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THE LOWER STRUCTURE FOR ENERGY EFFICIENT BUILDINGS

External constructions of buildings provide their protection from external influences. These constructions ought to create optimal comfort of interior environment in winter as well as in summer. It has been shown in practice that the largest number of breakdowns occurs in external constructions. The external constructions of walls, roofs and floors too present a big area of problems in design of new and reconstructed buildings respectively. Heat losses of buildings through external constructions - roof, external walls, floor on the ground - are not negligible. It is therefore important to pay more attention to these constructions.

Basementless buildings stepped directly on the ground are in direct interaction with subgrade and its thermal state. An amount of heat primarily destined for creation of thermal comfort in the interior escapes from foundational construction and floor on the ground to the cooler subgrade. The outgoing heat represents heat losses, which unfavourably affect the overall energetic effectiveness of the building. The heat losses represent approximately 15 to 20% of the overall heat losses of the building. This number is a clear antecedent of need for isolation and minimalization of heat flow from the building to the subgrade.

Keywords: **building construction, ground floor, thermal insulation, buildings on the terrain**

INTRODUCTION

With the economic development there is increased demand for energy resources and energy. Depletion of fossil fuels and negative impact on environment and combustion of fossil fuels leads to finding other sources of energy. Through burning of fossil fuels a significant amount of pollutants is released into the air, particularly CO_2 emissions, which is currently most discussed theme. In accordance with long-term strategic objectives of reducing emissions and improving energy efficiency, adoption of the Directive 2010/31/EU of 19 May 2010 on the energy performance of buildings raised commitment by 2020 to reduce overall greenhouse gas emissions by at least 20%. The Directive requires Member States to design all new buildings with nearly zero energy by 31 December 2020 [1].

1. ENERGY EFFICIENCY OF BUILDINGS

Improving energy efficiency in buildings is a major priority worldwide [2]. Sustainable building design, construction and operation require innovations in both engineering and management areas at all stages of a building's lifetime. The lifetime of buildings is composed of a series of interlocking processes, starting from initial architectural and structural design, through actual construction, and then to maintenance and control as well as to eventual demolition or renovation of buildings. Inside this lifetime, essential requirements are generated from considerations of social, environmental, and economic issues for high-efficient energy-saving building systems in accordance with building codes and regulations.

1.1. The design possibilities of a new generation of ground floor for energy efficient buildings

The correct proposal of construction details is one of the steps which will contribute to reducing energy requirements for heating and operation of the buildings which are situated on the terrain and at the same time increasing the quality of the indoor environment as well as performance at work.

We modeled totally eight cases that characterize the possible location of a mutual combination of thermal insulation during application in construction detail of ground floor to satisfying all building standards and construction requirements.

1.2. Results of 2D details modeling of new generation of the lower structure for energy efficient buildings

Distribution of temperatures and heat flows under the building and its immediate vicinity is closely linked with the correct calculation of the total heat loss in assessed buildings. Detailed analysis of construction design was to show effect on the position, mutual combination of thermal insulation, as well as the overall solution, and the correct proposal of construction details, in this case details of external wall, basement and floor which are in contact.

Boundary conditions for the calculation:
Outside air temperature calculated in the winter shall designate the location of the building, depending on the geographic location according to maps of temperature fields and, depending on altitude Košice 297 m above sea level (2. temperature region), $\theta e = -13°C$. Calculated relative humidity of ambient air is determined by the ambient temperature as calculated: $\varphi e = 84\%$. Calculation of the internal air temperature for the residential part of the building: $\theta i = 20°C$. Relative humidity of indoor air: $\varphi i = 50\%$. Surcharge for heating temperatures dipped to decrease indoor air: to 5 K.

Variant 1: Establishment with thermal insulation of basis and external wall

Establishment of this method (Figs. 1, 2) is the most used in Slovakia for ordinary houses in the energy standard. Thermal insulation of external wall continues up to the lower edge of base strip. Thermal insulation in the floor is laid on the upper surface of the base plate (slab). Thermal insulation of external walls and in the floor is separated with external construction.

