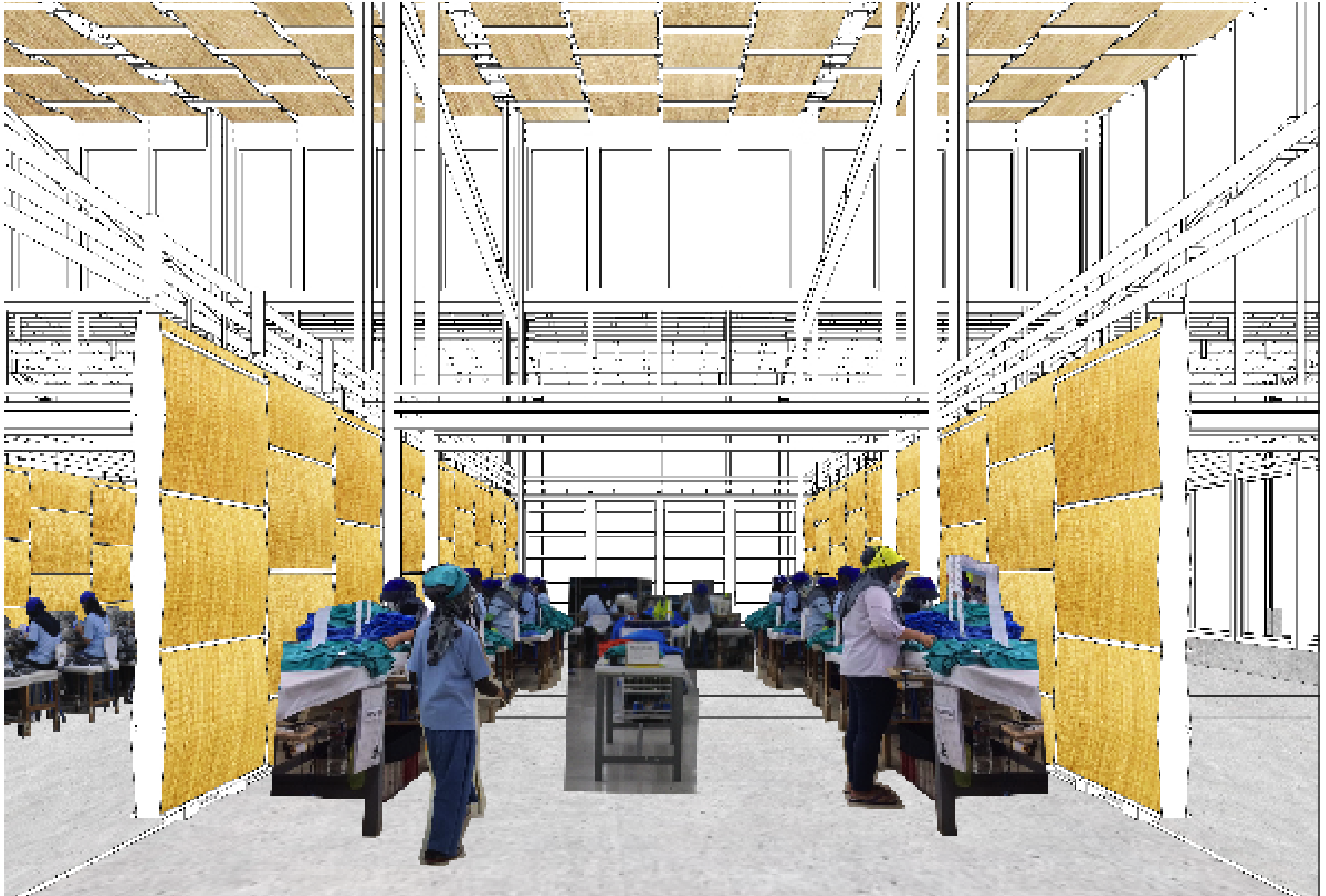


















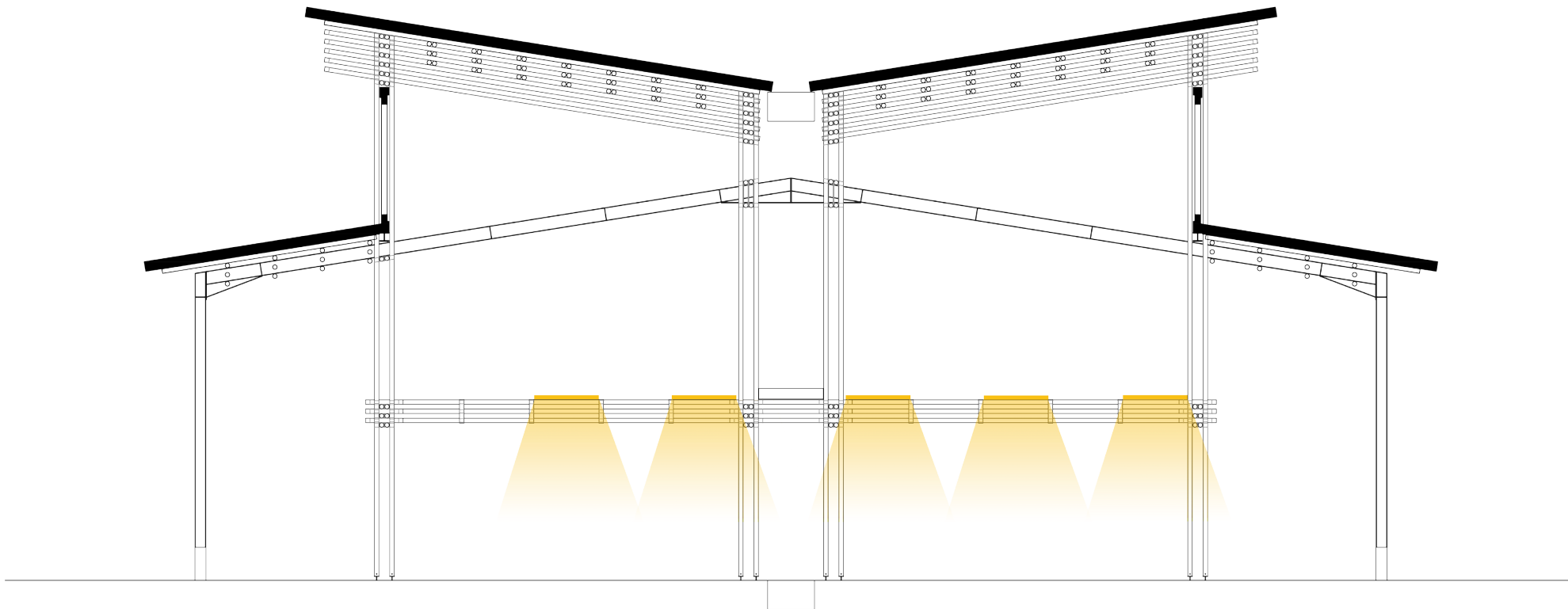






THANK YOU!

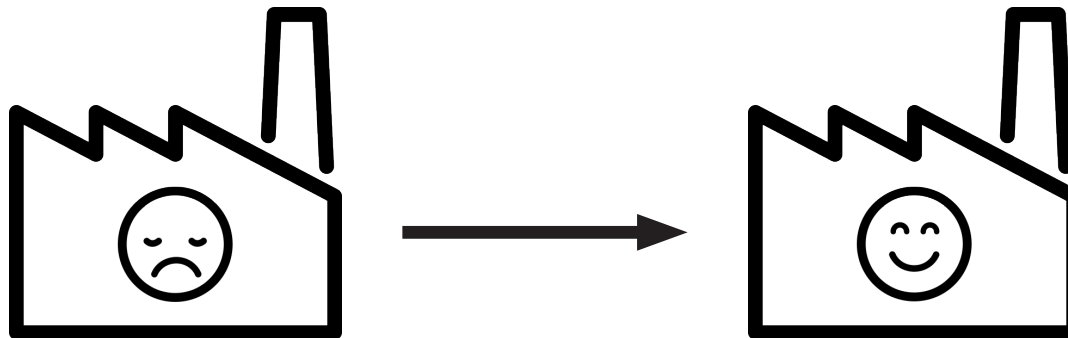
CONSTRUCTION



service zone | artificial lighting

OVERALL DESIGN QUESTION

How can a sustainable vertically integrated clothing factory in Bandung provide a healthy and comfortable indoor environment for the workers by using passive building design strategies?



THEMATIC RESEARCH QUESTION

What passive building design strategies are suitable to create a healthy and comfortable indoor environment in a garment factory located in the tropical climate of Bandung?

What (1) passive building design strategies are suitable to create a healthy and comfortable (2) indoor environment in a garment factory located in the tropical (3) climate of Bandung?

total:

12.000m² production garden

850m² factory

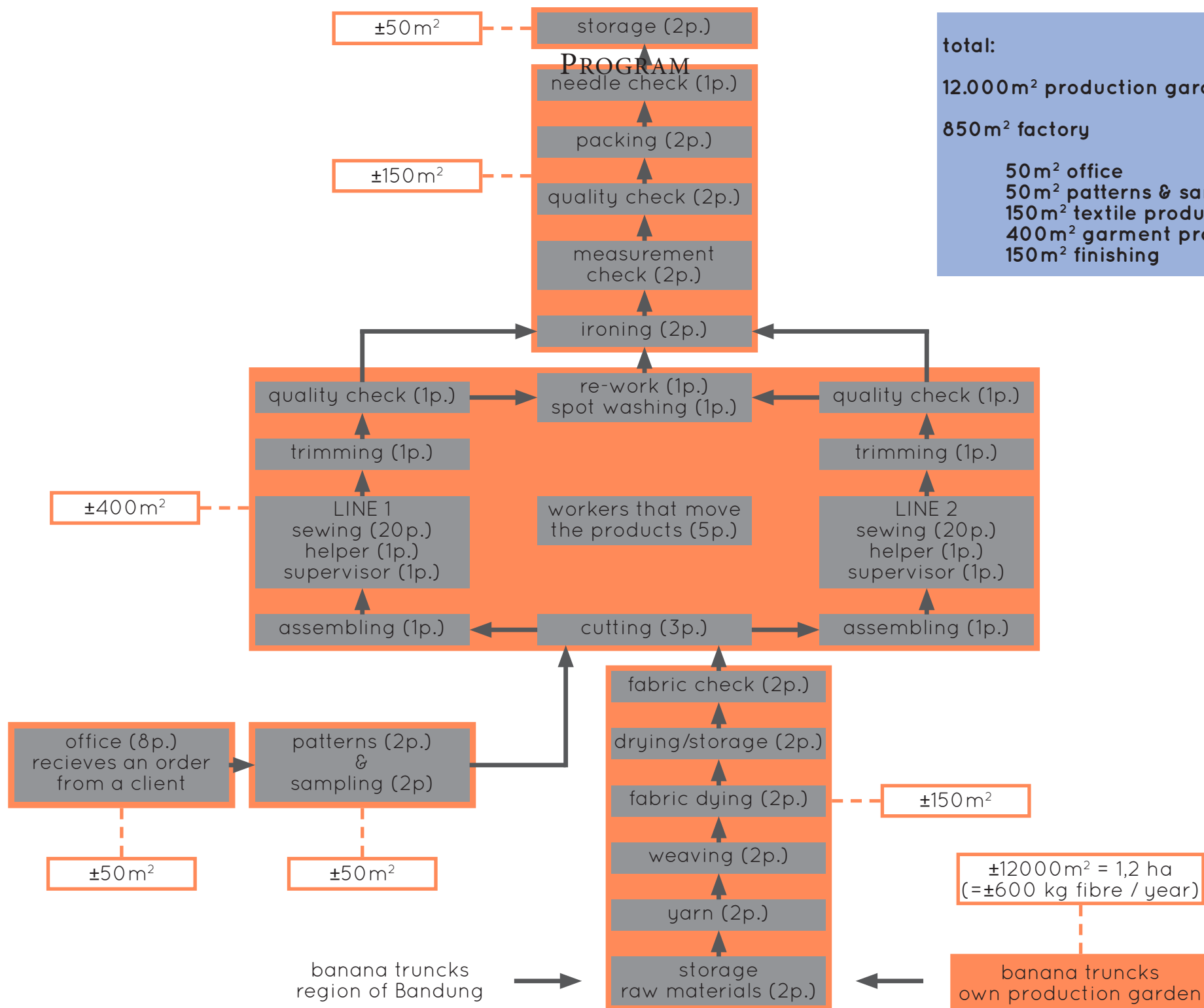
50m² office

50m² patterns & sampling

150m² textile production

400m² garment production

150m² finishing



ROOF

large roof area in Tropical Climate

=

challenges + opportunities

with regards to:

1.

healthy & comfortable indoor environment

opportunity: lighting

- provide indoor space with daylight

challenge: thermal comfort

- keep direct sunlight out
- protect against high solar radiation

ROOF

large roof area in Tropical Climate

=

challenges + opportunities

with regards to:

1.

healthy & comfortable indoor environment

2.

suitable passive building design strategies

opportunities

- protect facade against direct sunlight
- stimulate natural ventilation
- hot air escape the building via roof openings

ROOF

large roof area in Tropical Climate

=

challenges + opportunities

with regards to:

