| PET Paradise |

Turning a waste problem into a source to preserve the Maldivian Islands

Emilie Lodewijks
4557786

Building Technology Graduation Studio

University of Technology Delft | Msc
Faculty of architecture and the built environment

Mentors: Marcello Bilow & Job Schroën

Research question |

“How can a future proof system be created from recycled plastic waste for the preservation and protection of Maldivian islands?“

System | *Example*

Timeline | *Setup of the presentation*

***G**overnment*
| client |

***B**uilding Engineer*
| designer |

***E**cologist*
| scientist |

2020 → 2021 → 2022 → **2023** → Future

2025

***L**ocals*
| requirements |

***T**ourist*
| experiencer |

Paradise | *Expectation*

Ahmed Luham, 2023, Quora

Paradise | *Reality*

Getty images, 2020

2020

| The Government |

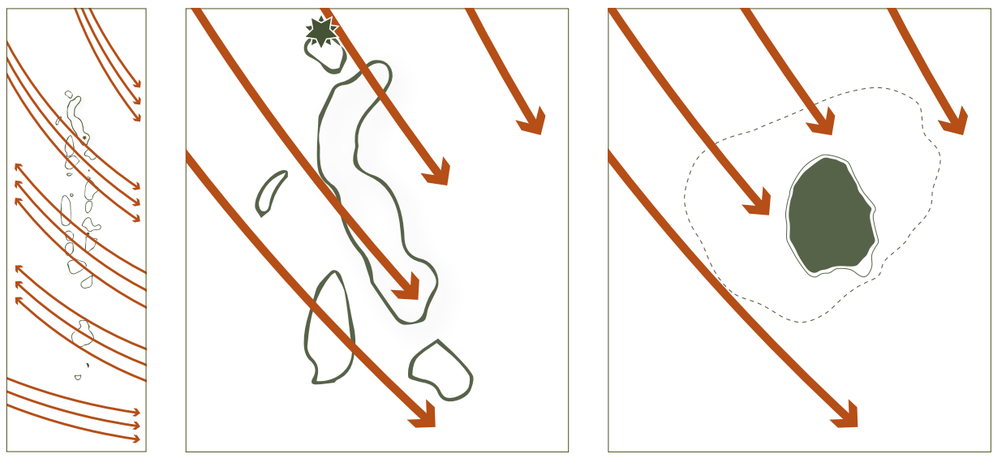
How can Maldivian islands and ecosystems survive sea level rise, coastal erosion and pollution by excessive waste?

Location | *Maldives*

Location | *Maldives*

Sea currents

Maldives - Atolls - Island



Sea currents and winds | (Meteoblue)

Problems | *Global warming - sea level rise*

greenhouse gasses

sea level and
temperature increase

more co2 and toxic
gasses absorbed

coral reefs and
species extinction

wave energy not
absorbed by reefs

more floodings and
extreme weather

contaminated
ground water

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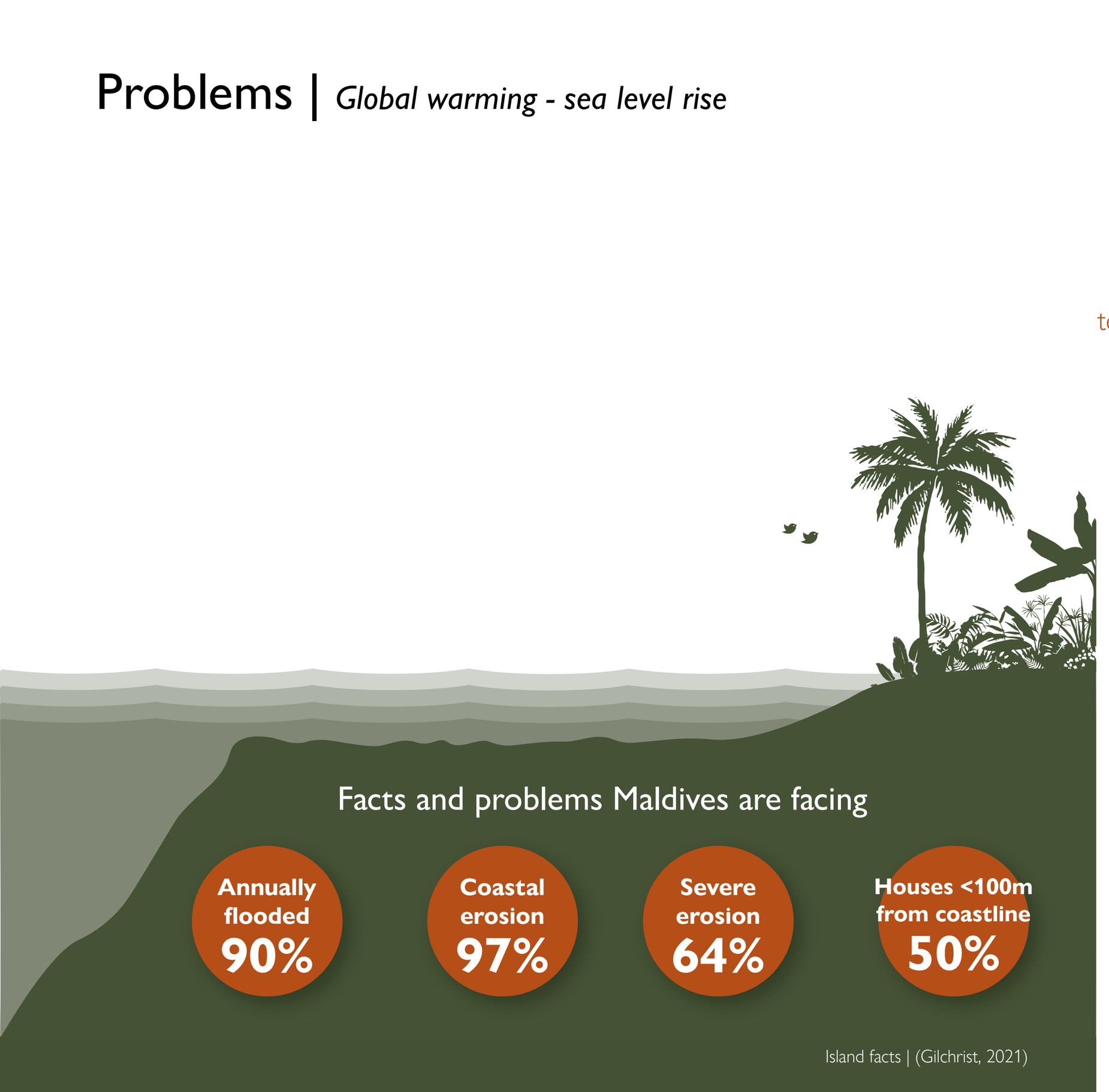

Facts and problems Maldives are facing

Annually flooded
90%

Coastal erosion
97%

Severe erosion
64%

Houses <100m from coastline
50%

Island facts | (Gilchrist, 2021)

Problems | *Waste - toxicity*

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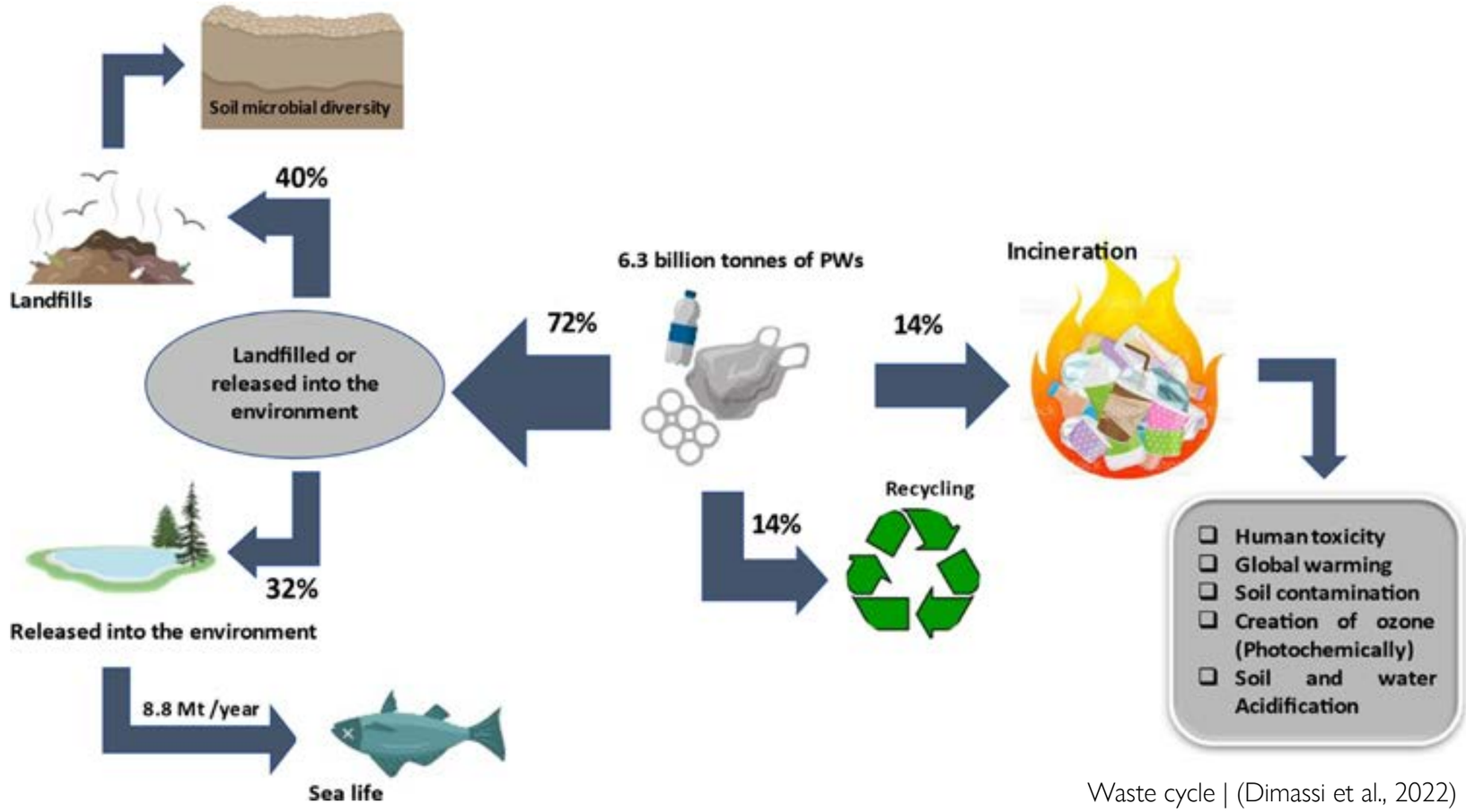

Waste cycle | (Dimassi et al., 2022)

Design task | *Requirements*

System

- Preserving the Maldives | Islands and nature
- Future proofing | Resilient and adjustable
- Benefits for the country | Eco-tourism
- Benefits for the population | Jobs
- Waste management solution | Plastic
- Awareness | Locals and tourists
- Design pilot | Sustainable identity

2021

| The Local |

What requirements does the new solution need to meet?

Haa Alifu Atoll | *Mobility and transportation map*

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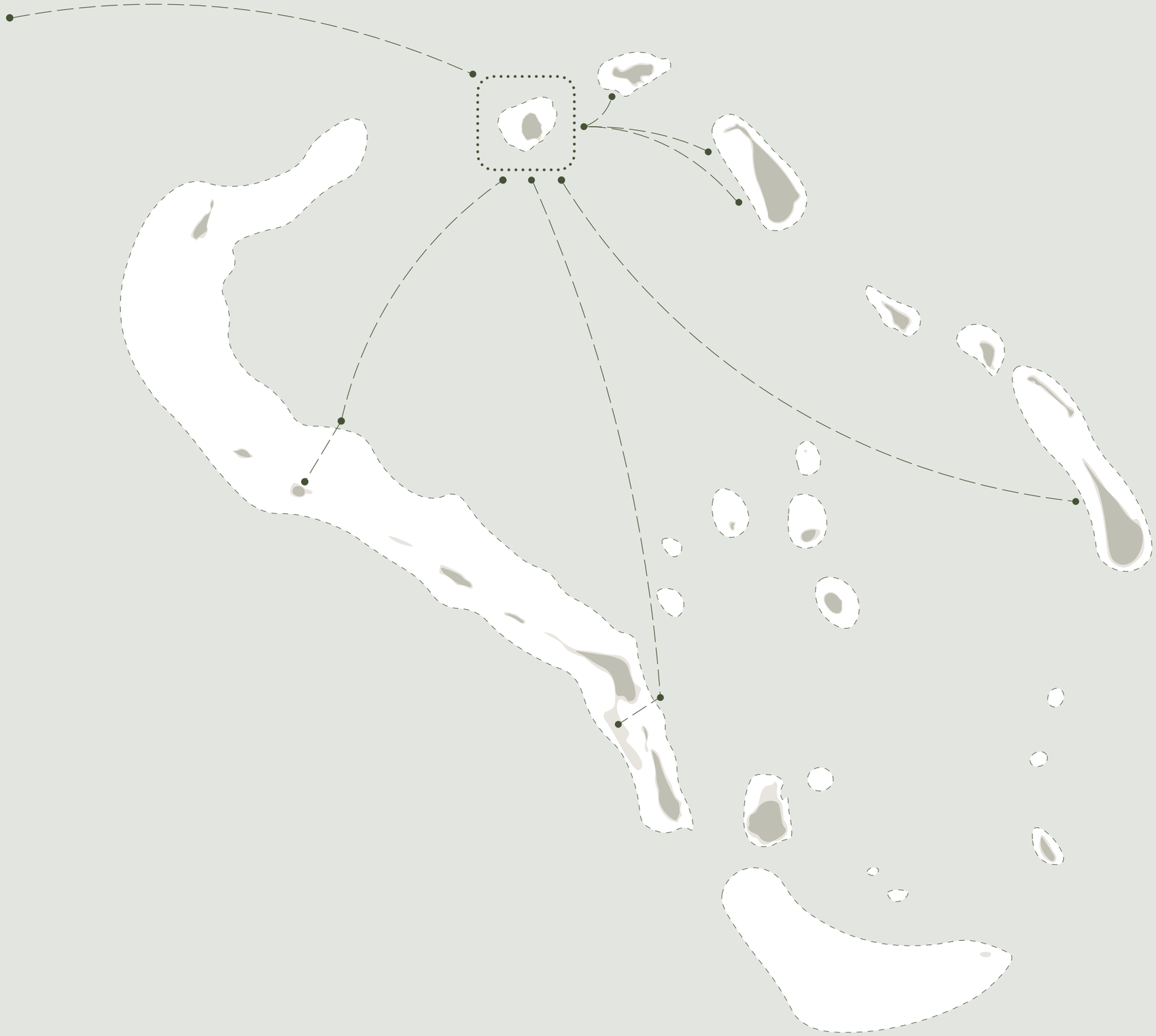
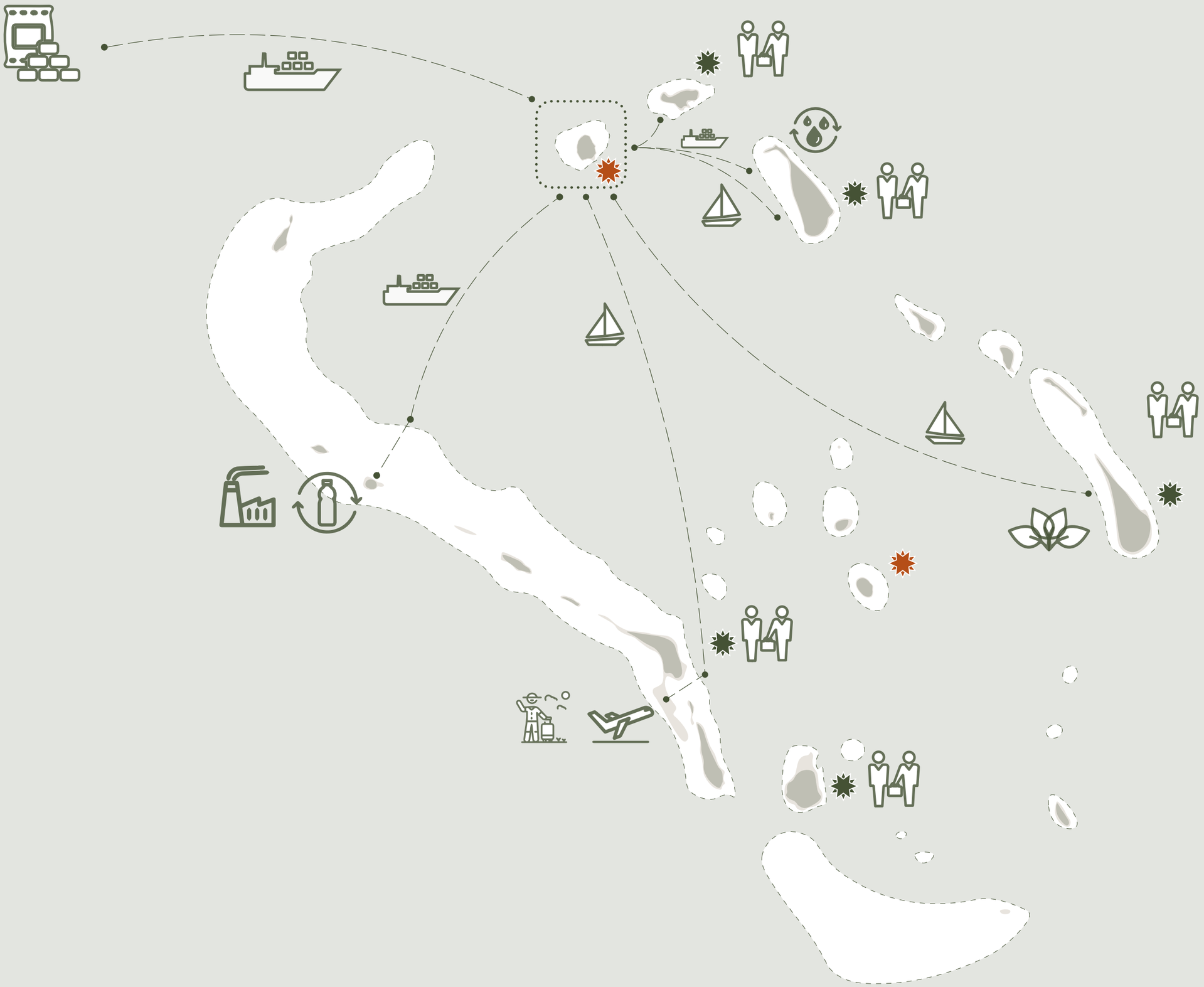


Haa Alifu Atoll | *Mobility and transportation map*



Vernacular architecture | *Resilience*

climate

location

site

materials

Vernacular architecture | *Resilience*

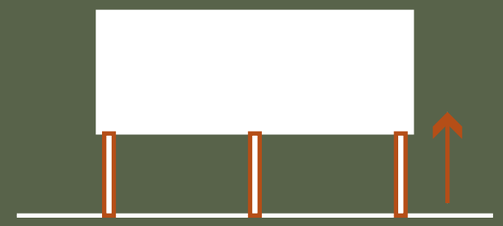
climate

location

site

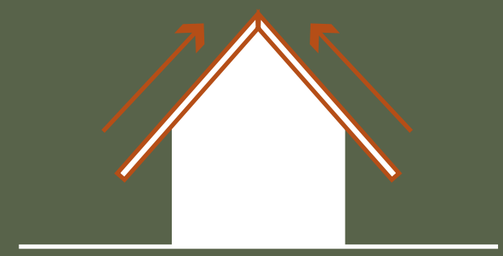
materials

lift foundations to prevent rot



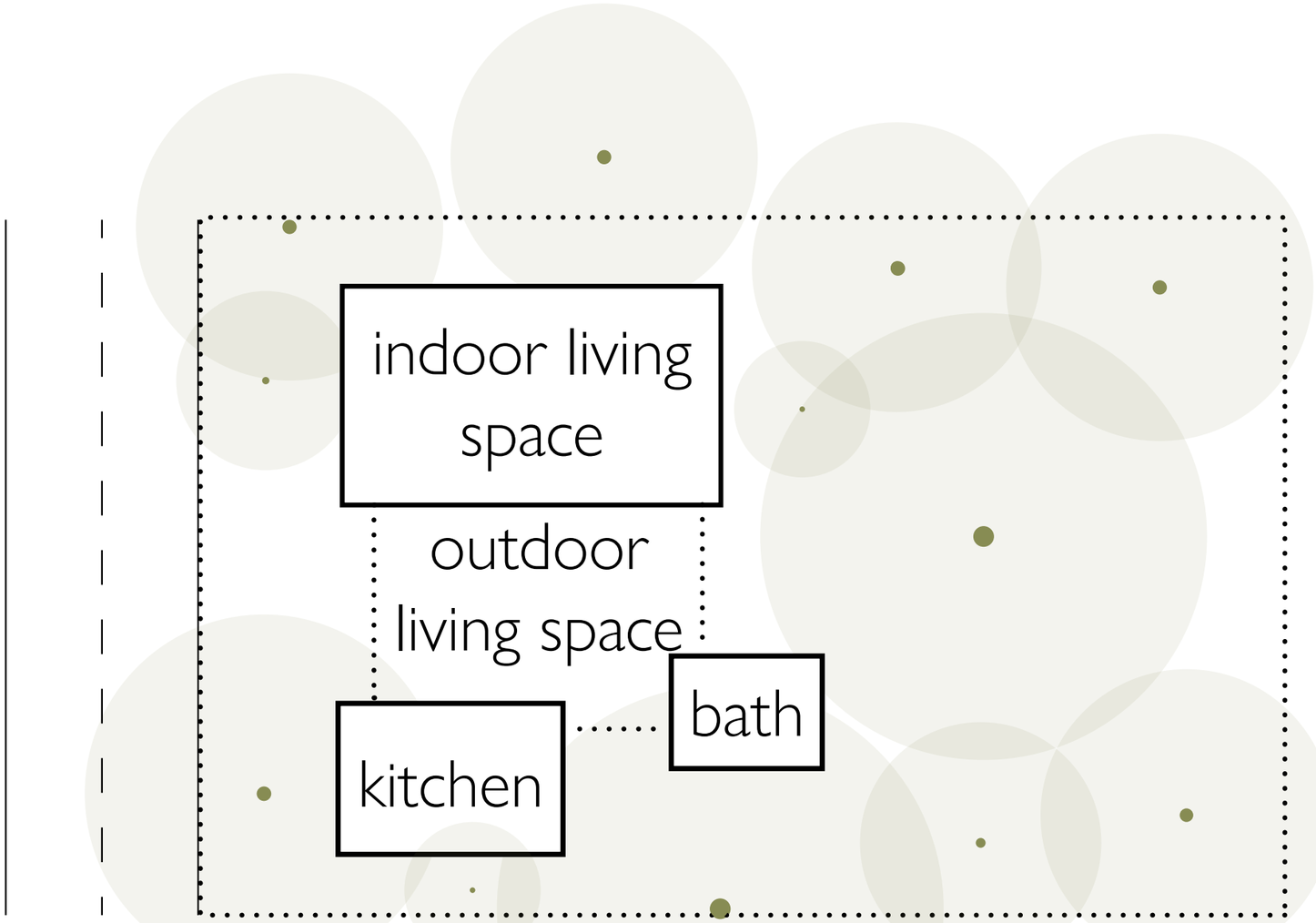
build on stilts, when available

extensive roofs



well sloped roofs

Traditional Maldivian house compound | *Goathi*



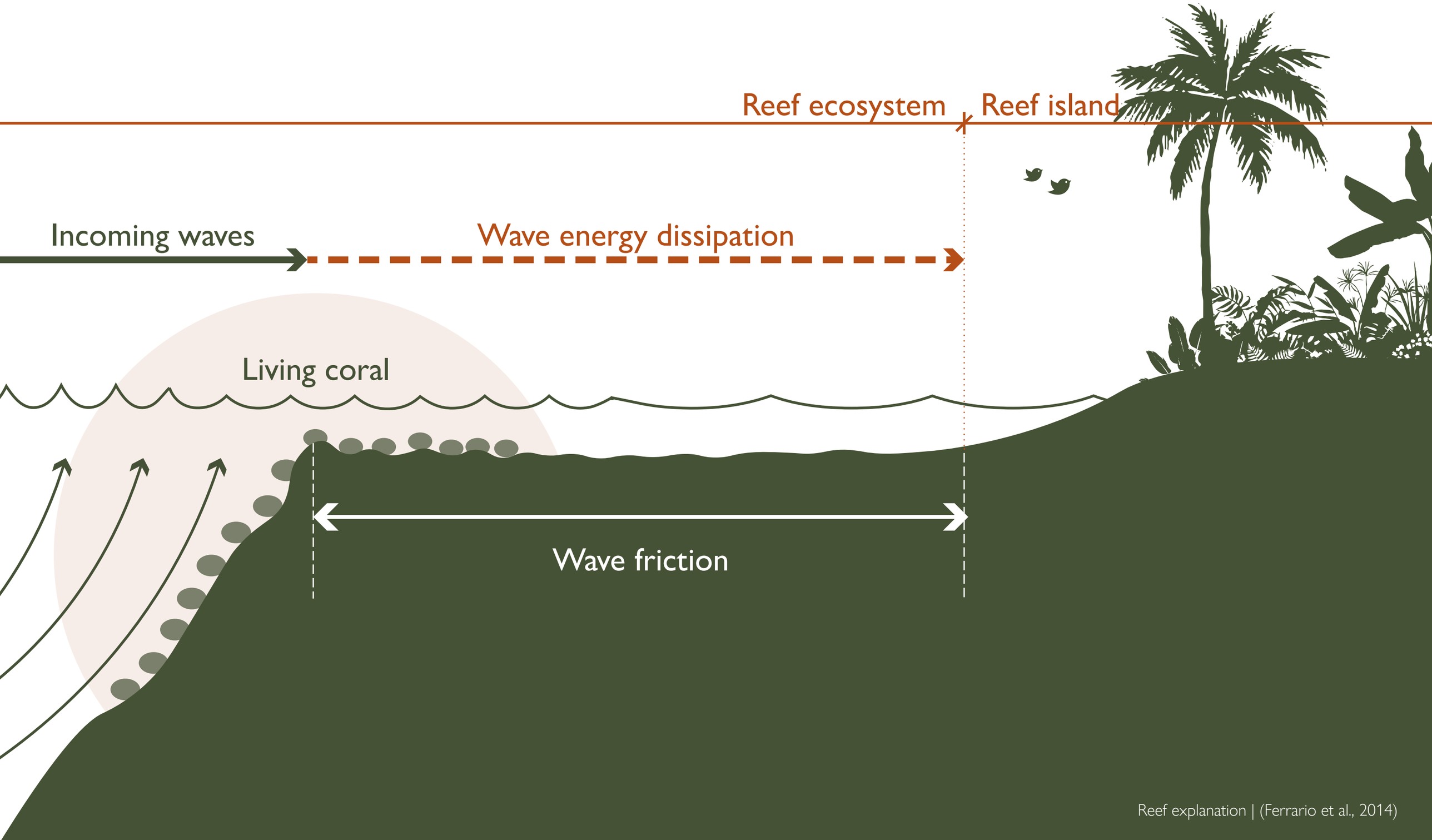
Traditional architecture | (Ahmed, z.d.)

