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**Autor:** Šijanec Zavrl, Marjana / Malovrh, Matjaz / Zupan, Matjaz

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## Energy Audits of Schools in the Town of Kamnik

**Marjana ŠIJANEC ZAVRL**  
Head of Environment Division  
Civil Engineering Institute ZRMK  
Ljubljana, Slovenia

Marjana Šijanec Zavrl, born 1961, received her civil engineering degree from the University of Ljubljana in 1984 and Ph.D. in thermal response of buildings in 1993.

**Matjaz MALOVRH**  
Head of Energy in Buildings Division  
Civil Engineering Institute ZRMK  
Ljubljana, Slovenia

Matjaz Malovrh, born 1946, received his mechanical engineering degree from the University of Ljubljana in 1972.

**Matjaz ZUPAN**  
Energy in Buildings Division  
Civil Engineering Institute ZRMK  
Ljubljana, Slovenia

Matjaz Zupan, born 1954, received his technical physics degree from the University of Ljubljana in 1982 and M.Sc. degree in mechanical engineering in 1996.

### Summary

In order to lower energy consumption and the costs for energy used for heating, lighting and hot water supply in primary schools in the municipality Kamnik an energy audit has been carried out. The energy consumption and current state of building envelope and heating system have been established for each of 17 schools in the municipality. A list of energy saving measures has been determined regarding cost efficiency and energy saving potential in order to give the investor a professional basis to plan necessary investments in energy restoration and building maintenance. As a result of this audit an integrated energy conservation plan was then prepared and implemented in 1996. The first year of energy consumption monitoring shows approx. 265 MWh (39 %) reduction.

### 1. Introduction

An important part of expenses for the operation and maintenance of buildings are expenses for energy used for suitable living and working conditions. Expenses for the maintenance of public buildings are in the large scale charging the local communities and the state budget. The expense for energy is one of the largest that can be supervised and lowered by implementation of the energy efficiency measures. The biggest number of buildings, which operation is based on the municipal budget are the primary schools. Systematic financing of the energy restoration of existing buildings offers possibility to decrease energy consumption and expenses and, with the means saved, to create a fund for investing into more intensive actions of the energetic refurbishment or into modernisation of the activity.

Municipality Kamnik is located 20 km north from Ljubljana, capital of Slovenia at the base of Alps. The heating degree day number for town Kamnik is approx. 3500 degree days, with the average temperature in winter around 0 °C and lowest temperatures in winter down to -25 °C. The Kamnik municipality methodically decided to arrange the energy politics when starting the energy plan of the town Kamnik.

### 2. Energy Audit of Fran Albreht Primary School

Fran Albreht school building is one of the 17 audited schools in municipality. It is an early 1960's "H" shaped four storey structure, with total heated floor area of 3280 m<sup>2</sup> (11,000 m<sup>3</sup> heated volume). It has a concrete roof and wood-framed double glazed windows. Space heating and hot water services were provided by two light-oil fired boilers. The average fuel consumption in the heating season for the Fran Albreht Primary School (1991 - 1995) is 66.000 l, average annual consumption of electrical energy is 53.400 kWh. Specific energy use for the school is 194 kWh/m<sup>2</sup>a.

As a result of this audit an integrated municipal energy conservation plan, aimed at reducing the energy consumption by reducing heat loss through the roof and windows, and to improve comfort conditions by improving the heating control, was then prepared.

### 3. Measures Implemented

A detailed energy audit recommended a series of measures and the final package included the following measures:

- loft insulation
- replacing the remaining original windows with new plastic framed windows with argon filled Low-E double glazing,
- connection to district heating with sub-station,
- Building Energy Management System (BEMS) with heating zone control and weather compensator,
- thermostatic radiator valves (TRVs) and hydraulic regulation,
- variable speed drive pumps

*Table 2. Breakdown of estimated savings at Fran Albreht elementary school*

Measure	Energy Savings (MWh/year)	Pay back Period (years)
Loft Insulation	122	2.9
Low-E Double Glazing <sup>(1)</sup>	53	2.3
Connection to DH <sup>(2)</sup>	24 (est. 5%)	4.0
Building Management System (BEMS)	48 (est. 10%)	4.9
Thermostatic Radiator valves (TRVs)	48 (est. 10%)	14.2
<b>All Measures</b>	<b>295</b>	<b>4.6</b>

(1) The difference between Low-E double glazing and normal double glazing - the air exchange rate was also improved, but these savings are small and are not included here  
(2) The difference between new boilers and connection to the local district heating (including heat sub-station and the main pumps)

### 4. Results

Achieved energy savings were found. Measured energy consumption in the heating season 1996/1997 was 410 MWh. Compared to average light oil fuel consumption of 66.000 l oil (660 MWh) it presents reduction of 250 MWh or 38% in energy use. Taking into account also heating degree day number - average for 1991 - 1995 was 3490 degree days and for the season 1996/97 it was 3571 degree days, the consumption should be 67.500 l, so the savings are 265 MWh or 39 %.

### 5. Conclusions

Measurements of energy consumption during one heating season after the implementation of the measures show 39% reduced energy use. The results achieved matched the investors expectations.

### 6. Acknowledgements

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