EPBD ENERGY PERFORMANCE CERTIFICATION FOR SUSTAINABLE BUILDINGS

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Summary

Paper is focused on description of the Czech national methodology and tool for energy performance calculation according to Energy performance building directive 91/2002/EC. The calculation is expressed by the total annual delivered energy across building envelope, including heating, cooling, ventilation, auxiliary and other energy required for building operation. The calculation presents a simplified multizone model. The energy calculation is based on the simplified hourly time step. Climate data are synthetic data for four climate zones according to Czech technical standards. Zone operation profiles are standardized for typical zones as offices, schools, dwellings etc. Building energy systems, including heating, cooling, hot water generation and ventilation, are incorporated as zone assigned systems, while energy sources (e.g. boilers, co–generation unit, solar collectors, etc.) are in the building model assigned to the energy delivery systems. Result of energy performance calculation is total annual delivered energy and the required level to obtain energy certificate.

Keywords: building certification, energy performance of buildings, EPBD calculation

1 Introduction

The Directive 2002/91/EC of the European Parliament and Council on energy efficiency of buildings (EPBD). The directive is considered as a very important legislative component of energy efficiency activities of the European Union designed to meet the Kyoto commitment and responds to issues raised in the recent debate on the Green Paper on energy supply security. The directive provides the general framework for the calculation procedures. A mandate has been given to the CEN committee to develop appropriate calculation procedures to support Member States in the national application of this article. This theme includes the assessment of the relevant EN (CEN) and EN ISO standards the way they are or will be implemented at national level, options for quality assurance of calculation methods, differences between methods or data input for new versus existing buildings, legal aspects (e.g. national versus CEN options), practicability (as "simple" as possible and yet sufficiently accurate and distinctive), methodologies for innovative technologies, further needs and possibilities for further harmonization and more.

2 Calculation procedure

There are many ways of calculating building total delivered energy across building system envelope and energy need for whole building, especially energy need for heating and cooling. The calculation method presented in the article is based on the delivered energy needed under standard indoor and outdoor conditions. Total delivered energy across building system envelope is an amount of the actually consumed energy or the expected amount of energy for the fulfillment of various needs related to the standard use of a building. In particular – heating, hot water preparation, cooling, treatment of air by ventilation and parameters modification of the indoor environment by air condition system and lighting. The basic process of the calculation is commonly divided into two stages:

- The calculation of the building energy need, or its parts – zones needs; it means the calculation of heat losses, and heat gains, required in each space in order to maintain specified internal conditions.
- The calculation of total delivered energy across building system envelope (building, or parts – zones, according to the energy needs), it means the calculation of the energy required by the energy systems (boilers, AHU units, DHW systems, lighting, etc.) needed to provide the necessary heating or cooling, or humidity control, etc.

The aim of the calculation procedure is to calculate total annual total delivered energy across building system envelope, including heating, cooling, ventilation, auxiliary and other energy required for building operation. Energy performance EP in GJ/year is total annual delivered energy. In the method was not used degree–day method, which is well–established and easily used method for heating and cooling energy calculations, especially for relatively simple buildings. But if the energy need for cooling is calculated by degree–day methods, there is a problem with using average monthly temperatures. Empirically, it is found that there are extensive correlations between cooling energy use and cooling degree–days for some buildings and systems, but not for all. For energy need for cooling it is not possible to use average month temperatures because average temperatures are lower in summer months than the indoor temperature – it does means no cooling requirements.

3 National calculation tool (NCT)

Based on the described method and according to new European standards is provided the calculation tool. The calculation tool is created in spreadsheet on the base of the calculation procedure to combine compact structure of the procedure and to give access to easy test the calculation procedure. The national calculation tool calculates the energy needs for heating, cooling, domestic hot water systems, lighting, etc. of each space in the building or zone, according to the activity within. The NCT includes different standardized profiles of the use that may have different temperatures, operating periods, lighting standards, etc. It calculates the heating and cooling energy use by carrying out an energy balance based on the climatic location. This is combined with information about system efficiencies to the determine energy consumption. The energy used for lighting is calculated for each zone and domestic hot water. It is calculated for whole building – it depends on the type of DHW system.

