Introduction

- European goals in terms of energy efficiency and CO\textsubscript{2} emissions
- Comfort and health of occupants
- Building stock:
  - Aging materials and assemblies
  - Bad envelope performance
  - ‘End-of-life’ technologies
Introduction

• Traditional approaches for retrofitting

Introduction

• Prefabricated façade elements
Introduction

- Prefabricated façade elements

- Increase the efficiency of techniques
- Enhance the quality
- Speed up the renovation process (also winter activity)
- Deepen its effect
- Take advantage of cost-benefits linked to scale
- Reduce nuisances
- Systematize the approach

- A more extensive building analysis phase
- A deeper interaction between professionals
- With a clear repartition of roles and responsibilities

Introduction

- Prefabricated façade elements
  - Design parameters

- Level of prefabrication
- Types of materials
- Level of technicality
Introduction

- Prefabricated façade elements
- Design parameters

Existing systems

- Many experimental and commercial products

<table>
<thead>
<tr>
<th>Wood-based</th>
<th>Metal-based</th>
<th>Composite-based</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Swiss flag]</td>
<td>![Portuguese flag]</td>
<td>![European flag]</td>
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<tr>
<td>![Wood-based facade]</td>
<td>![Metal-based facade]</td>
<td>![Composite-based facade]</td>
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</table>
AIMES project

• *Experienced-based Guidelines for Architectural Industrialized Multifunctional Envelope Systems*

“Develop a manual containing guidelines for the application of prefabricated façade systems adapted to the context of Brussels”

European feedback → ‘Guidelines’ for professional actors

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Systems sought after?

• Properties:
  • Based on durable materials
  • Applicable on top of an existing wall
  • Possibility of large dimension elements
  • ‘Multifunctional’
    • Possibility of integrating building services
    • Possibility of expending the building volume
  • With many option for the external layer
  • With sufficient technical and scientific feedback
Systems sought after?

- In a schematic way...

TES façade

- *Timber-based element system*

Family of systems based on 'traditional' timber frame construction
- Large dimensions (up to 13x3.8m)
- Horizontal or vertical orientation
- Many design options
Industrialisation and prefabrication of building systems for retrofitting

TES façade

- Timber-based element system

TES façade

- Many projects in Europe
Industrialisation and prefabrication of building systems for retrofitting

TES façade

- Many projects in Europe

- Two main approaches:

  **Closed TES**
  - Timber structure paneled on both sides
  - Off-site insulation
  - Separated adaptation layer

  **Open TES**
  - Timber structure paneled on the exterior side
  - On-site insulation, ensuring the adaptation function
Industrialisation and prefabrication of building systems for retrofitting

TES façade

• Closed TES

TES façade

• Open TES
Industrialisation and prefabrication of building systems for retrofitting

European cases analysis

• What about existing walls?

- Modules on top of existing walls
- Modules on top of existing walls after the removal of one/several layers
  (Removal of existing walls)

European cases analysis

• What about building extensions?

- Many forms of vertical and horizontal building extensions
European cases analysis

• What about building extensions?

Many forms of vertical and horizontal building extensions
European cases analysis

- What about the integration of building services?

Ventilation ducts for centralized systems integrated in façade elements

European cases analysis

- What about the integration of building services?

Ventilation ducts for centralized systems integrated in separated compartments
European cases analysis

• What about the integration of building services?

Decentralized ventilation devices

Solar systems (PV, thermal)
European cases analysis

• What about the integration of building services?

  Solar systems (‘passive panels’)

European cases analysis

• What about the anchorage of façade elements?

  ‘Standing construction’ – details at building base

  Direct anchorage in existing structure
European cases analysis

• What about the anchorage of façade elements?

‘Standing construction’ – details at building base
Use of existing foundation

European cases analysis

• What about the anchorage of façade elements?

‘Cladded construction’
European cases analysis

• What about the anchorage of façade elements?

‘Cladded construction’

Much information...
How to compile it?
‘Guidelines’

• Manual that provides Guidelines for designing and implementing prefabricated AIMES elements

• Method specificities and practical examples
• With indication concerning actors roles and transfer of information between them
• For TES façade in the context of Brussels
• Validated by practitioners
Industrialisation and prefabrication of building systems for retrofitting

‘Guidelines’

• Structure:
  • Following the sequence of a typical retrofitting project

Pre-project
  1st specifications
  Feasibility

Pre-construction
  Investigation
  Conception

Construction
  “off site”
  CAD/CAM
  Assembly
  “on site”
  Planning
  Interventions

Post-construction
  Inspection
  Monitoring
  Preventive/corrective actions

‘Guidelines’

Pre-Project

ARCHITECT

DIAGNOSTICS EXPERT

THERMAL ENGINEER EPRO EXPERT

BUILDING INVESTIGATION

(See Chapter 2)

OWNER

BI Checklist

Reports

Building inspection

Consultation

Evaluation of the retrofitting strategy

Simulations

General constraints and legal context

Goals definition

Early project specifications

TENANTS

LOCAL AUTHORITIES
Industrialisation and prefabrication of building systems for retrofitting

3 December 2015

Brussels Retrofit XL: Retrofitting Thursdays

‘Guidelines’

Pre-construction I: Investigation

ARCHITECT

MODULAR DESIGNER

GEOMETER

DIAGNOSTICS EXPERT

STABILITY ENGINEER

THERMAL ENGINEER (CIPD EXPERT)

TENANTS

Detailed description of the building architecture

Geometrical survey

Surroundings survey

Condition diagnostics

Stability survey

Energy performance assessment

Comfort & safety

Report(s)

CAD files

Report(s)

MODULAS PRODUCTION

Restoration/upgrade proposals

MODULAS DESIGN

Example: geometrical survey = key stage for prefabrication!

Dense point cloud from images (x,y,z,color)

True orthophoto
‘Guidelines’

Pre-construction II: Conception

- Core of the document
  - References to investigation stages
  - Various technical illustrations
  - Decision support tables
  - Special chapter for Building Physics

‘Guidelines’

Example: structural design
Industrialisation and prefabrication of building systems for retrofitting

‘Guidelines’

+ Annexes

Description of cases!

‘Guidelines’

- Final validation: end of 2015 by the working group
- Translation in FR and NL foreseen in 2016
Merci de votre attention!

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