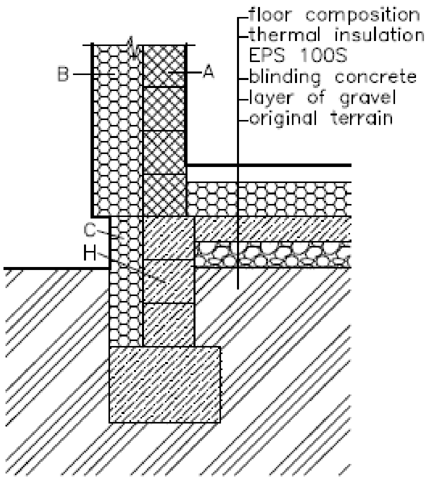

Fig. 1. Establishment with thermal insulation of basis and external wall
A - Ytong P2-400, B - expanded polystyrene EPS 70F, C - extruded polystyrene Styrodur 2800C, H - form block DT30

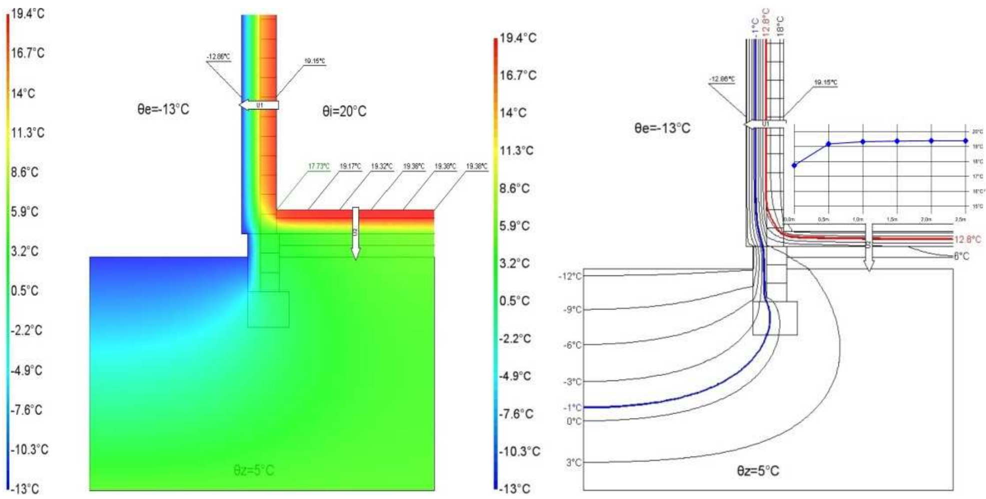

Fig. 2. Results of 2D modeling of detail and course of temperature

Variant 2: Establishment with special block, with or without plinth insulation

Thermal bridge, which forms the cladding in contact with the base plate (slab), can be interrupted by calcium-silicate blocks, respectively with block of foam glass. These methods of foundations can still be optionally combined with plinth insulation (Figs. 3, 4).

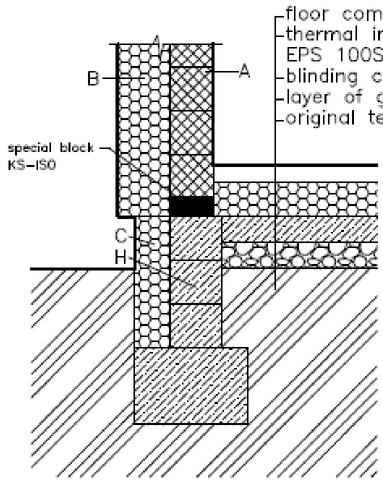

Fig. 3. Establishment with special block, with plinth insulation
A - Ytong P2-400, B - expanded polystyrene EPS 70F, C - extruded polystyrene Styrodur 2800C, H - form block DT30