2022-2023

| The Design Engineers |

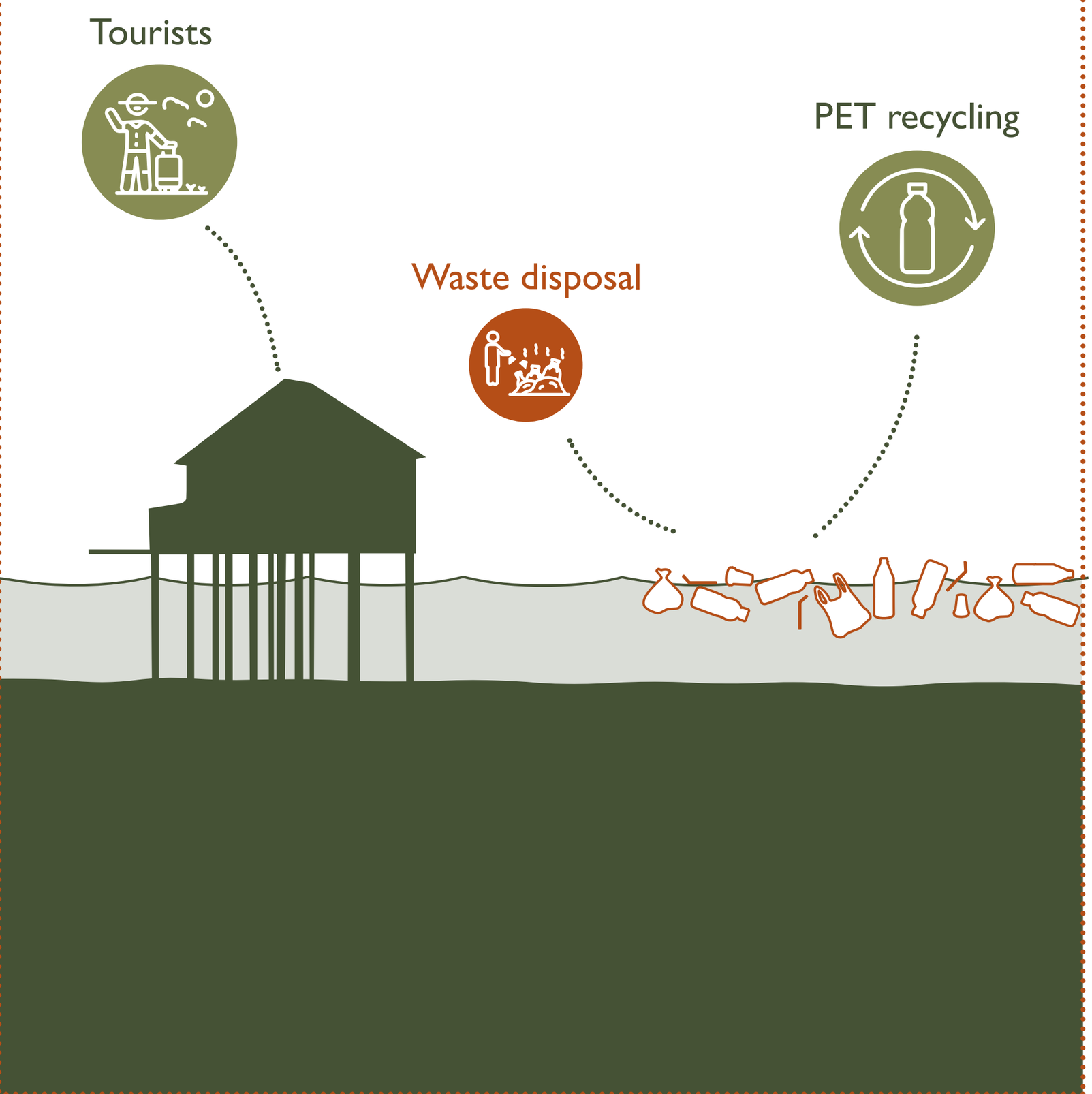
PET paradise

Design concept | *Coral reefs*



Reef explanation | (Ferrario et al., 2014)

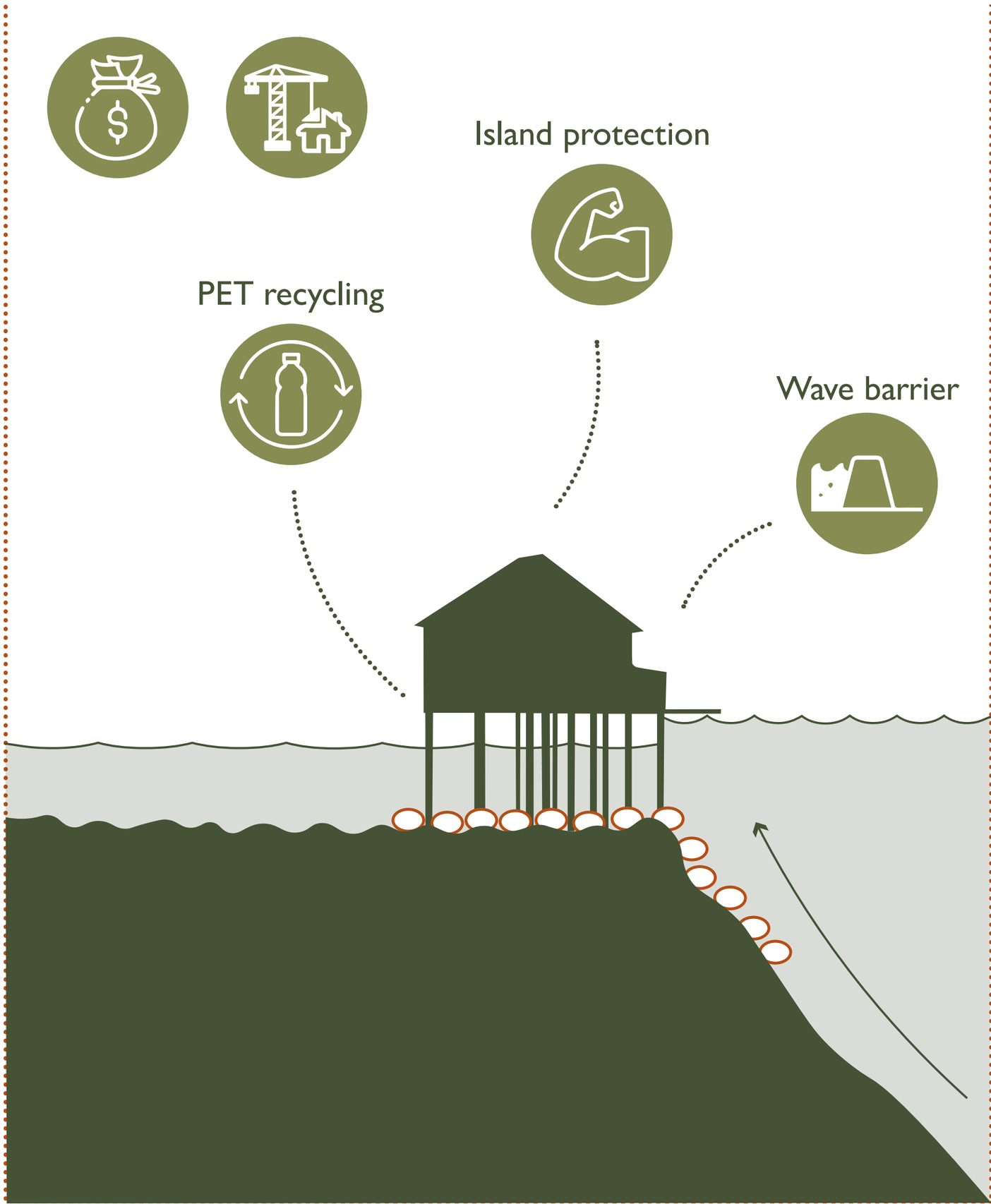
Design concept | *Waste*



- Tourists litter the environment
- Coral reefs are suffering
- Waste recycling required

Design concept | *Barrier*

- Protection barrier around islands
- Wave absorption
- Recycled waste in the design

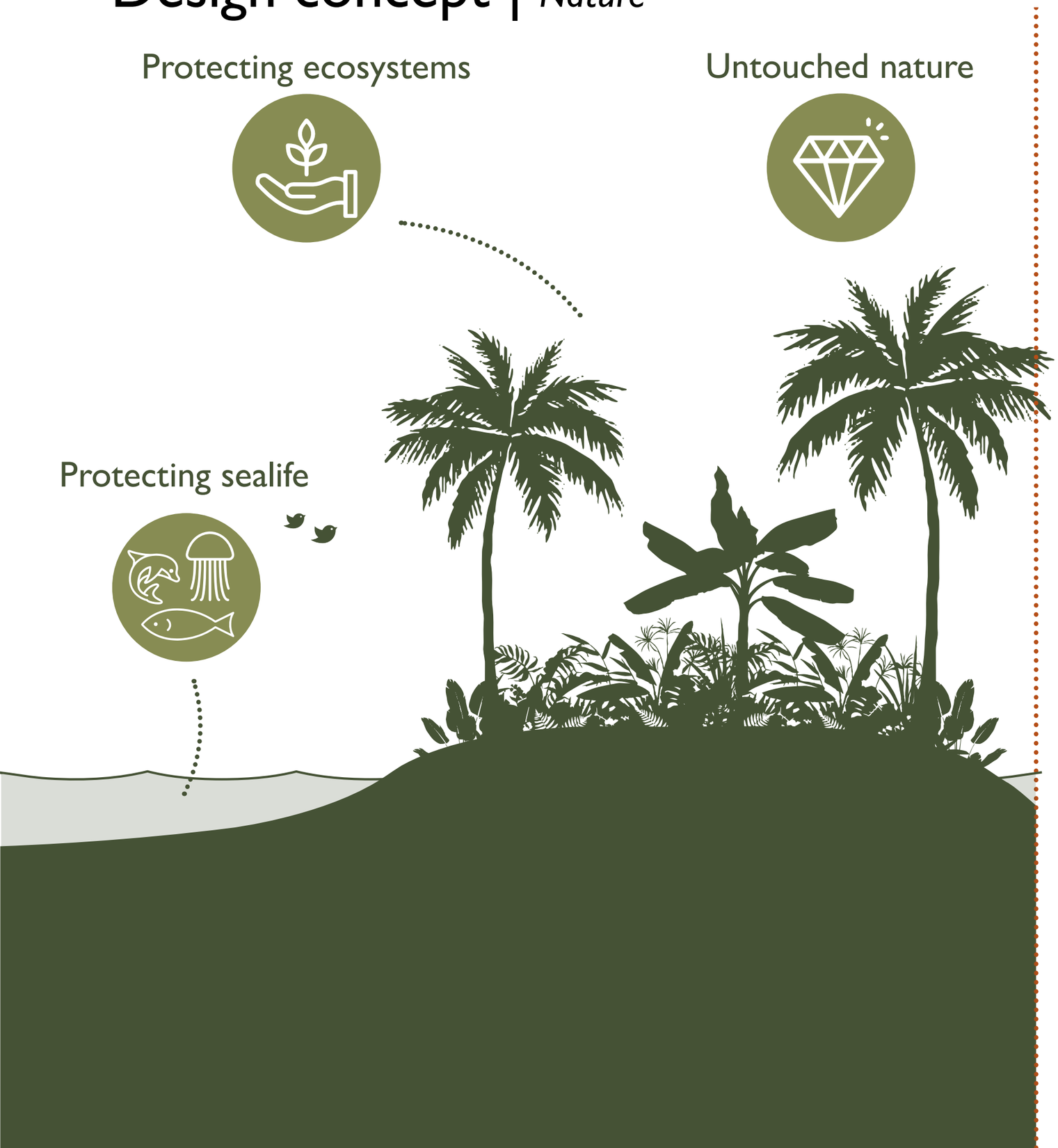


Design concept | *Nature*

Protecting ecosystems

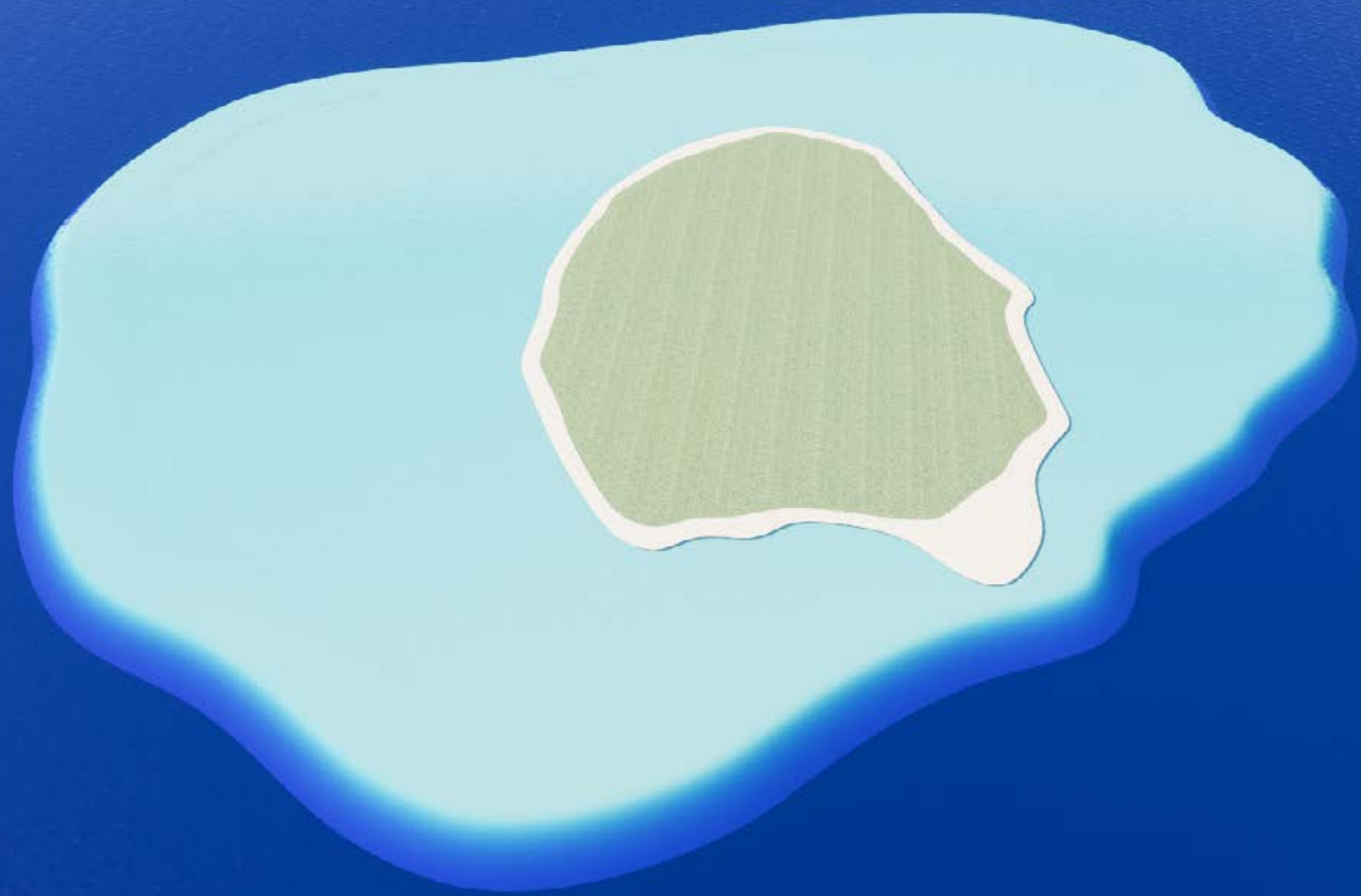
Untouched nature

Protecting sealife

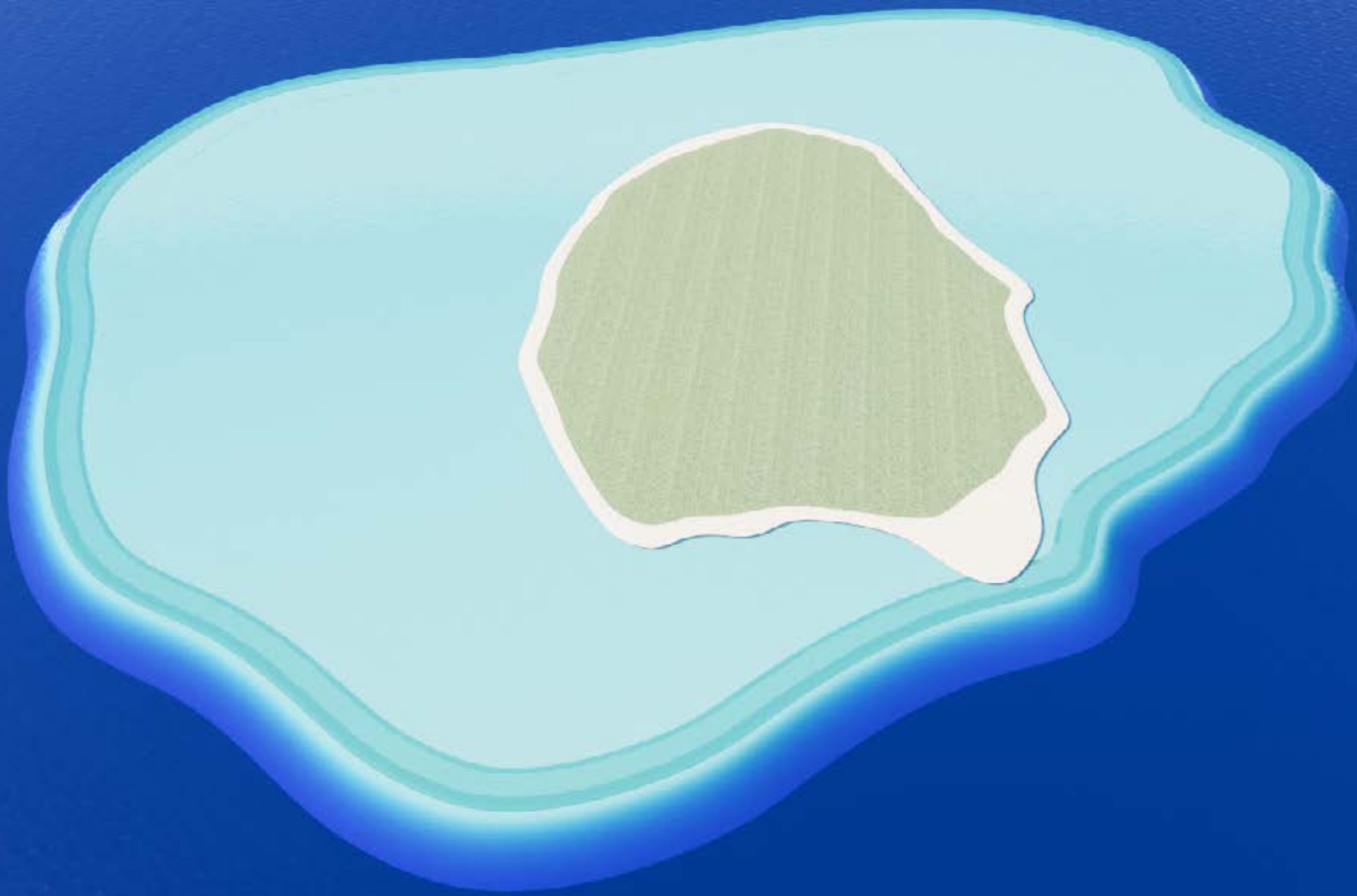


- Flora and fauna recovery
- Untouched nature
- Sustainable holiday destination

New artificial reef | *Vangaaru*



New artificial reef | *Vangaaru*

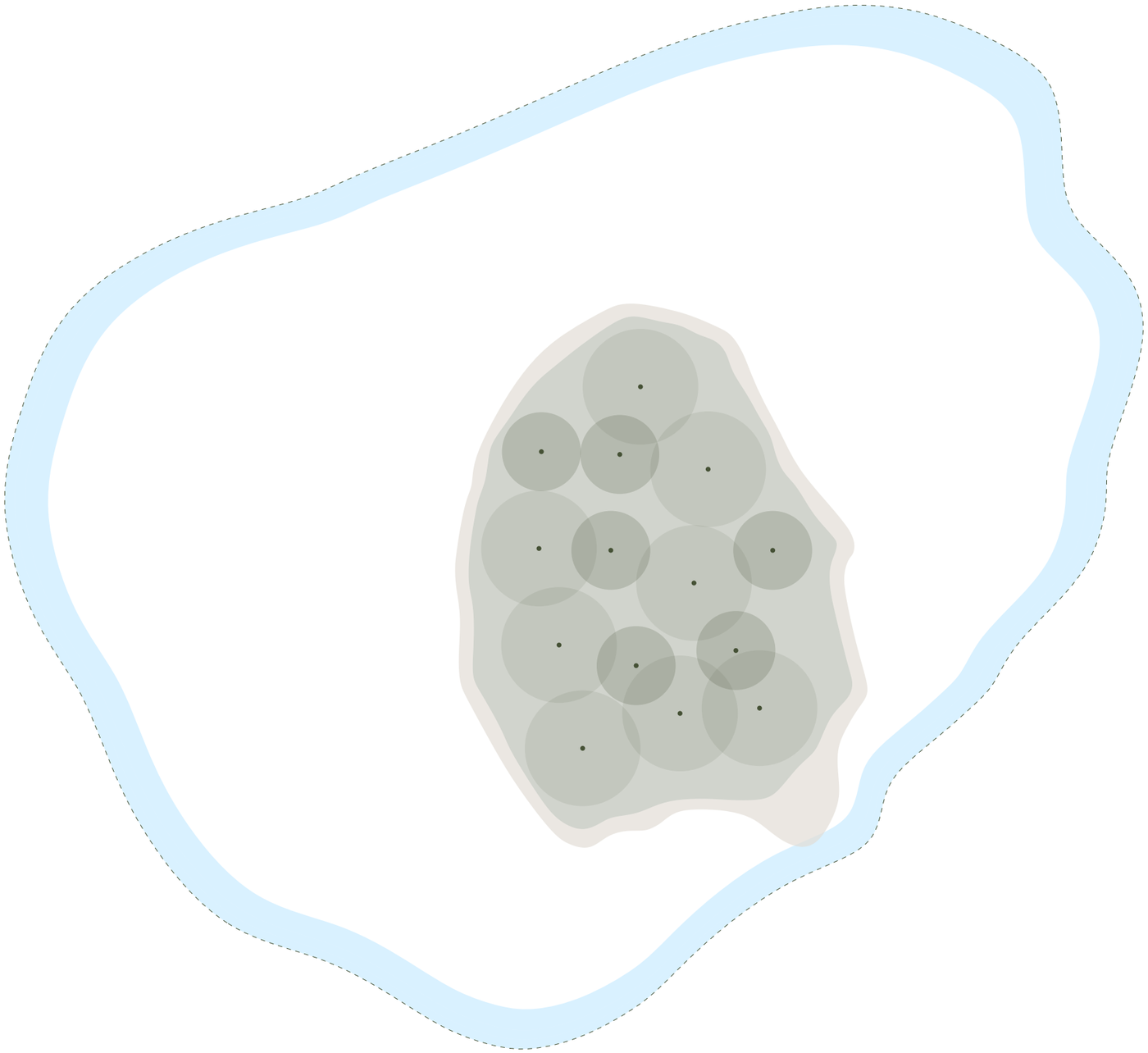


Artificial reef | *Concept*

Applying coral samples to artificial reef by Coastruction | (Piciocchi, 2019)

Artificial reef by Coastruction | (Piciocchi, 2019)

