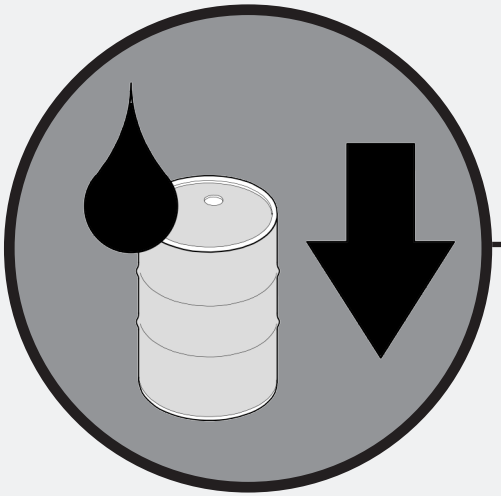
HARVESTED HOME

P5 Presentation

Credit : SYNCRUDE AURORA OIL SANDS FACILITY, north of Fort McMurray, consulted online, 01/11/2017. obiter-dicta.ca

CRUDE OIL

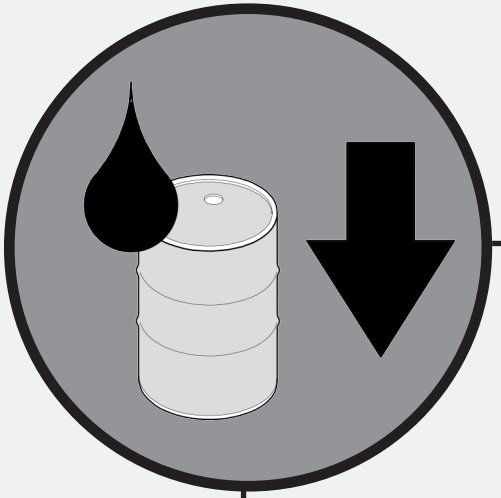


DERIVED PRODUCTS

Asphalt	Paraffin Wax
Bulk Tar	Plastics
Fertilizer	Synthetic Textiles
Hand Lotion	Toothpaste
Lubricants	Vitamin Capsules
Liquid Fuels	Vapor Barriers

Source : U.S. ENERGY INFORMATION ADMINISTRATION, Petroleum Products Supplied.

CRUDE OIL



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Caulking	**Roofing**
Epoxy	**Silicone**
Geotextiles	**Insulation**
Paints	**Vinyl Cladding**

50 yrs

of fossil fuel reserve left

Source : OURWORLDINDATA.ORG

50yrs

of fossil fuel reserve left

HOW WILL WE BUILD WHEN OIL RUNS OUT?

THE OBJECTIVE

To **create** a building approach that is truly -fully- renewable.

To **eliminate** all non-renewable materials from its structure.

To **minimize** its impacts on the environment, locally and globally.

To **preserve** the our quality of life for future generations.

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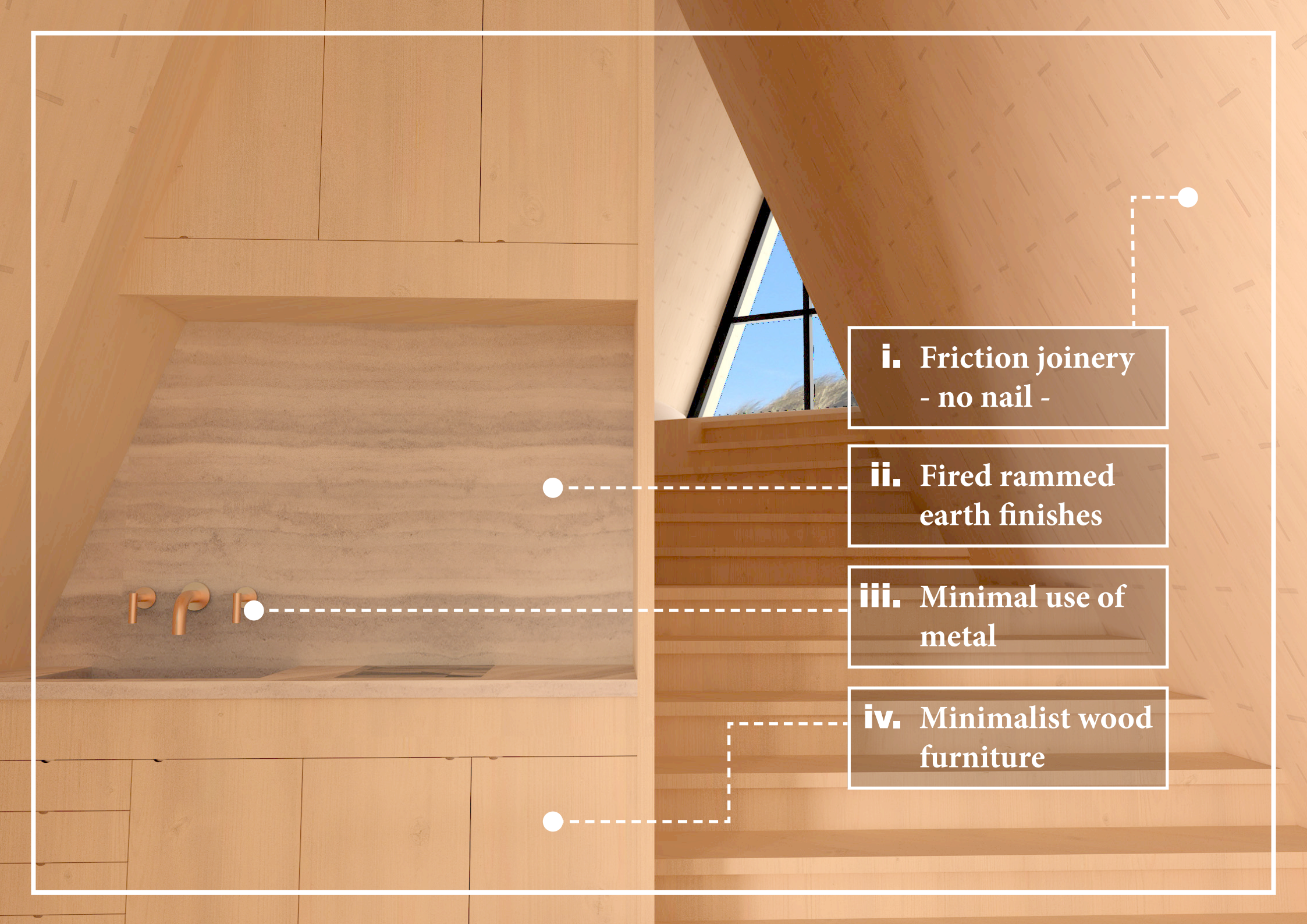
To develop a fully biobased structure for a new housing concept.

HARVESTED HOME

A Biobased Housing Approach

HARVESTED HOME

A Biobased Housing Approach


i. Friction joinery
- no nail -
ii. Fired rammed
earth finishes
iii. Minimal use of
metal
iv. Minimalist wood
furniture

Sec. 1 CONTEXT

TEXEL

(2016)

Total Area	**160** km²
Protected	**53** km²
Length	**25** km
Width	**8** km
Population	**13 582**
Sheep	**26 000**

694 847

(2013)

Toursists visited Texel

Beaches	**30** km
Bike Path	**140** km
Museums	**6**
Repeat Visit	**79**%

A. Protected Natural Zone

B. Construction Permitted

C. Ferry Access Point

CURRENT USAGE

DE KOOG

- Re-Development Site
- Koogerstrand Camping
- Dune Park Texel
- Forested Area

DE KOOG

Re-Development Site

Koogerstrand Camping

Dune Park Texel

Forested Area

RE-DEVELOPMENT PROGRAMME

Type	**Holiday Homes**
High Season	**Summer**
N° of Units	**40-75**
Unit Capacities	**1-8**
small	**1-2**
medium	**2-4**
large	**4-8**

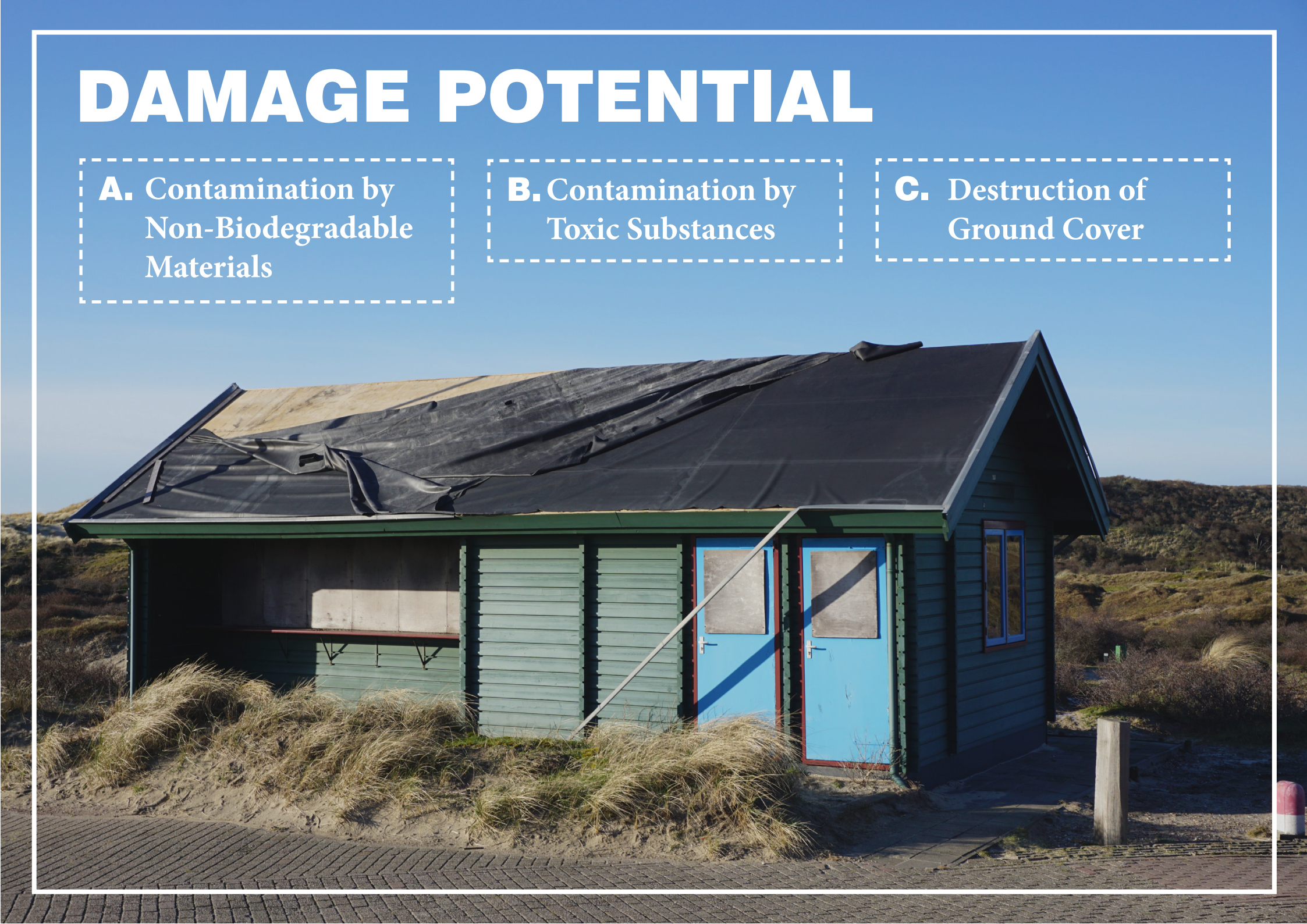
Ownership	**Private**
Owner	75% **Camping**
	25% **Individuals**

DAMAGE POTENTIAL

A. Contamination by Non-Biodegradable Materials

B. Contamination by Toxic Substances

C. Destruction of Ground Cover



DAMAGE TO NATURE

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PROGRAMME

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PROBLEM 01

The building materials endanger the biosphere of the Texel Dune Park.

PROBLEM 02

The building's foundations endanger the biosphere of the Texel Dune Park.

PROBLEM 03

A large and diverse quantity of homes must be built on uneven terrain.

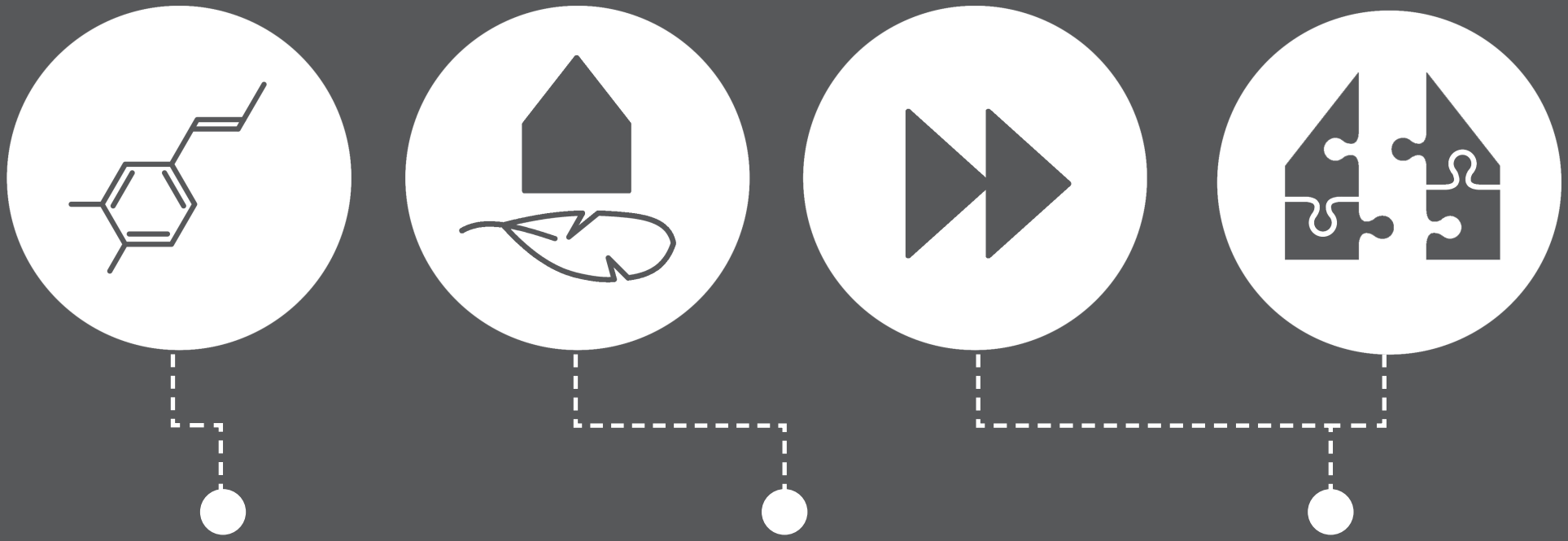
DESIGN SOLUTIONS / DESIGN APPROACH

BIOBASED MATERIALS

LIGHT FOUNDATIONS

RAPID ASSEMBLY

PREFAB



PROBLEM 01

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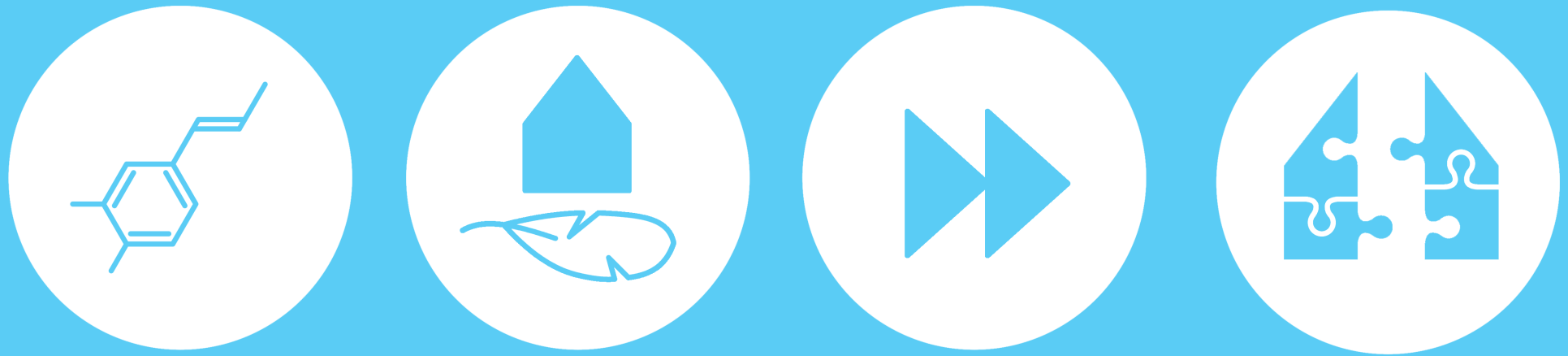
PROBLEM 02

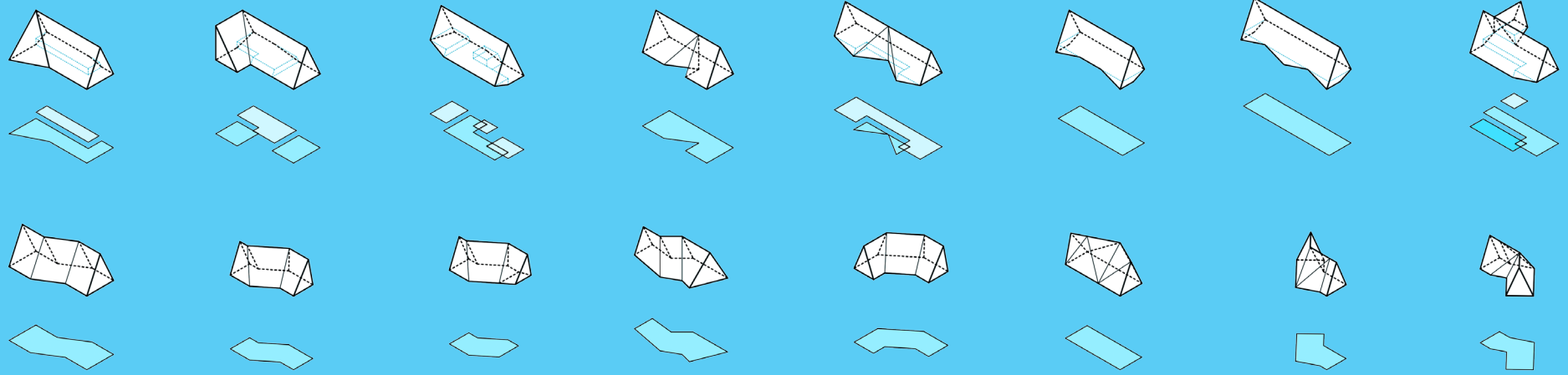
The building's **foundations** endanger the biosphere of the Texel Dune Park.

PROBLEM 03

A **large** and diverse **quantity** of homes must be built on uneven -and vulnerable- terrain.

Sec. 2 DESIGN





ZOOM-IN

Re-Development Site

Site for Demonstration

Trails / Access Routes

N

W

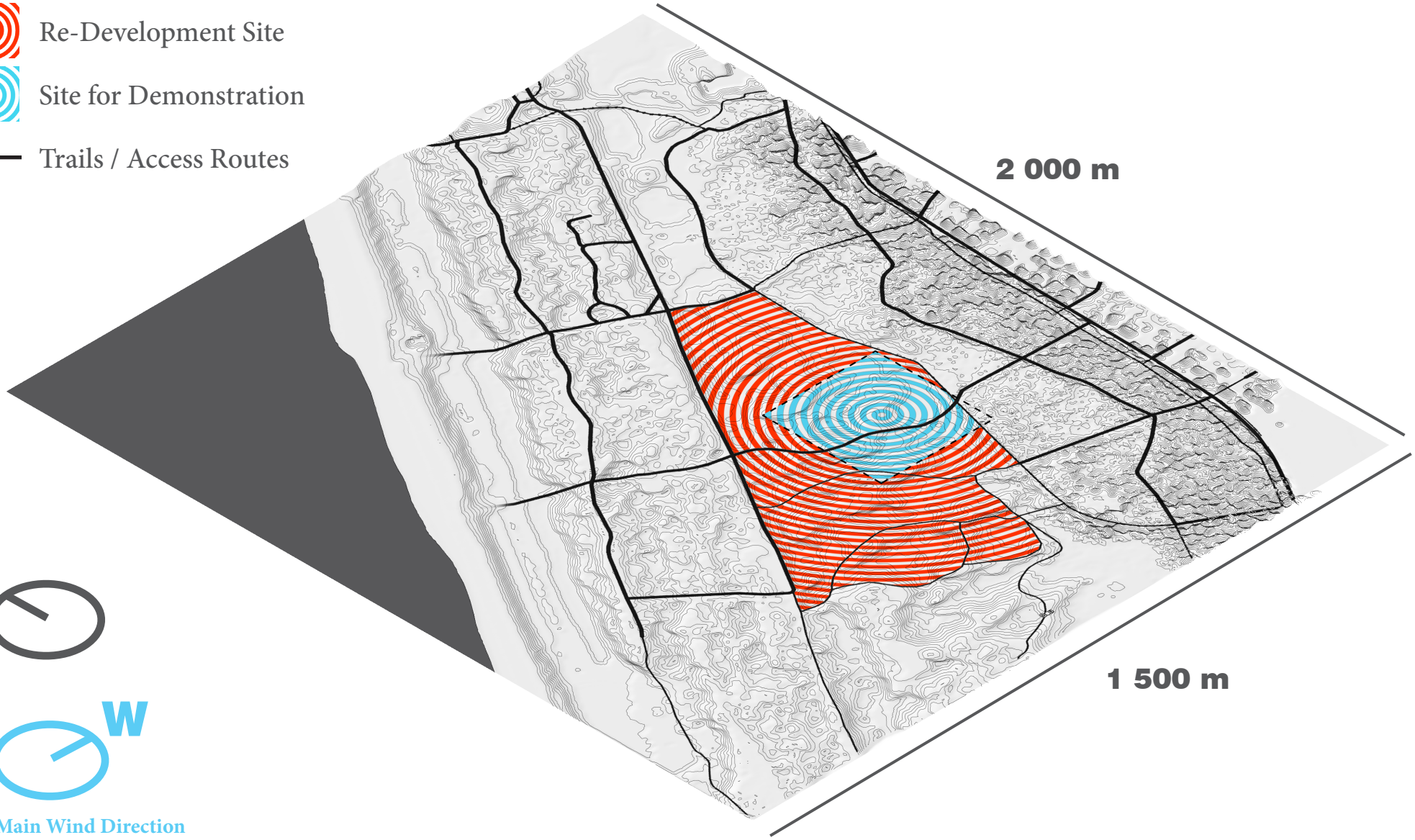
Main Wind Direction

ZOOM-IN

Re-Development Site

Site for Demonstration

Trails / Access Routes



N

W

Main Wind Direction

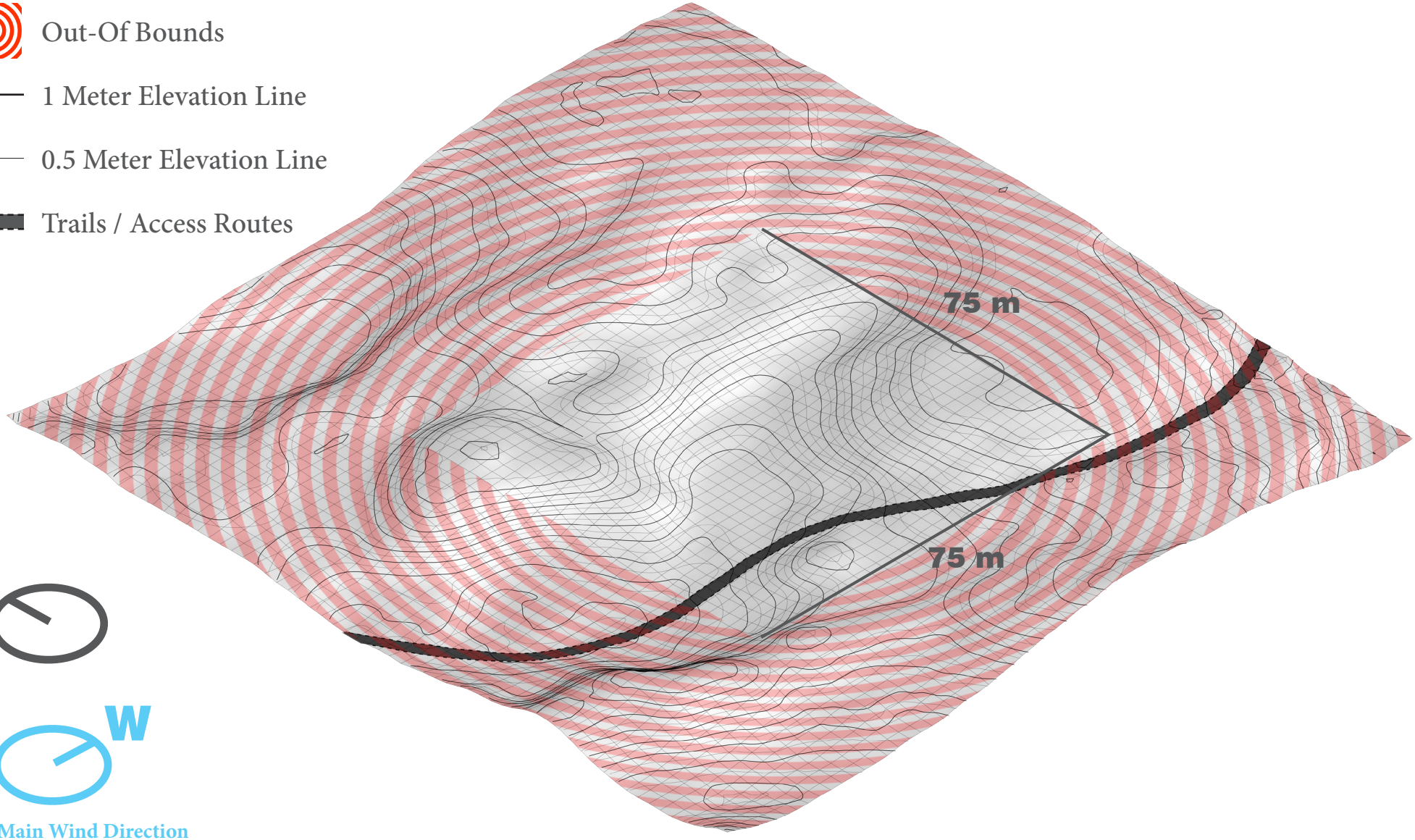
THE SITE

Out-Of Bounds

1 Meter Elevation Line

0.5 Meter Elevation Line

Trails / Access Routes



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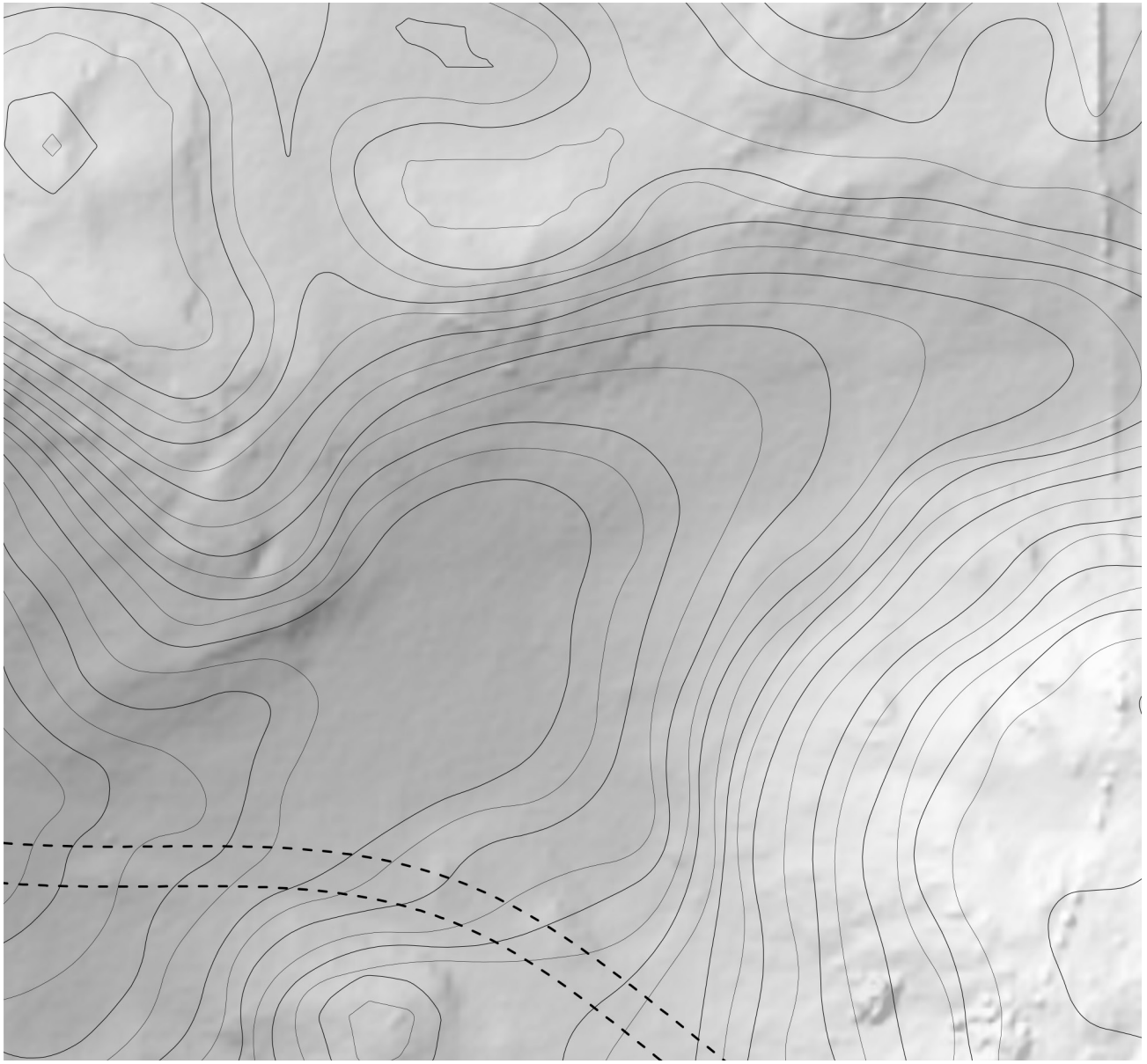
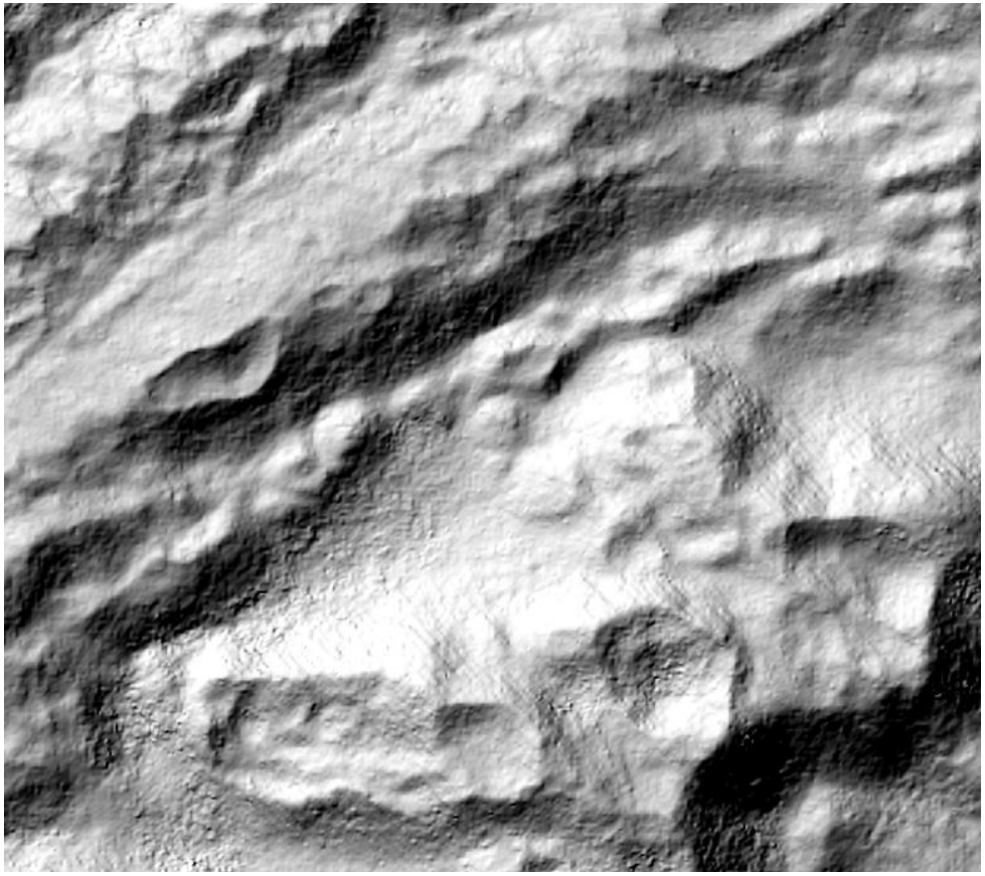
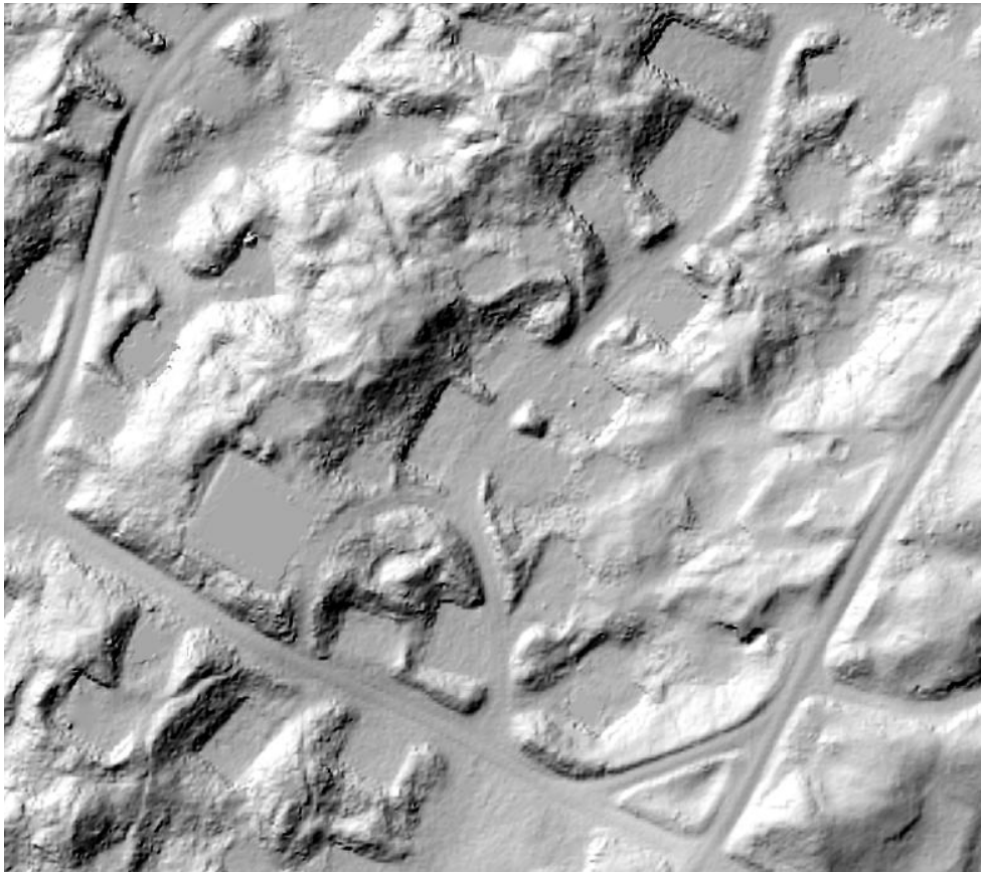


