Adapting the Marconitorens
Hyperbody studio
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INTRODUCTION
ROTTERDAM
- With 619,000 residents the second city of the Netherlands
- Relatively young population
- Industry specialises in healthcare
Merwe Vierhavens

- Former harbor area in development
- Located between Rotterdams’ center and Schiedam
- Well connected through public transport
PROJECT SITE

Marconiplein
- Large infrastructural node in Rotterdam
- Well connected through public transport
- Zone between the city and the harbor area
**BUILDING**

**Marconitorens**
- Designed by SOM and completed in 1975
- Being used for working, learning and laboratory activities
- Growing amount of vacant spaces
THEORETICAL BACKGROUND

Supports & Infill by John Habraken
- Divide a buildings’ private and collective subsystems
- Allow for customization within the infill
- Create 3D urbanism

Monofunctionality theory?
- XXXXX
- XXXXXXX
- XXXXXXXXXXXXX

Source: De Drager en de Mensen: het einde van de massawoningbouw by John Habraken
CONCEPT
How to adapt the Marconitorens in a sustainable way?

Housing a research and health institute in a sustainable way by adding a new structure on top of the existing Marconitorens.

REJUVENATING THE TOWERS  GREENIFY HIGH-RISE  DIVERSIFICATION EXISTING
ENVIRONMENTAL ANALYSIS

ANNUAL DAYLIGHT ENTRANCE

SUNLIGHT HOURS IN JUNE

CFD AIRFLOW RATE

QUALITY VIEWS

Source: DIVA plug-in for Grasshopper 3D

Source: Ladybug plug-in for Grasshopper 3D

Source: WinAir Computational Fluid Dynamics with Ecotect

Source: Own algorithm
CHOSEN FLOORS
How to alter the building?

1. **Existing building**
The existing Rotterdam Science Tower has a growing amount of vacant floors, including the top ones.

2. **Removing vacant top**
By removing the existing top floors of the building the possibility of a new lighter structure becomes realistic.

3. **Adding new structure**
By utilizing optimized structural elements the possibility of more and larger area’s becomes possible.
ADRESSING VACANCY

Source: CBS
BOTTOM-UP DEVELOPMENT

Lower risk
By improving the existing structure locally, the large financial risks of rebuilding are avoided.

Responding to local conditions
Often, urban tissue is altered very locally. This project aims to introduce this to high-rise too, responding to changing needs.

Source: Wagenaar et al.
DENSIFICATION STRATEGY

Growing urban population
Estimations by Unesco show that by 2050 more than 80% of the population in more developed areas will live in urban areas.

Sustainably close
Multiple researches indicate that there is a correlation between the density of an urban agglomeration and its energetic performance.

Source: UN
Healthy proximity
Research shows that the percentage of green space in people’s living environment has a positive association with the perceived general health of residents.

Climatic performance
Vegetation has the ability to reduce CO2 levels and the amount of fine particles.

Source: University of Utrecht
COMPUTATIONAL STRATEGY
1. Idea

2. Rule Algorithm

3. Source Code

4. Output

Designer judges the output

Modifies rules

Modifies code

Source: Bohnacker, Groß & Lazzeroni (2009)
1. **Spanning Planning**  
Organising the new program in 3D space with agent-based modelling techniques

2. **Creating a 3D body**  
By merging floors and the void a solid 3D body is created

3. **Morphing structure**  
By wireframe simulation techniques the structure will be slightly altered

4. **Adding Detail**  
Stairs, interior porosities, and facades are later added
1. SPACE PLANNING CONCEPT

**Void as circulation**
The three dimensional geometry can be considered as semi-public space, directing the people through the top of the building.

**Void as green interior**
Places were no circulation is, green is added to filter the infalling rainwater.

**Void as structure**
The form of the void should follow the existing core, so the void geometry is then also considered as load-bearing structure.
1. SPACE PLANNING SETUP

**Employee**
Space for front desk, offices, physiotherapists and storage
700m² (10% of total)

**Void**
Negative space which generates 3D public space of
1400m² (20% of total)

**Green**
Space for flowers, mosses and small trees of 1400m² (20% of total)

**Swimming**
Space for bathing and relaxation of 200m² (10% of total)

**Fitness**
Space for sports, lockers and cleaning facilities of 1400m²
(20% of total)

**Lounge**
Space for both visitors and patients to experience
services ranging from massages to physiotherapy of 1400m²
(20% of total)

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**Cluster type** | **Relational attraction** | **External attraction** | **Additional rules**
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Employee | ![Diagram](image1.png) | ![Diagram](image2.png) | "Wind"
Void | ![Diagram](image3.png) | ![Diagram](image4.png) | "Void > ground floor intervention"
Green | ![Diagram](image5.png) | ![Diagram](image6.png) | "Green part of void for curvacious body"
Swimming | ![Diagram](image7.png) | ![Diagram](image8.png) | "Swimming part of void for curvacious body"
Fitness | ![Diagram](image9.png) | ![Diagram](image10.png) | 
Lounge | ![Diagram](image11.png) | ![Diagram](image12.png) | 

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Adapting the towers Hyperbody Continuous Variation studio PS Presentation by Jeroen van Lith MSi4 Tutors: N.M. Biloria/H.H.Bier/K.J. Vollers TU Delft 2014/2015
1. SPACE PLANNING SIMULATION
1. SPACE PLANNING ITERATIONS
2. CREATING A VOID
2. MERGING FLOORS WITH VOIDS

Void
The outcome results into a cutted void which floorplans can be generated around

Joining void with floors
By joining the void with the floors a unibody is made which can be used for further analysis and optimization
2. ARCHITECTURAL LANGUAGE

**Transitions in form**
This limestone formation showcases the ambition of creating curvilinear geometries.

**Hybrid materials**
Materials which are informed by their material behavior, resulting into geometries which are nature-like.

