



**Ljubljana
(Slovenia)**

63% energy saving

Total living expenses lower than before renovation

Innovative technologies: passive house standard building envelope

Project data

Location, address:	Hermana Potočnika 17
Region:	Ljubljana
Surroundings:	Central of the country
Climate:	Sub Alpin
Heating degree days:	3300
Year of construction and renovation:	1975 (constructed); 2004 (renovated)
Typology:	Apartment building
No of dwellings:	57 non- profit tenancy apartments
Total floor area:	5105 m
Owner:	Housing Fund of Ljubljana
Architect and Builder:	University of Ljubljana, Faculty of Civil Engineering and geodesy
Costs of energy saving measures:	€ 220.000 (incremental investment to passive house standard envelope)
Renovation financed by:	Housing Fund Ljubljana



Objectives and Results

Thorough renovations of the building envelope and of the heating system were carried out to improve thermal characteristics of the building and to reduce the energy consumption by 63%. The project and the monitoring of energy consumption after the renovation have shown that it is possible to combine several innovative energy saving technologies in one integrated concept.

Figure 1: Apartment building Hermana Potočnika 17 after renovation

Renovation concept

Key renovation features

- Insulation of facades
- insulation of roof
- Insulation of ground floor
- New balconies without thermal bridges
- Solar protection roller blinds + night insulation
- High efficiency insulation glazing and frames

State-of-the-art	
Before renovation	After renovation
<p><i>Constructions [U-values: W/m²K]</i></p> <ul style="list-style-type: none"> • Non-insulated facade [1,2] • Non-insulated roof [1,0] 	<p><i>Constructions [U-values: W/m²K]</i></p> <ul style="list-style-type: none"> • Insulation of facade [0,16] • Insulation of roof [0,19]
<ul style="list-style-type: none"> • Non-insulated ground floor [0,9] 	<ul style="list-style-type: none"> • Insulation of ground floor [0,36]
<ul style="list-style-type: none"> • Windows (double glazing, wooden frame) [2,3] ¹ 	<ul style="list-style-type: none"> • Replaced windows (low-e + argon glazing) [1,4] • Solar protection: roller blinds • Night insulation: thermally insulated roller blinds
<p><i>Installations</i></p>	<p><i>Installations (in progress):</i></p> <ul style="list-style-type: none"> • Management and control system: BMS, heating system management and control • Comfort control and information system: consumption, impacts and comfort



Figure 2: Apartment building Hermana Potočnika 17 before renovation (Source: Bioklimatske stavbe 2005)

Energy saving and monitoring

Energy consumption before renovation:
KWh/m²: 252

Energy consumption after renovation:
KWh/m²: 92
Percentage savings²: 63%

Additional information

- The main reasons for the renovation were an insufficient maintenance state, bad quality window frames, further intention of the housing association to implement energy saving measures and to improve the aesthetical view of façades, as well as a change in use from dormitory for workers to social housing..
- The building used to be a workers' hostel until 90-ties.

Lessons learned and conclusions

- EC demonstration project enabled the design and execution of the passive standard building envelope in social housing sector,
- more ambitious measures like monitoring system and management & control systems (BMS, heating management and control, comfort control and information system) were unfortunately not implemented, due to financial reasons and long procedures of public procurement;
- A controlled ventilation with heat recovery is one of the first future measures to be implemented.

References

- [1] Energy efficient refurbishment design, Project N°NNE5-2001-00871, Large High Rise Reconversion Housing, Project N°NNE6- Housing Found of Ljubljana Municipalities
 [2] University of Ljubljana, Faculty of Civil Engineering and geodesy, Project manager: Dr. Ales Krainer)
 [3] Housing Found of Ljubljana; Technical responsible person: Mrs. Jožka Hegler, Mrs. Tonka Grgic

¹ Total U-value of glazing and the window frame
² Compared to the situation before renovation