THE IMPORTANCE OF PLACE(MENT)

A. Natural Dune Topography

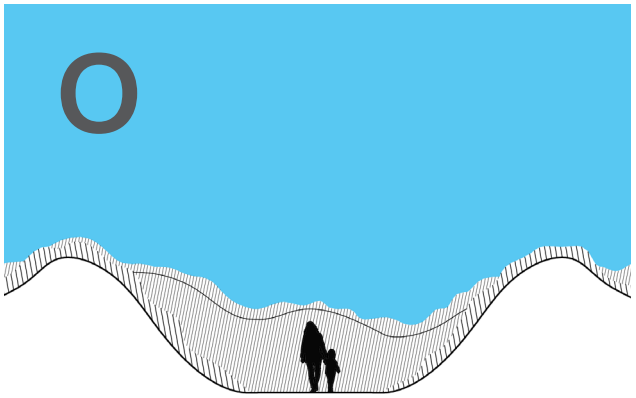


B. Camping Dune Topography

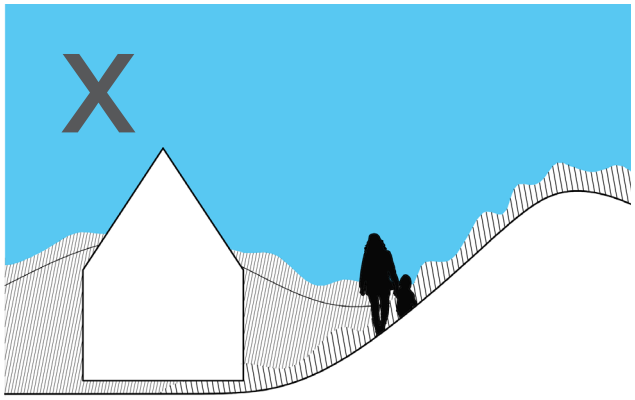


PLACEMENT STUDY

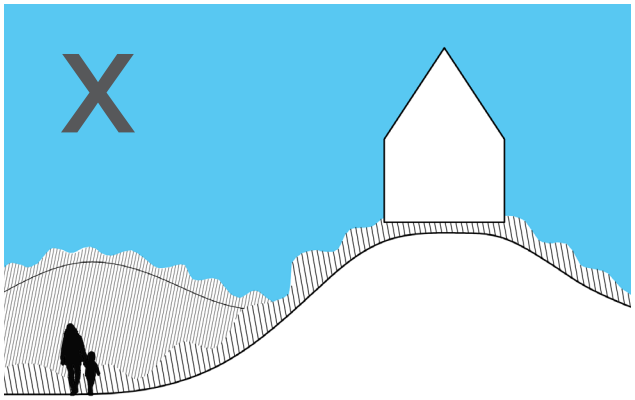
A. <u>Access</u> at Foot of the Dune



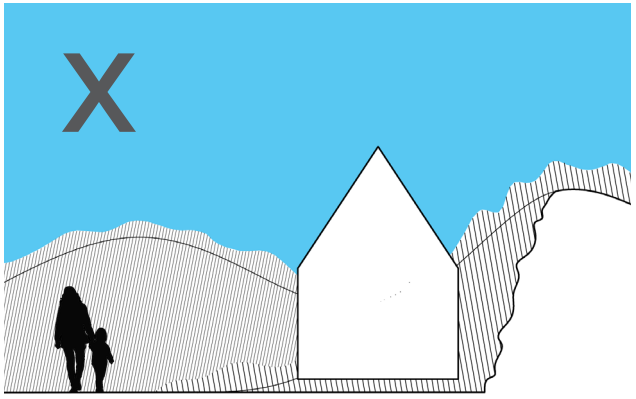
B. At <u>Foot</u> of the Dune



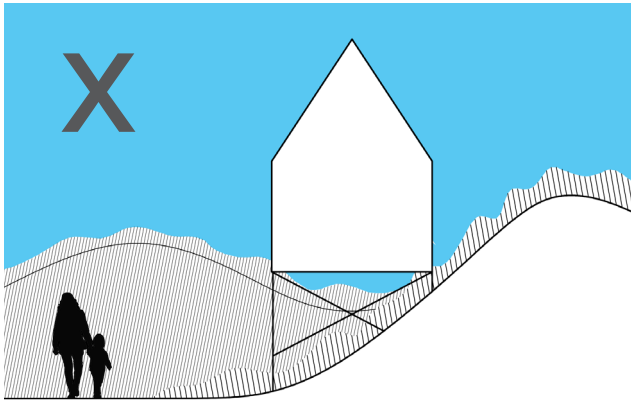
C. On <u>Top</u> of the dune



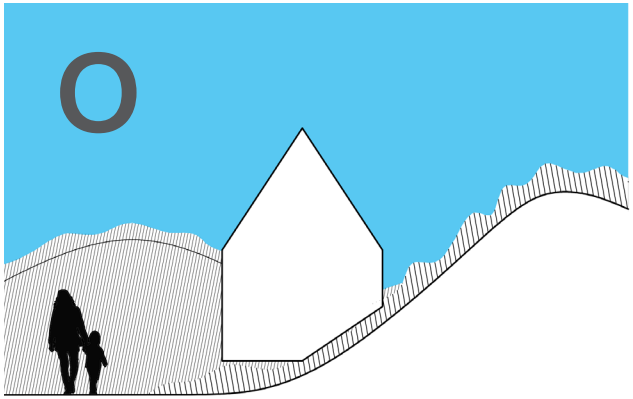
D. <u>Carved</u> Into the Dune



E. Raised <u>above</u> the Dune

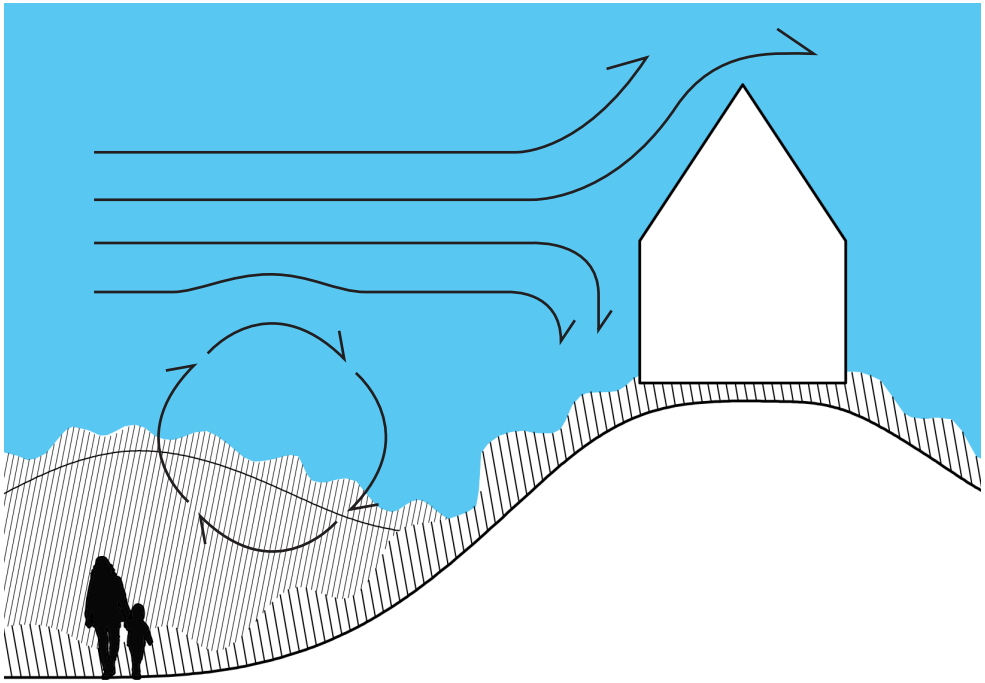


F. <u>Alongside</u> the Dune

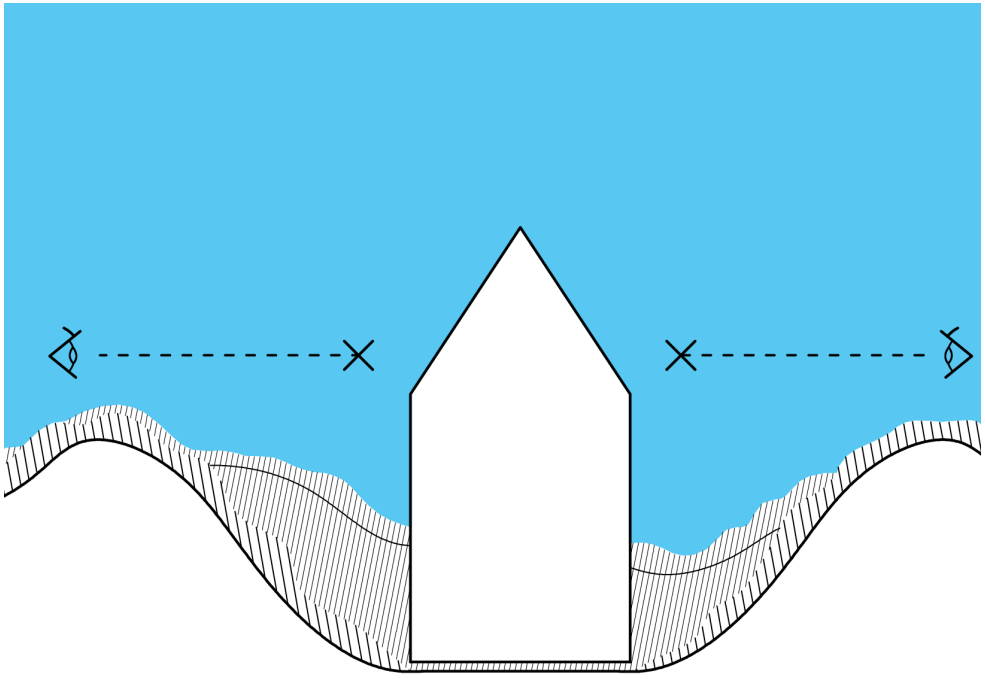


ADDITIONAL POINTS

H. Wind Exposure (and Microclimates)



I. Discretion and Preserving Views

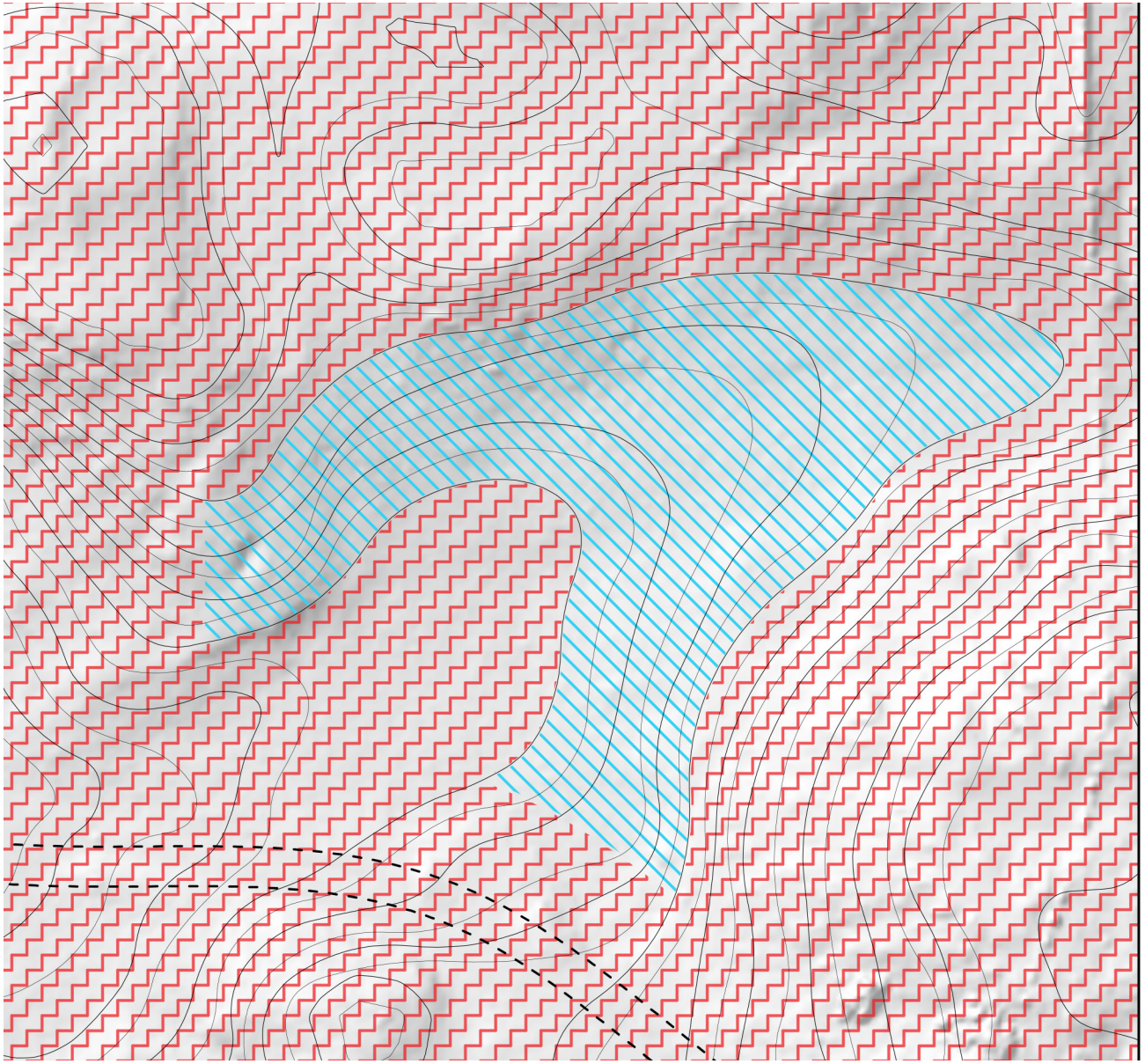


SUITABLE AREAS FOR BUILDING

Unsuitable for Building

Suitable for Building

Trails / Access Route



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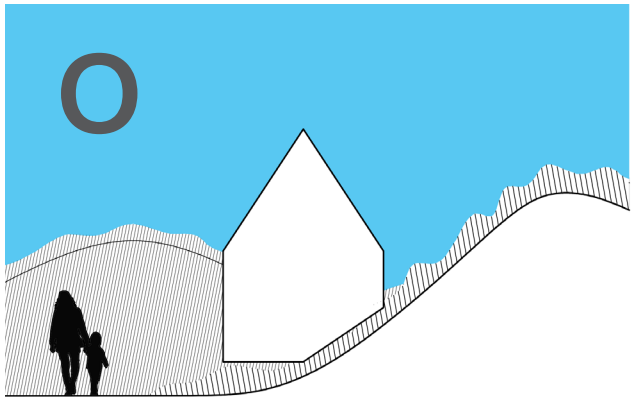
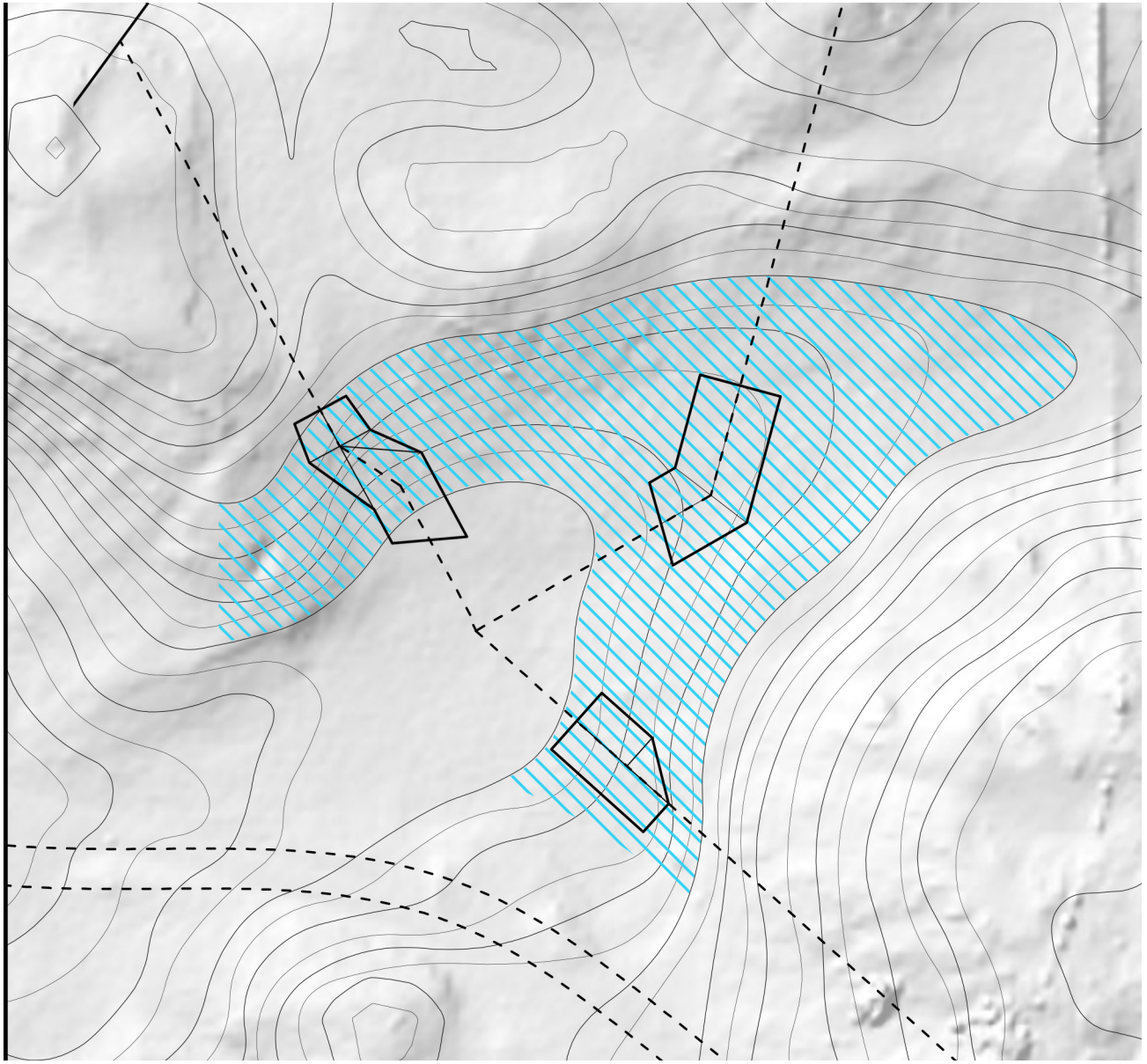


LAND ALLOCATION

Allocated Land

Trails / Access Route



N

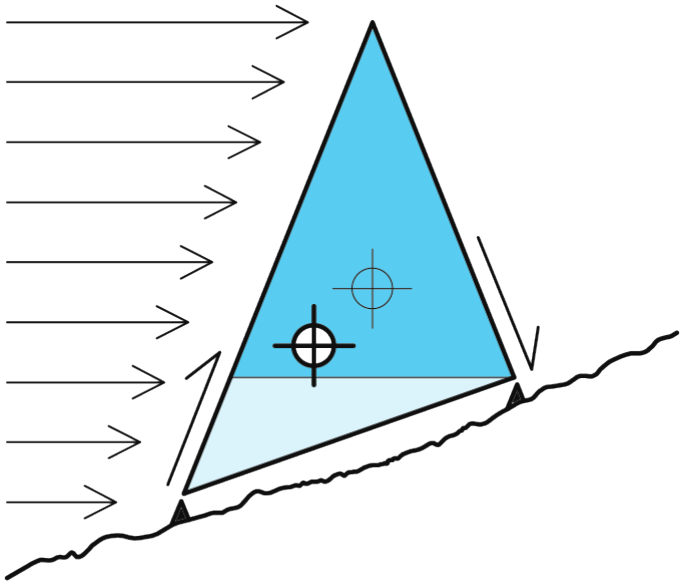
W

Main Wind Direction

FORM STUDY

TRIANGULAR STRUCTURE

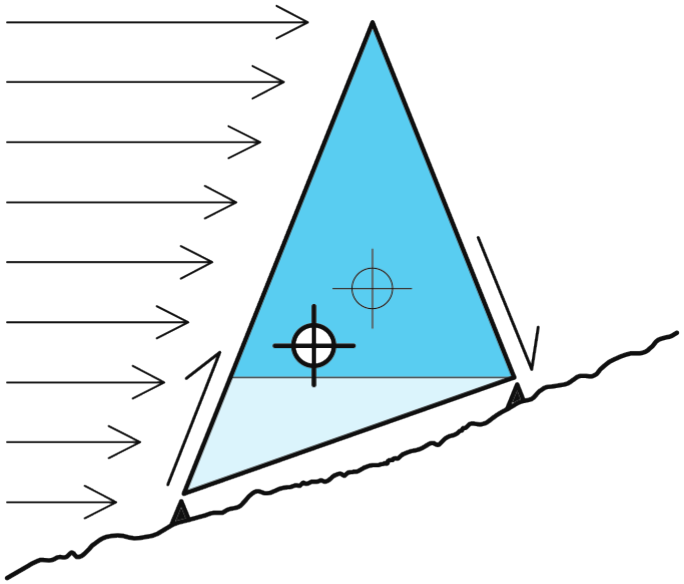
A. 4m Wide Base (interior);
B. Increased Stability;
C. Adapted to Sloped Terrain.



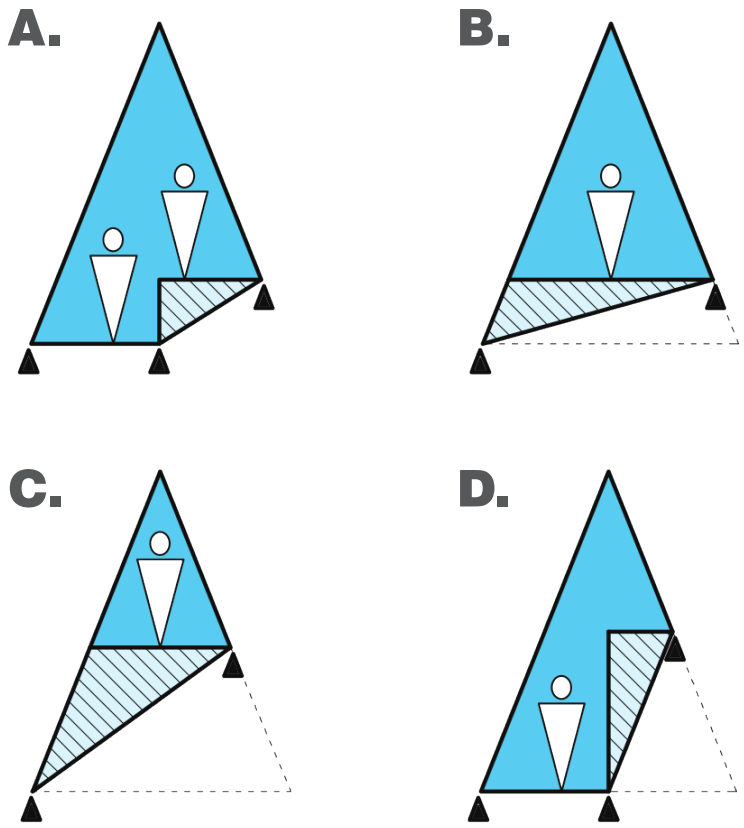
FORM STUDY

TRIANGULAR STRUCTURE

I. 4m Wide Base (interior)
II. Increased Stability
III. Adapted to Sloped Terrain



MULTI-LEVEL INTERIOR



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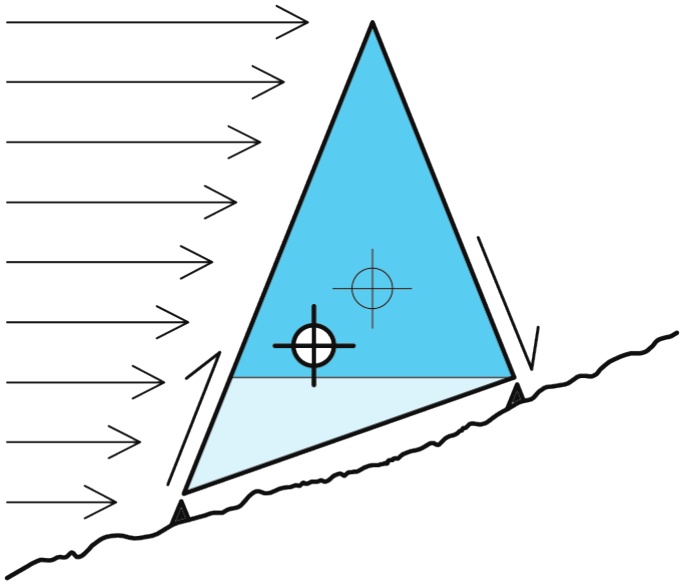
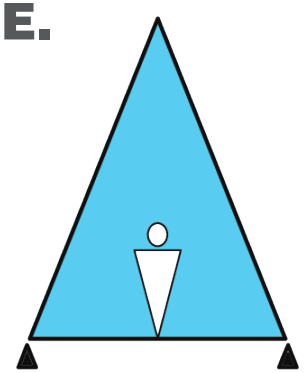
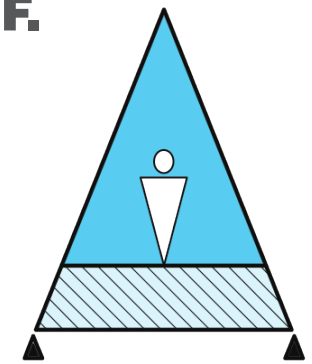


2-STOREY CAPACITY

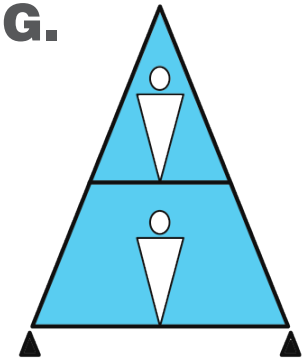
E.



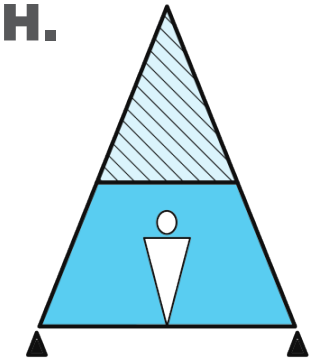
F.



G.

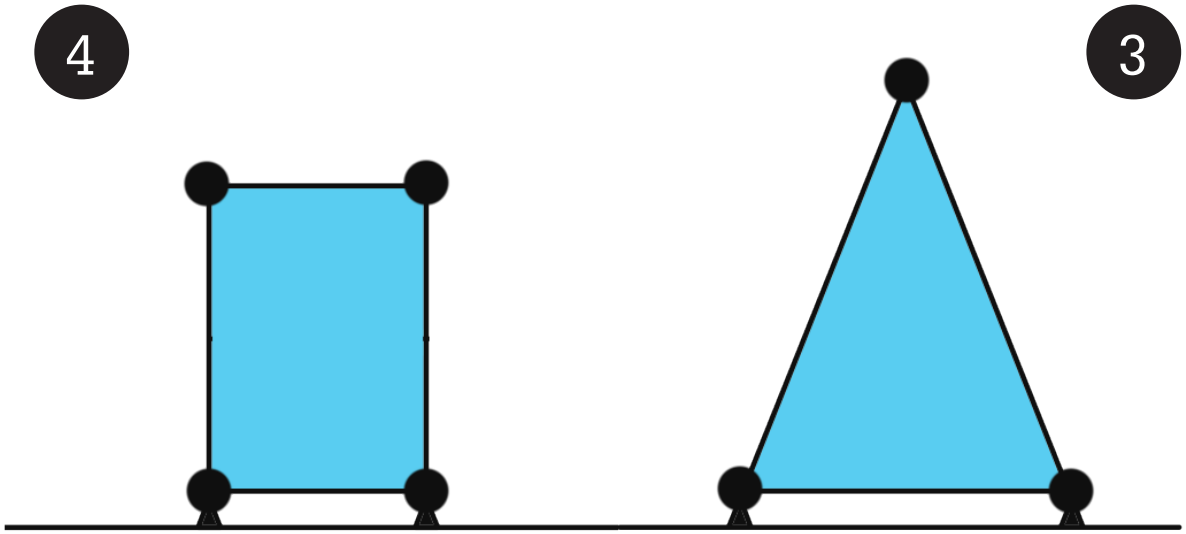


H.



FORM STUDY

FEWER CONNECTIONS / WEAK POINTS



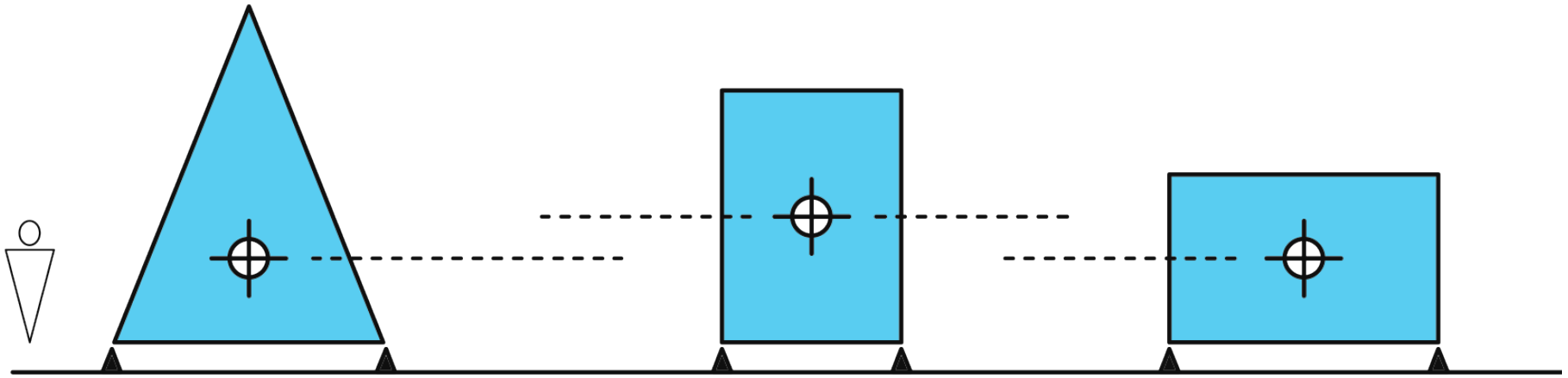
I. 4 Weak Points

J. 3 Weak Points

FORM STUDY

LOWER CENTER OF GRAVITY

All sections displayed have the same area.