1.
healthy & comfortable indoor environment

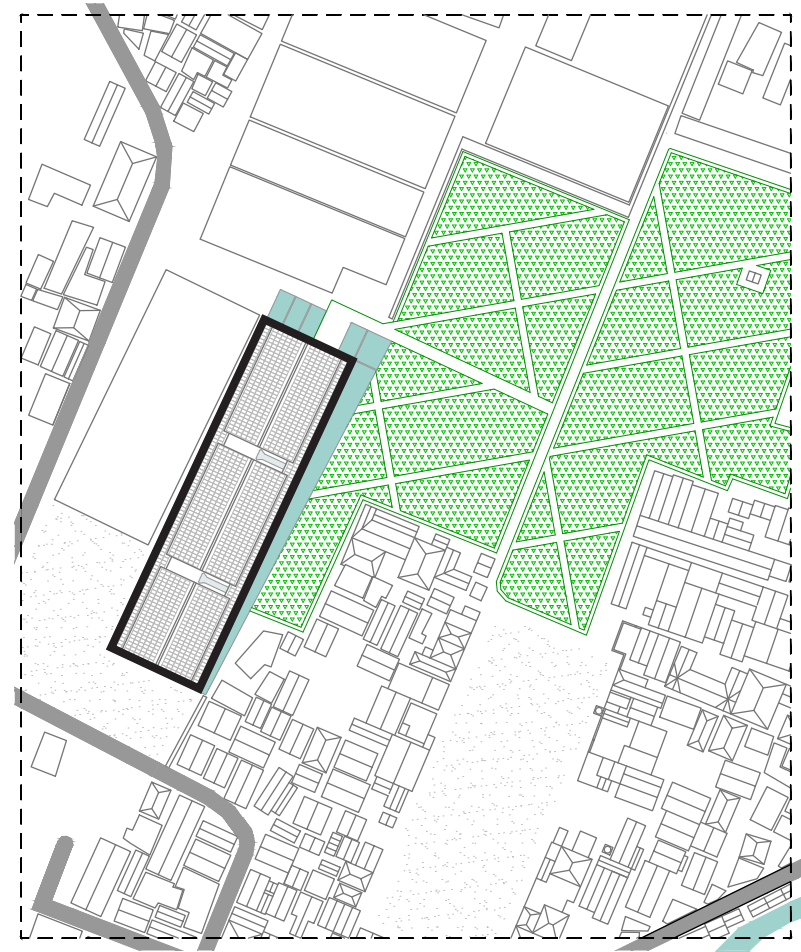
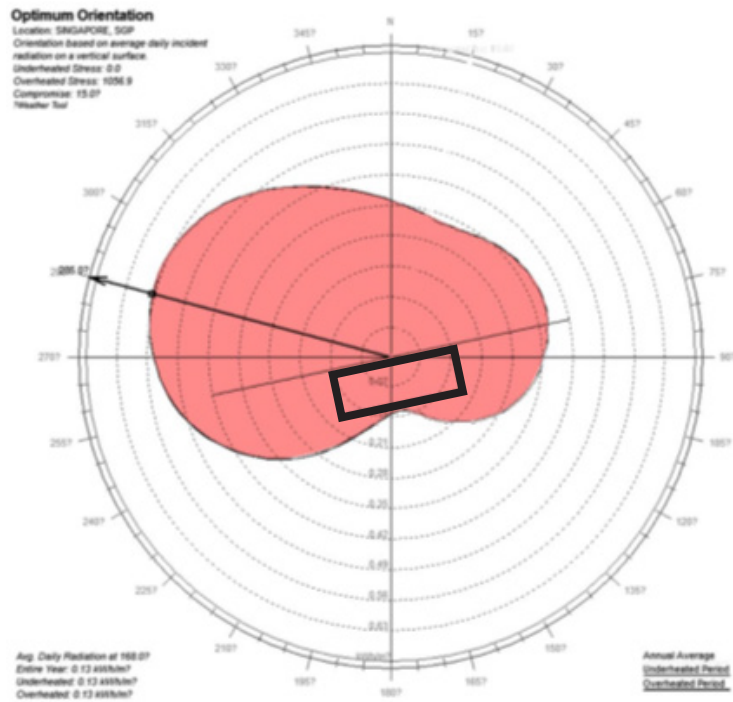
2.
suitable passive building design strategies

3.
sustainability

opportunities

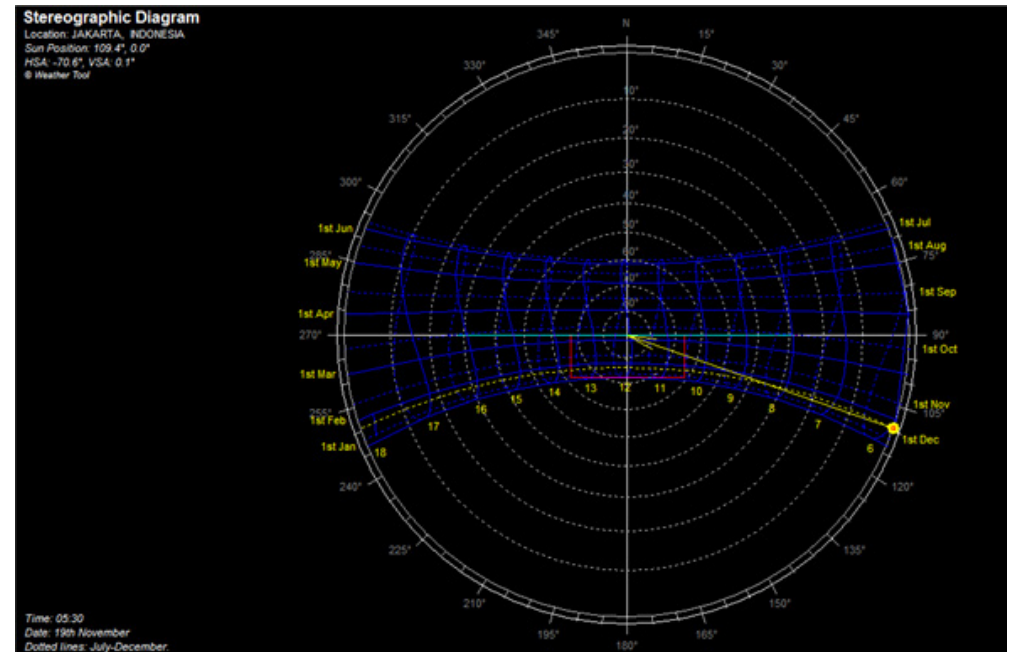
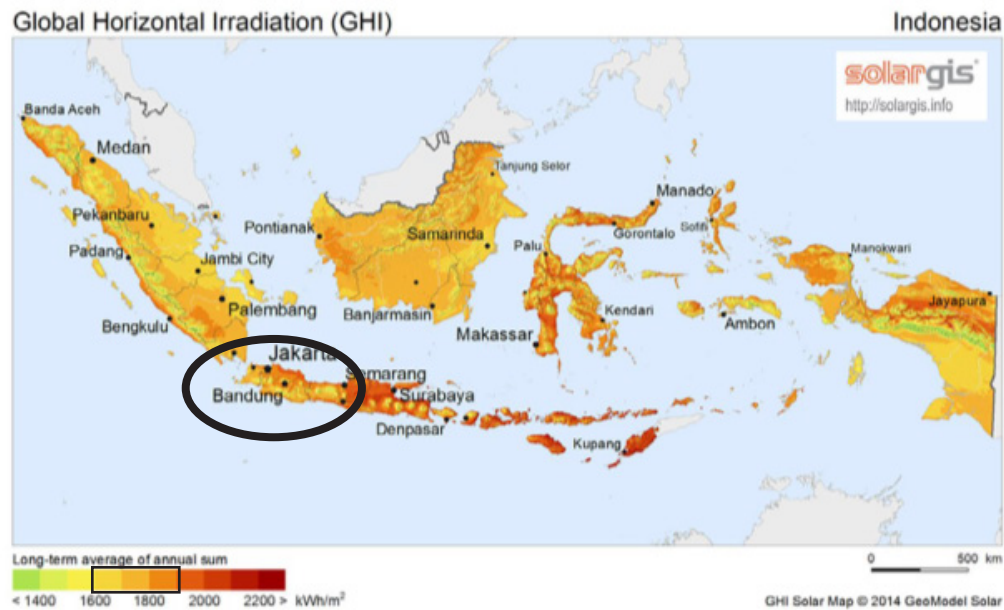
- energy production
- lower energy use on artificial lighting (daylight)
- harvesting rainwater

THERMAL COMFORT



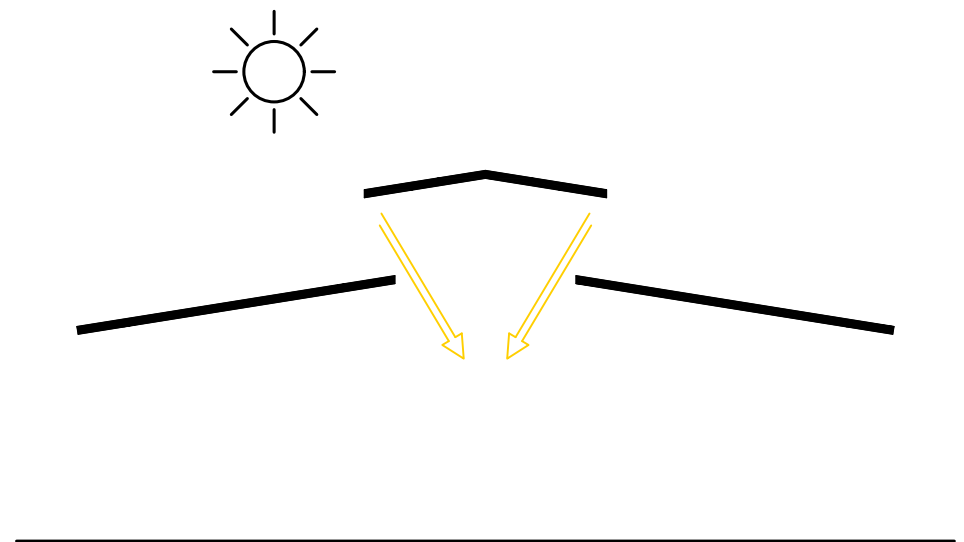
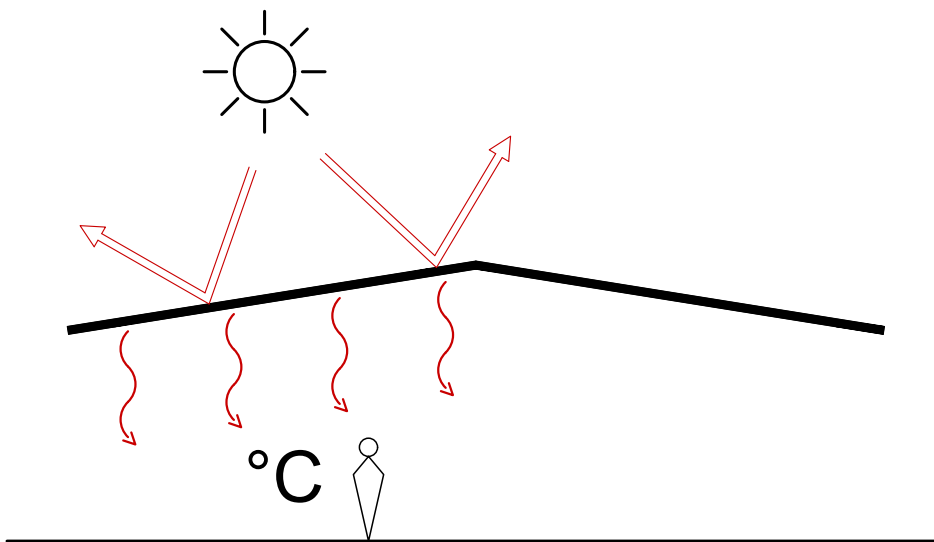
optimal orientation versus orientation of factory

THERMAL COMFORT

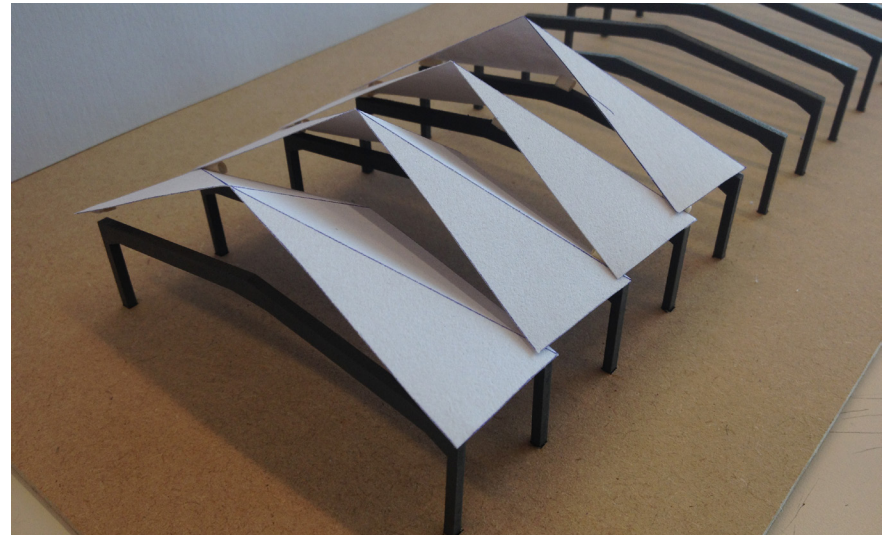
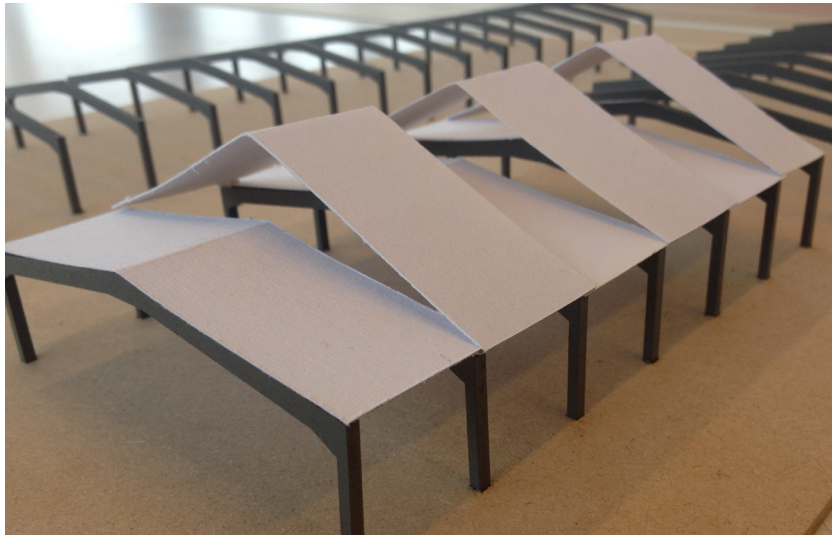
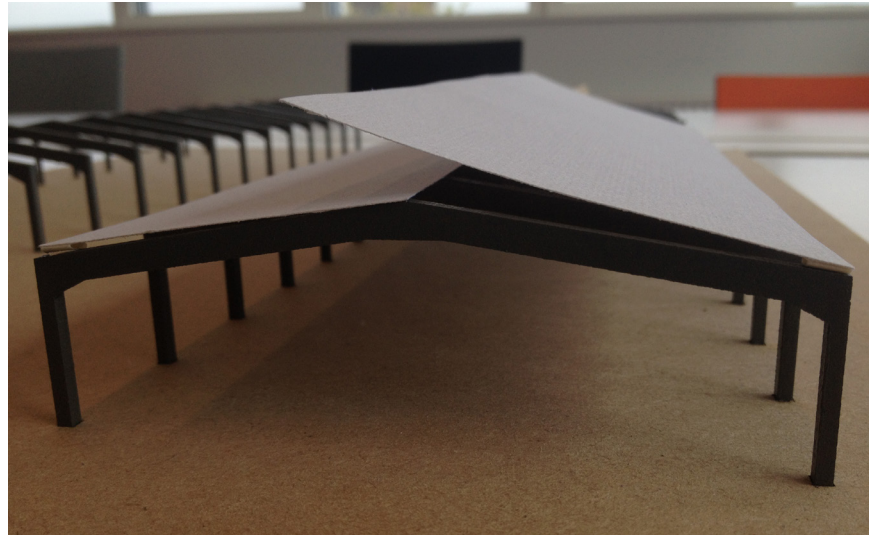