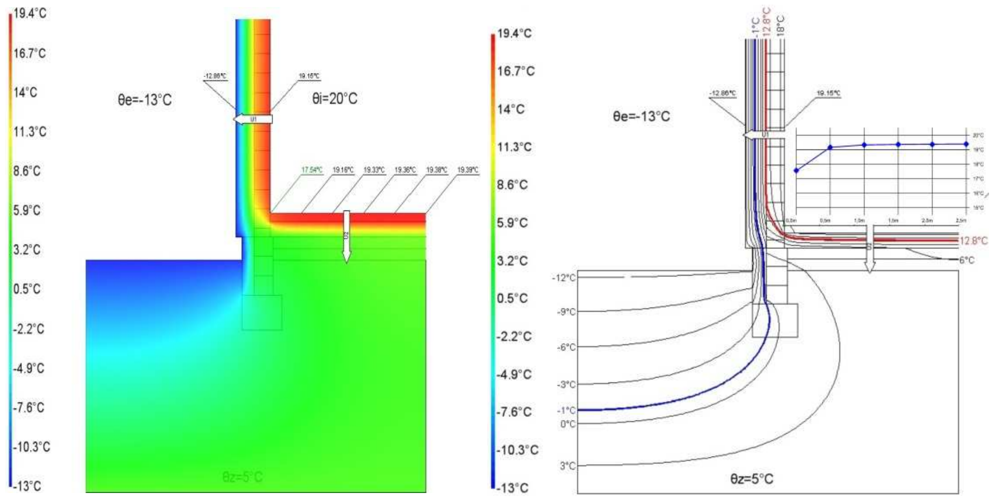

Fig. 4. Results of 2D modeling of detail and course of temperature

Variant 3: Establishment on brash of foam glass

Establishment on brash of foam glass is relatively a new solution. Brash of foam glass is poured into the tub which is lined with extruded polystyrene boards. Backfill is compacted in a ratio of 1:1.25. Thereafter reinforced concrete base plate (slab) is situated on backfill of foam glass (Figs. 5, 6).

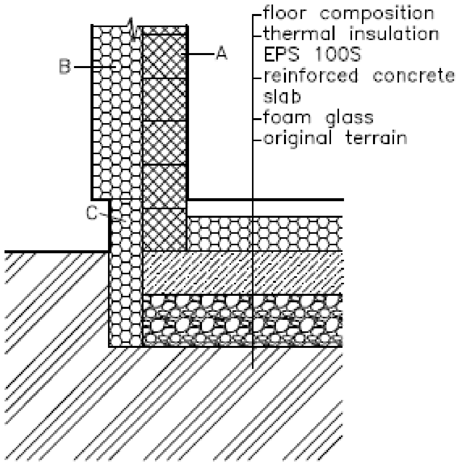

Fig. 5. Establishment on brash of foam glass
A - Ytong P2-400, B - expanded polystyrene EPS 70F,
C - extruded polystyrene Styrodur 2800C