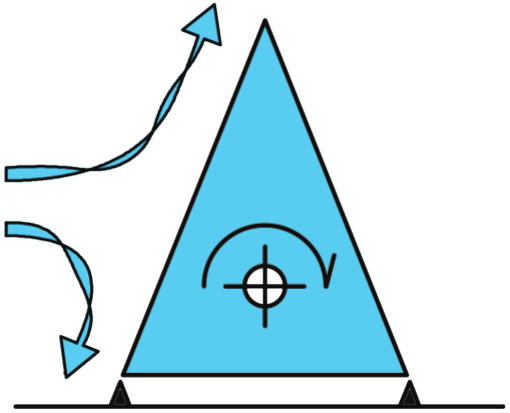
K. Lower Center
2 Floor Capacity

L. Highest Center
2 Floor Capacity

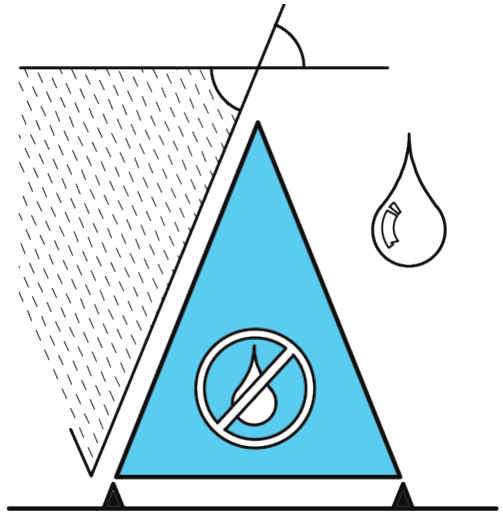
M. Low Center
1 Floor Capacity

FORM STUDY

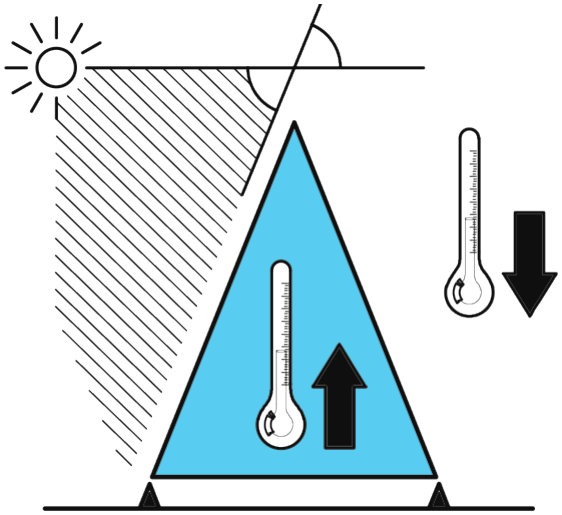
ENVIRONMENTAL ADVANTAGES



O. Aerodynamism



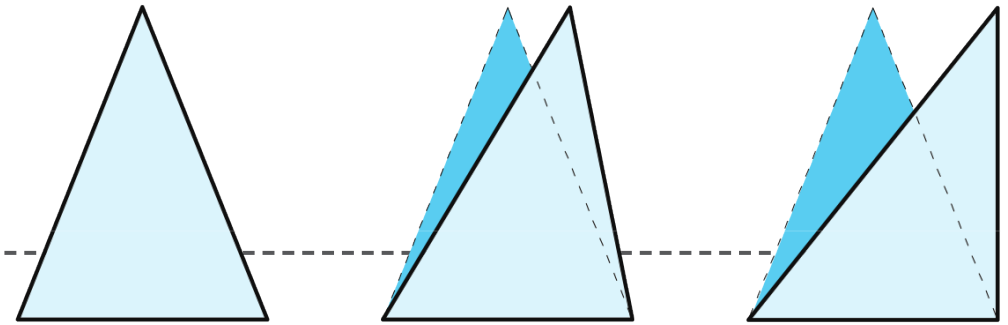
P. Water Evacuation



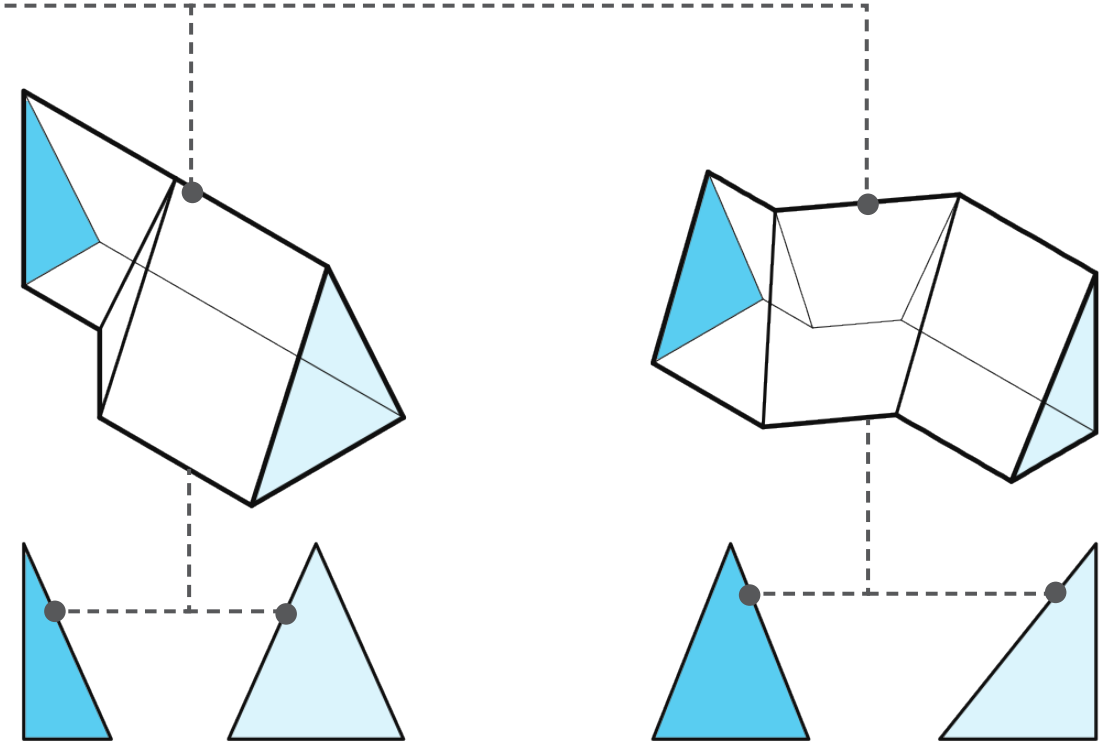
Q. Solar Gains

FORM STUDY

R. Shifts in Triangular Sections

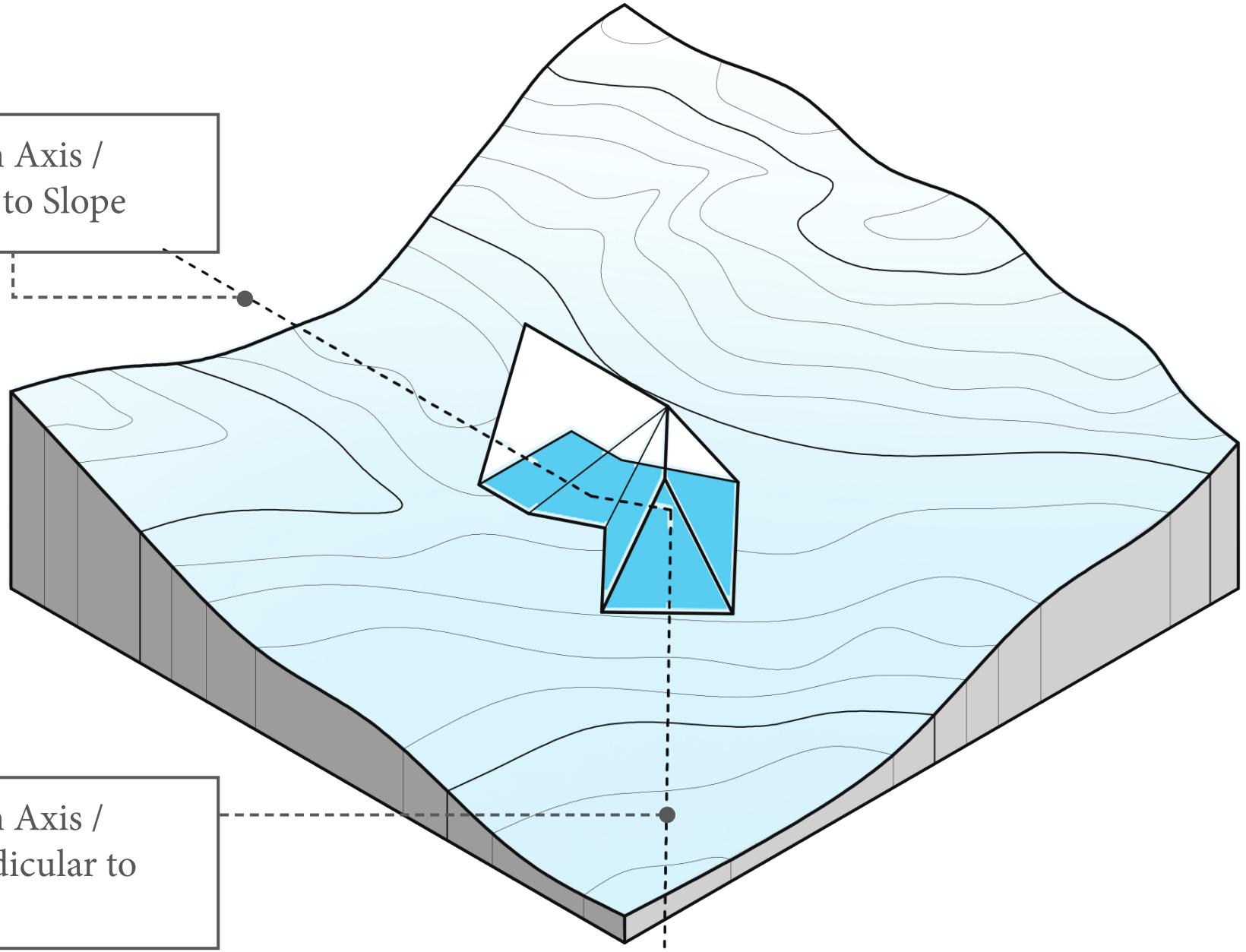


S. Transitions Between Different Sections



FORM STUDY

T. Shifts in Axis / Parallel to Slope



U. Shifts in Axis / Perpendicular to Slope

V.

FORM STUDY

ENVIRONMENTAL ADAPTABILITY

ADJUSTING
TO HEIGHTS DIFFERENTIALS

+

ADJUSTING
TO SUNLIGHT CONDITIONS

=

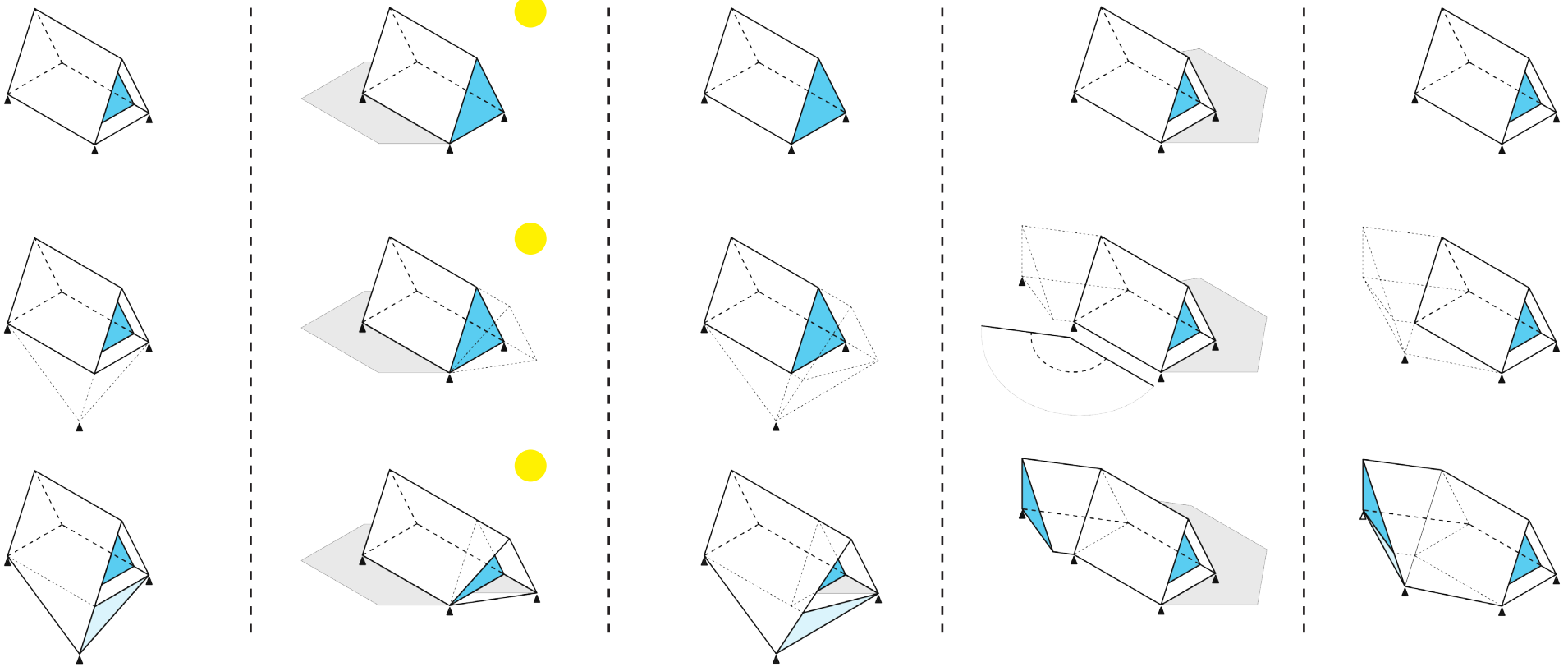
ADJUSTING
TO BOTH

+

ADJUSTING
TO OBSERVE THE LANDSCAPE

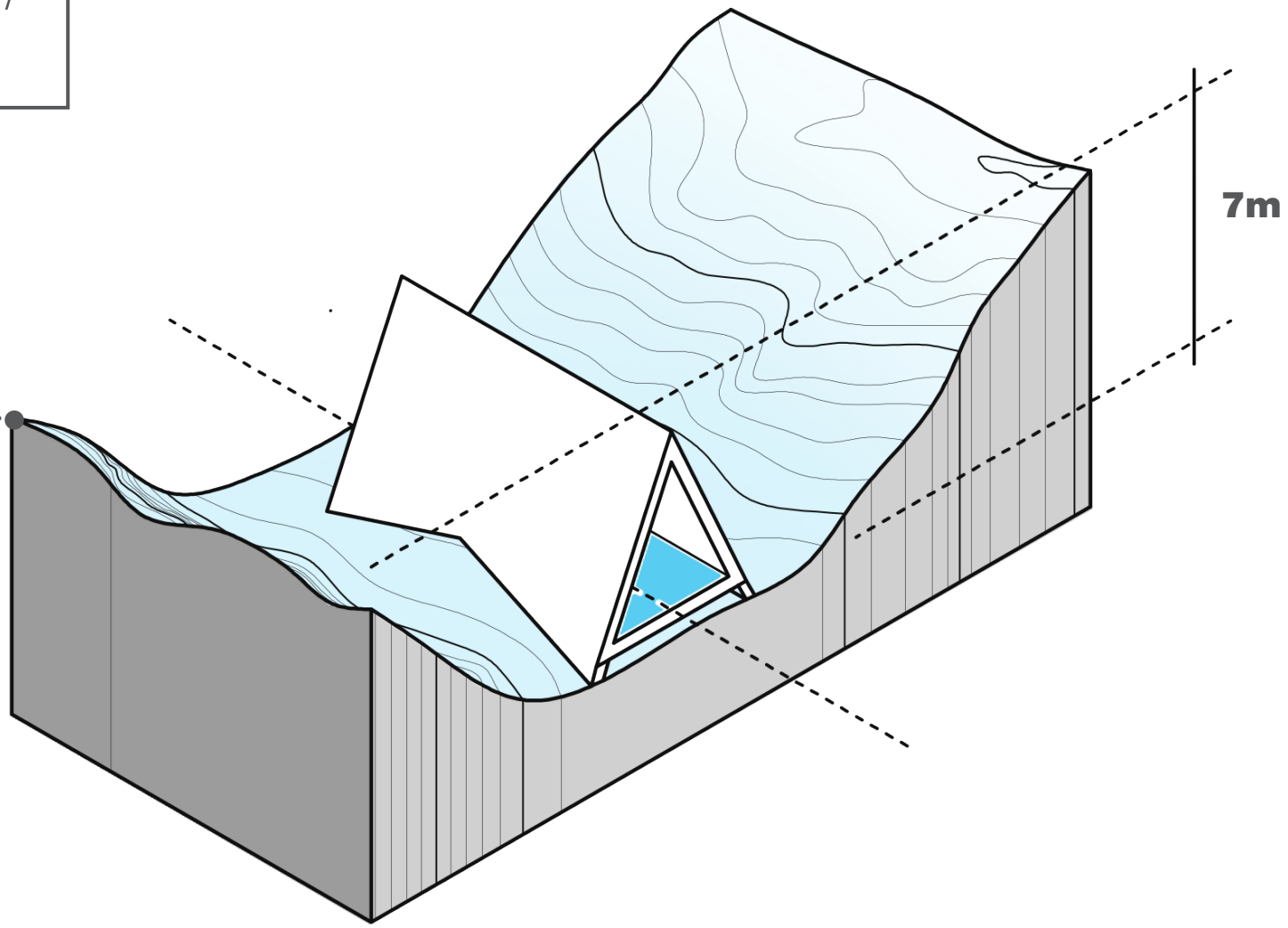
=

ADJUSTING
TO ALL FACTORS



FORM STUDY

W. Maximum Height / Blending In



HOME 01

Allocated Land

Chosen Lot

Visual Connection

Trails / Access Route

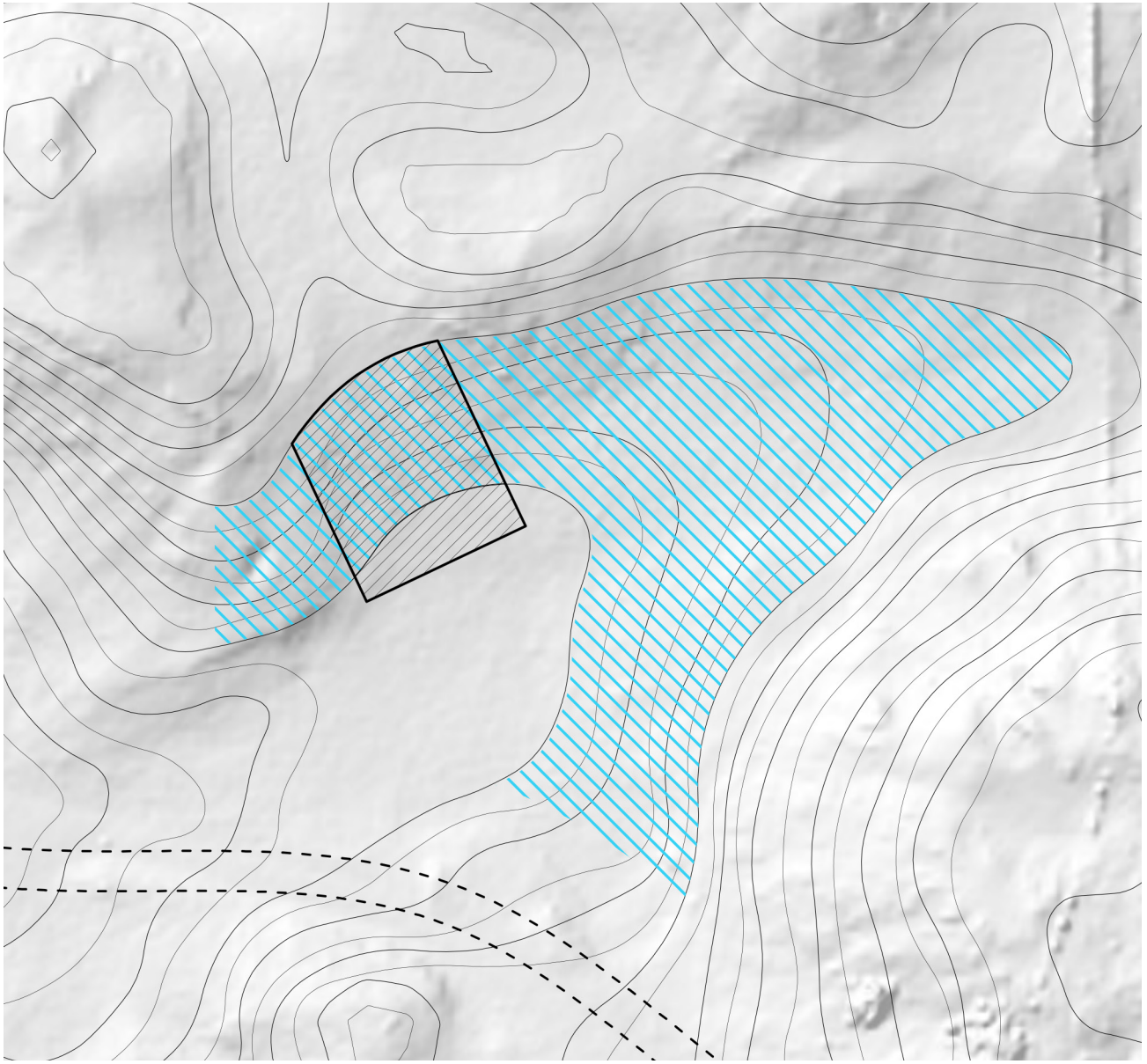
HOME #1 PROGRAMME

Unit Capacity	**2-4**
Limited Mobility	**No**
Full Bathroom	**Yes**
Special Addition	**Study**
Mezzanine	**Possible**

N

Main Wind Direction

W



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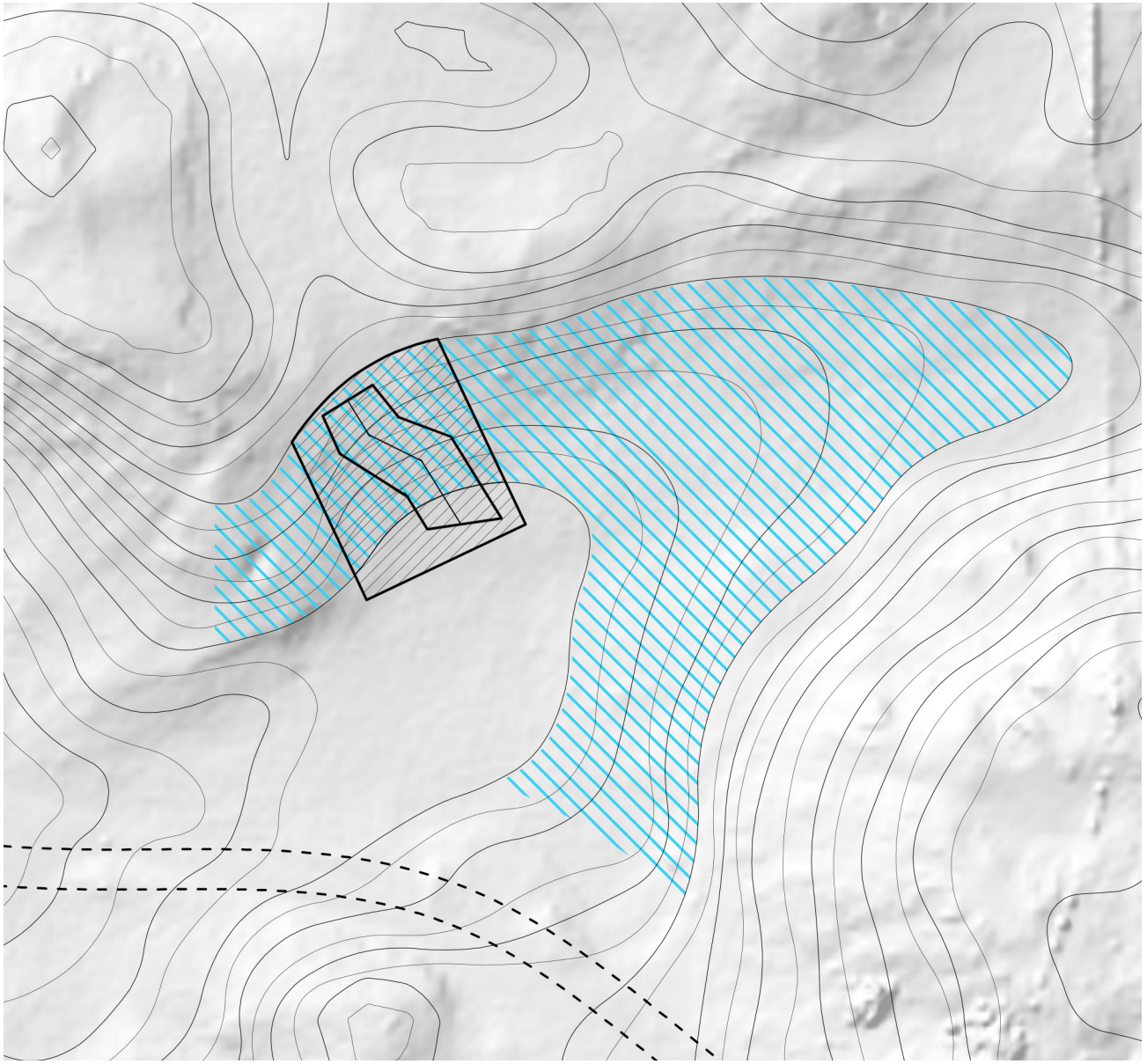
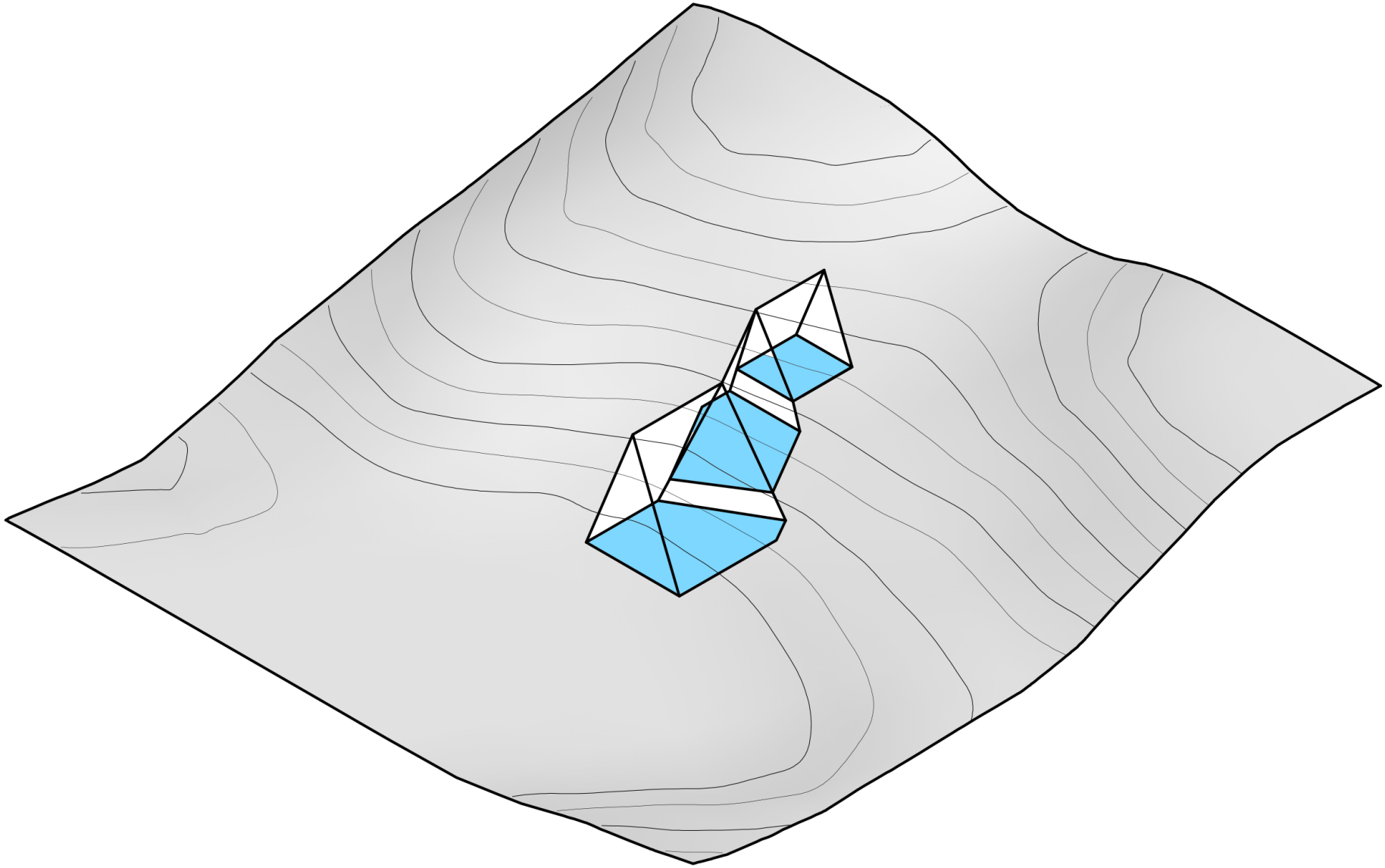
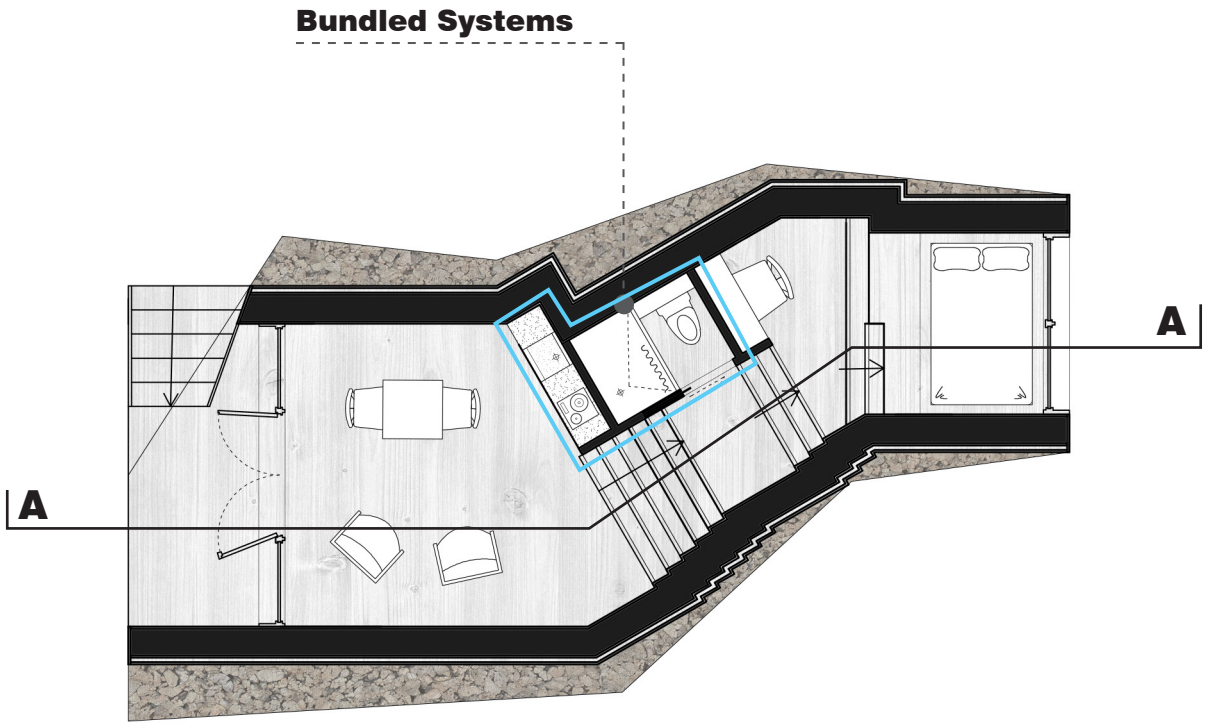