**Feel**
This mountain lodge refers to the preferred feeling: serenity, calmness and peacefulness.
MAPPING CIRCULATION

**Ramps**
Surfaces in the void ranging from 0 to 7 degrees of angle are considered as walkable ramps.

**Staircases**
On the surfaces ranging from 7 to 35 degrees slower and steeper staircases are added.

**ThyssenKrupp 3D lift**
A glazed 3D lift forms a continuous loop in the build and in the void, bringing people to their floors when they don't feel like taking the stairs.
4. ADDING DETAIL: Stairs
**Helophytes + larger flowers**
This heavier vegetation is placed on surfaces ranging from 0 - 35 degrees, whereby the helophytes can filter the falling rainwater.

**Mosses + small flowers**
A combination this vegetation is placed on the tilted yet not cantilevering surfaces, ranging from 35 - 90 degrees.

**Pergola**
Being one of the only plants able to grow on more than 90 degrees surfaces, pergola’s are placed here.
4. ADDING DETAIL: Green
Morphing the existing into new core
On top of the existing core, a new larger core will be built, opening up possibilities of more functions inside the core.

Loadbearing core with floorslabs
The resulting 3D structure is stiff and able to bear the loads of the surrounding floors.
REFERENCE PROJECTS

**Void as structure**
In the Sendia Mediatheque of Toyo Ito

**Cantilevers from core**
In the Turning Torso of Santiago Calatrava
3D SIMULATION OF FORCES
**PRINCIPLES FACADE**

**Geometric Diagrams**
Starting from a planar triangulated surface of the facade

**Subdivision**
Using the medians of the triangles, the triangles are subdivided

**Pattern**
The resulting 3D pattern
**RESOLUTIONS**

**Control climate – high resolution**
1=minimum control, 5=maximum control

**Views – low resolution**
1=unimportant, 5=important

**Privacy – high resolution**
1=unimportant, 5=important

**Resulting panelling**

**Employee**
- **Control climate**: 5 High control is needed for a pleasant work-environment
- **Views**: 2 Views are less important
- **Privacy**: 5 Privacy is important

**Void/Green/Swimming**
- **Control climate**: 2 Low control because the voids functions as climate buffer for the other spaces
- **Views**: 4 Being a semi-public space, the views are more important
- **Privacy**: 1 Privacy is less important

**Fitness**
- **Control climate**: 4 More control is preferred
- **Views**: 2 Only in the sports’ lounge views are important
- **Privacy**: 4 Privacy is more important

**Lounge**
- **Control climate**: 5 High control is preferred, considering the patients well-being
- **Views**: 3 Views are not decisive
- **Privacy**: 5 Privacy is very important
Electrochromic Dynamic Daylighting System
A coating between the two glass layers can be set under power in order to change the opacity of the glazing.

How it works
Changes in voltage let ions move from negative into positive states, resulting into changing opacities.
**Radiance**
Lowering the radiance reduces the cooling load while also reducing the amount of light within the space.

**Views**
At eye-height the facade can open up on sunny days while keeping radiance out.

**Accentuating**
By directing where light is falling into the building, certain spaces can be accentuated, to for instance direct the public in the void.
SURROUNDING IMPLEMENTATIONS

Communal lobby
A communal 3D landscape weaving the towers with the existing surroundings, embedding green and multi-level access points.

Floors under the void
These floors will be edited with the new adaptive facade and small cantilevering balconies.
RESULTING DESIGN
VISUALISATION 3D ROUTE
VISUALISATION 3D ROUTE
**Fragment of structure**
Picking representational element of the structure: a cantilevering slab

**Setting conditions**
Defining the loads, supports and boundary geometries

**Topological optimization**
Optimizing material layout within the given design space
**TOPOLOGICAL OPTIMIZATION**

- **Fragment of structure**
  Picking representational element of the structure: a cantilevering slab

- **Setting conditions**
  Defining the loads, supports and boundary geometries

- **Topological optimization**
  Optimizing material layout within the given design space
Robotic fabrication (Hyperbody, 2014)
The MSc3 students in cooperation with tutors designed and built a building component utilizing robotic fabrication techniques.

Robotic fabrication (Hyperbody, 2012)
MSc2 students in collaboration with tutors from Hyperbody and ETH Zurich worked together in building a robotically fabricated pavilion out of foam elements.
Focus on the furniture
Procedure: topology optimization

1. Piece of the design
2. Defining loads and supports
3. Removing material where possible

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TU Delft
2014/2015
Outcome refined mesh
CONCLUSIONS
PROJECT REFLECTIONS

Design Qualities
Enhance the qualities of spaces by embedding performative principles into the process (climate, structure, circulation).

Social Value
Revitalize the existing towers and their surroundings.

Sustainable innovation
By adding the new facade the existing building will reduce its heating loads while adding to comfort levels.

Prototypical
The project functions as prototypical example of rejuvenating existing monofunctional office towers into multifunctional sustainable ecologies.

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Thank you