solar radiation and sunpath

roof design:
finding the right **balance**
between **open** and **closed**...

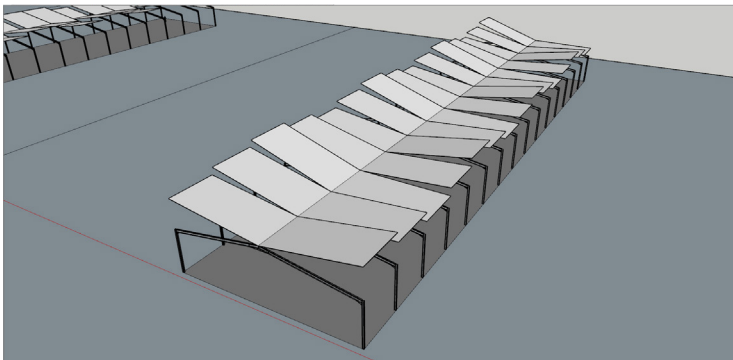
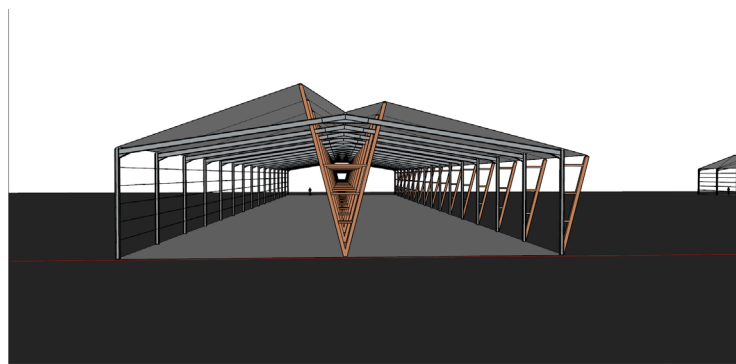
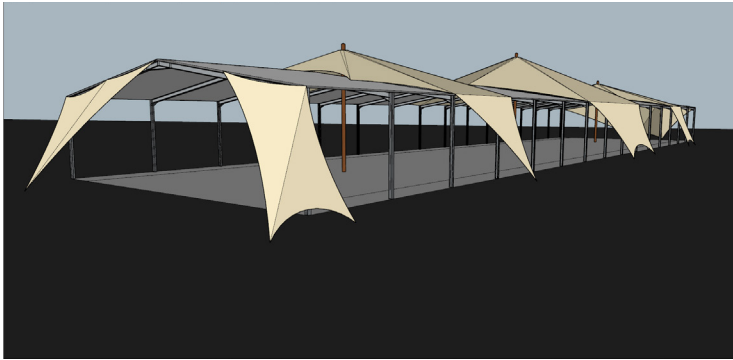


ROOF



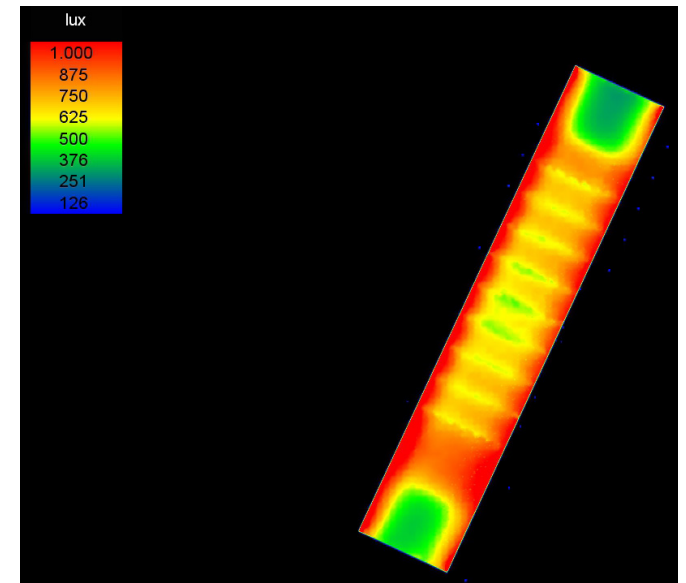
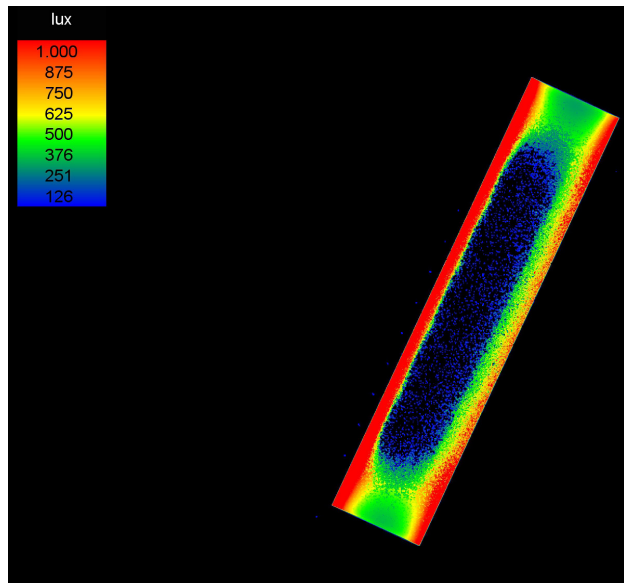
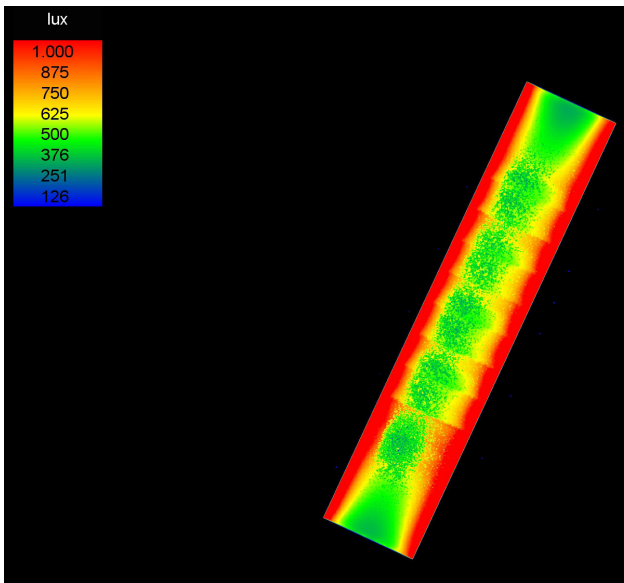
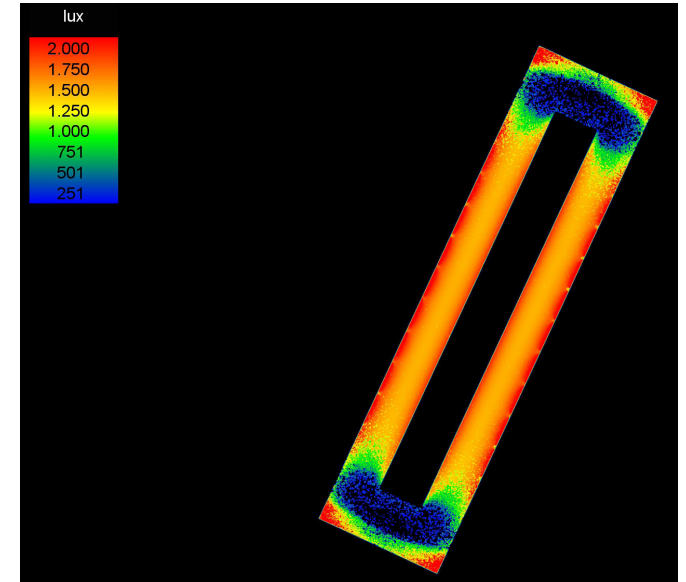
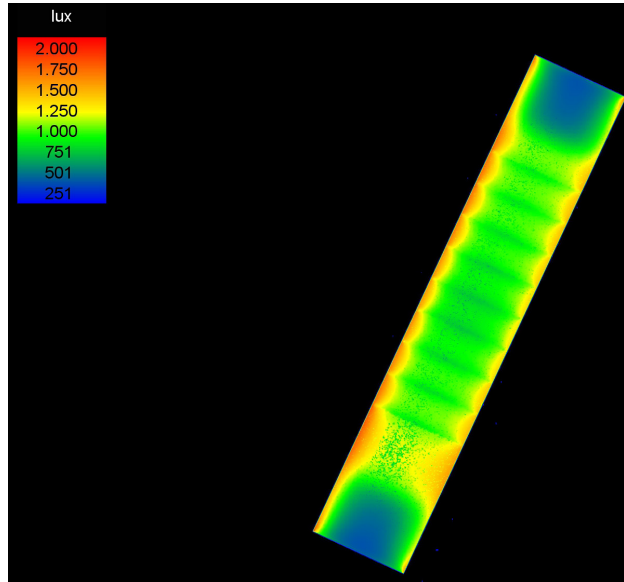
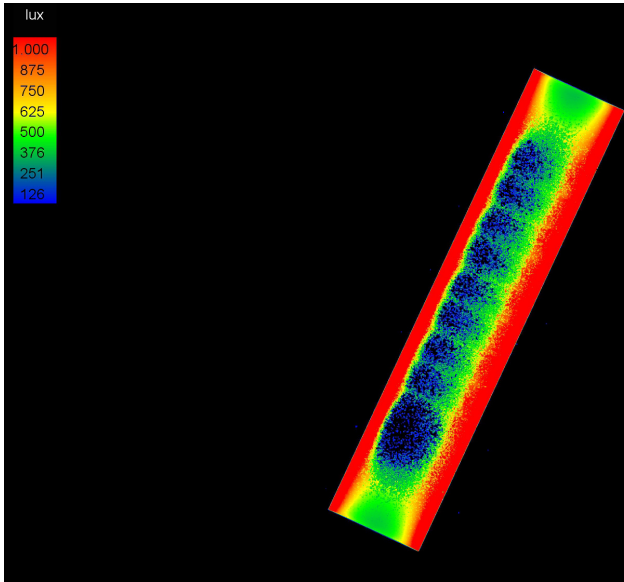
roof studies | models

