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Success & Failure in Flexible Buildings

A Guideline for Flexible Housing Projects

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D&CM Design & Construction Management
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TU Delft

Outline

- **Introduction**
  - IFD Programme
- **Research Project**
- **Results**
  - Survey, questionnaire
  - Case Studies
- **The Guideline**
  - Recommendations

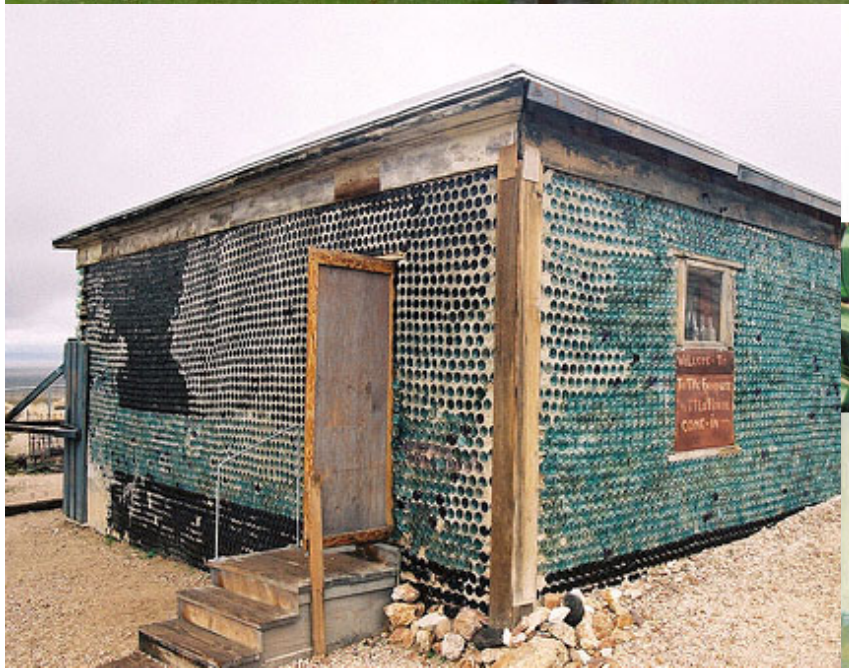




Sustainable Housing?

My home is my castle

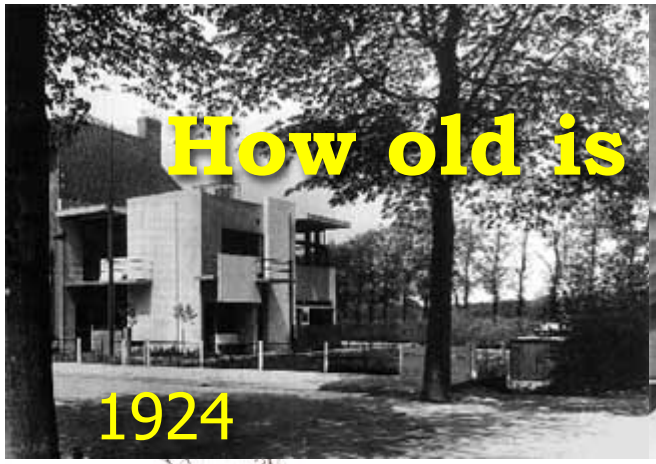
Sustainable Housing?