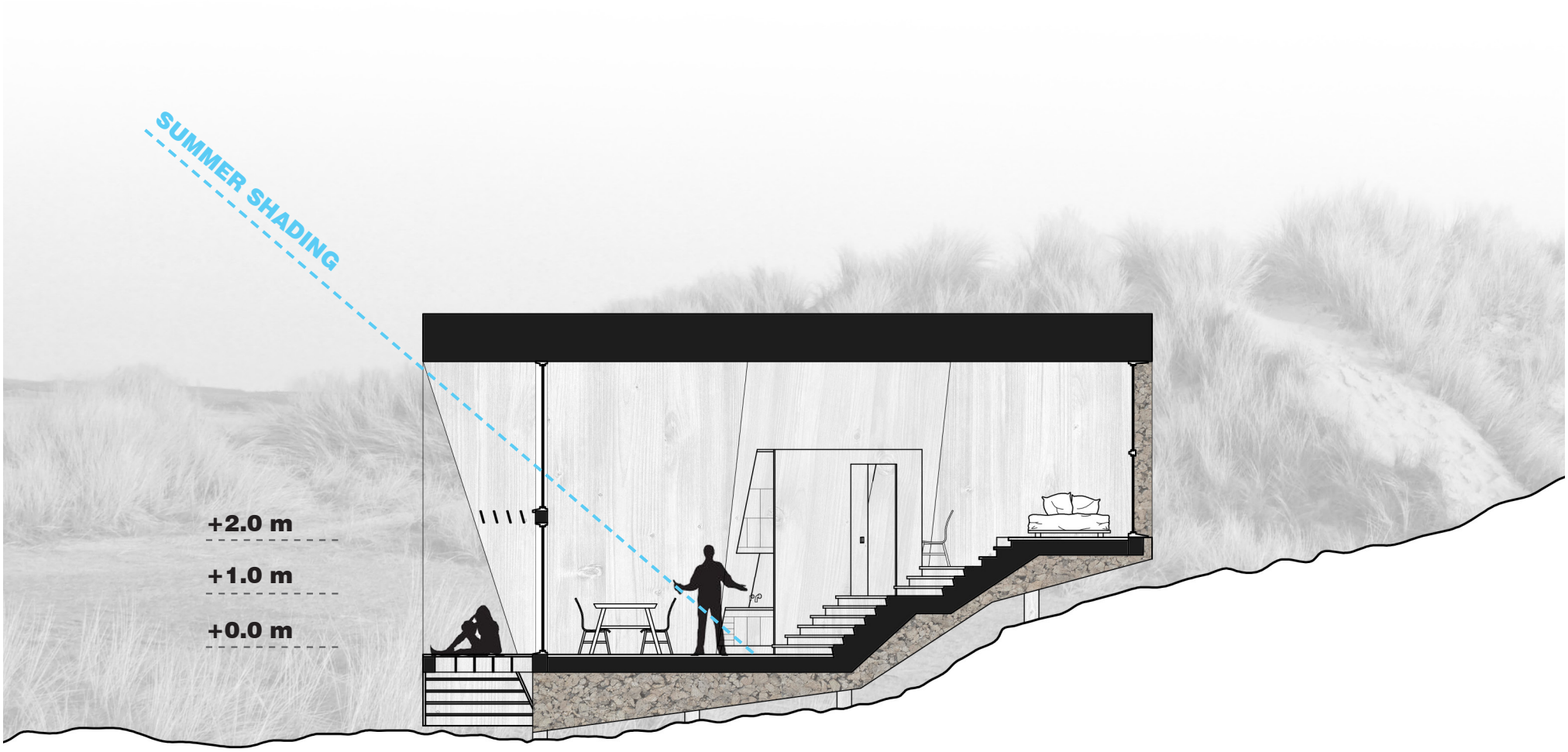
HOME 01



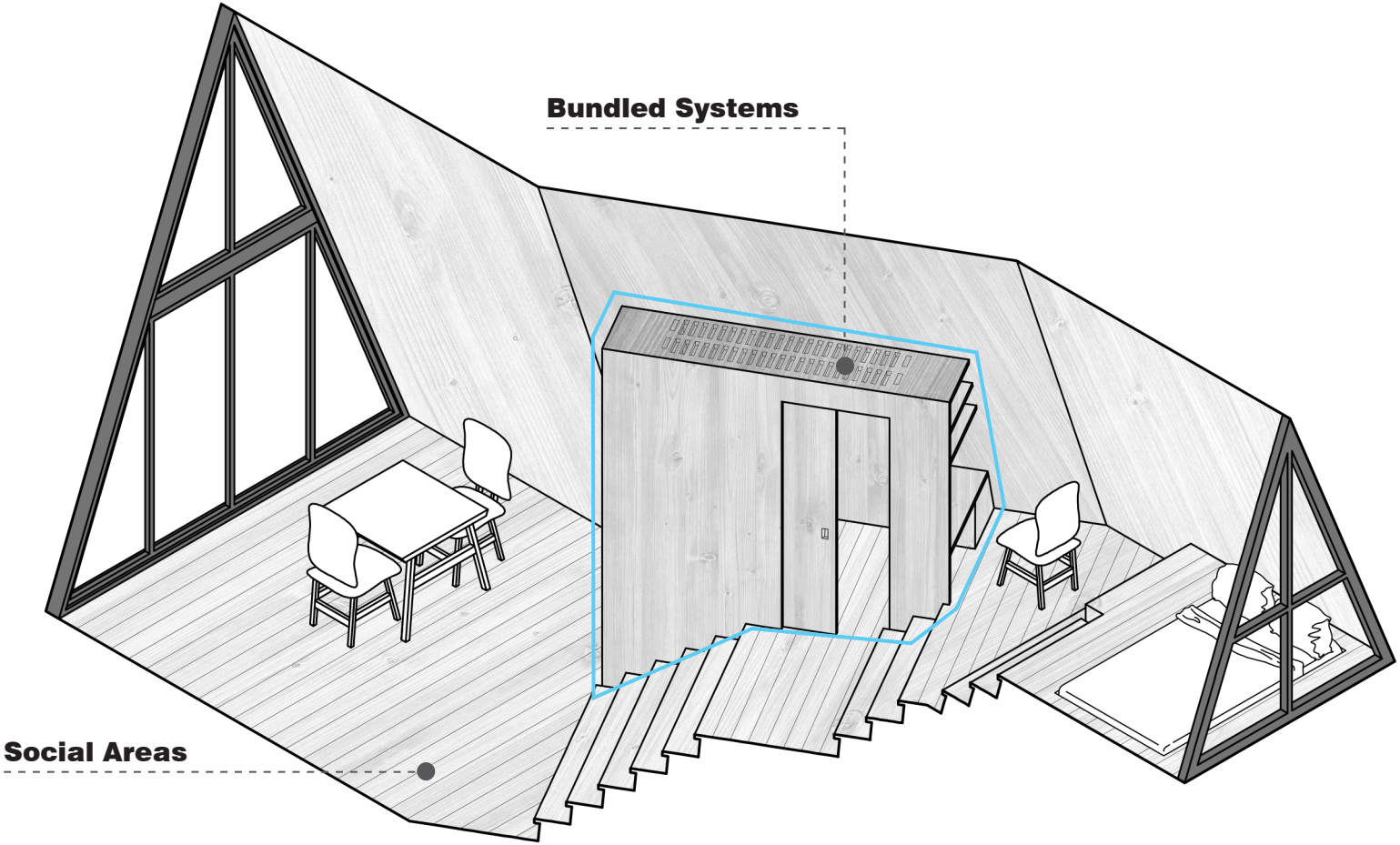
PLANS & SECTIONS - HOME 01



PLANS & SECTIONS - HOME 01



PLANS & SECTIONS - HOME 01



HOME 02

Allocated Land

Chosen Lot

Visual Connection

Trails / Access Route

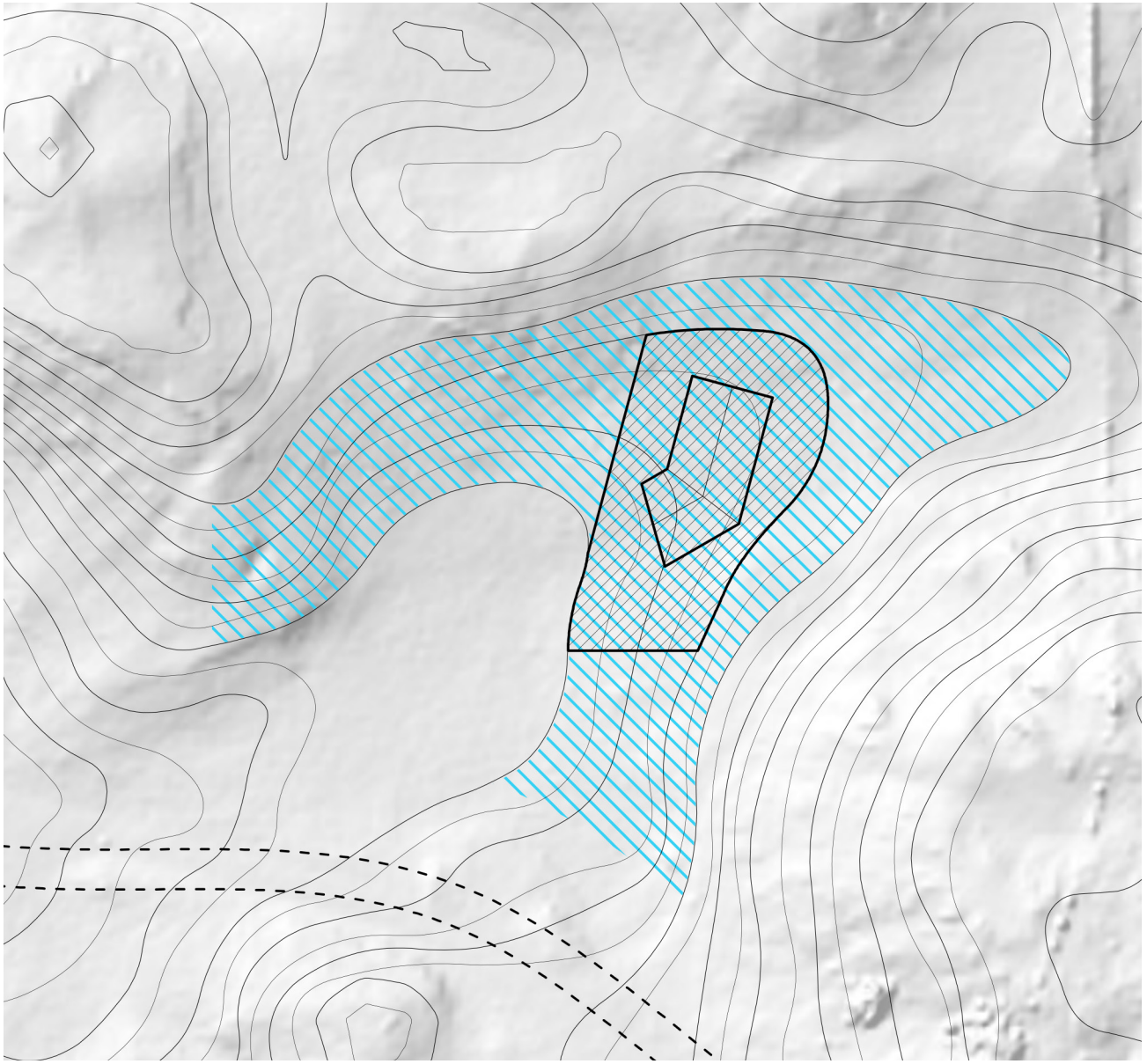
HOME #2 PROGRAMME

Unit Capacity	**4-6**
Limited Mobility	**Yes**
Full Bathroom	**Yes**
Special Addition	**none**
Mezzanine	**Yes**

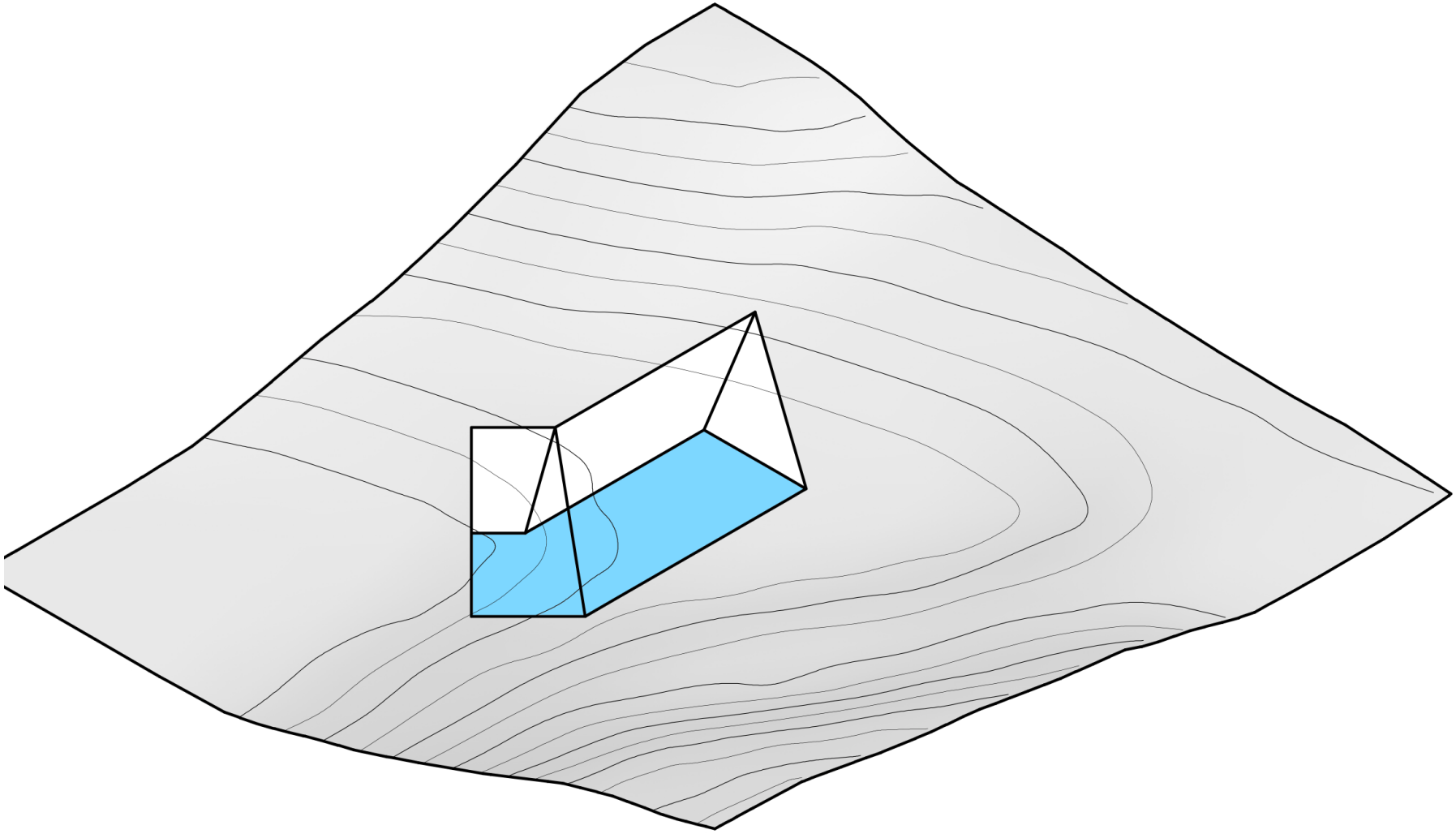
N

Main Wind Direction

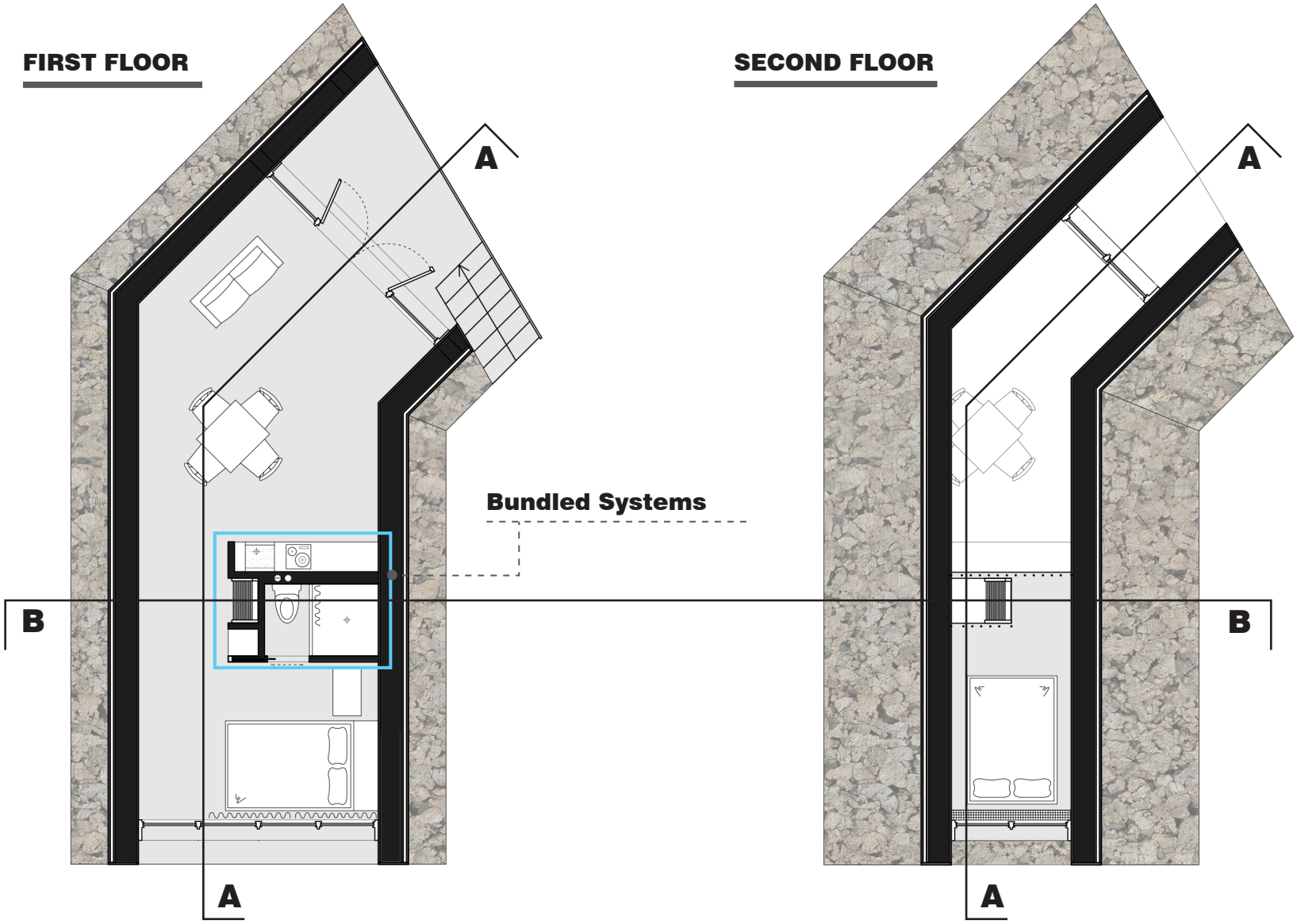
W



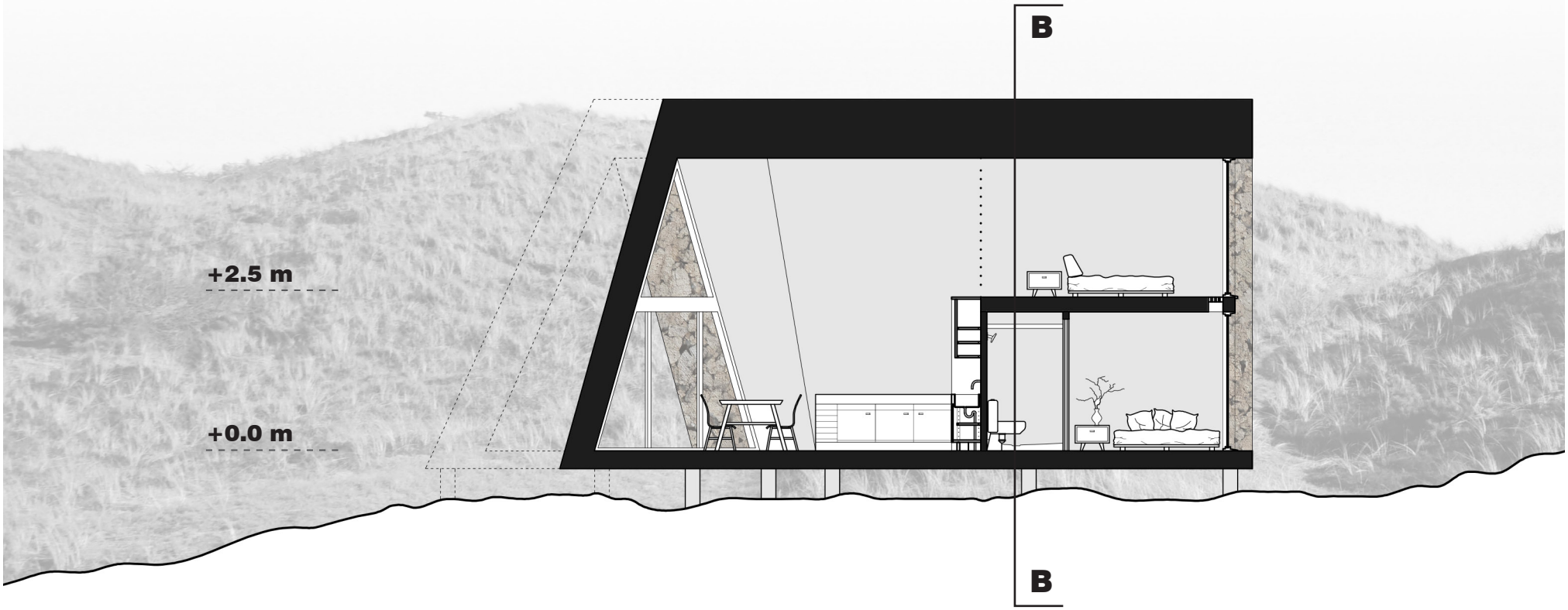
HOME 02



PLANS & SECTIONS - HOME 02

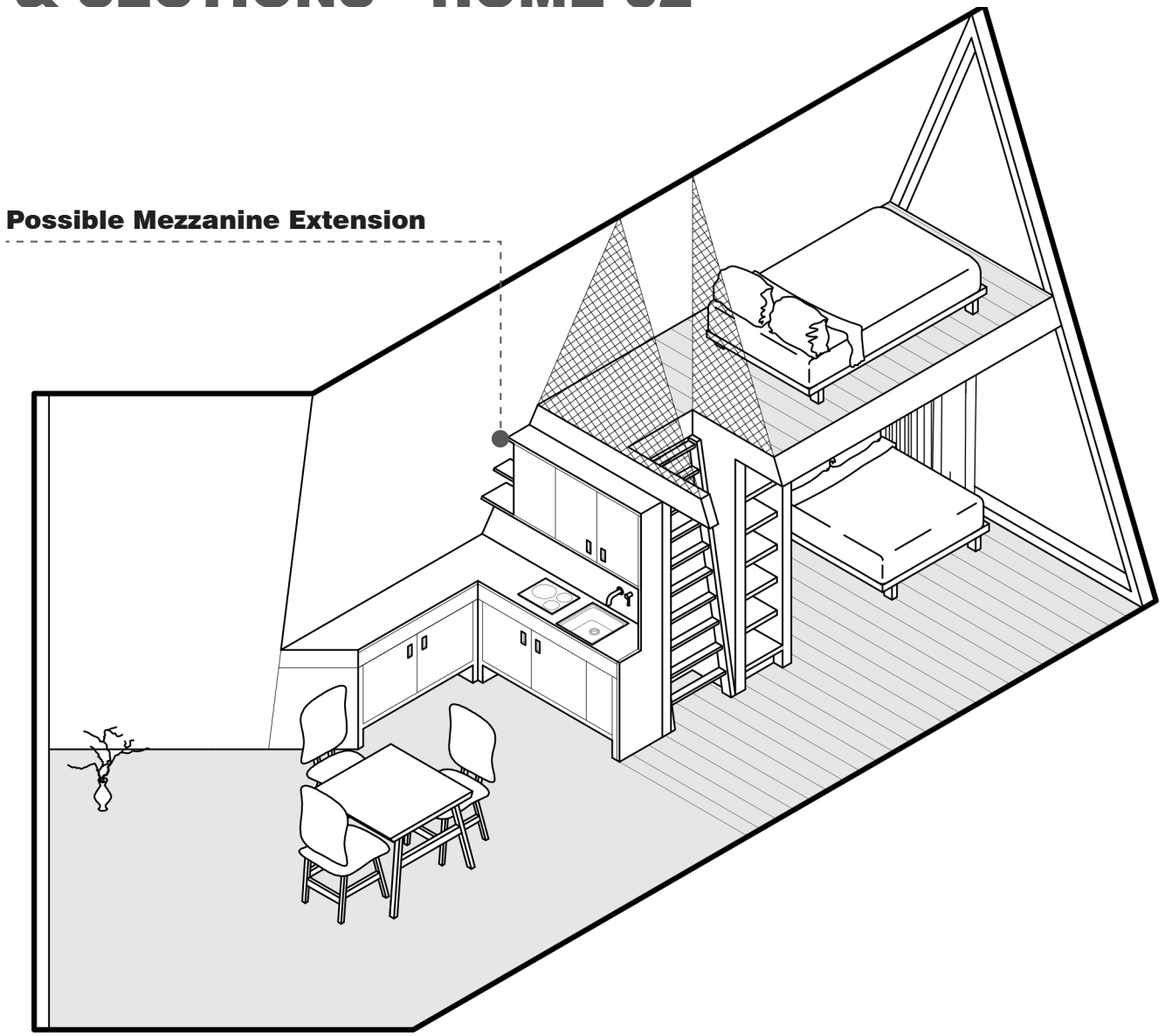


PLANS & SECTIONS - HOME 02



PLANS & SECTIONS - HOME 02

PLANS & SECTIONS - HOME 02



HOME 03

Allocated Land

Chosen Lot

Visual Connection

Trails / Access Route

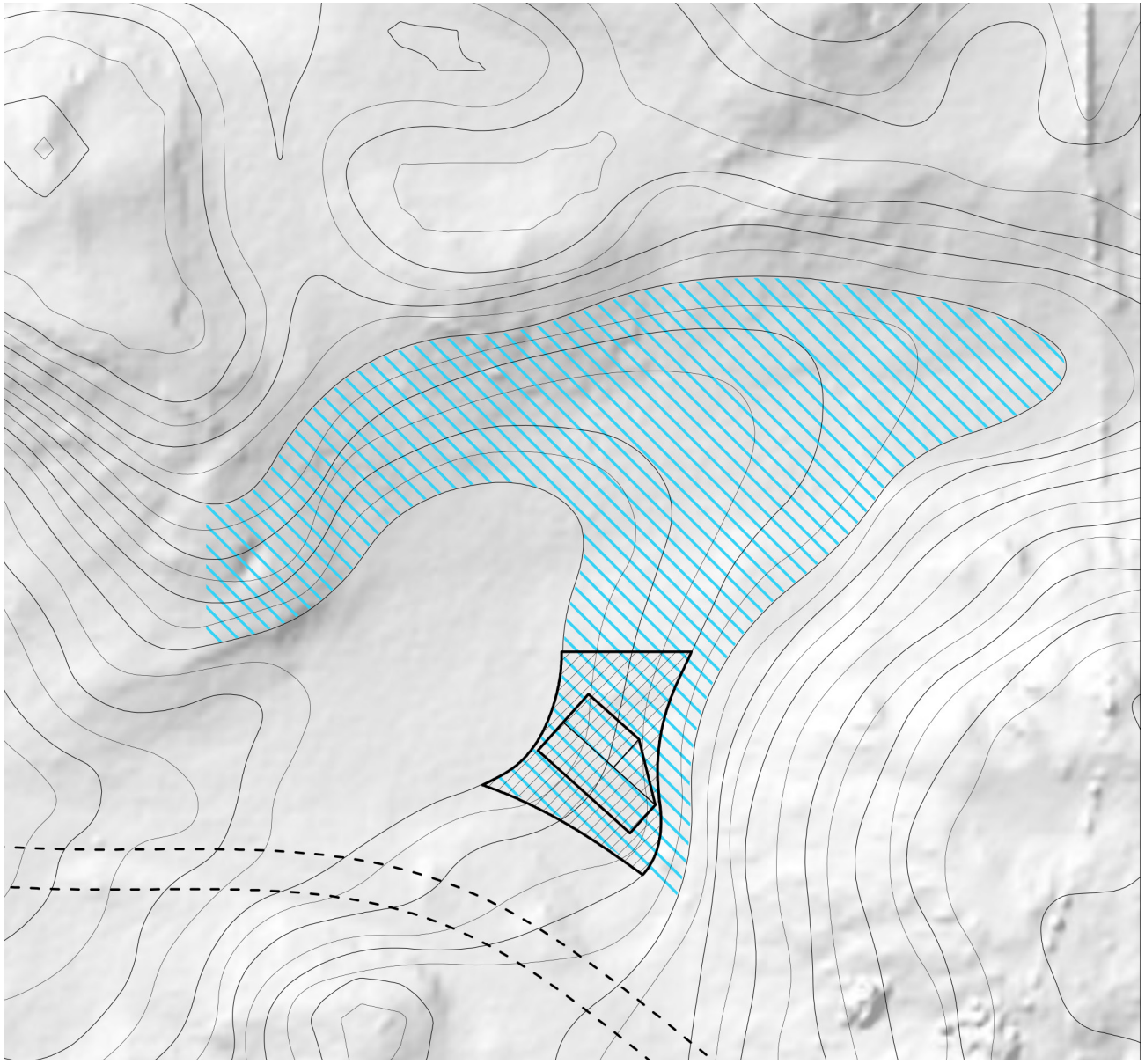
HOME #3 PROGRAMME

Unit Capacity	**1-2**
Limited Mobility	**No**
Full Bathroom	**Yes**
Special Addition	**study**
Mezzanine	**Yes**

