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ENERGY EFFICIENT RECONSTRUCTION OF BETHANY SHELTER CENTER BUILDING IN MALACKY, SLOVAKIA

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Problem statement. According to the European directive of energy efficiency of buildings [1] all new buildings from December 31, 2020 must meet the standard of a building with zero energy consumption or be "positive", all existing buildings must be thermally modernized to meet modern requirements.

Scientists and students of SHEE PSACEA took part in cross-training of the design of buildings and structures on the principles of sustainable development in the framework of the International Project InStep Project "International Sustainable Engineering Practices", which was supported by the Visegrad Foundation. One of the tasks to be solved was to increase the comfort of staying in the Shelter Center for women with children in Malacky (Slovakia).

Centers of social help for families and children are social service institutions directed to provide social, household, medical, psychological or legal assistance to families, children and individuals. The building of Shelter-Center is quite old and does not meet modern requirements in the field of energy efficiency, in the center there is no in-patient station for the provision of qualified medical care, there is no program for the rehabilitation of the shelter residents, there are no playgrounds for children and landscaping around the center.

Purpose of the study. To propose measures for improving the energy efficiency of the building and to improve the quality of the internal environment of a social institution for women with children in Malacky (Slovakia). The paper proposes a number of measures aimed to the energy efficiency of the building by insulating the external enclosing structures and reducing the energy consumption of the building. The next step was the design of a greenhouse combined with the building of the Center, which will partially solve the issue of psychological rehabilitation and leisure for residents of the center by growing, caring for and contemplating various plants [2].

Main results. To analyze the state of the building, a visual inspection of the building of the Shelter Center was performed. The building of the Center is one-storey with dimensions in terms of 42.38 × 12.53 m, height 4.85 m, attached to the end of a multi-storey residential building. The composition of external walls is profiled sheet + brick + interior plaster, total width is 330 mm, total area is 469,3 m^2, the heat transmission coefficient is U = 1,78 W/m^2K, significantly exceeds the standard value. 90 % of windows are plastic and have a two-chamber profile, but have a high coefficient of thermal conductivity. The rest (10 %) are old windows with aluminum profiles. The total area of windows and doors is 62,08 m^2, U = 2.0 W/m^2K. Roof construction of building is presented of flat roll roofing, the total area is 494,4 m^2, U = 0,6 W/m^2K. The heat transmission coefficient of floors is U = 0,27 W/m^2K.

Heat losses were calculated through the building envelopes every month during the heating period after the methodology [2]. The climatic condition data and calculated temperatures were taken according to [3].

The results of calculation show that the greatest heat losses occur through external walls – 60 %.

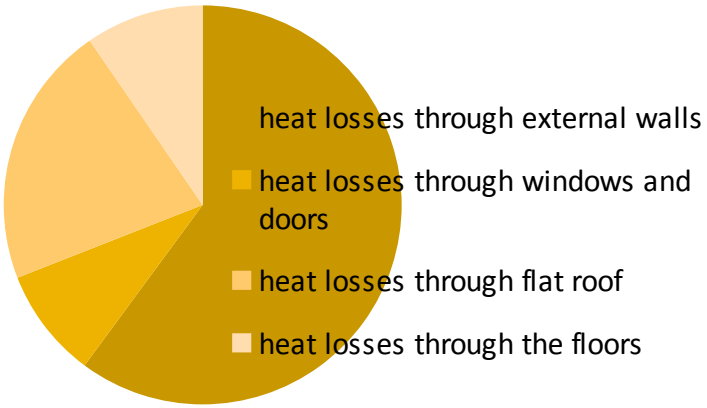

Fig. 1. Heat losses through Center's building envelope during the heating period, kWh, %

To reduce heat loss through the building envelope we proposed to do measures for the thermal insulation protection of the external building envelope and to attach the greenhouse on the southern and eastern side of the building [4].

