Danica Košičanová, Anna Sedláková
Technical University of Košice, Slovakia,
Institute of Architectural Engineering, Faculty of Civil Engineering

ENERGY PERFORMANCE OF BUILDINGS – ECONOMIC EVALUATION

This paper presents a method for economic calculation of the heating systems, relying on data from other systems that may influence the energy demand of the heating system. This method can be used, fully or partly, for the consider economic feasibility of energy saving options in buildings, compare different solutions of energy saving options in buildings (e.g. plant types, fuels), evaluate economic performance of an overall design of the building (e.g. trade-off between energy demand and energy efficiency of heating systems) and assess the effect of possible energy conservation measures on an existing heating system, by economic calculation of the cost of energy use with and without the energy conservation measure. The approach of the calculation method is according to a global point of view (overall costs). However, depending on the objectives of the investor, the calculation method may be applied considering only selected specific cost items. For example, calculations concerning alternative solutions for heating systems may be performed considering only costs for the domestic hot water system and the space heating system.

Key words: energy performance; calculation method; energy efficiency of heating systems.

Подано метод економічного розрахунку систем опалення, на підставі даних з інших систем, які можуть впливати на енергетичні потреби системи опалення. Цей метод може бути використаний повністю або частково для розгляду економічної доцільності опцій енергозбереження в будівлях, для порівняння різних вирішень енергозбереження в будівлях (наприклад, типів установок, палива), для оцінювання економічних показників загального розрахунку будівлі (наприклад, компроміс між попитом на енергію та підвищенням енергоефективності систем опалення), а також для оцінюваня впливу можливих заходів щодо збереження енергії для системи опалення через економічний розрахунок вартості використання енергії з урахуванням і без заходів із збереження енергії. Метод розрахунку базується на глобальному принципі (загальні витрати). Проте, залежно від цілей інвестора, метод розрахунку може бути застосований тільки до вибраних показників витрат. Наприклад, розрахунок, що стосується альтернативних рішень для системи опалення, може бути виконаний лише враховуючи витрати на системи гарячого водопостачання або системи опалення приміщень.

Ключові слова: енергетична ефективність; метод розрахунку; енергоефективність систем опалення.

Introduction

Main domain is to appoint required inputs, calculation methods, require outputs for economic calculations of energy systems related to the energy performance of buildings.

Any investment in the building, its walls design, or into the heating system, hot water, or other system should be documented not only technically but also in the design payback time for the building. The basic principle of finding a suitable response to the building structure or to HVAC system is presented in the following text.

This paper presents a various possibilities of energy precautions in buildings in dependence on energy efficiency of buildings, describe method for economic calculation of the heating systems, relying on data from other systems that may influence the energy demand of the heating system in according of standard STN EN 154 59, from 2008 year available in SR.

This method can be used, fully or partly, for consider economic feasibility of energy saving options in buildings, compared different solutions of energy saving options in buildings (e.g. plant types, fuels), evaluated economic performance of an overall design of the building (e.g. trade-off between energy demand and energy efficiency of heating systems), appointing the effect of possible energy conservation measures on an existing heating system, by economic calculation of the cost of energy use with and without the energy conservation measure.

This paper describes part of the method for calculation of economic performance of energy saving options in buildings (e.g. insulation, better performing generators and distribution systems, efficient lighting, renewable sources, combined heat and power).