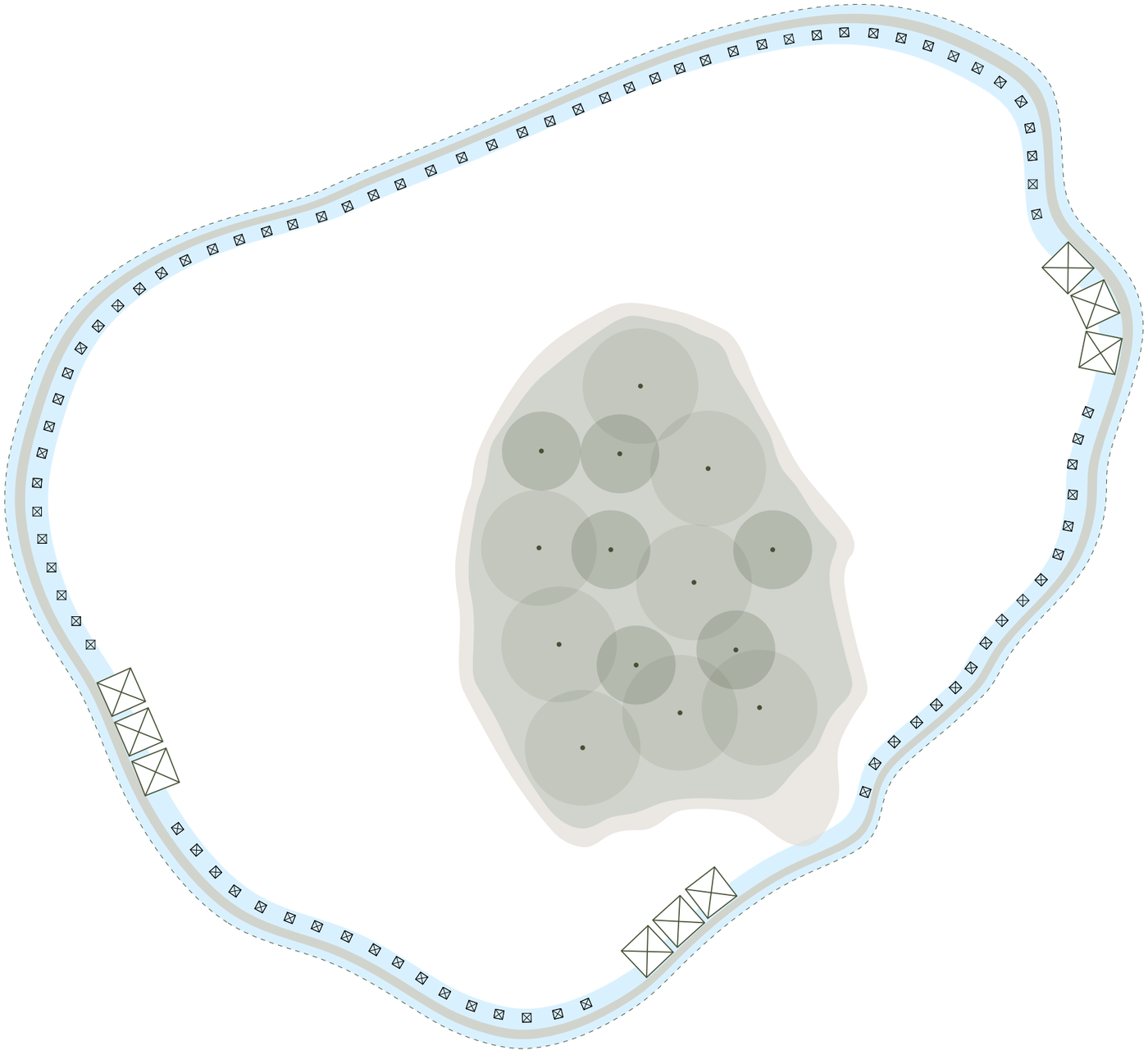
Artificial reef | *Concept*



Applying coral samples to artificial reef by Coastruction | (Piciocchi, 2019)

Artificial reef by Coastruction | (Piciocchi, 2019)

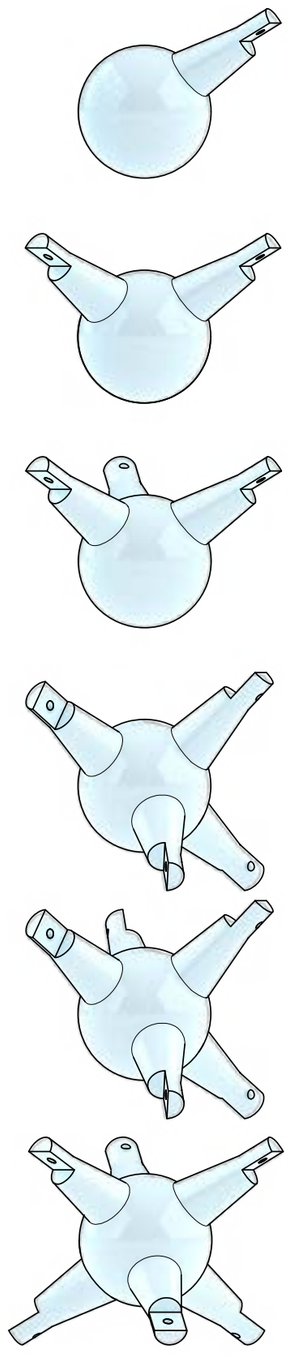
Artificial reef | *Concept*

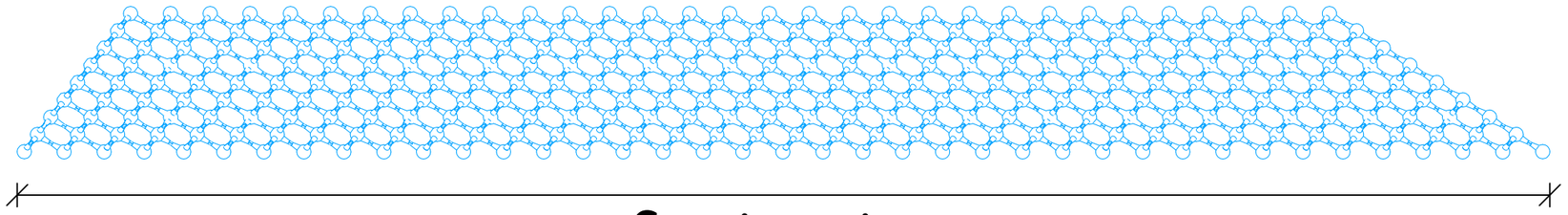


Applying coral samples to artificial reef by Coastruction | (Piciocchi, 2019)

Artificial reef by Coastruction | (Piciocchi, 2019)

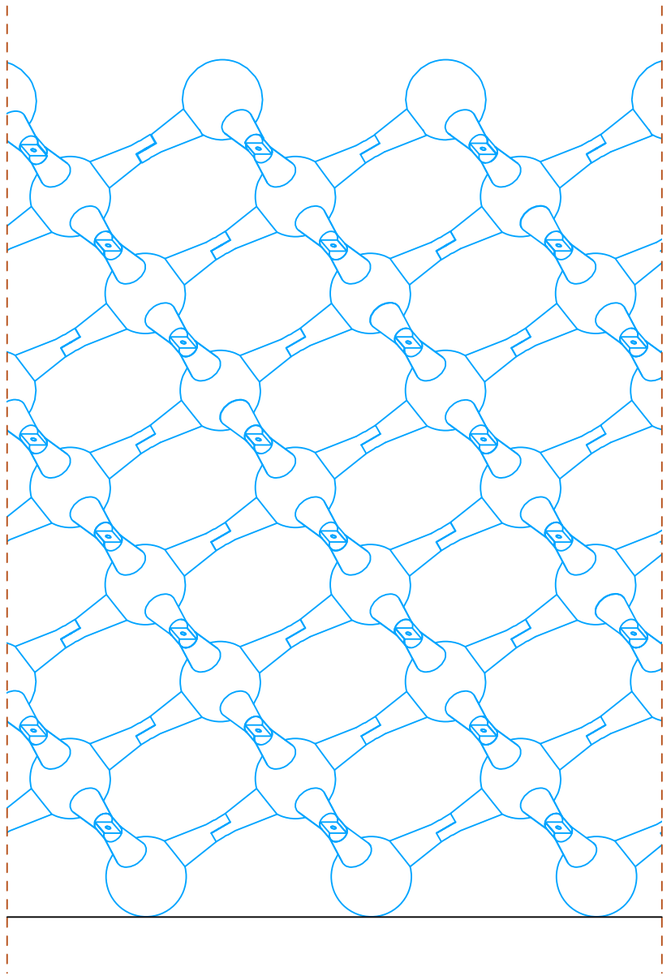
Wave breaking PET reef | *Dimensions*





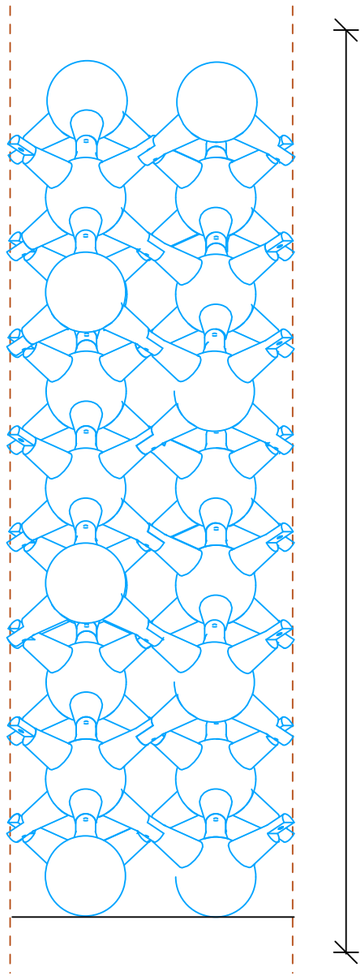
Section view

width ~ 30 m



Section view

height ~ 3.0 m



Front view

height ~ 3.0 m

Waste into product | *Recycling process for new use*

Recycling | (Sadeghi et al., 2021)

Waste into product | *Recycling process for new use*

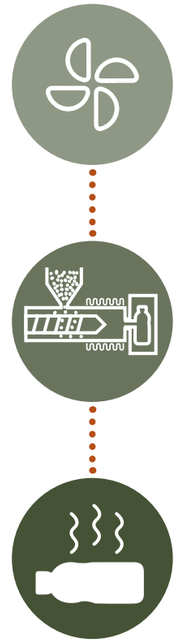
Injection Moulding

Drying granulate

Injecting heated PET

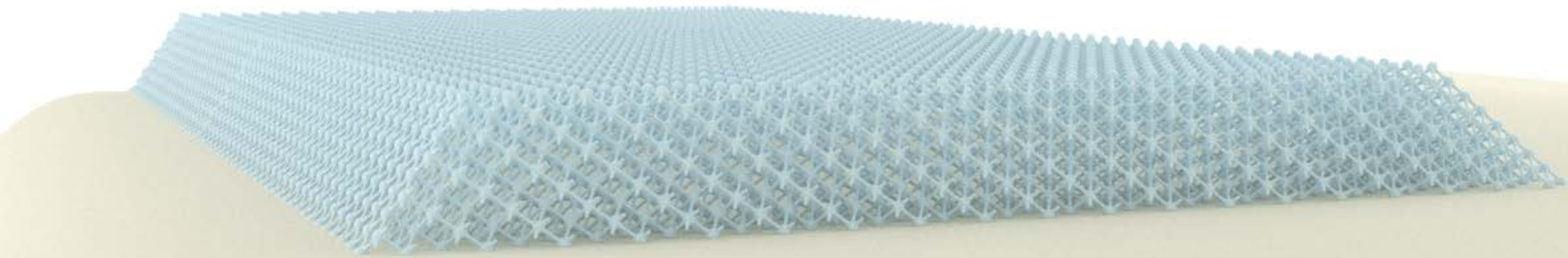
Cooling PET element

Solid

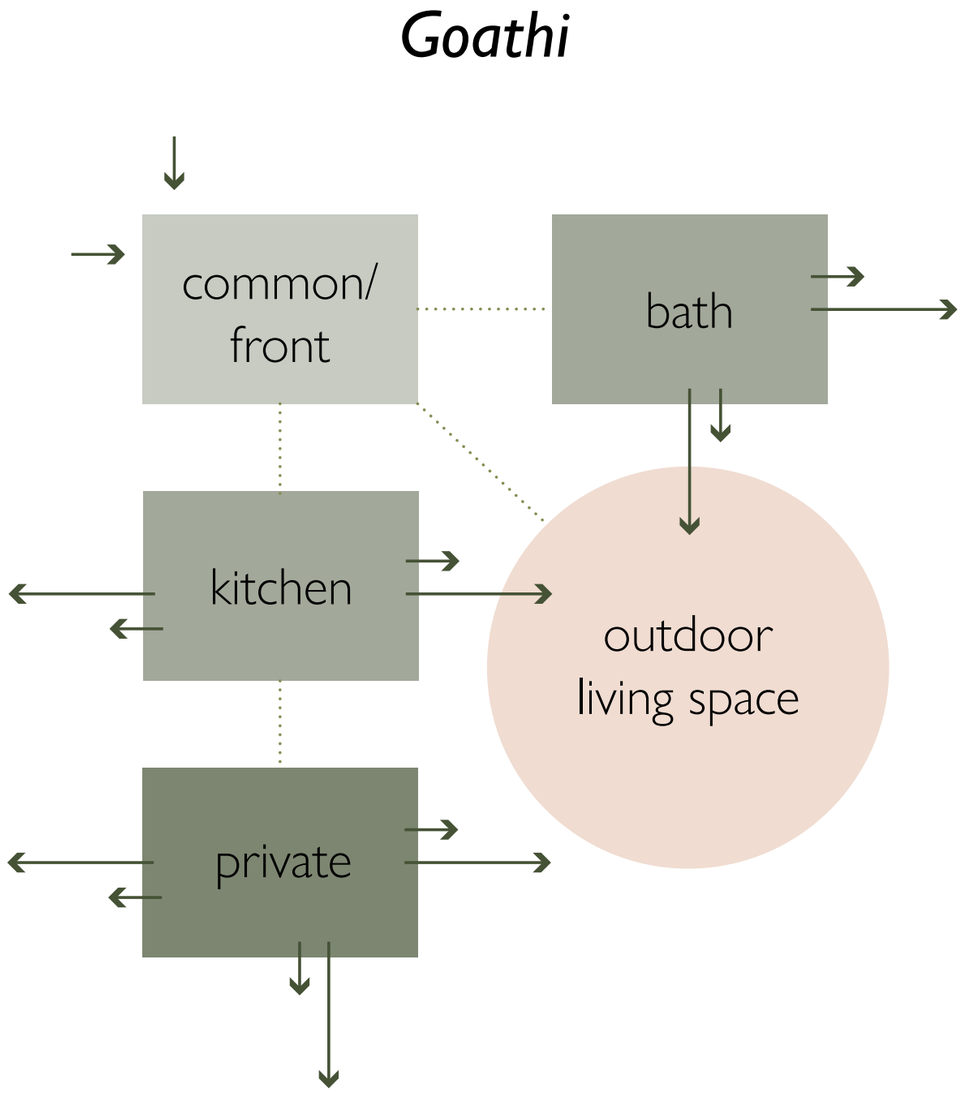


Reproduction | (Ceurstemont, 2020)