3.1 Standardized profiles of use

Whatever type of a building during its utilization period, is operated differently and likewise while the main day period is over and all systems decrease its performance. It is obvious for various building types, but the same come out in the case of similar or same types of buildings. In compare of completely equal buildings, when the first one is heated to the set point temperature 20 °C and the second one meets temperature 22 °C. Dissimilar values of annual heating total delivered energy across building system envelope are evidently received. These circumstances provide serious problem for the general assessment of building performance even in the case that is required a comparison of different buildings. Solutions are standardized profiles of use. While our performance assessment tool NCT was composed was decided to create certain profiles for major building types. The target of each profile is to set indoor conditions that meet desired quality level of zone environment. Basically the zone environment level setup fulfils requirements of thermal comfort (Fanger, 1970), ventilation, lighting and also effects related to activity such as heat gains. This choice of constant profiles serves to certain advantages, especially identical parameters for same zone type in different buildings, it does helps also to avoid underestimating of some energy consumers in a building, for example low lighting intensity. Finally is lower possibility to intentional affection of total delivered energy across building system envelope results. Generally it does mean large amount of data in each profile. These values serve as one of boundary conditions for energy building performance calculation of any zone or any building. For calculation purposes user just choose particular profile related to assessed zone. Concretely each zone standardized profile of use include data's groups defining operation time in a day and year, heating and cooling set point temperatures, ventilation air flow and supply air temperatures, indoor heat gains and artificial lighting in zone.

Collecting necessary microenvironmental data took complex search primary through national technical and law standards. However those sources include many relevant numbers, due to heterogeneous building types were some data missed. Purposefully was utilized values from some foreign standards e.g. DIN 4799 (1990) and ASHRAE (1999) for supply air in surgery zone definition. Unique part of gathered data was indoor heat gains caused by occupants and equipment, reasonable source that came in sight were databases of energy simulation programs, especially DesignBuilder (2006). Presently are available 9 groups containing totally 49 standardized profiles of use. These nine groups cover main types of buildings as dwelling houses, apartment buildings, office buildings, educational buildings, health and care institutions, hotels and restaurants, sports facilities, commercial buildings and finally theatres.

3.2 Climate data

For setting Ambient temperature is used climate dates for four climate areas (according to Czech technical standard CSN 730540, supplement H1) in the calculation procedure. Twelve synthetic reference days in hourly time–step temperature values, was created for every climate area. Each representative day cover a certain month. Creation of reference days was done utilizing climate dates in format TM2 (TRNsys 16 Climate Database) for four localities. Source data are in hourly temperature values format during the year, which does in sum 8760 values. Climate dates for methodology was processed in a typical day format where every month represents just one typical day. Typical day for a winter temperature is average of all separated values in month and in given time–step interval. For

a summer season, it was necessary to take into account an increased temperature in summer months, which is being expressively higher than average value. The temperature for months from June to August was determined using monthly values but with regard to an amplitude temperature in a summer season. For solar radiation data was necessary to create a file with radiation dates for various slope insulation surfaces and world's direction orientation for needs of the National methodology. Input values are the solar constant I0 = 1366 W/m2, the geographical latitude for Czech Republic (CR) 50,08°, the average altitude for CR 300 alt. and the atmosphere pollution coefficient (Cihelka, 1994), which is considered for the calculation as urban area.

4 Discussion

The presented method for the EPBD calculation procedure will be used according to the Czech law for all new buildings with floor area above 50m2 except temporary buildings to calculate the building certificate, describing building energy performance. Presented approach for the issue solution is the result of professionals groups together with experts from the Czech Ministry of Industry consensus, fulfilling European Commission requirements on EPBD implementation. Since 2007 new features of the NTC has been developed and added to the initial version, as well as experience with calculation results has been achieved.

Acknowledgment

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