Raising the roof

Exploiting the potentials of a roof structure for dwellings in a transformed office building.

Tutors: Peter Teeuw, Tjalling Homans, Engelbert van der Zaag
Presentation structure

- Introduction
- Problem statement
- Thematic Research
- Design Research
- Design
- Reflection

RAISING THE ROOF

Introduction
- Introduction
- Problem statement
- Thematic Research
- Design Research
- Design
- Conclusions
Sustainability crisis

- Climate change
- Depleting resources
  - Energy
  - Materials
  - Food
- Improving existing buildings
RAISING THE ROOF

Problem statement

- Problem statement
- Thematic Research
- Design Research
- Reflection
**Problem statement**

- Problem statement
- Thematic Research
- Design Research
- Design
- Reflection

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**Sloterdijk: area in transition**

1. **Transformation of vacant office buildings**

2. **New functions contribute to a more urban environment**

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**Current program 580.00 m²**

**Program 2023 800.000 m²**
Amsterdam: affordable housing demand

Structuurvisie:

“70,000 dwellings added until 2040”
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Problem statement

- Problem statement
- Thematic Research
- Design Research
- Design
- Reflection

What do we need?

- Improving energy efficiency of existing buildings
- Less office vacancy
- More dwellings in Amsterdam
- More dwellings in Sloterdijk
- Denser cities
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Thematic Research

- Problem statement
- Thematic Research
- Design Research
- Design
- Reflection

Possible solution?

- Kristinsson: Energy producing greenhouse

- Van den Dobbelsteen: Energy producing roof
Objective

Fulfilling the potentials of the roof plane

for:

- Sustainable buildings
- Functional, architectural spaces
How can I design a building where the roof is used as an attractive useable space and a vital element of the climatic and energetic systems of a transformed office building into (near) zero-energy dwellings in the Sloterdijk area of Amsterdam?
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Thematic Research

- Problem statement
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Energy producing greenhouse: annual surplus of heat

- Annual heat yield through roof = 2800-3000 MJ/m²
- Annual heating demand = 1500 MJ/m²

- Potential heat surplus
- Overheating summer prevented by:

Reducing solar irradiation
White washing glass

Intensive ventilation or cooling

Campen, Bakker, & de Zwart. (2006)
Energy producing greenhouse:

Possible climate functions:

- Solar collector
- Solar energy storage
- Solar chimney
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Thematic Research

- Problem statement
- Thematic Research
- Design Research
- Design
- Reflection

Possible functions of greenhouse

1. Heat storage
2. Solar collector
3. Liquid medium
4. Heat exchanger
5. Vent. in greenhouse
6. Heat storage

Possible functions of greenhouse

1. Heat storage
2. Liquid medium
3. Heat exchanger
4. Mech. Vent. in greenhouse
5. Heat storage

Possible functions of greenhouse

1. Heat storage
2. Thermal mass
3. Air medium
5. No storage input

Possible functions of greenhouse

1. Heat storage
2. Thermal mass
3. Air medium
5. No storage input

Possible functions of greenhouse

1. Heat storage
2. Thermal mass
3. Air medium
5. Drag

Possible functions of greenhouse

1. Heat storage
2. Thermal mass
3. Air medium
5. Drag

Possible functions of greenhouse

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Possible functions of greenhouse

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Possible functions of greenhouse

1. Heat storage
2. Thermal mass
3. Air medium
5. Drag
### Comparative matrix

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<tr>
<th>Solar collector</th>
<th>Fine wire heat exchanger</th>
<th>Conventional collector</th>
<th>Air-air heat exchanger</th>
<th>Air-water heat exchanger</th>
<th>Direct use of air</th>
<th>Thermal energy storage</th>
<th>High mass</th>
<th>PCMs</th>
<th>Solar chimney</th>
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Positive relation | Negative relation
RAISING THE ROOF

Thematic Research

- Problem statement
- Thematic Research
- Design Research
- Design
- Reflection

Solar collector: Fiwihex

Solar collector
Liquid medium
LTH

Heat storage

Fiwihex
Liquid medium
Heat storage

No storage input


Direct use

Air medium

No storage input


No heat recovery

Drag

Nat. Vent.

Heat exchanger

Mech. Vent. In greenhouse

Liquid medium

Heat storage

LTH

Thermal mass

Air medium


No heat recovery

Drag

Nat. Vent.

Heat storage


Heating system

Liquid medium

Heat storage

LTH

Thermal mass

Air medium


No heat recovery

Drag

Nat. Vent.

Heat storage


No storage input

Liquid medium

Heat storage

LTH

Thermal mass

Air medium


No heat recovery

Drag

Nat. Vent.