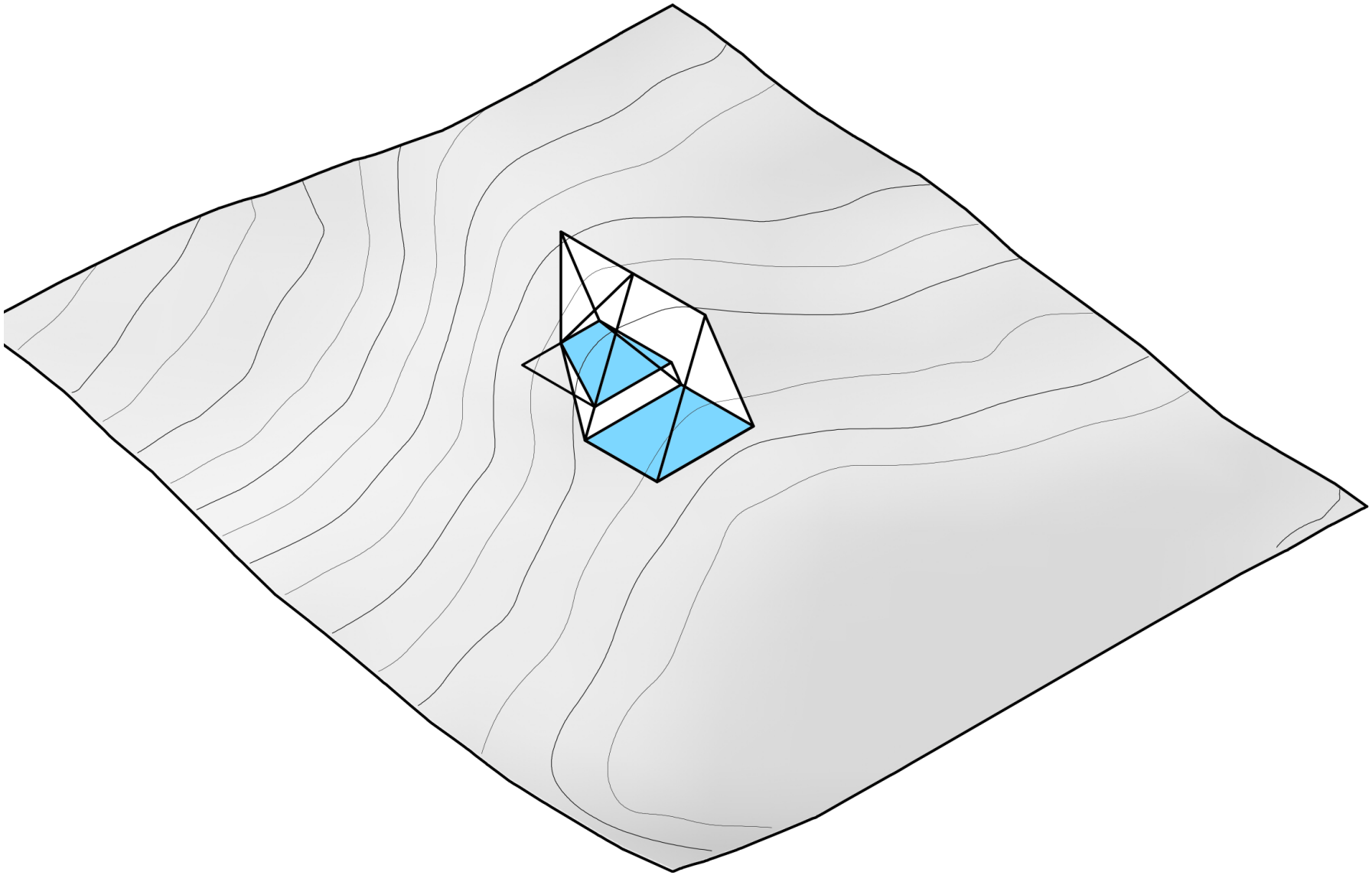
N

Main Wind Direction

W



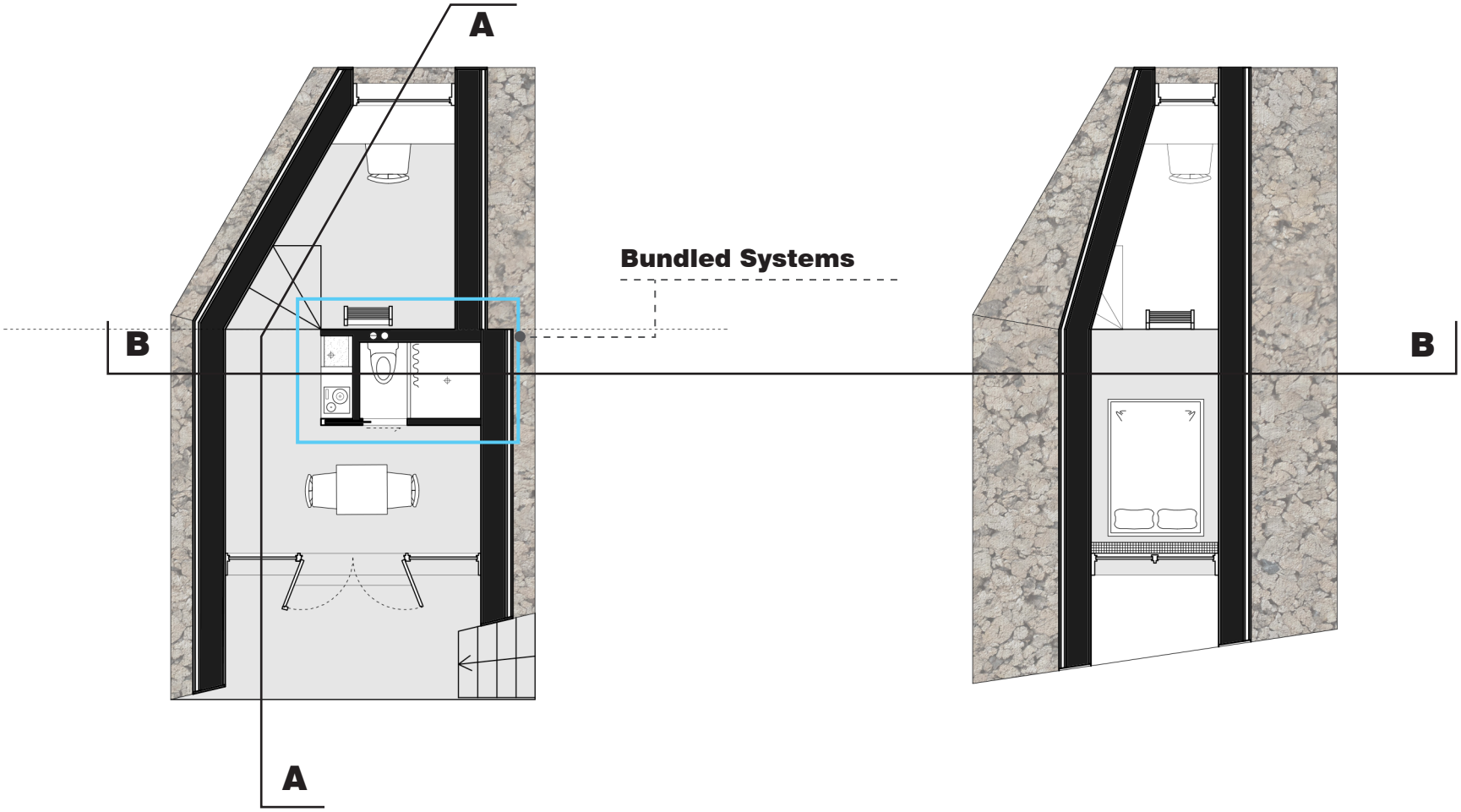
HOME 03



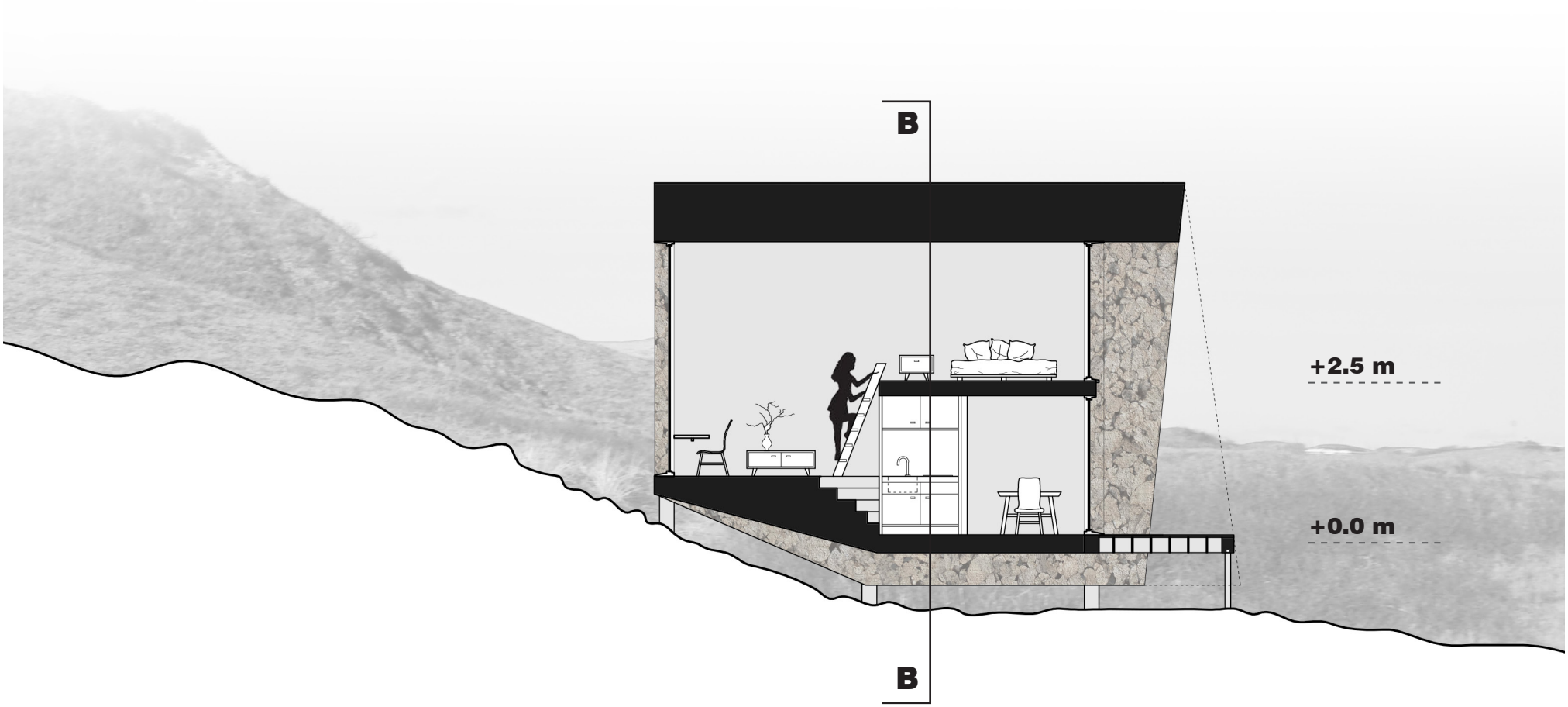
PLANS & SECTIONS - HOME 03

FIRST FLOOR

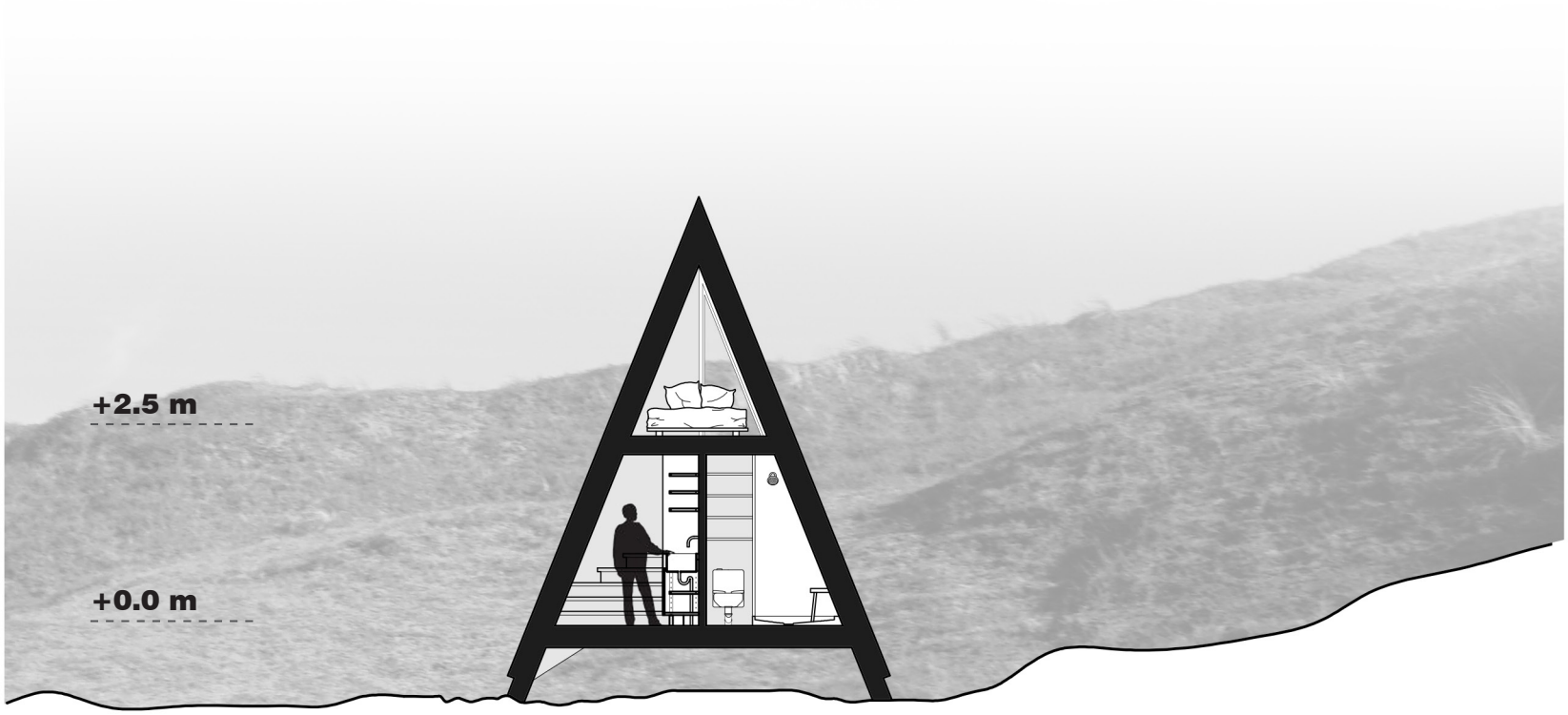
SECOND FLOOR



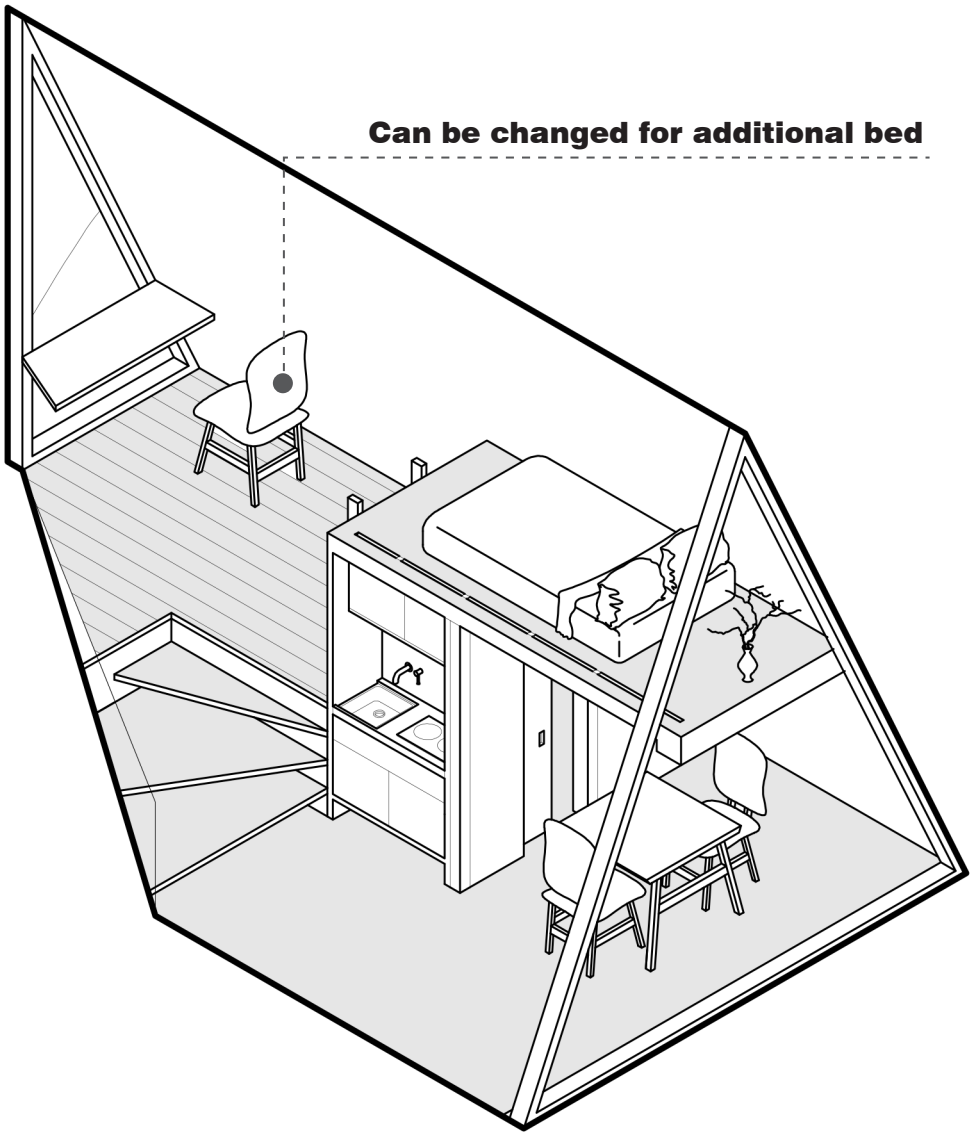
PLANS & SECTIONS - HOME 03



PLANS & SECTIONS - HOME 03

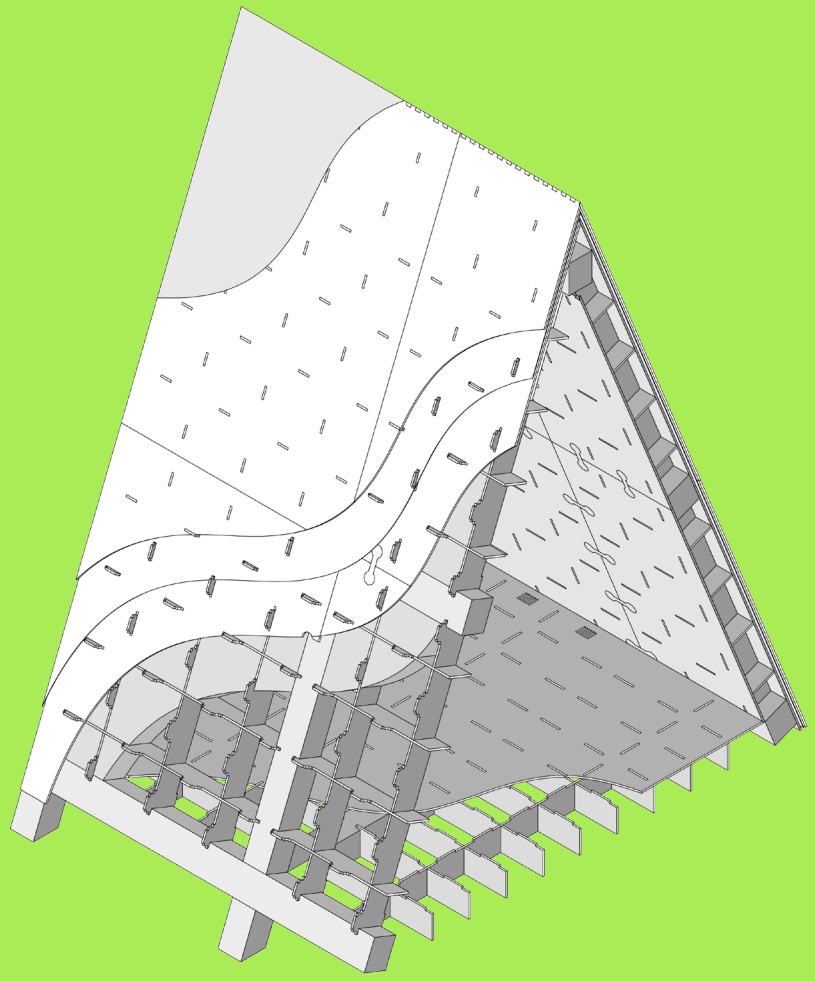


PLANS & SECTIONS - HOME 03



Sec. 3

BIOBASED STRUCTURE



MATERIAL CONSTRAINTS

FORBIDDEN PRODUCTS

a. Brick
b. Caulking
c. Concrete
d. Cladding (Metal or Synth.)
e. Epoxy
f. Geotextiles
g. Nails
h. Petroleum-Based Paints
i. Photovoltaic Panels
j Plastics (Oil-Based)
k. Polyurethane
l. Rigid Insulation
m. Vapor Barrier
n. Varnish

MATERIAL CONSTRAINTS

FORBIDDEN PRODUCTS

a. Brick
b. Caulking
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d. Cladding (Metal or Synth.)
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g. Nails
h. Petroleum-Based Paints
i. Photovoltaic Panels
j Plastics (Oil-Based)
k. Polyurethane
l. Rigid Insulation
m. Vapor Barrier
n. Varnish

IRREPLACEABLE PRODUCTS

o. Electrical Wiring
p. Glass
q. Heating Systems
r. Mechanical Systems
s. Sealing Tape

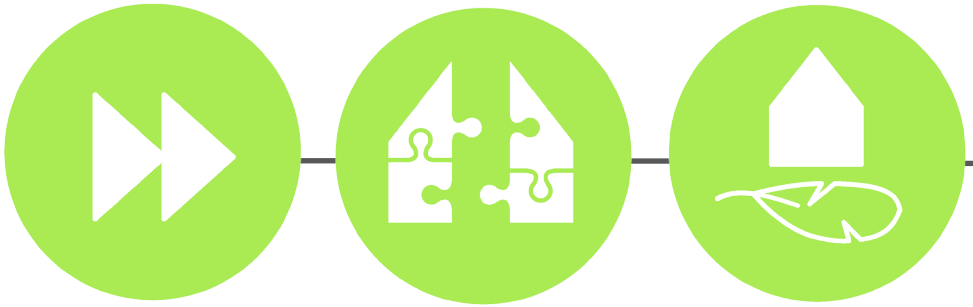
ENCOURAGED PRODUCTS

t. Wood
u. Hemp
v. Cork
w. Pine Adhesives
x. Flax Oil Paints

CONSTRUCTION METHODS

I. Structural task to accomplish

II. Specific detail requirements



PREREQUISITES

Functions as... **Roof** ☐
Functions as... **Wall** ☐
Includes... **Cladding** ☐

Nail-Less ☐
Capillary Break ☐

Lightweight ☐
Fast Assembly ☐
Prefabricated ☐

COB CONSTRUCTION

PREREQUISITES

Functions as...	**Roof**	☐
Functions as...	**Wall**	■
Includes...	**Cladding**	■
	Nail-Less	■
	Capillary Break	☐
	Lightweight	☐
	Fast Assembly	☐
	Prefabricated	☐

STRAW-BALE CONSTRUCTION

PREREQUISITES

Functions as...	**Roof**	☐
Functions as...	**Wall**	■
Includes...	**Cladding**	☐
	Nail-Less	☐
	Capillary Break	☐
	Lightweight	☐
	Fast Assembly	☐
	Prefabricated	■

LOG CABIN CONSTRUCTION

PREREQUISITES

Functions as...	**Roof**	☐
Functions as...	**Wall**	■
Includes...	**Cladding**	■
	Nail-Less	■
	Capillary Break	☐
	Lightweight	☐
	Fast Assembly	☐
	Prefabricated	■

TIMBER FRAME / FRICTION JOINERY

PREREQUISITES

Functions as... **Roof**	■
Functions as... **Wall**	■
Includes... **Cladding**	☐
Nail-Less	■
Capillary Break	☐
Lightweight	■
Fast Assembly	■
Prefabricated	■

CNC MILLING

PREREQUISITES

Functions as...	**Roof**	■
Functions as...	**Wall**	■
Includes...	**Cladding**	☐
	Nail-Less	■
	Capillary Break	☐
	Lightweight	■
	Fast Assembly	■
	Prefabricated	■

TIMBER FRAME

PREREQUISITES

Functions as...	**Roof**	■
Functions as...	**Wall**	■
Includes...	**Cladding**	☐
	Nail-Less	■
	Capillary Break	☐
	Lightweight	■
	Fast Assembly	■
	Prefabricated	■

+

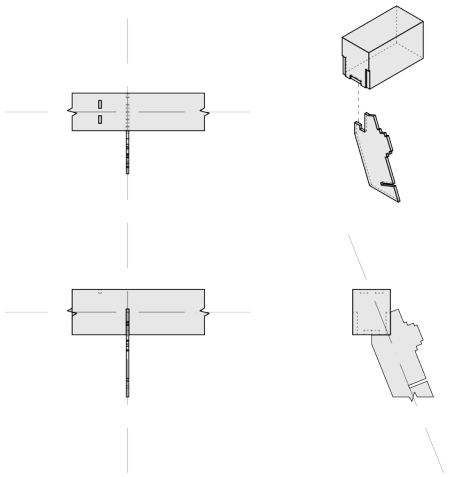
CNC MILLING

PREREQUISITES

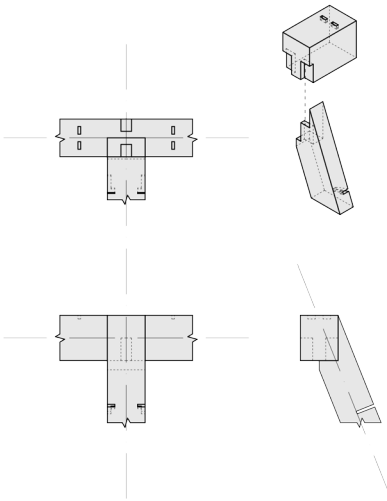
Functions as...	**Roof**	■
Functions as...	**Wall**	■
Includes...	**Cladding**	☐
	Nail-Less	■
	Capillary Break	☐
	Lightweight	■
	Fast Assembly	■
	Prefabricated	■