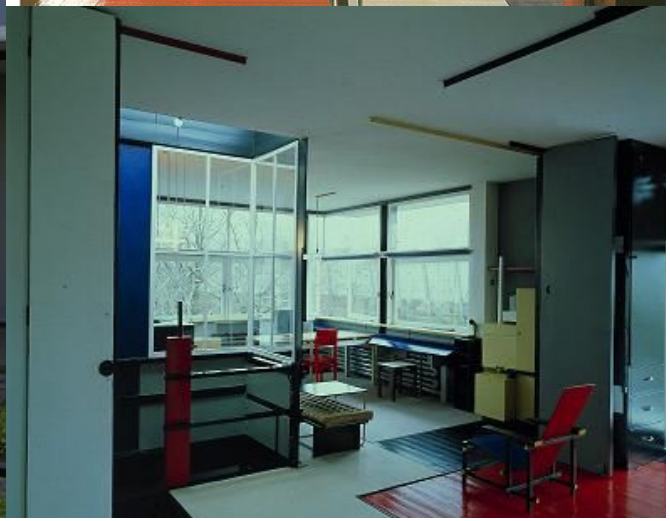


Bottle Homes

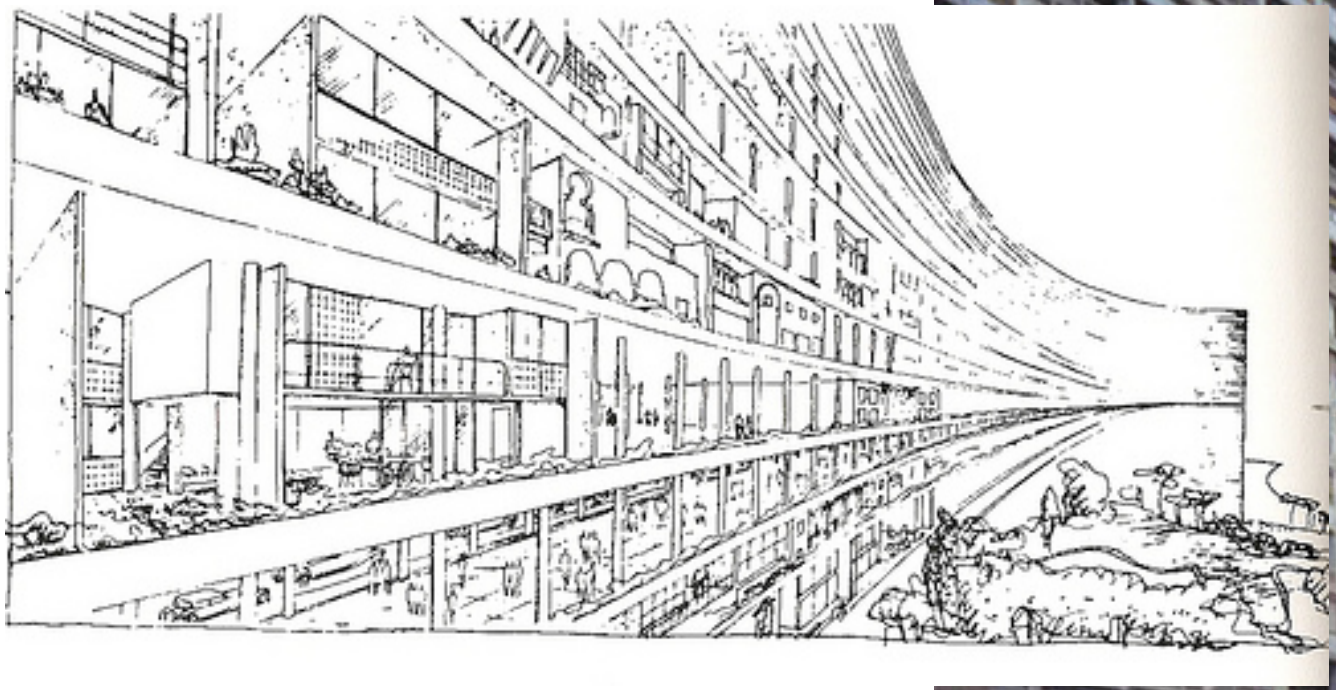

Sustainable Housing?
Container Homes

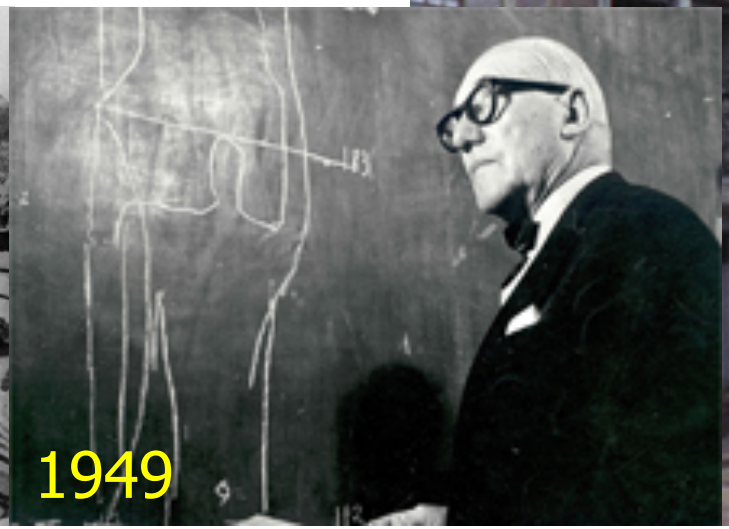
How old is flexibility in housing?





How old is flexibility in housing?

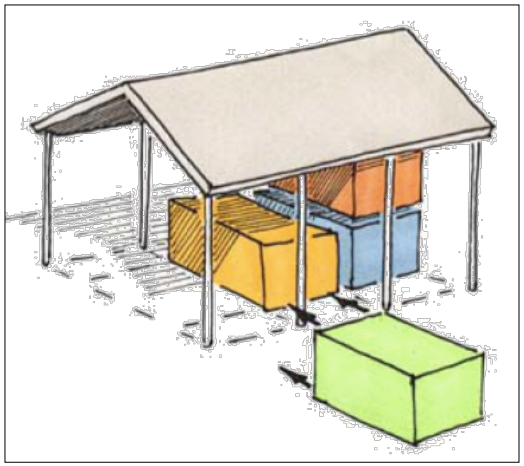


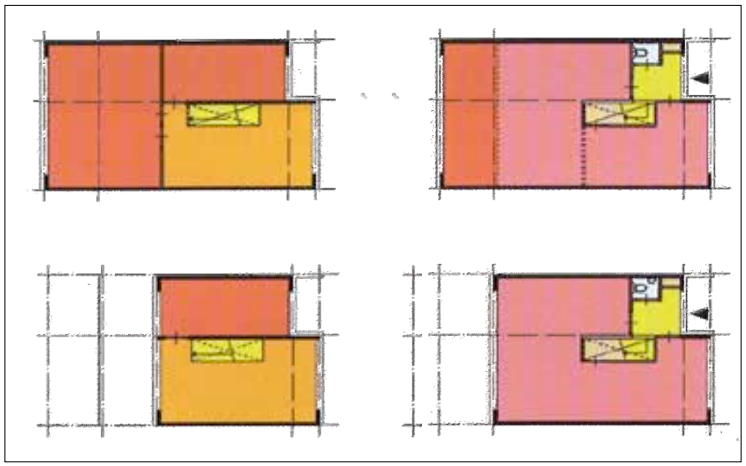


What is IFD? - Industrial building

- Construction elements produced in factories
- Mass production possible (standardization)
- Efficient construction process
- Quality control of innovative construction systems

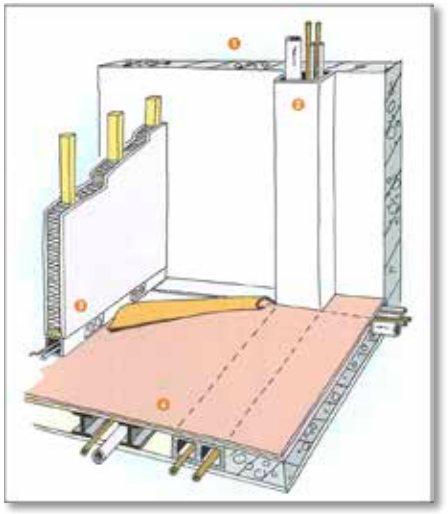
What is IFD? - Flexible building





- **Freedom of choice in volume, layout and design of dwelling**
- **Future adaptability of dwelling**

What is IFD? - Demountable building

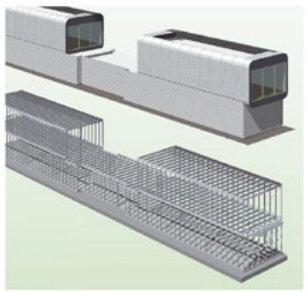


- **Direct assembly on construction site**
- **Exchanging, adding or removing of construction, facade and infill elements**

IFD Demonstration Projects

- **Experimental Programme, established in 1999**
- **Objectives:**
  - encouraging the construction industry to adopt IFD
  - on demand and supply side of the market
- **61 projects submitted**
- **Construction method for creating flexible and consumer-oriented housing.**
- **User is free to choose the size, the layout, facilities and finishing.**
- **During the life cycle dwellings can adapt to changing user and market demands**

