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ENERGY PRECAUTIONS IN BUILDINGS IN DEPENDENCE
ON ENERGY CONSUMPTION OF BUILDINGS

This paper presents a various possibilities of energy precautions in buildings in
dependence on energy efficiency of buildings, describe method for economic calcu-
lation 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 15459,
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).

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.

1. 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 sys-
tems 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 Figure 1.

![Costs presentation](image)

**Fig 1. Scheme of cost’s organization - presentation of various types of costs**

### 2. 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 $\tau$.

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

where: $C_G(\tau)$ is global cost (referred to starting year $\tau_0$), $C_I$ is the initial investment costs, $C_{a,j}(j)$ 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 $I$, $V_f,j(\tau)$ is the final value of component $j$ at the end of the calculation period (referred to the starting year $\tau_0$).
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 (Fig. 2).

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.

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