TIMBER FRAME SKELETON

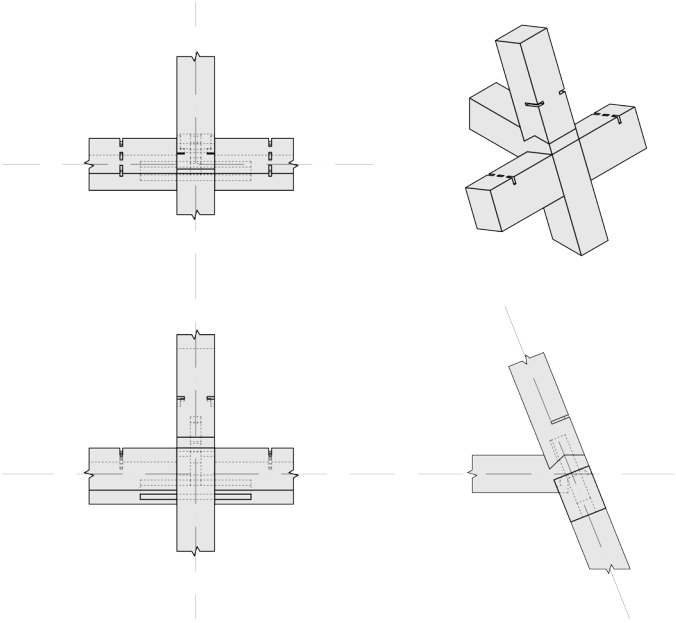
i. Ridge to vertical support



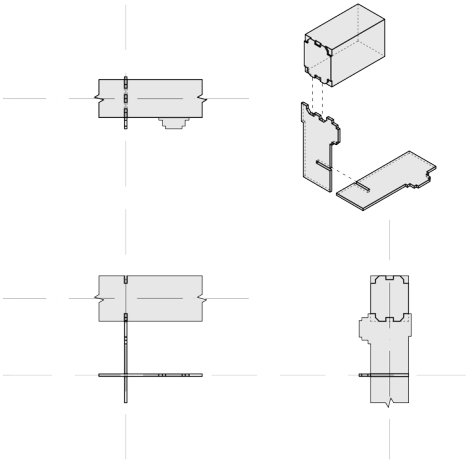
ii. Ridge to column



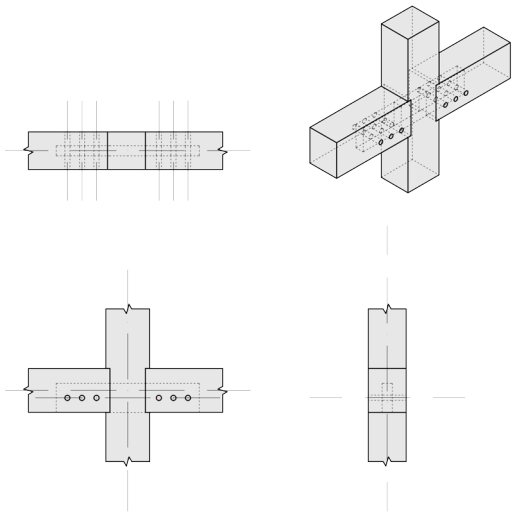
iii. Girder - Column - Pile



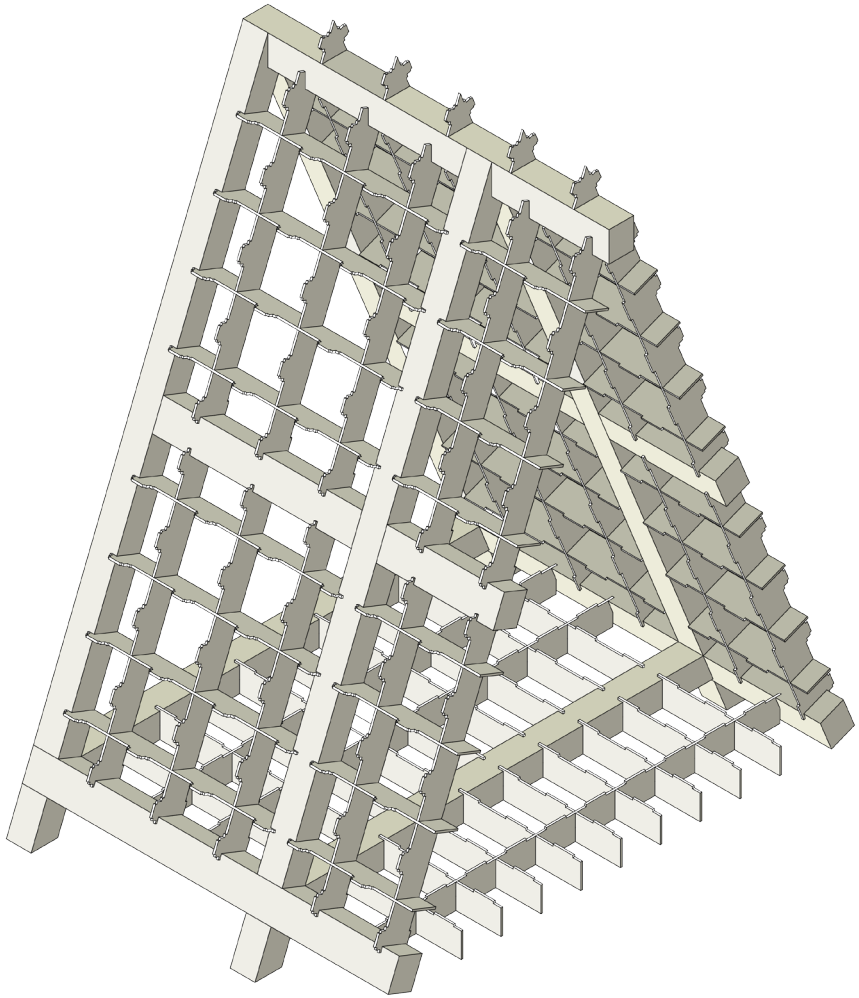
iv. Girder to vertical support

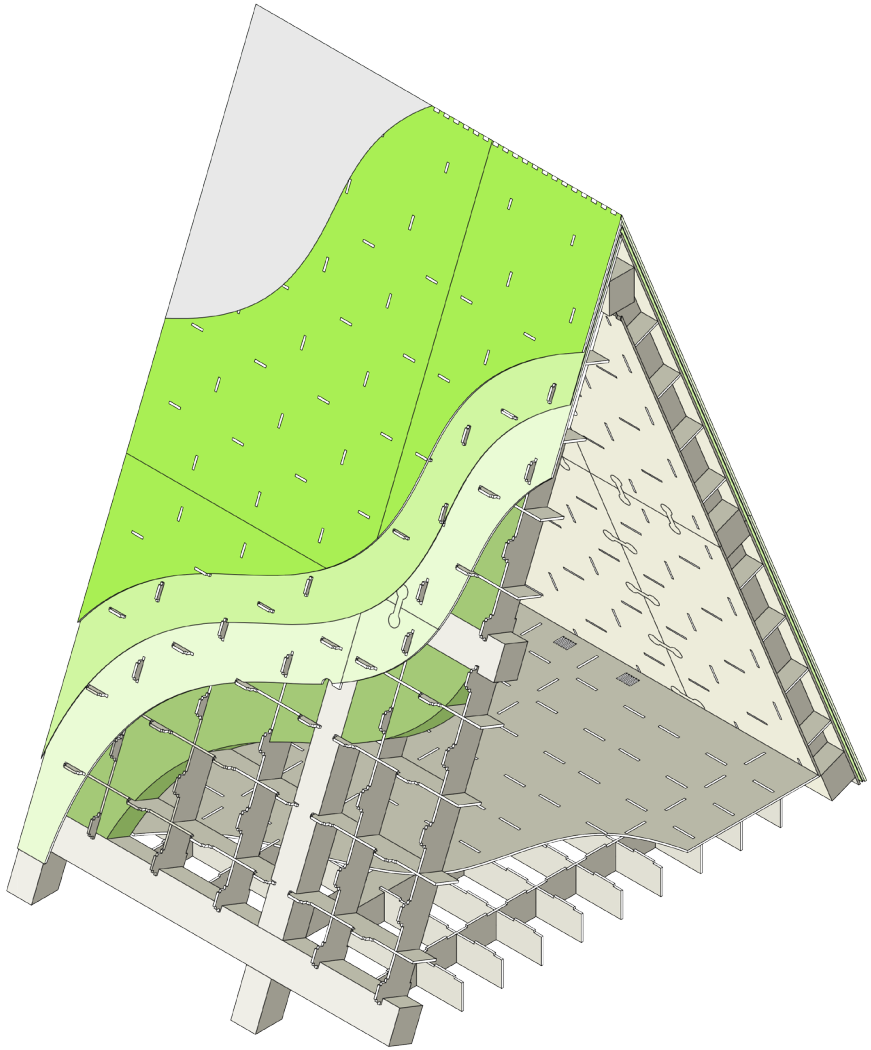


v. Girder to column

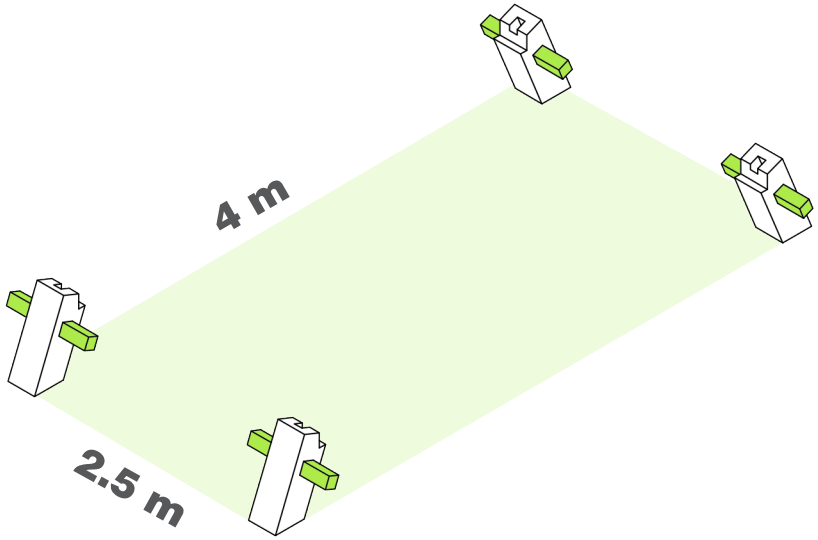


+ CNC MILLING





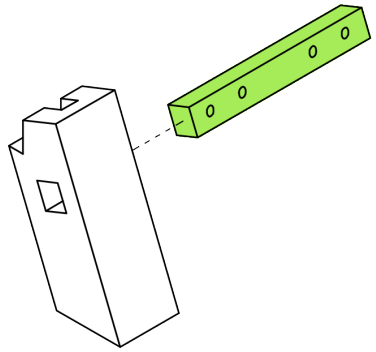
1. FOUNDATION



EUROPEAN SPRUCE

- BIOBASED
- BIODEGRADABLE
- RENEWABLE
- LIGHTWEIGHT
- WEATHER RESISTANT
- IMPACT RESILIENT

-0.46 kg CO_2 / kg
carbon footprint

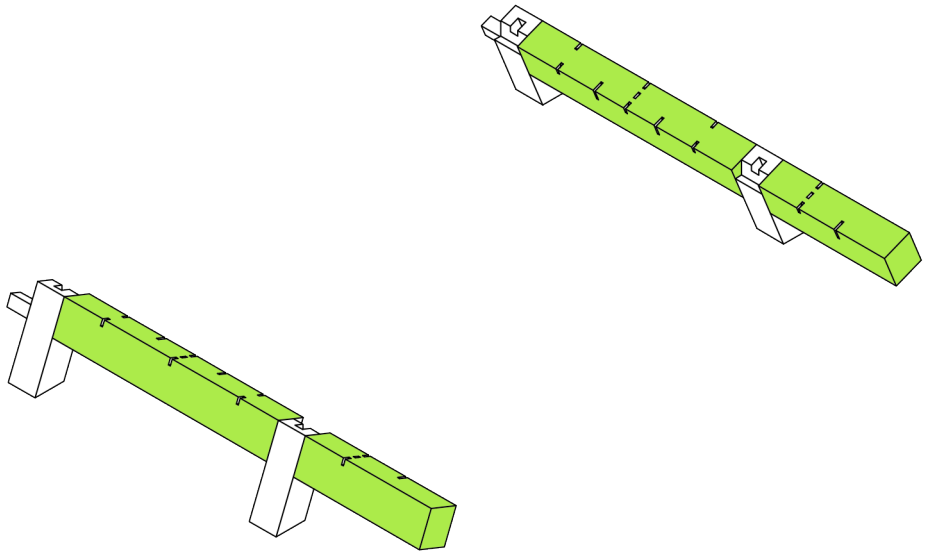


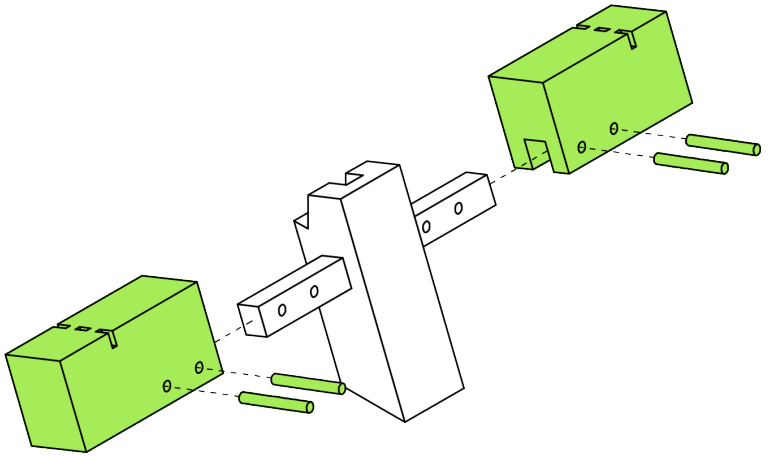
2. GIRDERS

EUROPEAN SPRUCE

- BIOBASED
- BIODEGRADABLE
- RENEWABLE
- LIGHTWEIGHT
- WEATHER RESISTANT
- IMPACT RESILIENT

-0.46 kg CO_2 / kg
carbon footprint



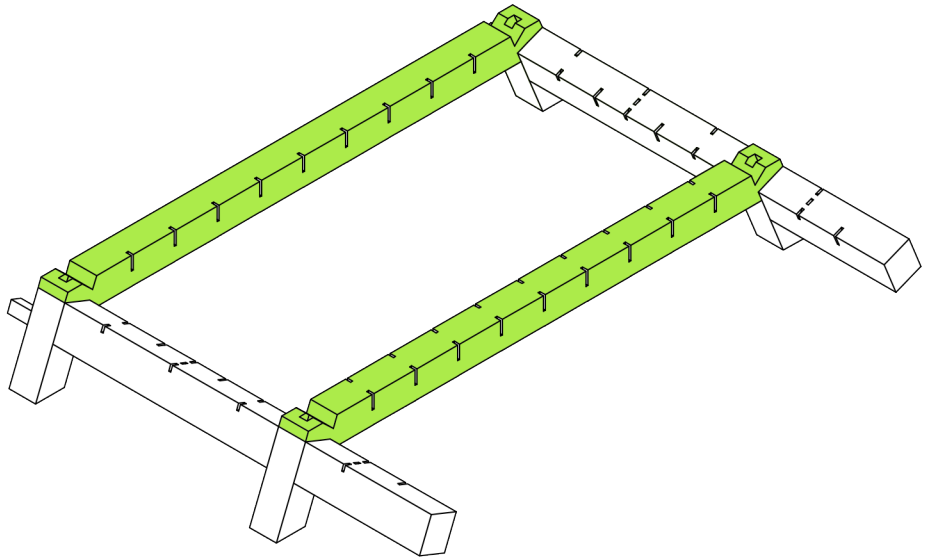


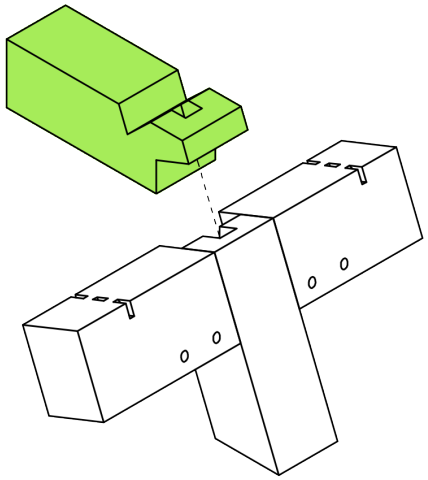
3. FLOOR BEAMS

EUROPEAN SPRUCE

- BIOBASED
- BIODEGRADABLE
- RENEWABLE
- LIGHTWEIGHT
- WEATHER RESISTANT
- IMPACT RESILIENT

-0.46 kg CO_2 / kg
carbon footprint



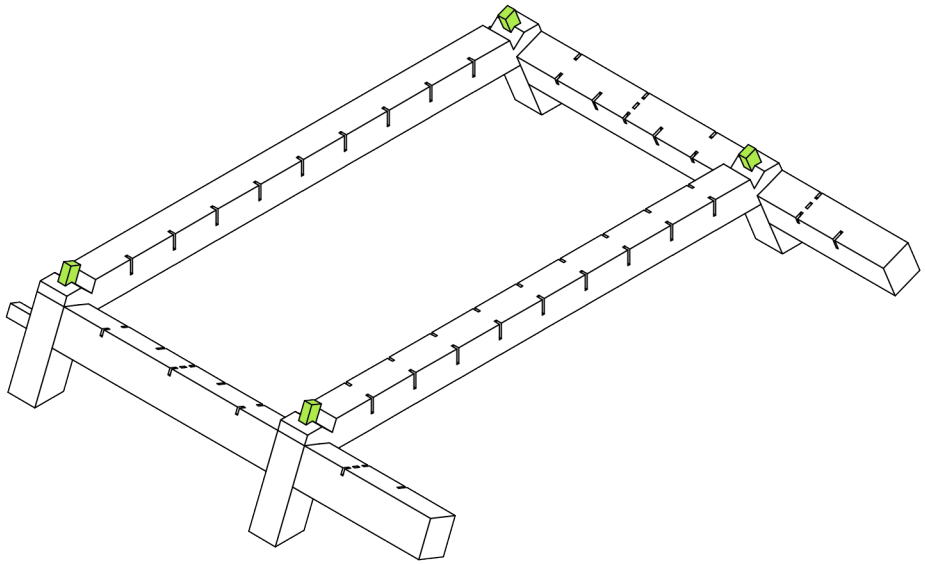


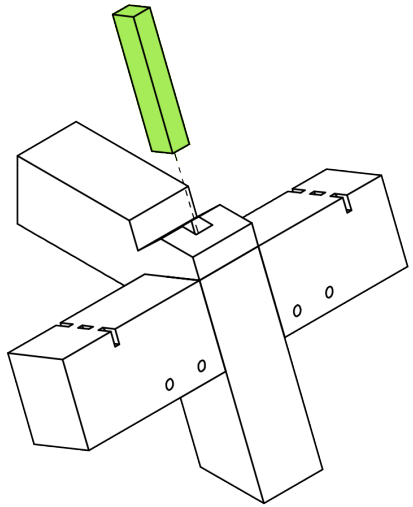
4. SQUARE PEG

EUROPEAN SPRUCE

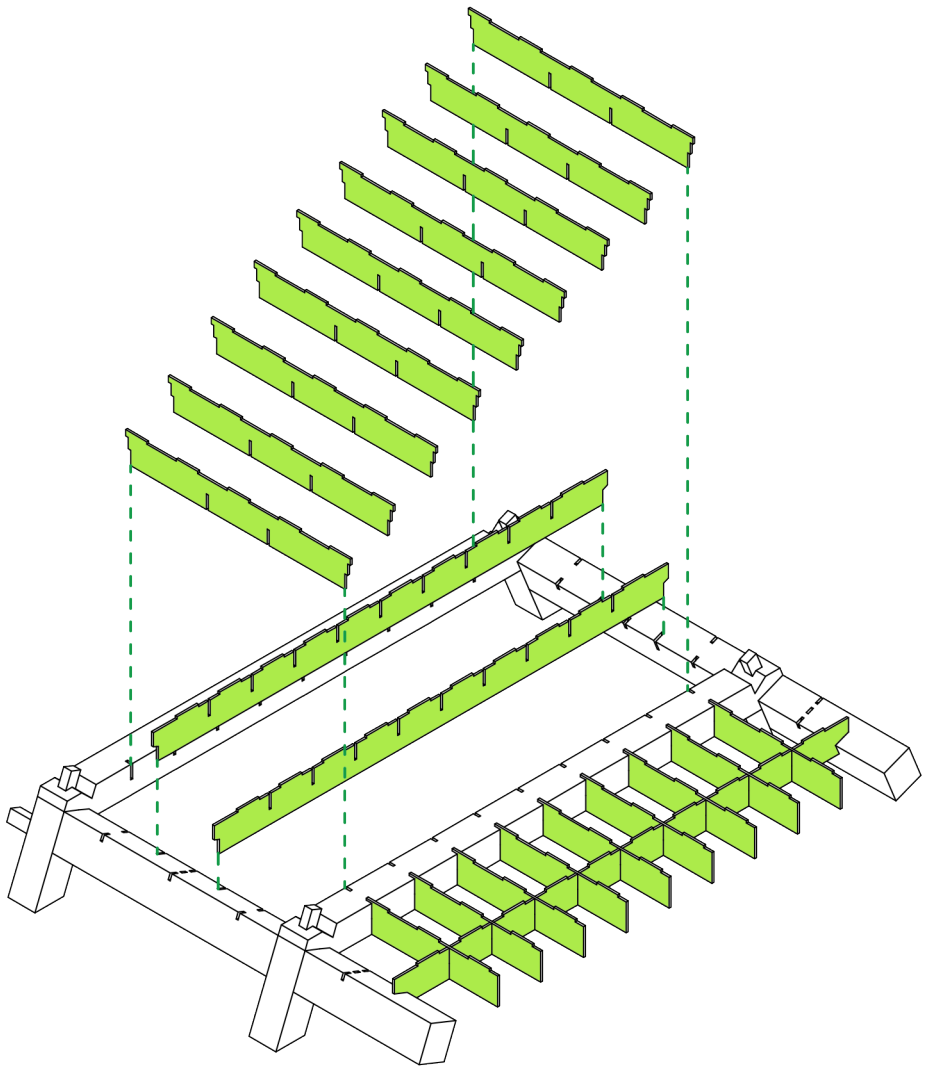
- BIOBASED
- BIODEGRADABLE
- RENEWABLE
- LIGHTWEIGHT
- WEATHER RESISTANT
- IMPACT RESILIENT

-0.46 kg CO_2 / kg
carbon footprint





5. FLOOR SUPPORT



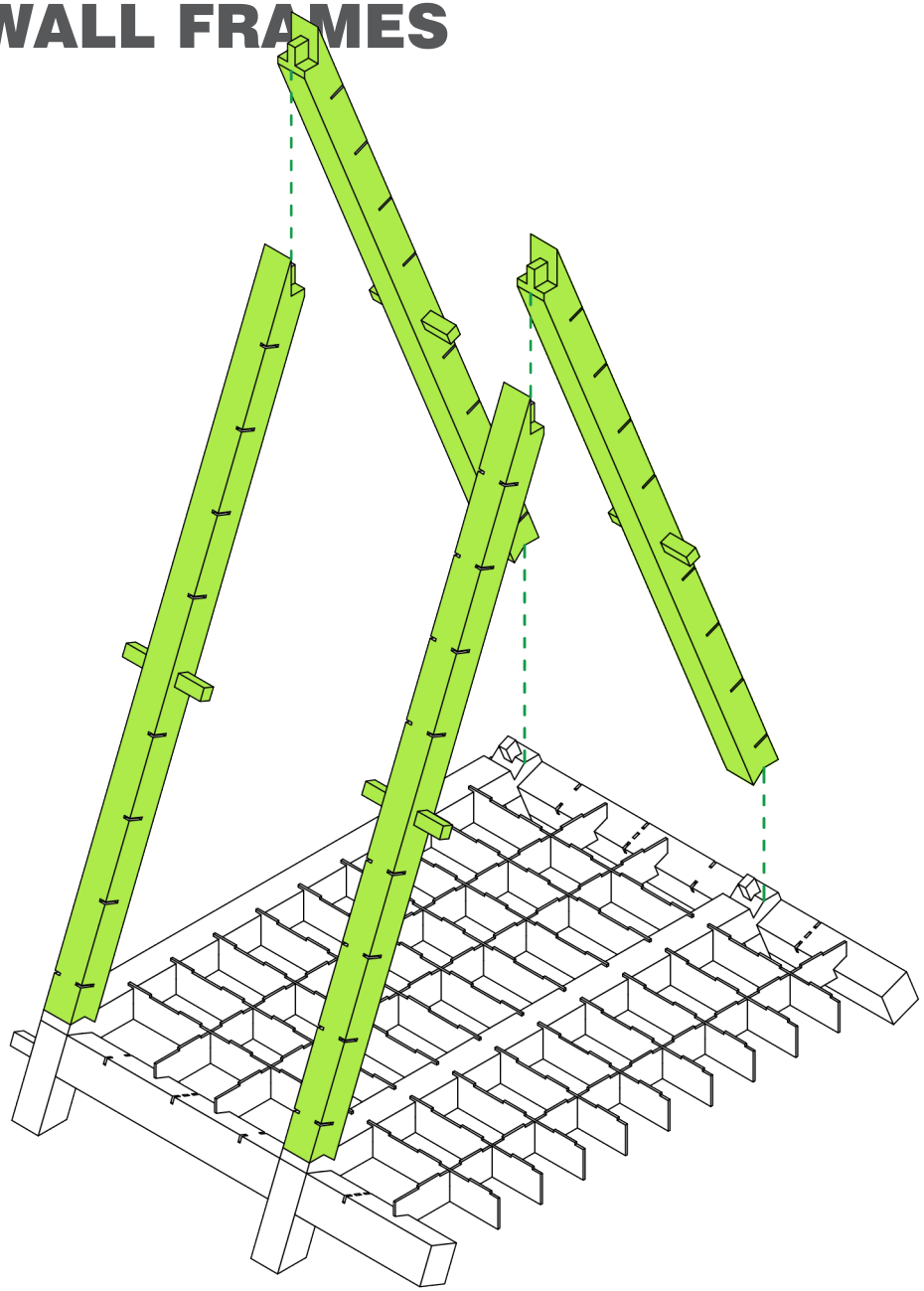
18 mm PLYWOOD

- BIOBASED
- BIODEGRADABLE
- RENEWABLE
- LIGHTWEIGHT
- ☐ WEATHER RESISTANT
- IMPACT RESILIENT

-0.29 kg CO_2 / kg

carbon footprint

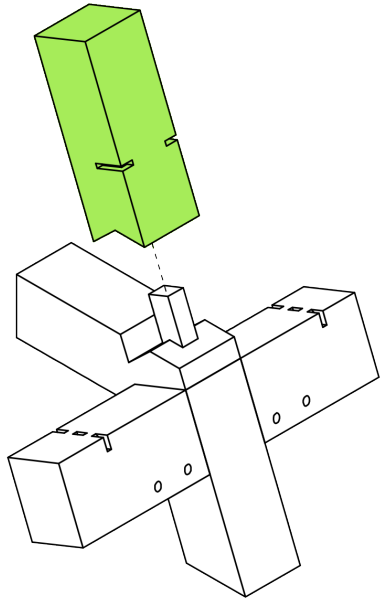
6. WALL FRAMES



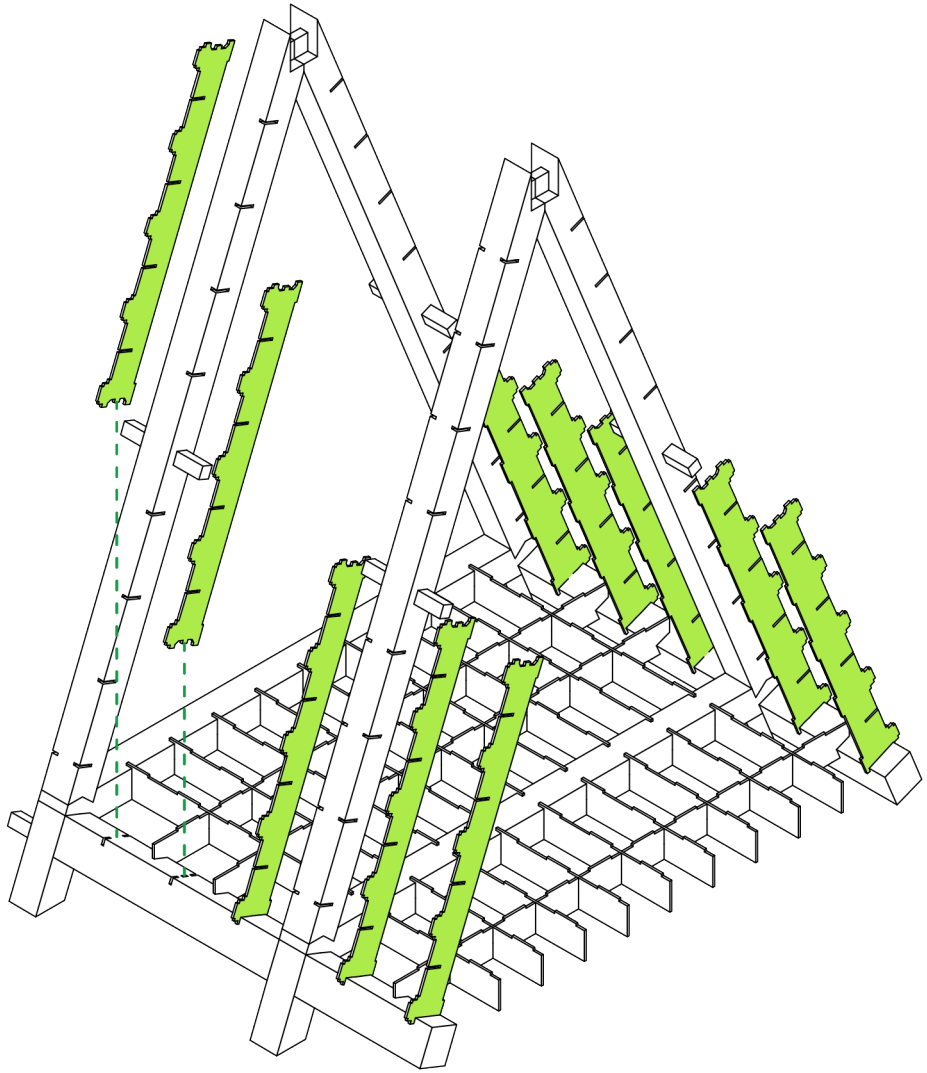
EUROPEAN SPRUCE

- BIOBASED
- BIODEGRADABLE
- RENEWABLE
- LIGHTWEIGHT
- WEATHER RESISTANT
- IMPACT RESILIENT

-0.46 kg CO_2 / kg
carbon footprint



7. VERTICAL SUPPORT

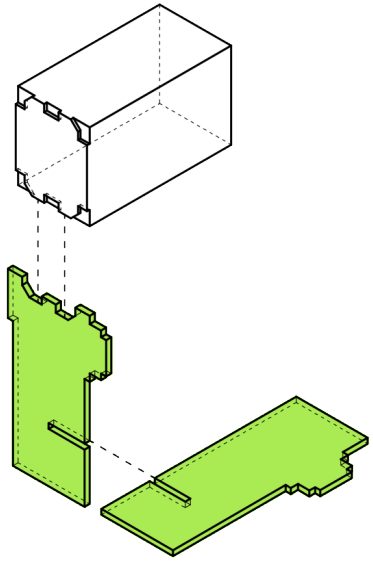


18 mm PLYWOOD

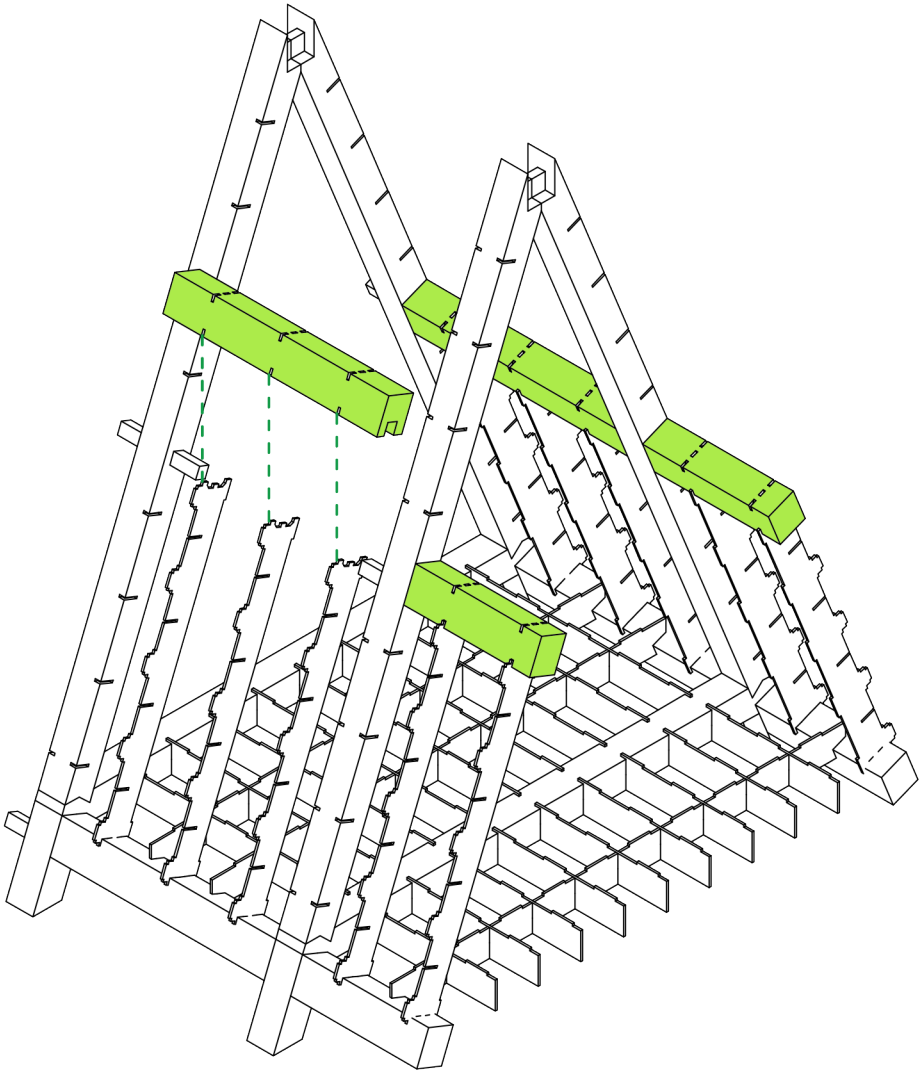
- [x] BIOBASED
- [x] BIODEGRADABLE
- [x] RENEWABLE
- [x] LIGHTWEIGHT
- [ ] WEATHER RESISTANT
- [x] IMPACT RESILIENT

-0.29 kg CO_2 / kg

carbon footprint



8. TOP GIRDER



EUROPEAN SPRUCE

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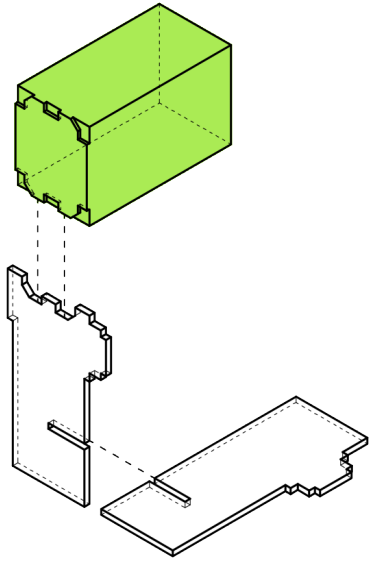
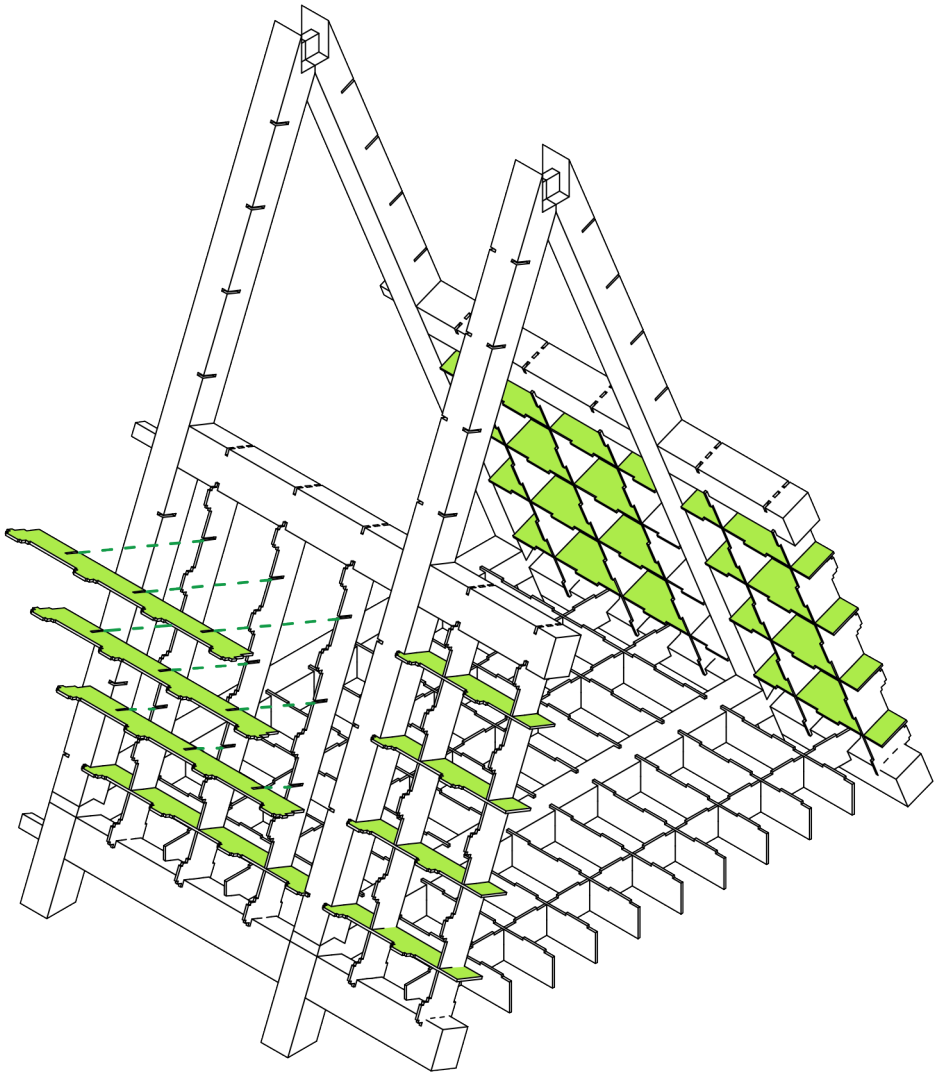
- BIODEGRADABLE
- RENEWABLE
- LIGHTWEIGHT
- WEATHER RESISTANT
- IMPACT RESILIENT

-0.46 kg CO_2 / kg
carbon footprint



9. HORIZONTAL SUPPORT

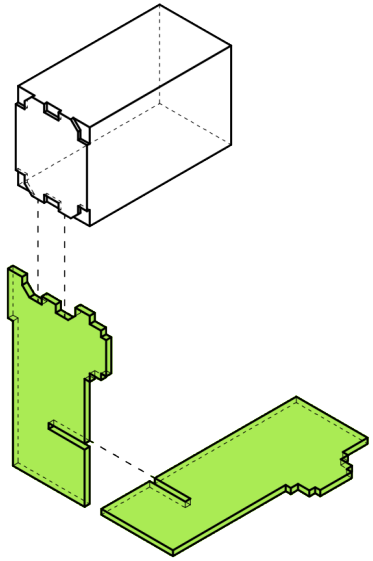


18 mm PLYWOOD

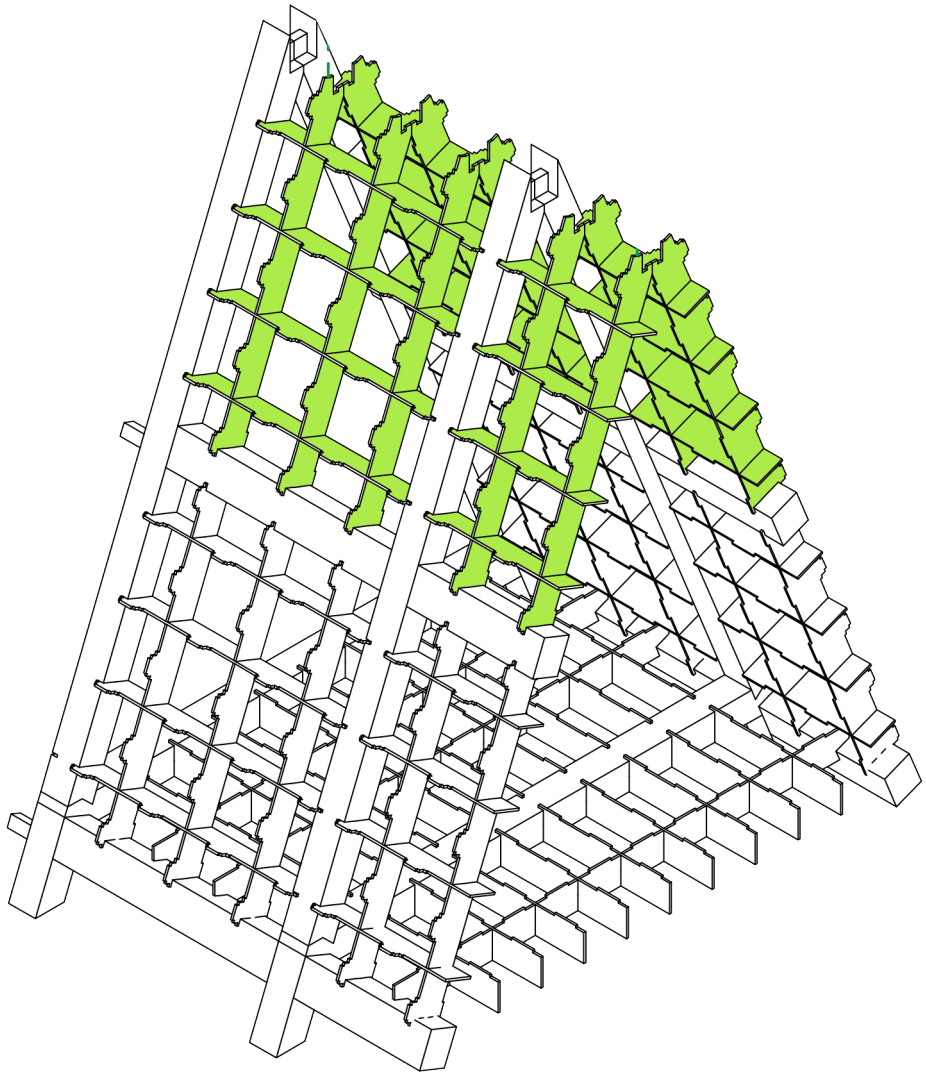
- [x] BIOBASED
- [x] BIODEGRADABLE
- [x] RENEWABLE
- [x] LIGHTWEIGHT
- [ ] WEATHER RESISTANT
- [x] IMPACT RESILIENT