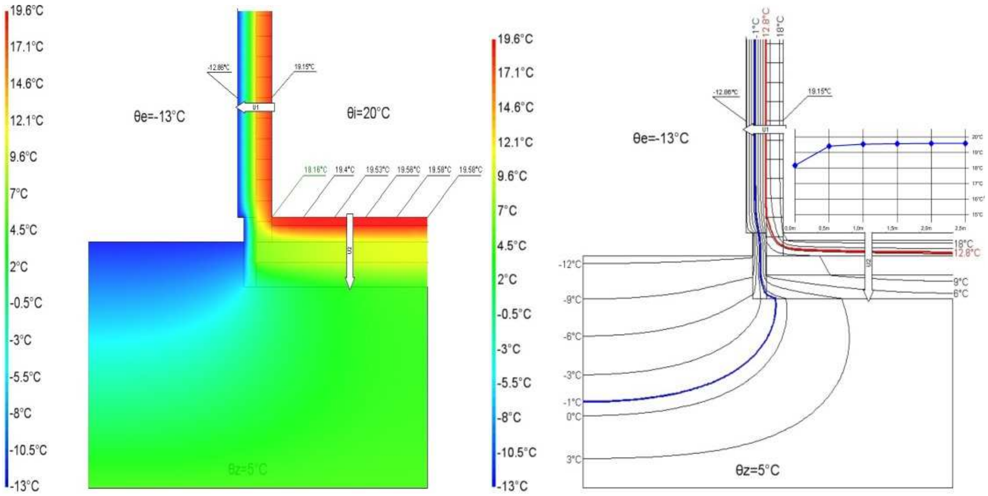

Fig. 6. Results of 2D modeling of detail and course of temperature

Variant 4: Establishment on tub of extruded polystyrene boards

Second and relatively a new way of establishment on tub of extruded polystyrene boards (Figs. 7, 8). Firstly, it is necessary to prepare a suitable substrate that can form eg. compacted embankment of gravel. On the prepared surface there are first mounted side boards of extruded polystyrene (XPS). Subsequently the individual sheets of XPS are stacked on the bottom of the tub. To the following upcoming tub is made of reinforced concrete foundation slab.

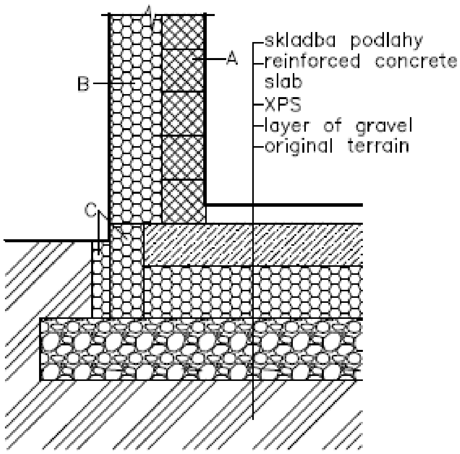

Fig. 7. Establishment on tub of extruded polystyrene boards
A - Ytong P2-400, B - expanded polystyrene EPS 70F,
C - extruded polystyrene Styrodur 2800C

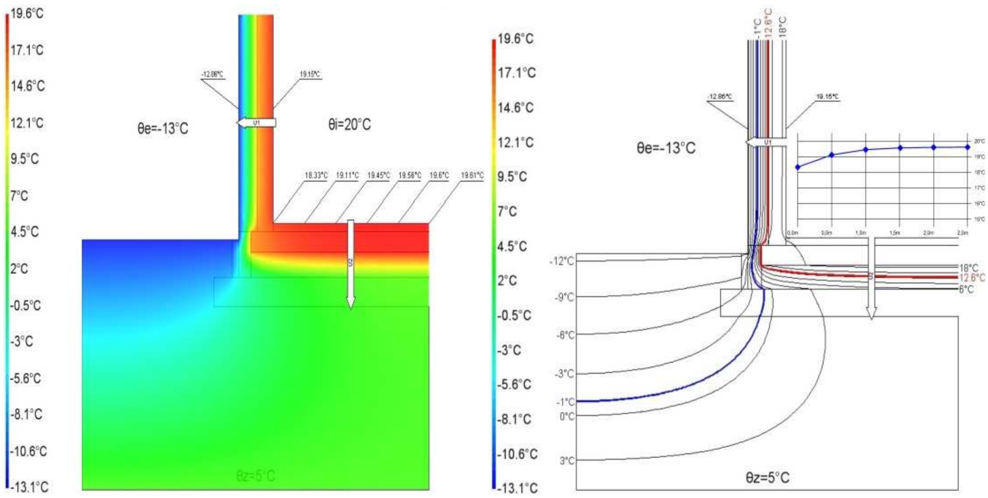

Fig. 8. Results of 2D modeling of detail and course of temperature

Variant 5: Establishment on pilots

The last, but in this time relatively popular solution is establishment on pilots (Figs. 9, 10). This type of foundation is used mainly for timber construction. On pilots there is situated a warm wooden ceiling which is separated with air gap from the terrain. Thereafter whole wooden house is on the ceiling construction.

