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CZECH-AUSTRIAN ENERGY PARTNERSHIP: STRATEGIES FOR THE ECOLOGICAL REHABILITATION OF PANEL BUILDINGS

AUTHOR: ADIL LARI, ARCHITECT MSC PHD
GENERAL MANAGER, LARI & ASSOCIATES
WAEHRINGER STR. 115, A-1180 VIENNA – AUSTRIA
TEL. +43.1.4089405, FAX +43.1.4025877
OFFICE@LARI.AT, WWW.LARI.AT

STUDY CO-AUTHORS: PROF. GEORG REINBERG, ARCHITECT MMSC
MARTIN TREBERSPURG, ARCHITECT MSC PHD

CONTRIBUTORS: PROF. WOLFGANG STREICHER, MSC PHD
ALEXANDER MANDIC, ARCHITECT MSC

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Background

Panel buildings, and strategies for their energy-efficient and environment-friendly rehabilitation, were among the issues at the center of discussions at an expert conference of the Czech-Austrian Energy Partnership on "Energy and Architecture" in Brno from 14 to 16 October 1999. The ecological rehabilitation of panel buildings in Central and Eastern Europe can lower their heating energy needs from currently 250-350 kWh/m²a by as much as 90%, to around 25-35 kWh/m²a. This would not only reduce pollutant emissions, but also improve the respective country's balance of payments. Refurbishment projects also offer a considerable market potential for Austrian (and other) products and specialists.

Serial rehabilitation programmes are facilitated by the high degree of standardization in prefabricated housing. Retrofitting strategies can also be adapted with relative ease for application in the entire CEEC region, including Southeast Europe. Before large-scale rehabilitation campaigns are carried out, however, prototype rehabilitation projects are needed to furnish practical experience on technological, economic and social aspects, and to review refurbishment startegies for their ecological and economic efficiency.

Project Goal

Within the framework of the Czech-Austrian Energy Partnership, and in cooperation with the Austrian Energy Agency E.V.A., the present study establishes the foundation for strategies aimed at the ecological, energy-efficient rehabilitation of three typical panel buildings in Brno – Nový Lískovec. The option of additional floors, to serve as an economic incentive for refurbishment, was also reviewed. The study was supported by the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management.

The principal idea of the study consisted in creating a flexible model for rehabilitation which can be serially applied to various types of prefabricated housing. The study serves to clarify the technological, economic and financial conditions for rehabilitation of the three buildings to achieve low-energy-housing levels, with regard to the following aspects:

- insulation of the building shell,
- roof insulation,
- rehabilitation of balconies – loggias / winter gardens,
- central heating regulation, if needed complete overhaul of heating,
- radiator regulation,
- repair or replacement of windows,
- natural lighting for the stairwells,
- greenery / landscaping,
- improved lighting for the surrounding grounds, and
- information for the residents.

Description of the Status Quo

The district of Nový Lískovec is situated on a hill west of the Brno city center. The three buildings in question are purely residential buildings; they are five- to nine-floor panel buildings of the KS-T06B-KDU type, built approx. 17 years ago. The building substance of all three buildings is partly in need of repair. The windows are equipped with single glazing; they are not air-tight, and insufficiently insulated. The heating systems are not optimally functional; thermostats or, in some cases, any regulation mechanisms for the radiators are lacking. The heating pipes are not sufficiently insulated. Heating energy needs are estimated at around 240 kWh/m²a. Structural and thermal expertises were provided by Czech colleagues, and taken into account in the rehabilitation strategies proposed in the study.

Strategies for Building 1

The first building in question is rectangular, with the slightly narrower sides facing south and north, and the broader sides facing east and west. It has eight floors of apartments, and a partly subterranean basement containing storage space, electro-mechanical facilities and common rooms. A central stairwell leads to four apartments per floor.

The proposed rehabilitation strategy focuses on measures to improve the interior lauyout and the electro-mechanical facilities of the building. Besides basic thermal refurbishment and the improvement of the ground plan by means of minor building additions, the southern facade is equipped with passive solar energy collectors for water heating purposes, collectors to provide indirect solar warmth to the adjacent apartments (via a honeycomb paper facade – transparent insulation), and a solar air heating system (Solar Wall) to provide warm air (in support of the air supply system). The additional floors are intended to serve communal uses (sauna, common room, sun-roof), making rehabilitation more palatable to the tenants. Prefabricated bathroom units allow for refurbishment in a single day.