Fig. 2. Greenhouse attached to the Center's building from the southern and easten side

The part of the enclosing structures of the Center building, which do not contact with the greenhouse, is proposed to be insulated with the use of ventilated systems, where basalt wool slabs are used as a heat-insulating layer. It is necessary to replace window filling with modern energy-efficient structures for reducing heat losses through translucent openings. For the construction of greenhouses in the center of Bethany, we propose to use a frame made of light steel thin-walled structures. As a material of translucent coating in the greenhouse we use cellular polycarbonate, 16 mm thickness.

Heat losses were calculated monthly for the heating period, as well as monthly solar heat gains were calculated every month for Center's building.

According to the results of the calculations, it was found that the annual heat inputs significantly exceed the annual heat losses of the building. But at the same time, due to the climatic conditions, heat inputs are unevenly distributed throughout the year.

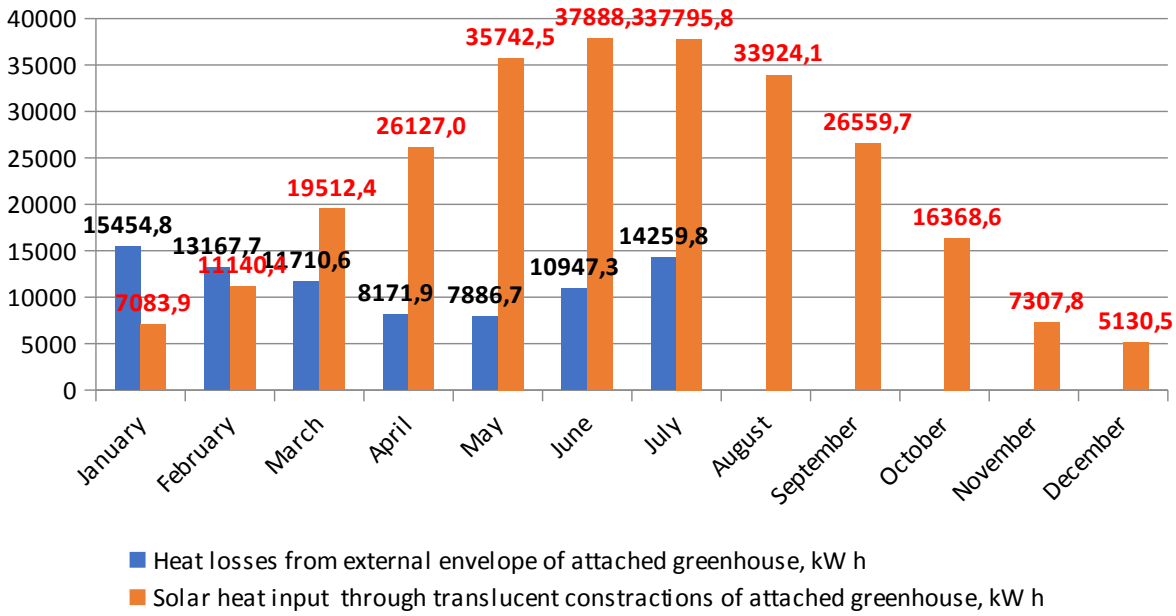

Fig. 3. Annual heat losses and heat inputs through the translucent structures of the attached greenhouse

Therefore, for the operation of the greenhouse all year around, it is necessary to provide additional sources of heating during the coldest period or means of external protection of translucent structures from overcooling (external louvers). Additional sources of heating can be proposed heat accumulators: daily allowances for the autumn-spring transitional periods, and seasonal for the coldest winter months.

Conclusion. The erecting of a greenhouse, combined with the building of the Center, has a multifunctional value for increasing the comfort and quality of stay in the Center. The design of the greenhouse can serve as an additional heating source during the cold period, and solar energy stored in the greenhouse can be used as an additional source for heating the building. Also, the greenhouse design serves as a transitional thermal zone between the exterior and interior space.

On the social and domestic side, building a greenhouse and growing plant products in it will diversify the daily diet of Bethany residents with high-quality and healthy food, save money for buying food, and possibly give additional gains from selling the overage products.

Another positive aspect of the construction of the greenhouse can be considered the organization of leisure activities of the residents of Bethany by employment in gardening, which is very important not only for adults, but especially for children from the point of view of education and becoming a personality.

References

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