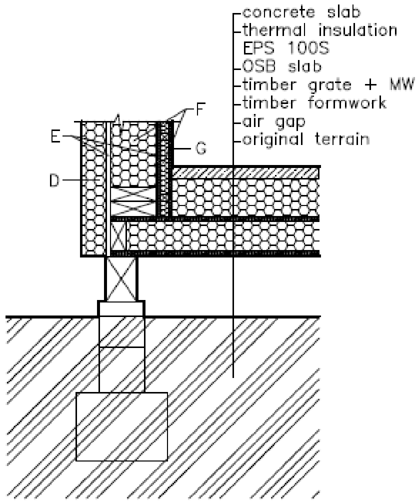

Fig. 9. Establishment on pilots
D - mineral wool Isover TF profi, E - OSB slab, F - mineral wool
Isover Unirol profi, G - gypsum plaster slab

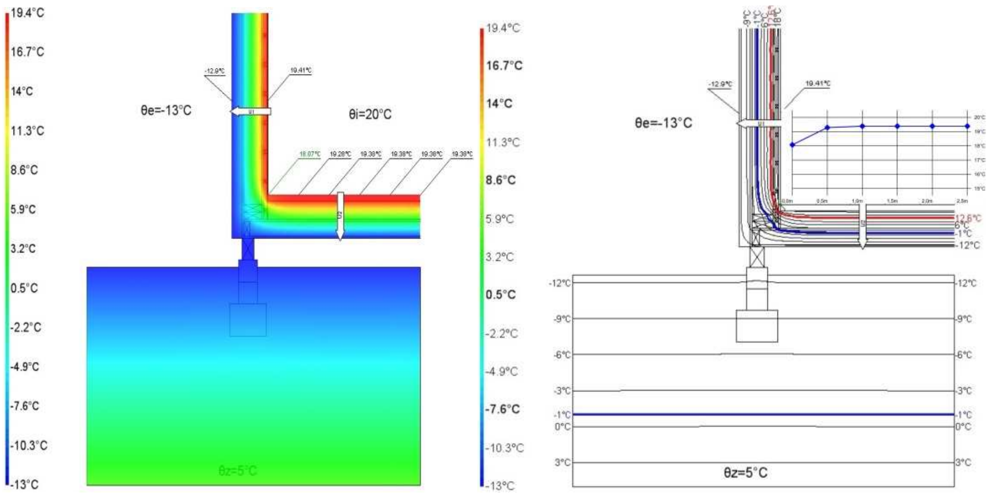

Fig. 10. Results of 2D modeling of detail and course of temperature

CONCLUSION

Thermal insulation is now a word that we have heard all around particularly with respect to rising energy prices in line with long-term strategic goals of reducing emissions and improving energy efficiency in buildings, which is the subject of European Parliament and Council 2013/31/EU of 19th May 2010 on the energy performance of buildings. The European Union has committed to reduce by 2020 overall greenhouse gas emissions by 20% at least compared to year 1990. To the same date to reduce energy consumption in EU countries by 20% and achieved in total energy consumption 20% share of renewable energy sources.

Acknowledgments

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KONSTRUKCJA PRZYZIEMIA DLA BUDYNKÓW ENERGOEFEKTYWNYCH

Przedmiotem niniejszej pracy było wskazanie skutecznych sposobów eliminacji mostków termicznych w obszarze przyziemia wraz z określeniem optymalnej głębokości h_z posadowienia budynku. Przedstawiono usprawnienia w części nadziemnej, modelowanie i realizację detali konstrukcyjnych w obszarze przyziemia poprzez odpowiedni wybór lokalizacji budynku, rodzaju połączenia oraz rodzaju i grubości izolacji termicznej.

Słowa kluczowe: konstrukcje budowlane, podłoga na gruncie, izolacja cieplna, przyziemie