Wave breaking PET reef | *Visualisation*



Goathi design | *Tourist accommodation*

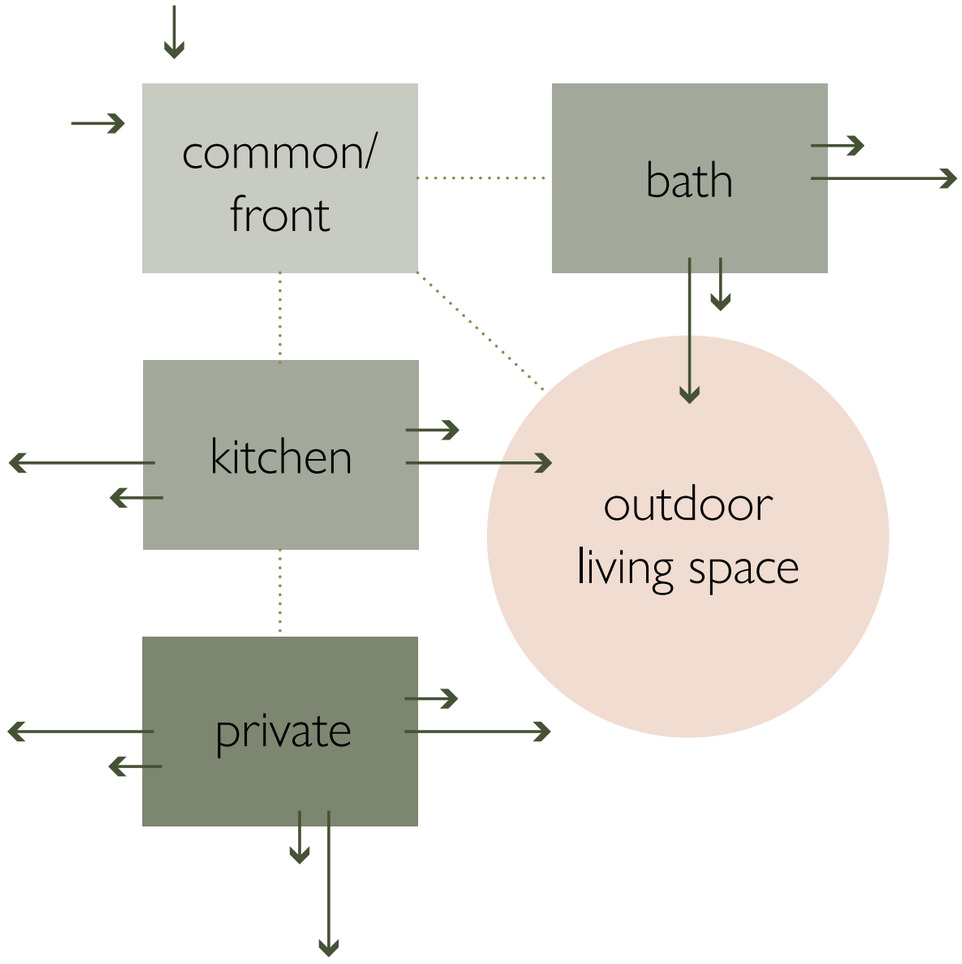


Goathi design | *Tourist accommodation | Modules*

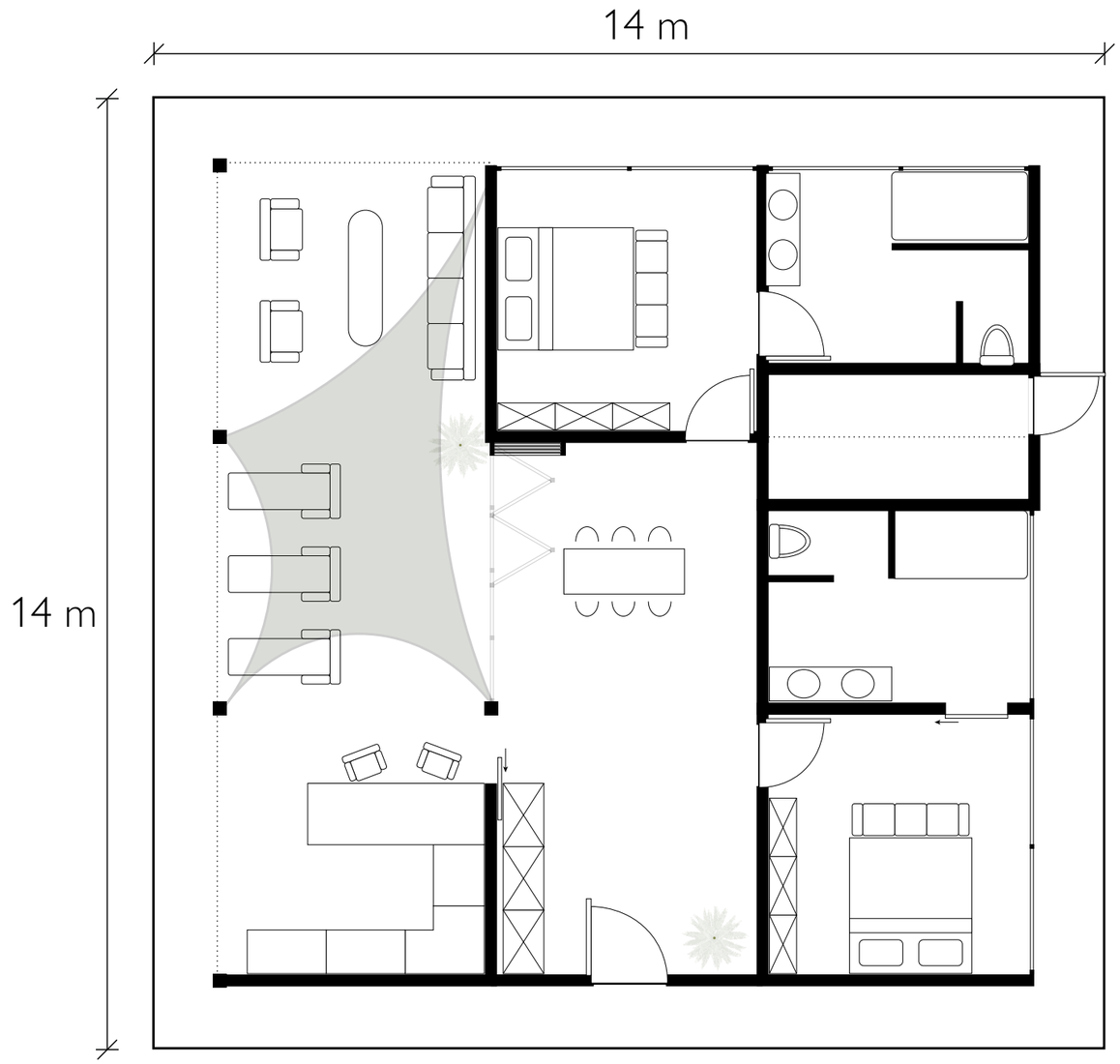
Shape

Interior options

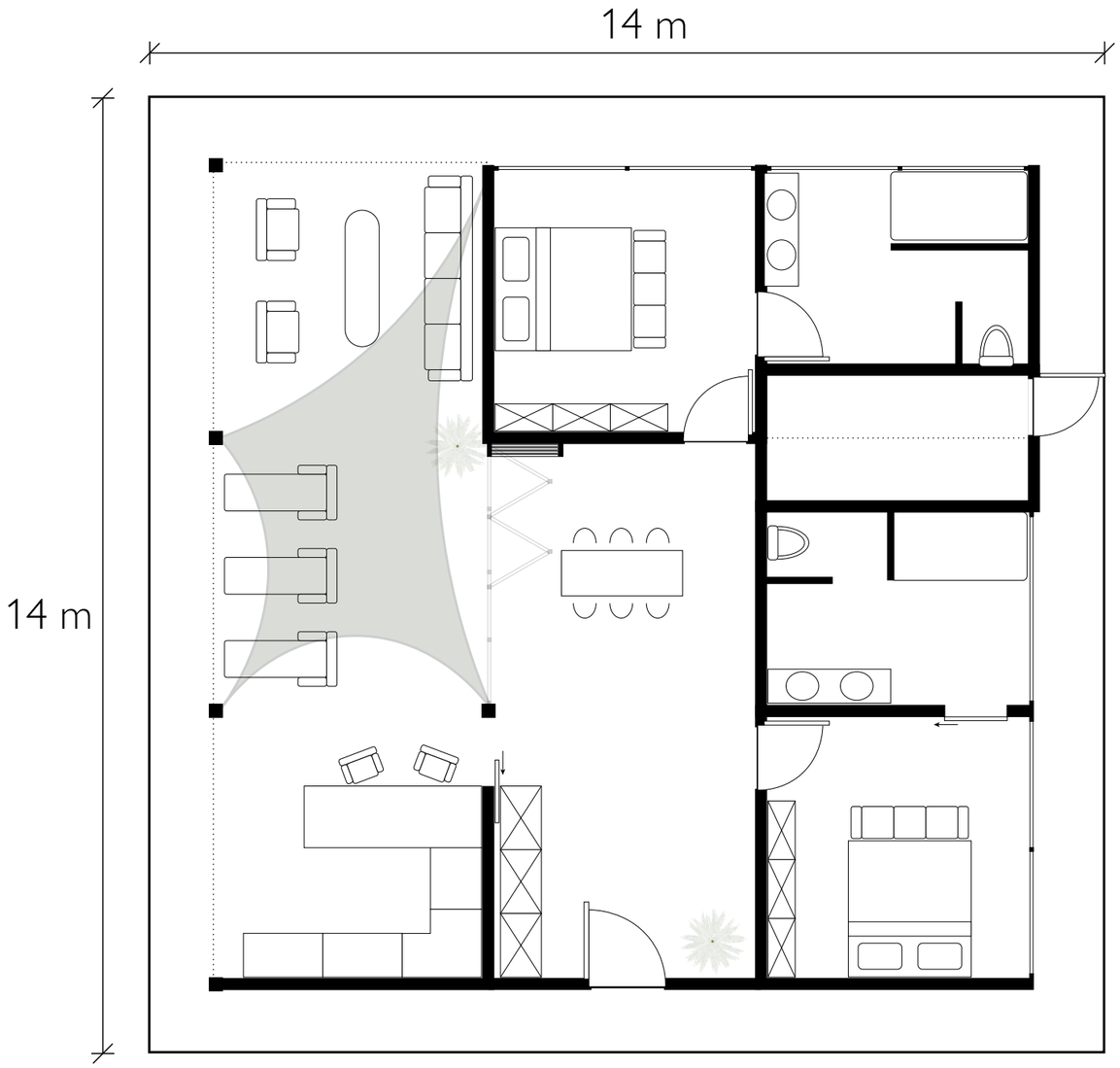
Goathi

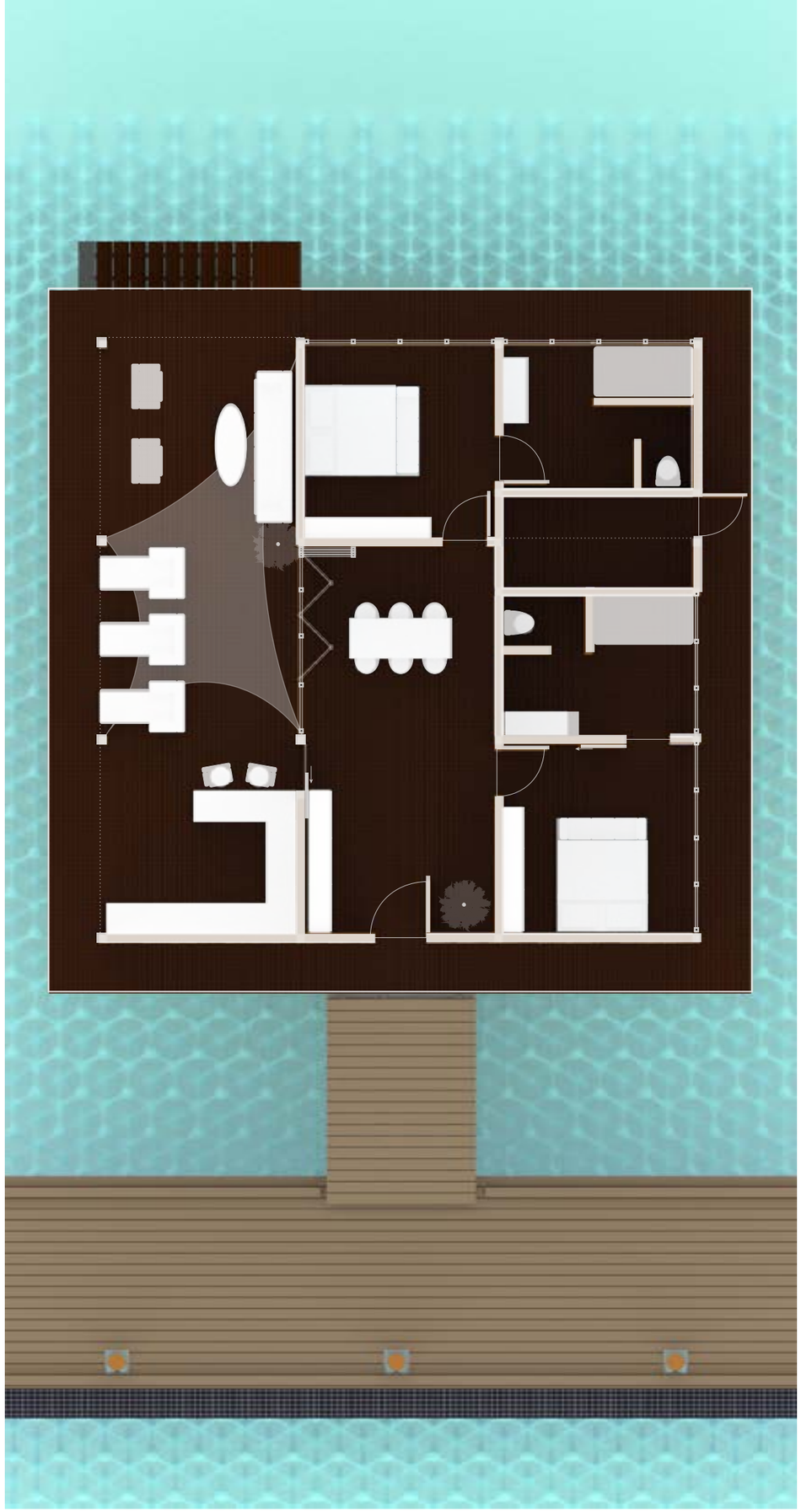


Goathi example | *Floorplan family goathi 4p*

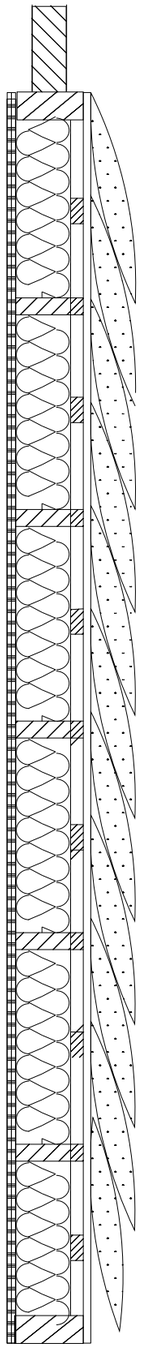


Goathi example | *Floorplan family goathi 4p*

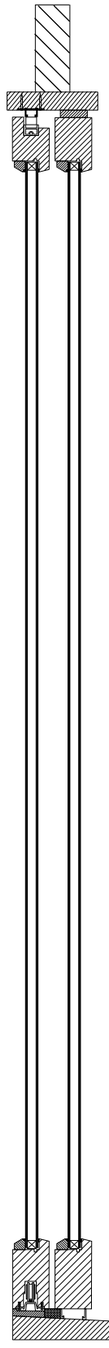




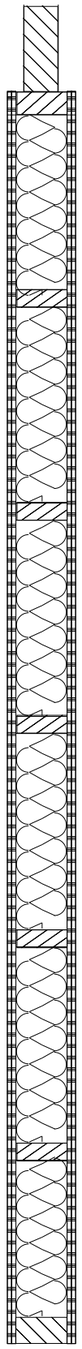
Modules | *Wall elements*



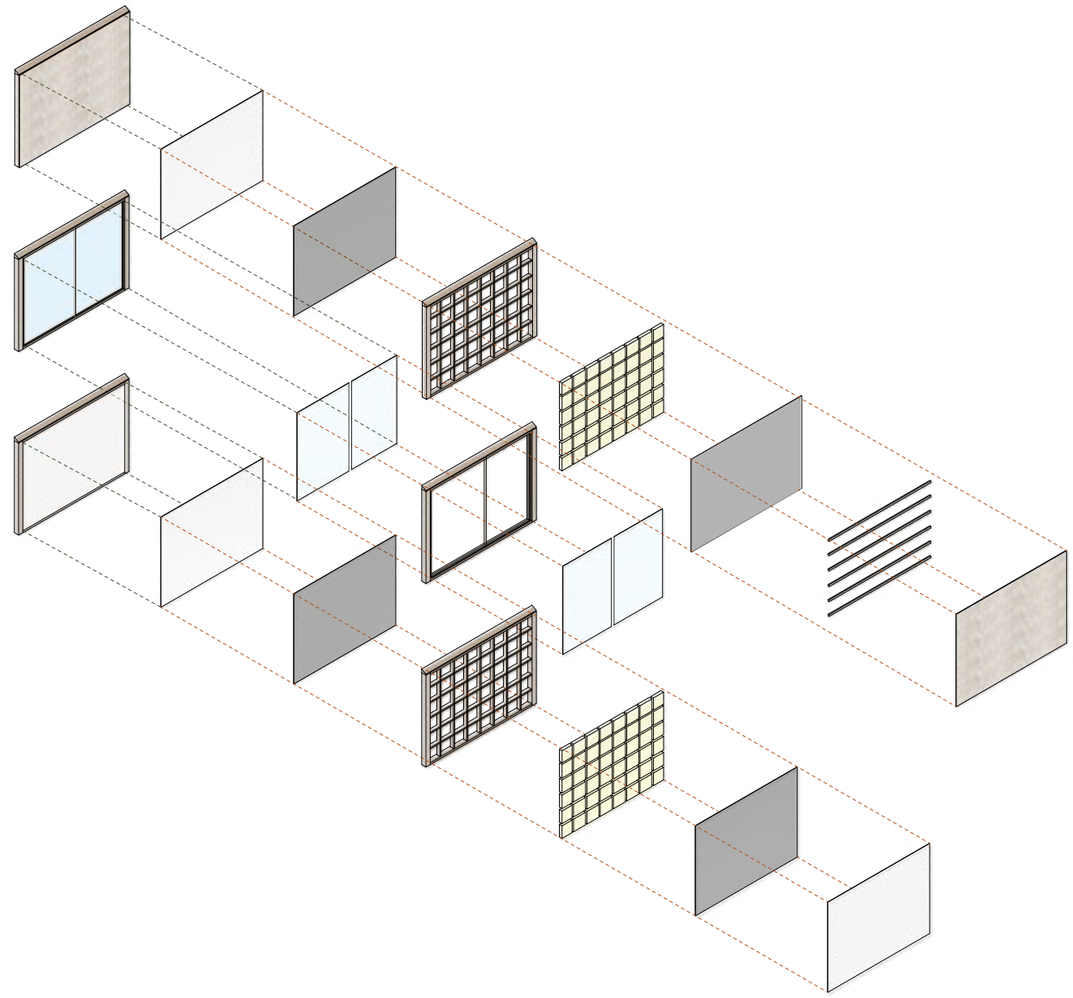
Exterior wall



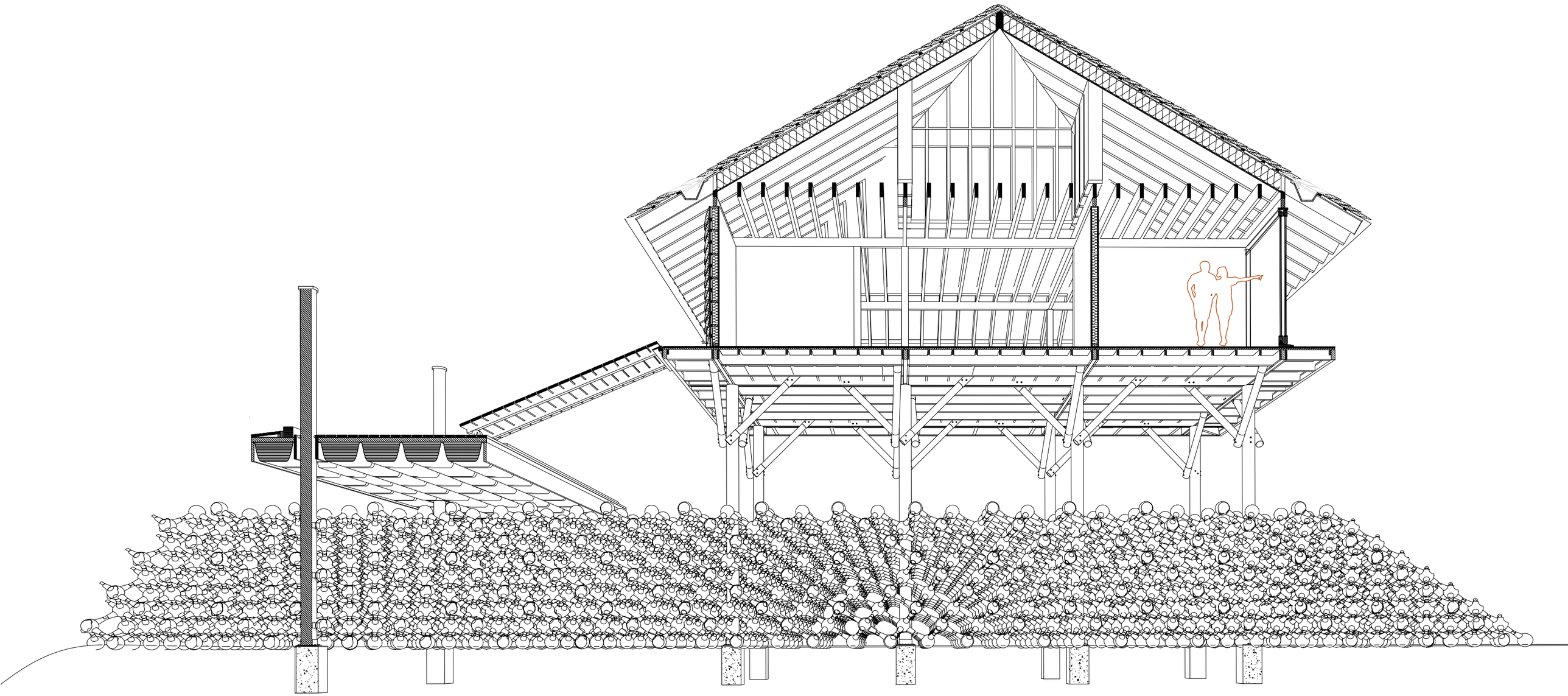
Sliding glass doors



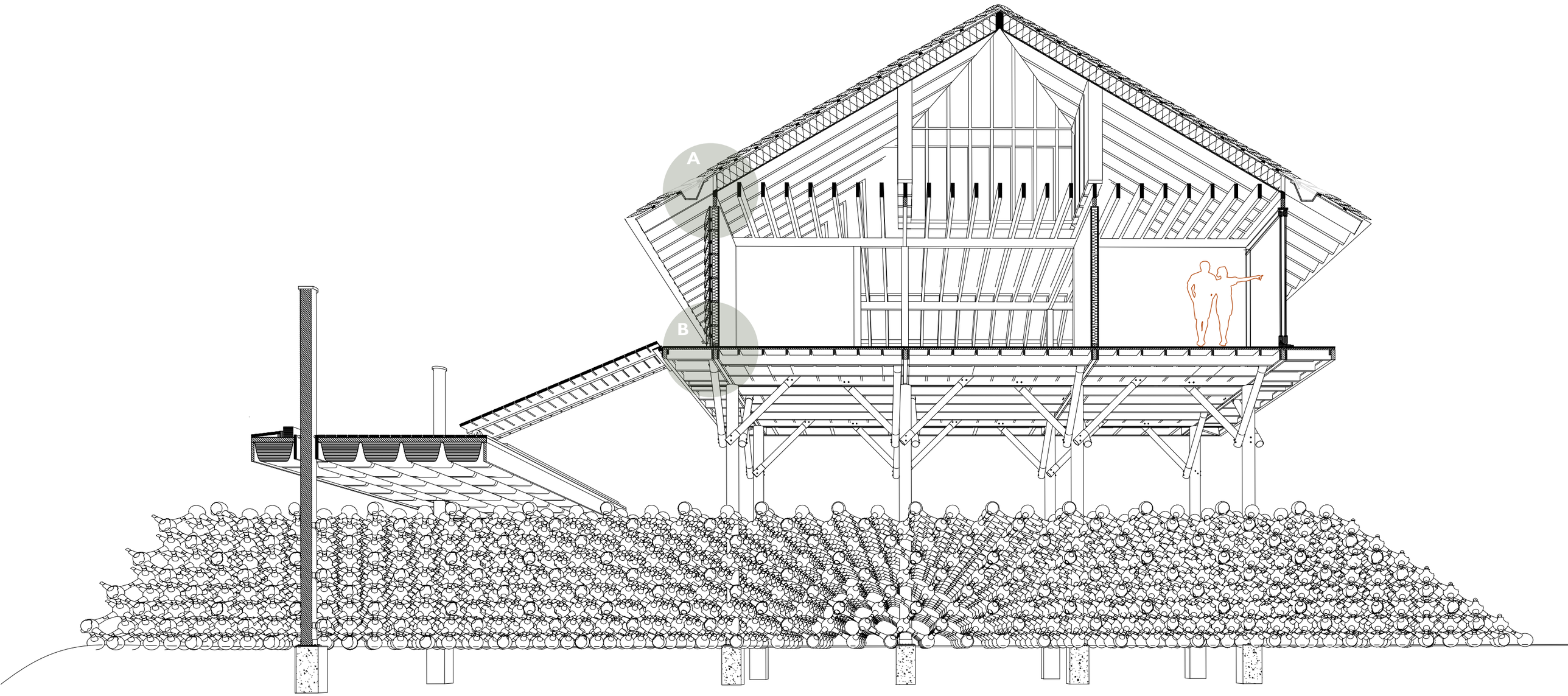
Interior wall



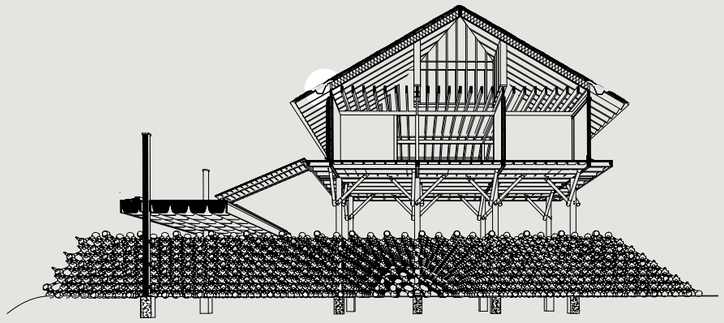
Detailing | *Section 1 : 20*



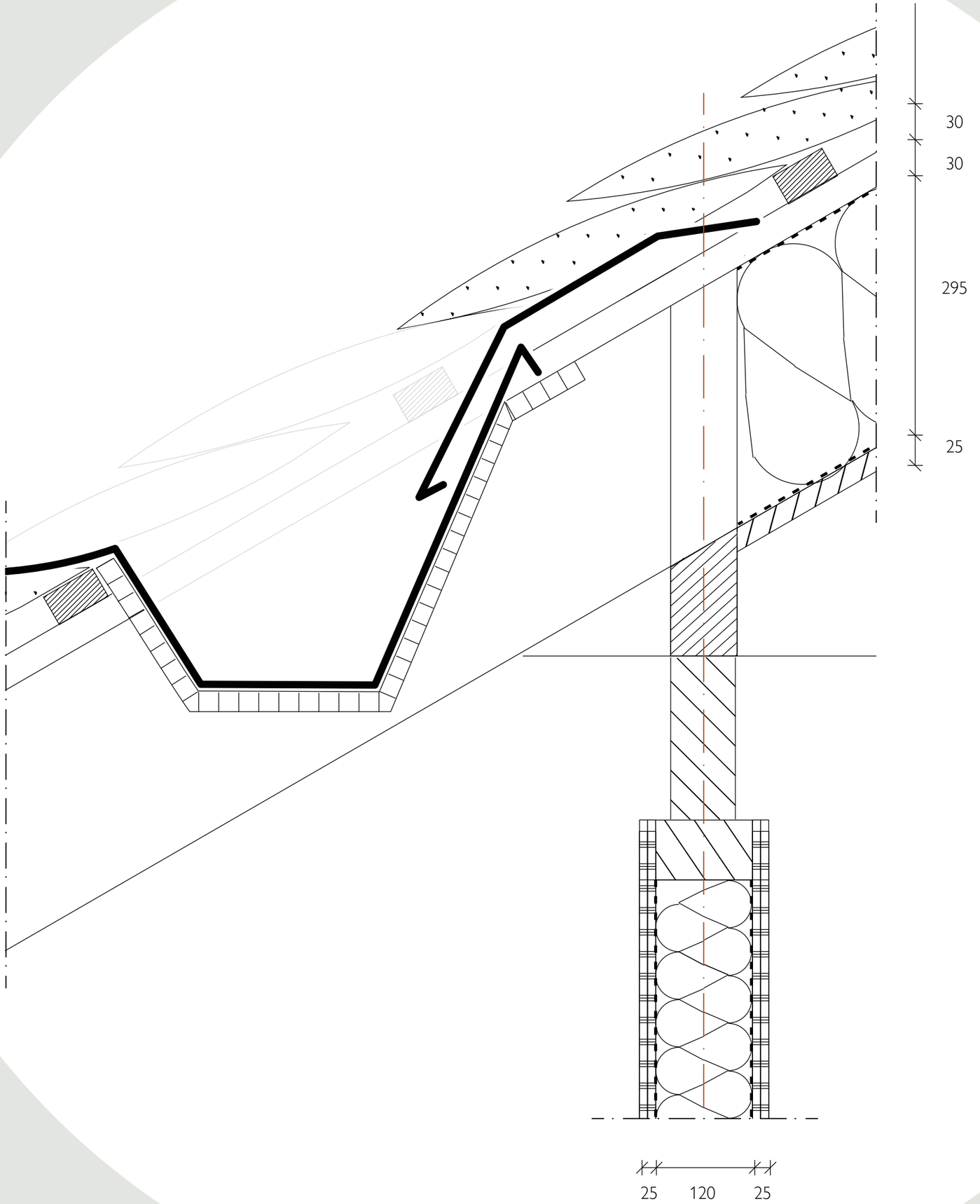
Detailing | *Section 1 : 20*



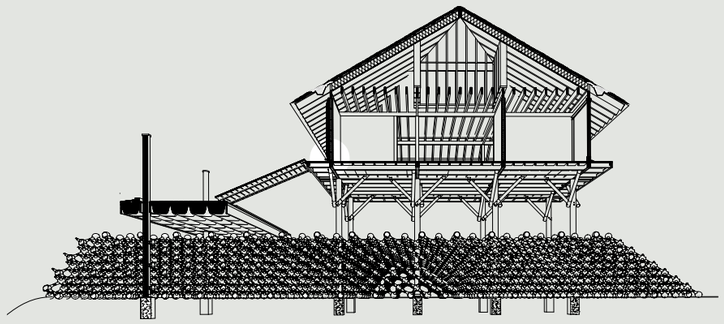
Detailing | *Detail scale 1 : 5*



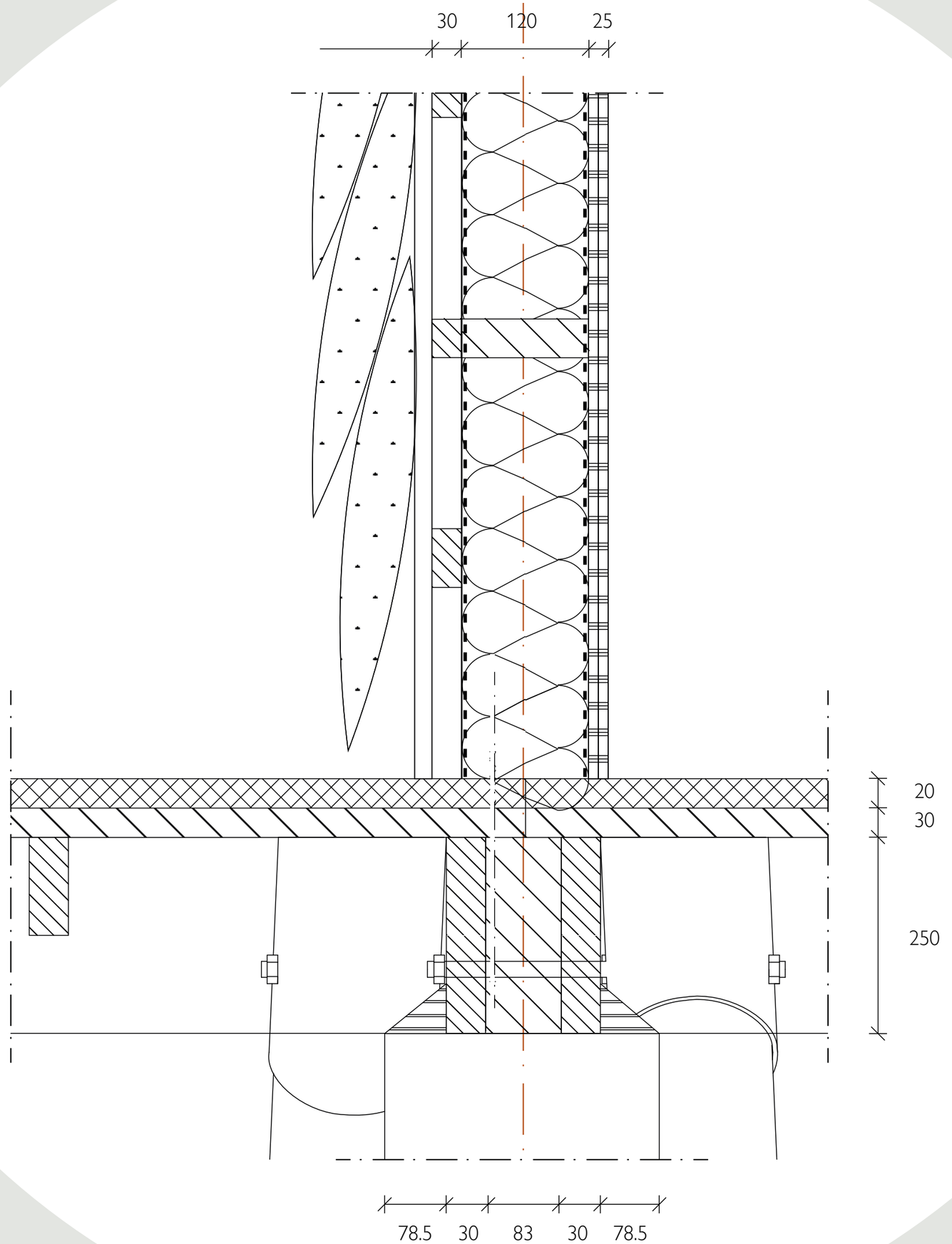
- Palm frond roof finish
- Timber frame
- Water drainage gutter
- Water blocking foil
- Fiber glass insulation
- Damp blocking foil
- Plasterboard or wooden finish