Heat storage


No storage input

Liquid medium

Heat storage

LTH

Thermal mass

Air medium

Thematic research: Conclusions

- Compatibility with existing climate system
- Input for heat storage
  - essential towards zero-energy building
- Water as heat transport medium
- Level of independency between greenhouse and building
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Thematic Research

- Problem statement
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No commercial agriculture
Mix of functions:  - Communal
                 - Semi-public

- Bar restaurant
- Food production
Thematic research: Conclusions

Design dilemma:

- Fully integrated climate system
  - Complex
  - Interdependent
  - High performance

OR

- Robust climate system
  - Independency
  - Flexibility
  - Simplicity
Thematic research: Input for design

Robust climate system
- Independency
- Flexibility
- Simplicity

Telespy
- (Energy) streams hard to control
  - individual users
  - fluctuating demand
- Sloterdijk area in transition
  - Future function change
- Existing building characteristics
  - Limits possibilities
Facade form

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Design research

- Problem statement
- Thematic Research
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- Reflection

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Design research

- Problem statement
- Thematic Research
- Design Research
- Design
- Reflection

Facade form
RAISING THE ROOF

Design research

- Problem statement
- Thematic Research
- Design Research
- Design
- Reflection
Introduc-tion

- Problem statement
- Thematic Research
- Design Research
- Design
- Reflection
**Introduction**

- Problem statement
- Thematic Research
- Design Research
- Design
- Reflection

**RAISING THE ROOF**

**Facade form**
RAISING THE ROOF

Introduction

- Problem statement
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New functions, material
Location analysis: Future strategy

- Problem statement
- Thematic Research
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Design Research

Location analysis: Future strategy

- New routes to center Amsterdam
- New routes to Seaport
- New routes to Brettenzone green area - Halfweg
- New routes to Slotermeer - residential area

Arlanandaweg: Green route through Sloterdijk area

Location analysis:

Future strategy

- Problem statement
- Thematic Research
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- Design
- Reflection
Location analysis: Direct surroundings

- Problem statement
- Thematic Research
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- Design
- Reflection

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Design Research
RAISING THE ROOF

Design research

- Problem statement
- Thematic Research
- Design Research
- Design
- Reflection

Appartment layout
RAISING THE ROOF

Design research

- Problem statement
- Thematic Research
- Design Research
- Design
- Reflection

Appartment layout
RAISING THE ROOF

Design research
- Problem statement
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- Reflection

Appartment layout

Daylight analysis
Deep appartments on south
Wide appartments on north
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Design research

- Problem statement
- Thematic Research
- Design Research
- Design
- Reflection

Appartment layout

Daylight analysis
Deep appartments on south
Wide appartments on north
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Design research

- Problem statement
- Thematic Research
- Design Research
- Design
- Reflection

Appartment layout

Daylight analysis
Deep appartments on south
Wide appartments on north
Appartment layout

Daylight analysis
Deep appartments on south
Wide appartments on north
Appartment layout
Appartment layout

Design research

- Problem statement
- Thematic Research
- Design Research
- Design
- Reflection
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Introduction

- Problem statement
- Thematic Research
- Design Research
- Design
- Reflection

New functions, new balconies
New functions new balconies
New functions new balconies

Introduction

- Problem statement
- Thematic Research
- Design Research
- Design
- Reflection
Greenhouse shape

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Design research

- Problem statement
- Thematic Research
- Design Research
- Design
- Reflection
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Design research

- Problem statement
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- Reflection

Roof decks

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Design research

- Problem statement
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- Design Research
- Design
- Reflection

New elevator core
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Design research

- Problem statement
- Thematic Research
- Design Research
- Design
- Reflection
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Design research

- Problem statement
- Thematic Research
- Design Research
- Design
- Reflection

Greenhouse floor plan
Greenhouse floor plan
Transformation interventions
Adding insulation

Design

- Problem statement
- Thematic Research
- Design Research
- Design
- Reflection

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RAISING THE ROOF

Design

- Problem statement
- Thematic Research
- Design Research
- Design
- Reflection

Adding greenhouses
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Design

- Problem statement
- Thematic Research
- Design Research
- Design
- Reflection

Installing balanced ventilation
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Design

- Problem statement
- Thematic Research
- Design Research
- Design
- Reflection

Introducing wood
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Design

- Problem statement
- Thematic Research
- Design Research
- Design
- Reflection

Fiwihex in rooftop greenhouse
Low temperature floor heating
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Design

- Problem statement
- Thematic Research
- Design Research
- Design
- Reflection

Photovoltaic Thermal Panels
Balanced ventilation w/ heat recovery

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Design

- Problem statement
- Thematic Research
- Design Research
- Design
- Reflection
Combination in one system

- Problem statement
- Thematic Research
- Design Research
- Design
- Reflection

R A I S I N G
THE ROOF

Design

Combination in one system

1. CHP distribution
2. Interseasonal heat storage

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Inside the greenhouse

RAISING THE ROOF

Design

- Problem statement
- Thematic Research
- Design Research
- Design
- Reflection

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RAISING THE ROOF

Design

- Problem statement
- Thematic Research
- Design Research
- Design
- Reflection

PVT panels
Design

- Introduction
- Problem statement
- Thematic Research
- Design Research
- Preliminary Design
- Conclusions
Design

- Introduction
- Problem statement
- Thematic Research
- Design Research
- Preliminary Design
- Conclusions
RAISING THE ROOF

Design

- Problem statement
- Thematic Research
- Design Research
- Design
- Reflection

Detailing
Reflection

Design

- Problem statement
- Thematic Research
- Design Research
- Design
- Reflection
Reflection

- Problem statement
- Thematic Research
- Design Research
- Design
- Reflection
RAISING
THE ROOF

Introduction

- Problem statement
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- Design
- Reflection

Question