ROOF



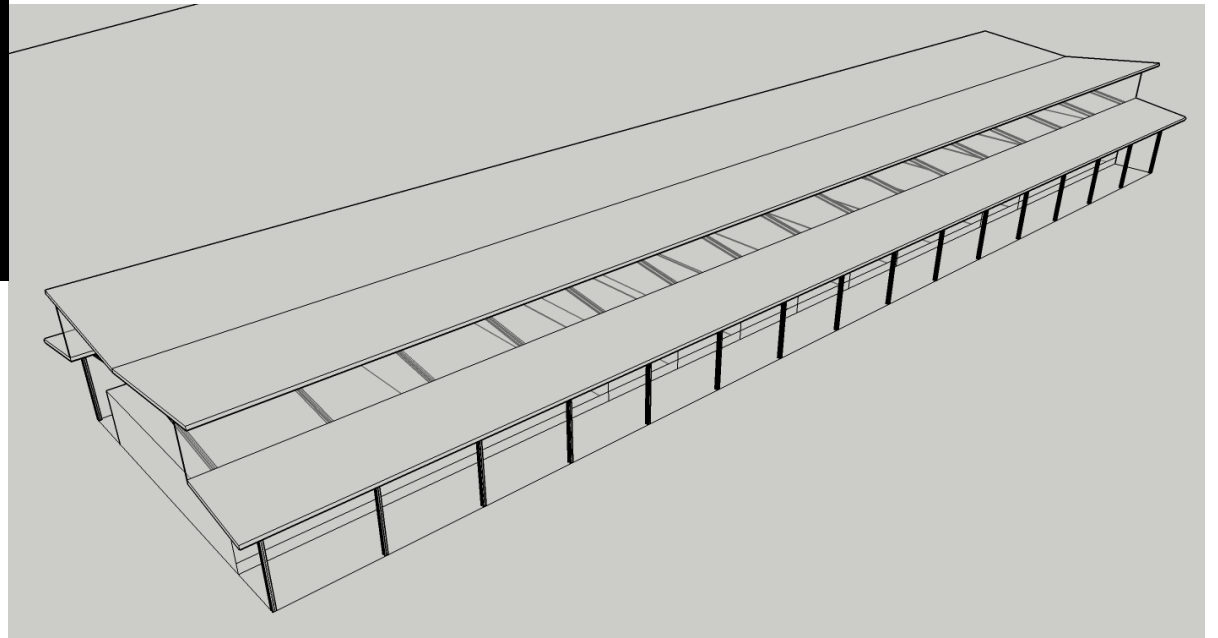
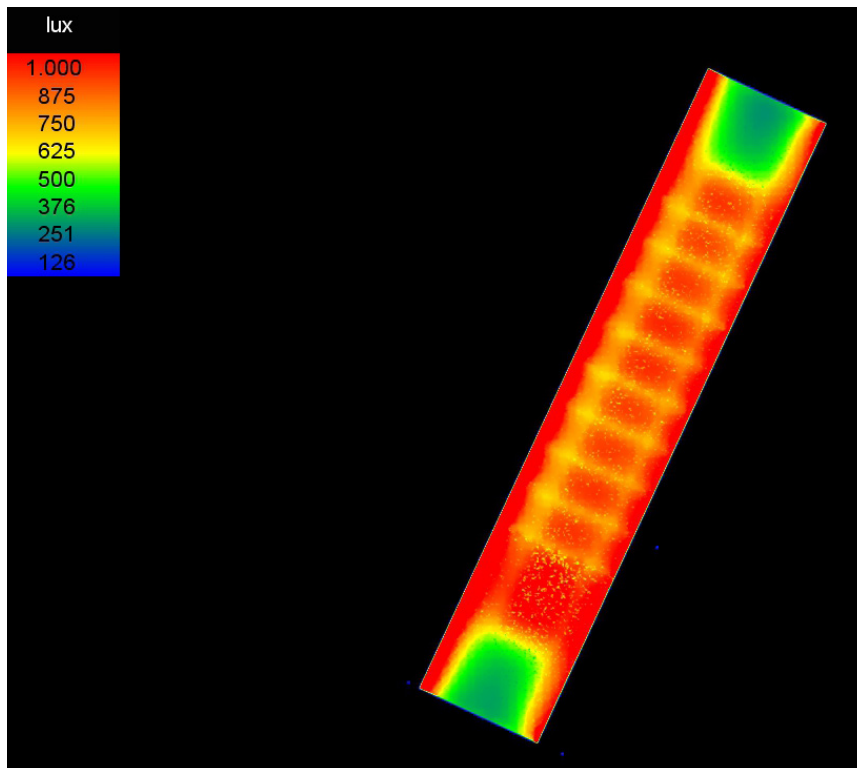
roof studies | computer models

ROOF



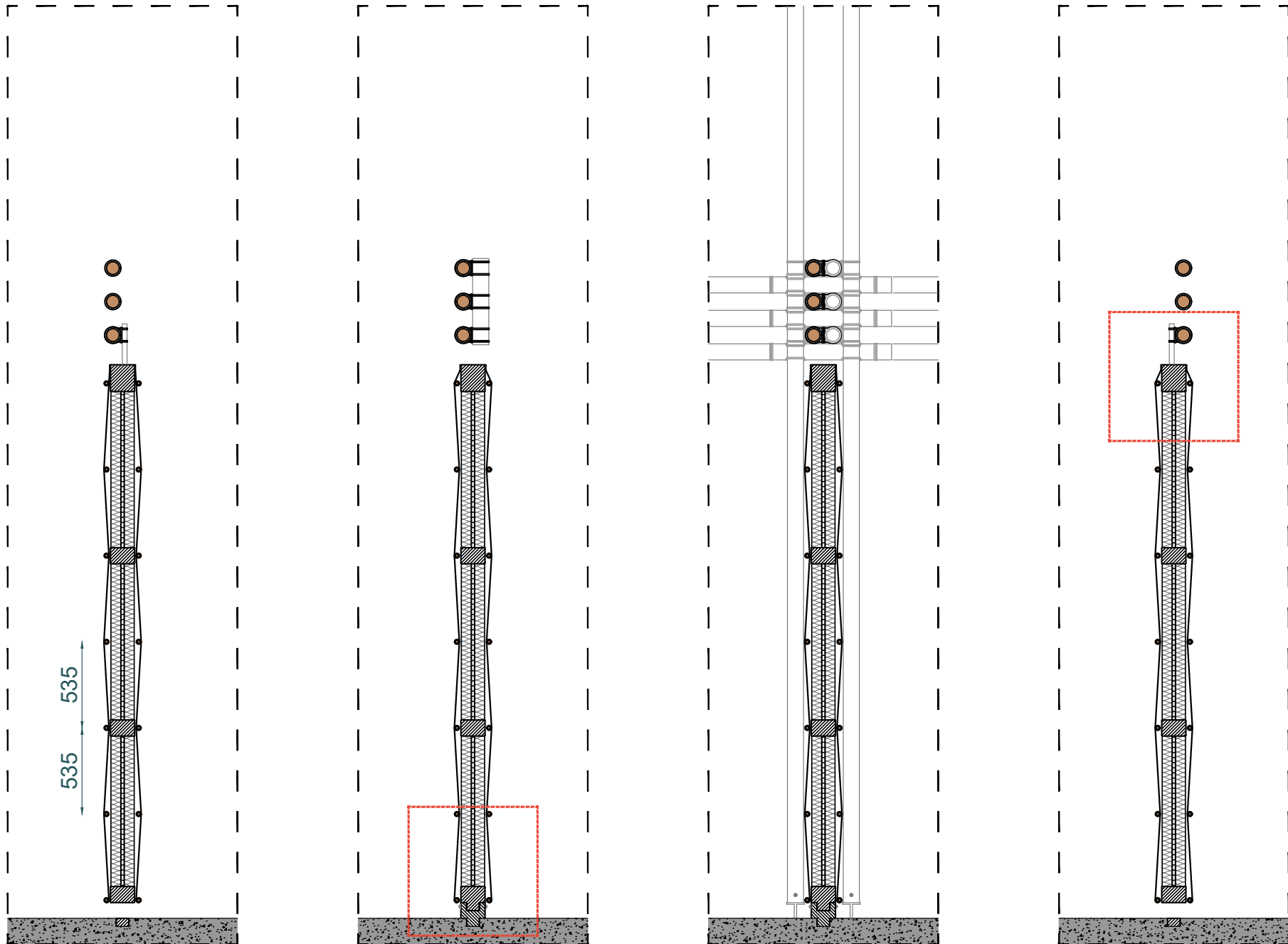
roof studies | daylight simulation (VELUX)

ROOF

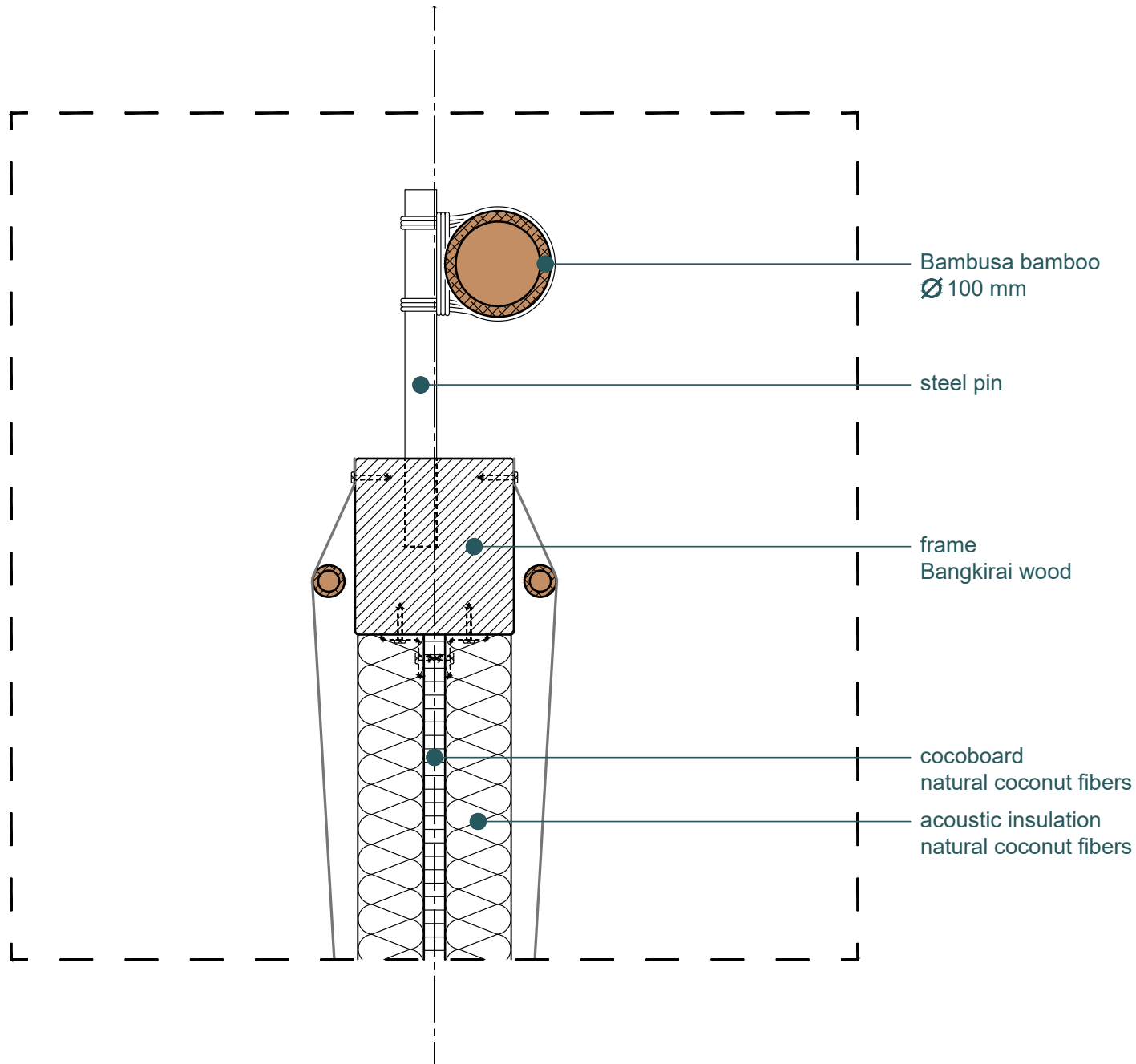


roof studies | daylight simulation (VELUX)