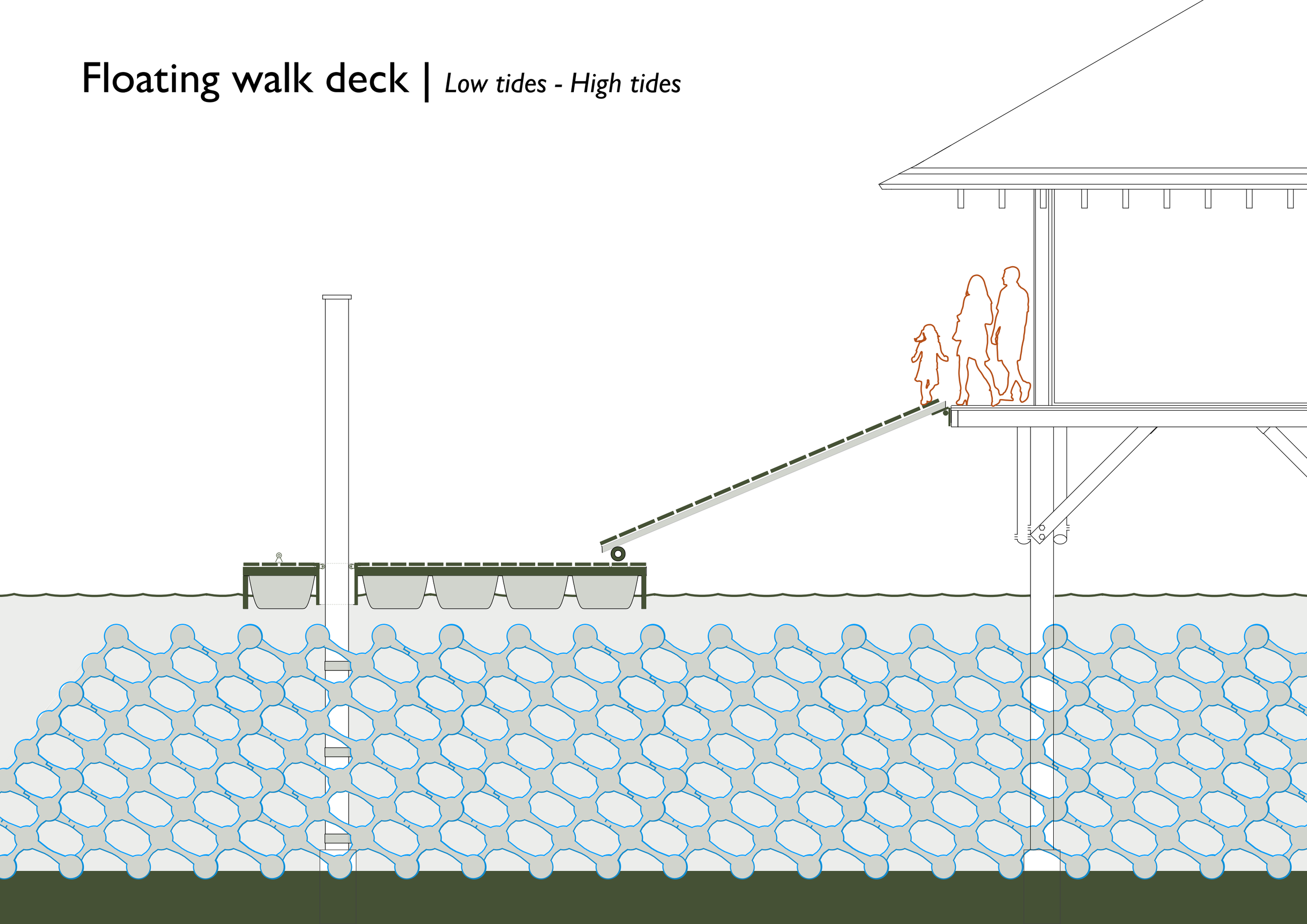
Detailing | *Detail scale 1 : 5*



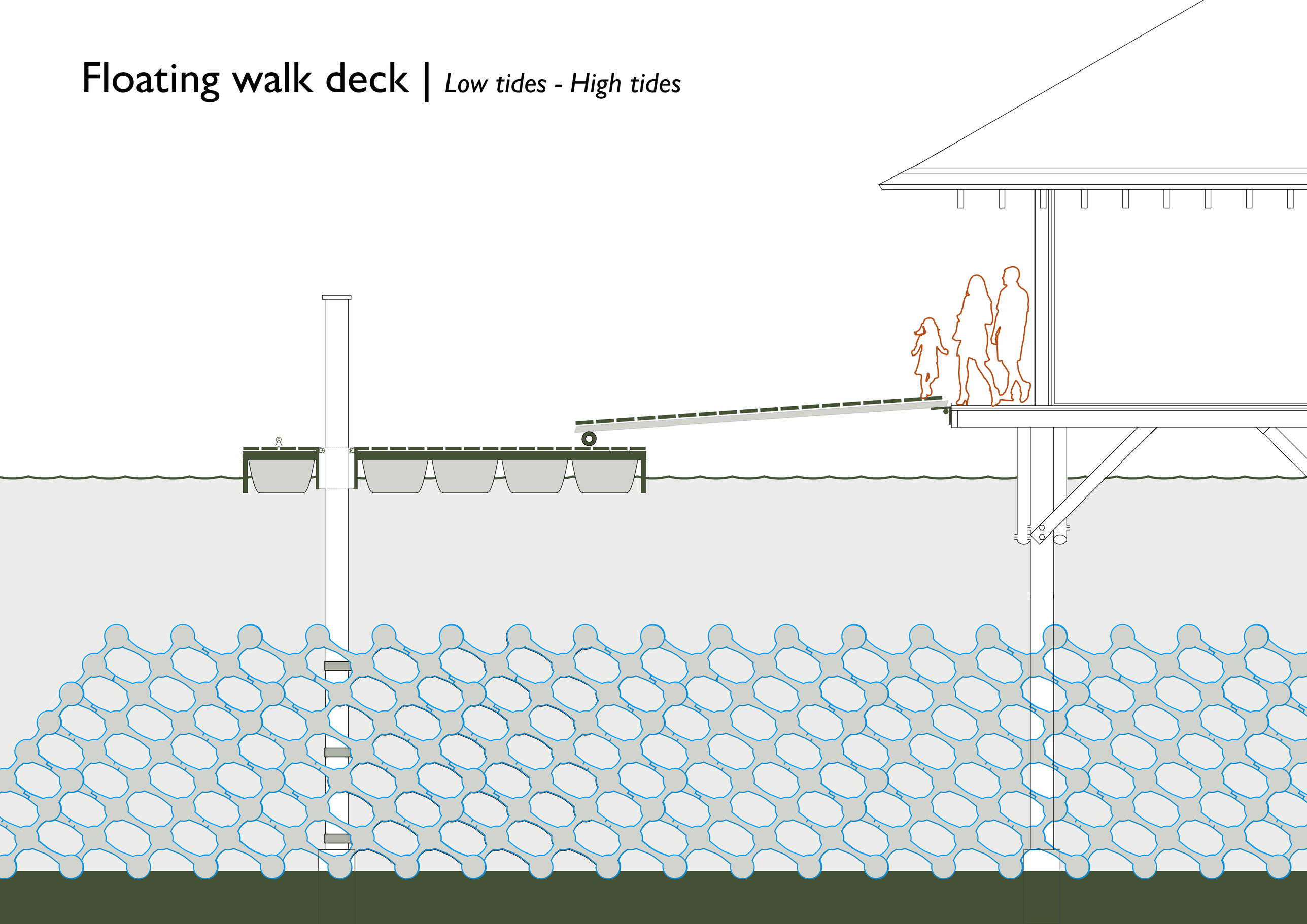
- Hard wood flooring
- Wooden underlayer
- Timber structure
- Timber floor beams
- Timber column
- Timber stability bracing



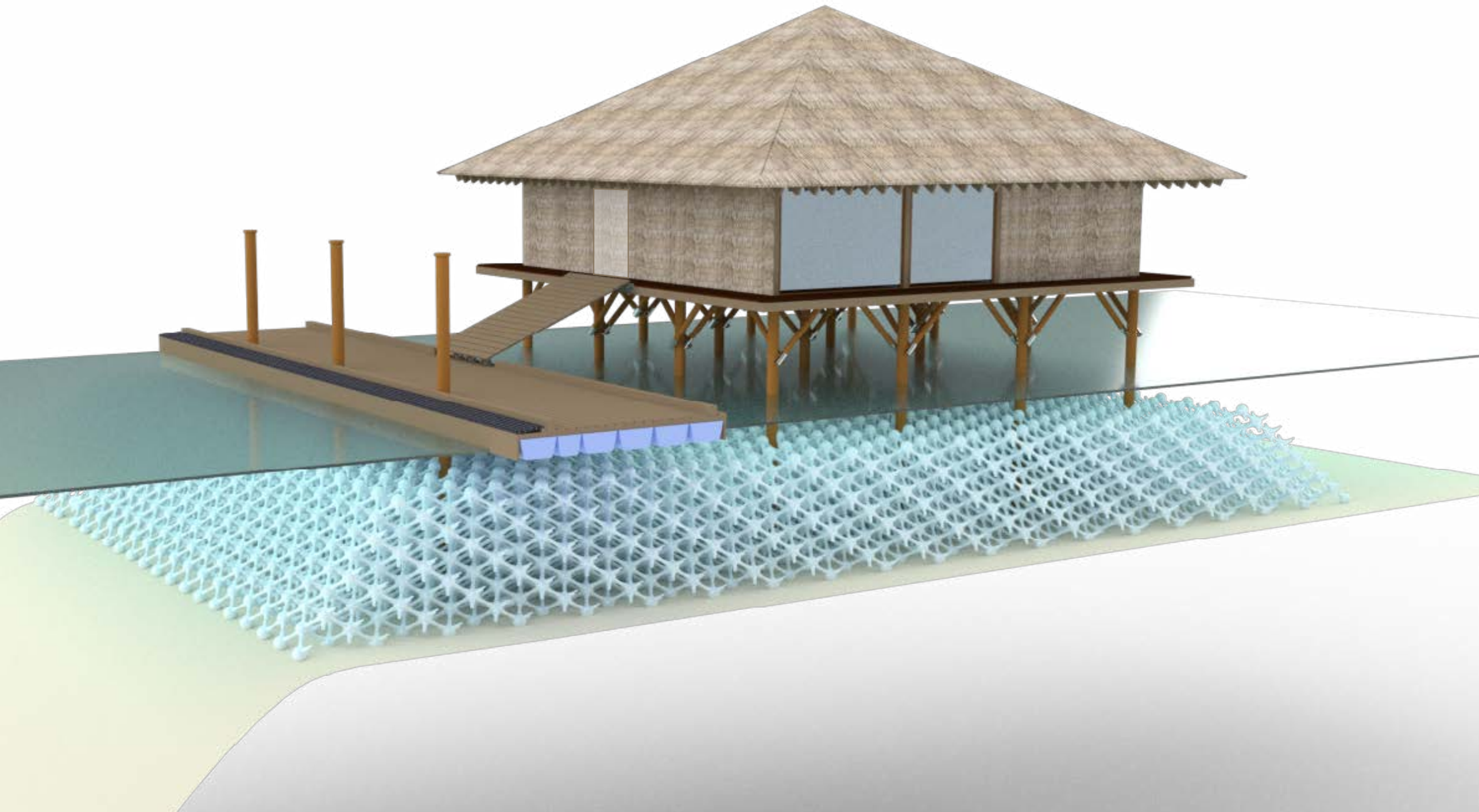
Floating walk deck | *Low tides - High tides*