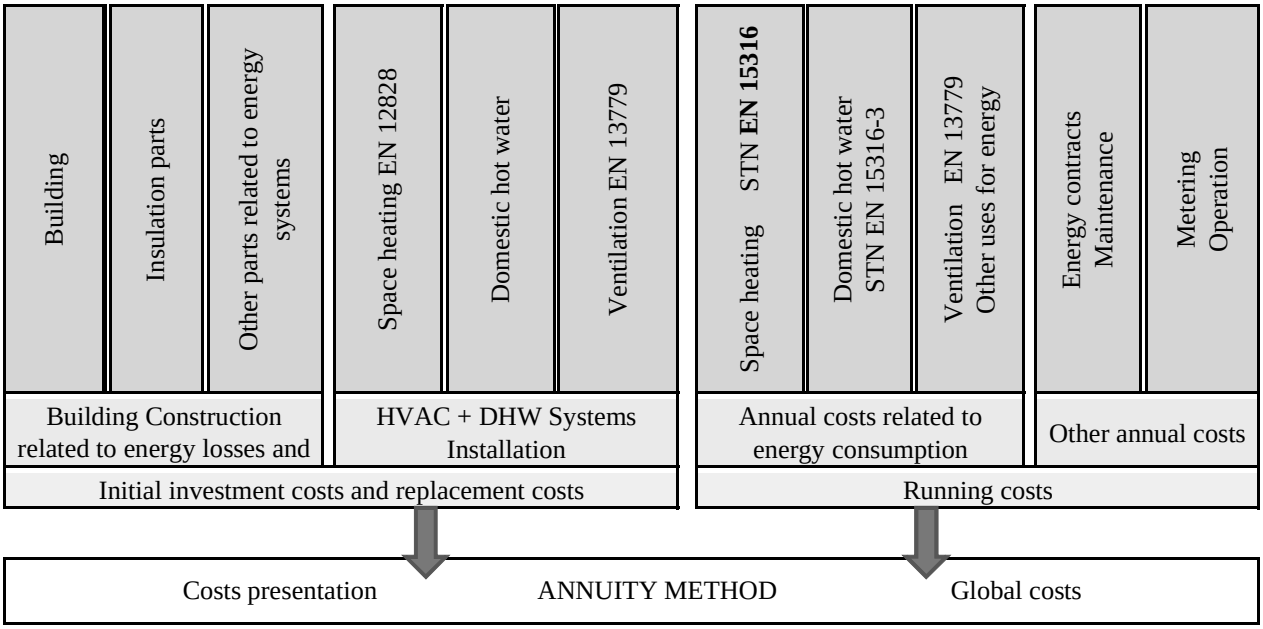
Calculation method

The calculation method is according to a global point of view (overall costs). The calculation method may be applied considering only selected specific cost items, for example, calculations concerning alternative solutions for heating systems may be performed considering only costs for the domestic hot water system and the heating system. Global costs are separated into investment costs, and running costs.

The various types of costs is given in Table 1.

Table 1

Scheme of cost´s organization – presentation of various types of costs



Calculation OF GLOBAL COST

The calculation may be performed either from detailed data on costs on an annual basis or from general data on economic calculations for every component. Dynamic calculations take into account annual variations of the discount rate as well as annual variations of the rate of development of prices for any of the costs considered in the annual costs (i.e. energy costs, operational costs, periodic or replacement costs, maintenance costs and added costs).

Calculation may be performed by a component or system approach, considering the initial investment C_I and – for every component or system j – the annual costs for every year i (referred to the starting year) and the final value. Global cost is directly linked to the duration of the calculation period τ.

$$C_G(\tau) = C_I + \sum_j \left[\sum_{i=1}^{\tau} (C_{a,i}(j) \times R_d(i)) - V_{f,\tau}(j) \right] \quad (1)$$

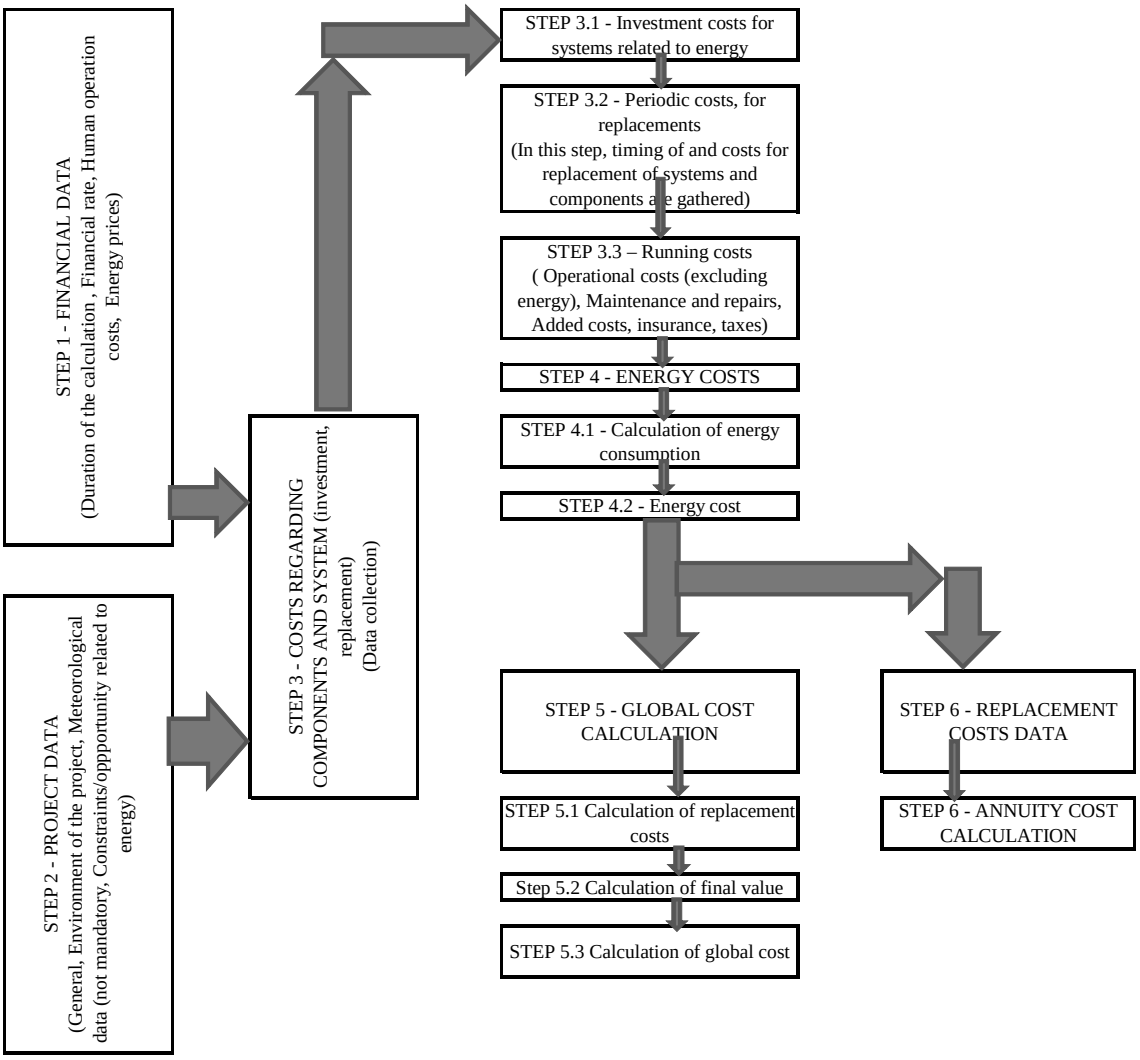
where: $C_G(\tau)$ is global cost (referred to starting year τ_0), C_I is the initial investment costs, $C_{a,i}$ (j) is the annual cost year i for component j (including running costs and periodic or ;replacement costs), R_d (i) is the discount rate for year I, $V_{f,\tau}$ (j) is the final value of component j at the end of the calculation period (referred to the starting year τ_0).

