Development and advanced prefabrication of innovative, multifunctional building envelope elements for MOdular RETrofitting and CONNECTions

by MORE-CONNECT team

www.more-connect.eu

- retrofitting technology and the components for buildings’ renovation in five geo-clusters across Europe: Portugal, Netherlands, Denmark, Czech Republic, Estonia and Latvia.

Description of case building and design target

The Estonian pilot project is typical soviet five storey multi apartment building apartment built in 1986. Pilot building is constructed by prefabricated concrete large panel elements. There are 80 apartments with total heated area of 3306 m². Construction date is 1986.

<table>
<thead>
<tr>
<th>PARAMETERS</th>
<th>BEFORE RENOVATION</th>
<th>DESIGN VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>WALL</td>
<td>0.90</td>
<td>0.11</td>
</tr>
<tr>
<td>ROOF</td>
<td>0.80</td>
<td>0.10</td>
</tr>
<tr>
<td>WINDOW</td>
<td>1.6</td>
<td>0.80</td>
</tr>
<tr>
<td>THERMAL BRIDGE</td>
<td>0.13</td>
<td>0.047</td>
</tr>
<tr>
<td>HEATING KWH/M²</td>
<td>168</td>
<td>10</td>
</tr>
<tr>
<td>HOT WATER, KWH/M²</td>
<td>59</td>
<td>31</td>
</tr>
<tr>
<td>TYPE OF VENTILATION</td>
<td>Natural</td>
<td>Mechanical with heat recovery</td>
</tr>
<tr>
<td>HEATING SOURCE</td>
<td>District heating</td>
<td>District heating</td>
</tr>
<tr>
<td>INSTALLED PV, M²</td>
<td>-</td>
<td>87</td>
</tr>
<tr>
<td>INSTALLED THERMAL SOLAR, M²</td>
<td>-</td>
<td>100</td>
</tr>
</tbody>
</table>

SWOT analysis of Estonian pilot building

**STRENGTHS**
- Typical building soviet series apartment building: results are easily to disseminate;
- The building is not far from project partner (TUT). This makes possible to make continuous and effective survey during renovation process;
- Mono-functional building makes clear assessment of energy use of the building;

**WEAKNESSES**
- The building operates as dormitory; but still it is residential building and represents typical construction series built before 1990 in Estonia and other states in Eastern Europe;

**OPPORTUNITIES**
- to disseminate results to owners, housing associations, and building companies;
- to use PV and solar collectors;

**THREATS**
- Delay of construction works;

**LIVE STREAM OF THE MORE-CONNECT RENOVATION PROCESS**

You can follow the renovation process of MORE-CONNECT’s Estonian pilot:
- https://www.youtube.com/watch?v=CMwy67xezSk
- https://www.youtube.com/watch?v=2LaXcznMRzE

**MOUNTING OF THE PREFABRICATED PANELS IS EXPECTED IN JUNE/JULY 2017**
Production and Process

Estonian case building has an unsatisfied performance of external building envelope: $U_{\text{wall}} = 1.0 \text{ W/(m}^2\text{K)}, U_{\text{roof}} = 1.1 \text{ W/(m}^2\text{K)}, U_{\text{floor}} = 0.6 \text{ W/(m}^2\text{K)}$. During energy audit, thermal bridges, lack or insufficient ventilation, water-proofing failures on balconies and on window drip molds were detected. Windows with plastic frames have high thermal transmittance ($U_{\text{window}} \geq 1.8 \text{ W/(m}^2\text{K)}$) and broken closing mechanisms and fixings. Failures and water leakages in the arched chimney are non-existent as there is no temperature gradient between inside and outside.

![Figure 1. Thermal bridges in original wall](image1)

The existing concrete panel with a thickness of 250 mm consists from concrete sections and insulation layers: 60 mm external reinforced concrete slab + 70 mm wood-chip insulation layer + 50 mm phenolic foam insulation layer + 70 mm internal reinforced concrete slab. Typical height of panels is 2700 mm and the width varies depending on the dimensions of rooms. The external side of the panels is covered with gritstone, the interior side of the panels is caulk and finished with paint or wallpaper.

![Figure 2. Designed solutions at the different structural points of the pilot building](image2)

The fully mechanical supply/exhaust ventilation will be installed. The integration of ventilation ducts into prefabricated panel allow significant indoor space savings. Air flowing through the ducts is preheated at the AHU and therefore the theoretical heat loses through building envelope are non-existent as there is no temperature gradient between inside and outside.

![Figure 3. Placement of embedded ventilation ducts on the faced](image3)

Ventilation systems

More information is available on project web-page and publications:

- Pihelo P., Kalamees T., Kuusk K. nZEB Renovation with Prefabricated Modular Panels. 11th Nordic Symposium on Building Physics, NSB2017, 11-14 June 2017, Trondheim, Norway
- Pihelo P., Kalamees T., Kuusk K. Renovation of multi-storey building with prefabricated modular panels to nZEB. Renovation of multi-storey building with prefabricated modular panels to nZEB. 27th to 29th of September 2017, Riga, Latvia

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