Adaptive Urban Housing

Design a floating, modular and self-sustaining neighbourhood
Content

Relevance
Concept
Urban system
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Relevance
Climate change

Hurricane Irma
Flooding

Flooding in NL as a result of heavy rain and the paving of natural soil
Shortage of houses
Shortage of space

Many people moving to urban areas

Percentage population growth 2015 - 2030

+150,000 people in 15 years

Source: CBS 2016
Land take

Expanding cities and taking more green and land for agriculture.
Will this landscape disappear?
Transition to a sustainable energy system
Greenhouse emission

Build environment is responsible for over 30% of world-wide CO2 emission
Reducing energy use of built environment

Reduce amount of energy needed during production of the buildings

  Materials
  Smart building system -> modular / prefabrication

Reduce amount of energy needed during transportation

  Transportation by ship instead of truck

Reduce energy use of buildings

  Good insulation
  Renewable energy sources
  Passive design methods (solar heat)

Reduce amount of energy needed in future

  Building system that can adapt to future scenarios
Concept
Water in urban areas
Extending the city to the water
Self-sustaining

Building that is self-sustaining regarding energy

Zero Energy

A
B
C
D
E
F
G
Self-sustaining

Building that is self-sustaining regarding water
Modular system
Prefabrication and adaptability
Relation with the water
Relation with water regarding experience and energy
Generic system
A system that can be applied around the world
Urban system
Plug-in system

Backbone where elements can be "plugged-in" to

Backbone

Houses

Green & public space
Plug-in system

Good orientation and a relation with the water
Backbone of the system

Jetty that contains infrastructure and routing
Houses

Modular houses are placed on a fixed grid
Green in public space

Constructed wetlands that filter wastewater
Relation with the water

Floating, public elements that are plugged-in to jetty
Modular system

Topview of the system
Extending the system

System can be extended and connected
Case study

Amsterdam
Case study

Amsterdam
Case study

Marine terrain

Nemo

Marine terrain
Case study

Boat route
Case study

Boat route and shore create a plot
Case study

Modular system is projected on plot
Masterplan
Top view of part of masterplan
Infrastructure

Infrastructure from land and wastewater from houses connect to "backbone"
Masterplan

Front view of part of masterplan
Living module
Modular house

Many modular systems in the Netherlands
Modular system

Modular systems have many different dimensions
Transportation

Universal module size to accommodate easy transportation
Cargo container

Enable use of the cargo ship network
Disadvantages of the cargo container

Small height
Disadvantages of the cargo container

The large weight isn't favorable to use on water
Insulation wrapped around module

Most modular systems are wrapped in insulation when they are placed.
Insulation wrapped around module

Most modular systems are wrapped in insulation when they are
Enabling adaptability

Insulation inbetween modular frame
Framework for "plug-and-play" system

People can choose and add elements to modular framework
Framework for "plug-and-play" system

Standard module
Framework for "plug-and-play" system

Modules can be placed and stacked as people like
Framework for "plug-and-play" system

People can add elements to the modular framework.
Framework for "plug-and-play" system

Modules can be added in the future
Materials

Accoya wood makes the insulation strategy possible
Module dimensions

Two modules that correspond with width and length of containers
Length of the building

Houses can be 3 or 4 modules long

- 6000 mm
- 2400 mm
Heighth of the building

The house is 2, 3 or 4 levels
Modular frame

The module is a frame of wood with steel joints to connect elements together.
Modular frame

Modules can be connected to each other
Modular frame

Facade panels are placed in the wooden frames
Modular frame

Facade panels are placed in the wooden frames
Facade panels

Closed panel

Inside

Outside
Facade panels

Hennep insulation enables a vapor-open construction
Facade panels

Open panels are placed to the back to create room for sunshading
Facade panels

Various types of transparent facades are possible
Facade panels

Open and closed panels of the short side of the module
Facade panels

Long side of the module
Floor system

Wooden boxes are placed inbetween beams
Floor system

Studded floor with floor heating/cooling system and finishing is placed on the wooden boxes
Combining the modules

Roof terraces can be created
Combining the modules

Roof is a separate module
Roof module

Flat roof with east/west solar panels
Roof module
Sawtooth roof with northern light and solar panels on south
Roof module

Shed roof with solar panels on south when orientation of masterplan changes
Floating system

Composite waterproof layer
Floating system

Same building system can be applied in souterrain
Floating system

Composite layer is placed around lower level of building
Floating system

Watertanks are used as ballast
Mooring system

Steel bracket is placed around fixated poles
Entrance

Small platform can be placed to connect the house with the public jetty
Open floor plan
Shaft

Vertical connection is needed for infrastructure
Service module

Modular service unit with integrated shaft that can be placed in the open floor plan
Service module

Buildt-in cabinet can be integrated in the modules of the service unit

Buildt-in cabinet behind doors
Service module

Entrance hallway is created
Service module
Various locations possible
Service module
Various locations possible
Living concept