Strategies for Building 2

The second building under review has a southwest-northeast orientation. It is divided into three stairwells and has four residential floors. The basement contains storage rooms.

The aim of the proposed rehabilitation strategy is to provide the necessary infrastructure for ecological improvement of the building by means of a southward reorientation, without causing any inconvenience to the tenants. To this end, a greenery-covered projection is designed for the southern facade. This "green wall" offers residents the opportunity to individually extend their apartments in the shape of winter gardens at a time of their chosing. This individualized approach enables retroffiting without detracting from the overall impression of the building, or inconveniencing the tenants. The option of apartment extension in the shape of a winter garden creates an incentive to situate living rooms towards the southern facade in the interest of energy-efficiency, while the northern parts of the apartments are reserved for bedrooms.

The additional floors are designed to contain apartments, two each accessed by a stairwell, with the bedrooms facing north. The living rooms face exclusively to the south and are equipped with winter gardens and terraces, which combine with shading elements to add a playful feature to the facade.

The additional floors and the facade projection are designed as wood constructions. The load-bearing structure for the winter gardens is made of steel. Shades and terraces in wood increase living comfort. A system of prefabricated wooden boards makes retrofitting and the construction of the additional floors rapid and efficient. The low weight of the materials used keeps demands on the structural strength of the existing building substance to a minimum.

Strategies for Building 3

The third building considered in the study has a southeast-northwest orientation. It is divided into five stairwells and has four floors of apartments. The basement contains storage rooms.

The proposed rehabilitation strategy emphasizes the improvement of the floor plans and the interior layout of the apartments. The second element of this strategy is a general enhancement of living comfort by adding a glass facade to the southeast. By means of passive solar energy and thermal refurbishment, the building's energy needs are to be lowered to one tenth of their current level. To this end, the existing southeastern facade ist to be dismantled, the entire building structure extended by approx. 2.2 m to the south towards the parking lot, and an insulated aluminium-glass-facade mounted.

General Strategies

Additional measures to improve energy-efficiency, proposed for all three buildings, include:

- insulation of the building shell, consisting of 20 cm polystyrene (walls) und 30 cm polystyrene (roof);
- new, airtight windows;
- fixed and mobile shading elements to to utilize solar gains and avoid overheating;
- controlled ventilation with heat recovery from exhaust air;
- additional heating for individual apartments in supply air (long-distance heat supply, elimination of radiators);
- air supply via perforated plate collectors (passive solar energy, night cooling in summer);
- water heating collectors adjusted for summer and winter operation;
- ground collectors (additional air supply channel through ground and building, as frost prevention for heat exchanger);
- overhaul and optimization of the existing electro-mechanical facilities (radiators, thermostats, etc.);
- additional insulation for the basement.
- Human resources: The residents themselves are an important factor in reducing energy needs. A "user manual" to explain the applied energy-efficiency measures and the optimum utilization of the building helps to prevent disadvantageous behavior which can raise energy needs by as much as 300%. An Internet-based information system showing the energy used by their apartments can provide tenants with the opportunity to optimize their heating, ventilation, and sun-shading habits.

Variations of Application

Depending on the means available, the three strategies proposed can be applied in combination so as to create optimum conditions for lowering heating energy needs.

To review the energy-efficiency effect of the proposed rehabilitation measures, an energy balance was drawn up for Building 1 by a team at the University of Technology in Graz / Austria, Institute of Thermal Engineering, headed by Prof. Wolfgang Streicher, MSc PhD. The results of the simulation show that the proposed measures can lower heating energy needs to as little as 23 kWh/m²a.

Further Steps

The study was presented to an expert audience in Brno on 24 July 2001, and to the responsible local authorities on 17 September 2001. As a consequence, a basic decision was taken by the authorities to implement the proposed strategies as concrete rehabilitation projects.