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Assessment of thermo modernization using the global cost method

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Abstract

The article uses the global costs method to choose the best thermo modernization solutions for the buildings. Global costs were calculated according to the cost-optimal draft regulation as summing up the initial investment costs and the discounted annual operating costs.

Requirements of thermo modernization work assumed to comply with the new requirements of the building's thermal protection entered in Poland on January 1, 2014.

The case study was carried out for multi-family building located in Poznan.

Global cost method was compared with the more common indicators of economic evaluation Simple Pay Back Time (SPBT), and Net Present Value (NPV).

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Keywords: Global cost methodology; low energy building

1. Introduction

The analysis of energy usage in the certain areas shows that the building industry consumes more than 40% of the globally produced energy. In case of the residential buildings, over the years, the dynamic changes in the architecture as well as the usage of the new building techniques were observed. By mid of 20th century the changes in the building industry were inducted mainly by the social and economic factors [1, 2]. But nowadays, as an environmental awareness grows and in the same time an energy demand increases in the building industry the appropriate building regulations regarding the building thermal protection were implemented. The directive 2002/91/CE dated 2002 had initialized the activities, than its transformed version entered into force: 2010/31/UE, so called Recast EPBD [3].

Poland, as the member state of European Union, had implemented the new thermal regulations for the buildings

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on January, 1st 2014, under the comparative methodology. Consequently, a thermal insulation of the building envelope has been improved when the ventilation demands in the building through air flow control have dropped. The Polish regulations draw an attention also to a technical equipment of the building [4].
In accordance with the recommendations of United Nations Industrial Development Organisation (UNIDO) for an evaluation of the proposed thermo-insulation improvements the static and dynamic investment profitability indexes might be used. An European directive has required from the European Commission the preparation of the frames, which are supposed to be used when setting the energy usage requirements for the buildings and its components, influencing the whole building energy performance, at the optimal level in respect to the costs. The implementation of the global cost method, contained in the standard PN-EN 15459 "Energy performance of the buildings – economic evaluation of the energy installation in the buildings" is proposed to be used in the optimization calculations made for the building including the technical systems [5].

This paper presents the comparative analysis of the investment profitability indexes use for the evaluation of the thermo-modernisation improvements. The analyses were made for the modernized multi-family building, located in Poznań. Modernisation goal was to fulfil the requirements will be binding from January 1st, 2021. The global cost analysis was particularly useful during the comparison of the energy savings related to the given thermo-modernisation improvement, taking under consideration the energy usage, as well as the investment costs and economic assumptions. The presented analysis has helped to compare the methods and to determine the most universal of them.

2. Investment profitability indexes

In accordance with UNIDO recommendations the investment profitability, the economic effectiveness indexes can be divided into the following groups: the static ones (if it is assumed that the value of money is the same in the time), the dynamic ones (if the basis for the calculation is the discounted values). This paper presents the comparative analysis of three chosen indexes of the building's economic effectiveness evaluation.

Simple **P**ay **B**ack **T**ime index defines the time when the investment expenditures are to be covered by the incomes from the investment. It is calculated from the very moment of the investment's start until the gross sum benefits received as a result of investment realization will offset the expenditures. But an inflation is not taken under consideration.

Net **P**resent **V**alue represents the value of the thermo-modernisation improvement at the given discount rate. It is a sum of the cash flows (CF_t) discounted according to the discount rate. The value of the discount rate depends on rate of the inflation and the estimated cost of capital acquiring to finance the given investment, i.e. the interests of the investment loan, WIBOR.

Global **c**osts of the buildings and their components, including installations, are calculated as summing up the initial investment costs and the discounted annual operating costs during the calculation period minus the residual value of each of the components taken into account. Energy costs represent the costs of energy consumption and fixed fees for its willingness to provide energy.

3. Method

For the energy rating evaluation very important are the following factors: the climate, the local building technology and the legal requirements. The EU member states have the right to take into account the above mentioned differences in the process of defining the methodology of the energy requirements. In recent years, the number of the legal requirements, guidelines and the standards adjusting the Polish regulations to the requirements of the European directive were introduced in Poland. Below, there are presented the basic assumptions necessary for an indication of energy efficiency indexes significant for the requirements working in Poland.

This method is based on the monthly balance sheets, including the heat losses due to the penetration and ventilation and the solar and internal heat gains [6]. The climate related data used in this paper are consistent with the data available at the Polish Ministry of Infrastructure and Development website. In accordance with the applicable rules the usable energy index, which is a function of the parameters given in equation (1), is recorded to the heated area, where the temperature is regulated A_f.