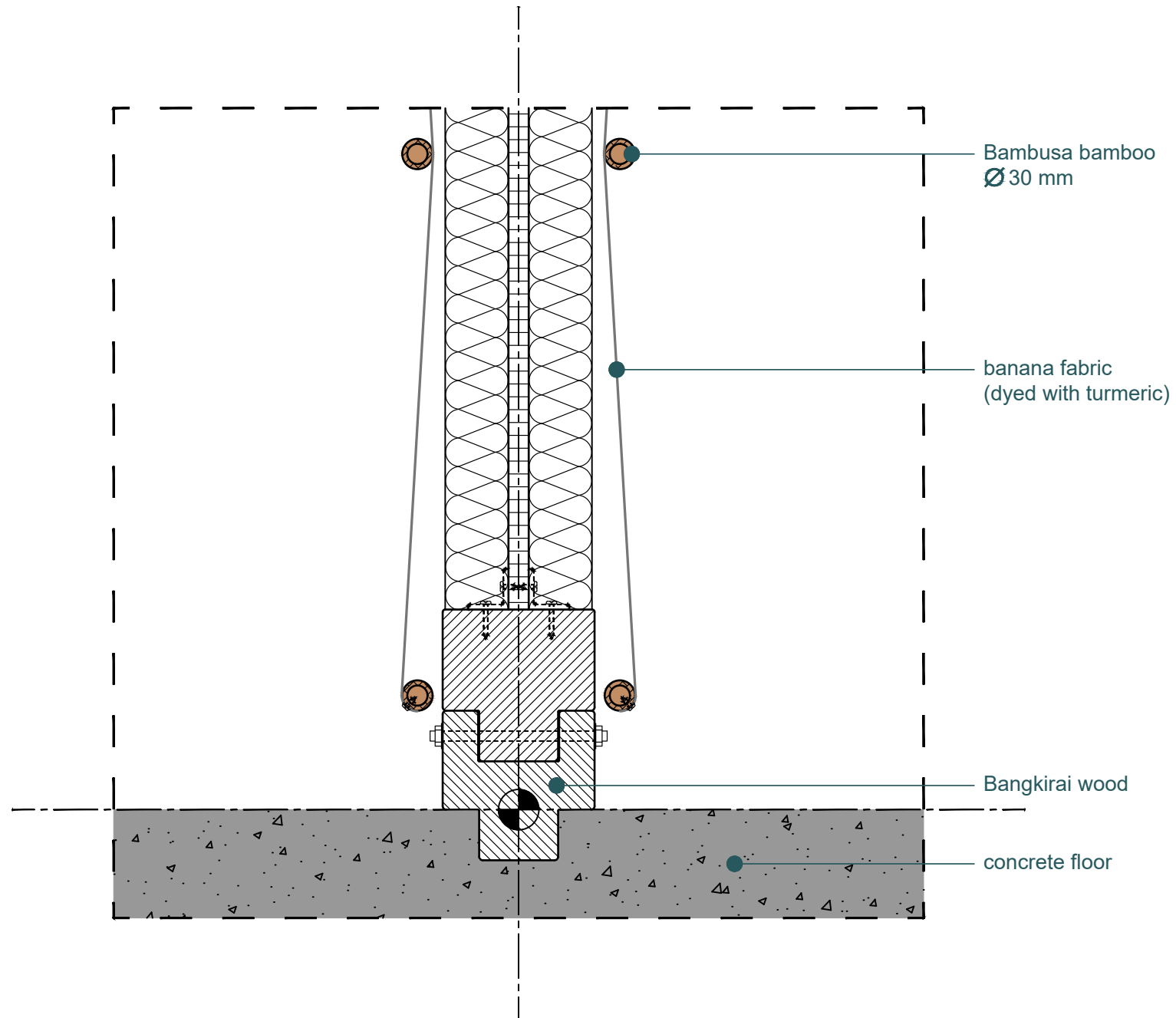
ACOUSTICS



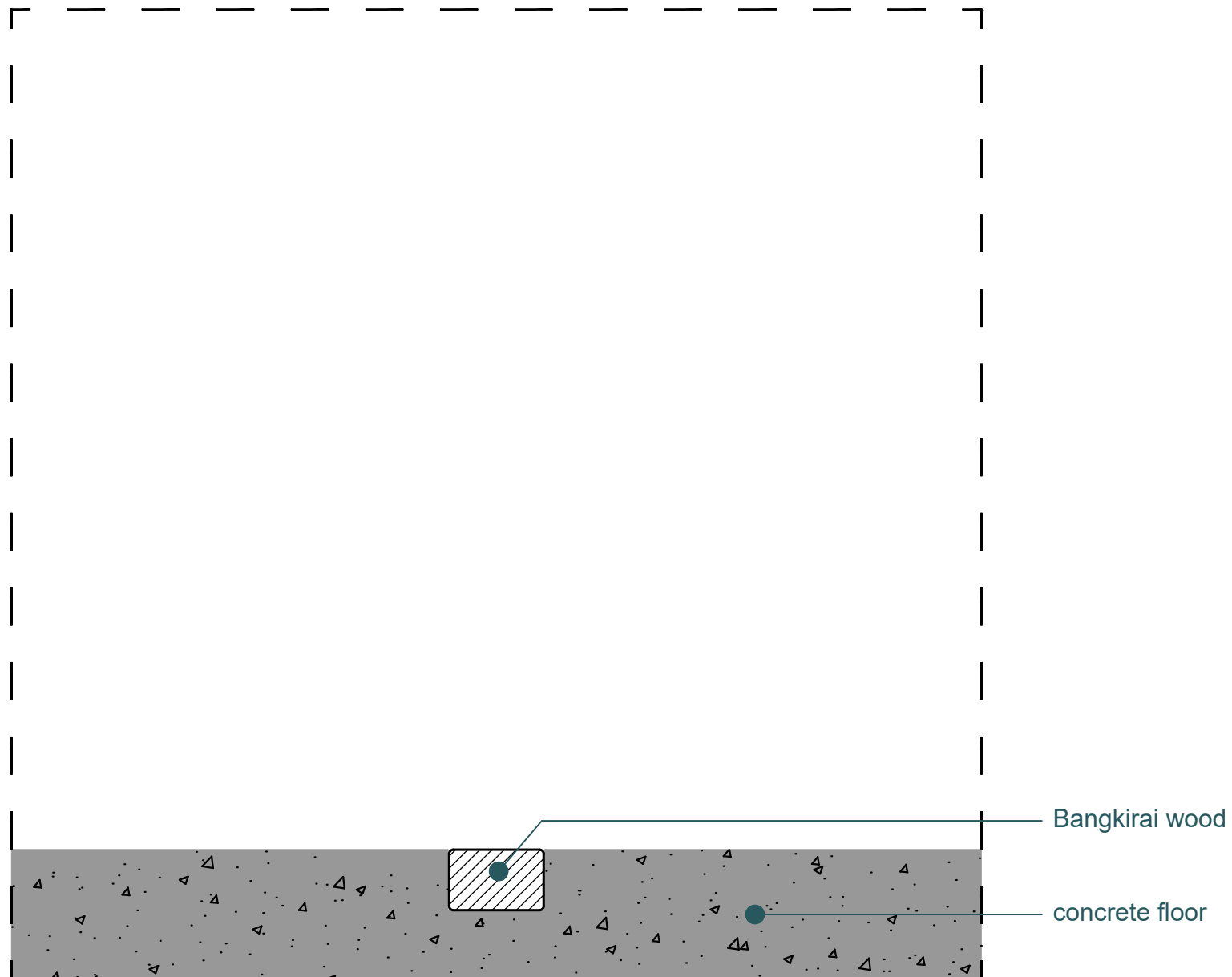
ACOUSTICS



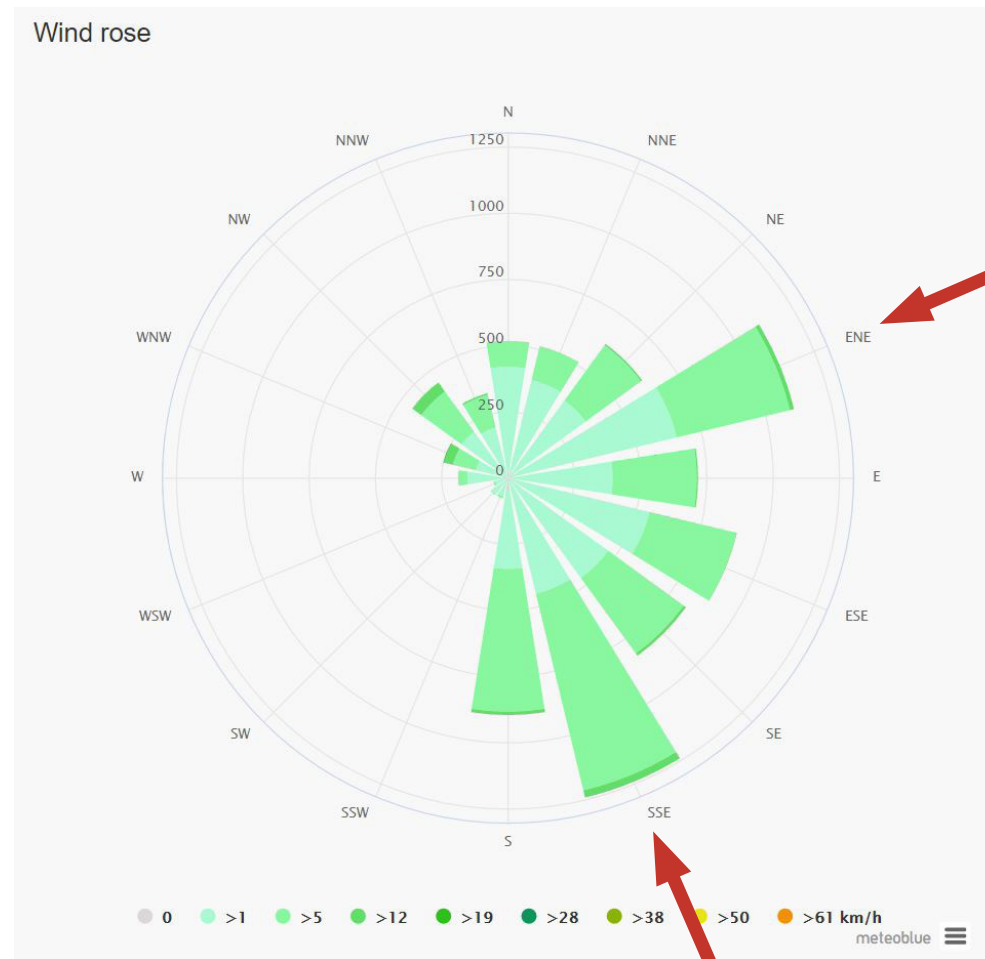
ACOUSTICS



ACOUSTICS

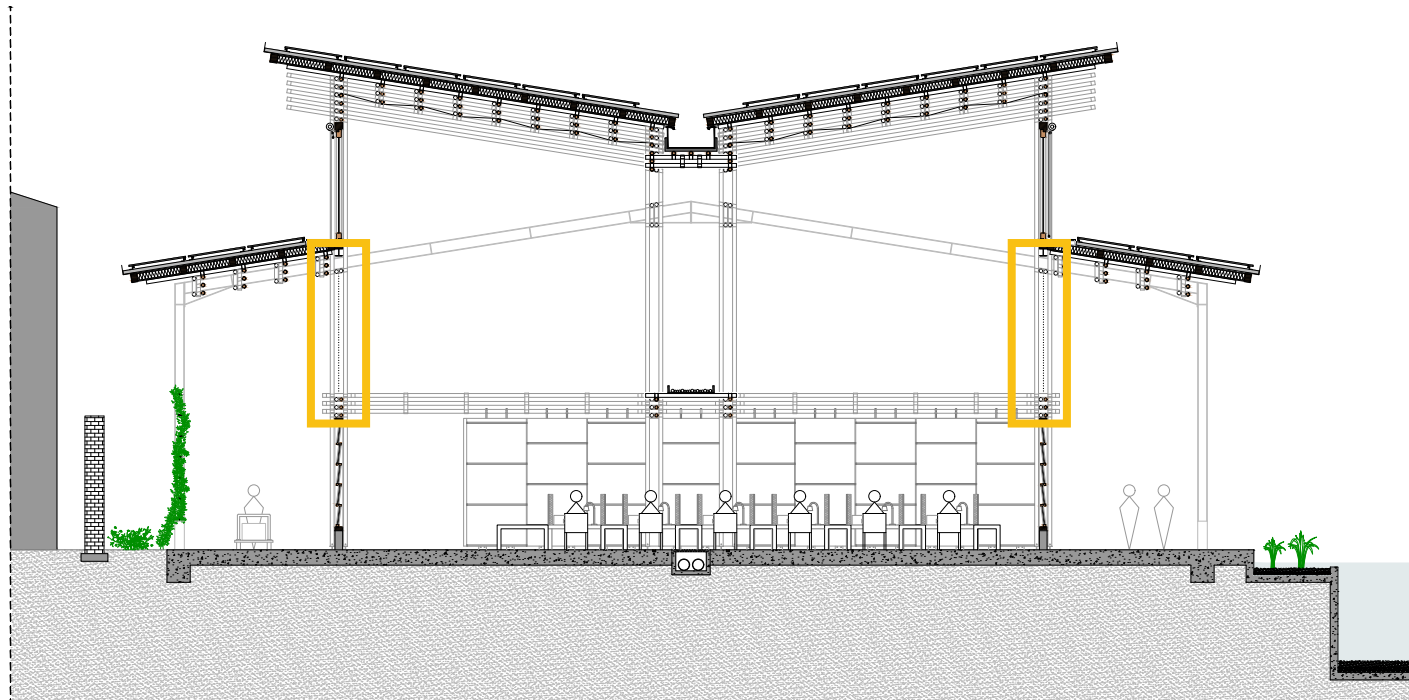
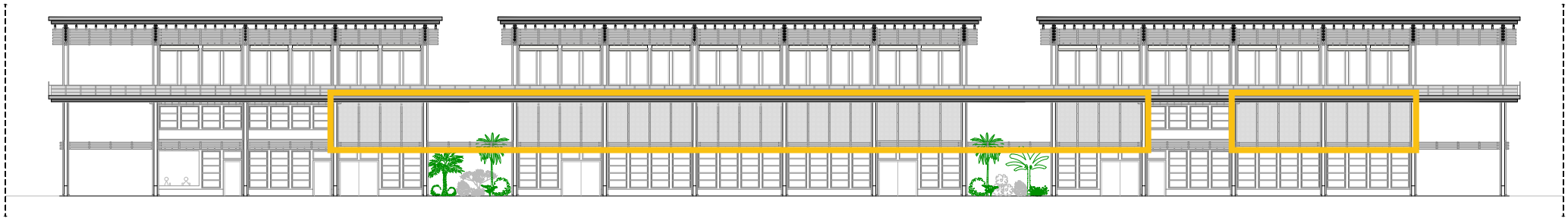


DESIGN GUIDELINES



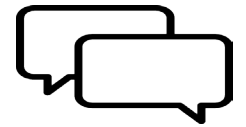
prevailing wind directions in Bandung: SSE and ENE

VENTILATION

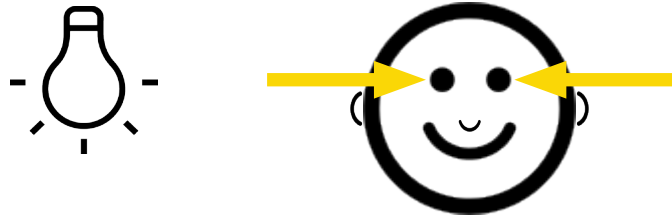


half open facade (banana fabric mesh)

INDOOR ENVIRONMENT



1. How is the lighting for you?



Good



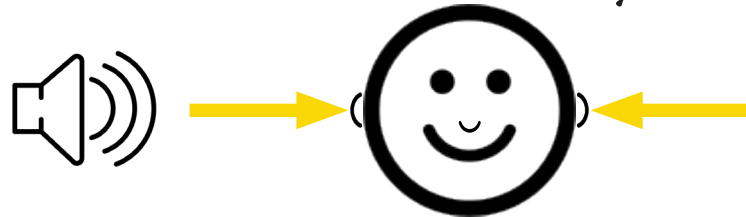
Ok



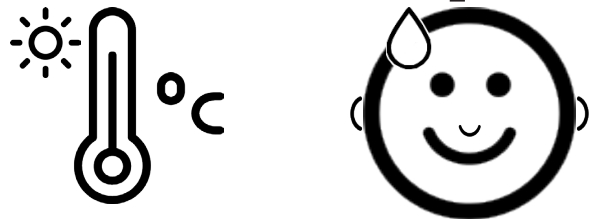
Bad



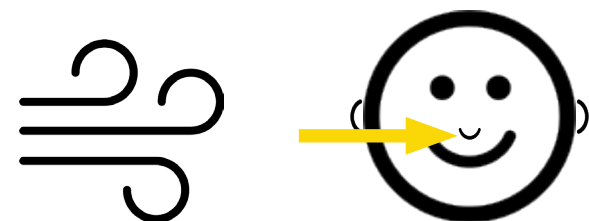
2. How is the noise for you?