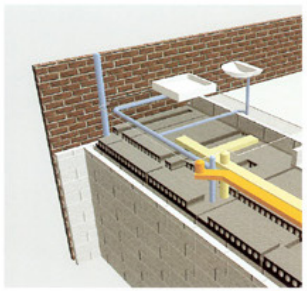
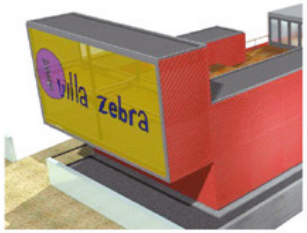
IFD Demonstration Projects



















Number of IFD Projects

Office building:	11
Hospital:	3
Homes:	34
School:	1
Other:	12

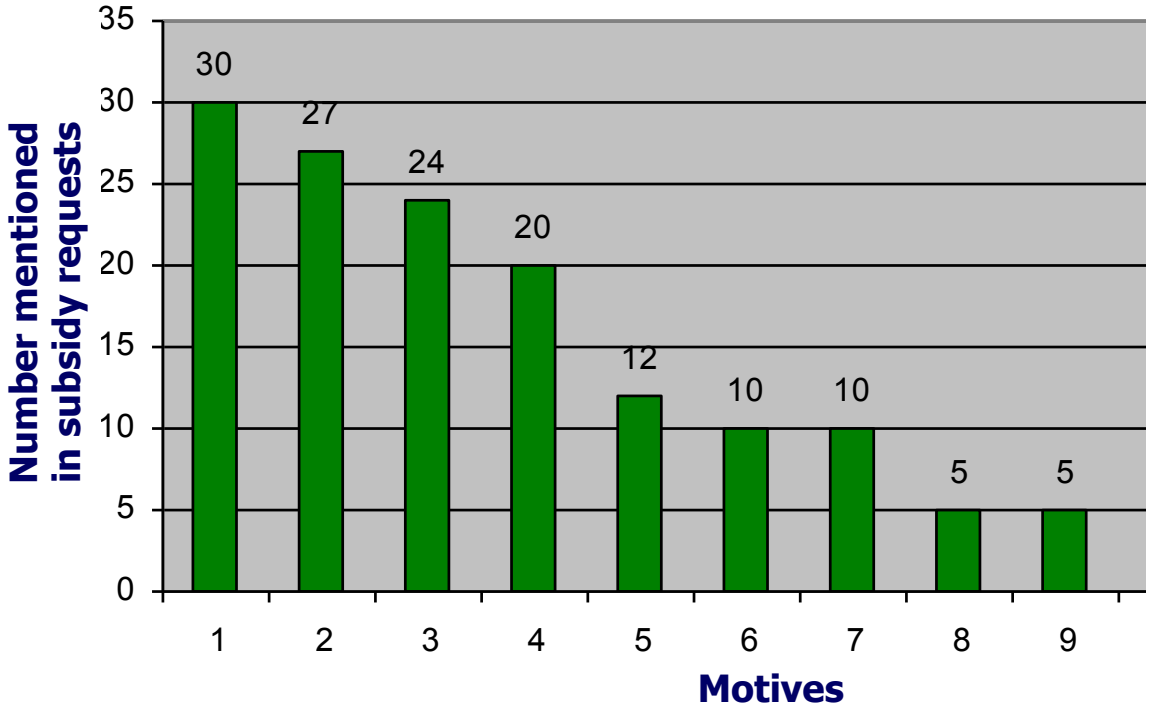
Problem and Research Aim

- **IFD house-building projects still experimental**
- **The aim is not being achieved**
- **How to create optimal conditions for a building process involving IFD housing?**
- **How to remove obstacles for creating consumer-oriented buildings?**





Clients motivation for participation Objectives at the start of IFD

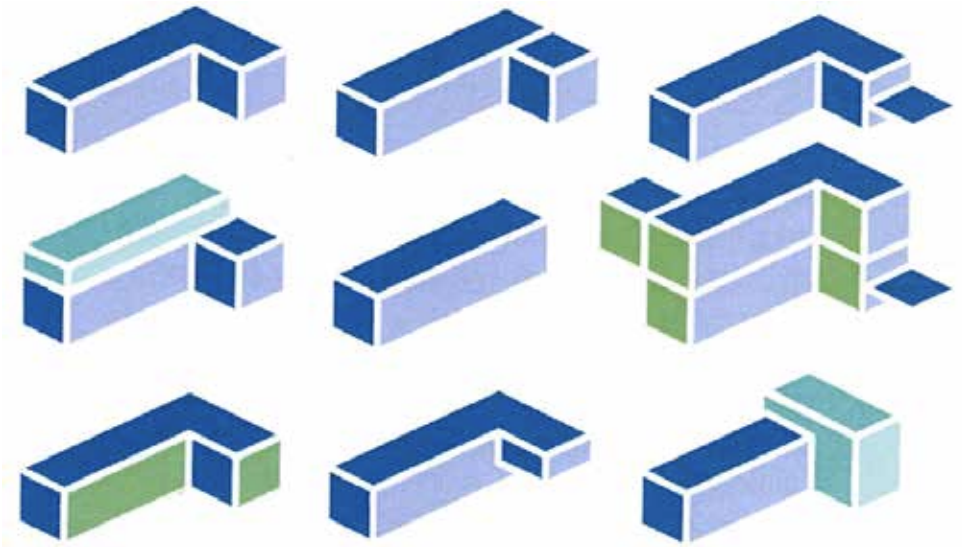


Main objective:
Consumer-oriented Building

1 Flexibility & Adaptability
2 Increase influence consumer
3 Sustainability
4 Economics
5 Reduce construction time

6 Gain experience
7 Demonstration IFD philosophy
8 Innovative collaboration
9 Limited available construction site
10 Reduce inconvenience neighbourhood
11 Temporary available site

Examples Original Objectives



- **A+Dwellings: Flexibility in dwelling layout**
- **Smarthouse: Flexibility volume of dwelling**