Floating walk deck | *Low tides - High tides*



Goathi | *Example render*



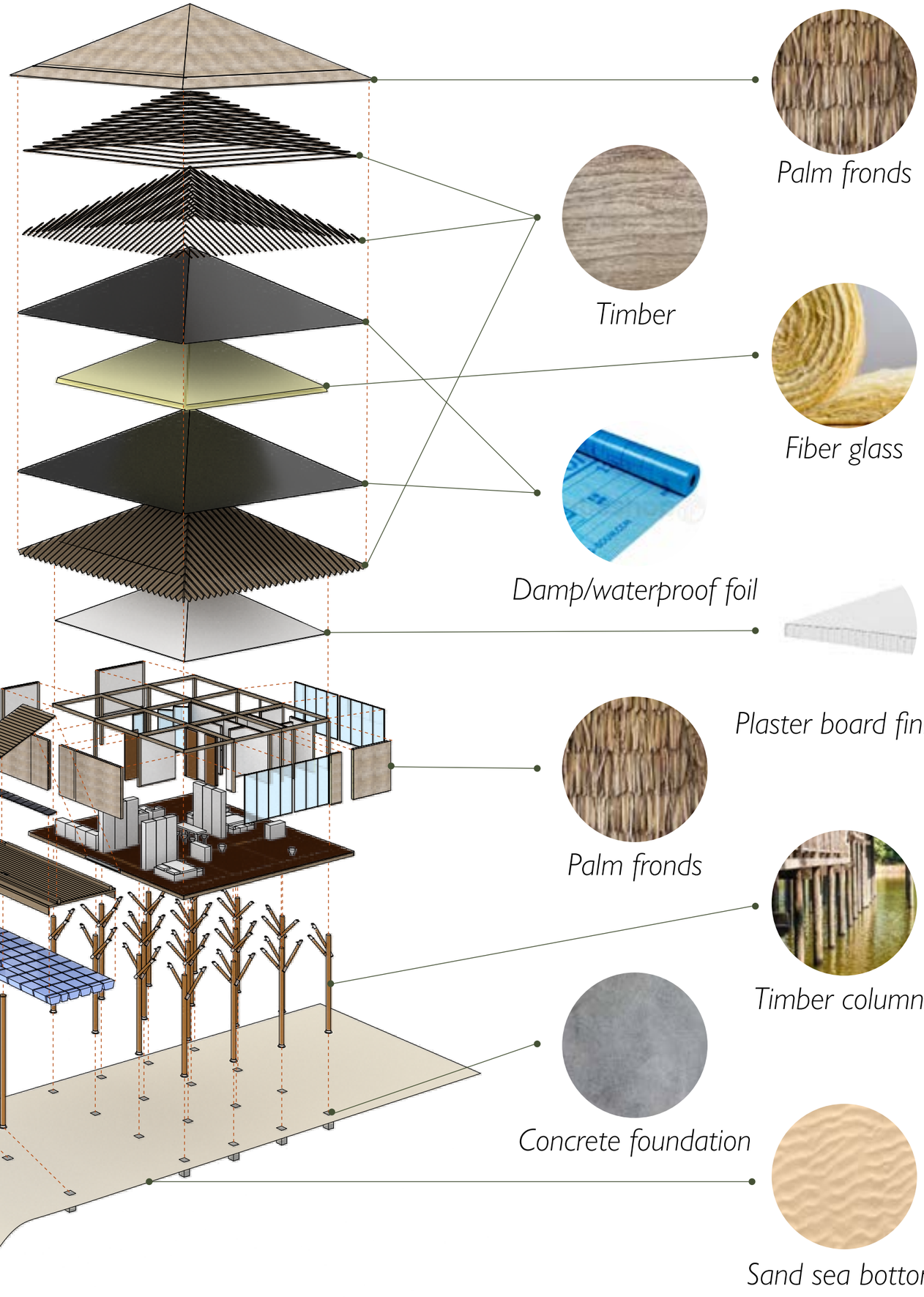
Goathi design | *Materials*

Solar panels

Timber

Floating containers

Timber columns



Palm fronds

Timber

Fiber glass

Damp/waterproof foil

Plaster board finish

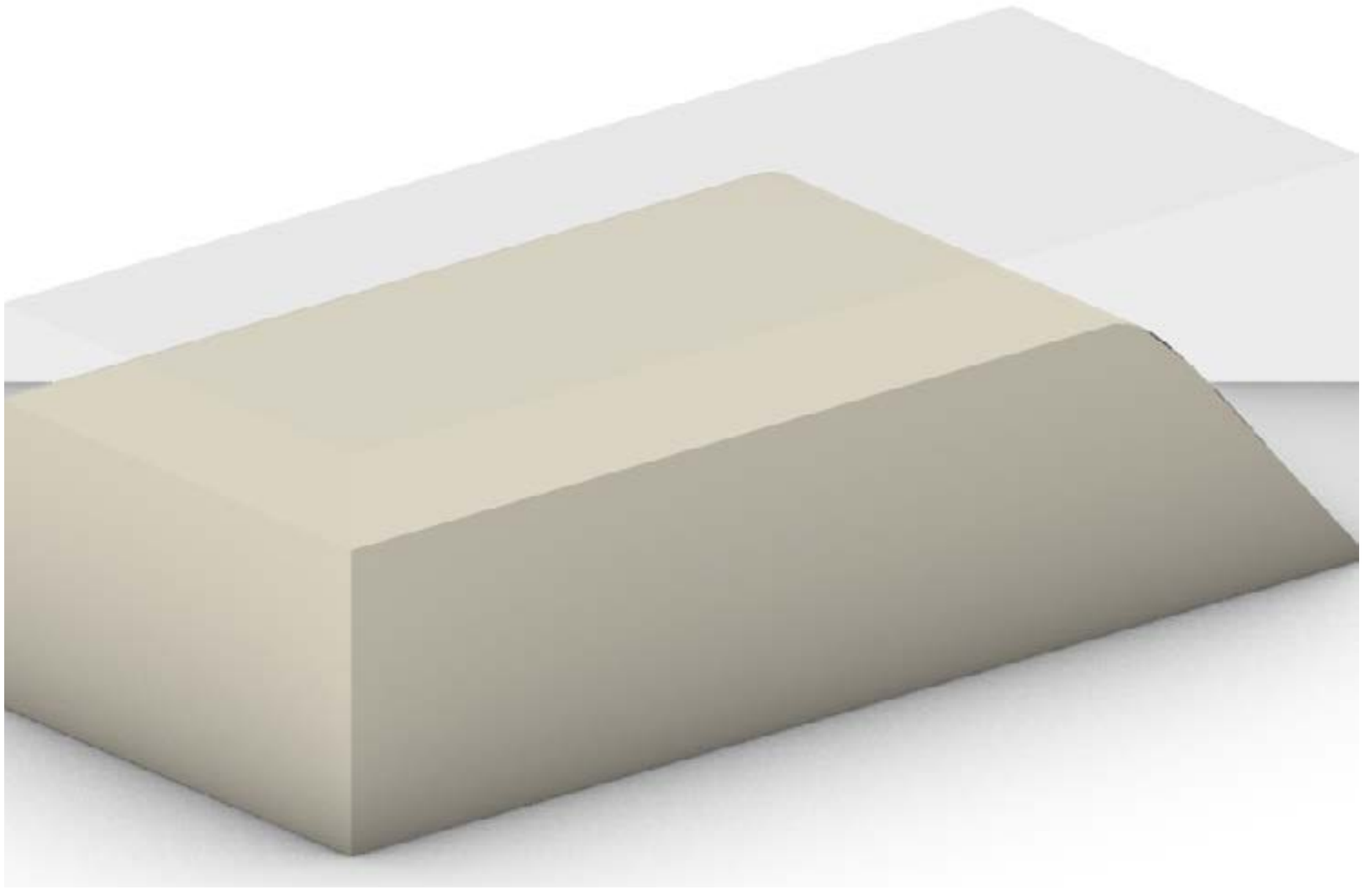
Palm fronds

Timber columns

Concrete foundation

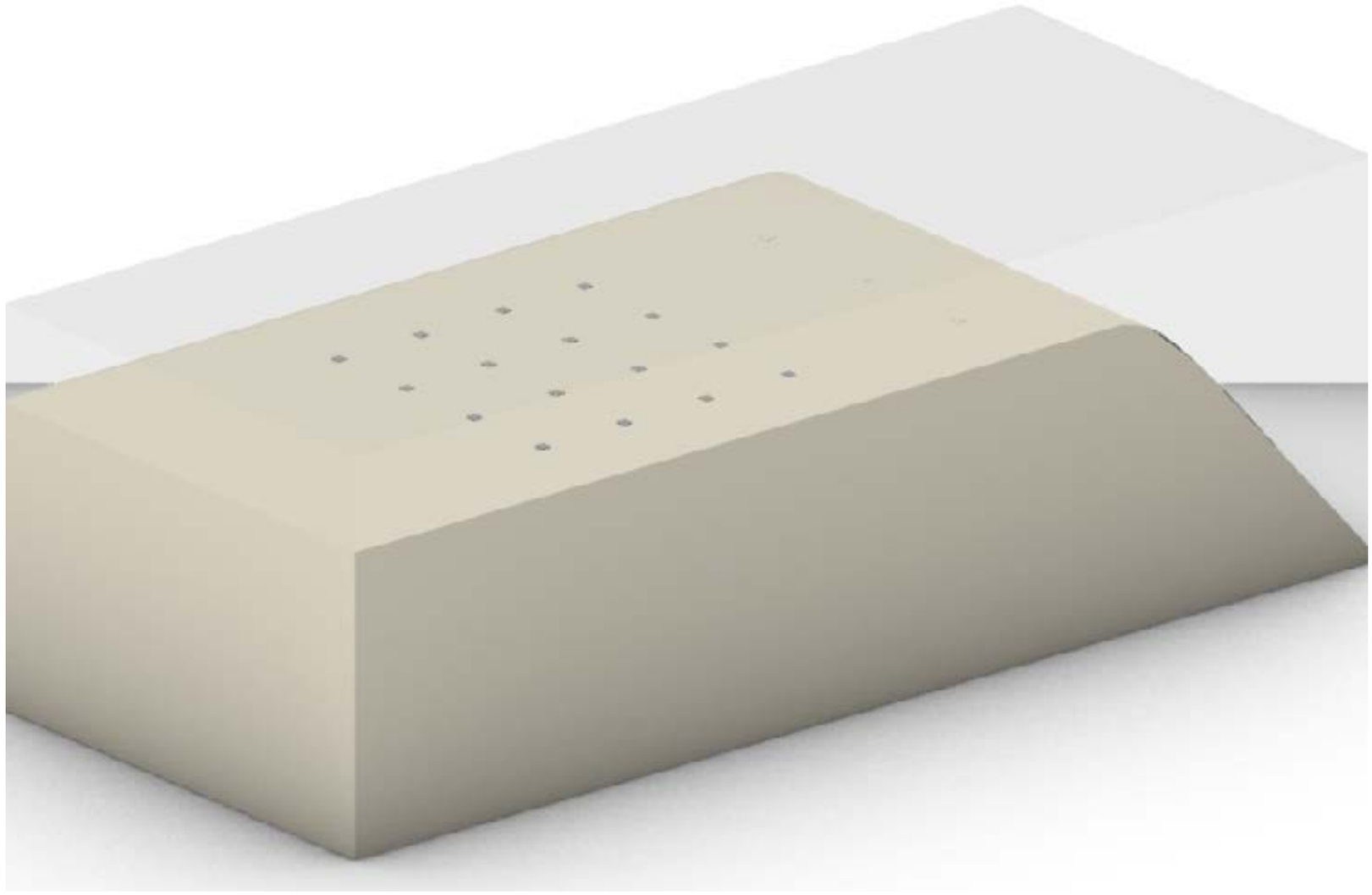
Sand sea bottom

Goathi | *Construction process*



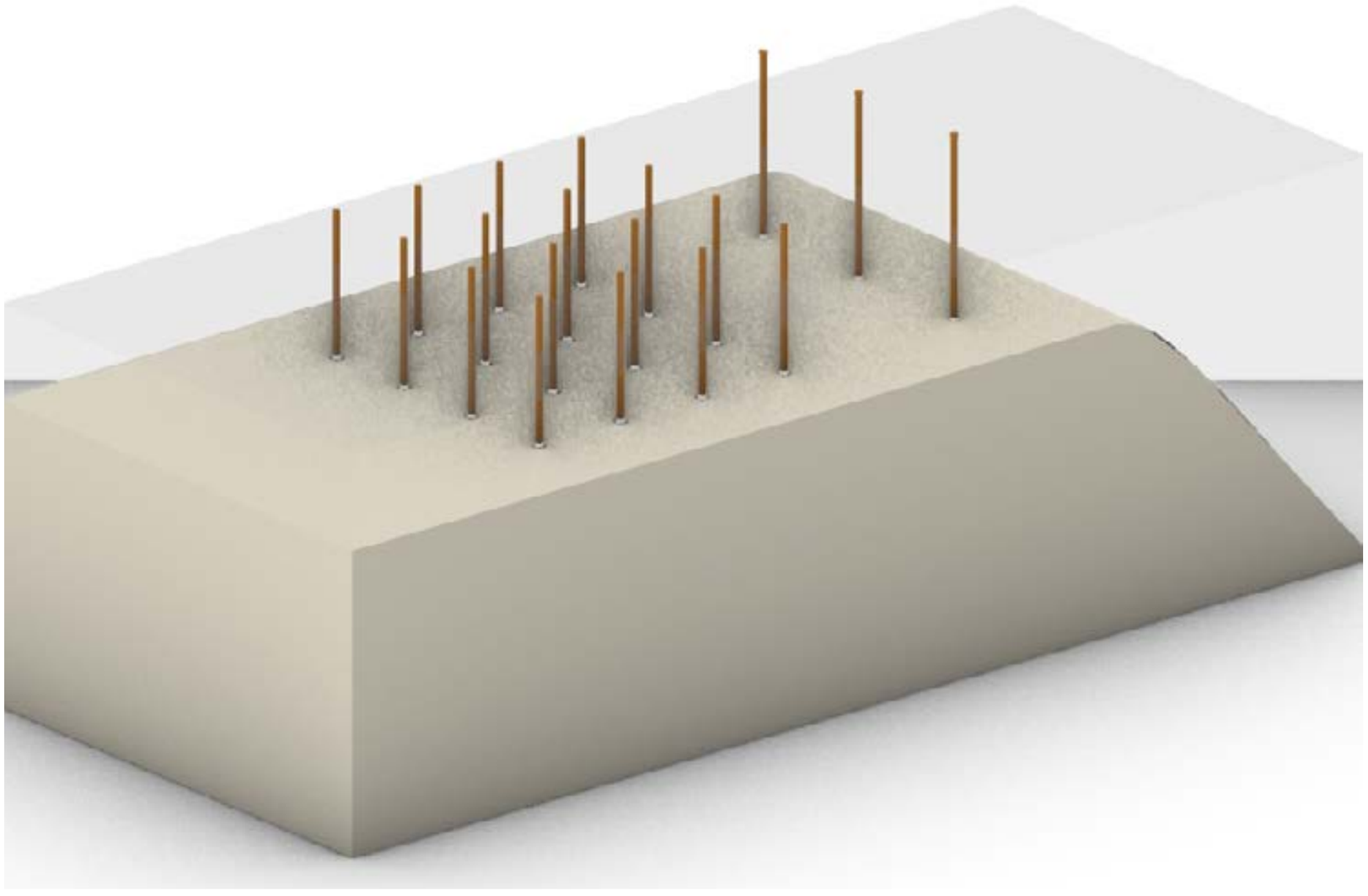
Prepare the sea bottom

Goathi | *Construction process*



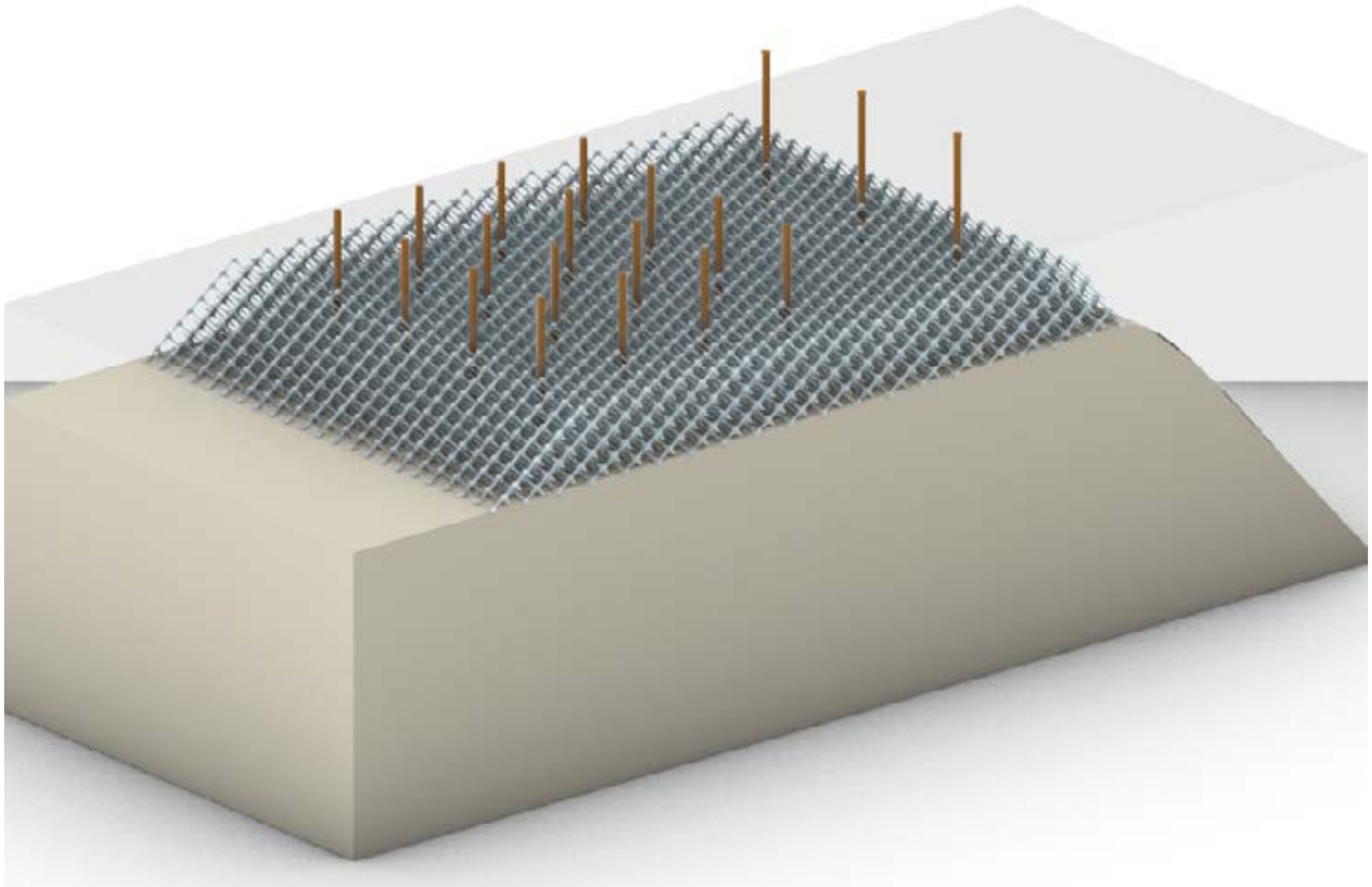
Foundations

Goathi | *Construction process*



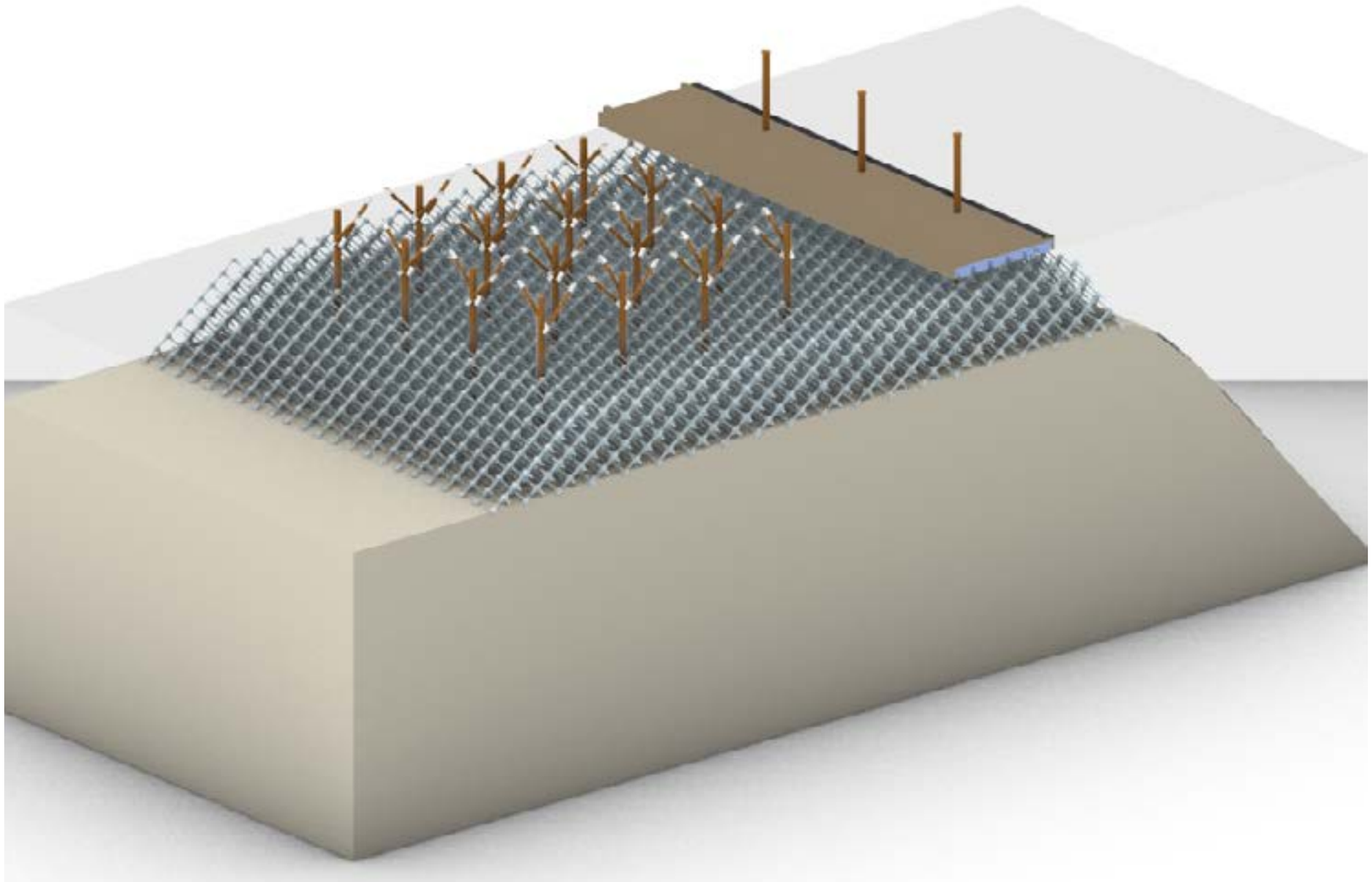
Place columns

Goathi | *Construction process*



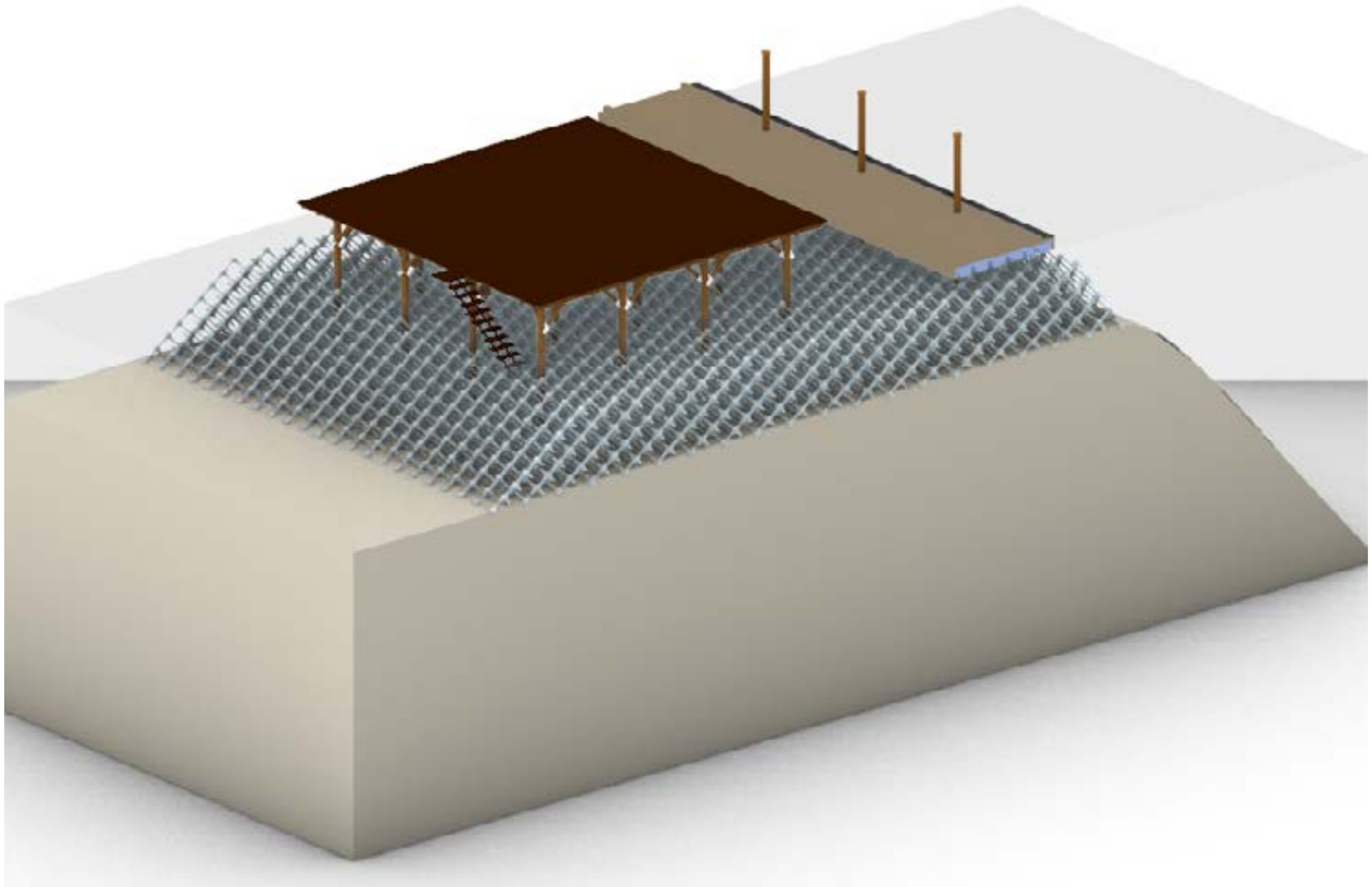
Add PET reef

Goathi | *Construction process*



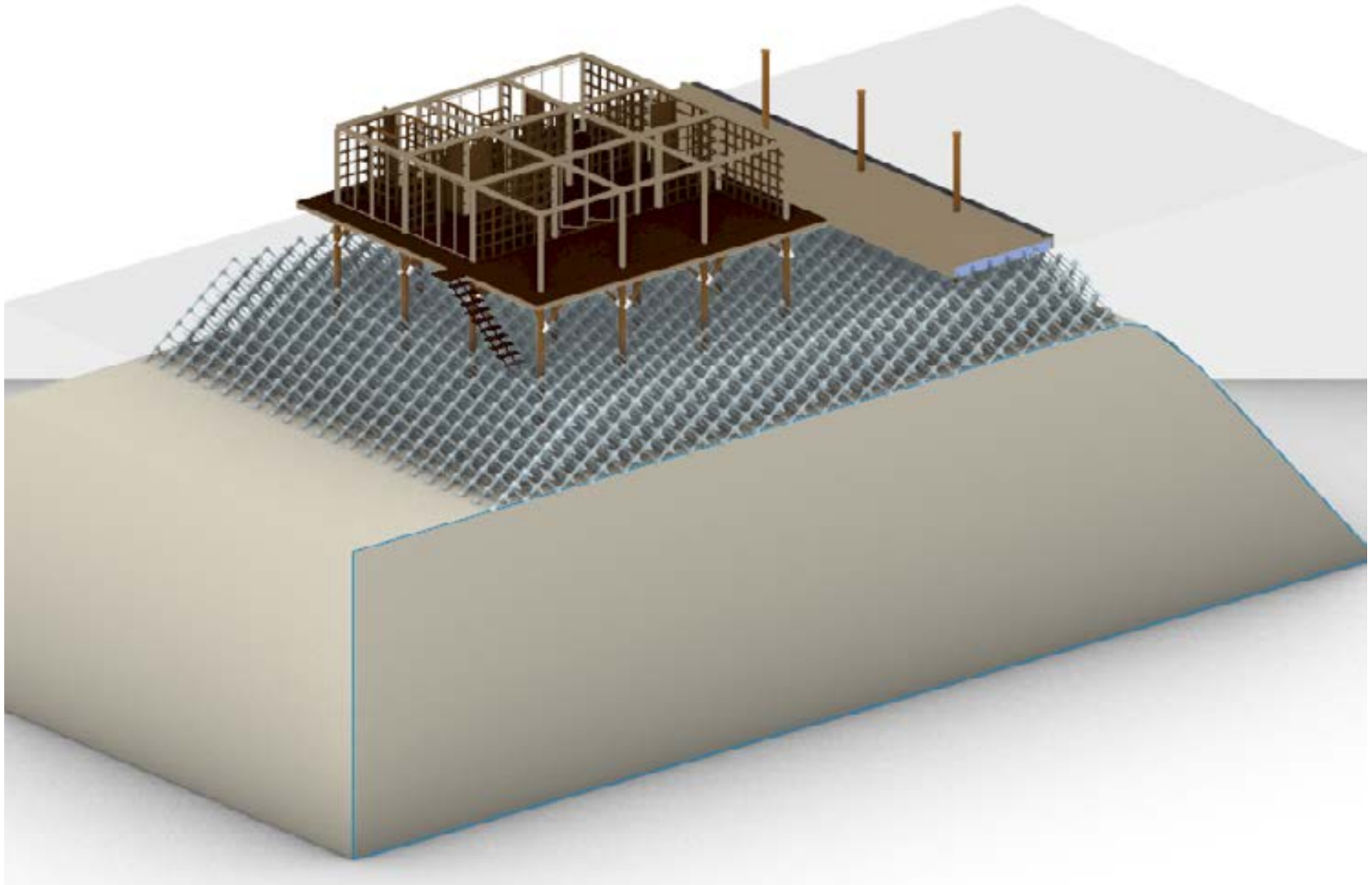
Stability bracing and deck

Goathi | *Construction process*



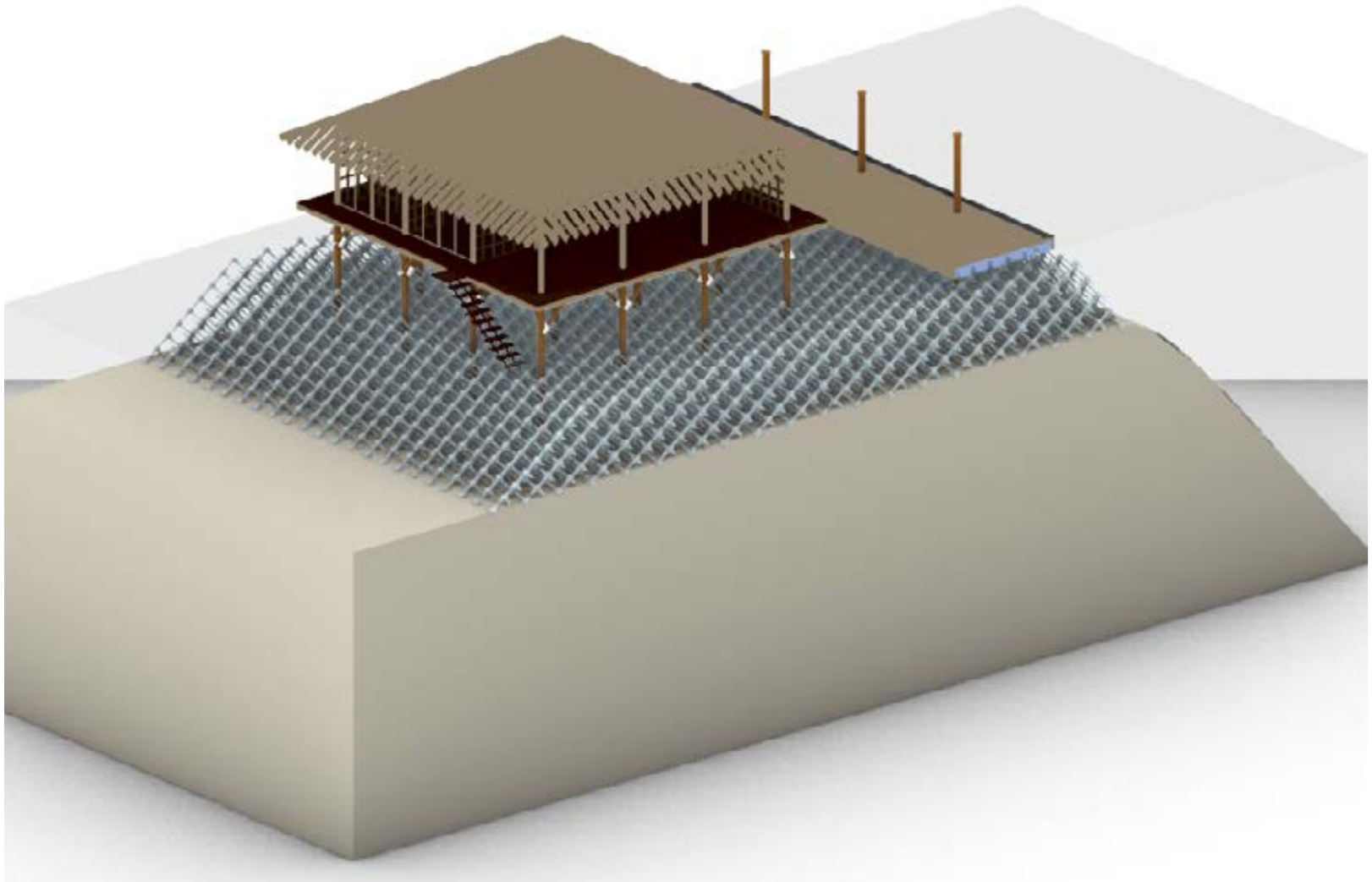
Floors

Goathi | *Construction process*



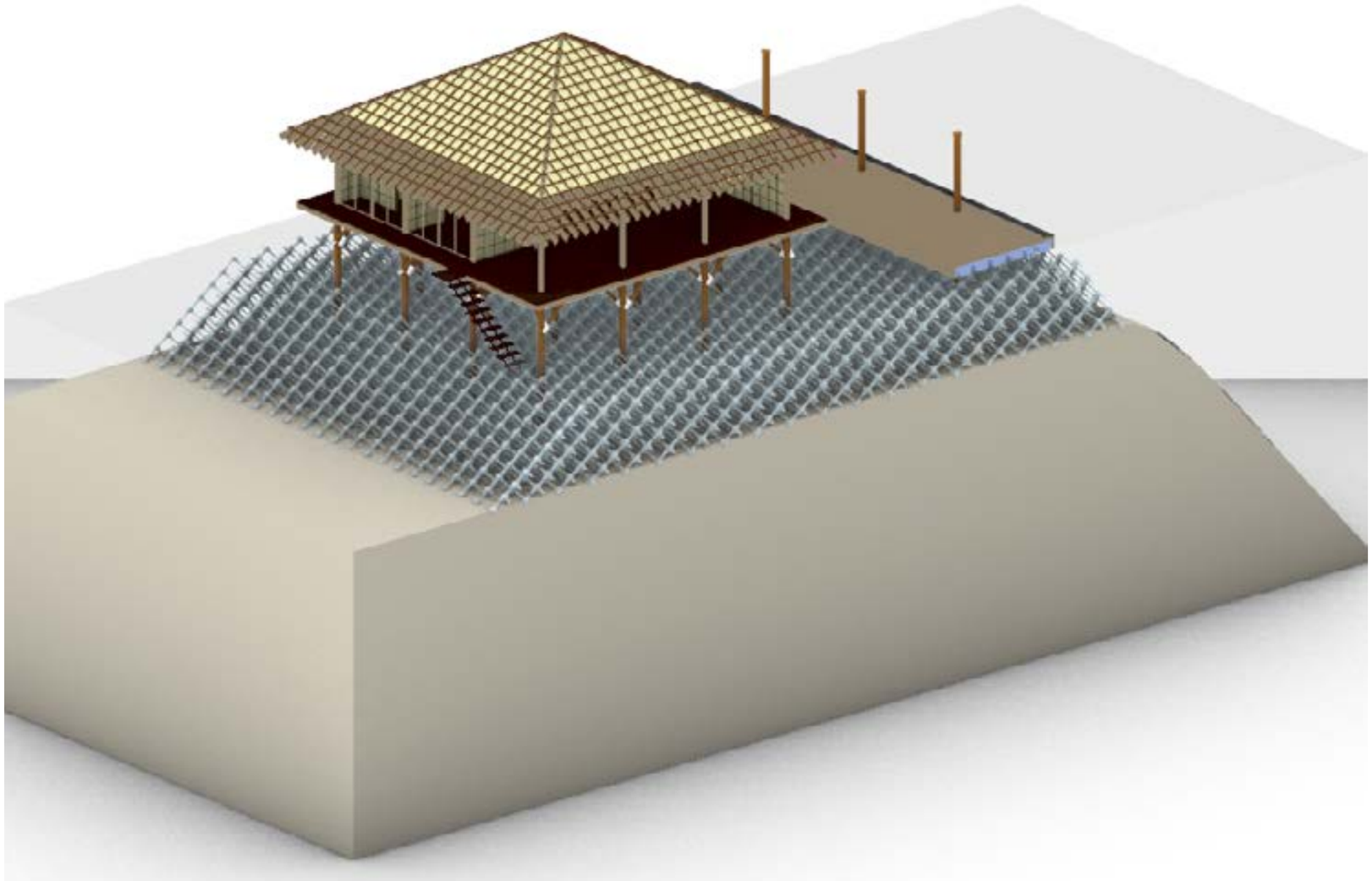
Walls

Goathi | *Construction process*



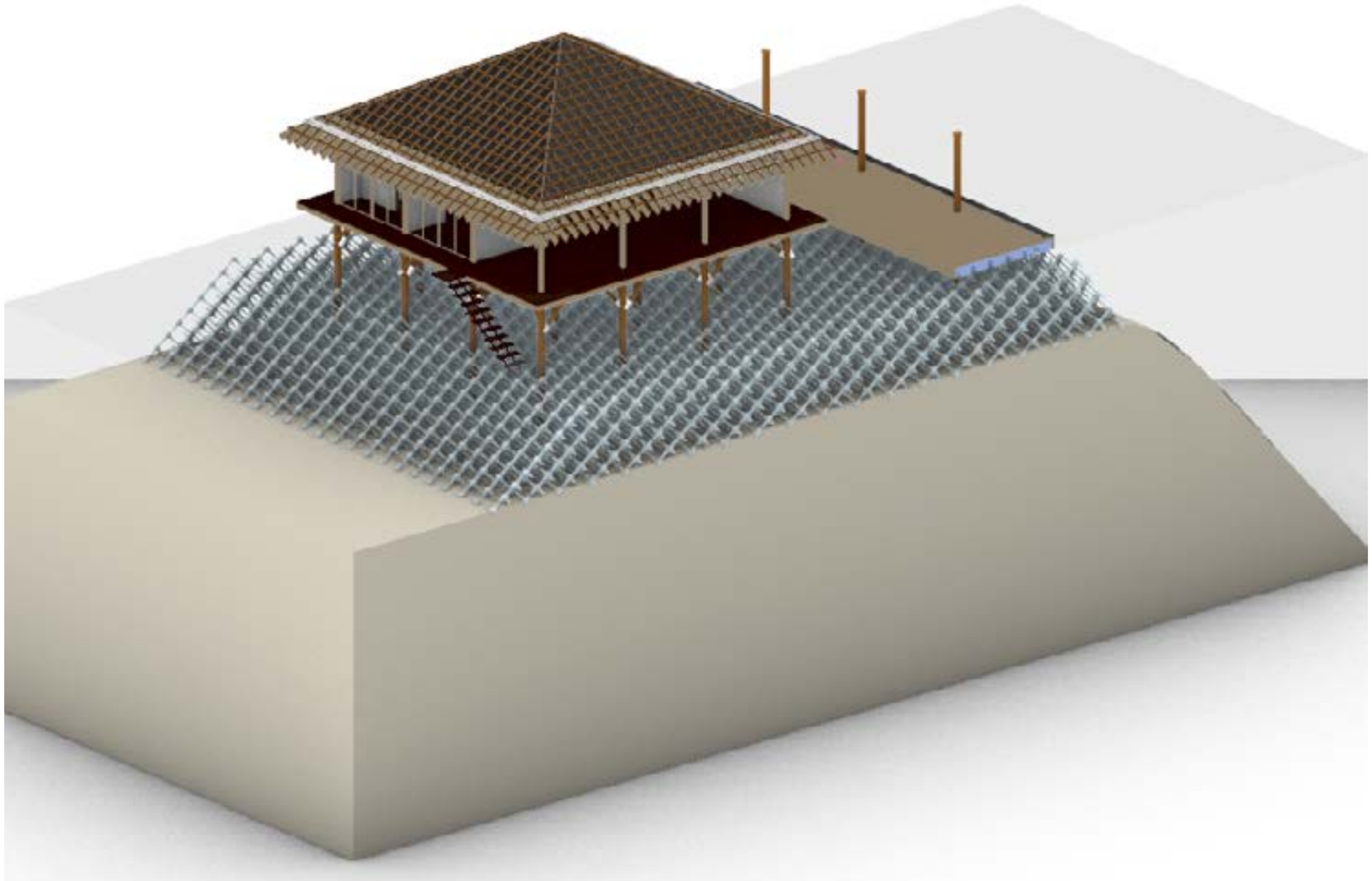
Timber roof construction

Goathi | *Construction process*



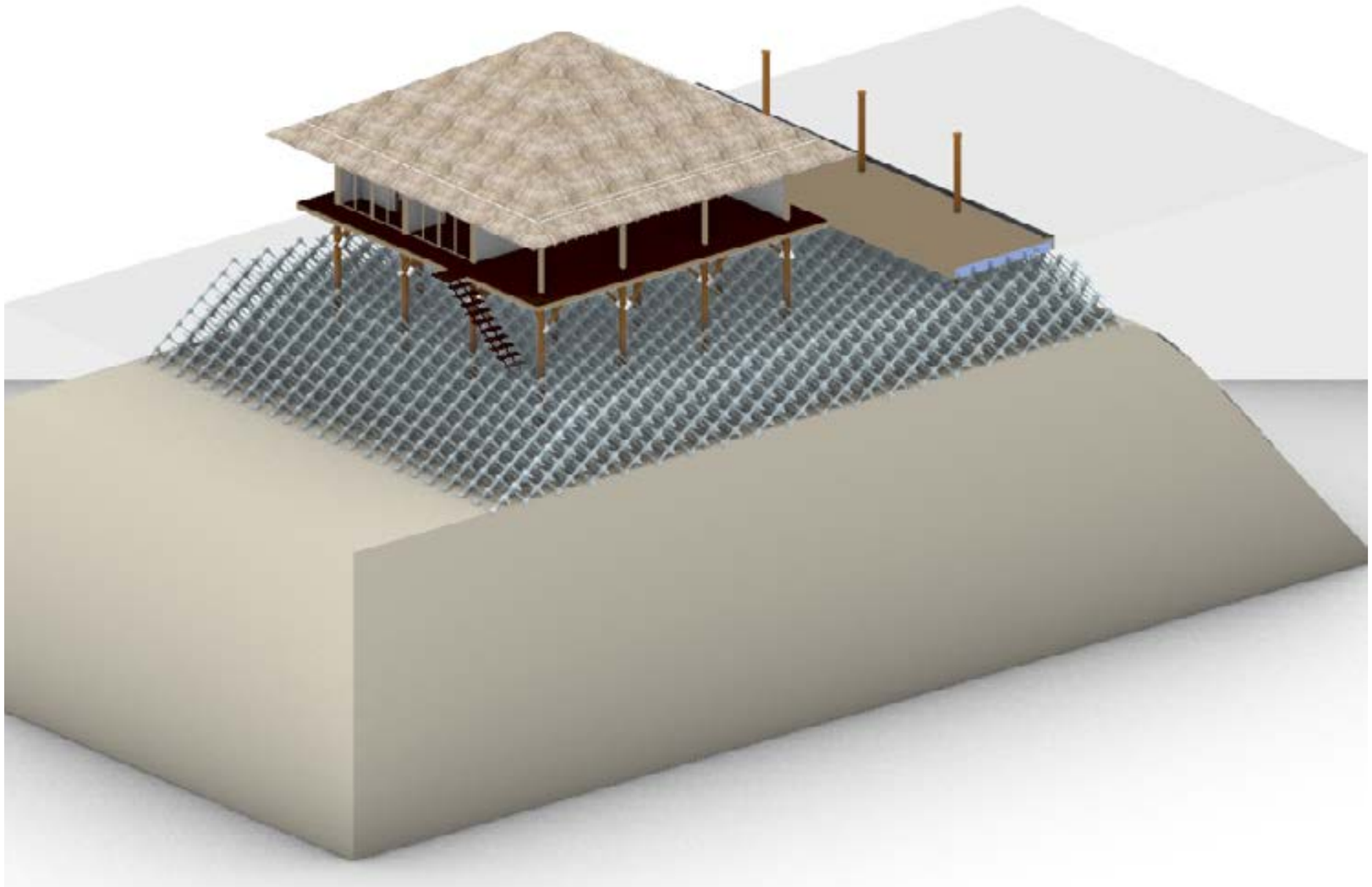
Insulation in walls/roof

Goathi | *Construction process*



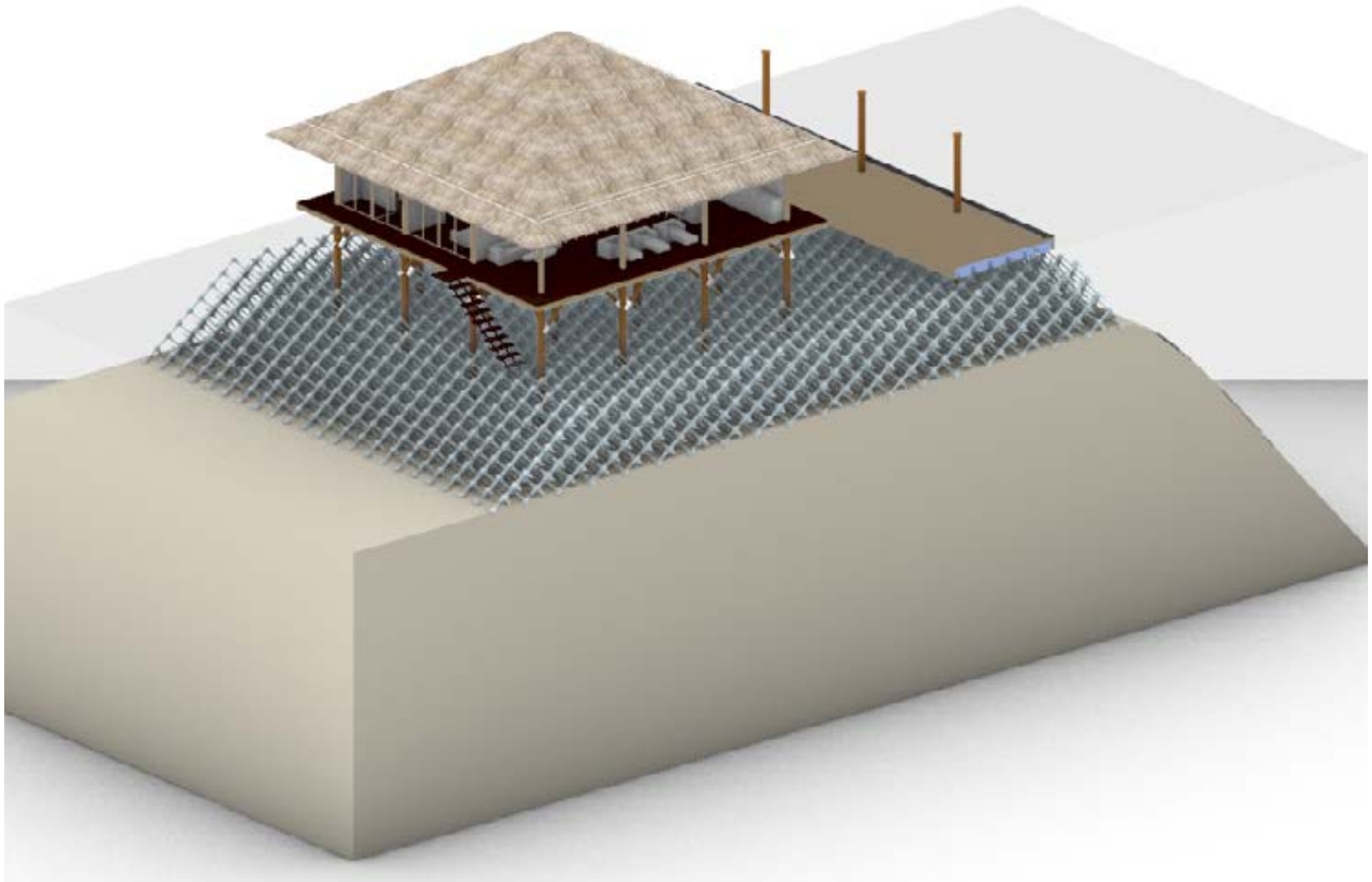
Gutter and foils

Goathi | *Construction process*



Palm fronds to facade/ roof

Goathi | *Construction process*



Glazing and furniture

2025

| The Experiencer |

How is the design/system being experienced
by the tourists and the locals?

Eco-tourism | *Explanation*

"Responsible travel to natural areas that conserves the environment, sustains the well-being of the local people, and involves interpretation and education"

- Conservation
- Communities
- Sustainable travel

Definition | (TIES, 2015)

Vangaaru Island | *Mobility and logistics map*

Arabic Sea

- ocean side -

- island lagoon -

Waste export

Employees

Leisure area

restaurant/bar/wellness

Charter international

snorkling point

Import of supplies
by boats

Tourists arrival
and daytrips

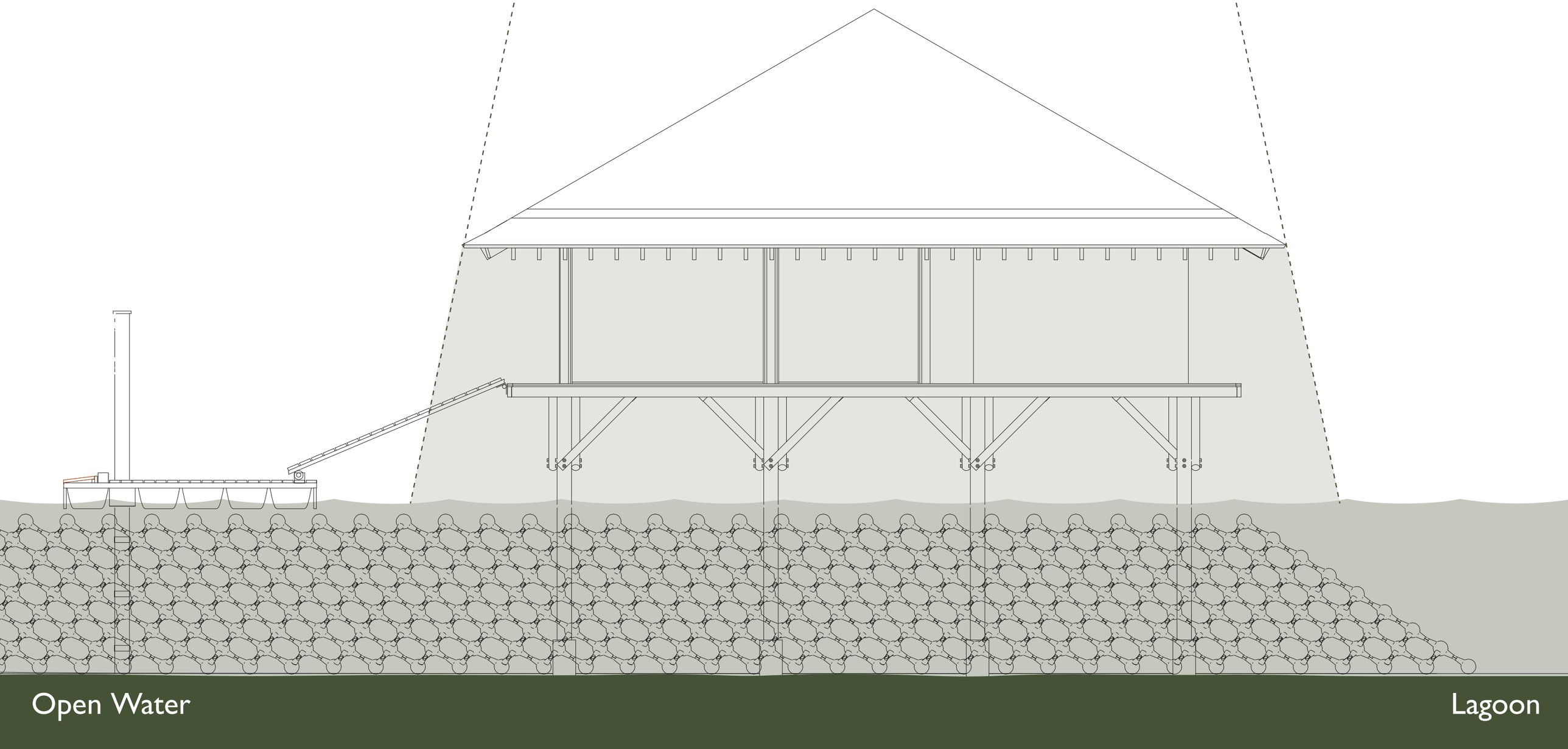
- atoll lagoon side -

Import/supplies boat routes
Small boat transport/ferry
Walking deck
Emergency openings deck

0m 100m 200m 300m

Arrival | *Example render*

Goathi climate design | *Traditional interventions concept*



Goathi climate design | *Traditional interventions concept*

Sloped 30° angle - ventilation + shading

Extensive roofs - ventilation + shading

Open spaces /vents - ventilation

Mid-day

Highest intensity

Morning Evening

Raised floors - ventilation

Open Water

Lagoon

Goathi climate design | *Circularity interventions concept*

Apps + monitoring - weather prediction

Precipitation collection - water

Sea water + air cooling solar panels

Storage and filtering - water

Domestic batteries - electricity storage