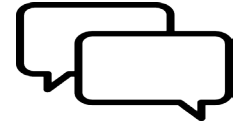
3. How is the temperature for you?



4. How is the air quality for you?



INDOOR ENVIRONMENT



1. For how many years do you work in the factory?
2. How many hours a day do you work in the factory?
3. Do you feel chest tightness or breathing difficulty?
4. Do you have a blocked, stuffy or running nose in the factory?
5. Do you have a dry or irritated throat in the factory?
6. Do you have headaches / pain in your head in the factory?
7. Do you have any itch?
8. Do you have a rash or irritated skin in the factory?
9. Do you have dry skin in the factory?
10. Do you have pain in your ears?
11. Do you have pain in your eyes?
12. Do you have dry eyes when you are in the factory?
13. Do you have watering or itchy eyes in the factory?
14. Do you have flu-like symptoms in the factory?
15. Do you feel tired or sleepy in the factory?
16. Do you have other health-problems?
17. How do you sleep at night?

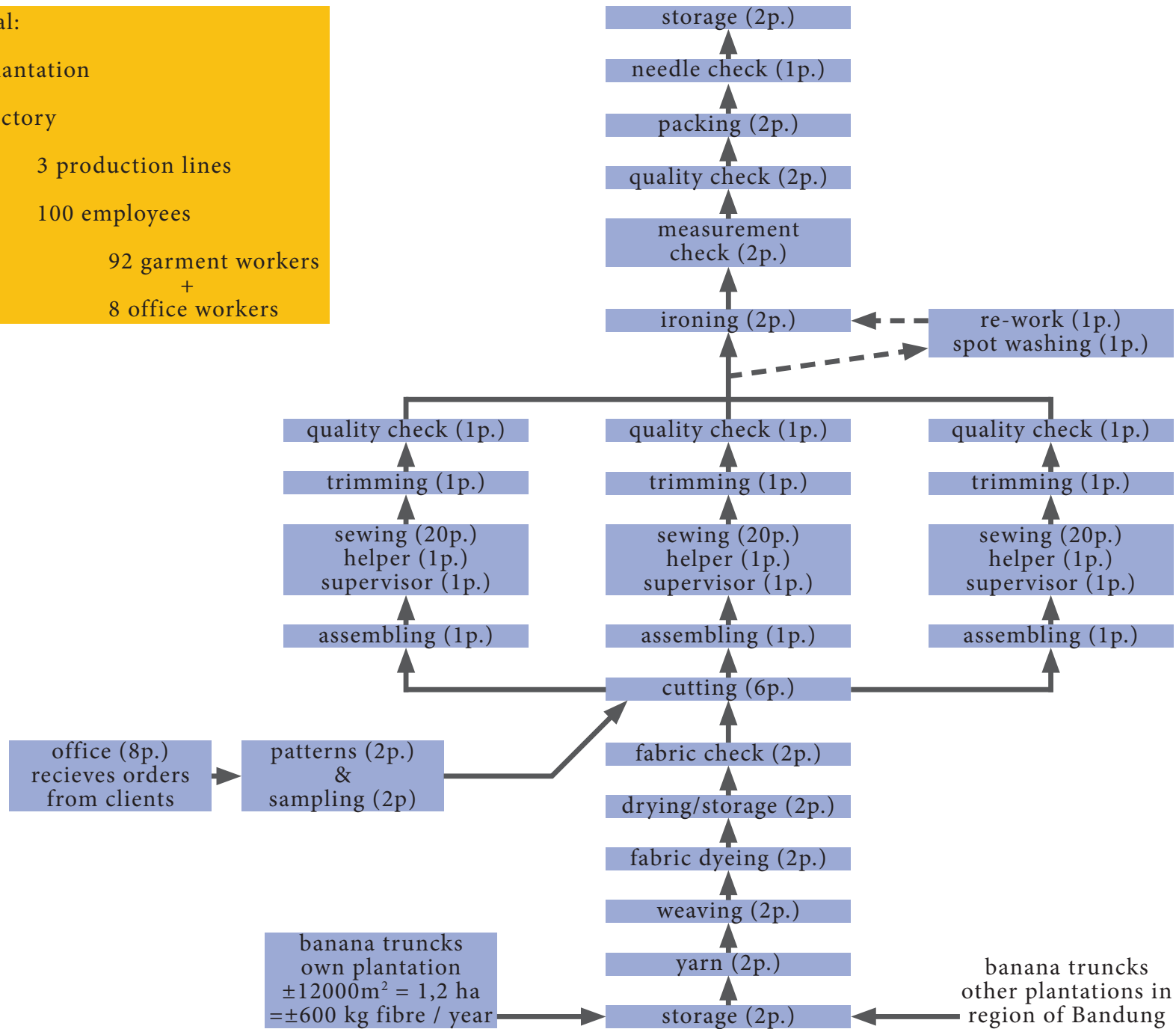
OBJECTIVE

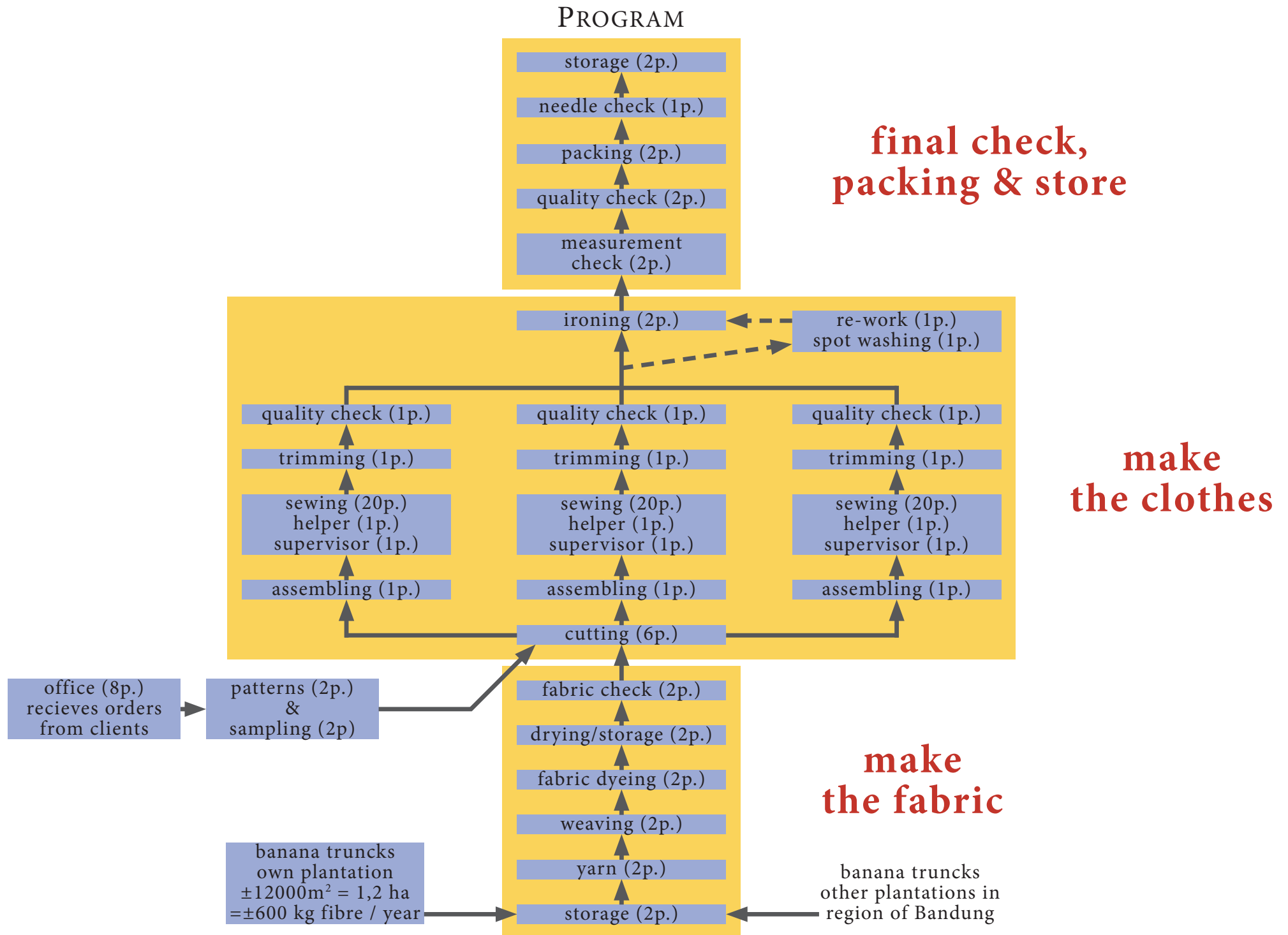
“Demand quality,
not just in the products you buy,
but in the life of the person who made it.”

*Orsola de Castro,
Co-founder of Fashion Revolution Day*

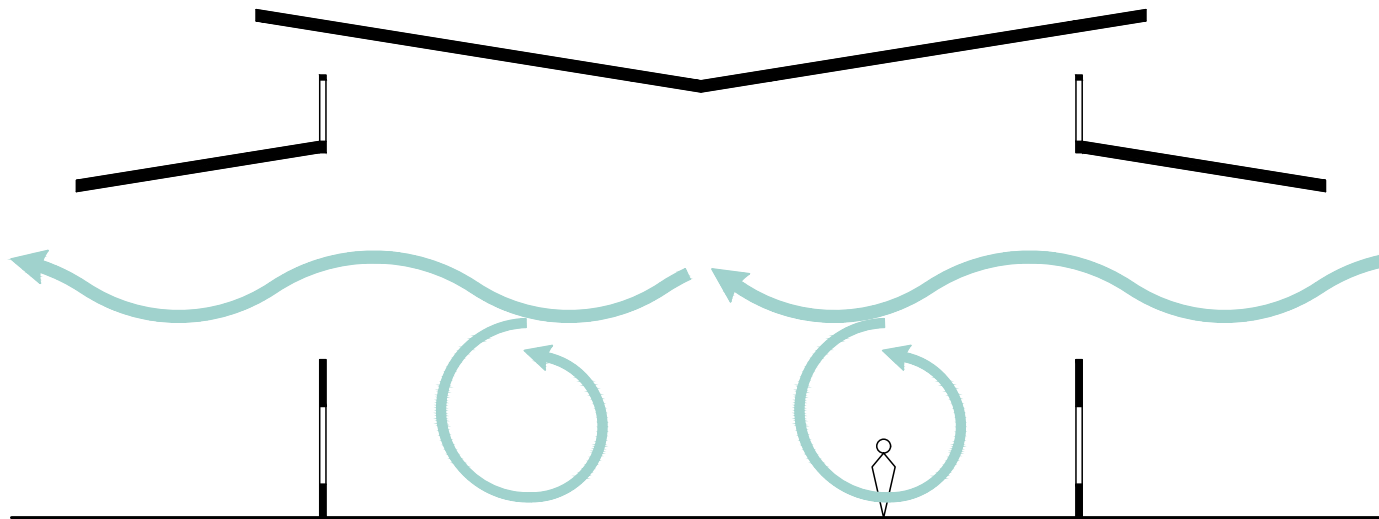
PROGRAM

total:
 - plantation
 - factory
 3 production lines
 100 employees
 92 garment workers
 +
 8 office workers