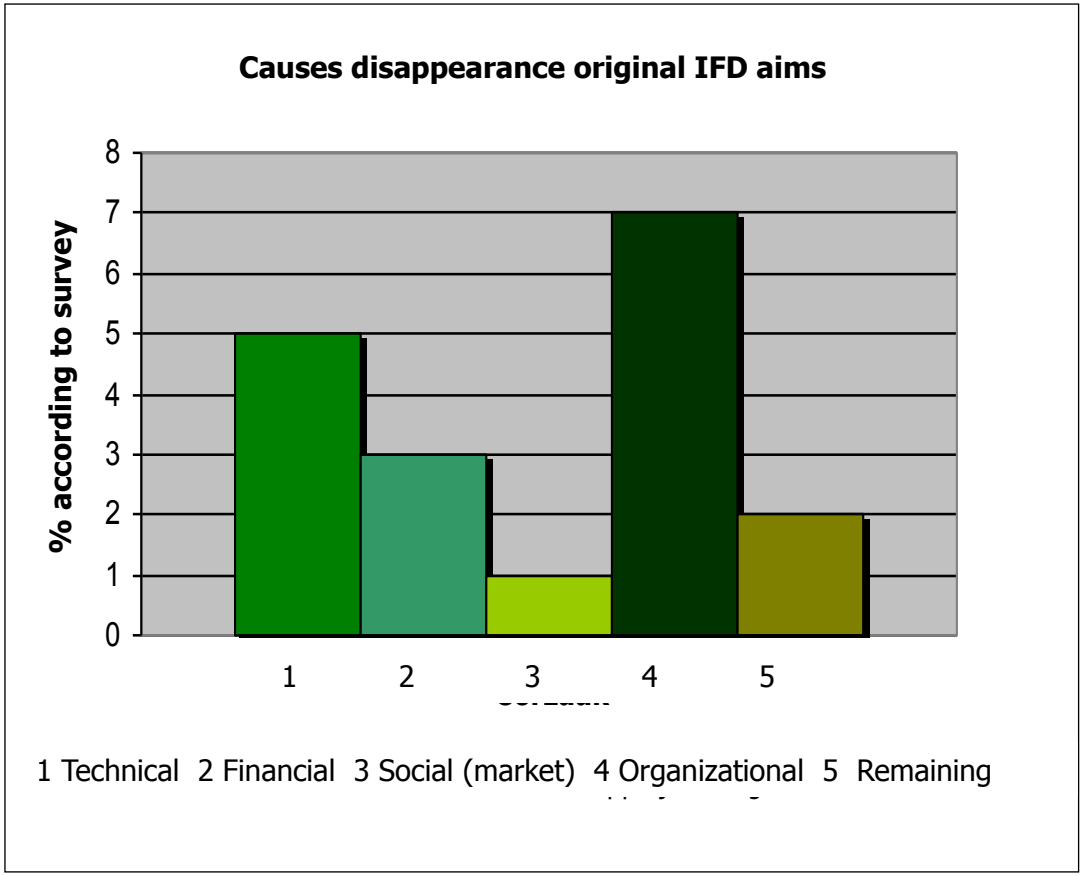
Objectives & Causes of disappearance

Central Objective
- Consumer Oriented Building

Objectives Industrial Building
- Improving Quality
- Guarantees for Quality
- Reduce Construction Time
- New Innovative Product Developments
- Improving Working Conditions

Objectives Flexible Building
- Freedom of Choice first user
- Future Adaptability next users

Objective Demountable Building
- Future Adaptability
- Reduce Construction Time
- Reducing Costs



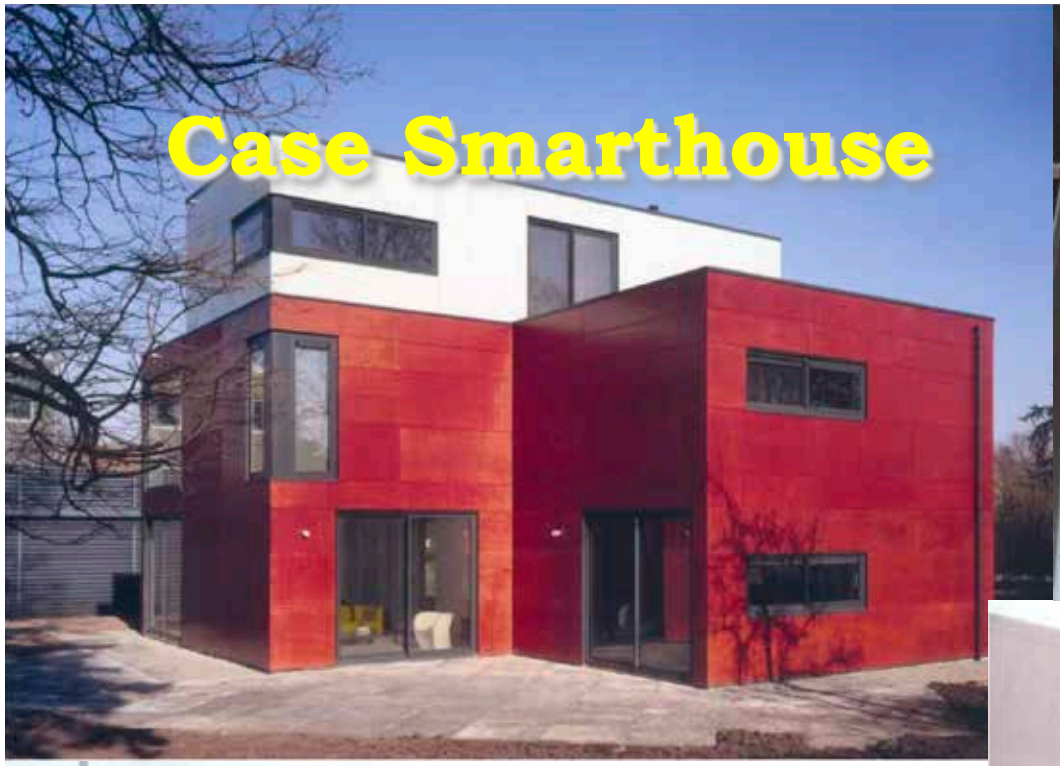
Original Objectives

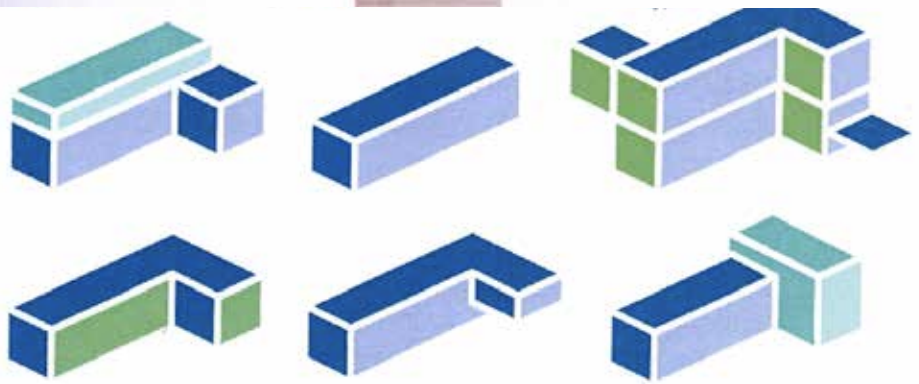
Causes of disappearance during the process