Septic tank - waste water collection

Solar panels 7° angle - electricity

Open Water

Lagoon

Goathi experience | *Example render*

iMaldives | *App design concept*

Goathi

- *All info about the goathi*
- *Traditional features*
- *Indoor climate*
- *Water consumption*
- *Water collection*
- *Electricity consumption*
- *Electricity generation*
- *Nature inclusive design*

Weather/climate

- *Daily weather forecast*
- *UV intensity*
- *Climate*
- *Sea water temperature*
- *Changed climates*

iMaldives | *App design*

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Plastic

- *Consumption per day*
- *Waste per year Maldives*
- *Recycling facilities*
- *PET reef construction and production*
- *Average footprint*
- *Timeline/live stream of a new recycled reef*

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- *Changed waterlevels*
- *Extinct species*
- *Coastal erosion impact*
- *Untouched nature*
- *Maldivian culture*
- *Maldivian architecture*

iMaldives | *App design*

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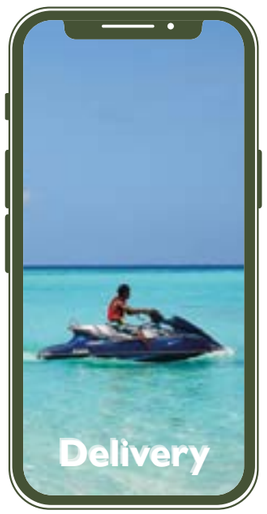

Delivery service

- *Food delivery*
- *Room service*
- *Wake up calls*

Weather/climate

- *Daily weather forecast*
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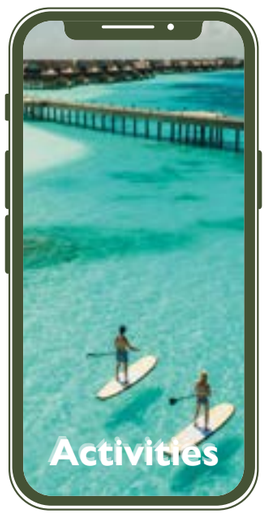

Activities

- *Daytrips*
- *Educational trips*
- *Relaxing*
- *Work-outs*
- *Watersports*
- *Food experiences*
- *Special Maldivian experience*

iMaldives | *App design*

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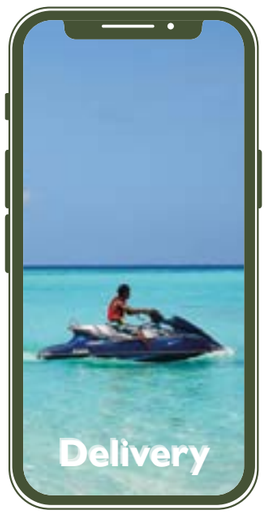

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Maldives

- *Island information*
- *Effects on worldlevel*
- *Flora and fauna*
- *How to help recovery?*

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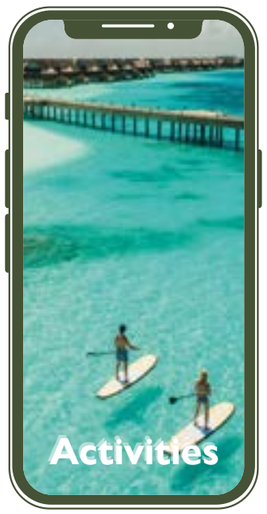

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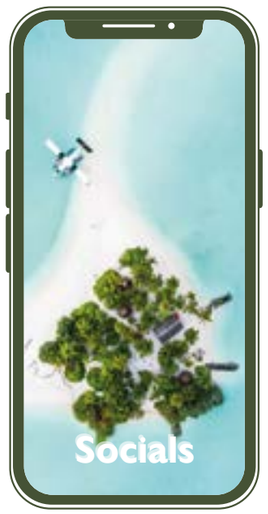

Socials

- *Instagram*
- *LinkedIn*
- *Facebook*
- *TripAdivisor*
- *Tiktok*

iMaldives | *App design*

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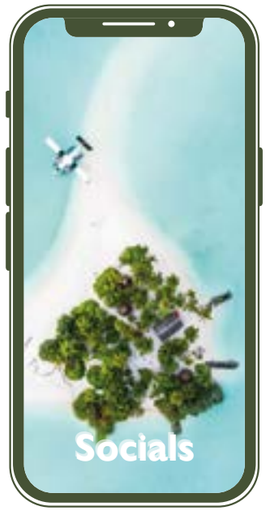

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2025

| The Ecologist |

Sustainability and awareness

The ecologists and scientists | *Task*

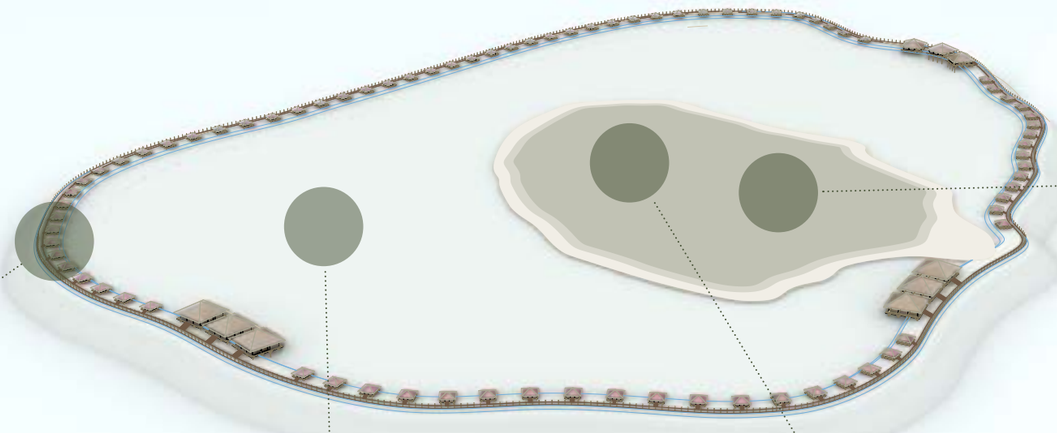
Researching the relationship between flora, fauna and the environment

Investigate impact/effect of design and human activity on flora and fauna

Site visiting to undertake surveys of flora and fauna

Biodiversity | *Ecosystems in the water and on the island*

On the island

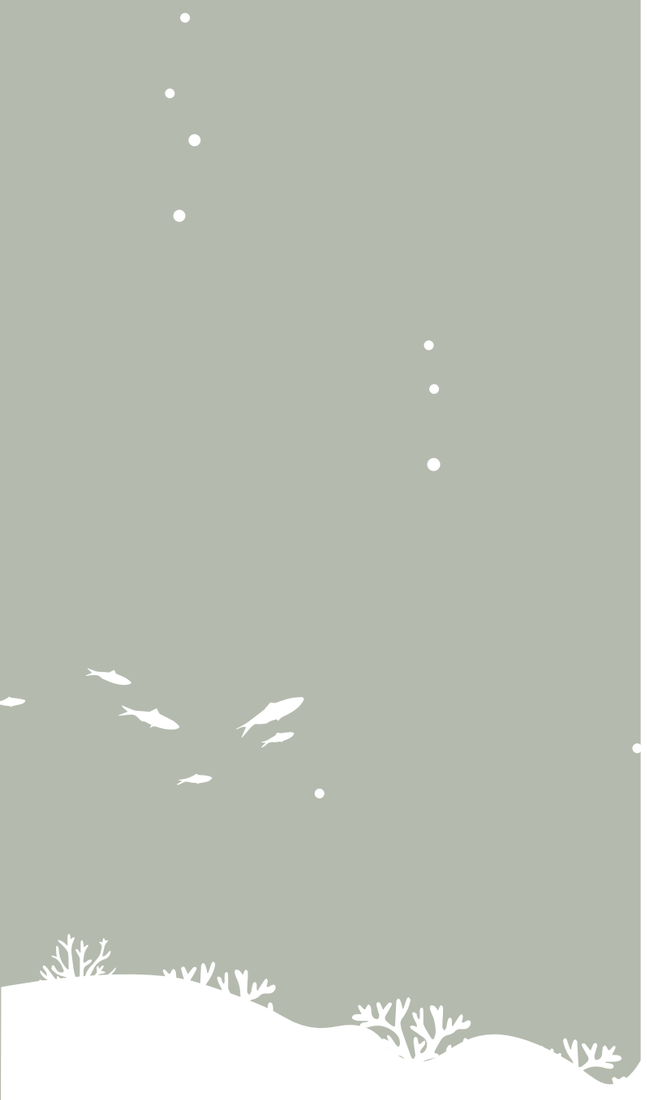


Artificial coral reef

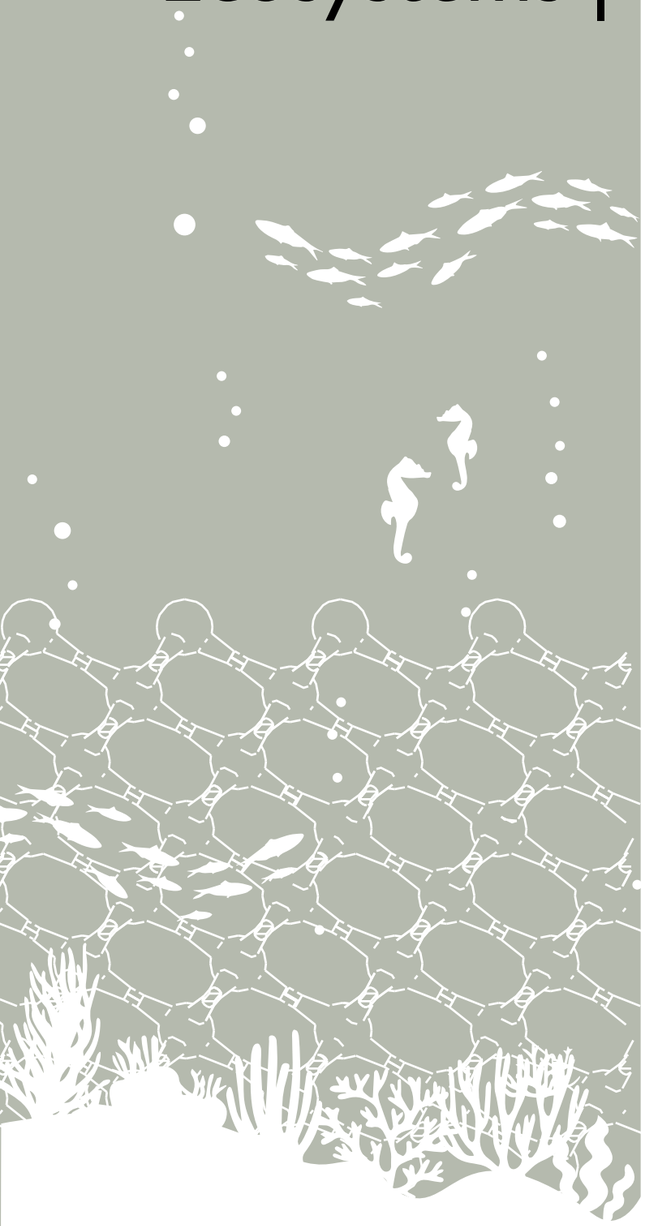
Lagoon

On the island

Ecosystems | *Without artificial PET reef*

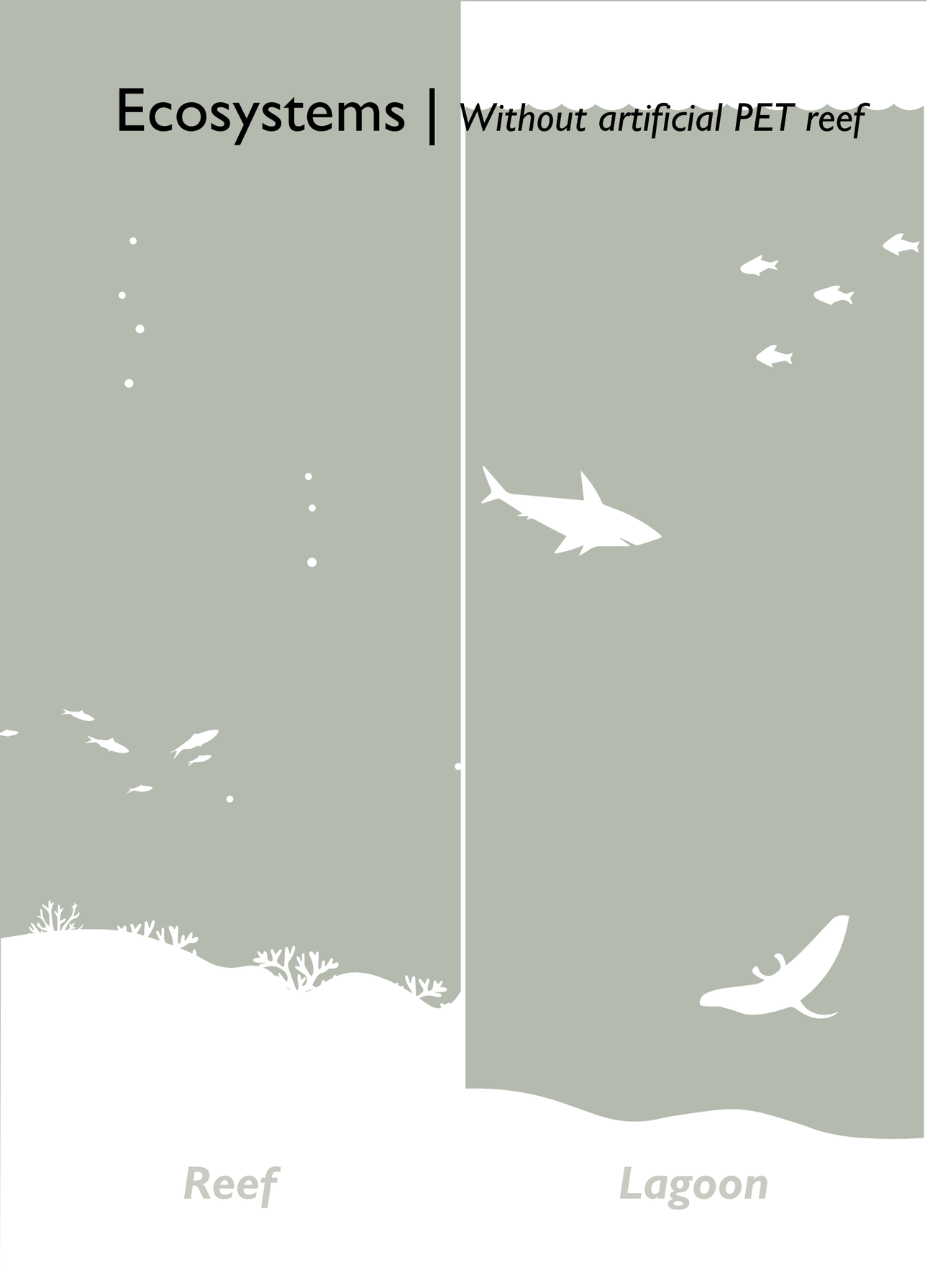


Ecosystems | *With artificial PET reef*



Reef

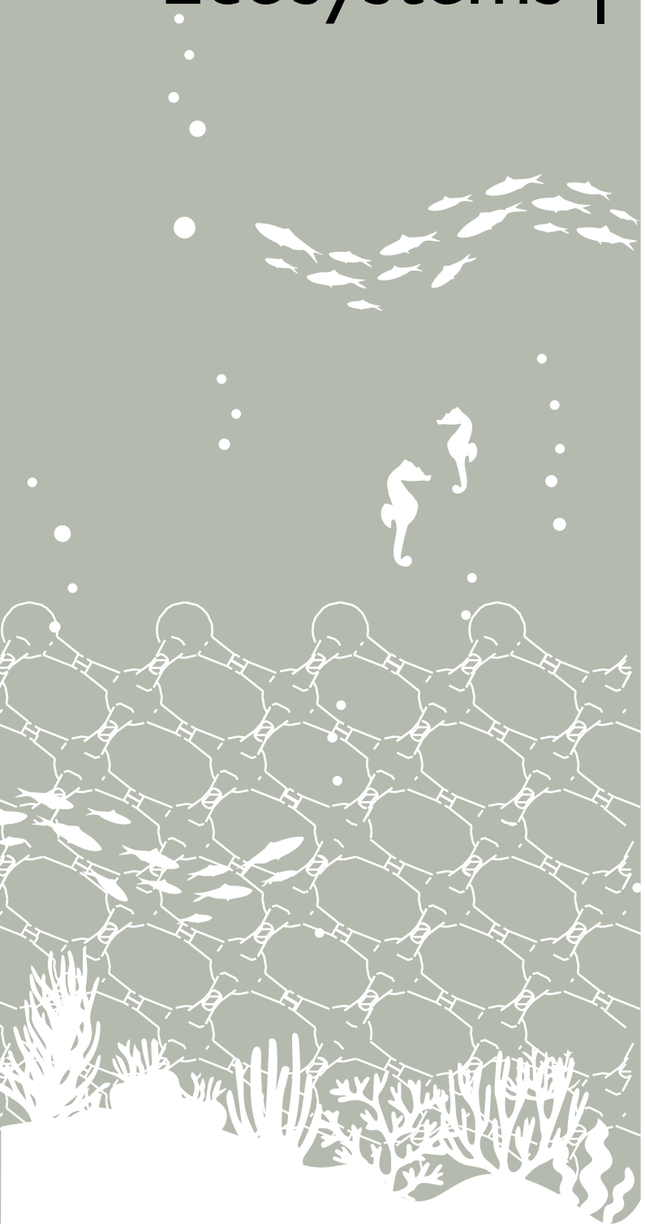
Ecosystems | *Without artificial PET reef*