-0.29 kg CO_2 / kg

carbon footprint



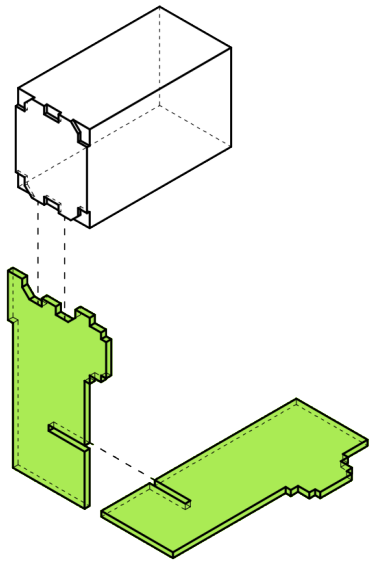
10. TOP. HORIZONTAL & TOP VERTICAL SUPPORT



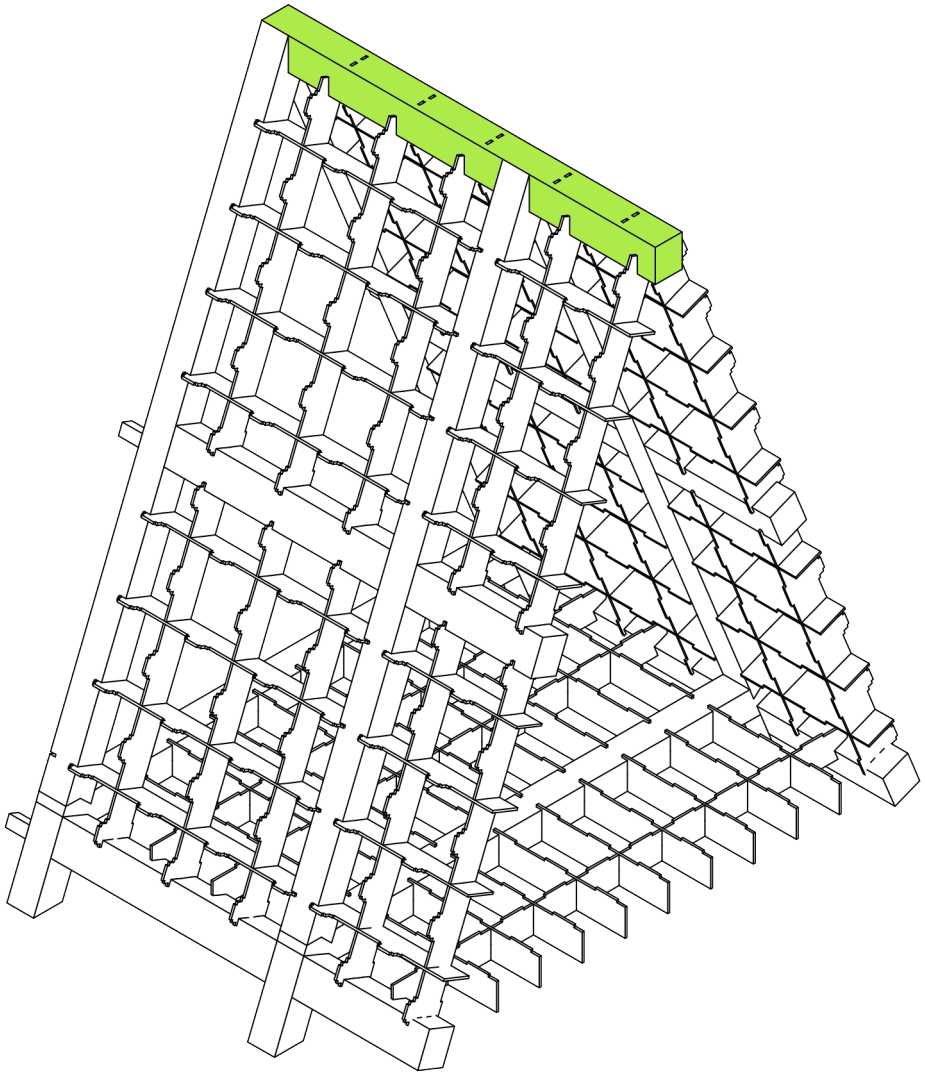
18 mm PLYWOOD

- [x] BIOBASED
- [x] BIODEGRADABLE
- [x] RENEWABLE
- [x] LIGHTWEIGHT
- [ ] WEATHER RESISTANT
- [x] IMPACT RESILIENT

-0.29 kg CO_2 / kg
carbon footprint



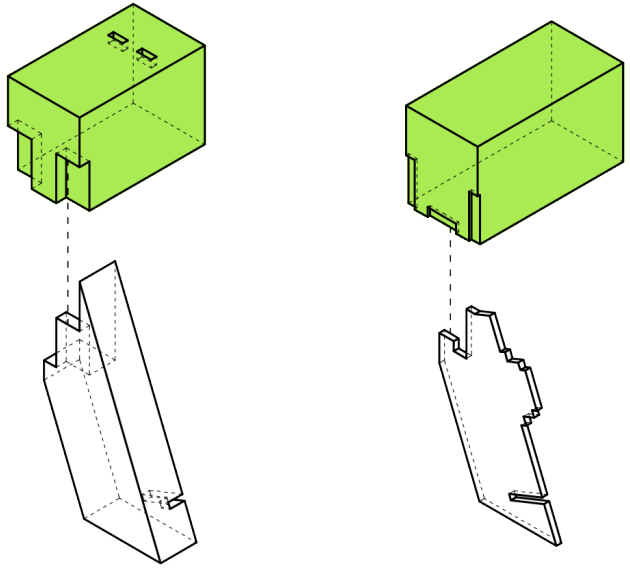
11. RIDGE



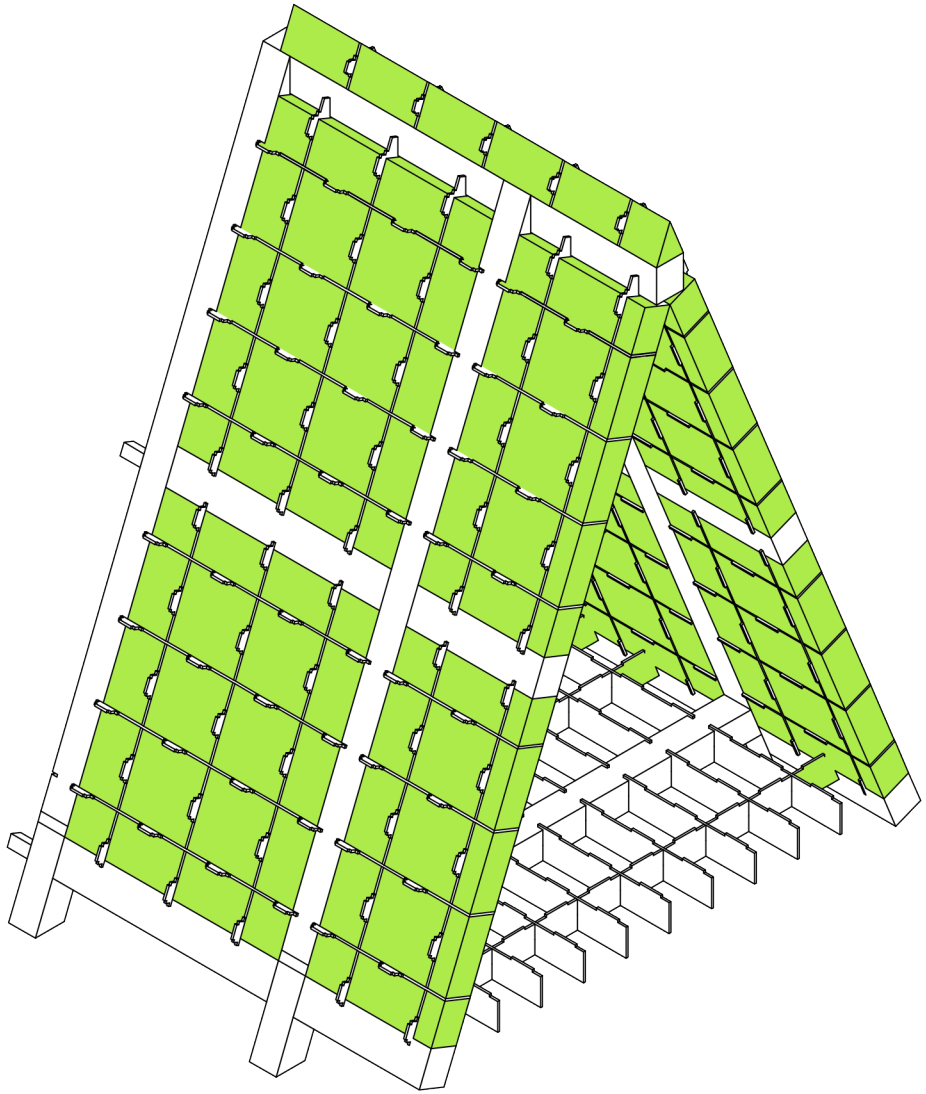
EUROPEAN SPRUCE

- BIOBASED
- BIODEGRADABLE
- RENEWABLE
- LIGHTWEIGHT
- WEATHER RESISTANT
- IMPACT RESILIENT

-0.46 kg CO_2 / kg
carbon footprint



12. HEMP INSULATION



HEMP FIBRE INSULATION

- BIOBASED
- BIODEGRADABLE
- RENEWABLE
- LIGHTWEIGHT
- THERMAL RESISTANT
- IMPACT RESILIENT

-0.73 to **-0.50**

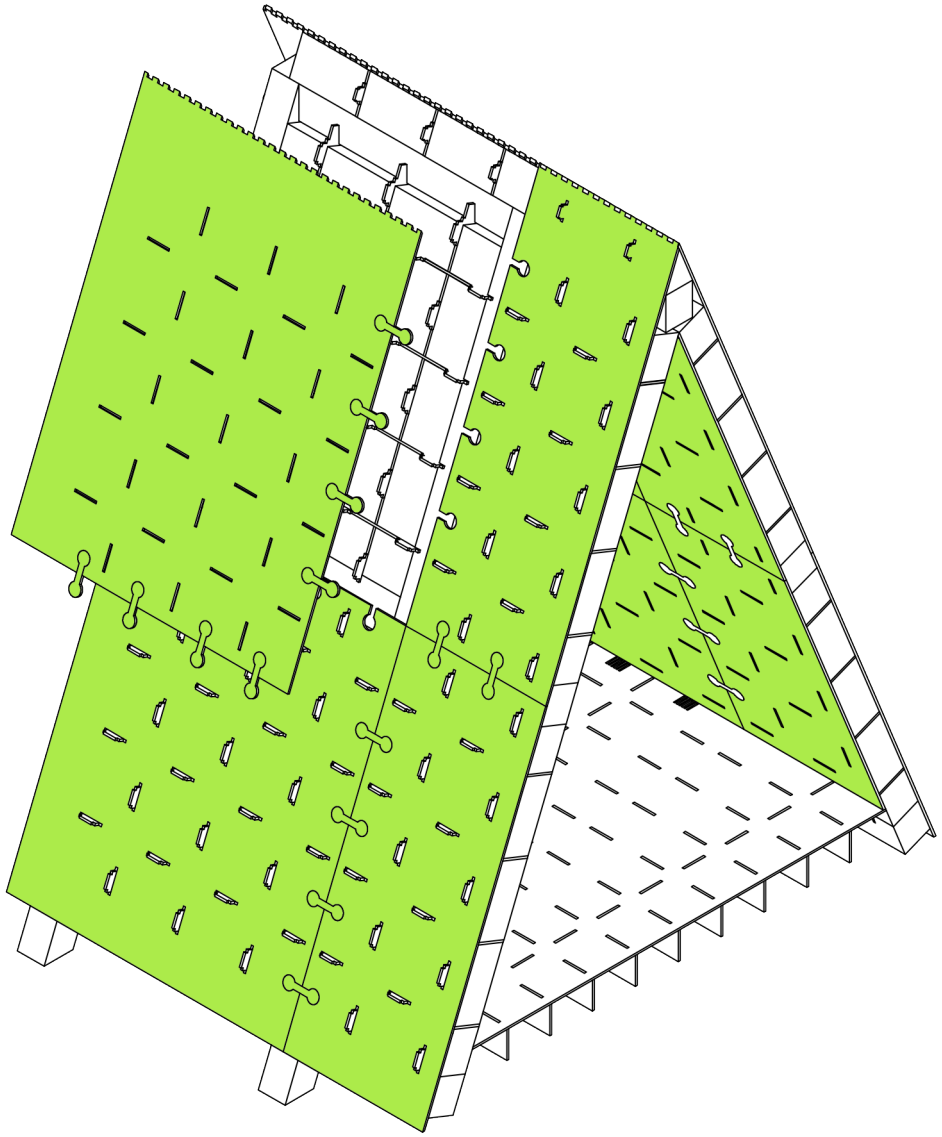
kg CO_2 / kg

0.039 W/M°K

ALTERNATIVE

Can be replaced by solid Cork Insulation and left exposed without interior finition.

13. SHEETING

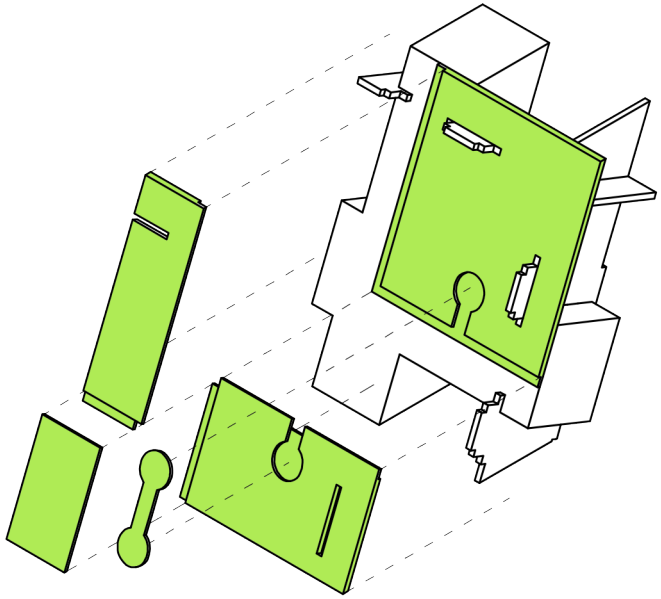


18 mm PLYWOOD

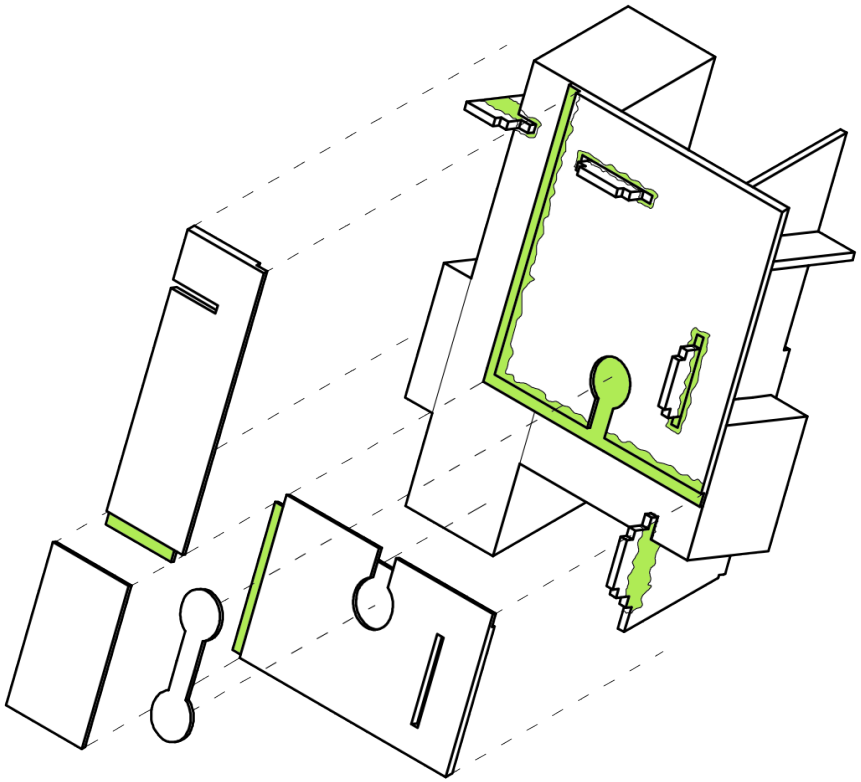
- BIOBASED
- BIODEGRADABLE
- RENEWABLE
- LIGHTWEIGHT
- ☐ WEATHER RESISTANT
- IMPACT RESILIENT

-0.29 kg CO_2 / kg

carbon footprint



14. CAULKING



PINE PITCH

- BIOBASED
- BIODEGRADABLE
- RENEWABLE
- LIGHTWEIGHT
- WEATHER RESISTANT
- HEAVY DUTY ADHESIVE

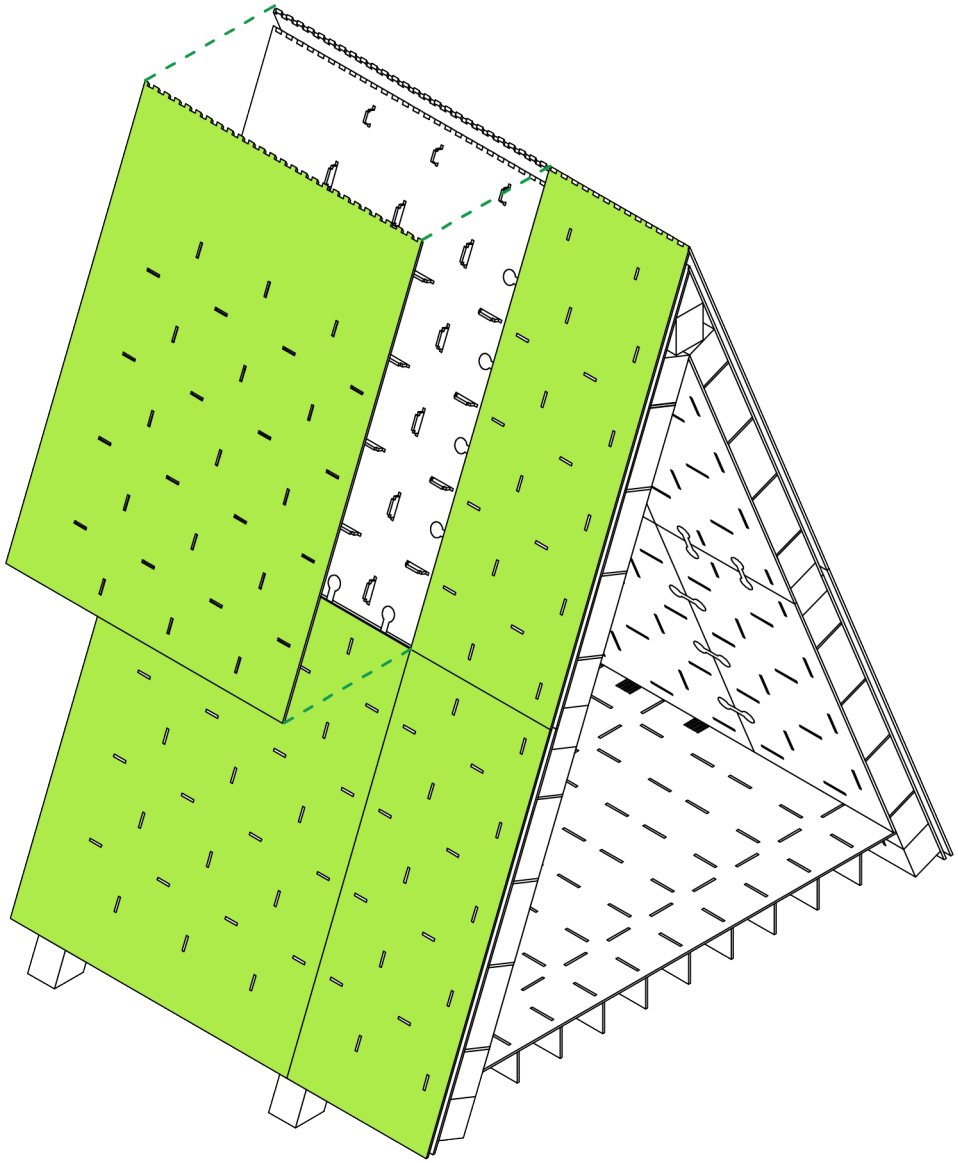
-0.30 to **-0.01**

kg CO_2 / kg

ADVANTAGES

i. Proven strength;
ii. Strong adhesive;
iii. Similar expansion coefficient as wood.

15. TOP SHEETING

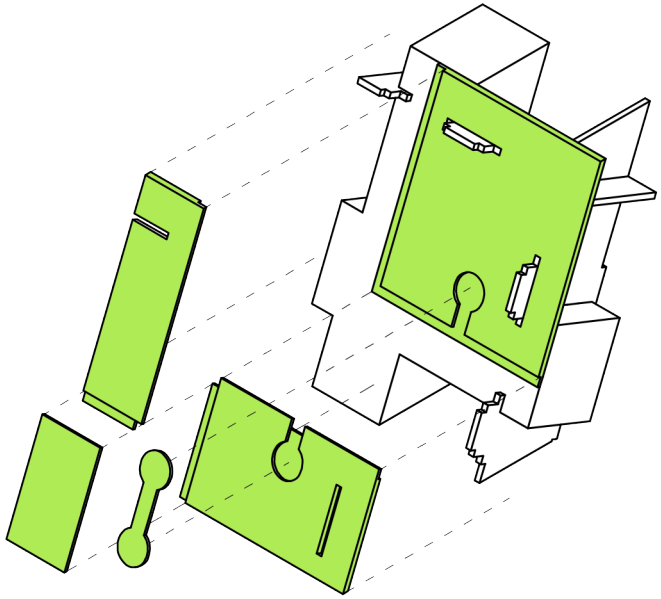


18 mm PLYWOOD

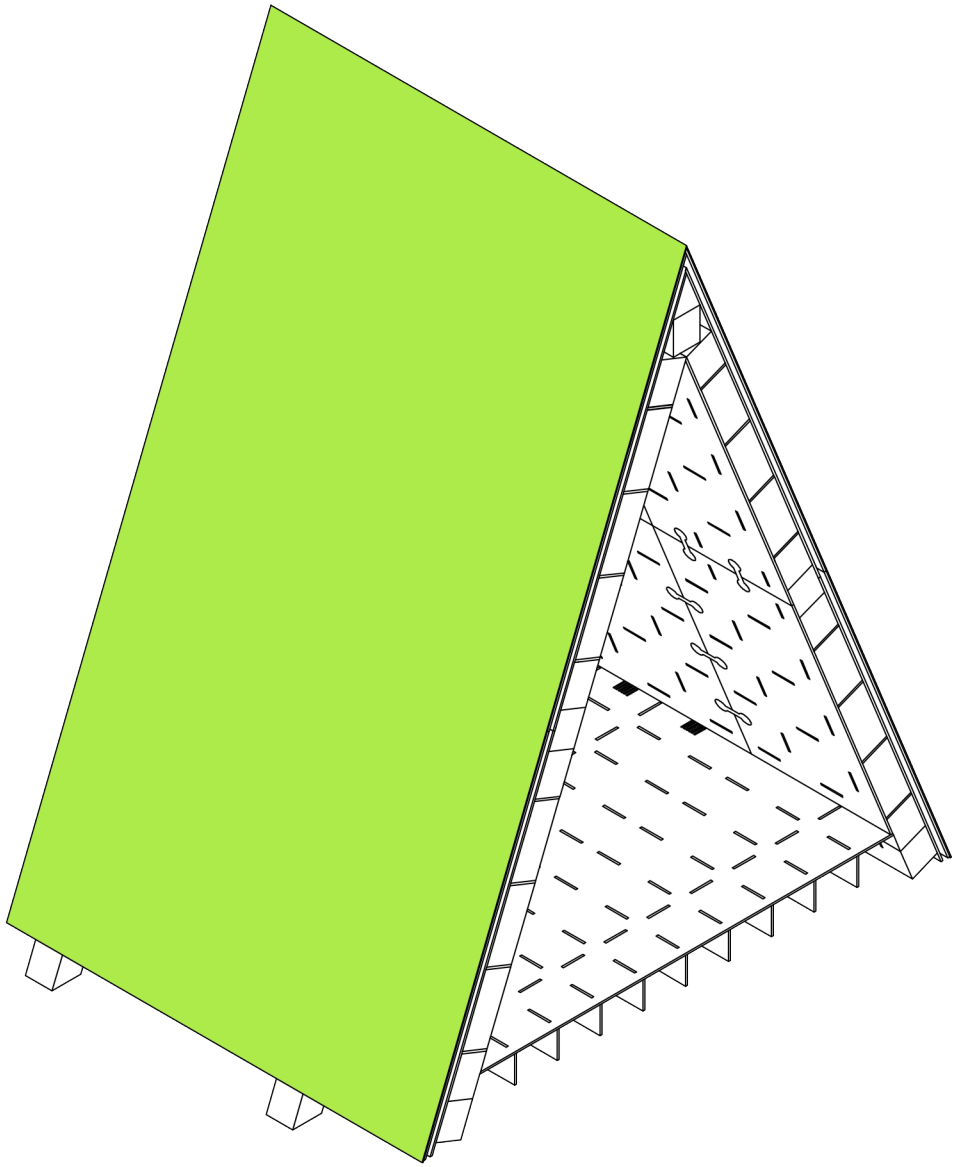
- BIOBASED
- BIODEGRADABLE
- RENEWABLE
- LIGHTWEIGHT
- ☐ WEATHER RESISTANT
- IMPACT RESILIENT

-0.29 kg CO_2 / kg

carbon footprint



16. TOP COVER



SPRAYED CORK

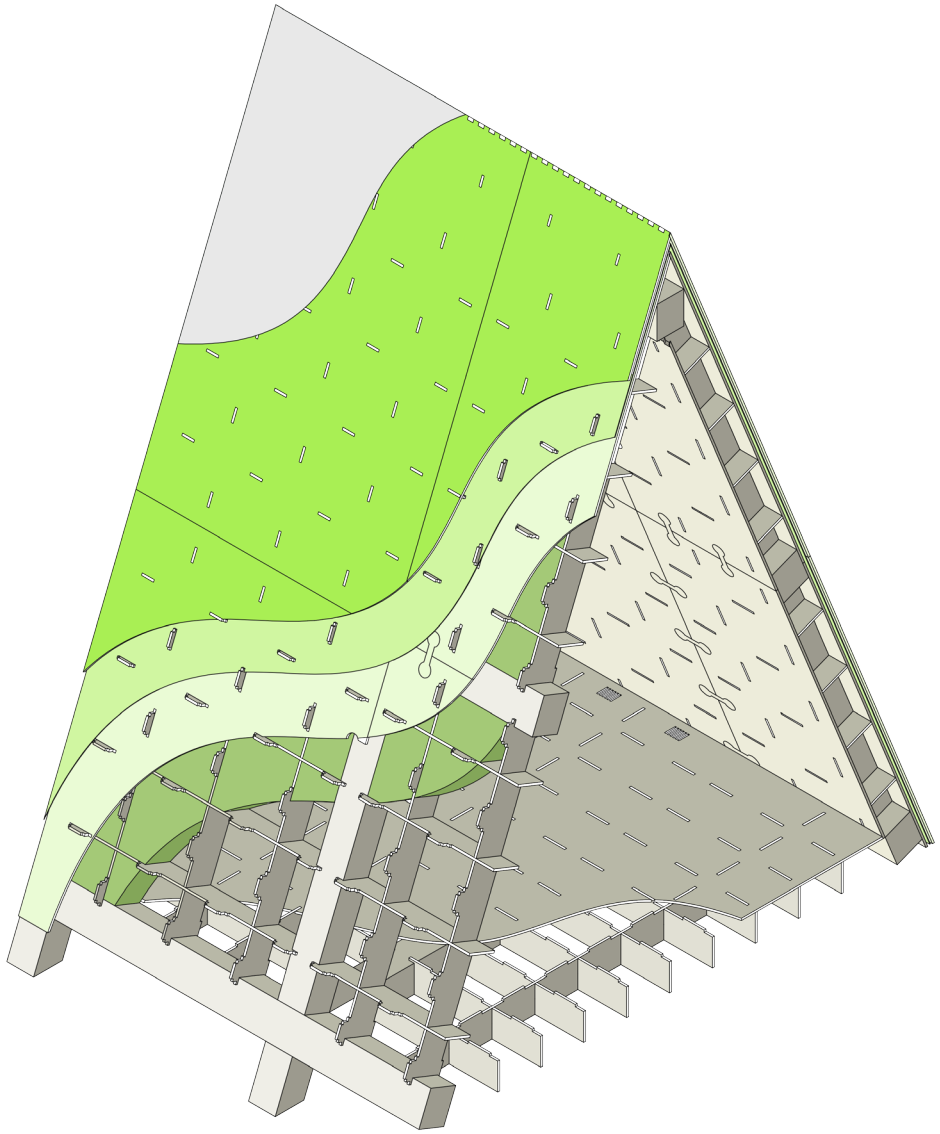
- BIOBASED
- BIODEGRADABLE
- RENEWABLE
- LIGHTWEIGHT
- WEATHER RESISTANT
- IMPACT RESILIENT

-0.43 to **-0.15**

kg CO_2 / kg

ADVANTAGES

i. Continuous layer;
ii. Covers joints;
iii. Water resistant.