5 cases: Objectives and why there were not achieved

1. Smarthouse Rotterdam
2. The Seven Heavens Rotterdam
3. A+ dwellings Etten-Leur
4. The Mask Veenendaal
5. Terbregse.nl Rotterdam

Case Smarthouse





Case Smarthouse

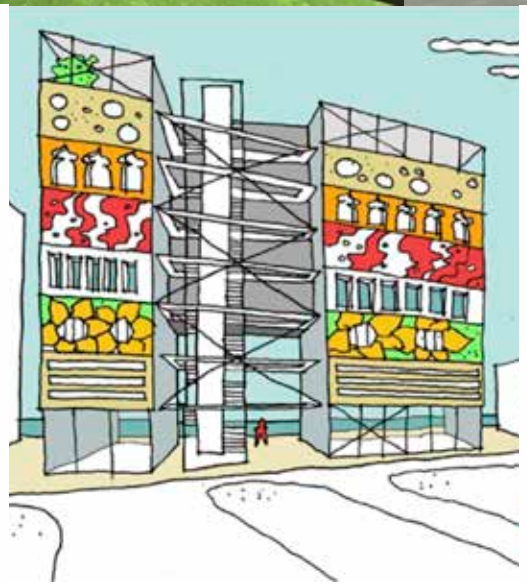
Objectives:

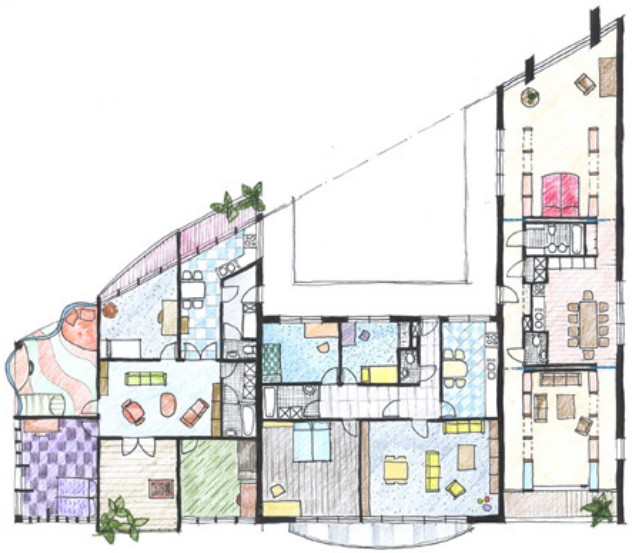
- Private buyers
- Own plot
- Specially tailored architecture
- Fixed time, costs, quality

Cause of failure:

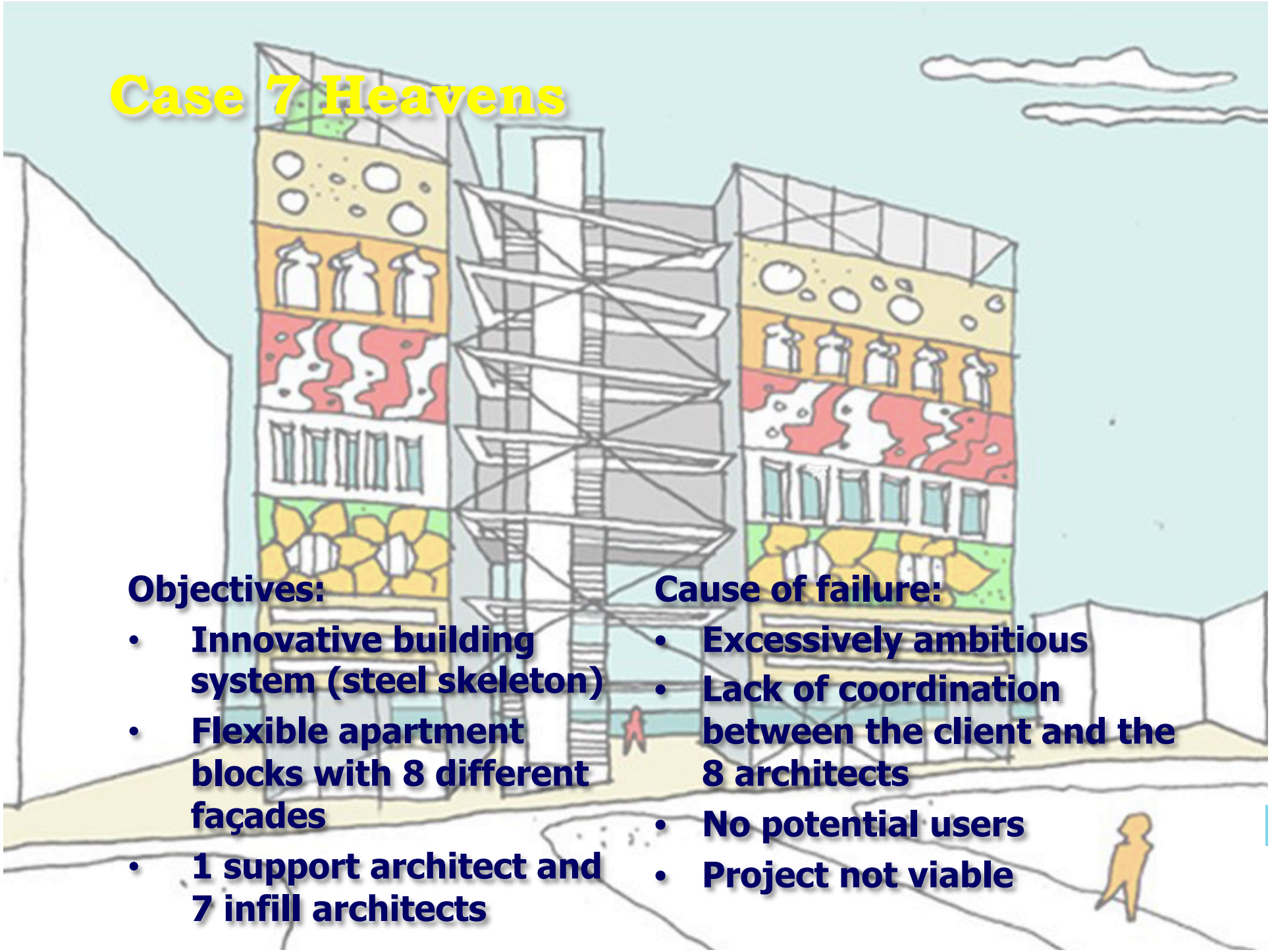
- Deteriorating market
- Very little demand
- Only 1 prototype built