ELEMENTS



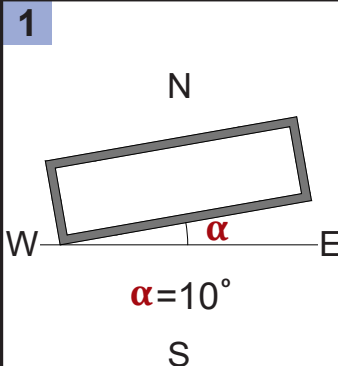
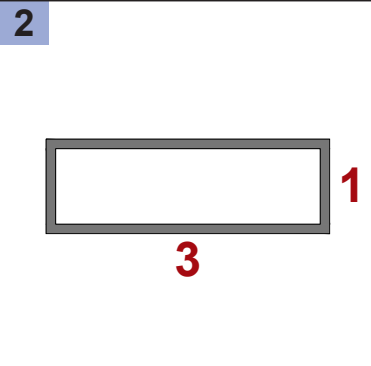
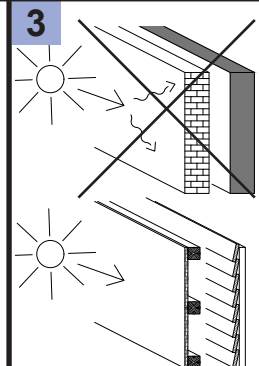
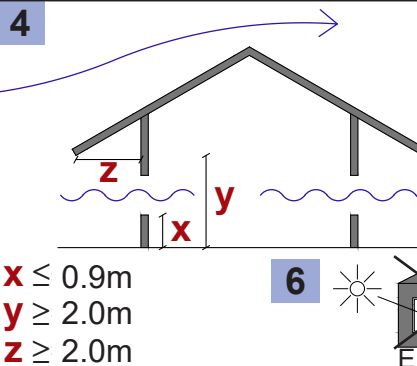
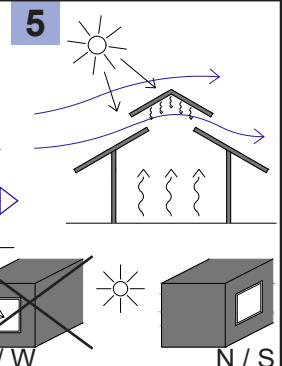
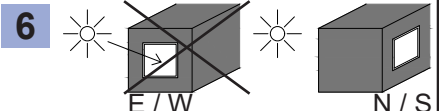
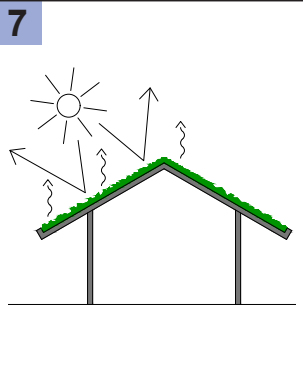
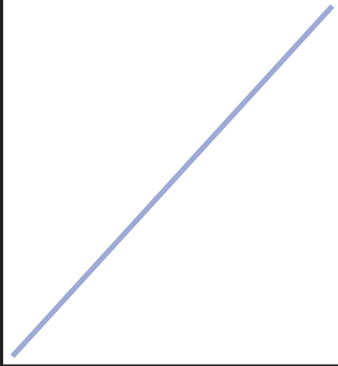
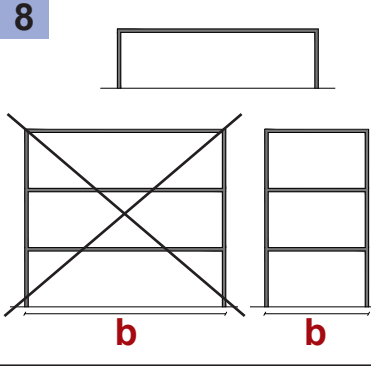
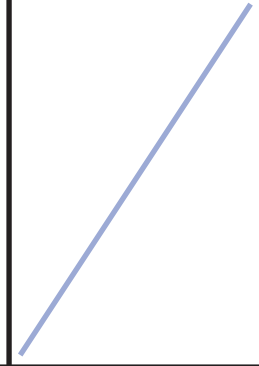
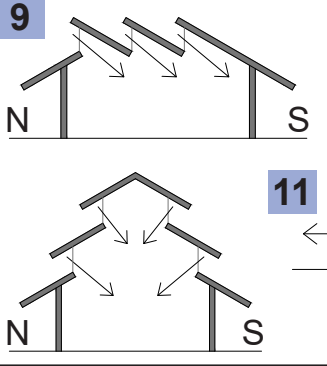
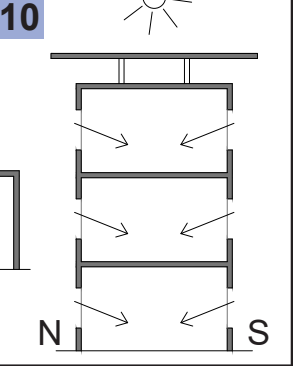
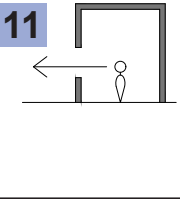
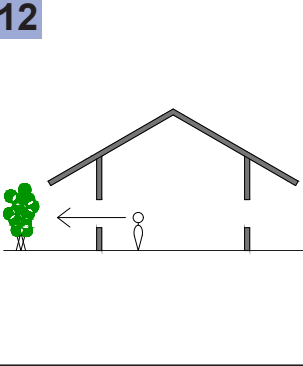
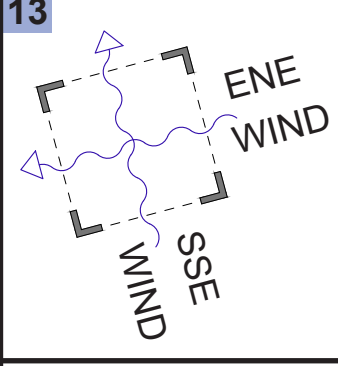
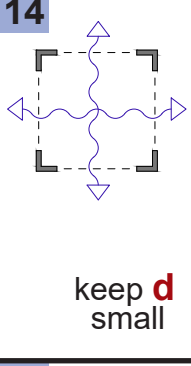
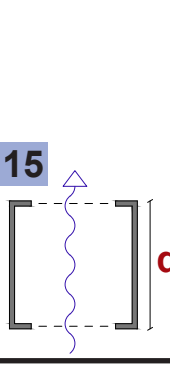
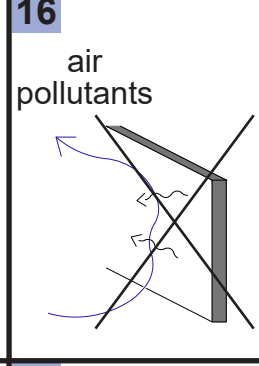
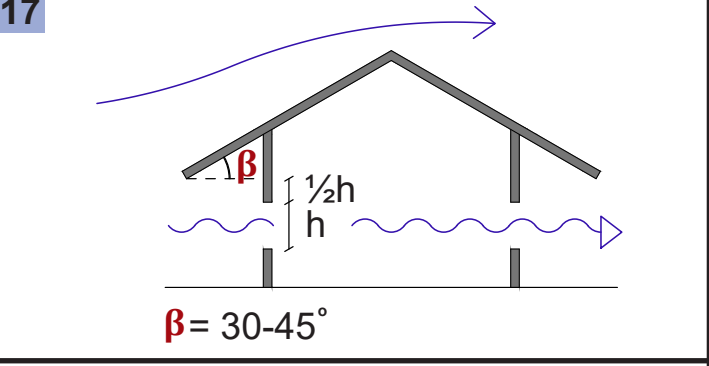
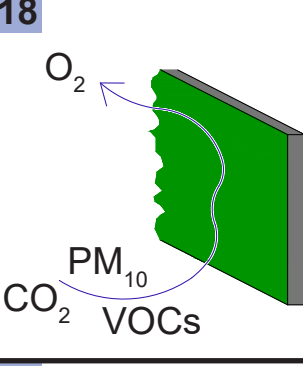
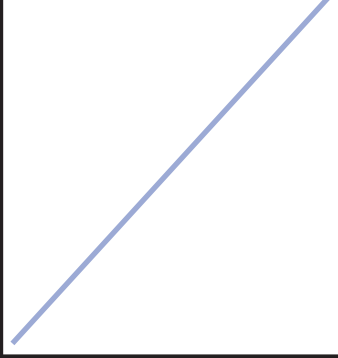
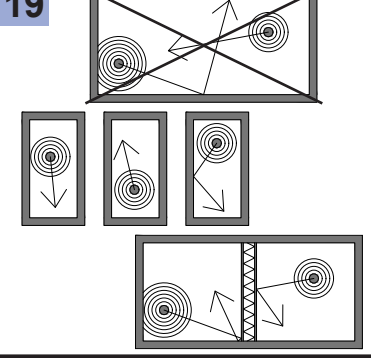
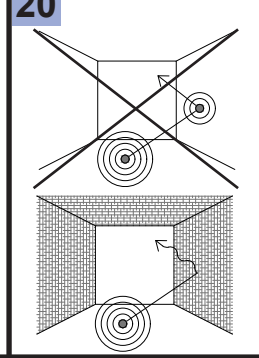

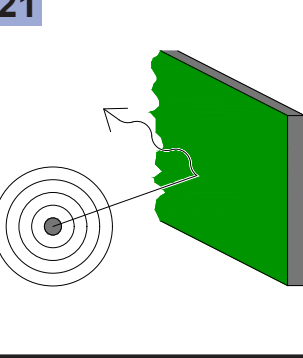
facade - air flow through the building

PASSIVE BUILDING DESIGN STRATEGIES



PASSIVE BUILDING DESIGN STRATEGIES



	ORIENTATION	CONFIGURATION	MATERIALS	ROOF, FACADE & OPENINGS	VEGETATION
THERMAL COMFORT	<div>1</div> 	<div>2</div> 	<div>3</div> 	<div>4</div>  <div>5</div>  <div>6</div> 	<div>7</div> 
LIGHTING QUALITY		<div>8</div> 		<div>9</div>  <div>10</div>  <div>11</div> 	<div>12</div> 
INDOOR AIR QUALITY	<div>13</div> 	<div>14</div>  <div>15</div> 	<div>16</div> 	<div>17</div> 	<div>18</div> 
ACOUSTIC QUALITY		<div>19</div> 	<div>20</div> 		<div>21</div> 

PROGRAM



ENERGY PRODUCTION

‘back on the envelope’ calculation:

suitable roof area = 2160 m²

2160 m² / 1,65 m² (pv-panel) = 1309 panels

1309 x 221 W_p = 289 kW_p

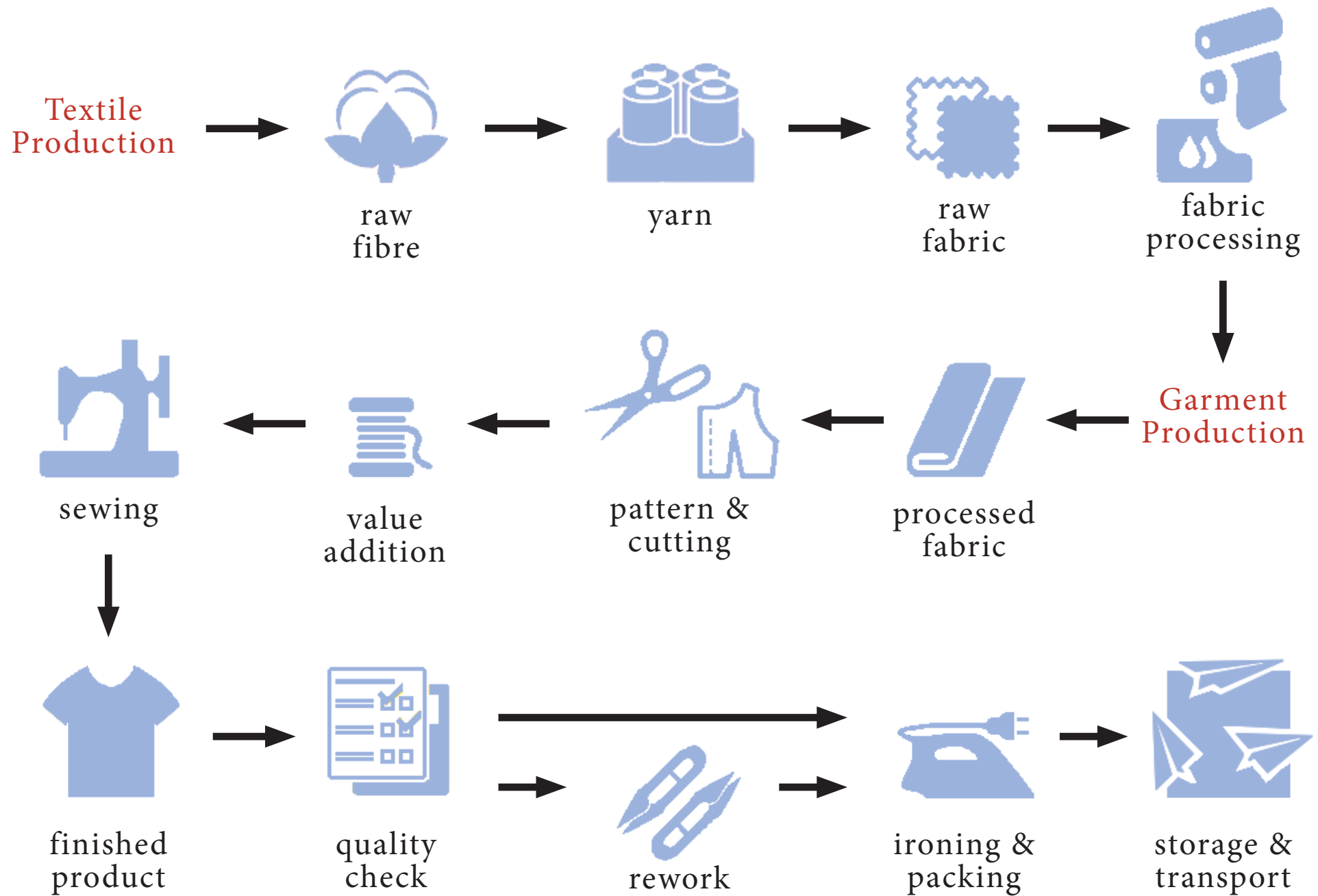
1095 kWh/kW_p/year* x 289 kW_p = **316455 kWh/year**