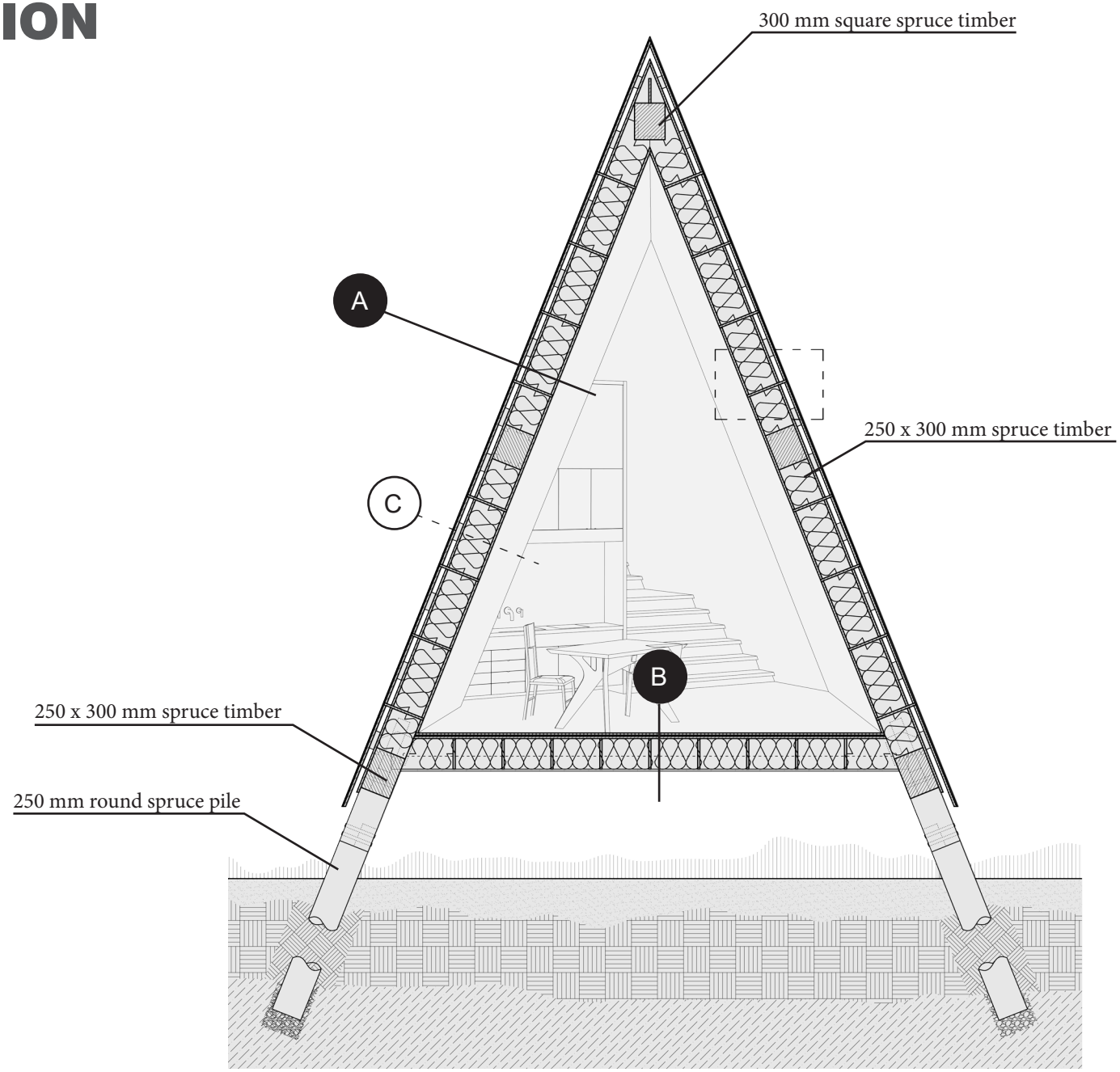
ENVELOPE SECTION

A EXTERIOR WALL

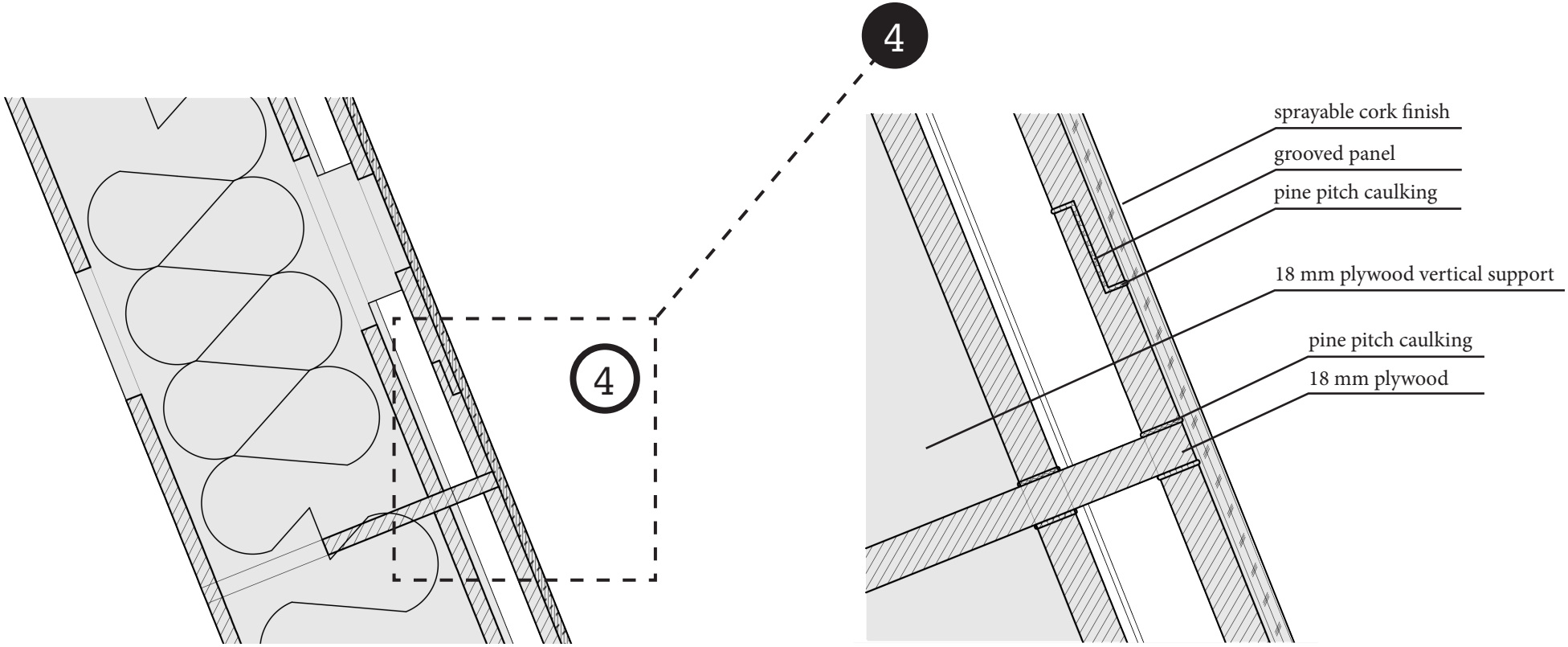
10 mm sprayed cork (iso-cork)
18 mm exterior grade plywood
pine pitch caulking
40 mm rainscreen
linseed oil sealant on plywood
18 mm exterior grade plywood
pine pitch caulking
18 mm Plywood Custom Stud
250 mm hemp fibre insulation
18 mm interior grade plywood
linseed oil paint finish

B FLOOR

3 mm coffee-based floor coating
flax water resistant underlay
(Flaxline)
18mm exterior grade plywood
18 mm Plywood Custom joist
250 mm hemp fibre insulation
13 mm exterior grade plywood



ENVELOPE DETAILS

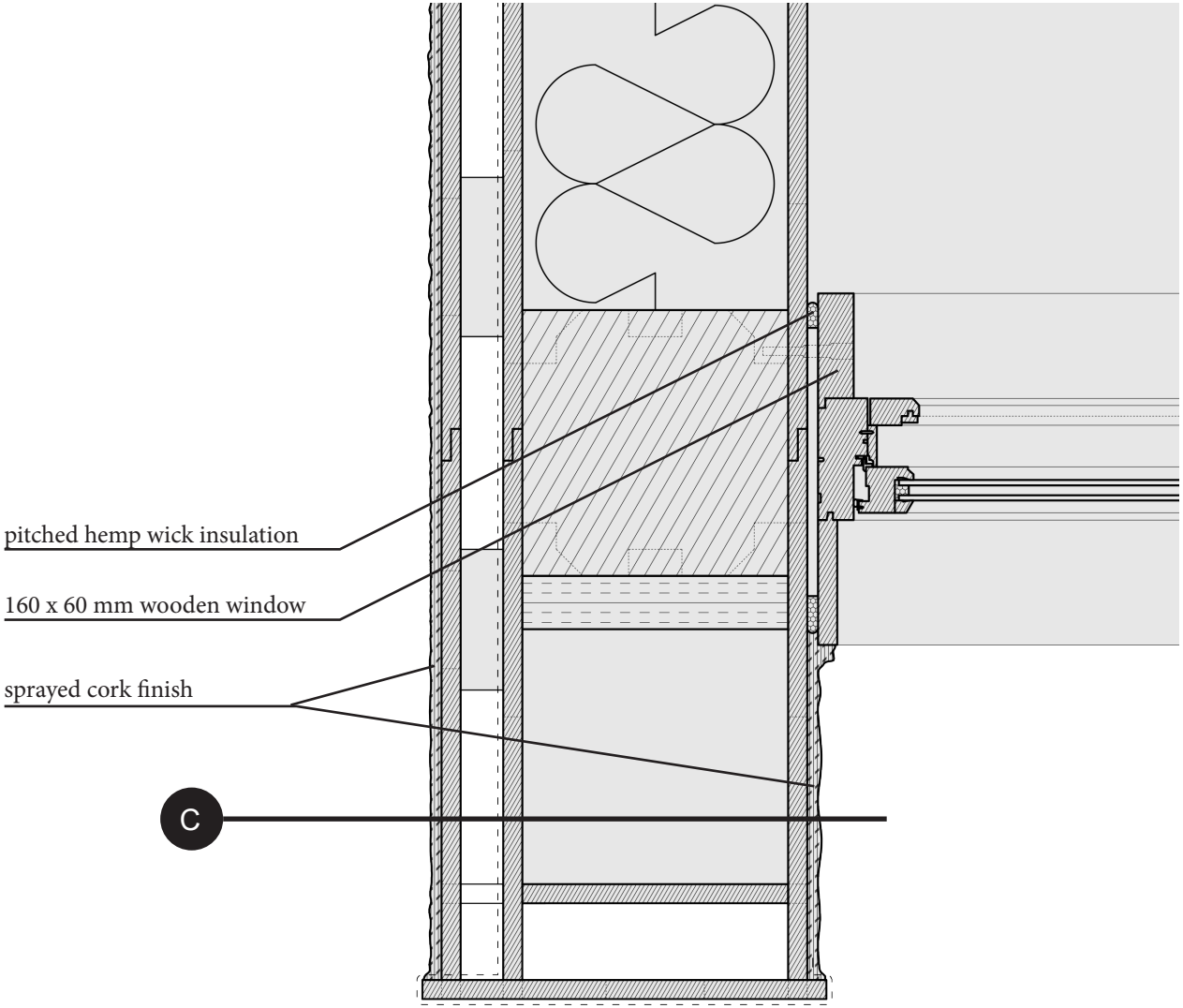


WINDOW & OVERHANG

C

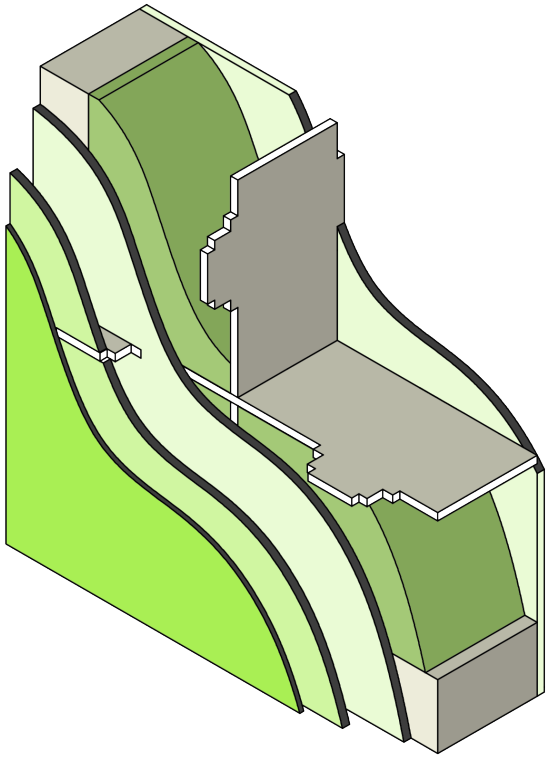
OVERHANG

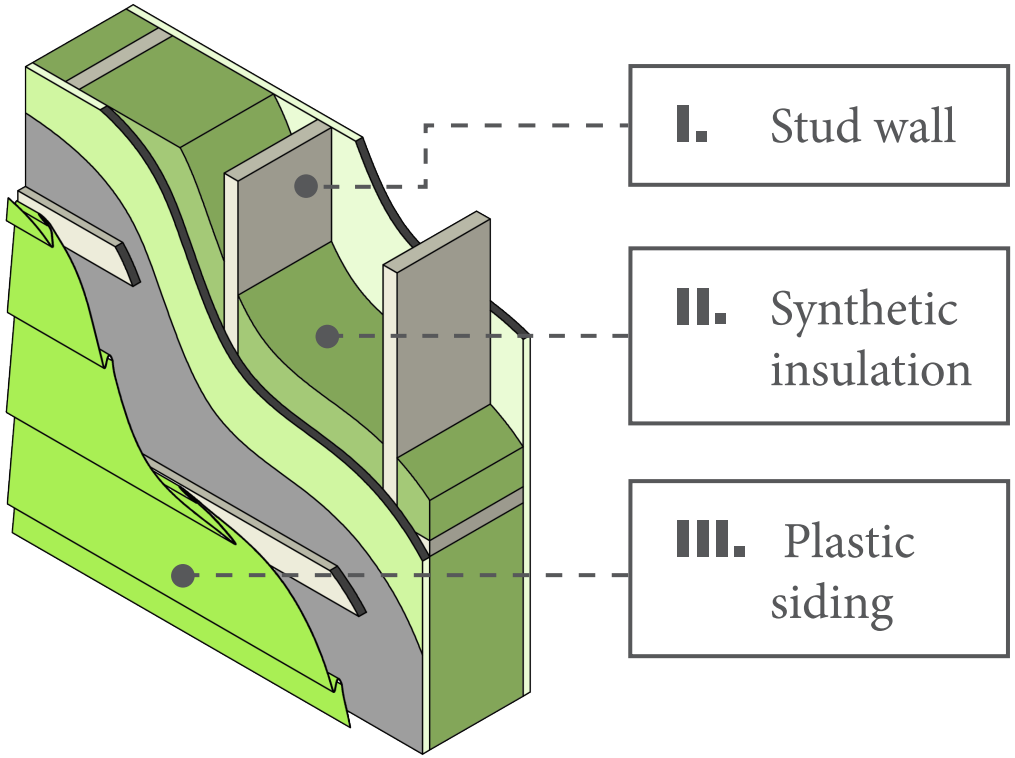
10 mm sprayed cork (iso-cork)
18 mm exterior grade plywood
pine pitch caulking
40 mm rainscreen
linseed oil sealant on plywood
18 mm exterior grade plywood
pine pitch caulking
18 mm Plywood Custom Stud
250 mm hemp fibre insulation
18 mm exterior grade plywood
10 mm sprayed cork (iso-cork)



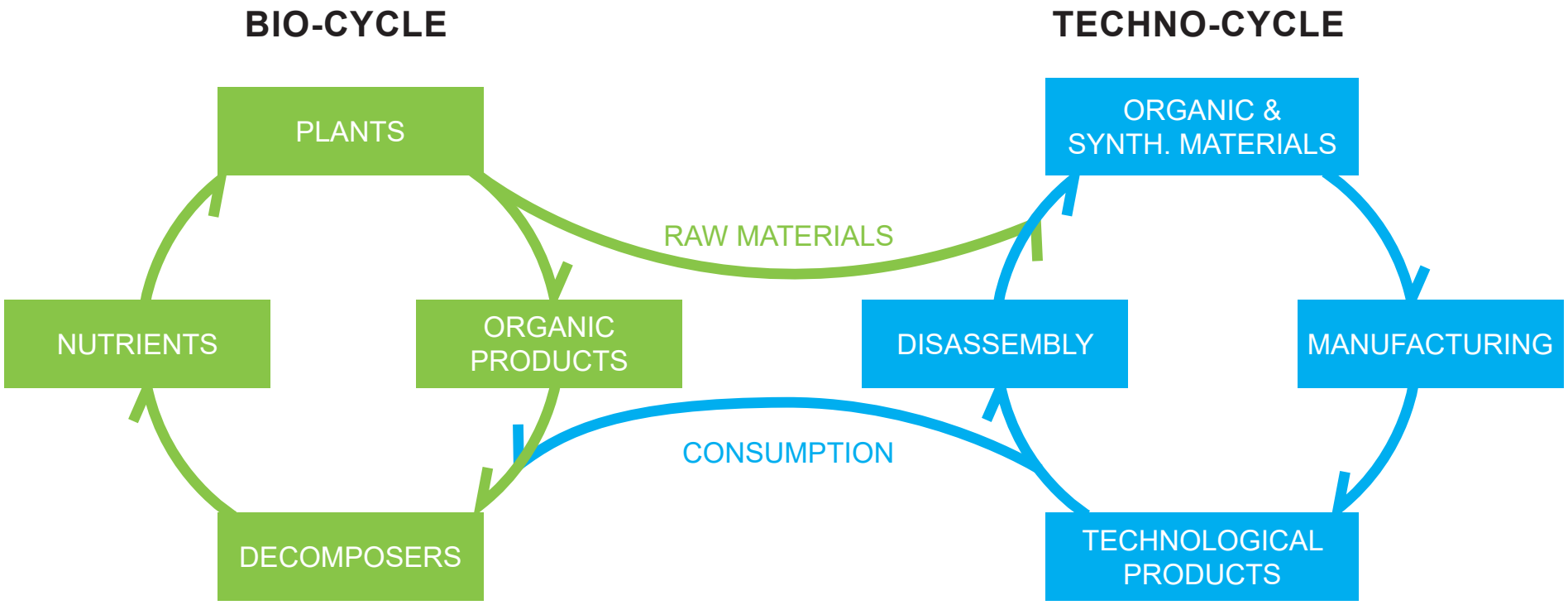
ENVIRONMENTAL IMPACTS COMPARISON

HARVESTED HOME vs. COMMON WALL

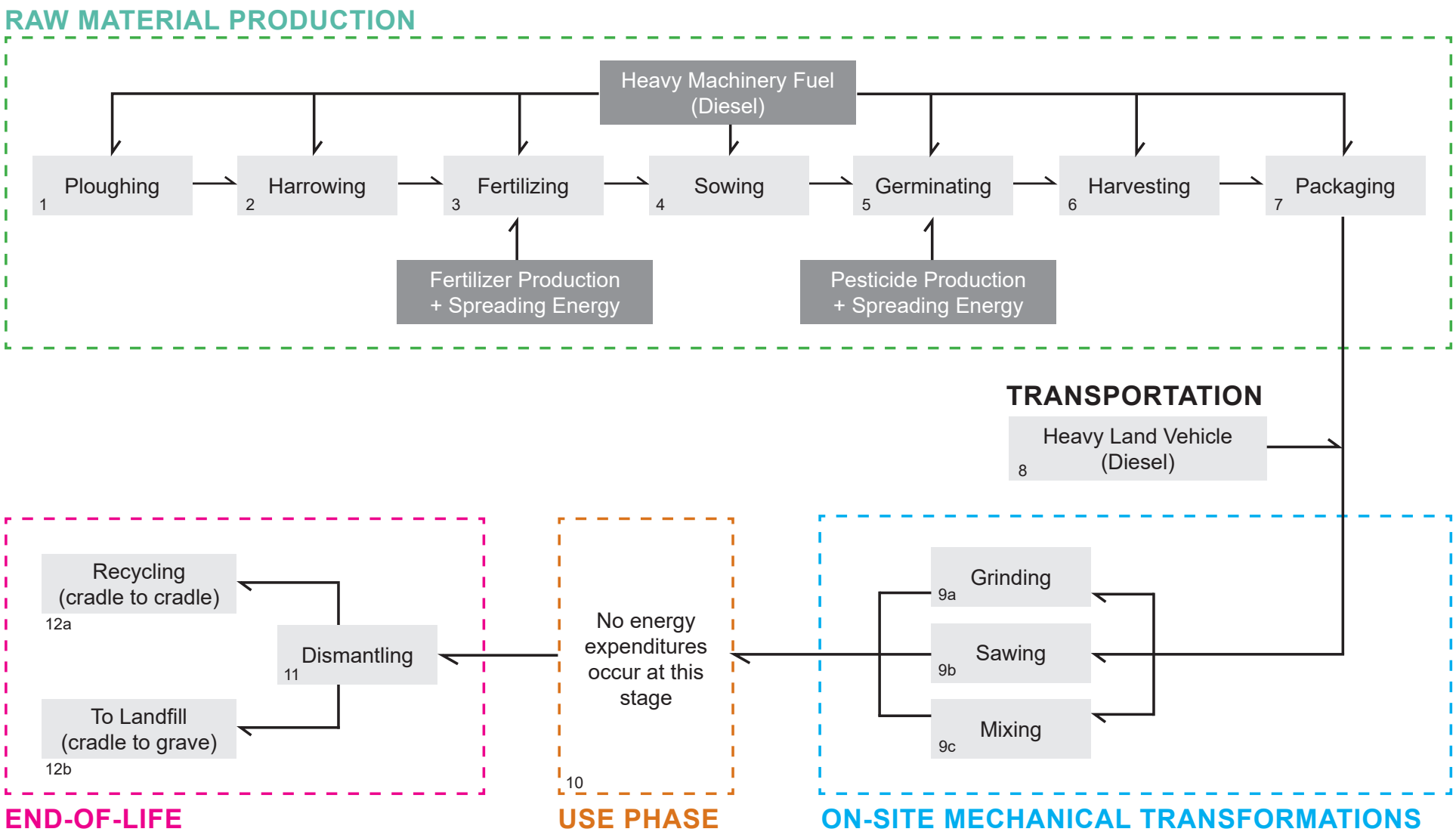




CRADLE TO CRADLE FRAMEWORK



LIFE-CYCLE ANALYSIS



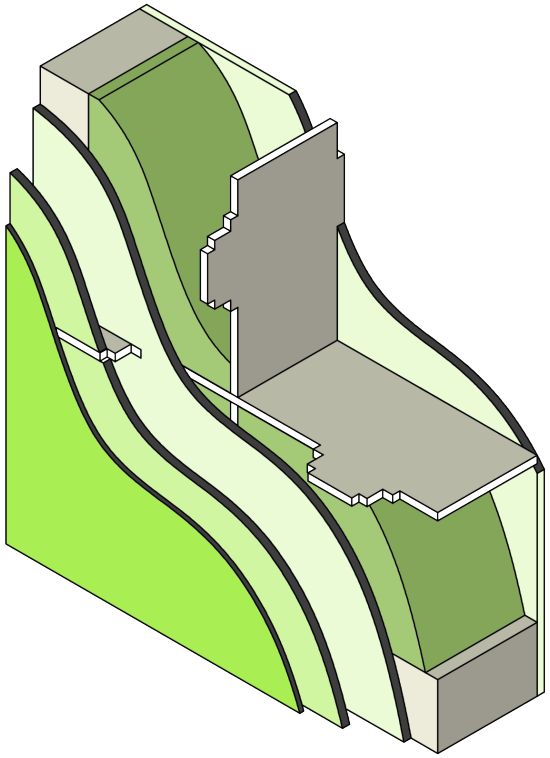
ENVIRONMENTAL IMPACTS

I. Calculated for 1 m^2 of exterior wall (typical).

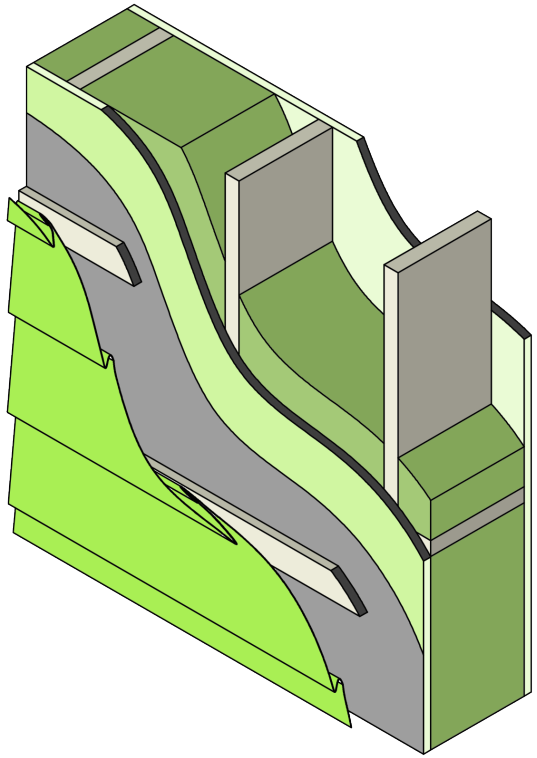
II. Data provided by Idemat Database (TU Delft).

	Component	Material	Total Volume m^3	Density m^3/kg	Total Mass kg	Footprint min kg CO2/ kg	Footprint max kg CO2/ kg	Total Carbon min kg CO2	Total Carbon max kg CO2
H. H.	Timber Frame	European Spruce	0.0656	430	28.191	-0.46		-12.968	-12.968
	Sheating	18 mm Plywood	0.0605	680	41.120	-0.29		-11.925	-11.925
	Insulation	Hemp Fibre	0.1766	30	5.298	-0.73	-0.50	-3.868	-2.649
	Caulking	Pine Pitch	0.0003	670	0.201	-0.30	-0.01	-0.060	-0.002
	Finishing	Sprayed Cork	0.0100	120	1.200	-0.43	-0.15	-0.516	-0.180
								-29.336	-27.723
OTHER	Wood Frame	European Spruce	0.0345	430	14.822	-0.46		-6.818	
	Sheating	18 mm Plywood	0.0360	680	24.480	-0.29		-7.099	
	Insulation	Glasswool	0.2030	16	3.248	3.98		12.927	
	Vapor Barrier	Low Density Polyethylene	0.0005	940	0.470	3.70		1.739	
	Nails	Carbon Steel	0.00003	7850	0.265	2.02		0.534	
	Cladding	PVC Horizontal Siding	0.0013	1380	1.794	2.71		4.862	

ENVIRONMENTAL IMPACTS COMPARISON



HARVESTED HOME

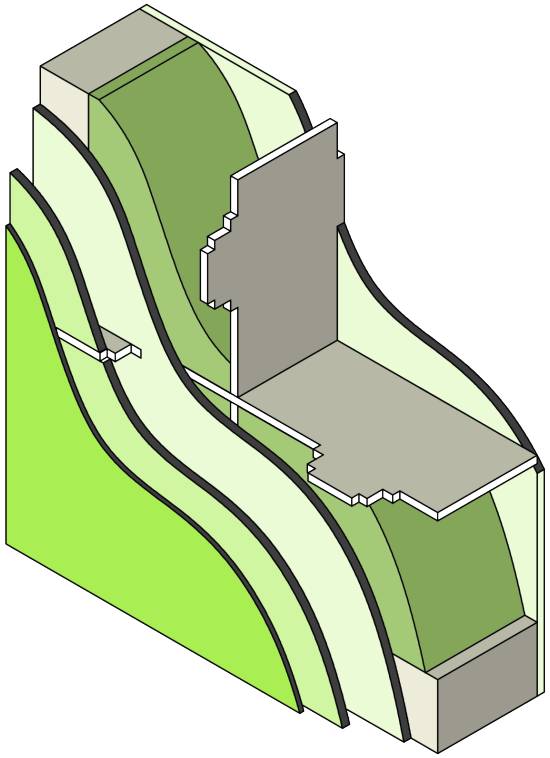


COMMON WALL

6.15 kg

of CO_2 per m^2 of wall

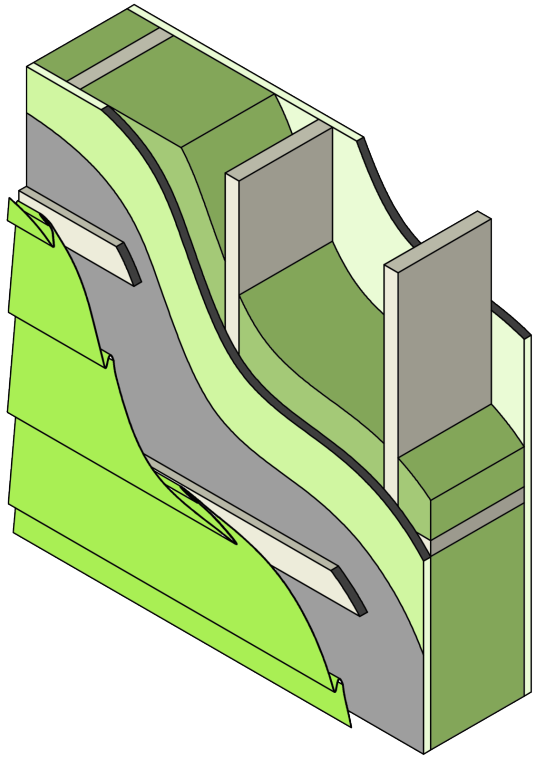
ENVIRONMENTAL IMPACTS COMPARISON



HARVESTED HOME

-27.72 kg

of CO_2 per m^2 of wall

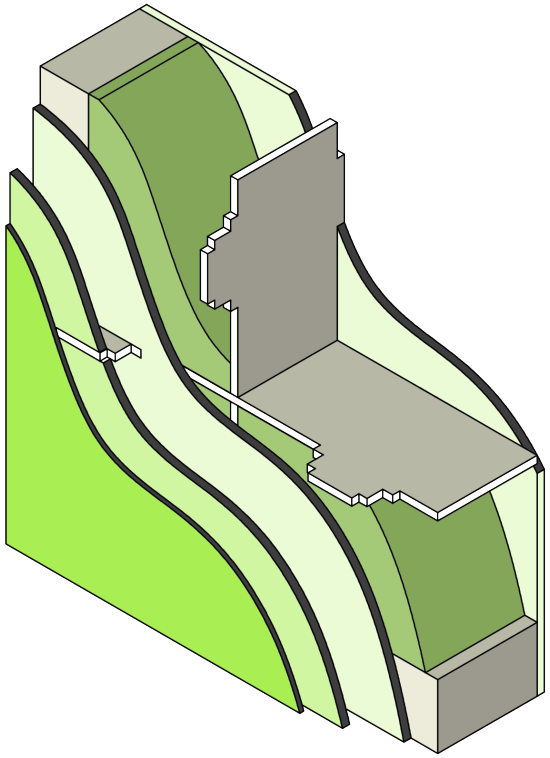


COMMON WALL

6.15 kg

of CO_2 per m^2 of wall

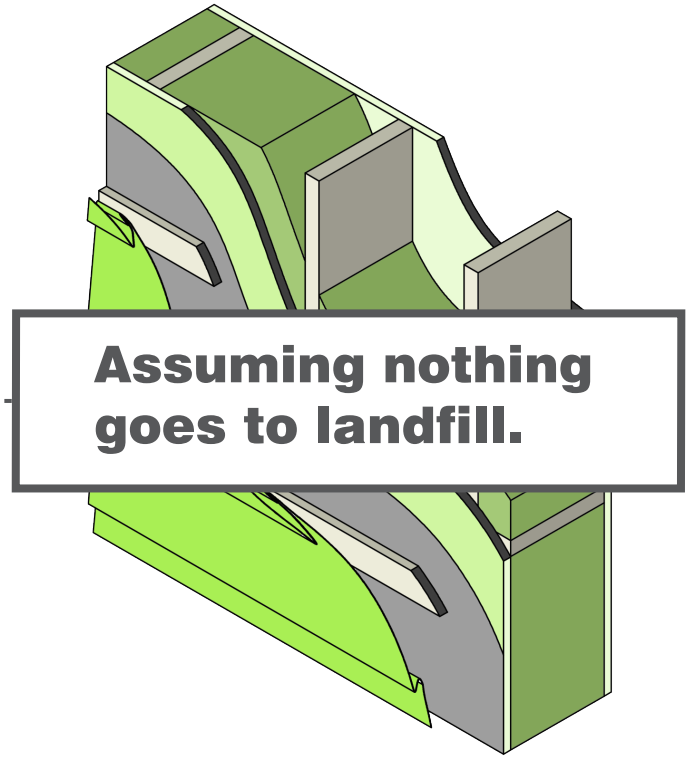
ENVIRONMENTAL IMPACTS COMPARISON



HARVESTED HOME

-27.72 kg

of CO_2 per m^2 of wall



Assuming nothing goes to landfill.

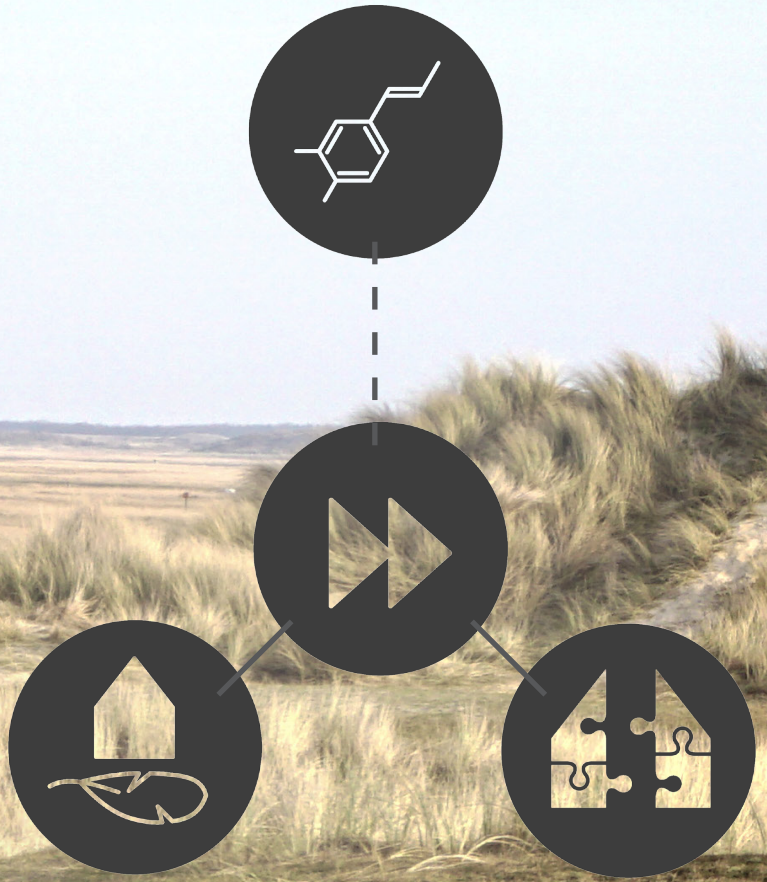
COMMON WALL

6.15 kg

of CO_2 per m^2 of wall

CONCLUSION

CONCLUSION



THANK YOU