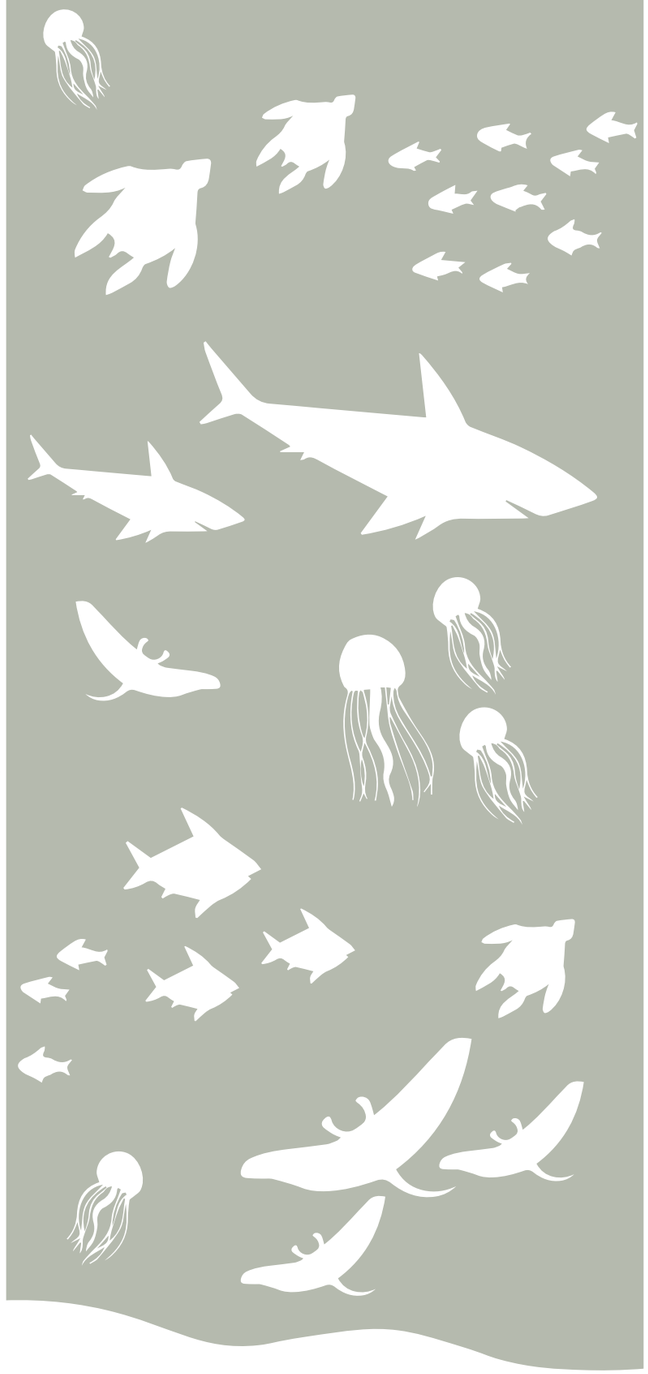


Reef

Lagoon

Ecosystems | *With artificial PET reef*

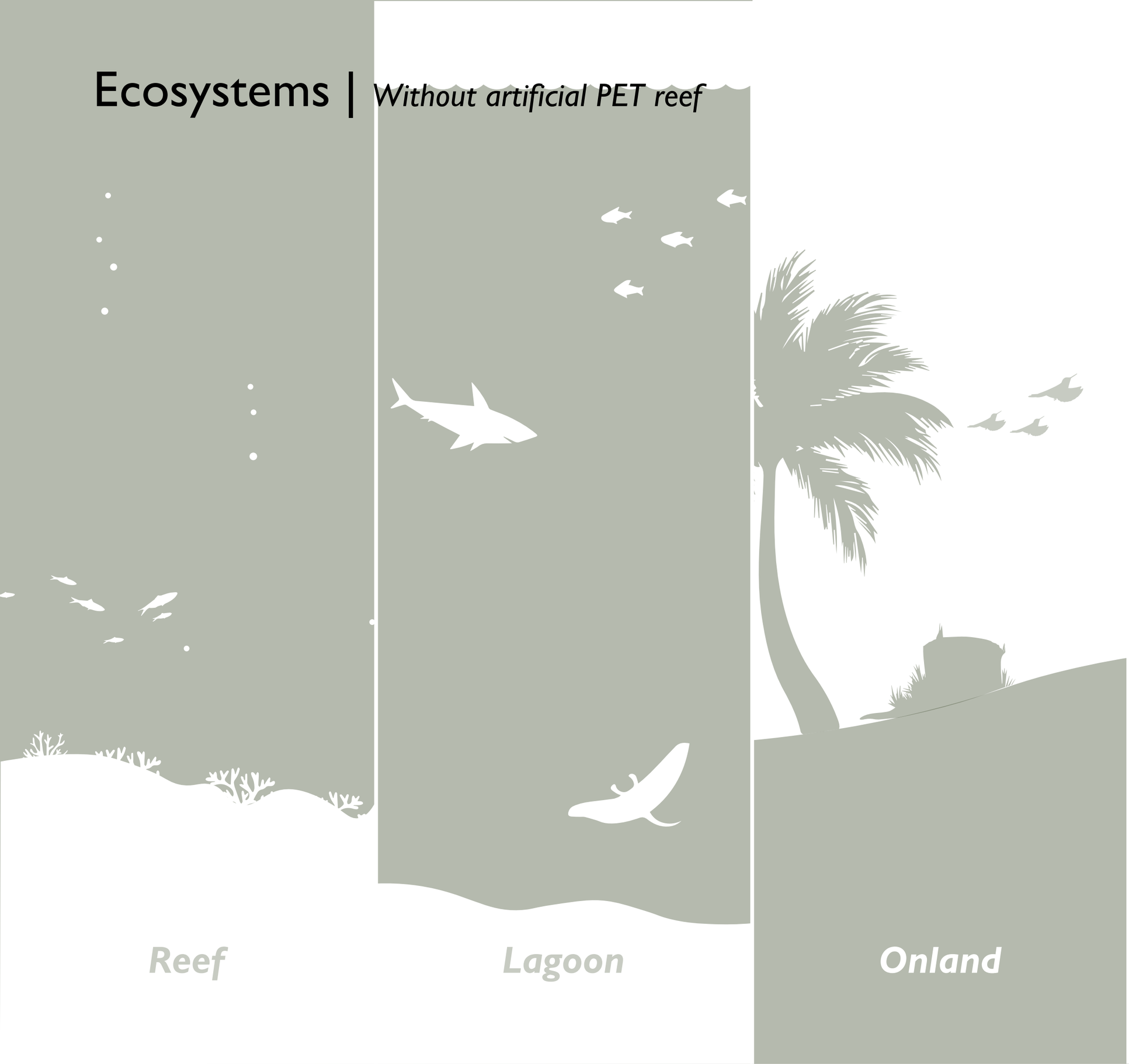




Reef

Lagoon

Ecosystems | *Without artificial PET reef*



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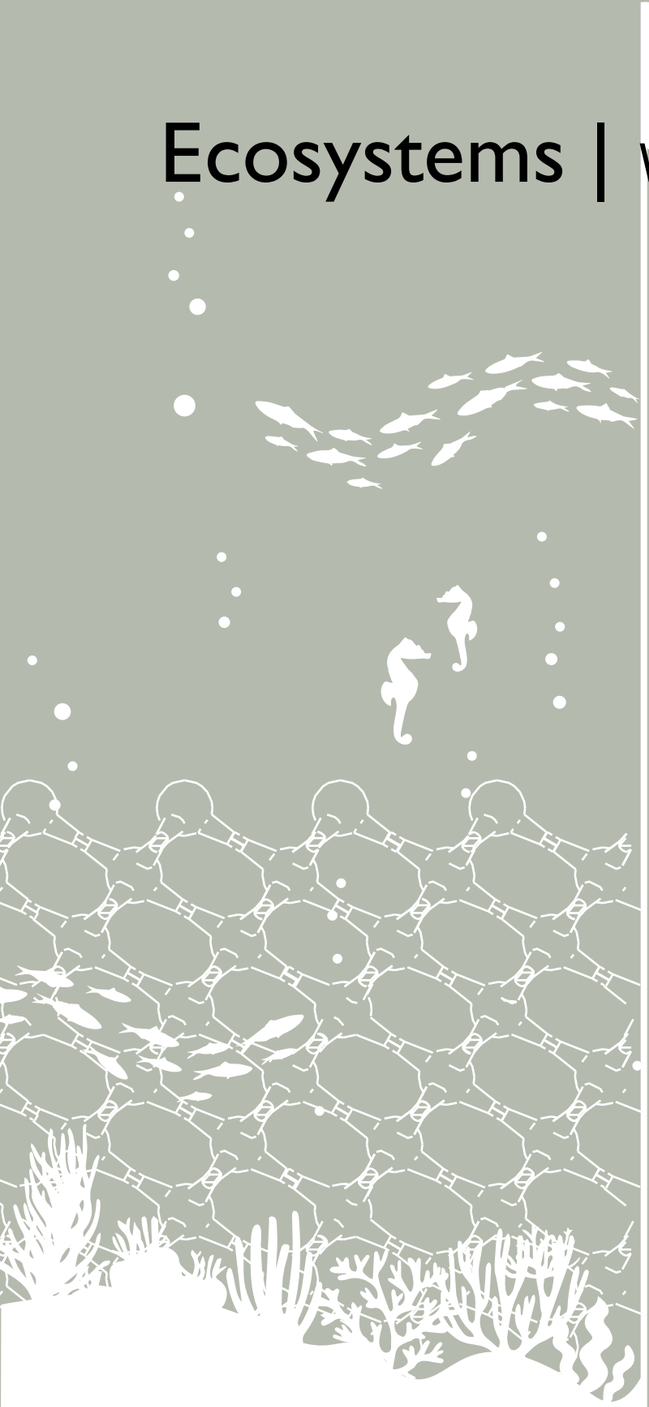

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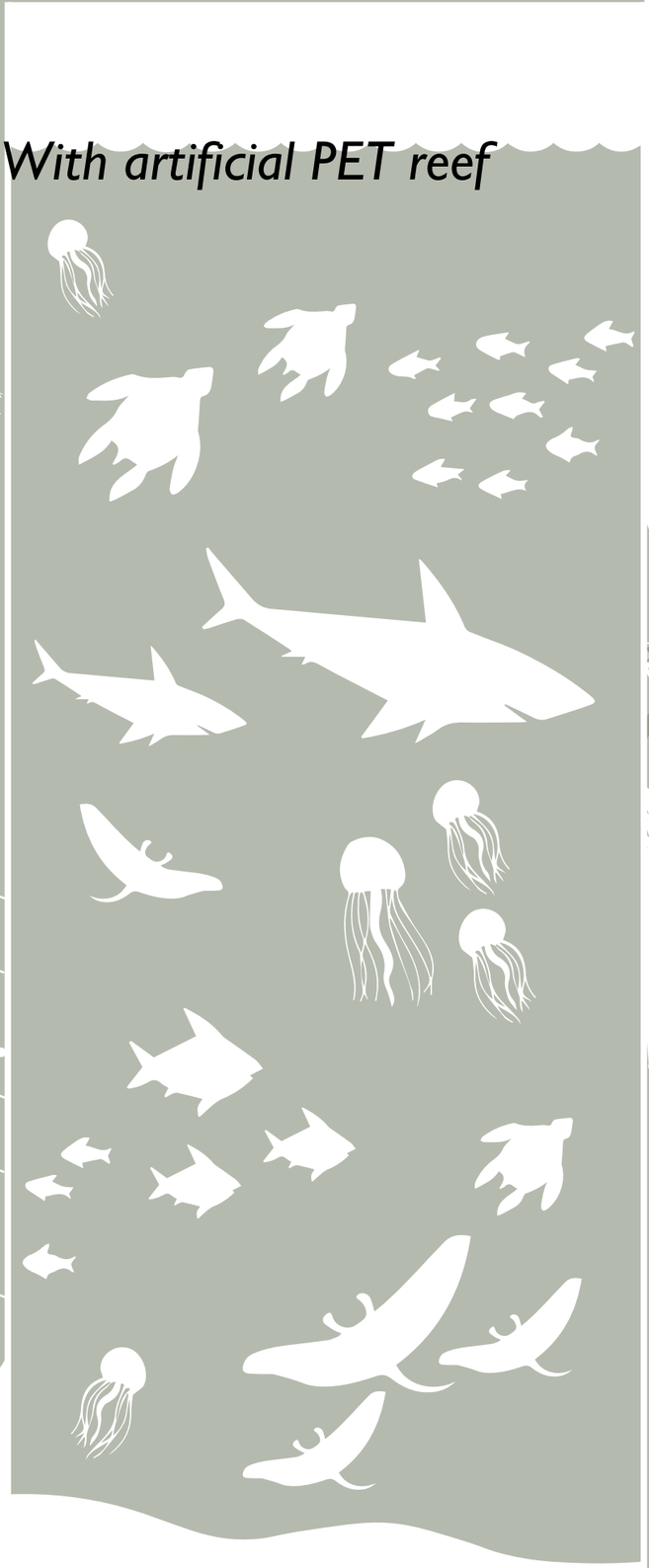
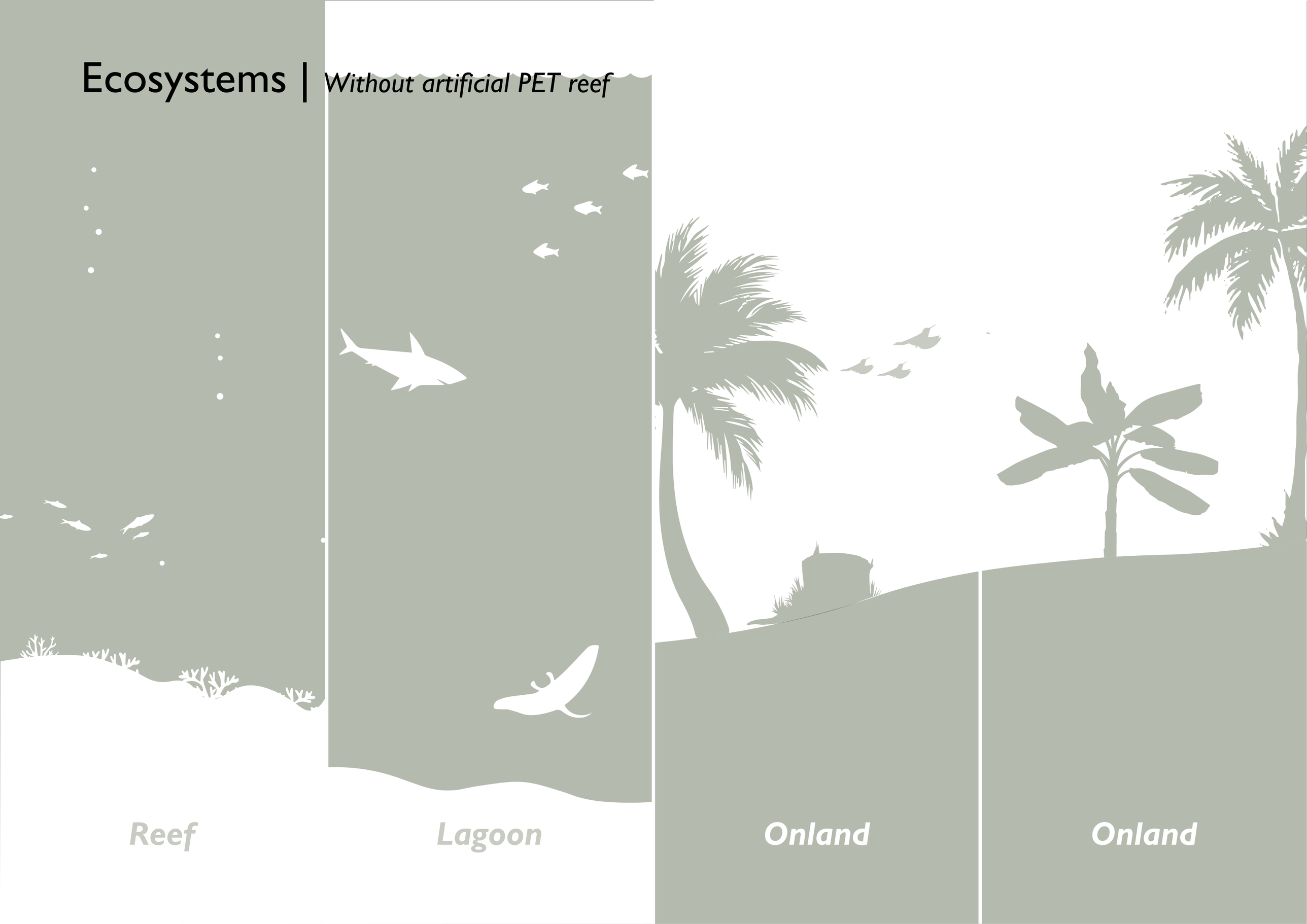


Lagoon

Onland

Ecosystems | *Without artificial PET reef*



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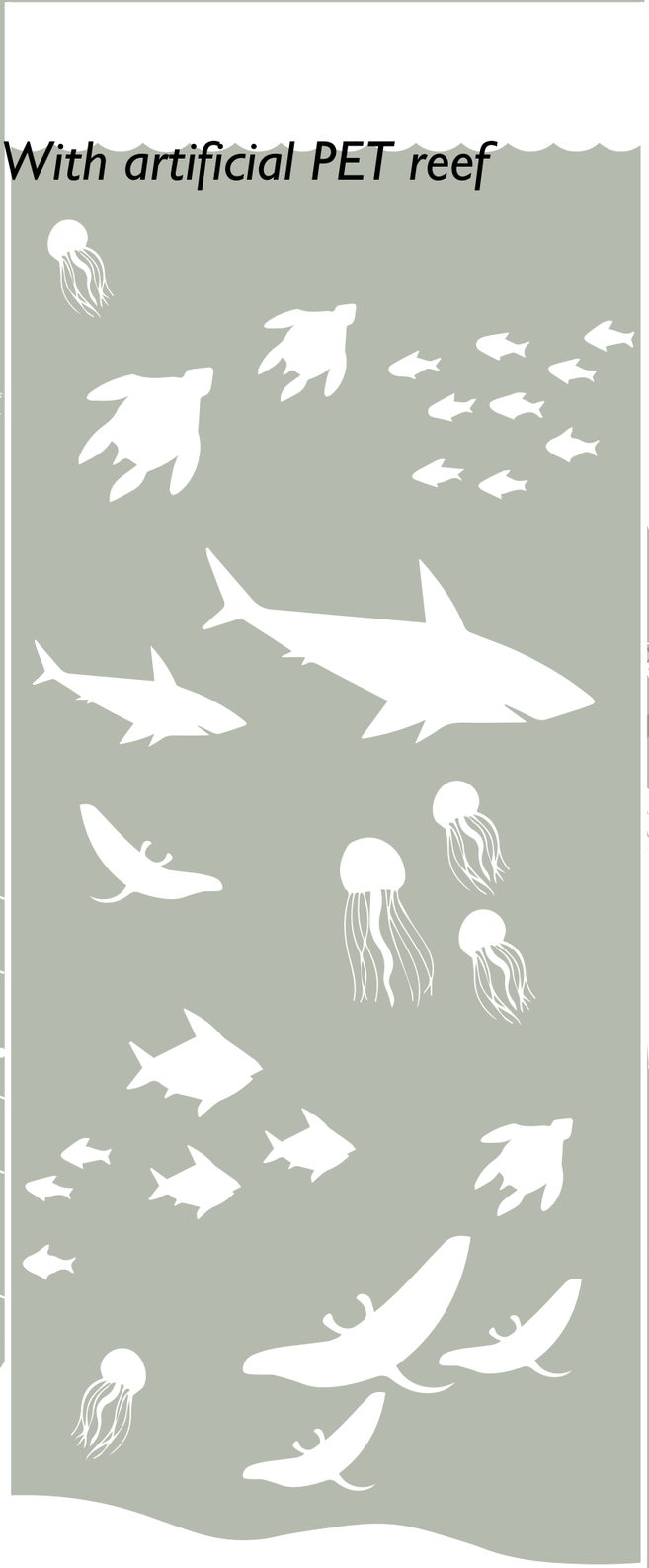


Reef

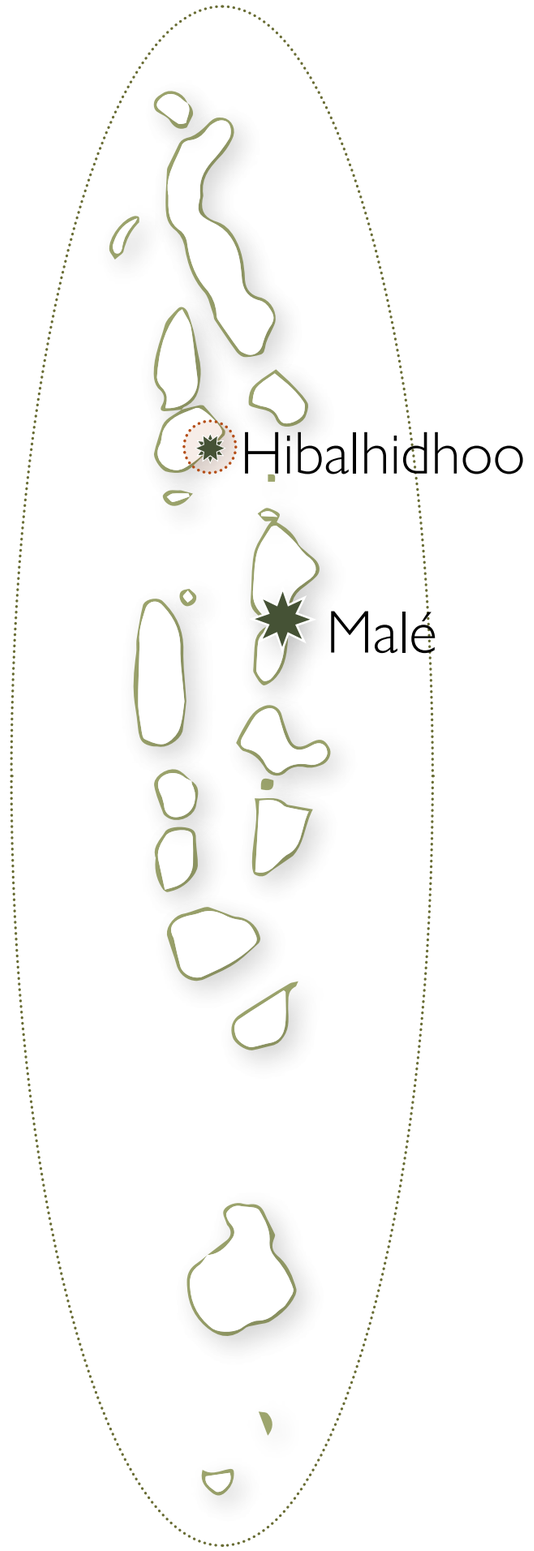
Lagoon

Onland

Onland

Applicability | *Design system applied to other islands*

Google Maps image of Hibalhidhoo



Recommendations | *Research and experts*

Experts are needed!

- Material scientist: The degradation of PET in the marine environment
- Civil engineer: The behaviour of the PET reef towards the impact of wave energy
- Social research: Research the needs of future users

The result | *Conclusion*

“How can a future proof system be created from recycled plastic waste for the preservation and protection of Maldivian islands?“

| Thank you for listening! |

Are there any questions?