Koniklecová 4, Brno-Nový Lískovec

Project summary

Energy concept: Renovation to low-energy / passive house standard

Background for the renovation – reasons:

Intention for the renovation:

- Overall modernization of the aging building
- Improvement of inner conditions
- Significant reduction of energy consumption

Site: Koniklecová 467/4, 634 00 Brno-Nový Lískovec, Czech Republic

Altitude: 325 m

Heating degree days: 3712 Kd (base temp. 13°C)

Cooling degree days: 0 Kd

Owner: Statutory City Brno

Architect: MENHIR projekt, s. r. o.

Contact Person: Martina Kašparová (Borough Office Brno-NovýLískovec)

Important dates:

Start of the renovation: 10/2009
End of the renovation: 08/2010
Date completed: October 20th 2014

Building description / typology:

- Block-of-flats
- Built: 1983
- Capacity: 60 flats (47.21 to 75.17 m²)
- Net heated floor area: 5412 m²

Street (western) view of the Koniklecová 4 block-of-flats before (left) and after (right) renovation. [1]
Building envelope, heating, ventilation, cooling and lighting systems before the energy renovation

Description of building (building situation, building system, renovation needs and renovation options).

Described block-of-flats was built during the 80s', using B 70 R/K structural system.

The building has 12 floors and a basement. There are 60 flats in the building (5 flats/floor). Total net heated area of building is 5412 m². The building is owned by municipality and serves as a housing for socially disadvantaged.

Building envelope

External walls are made of reinforced concrete panels (200 and 270 mm) with in-built EPS thermal insulation (approx. 60 mm).

The building has flat cold roof (with ventilated air cavity). The superstructure of the roof is made of reinforced concrete panels. It was originally thermally insulated using 120 mm of mineral wool. The roof was covered by bituminous sheets with mineral granules. The attic wall was covered by Ti-Zn flashing.

Doors and windows in the building were wooden, steel or plastic (result of previous renovations and maintenance), using single or double glazing.

The most heat was lost through the building envelope due to low thermal resistance (U-values) of the structures and problems with air tightness - especially in and around window and door openings, where the sealing (even though repeatedly replaced) was in bad condition.

Heating, ventilation, cooling and lighting systems before retrofit

Heat energy for heating and DHW systems are supplied by district heating from a nearby (gas burning) heating plant to central (water-water) heat exchanger.

No cooling is installed in the building.

The building is mostly naturally ventilated. Small ventilators are installed only in kitchens, toilets and bathrooms of individual flats to suck off odours and vapours into central ventilation shafts. These ventilation shafts are running through the whole height of the building. Exhaust air outlets are located on the roof.

Manually operated bulbs and fluorescent tubes (with timers in common areas) were used for lighting.

<table>
<thead>
<tr>
<th>Element</th>
<th>Area m²</th>
<th>U-Value before renovation W/m²K</th>
<th>U-Value after renovation W/m²K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Façade</td>
<td>3048</td>
<td>0.78 – 0.80</td>
<td>0.17 – 0.24</td>
</tr>
<tr>
<td>Ceiling</td>
<td>407</td>
<td>1.13</td>
<td>0.33</td>
</tr>
<tr>
<td>Windows, doors</td>
<td>881</td>
<td>1.20 – 5.65</td>
<td>1.05 – 1.70</td>
</tr>
<tr>
<td>Roof</td>
<td>441</td>
<td>0.50</td>
<td>0.15</td>
</tr>
</tbody>
</table>

Ground plan of the A block's 2nd floor – classrooms.
Energy renovation features

Energy saving concept

Similarly to the other Czech shining example, Elementary School Kamínky 5, main goal of this renovation was to improve the energy performance of the building:

• The building’s envelope was to be renovated according to low–energy and passive house standards

• Renovation of heating and DHW to reduce the energy loses of their respective distribution systems. Renovation of ventilation systems in individual flats to improve its efficiency and reduce noise.

• Replacement of lighting in common areas of the building using energy-saving components

Building

• All wooden and metal doors and windows in the building’s envelope were replaced. New doors and windows have aluminum or plastic frames with triple glazing.

• Additional thermal insulation (ETICS) made of expanded (EPS) or extruded (XPS) polystyrene or mineral wool was installed on the external walls, ceiling of the ground floor and roof.

• The concept of the roof was changed by the renovation from a cold roof (with ventilated air cavity) to a warm roof (air cavity not ventilated) – all the ventilation openings were sealed. This simplified the energy concept and reduced heat losses through the roof. New bituminous waterproofing was installed on the roof.

• Open balconies were converted to closed loggias with sliding windows. This reduced the heat losses through the balcony doors and windows and improved year-long use of the space.