Case 7 Heavens





Case 7 Heavens



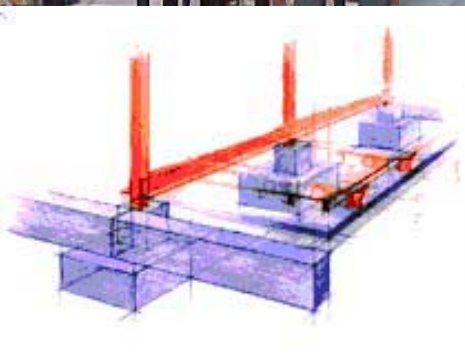
Objectives:

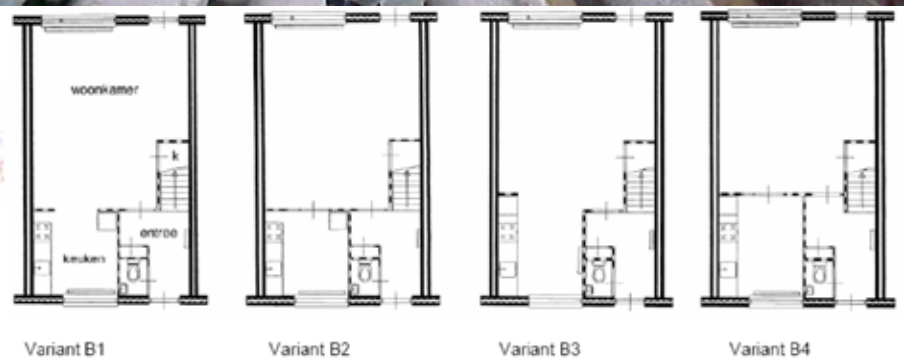
- Innovative building system (steel skeleton)
- Flexible apartment blocks with 8 different façades
- 1 support architect and 7 infill architects

Cause of failure:

- Excessively ambitious
- Lack of coordination between the client and the 8 architects
- No potential users
- Project not viable

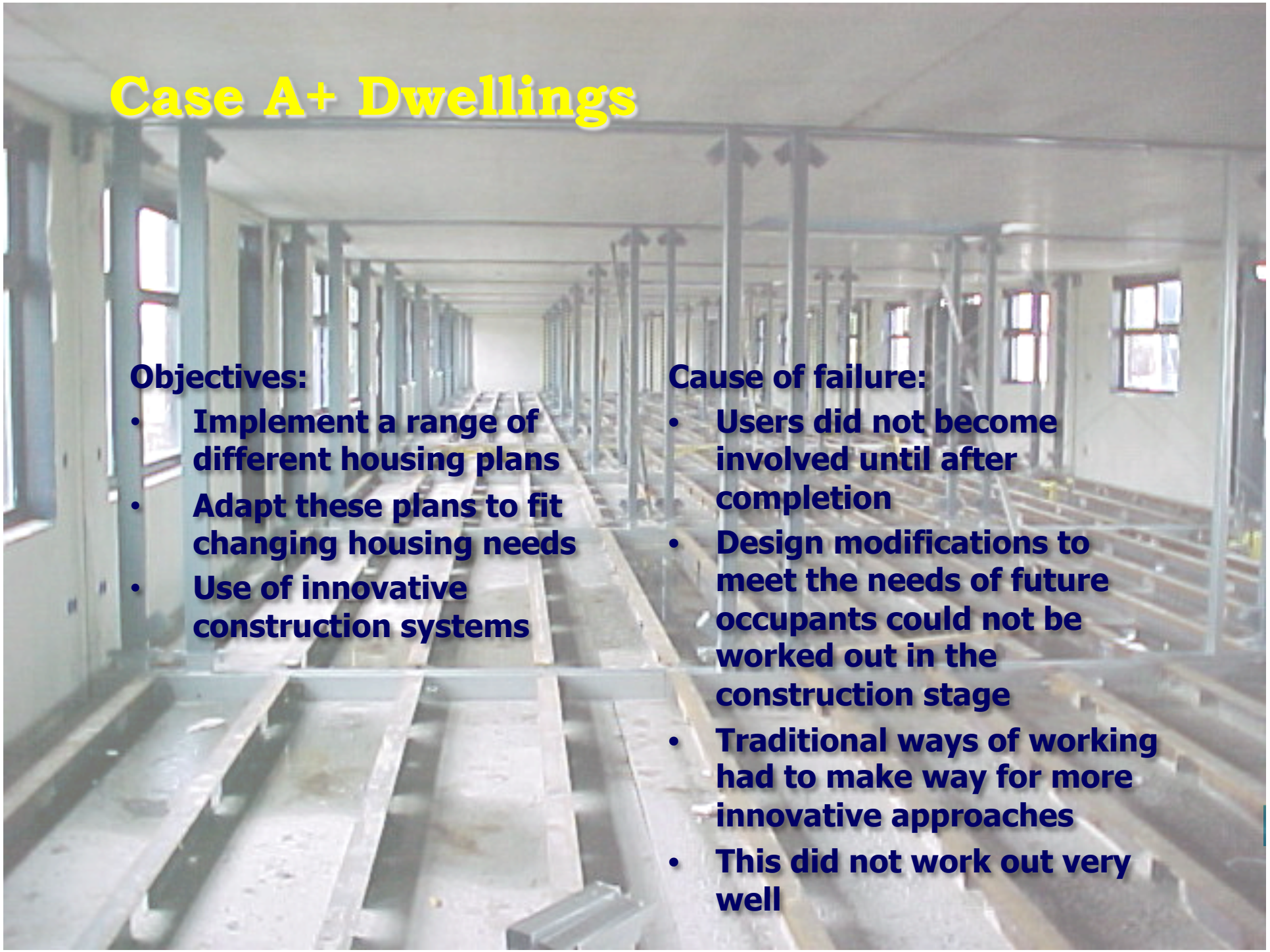
Case A+ Dwellings





Variant B1 Variant B2 Variant B3 Variant B4

Case A+ Dwellings



Objectives:

- Implement a range of different housing plans
- Adapt these plans to fit changing housing needs
- Use of innovative construction systems

Cause of failure:

