Concepts for Cost-Effective Deep Energy Retrofit

Mark Zimmermann
Switzerland
Optimal renovation strategy?

Repair – Renewal – Reconstruction?

### Renewal or Reconstruction?

<table>
<thead>
<tr>
<th>Potential for extension</th>
<th>Renewal</th>
<th>Renewal evtl. Reconstruction</th>
<th>Reconstruction</th>
</tr>
</thead>
<tbody>
<tr>
<td>small</td>
<td>Renewal</td>
<td>Renewal</td>
<td>Reconstruction</td>
</tr>
<tr>
<td>≈ 0 %</td>
<td>Repair</td>
<td>Repair</td>
<td>Repair</td>
</tr>
<tr>
<td>medium</td>
<td>Renewal</td>
<td>Renewal</td>
<td>Reconstruction</td>
</tr>
<tr>
<td>≈ 15 %</td>
<td>Repair</td>
<td>Repair</td>
<td>Repair</td>
</tr>
<tr>
<td>large</td>
<td>Renewal</td>
<td>Renewal</td>
<td>Reconstruction</td>
</tr>
<tr>
<td>&gt;25 %</td>
<td>Repair</td>
<td>Repair</td>
<td>Repair</td>
</tr>
</tbody>
</table>

#### ... also to be considered

- Usability / flexibility / Demand
- Construction quality, sound protection, earthquake safety
- Integration in neighborhood, historic value
- Tenant situation

**Location**
- poor
- medium
- attractive

**Usability / flexibility / Demand**
- 

**Construction quality, sound protection, earthquake safety**
- 

**Integration in neighborhood, historic value**
- 

**Tenant situation**
-
European Retrofit Advisor: era.empa.ch
European Retrofit Advisor
Deep Building Renovation

80-90 % energy savings + added values (room extension, attic apartment)
Traditional Renovation

- hardly future oriented
- too many technical compromises
- to many craftsman involved
- poor coordination on site
- low quality level
- inefficient construction processes

Mark Zimmermann - Deep Energy Retrofit of Buildings
Prefab Building Renovation

- whole building concept
- no technical compromises
- few companies involved
- well coordinated modules
- quality assurance
- rapid construction processes
Challenge of Pre-Fabrication

Pre-fabrication of large elements has to ensure that the elements will fit to the existing building.
Laser Scanning – Design Support

Planarity of façades

Horizontal sections
Modular approach

Small or large size module developed by Swiss team

Contractors generally prefer to work with large size modules!
Pre-fabrication of Façade Elements
Mounting of Façade Elements
Krummbach School and Caretakers Building
Austrian Demonstration Buildings

Renovation of 3 apartment buildings (1959) completed 2008, GAP-Solution / AEE INTEC
German Demonstration Building

Renovation of 60 apartment buildings (1966) in Augsburg completed 2013, Frank Lattke / TU Munich

Wood-Wisdom, TES-Energy Façade
Dutch Demonstration Buildings

Renovation of residential area by DAT archiechten / Trecodome
Swiss Demonstration Buildings

Renovation of apartment building (1952) completed 2009, Miloni Architects
Swiss Demonstration Buildings

Renovation of apartment building (1952) completed 2009, Beat Kaempfen Architects
IEA Demonstration Buildings

- 6 Demonstration sites with totally 363 apartments and 1 school

![Bar chart showing energy consumption for heating ventilation, hot water before and after retrofit, including PV electricity.](image)
Historical Buildings

Traditional buildings should be refurbished with traditional methods.
New Insulation Rendering

- Purely mineral
- Thermal conductivity $< 30$ mW / (m·K) in real application
- 60 – 80 mm thickness in one layer
- Sprayable with available rendering machines
- Very low vapour resistance $\mu < 5$
- Applicable in- and outside
Thermal Conductivity of Insulation Renderings

Thermal conductivity of insulating rendering systems in mW/(m·K)

![Bar chart showing thermal conductivity values for different rendering systems.](chart.png)
Summary Building Repair and Restauration

- Building repair mainly for low income housing with low attractiveness
- Building restauration for historical buildings
- Energy savings potential lower but still >60%
- Aerogel rendering is an interesting new solution
Summary Prefab Building Retrofit

- Prefab Retrofit suitable for deep renovation with energy savings > 80% - Technologies available
- Deep renovation has additional legal requirements (earthquake, fire, sound, energy, water management, electrical installations)
- Energy savings measures are hardly cost effective > added values needed
- Expected service life > 50 years
Thank you for your attention!

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