



**Ljubljana
(Slovenia)**

34% energy saving

Total living expenses lower than before renovation

Nearly all users have chosen for energy saving measures

Project data

Location, address:	Tugomerjeva 4,6
Region:	Ljubljana
Surroundings:	Central Slovenia
Climate:	Sub-Alpine
Heating degree days:	3300
Year of construction and renovation:	1962 (constructed); 2005 (renovated)
Typology:	Apartment building
No of dwellings:	40 dwellings
Total floor area:	1882 m ²
Owner:	Various private owners
Architect and Builder:	Facade: Toplak d.o.o., Ptuj; Windows: Interalta d.o.o.
Costs of energy saving measures:	€ 167.000
Renovation financed by:	The owner; state subsidy



Objectives and Results

A detailed refurbishment of the building envelope as well as the measures on the heating system and energy consumption metering were carried out to improve thermal characteristics of the building and to reduce the energy consumption by 34%.

Figure 1: Apartment building Tugomerjeva 4, 6 after renovation

Renovation concept

Key renovation features

- Insulation of facades
- High energy efficiency windows
- Heat consumption meters
- Thermal insulation of pipes

State-of-the-art

Before renovation

Constructions [U-values: W/m^2K]

- Non-insulated facades [1,3]
- Windows (double glazing) [2,7]¹

Installations:

After renovation

Constructions [U-values: W/m^2K]

- Insulation of façade [0,35]
- Installation of energy efficient windows with low emissivity double glazing (with six chambers PVC window frames, where $U_{\text{glazing}} = 1,1$)

Installations:

- Heating system unit with a heat meter was installed in the basement; district heating
- All horizontal distribution pipes of the central heating system in the basement were thermally insulated.

Energy saving and monitoring

Energy consumption before renovation:
KWh/m²: 151

Energy consumption after renovation:
KWh/m²: 100
Percentage saving²: 34 %



Figure 2: High energy efficiency window



Figure 3: Apartment building Tugomerjeva 4, 6 before renovation

Additional information

- The main reasons for the renovation were an insufficient maintenance state, bad quality window frames and further intention of the housing association to implement energy saving measures and to improve the aesthetical view of façades.
- The building was designed and built in the period when there was no regulation on thermal insulation and energy efficiency in buildings. The building is a representative of a few concrete panel buildings, that are not very common in Slovenia. The existing envelope structure consists of prefabricated concrete plates (total thickness 16 cm) with a core of concrete mixed with wooden chips ("betocel") in thickness of 8 cm as a thermal insulation. That resulted in U value of approx. 1,3 [W/m^2K] for outer wall.

Lessons learned and conclusions

- The project would not have succeeded without co-operation and of course without financial contribution of the occupants and state subsidy. The benefit for the occupants is manifested through lower heating costs and higher level of thermal comfort. To integrate these solutions, also bringing better appealing architecture.

References

[1] Building management: Finance Operativa d.o.o.; contact person: Miloš Šulin.

¹ Total U-value of glazing and the window frame

² Compared to the situation before renovation