- Users did not become involved until after completion
- Design modifications to meet the needs of future occupants could not be worked out in the construction stage
- Traditional ways of working had to make way for more innovative approaches
- This did not work out very well

Case The Mask

Case The Mask

Objectives:

- Innovative building system (steel skeleton)
- Users can design their own house
- Future adaptability

Cause of success:

- No failures
- The flexibility targets have been achieved
- Residents: full use of their individual freedom
- Intensive preparation stage; good coordination
- Future adjustments are expected

Case Terbregse.nl

Case Terbregse.nl

Objectives:

- Freedom of choice for the 1st users
- Future adaptability
- Integrated design & consumer oriented guidance process

Cause of success:

- Previous in-house experience
- Good process approach to consumers; logical steps
- Adaptable floor system

Main conclusions 5 cases

- **Flexibility for initial users and future adaptability call for new development processes**
- **Industrially manufactured components allows dwellings to be completed in much less time**
- **Preparation stage is more intensive**
- **Design work and implementation have to be fully integrated and run concurrently.**





Recommendations 5 cases

- Define the target group (market research)
- Objectives relate directly to the selected target group and will have to be monitored
- Consumers tend to have traditional views. They want to know what the end product will look like.
- Determine the degree of involvement; this influences the design & construction process
- Integrated design at an early development stage
- Close coordination between the various disciplines
- The intended degree of flexibility will have to be translated into a design: Open Building principles





7 steps for IFD Housing Projects

1. Market Research
2. Draft the initial guiding principles
3. Formulate objectives
4. Select methods
5. Monitoring flexibility in the design stage
6. Structuring implementation stage
7. Monitoring flexibility options

Step 1: Market Research

- Launch Market Research in initial stage
- Select appropriate Target Groups
- Inventorise living requirements
- Keep future adaptability in mind

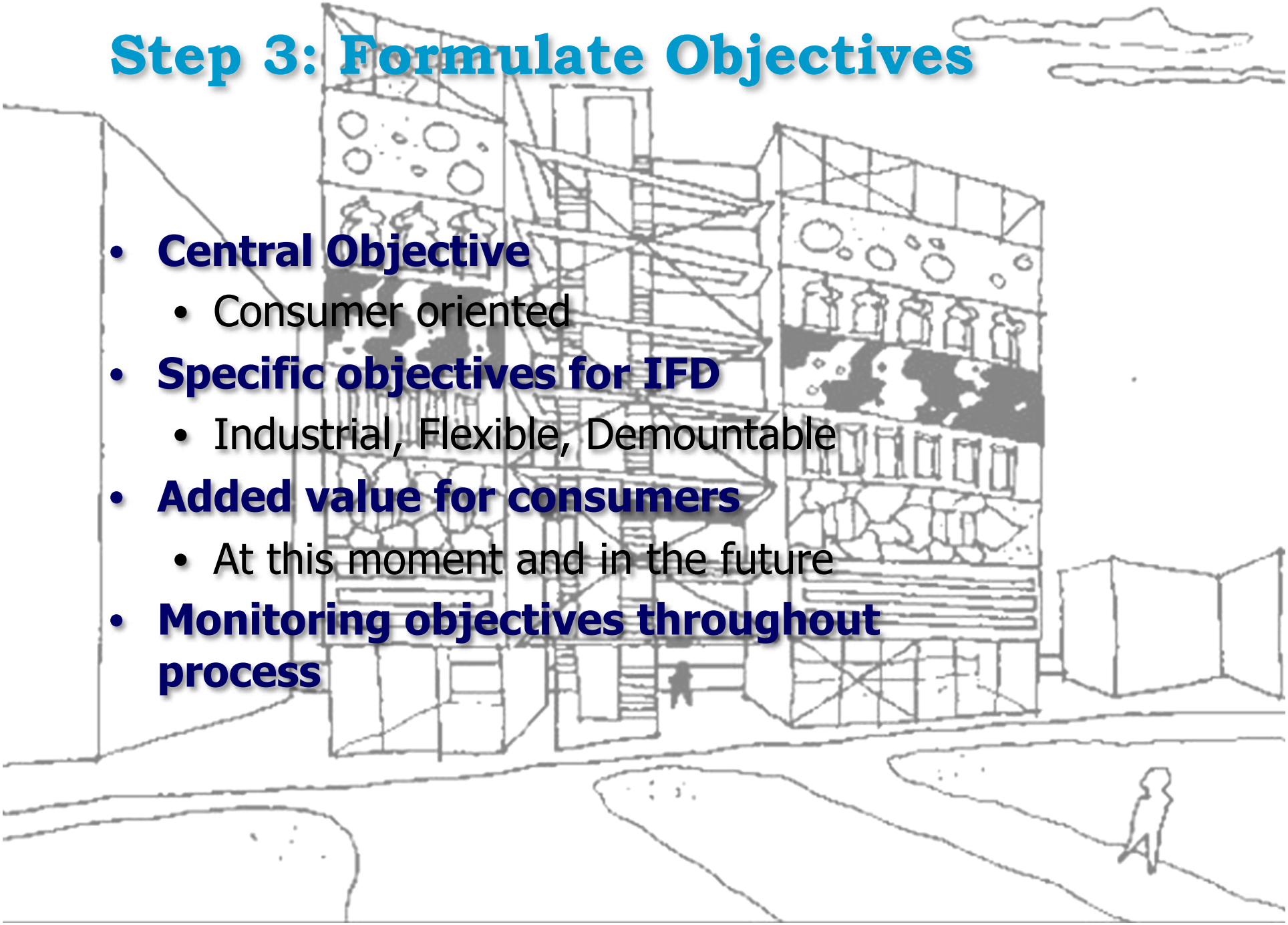





Step 2: Draft the initial guiding principles

- **Definitions of Flexibility**
- **The Development Concept (f.i. IDF)**
- **The process dealing with consumers**
  - Meant for the consumer,
  - With the consumer, or
  - By the consumer

Step 3: Formulate Objectives



- **Central Objective**
  - Consumer oriented
- **Specific objectives for IFD**
  - Industrial, Flexible, Demountable
- **Added value for consumers**
  - At this moment and in the future
- **Monitoring objectives throughout process**