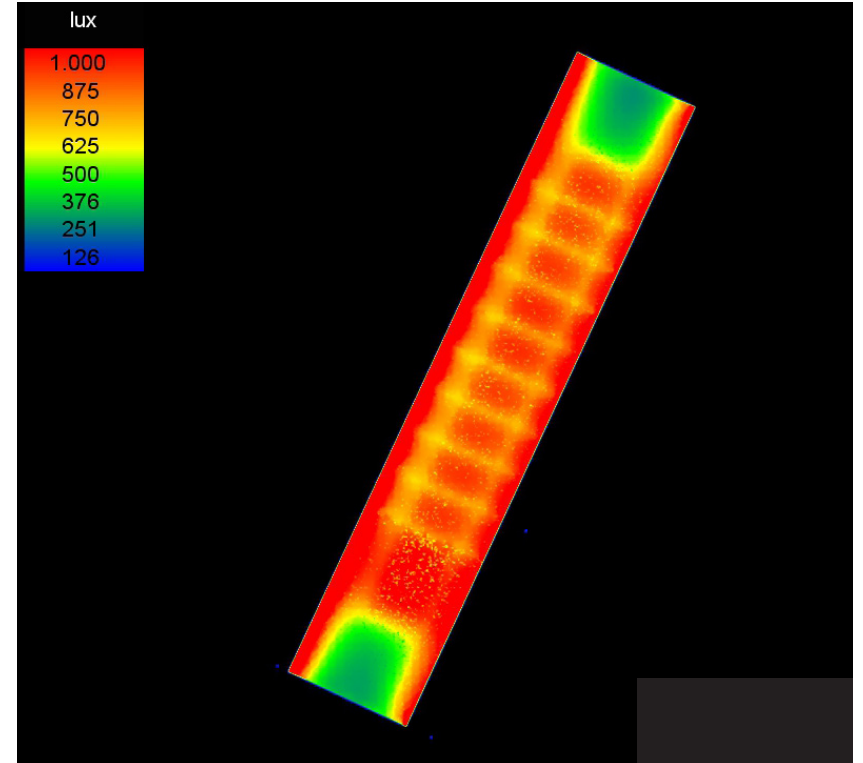
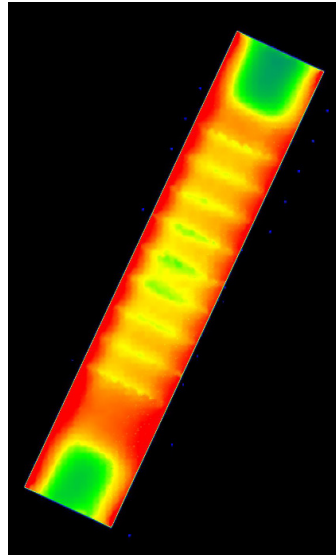
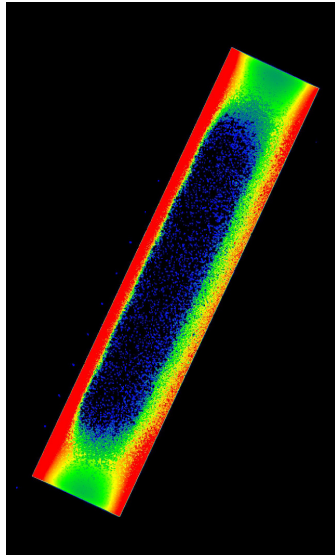
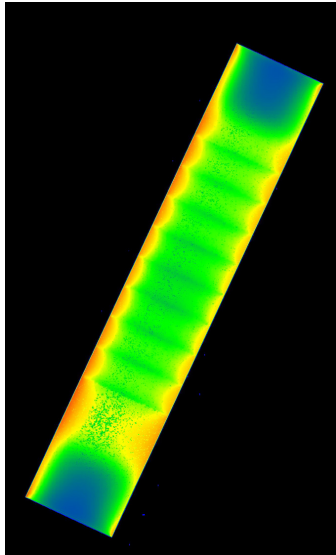
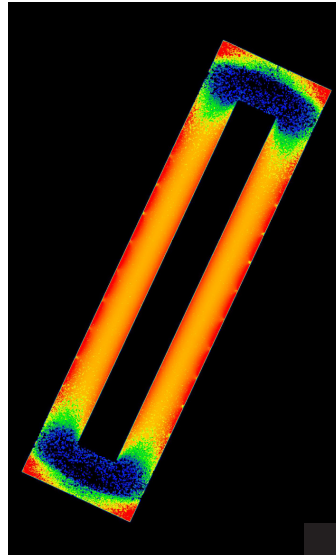
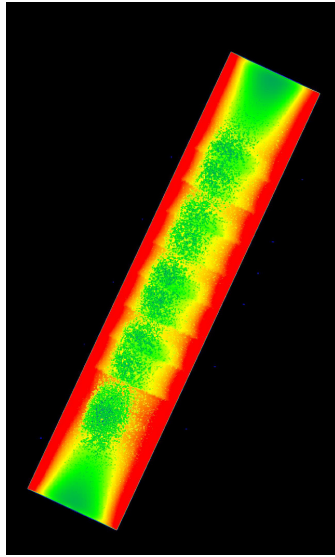
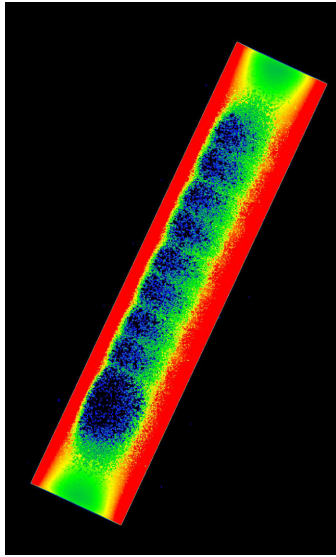
average Dutch household = 6712 kWh / year

316455 / 6712 = **47 households**

*in Indonesia

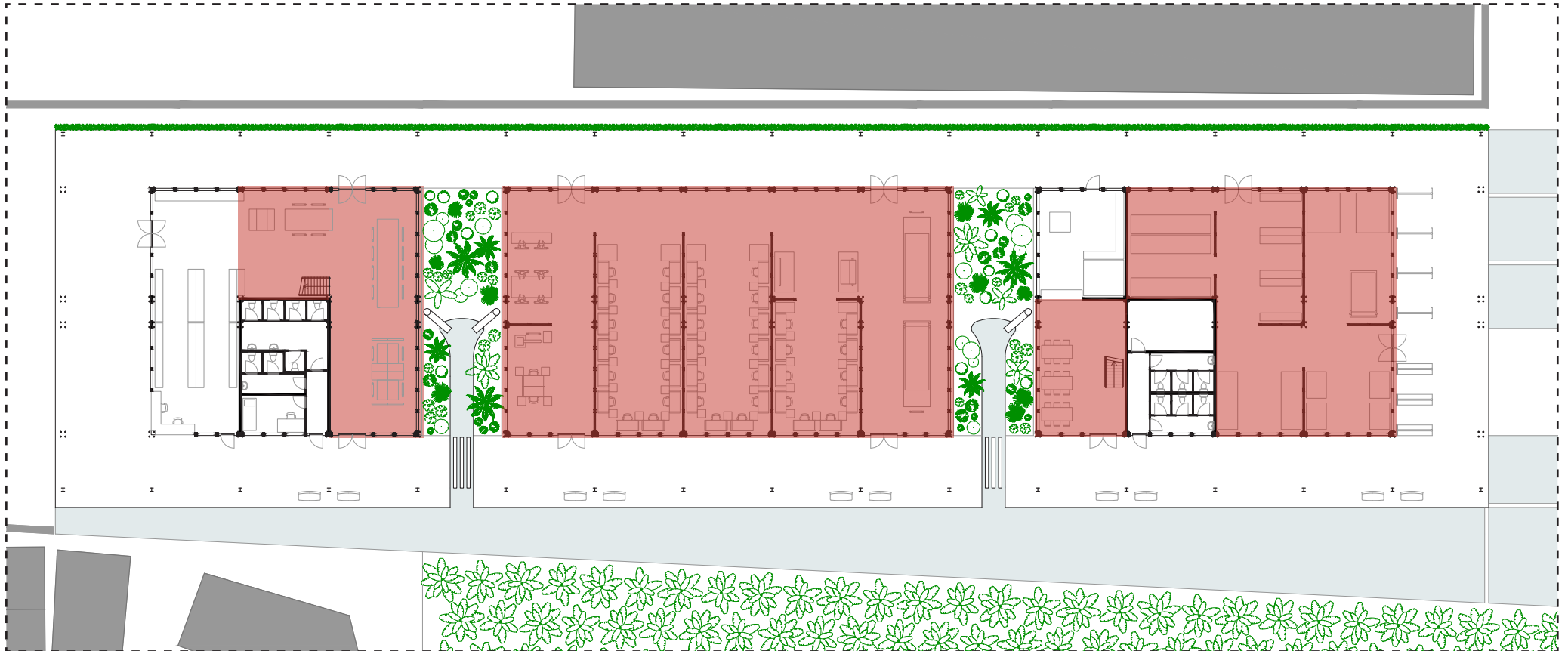
DESIGN LAYOUT





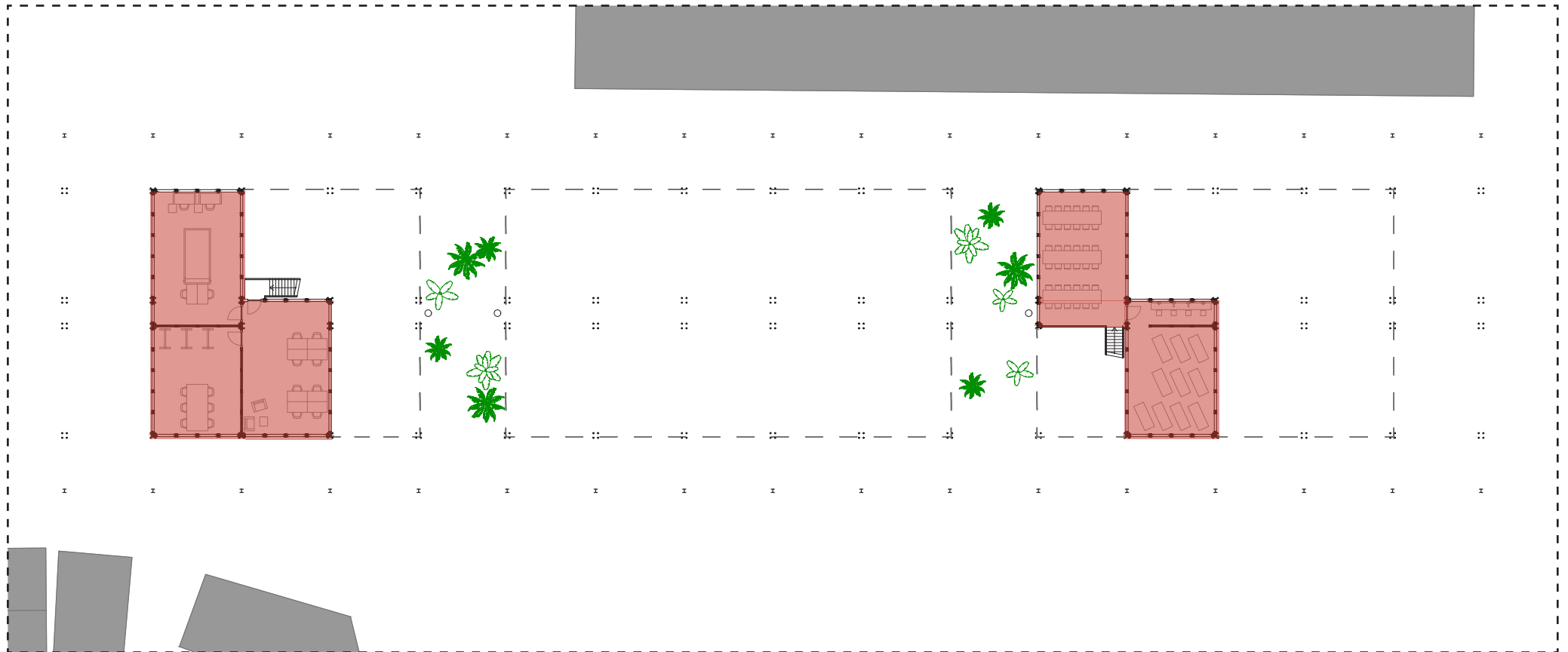
daylight simulation (VELUX)

LIGHTING



ground floor - daylight via roofwindows

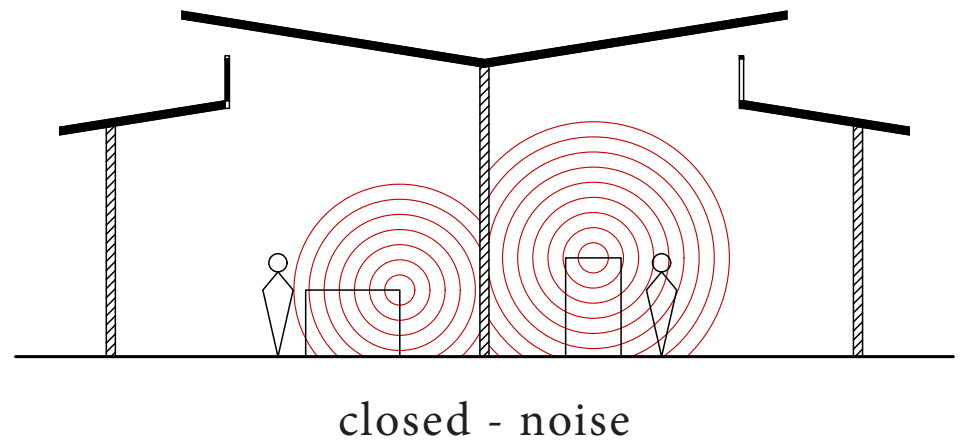
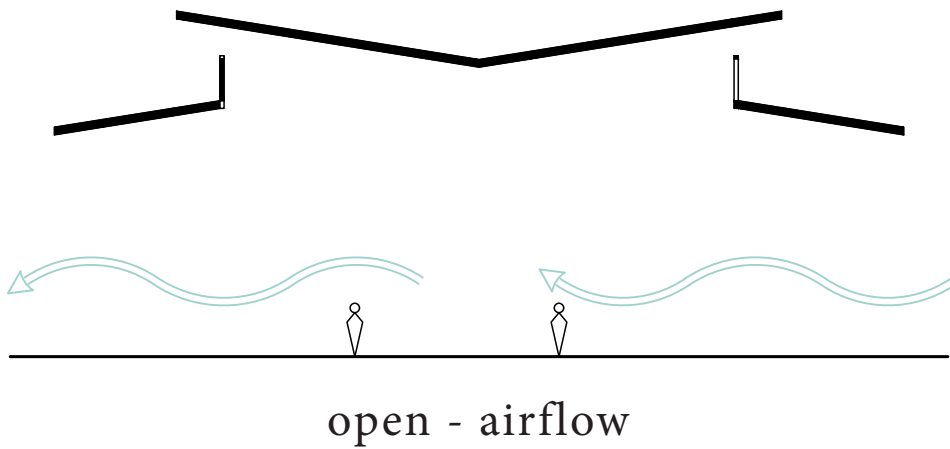
LIGHTING



first floor - daylight via roofwindows

ACOUSTICS

indoor space:
finding the right balance
between open and closed...



THERMAL COMFORT



well insulated roof!