The data shall be documented in order to provide possibility for comparison between buildings or use of conventional costs ratio in the building construction (e.g. cost per surface unit). The parameters shall be chosen in accordance with those considered for the energy certification of the building.

The different stages of the method, are described in the following steps.

Table 2

Scheme of cost´s organization – – presentation of different economic and energetic steps



The most interesting is STEP 4 – Energy costs. Energy costs are mainly separated in two parts:

1. this part is directly related to energy consumption according to meters or fuel oil consumption of the building. The method for determination of energy consumption shall be coupled to energy content of the fuel according to data from the provider;

2. this part is fixed according to the quantity of energy subscribed with energy utilities or rental for energy systems (e.g. gas tank, electricity transformation).

For district heating systems, special subscription conditions may apply. Environmental (or social) costs could also be introduced as a cost related to energy. Energy sales (if relevant) are counted separately as negative costs.

Calculation should be performed according to standardized methods. prEN 15203 allows calculation of the energy consumption for the whole building. If the economical analysis only takes into account some of the energy systems, then the energy consumption calculation shall similarly only take these systems into account (i.e. EN 15316 series for space heating and domestic hot water systems). Energy consumption is coupled with tariff for the energy considered.

In some cases, the energy consumption can be calculated according to the variable tariffs of the utility. These tariffs (mainly for electricity) may vary during the day and during specific periods of the year.

Renewable energy sources or energy sales (electricity or hot water) shall be considered either as a financial income (as electricity from Photovoltaic cells can be sold directly on the electric grid) or as a way to reduce energy cost of the building (example solar collectors). Design of the system shall be considered in accordance with these two possibilities.

Conclusions

The European Union is introducing energy certification of buildings (energy performance of buildings) gradually from the time, when was accepted EU Directive 2002/91/EC on the energy performance of buildings (EPBD). EPB recovered four sampling positions – thermal protection of buildings, heating and hot water (DHW), ventilation and air conditioning and electrical systems.

Factors that cause excessive heat losses, which are simultaneously related to the loss of thermal comfort are as follows:

- type and thickness of thermal insulation of cooling baffles surrounding a room,
- excessive elevation glazing,
- ways of room ventilation,
- ways of room exploitation,
- technical condition of a building.

Heat losses by transfer up till now have dominated in the annual balance of losses. First of all the losses depend on the kind and thickness of heat-insulating layer. Increasing in a certain range the thickness of insulation to a small extent influences an increase in capital costs related to the construction of new buildings and thermal modernisation works. Such actions significantly improve the thermal characteristic of a building. After reaching a certain value a further increase in the thickness of insulation does not bring any economic effects, while it becomes a cause of constructional problems.

We wish to highlight the need to assess the building not only in terms of energy, but also in terms of return on the investments in construction, from the project through to its disposal. This assessment methodology will ensure optimization of the cost of building works in relation to its energy consumption.

Acknowledgements

This work was funded by project VEGA 1/0748/11 Theoretical and experimental analysis of Building services and HVAC systems from the point of view of microbiological risk and regarding to effective use of renewable sources.

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