Step 4: Select Work Method

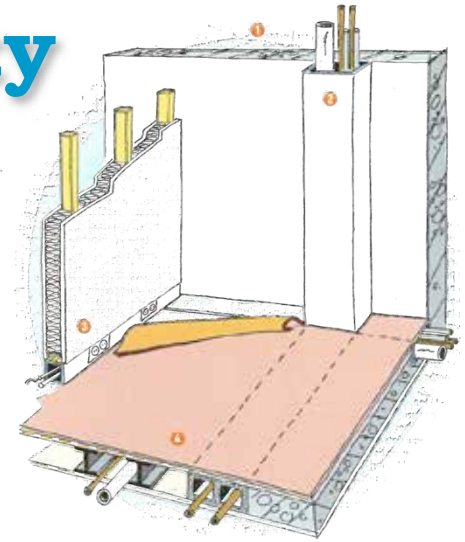
- **Determine influence consumer**
  - Building *with* consumer (freedom in volume, layout and finishing)
  - Building *for* consumer (choice in different types)
  - Building *by* consumer (consumer = client, owner)
- **Choice of Innovative building system**
  - More of less experience
- **Determine Organizational Structure**
  - More or less influence consumer
  - Coordination
  - Information and decision process

Smarthouse:
with the consumer

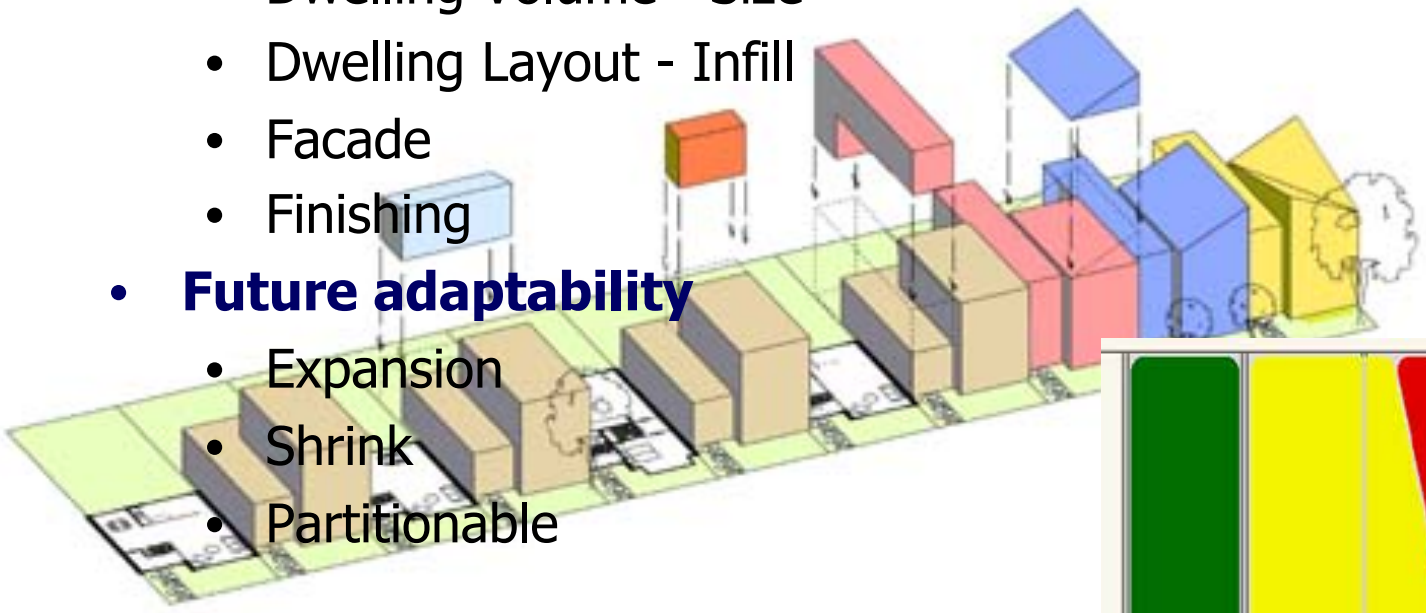
A+ Dwellings:
for the consumer

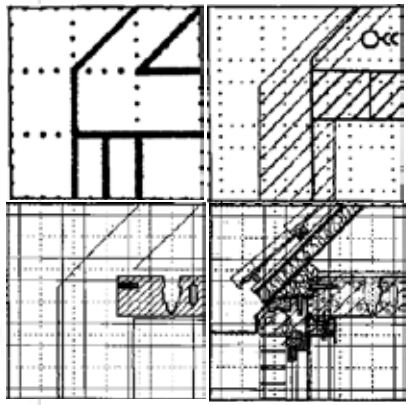
Terbregse.nl:
by the consumer

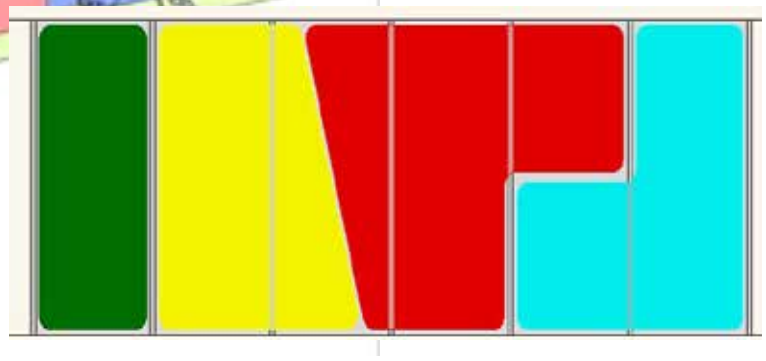
Step 5: Monitoring flexibility in the design stage



- **Translate objectives into a design**
  - Using decisions levels; support - infill
  - Using Modular Coordination
- **Make choices available on:**
  - Dwelling Volume - Size
  - Dwelling Layout - Infill
  - Facade
  - Finishing
- **Future adaptability**
  - Expansion
  - Shrink
  - Partitionable







Step 6: Structuring implementation stage

- **Organize construction phase with respect to**
  - Minimum construction time
  - Prefab components assembled on site
  - Keep track of construction logistics, sequence
  - Experienced co-makers, contractors and suppliers
  - Coordination different disciplines
  - Utilize different knowledge







Step 7: Monitoring flexibility options

- **Preserve future adaptable possibilities**
- **Create insight in future possibilities**
- **Who owns the dwellings?**
  - Individual user:
    provide for blue prints future flexibility
  - Housing Association:
    responsible for future adaptability

Final Recommendation:
Experiment with innovations!

- **Build prototypes**
  - Total concepts
  - Components
  - Products
- **Evaluate**
- **Improve**

Open & Sustainable Building:

Industrial

Flexible

Demountable