Heat rises which makes the private souterrain cool and the upper level warm
Living concept

Souterrain is suited for sleeping and the upper level for living
Living concept

Heat rises which makes the private souterrain cool and the upper lev-
Living concept

Souterrain is suited for sleeping and the upper levels for living
Living concept

Souterrain is suited for sleeping and the upper levels for living
House example

Possible section
House example

Possible ground floor plan
House example

Possible upper level floor plan
House example

Possible souterrain floor plan
House example

Possible souterrain floor plan
House example

Possible souterrain floor plan
House example

Possible souterrain floor plan
Self-sustaining system
Water as energy source
Watersource heatpump

Heat from the surrounding water is used to heat the house (during winter)
Watersource heatpump

Cold from the surrounding water is used to cool the house (during summer)
Passive design

Lamella's are used to block sun in summer and use heat in winter
Ventilation

Mechanical extraction draws in fresh air that is pre-heated in the facade
Pre-heating ventilation air

Fresh air is pre-heated by room temperature and/or by the sun
Pre-heating ventilation air

Fresh air is pre-heated by room temperature
Generating electricity

Electricity is generated by solar panels on the roof

Solar roof tiles
2x 10 m²

1000 full sun hours in NL

1 person household: +/- 15 m²
2 person household: +/- 20 m²

Technical room

14 kWh battery
(Tesla Powerwall 2)
Rainwater harvesting

Rainwater is harvested in the roof modules and collected in a tank.
Rainwater system

Pluvia rainwater system enables horizontal transportation of water
Rainwater filtering

Rainwater is filtered before it is used in household activities

- Rough filter
- Sand filter
- Septic tank
- 10 µm filter
- 25 µm filter

Micro-filtration
Wastewater

Constructed wetlands are used to filter wastewater
Wastewater filtering

Constructed wetland system

- Inlet
- Air
- Outlet
- Wetland plants
- Drainage pipe
- Gravel +/- 100 mm
- Sand +/- 400 mm
- Gravel +/- 200 mm

2-4 m² per person
Examples of configurations
Build your own house
Software tool to generate your own design
Build your own house

Start the tool

Base

Size of the floating base

In this step you choose the size of the floating base. The fixed width is 6 meters. The length of the base can vary. The options are 3 or 4 modules long. One module is 2.4 meters deep, which means the base can either be 7.2 or 9.6 meters in length. The height is always 3.3 meters.

Costs

Materials

CO₂

Factory

- Accoya wood
- Composite base
- Hennep insulation
- Triple glazing
- Eco interior wood panels
- Green roofing
- Eco based EPDM

Final

Select
- Order request
- Order

Send
Build your own house

Choose the size of your base

Step 1 - Base

- 3 modules
- 4 modules

Size of the floating base

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Materials

- Accoya wood
- Composite base
- Hennep Insulation
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- Eco interior wood panels
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Select

- Offer request
- Order

Send
Build your own house

Choose the number of levels

Step 2 - Levels

- 2 Levels
- 3 Levels

West view

Size of the floating base
In this step you choose the size of the floating base. The fixed width is 6 meters. The length of the base can vary. The options are 3 or 4 modules long. One module is 2,4 meters deep, which means the base can either be 7,2 or 9,6 meters in length. The height is always 3,3 meters.

Costs
- Accoya wood
- Composite base
- Hemp insulation
- Triple glazing
- Eco interior wood panels
- Green roofing
- Eco based EPDM

Materials

CO₂

Factory

System

Base

Steps
- 1 - Base
- 2 - Levels
- 3 - Modules
- 4 - Service...
- 5 - Stairs
- 6 - Facade
- 7 - Roof
- 8 - Terrace
Choose the module type

Step 3 - Module type

- [x] 6 meters
- [ ] 3 meters
- [ ] Terrace

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Build your own house

Place the service unit

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**Step 4 - Service unit**
- Level 1 - Souterrain
- Level 2 - Ground floor
- Level 3 - First floor

**Bathroom**
- Toilet
- Sink
- Shower
- Bathtub
- Laundry area

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Build your own house

Place the stairs

Step 5 - Stairs
- Level 1 - Souterrain
- Level 2 - Ground floor
- Level 3 - First floor
Build your own house

Choose the facade type
Build your own house

Choose the roof type

Step 7 - Roof

- Roof - Flat
- Roof - Saw tooth

Size of the floating base

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Build your own house

Choose the terrace

Step 8 - Terrace

- [ ] Small
- [x] Large

Size of the floating base

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Materials

- Accoya wood
- Composite base
- Hemp insulation
- Triple glazing
- Eco interior wood panels
- Green roofing
- Eco based EPDM

Costs

- Factory

Select

- Offer request
- Order

Send
Build your own house

Enjoy the result
Order is placed

**Build your own house**

**Order is placed**
Various configurations

4 modules long
Various configurations

Flat roof type
Various configurations

Start with a small house
Various configurations

Extend your house in the future
Thank you