

EXPERIENCES AND KNOWHOW FROM IMPLEMENTATION OF EXPERIMENTAL LOW-ENERGY HOUSE IN ACCORDANCE WITH CRITERIONS OF SUSTAINABLE CIVIL ENGINEERING

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Summary

A building industry greatly influences environment. It not only exploits resources of earth but also significantly contaminates surroundings. In the future the problem of sustainability in civil engineering should be addressed to maintain long term well being. Successful implementation of low-energy houses is one way of decreasing negative influence of building industry on environment. The article presents experience and knowhow from implementation of experimental low-energy house in Slovak conditions in accordance with criterions of sustainable design. The result is the analysis of chosen approaches and procedures used for building of low-energy house, solution of problems and barriers accounted, analysis of possibilities of further development in accordance with specific conditions in Slovak Republic.

Keywords: sustainability, expediencies, low energy house, barriers

1 Important points

Sustainability in terms of the SR is a global challenge with local requirements and constraints. Strategy for sustainability of the SR [1] defines what sustainability is and how to achieve it. Design and use of buildings is part of this strategy since consumers are building substantial resources. To achieve sustainability criteria for each project are four essential steps:

- Building design
- Building implementation
- Building controlling
- Building use

These steps are specific to particular residential buildings (houses, row houses, small apartment buildings). Based on the project NED FIAMO [2, 3] are below the relevant experience.

1.1 Building design

Accomplished: The proposal of building was based on requirements for passive houses by PHI Darmstadt [Feist, 1988]. The solution was computationally verified [4]. The project was processed on the basis of theoretical knowledge [5, 6]. In designing the selection procedures methodology was used in for certain construction products (window frame system, glass system). In the project were designed and built more innovations products on the Slovak building market (window frame system, glass system, thermal insulation).



Fig. 1 Windows of south facade



Fig. 2 Insulation of roof



Fig. 3 Insulation of external walls

Experience: The proposal must respect the economic power of the population. If the proposed solution is to be sustainable it must be economically sustainable too. The global financial crisis confirms this argument. Price works must comply with investor opportunities. The rigorous treated project budget based on a detailed implementation project is essential.

It is necessary to treat the interior project. Interior items are costly and may create the impression of expensive buildings. In extreme cases can lead to deterioration of the work. Project interior has been processed, but only at a later stage. It was mistake. Information needed from the interior project was not available in time (diffusers of water and sewer, electrical, air system outputs, types of floors layers, etc.).

Specific details must be made in explicit way and description of the each element. The draft solutions are necessary to consult directly with the manufacturer of a building material or product.

1.2 Building implementation

Accomplished: Project was implemented by several suppliers. Selected parts made by specialized companies (roof structure, windows, roof, air heating, electric, solar equipment, heat protection and finishing works). Period of execution was 15 months [7].

Experience: Realization companies are unable to meet the required criteria. There is missing professional and technical knowledge at the required level. Intensive controlling is necessary of working procedures. At the controlling is necessary to know the technological procedures. There is a tendency to implement changes to the project, often with negative implications. In terms of Kosice there is insufficient supply of construction materials and products at affordable price levels. Materials are available on order (delivery 4 to 6 weeks), which extends the period of implementation. Significant weakness is complementary products to major building structures (bars, anchors, plumbing construction, ancillary products for air handling, etc.). Therefore it must be designed atypical details, which are at present craftsmanship difficult to implement.

The most problematic point was the supply and installation of hot air heating and ventilation. There was very low level of the selected installation company to supply hot air heating. Knowledge and expediencies are available only from the experience of standard HVAC system assembly. Measurement and control system is at a higher level but lacked experience in implementing similar house. Part of the reason is a small market, respectively weak competitiveness.



Fig. 4 System of Air distribution

1.3 Building controlling

Accomplished: Control activities are linked to the design of building. Copyright supervision was provided at building designers and investors. There was carried out airtight test with result 0,58 (1/ n) in the project [8, 9]. Also, building was inspected using thermal detection of local defects (particularly window design). Due to the nature of the research project will be conducted again controlling steps during the whole period of monitoring the building, i.e. three years.

The monitoring project includes following variables: Internal air temperature and air temperature in heating system, wall and glass surface temperature, Heat flow, Gas concentration in the glass unit, CO₂ concentration, Internal humidity, Electricity consumption, Heat gains from solar, equipment regime, external air temperature, humidity and solar radiance.

Experience: Control activities in terms of Slovakia (Kosice) are a key point to ensure the required quality of work. In the future, it seems necessary that the individual producers of materials have to carry out rigorous control of their own products use. Since in most cases the product sold to the contractor, and then he builds it through another organization on site. Transfer of knowledge from the information source is so long but mainly is losing on the different levels. Designer but neither site supervisor can't replace the lack of knowledge of technology and assembly instructions of craftsmen. Include such amount of information is impossible.



Fig. 5 Blower door test



Fig. 6 Airtight test in contact with the window wall

1.4 Building use

Accomplished: This step is currently very difficult evaluable in conditions of Slovak republic. The issue is the small number of realizations, a short period of use of buildings (failures not to appear yet) and almost minimal feedback from owners - users. Project NED FIAMO is to take one winter only.

Experience: First experience in project NED FIAMO and use of the building say that despite the technical and theoretical knowledge about sustainable design of the building's owner the building use is in a slight conflict with his assumptions. The most complicated seems to set different modes of air heating. Set the time to heat water as well as its temperature is only implemented a system-error experiment. The complexity of the system

is affected by lack of knowledge and experience of suppliers, or service technicians, who don't have necessary experiences. In this case, the architect's knowledge was based solely on the literature.

Another fact affecting the use of building is the well practiced customs from living in the block of flat, which are stronger than expected. Customize to a different type of buildings and their different operation regime is strongly affected by this fact. The designer has to rely on this fact.

Architect's experiences must take into account in the design of the building so that the user-mode is for the investor a simple and affordable. The building must be designed directly to user (performance based building design). Only this way we can ensure that the use of the building doesn't make worse the expected results defined in the proposal.

In terms of further progress in this area is obvious that it is necessary to particular solve the issue of hot water preparing. In term of energy demand this is a key point and also the largest energy consumers. Set water temperature, the volume of water supplies, heating method, and efficiency of the support by solar heating will be the subject of further research.

2 Conclusion

Based on the defined four steps and filling them in content project can be realized so that it can be said to satisfy the criteria of sustainability.

There are a number of methodologies that allow assess the building and determine the extent to sustainability criteria. Most methodologies are based on other input assumptions, what are the conditions in Slovakia. Disregarding these specific conditions can lead to fulfil the general criteria, but to failure the local criteria.

Local sustainability criteria must be defined at the local level, whilst respecting the general criteria. As an example is the design of the building – land choice. If the building is operated with energy costs € 1000 per annum then the choice of land can't cause the need for costs minimal € 1500 per annum to provide transport to work (school) and back. Not to mention the emissions from transport. Offer of building land in the area of Kosice leave no other choice. This example clearly shows the specificity of local boundary conditions.

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