Systems

Heating: Energy for heating and DHW is supplied by two horizontal counter-flow heat exchangers in a boiler room on the ground floor of the building. The heating system has two main sections (East and West) representing east- and west-oriented flats. Both sections have equithermal regulation. There are gilled radiators installed in the whole building. All the radiators have thermostatic heads (since 2002). During the renovation the measuring and regulation equipment was replaced. Electronic sensors of exterior temperature were installed. Old circulation pumps were replaced by new ones with electronic regulation. Old damaged valves and heads were replaced.

Ventilation: Original ventilation equipment was both morally and technically outdated, damaged and partially inoperable. It was decided to leave original ducts in central shafts in place. Only the noise silencers and outlets on the roof were replaced. Individual ventilators (kitchens, bathrooms, toilets) as well as the ducts connecting them with the central ducts were replaced. They are operated manually (with timers) by the users.

Designs for installation of a modern HVAC system is currently being prepared and borough office will submit a government subsidy application to finance this system. After installation of this system the building will reach passive house standard.
Achieved Energy Savings, CO₂ reductions and Life Cycle Costs

<table>
<thead>
<tr>
<th>Before renovation</th>
<th>Energy consumption</th>
<th>After renovation</th>
<th>Energy consumption</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating:</td>
<td>350.03 MJ/m²a</td>
<td>Heating:</td>
<td>89.62 MJ/m²a</td>
<td>74.40 %</td>
</tr>
<tr>
<td>DHW:</td>
<td>116.47 MJ/m²a</td>
<td>DHW:</td>
<td>92.94 MJ/m²a</td>
<td>20.20 %</td>
</tr>
<tr>
<td>Total:</td>
<td>466.50 MJ/m²a</td>
<td>Total:</td>
<td>182.56 MJ/m²a</td>
<td>60.87 %</td>
</tr>
</tbody>
</table>

**Energy savings**

Improvements in thermal properties and air tightness of the building's envelope and renovation (including re-regulation) of the heating system reduces the heating energy consumption by almost ¾. Thanks to this the renovated building easily meets Czech low-energy standards (82.62 MJ/m²a < 180 MJ/m²a).

Renovation of DHW system brought above 20 % savings of energy required for DHW production and distribution.

| Calculated CO₂ production before renovation | 77.9 kg CO₂Eq./m²a |
| Calculated CO₂ production after renovation | 49.3 kg CO₂Eq./m²a |
| Reduction:                                  | 36.7 %             |

**CO₂ reduction**

The renovation reduced the CO2 production of the building by approximately ¾. The largest savings were achieved by reducing the heating energy consumption. Before renovation heating of the building produced 35.0 kg CO₂Eq./m²a, while after renovation this was reduced to only 11.6 kg CO₂Eq./m²a (66.8 % reduction).

Note: All the data about energy and CO₂ reductions on this page are related to the net floor area.

**Renovation costs**

| Total | 21.0 Million CZK |
Overall improvements

Energy benefits
Energy savings: 81.06 kWh/m²a
(heating, DHW, ventilation, lighting)

Indoor climate technical improvements
The indoor climate was improved due to:
• Reduction of heat losses and draught through the buildings' envelope.
• Renovation and re-regulation of the heating, DHW and lighting systems
According to survey among the tenants, the renovation significantly reduced overall energy consumption of the building which lead to lower the operating costs. Also the indoor climate has improved. Installation of thermal insulation and new airtight windows and doors improved the thermal comfort and stability in the individual flats – e.g. there are no more drafts around the windows, which had a negative influence on the indoor climate, especially in winter.

Non-energy benefits
The overall renovation of the building also improved:
• User comfort of the tenants. New equipment, windows, doors, etc. are easier to use and maintain than original ones.
• Aesthetic perception of the building and its surroundings has improved after the renovation. The renovation of the building was related to other works - renovation of surrounding pavements, playgrounds, etc. – which also had positive impact on the living conditions.
Summary

Koniklecová 4 block-of-flats was renovated. The building envelope (walls, roofs, ceilings and floors) was insulated using EPS, XPS and mineral wool. Doors and windows in the building’s envelope were replaced by new ones. New waterproofing was installed on the roof. Heating, DHW, ventilation and lighting systems were partially replaced and modern measuring and regulation equipment was installed. Above mentioned measures decreased heating and DHW energy consumption by 60.9 % - tenants survey confirmed that there are significant savings in energy consumption since the renovation. The renovation also had positive impact on the aesthetic perception of the building and its surroundings.

Acknowledgments

Special thanks belong to:

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- MENHIR projekt s. r. o. for sharing the necessary data about the renovation
- Grant No. 2112 of Brno University of Technology for support

References

[1] MENHIR project s. r. o.