Renovation and energy efficiency measures of apartment buildings

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WSP Environmental
Million homes being built in ten years, from 1965 to 1975

- 100,000 apartments need to be renovated (renewal of technical building functions, technical installations and energy use) within the next five years.
- A total of 320,000 require more or less extensive renovation.
- An excellent opportunity to make these homes more energy-efficient.
- 200,000 apartments have been renovated, few of them energy improved.
Average energy use for heating and hot water in apartment blocks in 2010
## Number of low energy buildings

<table>
<thead>
<tr>
<th>Year of construction</th>
<th>Number of LEB apartments built</th>
<th>Number of apartments converted to LEB</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>34</td>
<td></td>
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<tr>
<td>2001</td>
<td>31</td>
<td></td>
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<tr>
<td>2002</td>
<td>0</td>
<td></td>
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<td>2003</td>
<td>0</td>
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<tr>
<td>2004</td>
<td>111</td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>68</td>
<td>101</td>
</tr>
<tr>
<td>2006</td>
<td>924</td>
<td></td>
</tr>
<tr>
<td>2007</td>
<td>154</td>
<td></td>
</tr>
<tr>
<td>2008</td>
<td>193</td>
<td></td>
</tr>
<tr>
<td>2009</td>
<td>490</td>
<td>709</td>
</tr>
<tr>
<td>2010</td>
<td>1224</td>
<td></td>
</tr>
<tr>
<td>2011</td>
<td>3229</td>
<td>810</td>
</tr>
</tbody>
</table>

Åke Blomsterberg, 2013-05-13
Brogården, Alingsås, Sweden

Energy concept: renovation to nearly passive house standard.

Background for the renovation – reasons
The goal was to renovate the buildings because of wear and tear:
• Improve on the poor thermal comfort
• Take care of moisture problems in the base plate
• Renovate the façade because of poor quality bricks
• Replace the radiators
• Improve the poor energy efficiency

Before renovation.
Building envelope, heating, ventilation, cooling and lighting systems before the energy renovation

- The apartments have good floor plans, with generous and easily furnished rooms.

**Building envelope**
- Walls: Wooden studs, 95 mm insulation and façade bricks.
- Basement: cast-in-situ concrete walls without any insulation.
- Roof: 300 mm insulation on roof slab.
- Windows: double-pane
- The apartments: drafty and poor indoor thermal comfort due to leaky facades.
- The balconies constitute thermal bridges.
- The façade bricks are partly destroyed by moisture.

Architecturally preserve the impression of the façade e.g. the yellow brick façade.

**Heating, ventilation, cooling and lighting systems before retrofit**
- District heating with radiators under the windows.
- Domestic hot water heated by district heating.
- District heating is renewable to 98%.
- The apartments are ventilated by mechanical exhaust with air intake through window vents.

Before renovation
Energy renovation features

Energy saving concept

Necessary renovation + upgrade to nearly passive house standard. The total investment cost was 14,000 SEK/m² out of which 3,800 SEK/m² for energy efficiency measures.

Building

• Replacing the infill walls with well insulated new facades
• Adding thermal insulation to the gables, the roof and the base plate
• Improving the airtightness from 2 l/sm² to 0.2 l/sm² at 50 Pa.
• Replacing the windows with triple pane windows.
• Incorporating the balconies with the living rooms to eliminate thermal bridges and building new balconies supported by columns

Systems

Heating: Replacing the radiators with heating coils in the supply air

Ventilation: Installation of decentralized balanced ventilation systems with heat recovery

<table>
<thead>
<tr>
<th>U-values</th>
<th>Before renovation</th>
<th>After renovation</th>
<th>After renovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exterior walls</td>
<td>0.30</td>
<td>0.11 W/m²K</td>
<td>Altogether 480 mm thermal insulation. Adding 430 mm of thermal insulation to the gables</td>
</tr>
<tr>
<td>Roof</td>
<td>0.22</td>
<td>0.13 W/m²K</td>
<td>Adding 400 mm of thermal insulation to the roof</td>
</tr>
<tr>
<td>Base plate</td>
<td>0.38</td>
<td>0.16 W/m²K</td>
<td>Adding 60 mm of EPS</td>
</tr>
<tr>
<td>Windows, average</td>
<td>2.00</td>
<td>0.85 W/m²K</td>
<td>Triple pane</td>
</tr>
<tr>
<td>Doors</td>
<td>2.7</td>
<td>0.75 W/m²K</td>
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</tbody>
</table>
Achieved Energy Savings

Energy consumption before and after, BBR2012 is building code requirement for new construction

- Before
- BBR2012
- After

- Total energy
- Heating
- Hot water
- Facility electricity
- Fan electricity

Nice looking buildings with new balconies

During reconstruction the building was covered by a tent.
Overall improvements, experiences and lessons learned

Energy
Annual savings 100 kWh/m².

Indoor climate
• Improved thermal comfort
• Improved indoor air quality

Economics
The client divided the costs in three parts;
1) Energy saving measures,
2) Improved standard of the apartments paid for by the tenants (5 m² larger living rooms, renovated bathrooms etc.)
3) The maintenance cost for the buildings, in any case needed.
The energy saving investment paid back in 10 years.

Non-energy benefits
• New balconies
• Larger living rooms
• Better indoor climate

Main conclusions
Passive house technology for renovation requires that all competence work together from the start.
It is possible to renovate a million programs’ home to a very low energy use using traditional materials and common contractors.
It is an advantage to use standard material in standard sizes.
Purchaser group apartment buildings

Technical procurements
• Heat recovery on ventilation
• Rational additional thermal insulation
• Heat recovery on sewage water

Demonstration projects
• Reliable renovation: six apartment building – cost efficient halving of energy use
• Halve-more: 35 pilot studies for energy efficient renovation of apartment buildings.

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Conclusions

• Combine necessary renovation with energy efficiency measures
• Combine energy efficiency measures
• The products and concepts are there

Advantages:
• Improved thermal comfort
• Improved indoor air quality
• Increased property value?
• Reduced energy costs

Potential problems:
• Financing of investments?
• Increased rents?
• Evacuation of occupants?

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