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INTERACTION OF POWER ENGINEERING AND LIVING ENVIRONMENT IN THE CZECH REPUBLIC

The Cideas scientific centre carries out a number of housing redevelopment studies. The studies concern complex building-energy and technical-functional conceptions of redevelopment of houses built in the second half of the last century by the series construction. Two objects from the Ostrava region were selected for the purpose of this paper, namely a panel house of T06B type series and a prefabricated framed structure building of MS-OB type. The conception of redevelopment was viewed from the aspect of construction heat engineering and energy consumption according to the Directive no. 2002/91/EC on the energy performance of buildings.

Научный центр Cideas проводит ряд исследований по реконструкции жилых зданий. Изучаются комплексные строительно-энергетические и техническо-функциональные принципы реконструкции серийных зданий, построенных во второй половине прошлого века. Два объекта из района Остравы были выбраны для рассмотрения: панельный дом серии T06B и сборный дом рамной конструкции серии MS-OB. Принципы реконструкции рассматриваются с точки зрения строительной теплоэнергетики и потребления энергии в соответствии с Указанием № 2002/91/EC по энергетике зданий.

Introduction – Kyoto protocol

Our society has been trying to decrease the volume of harmful greenhouse gases and emissions for many years, especially the volume of CO_2 in the atmosphere. The group of greenhouse gases includes methane, dinitrogen oxide, hydrogenated hydrofluorides, polyhydrogen fluorides and sulphur hexafluoride. With increasing concentration of those gases the ozone layer protecting the Earth from excessive overheating and harmful UV radiation narrows. The Earth climate keeps on warming up and irreversible changes in the environment occur. Those changes influence earthly life of people and animals as well as nature as a whole. Scientists from all countries set the alarm bells ringing and dare all society to ecological behaviour and treating of nature and its resources, which are of great importance for us, the way we as a society were able to survive in the next centuries. It is necessary to change the approach and methods of energy treatment, whose classical production (from fossil fuels) is very expensive and burdens nature. It is necessary to save it, to use renewable sources, invent new principles of more ecological production (cleaner ones) and to invest into measures that would guarantee its smaller consumption. These measures don't concern only energy consumption in industry, households, but also automobile industry.

As the first step and an exemplary attempt we can daringly indicate so called Kyoto protocol. Its main goal is to decrease the amount of carbon dioxide and other greenhouse gases emissions in 2008 – 2012 by 5,2 % compared to the level from 1990. EU countries even by 8 %. Common effort of industrial countries lead by EU can lead to limitation of emission production by 80 % by 2050 in comparison with 1990. Kyoto protocol was signed in December 1997, but took effect only on 16th February 2005 after Russian ratification. The condition for taking effect was the ratification of at least 55 countries that produce more than 55 % of total amount of greenhouse gases originated in developed countries in 1990.

The Czech Republic joined the agreement in November 2001 and with almost 12 tons of emissions per 1 inhabitant it belongs to the group of the worst air polluters in Europe and

in the world. In the Czech Republic power industry is responsible for 42 % of CO_2 emissions. The consumption of primary energy resources on a unit of gross domestic product is 2,3 times higher in the Czech republic than in other EU countries.

Greatest world air pollutants in emissions conversion per 1 inhabitant (Source: OSN, 1996)

Rank	Country	Amount of emissions per 1 inhabitant [tons]
1.	USA	19,8
2.	Luxembourg	19,4
3.	Australia	18,0
4.	Canada	14,0
5.	Estonia	11,7
6.	Czech Republic	11,6
7.	Ireland	11,1
8.	Norway	11,1
9.	Finland	10,3
10.	Belgium	10,0

Cideas research centre

Cideas is a research centre, which specializes in maintenance of buildings, support of reduction of its energy performance and integrated design of structures and systems for building in the Czech Republic. It was established in 2005 with assistance of ČVUT Praha, VŠB-TU Ostrava and VUT Brno. The Section of management and construction maintenance in areas with increased industrial activity is situated at VŠB-Technical University of Ostrava. This Section deals with "Complex building-energetic and technical-functional conception with respect to possibilities of utilisation of those buildings for new functions of regenerated industrial settlements", works on "Multi-criteria analysis of decision-making within determination of utilization of buildings in such areas" and also "Building acoustic-sound-insulating properties of interapartmental walls and partitions". Pointed reduction of energy performance of buildings in agreement with EU legislation, especially the Directive 2002/91/EC of 16 December 2002 on the energy performance of buildings is a part of these tasks.

Energy performance of buildings

Our analysis of requirements was focused on Article No. 6 of the Directive, which claims that member states must accept all necessary measures so that energy performance of buildings of total useful areas of over 1000 m^2, where major renovation is in progress, decreases aiming at meeting the minimum requirements technically, functionally and economically if possible. After introducing the Directive 2002/91/ES it will be necessary to elaborate an energy certificate that would assess objects according to the amount of energy delivered to the object, similarly like with electrical appliances (energy delivered to the object = bought energy + energy produced in the building – sold energy). The energy certificate will assess building from the aspect of energy consumed for heating, lighting, hot water making, ventilating and cooling. The certificate will express the energy performance categorized into groups A – G in words and pictures.

Residential building and public amenity building from the building-energetic aspect

One of the assessed buildings was a panel residential house of T06B structure system with 4 storeys built in 1976. The subject house was assessed and evaluated from the building-energetic aspect and thermal-technical aspect. As the building did not meet the assessment requirements, 2 alternatives of planned external cladding of the building incl. replacement of doors and windows were suggested. The first alternative complies with the values of thermal-technical quantities issued from the norm; the second alternative complies with the recommended values. The assessment implies that for the two alternatives of external cladding of the panel house the total thermal loss of the object will come down by 51,3 % for the 1st alternative and by 54,5 % for the 2nd alternative in comparison with the initial state. It is necessary to add that there is great amount of alternatives and combinations that lead to the decrease of the energy performance of buildings on needs of heating composed by overcladding systems. That's the reason why we took technical, operational, economical and ecological aspects into consideration. We considered total ther-

mal losses of the building (consisting of thermal losses through structure transmission and by ventilation) and the degree of thermal performance DTP coming out of average overall heat transfer coefficient U_{em}, see Fig.1. Similar assessment was done with MS-OB object type also with two alternatives.

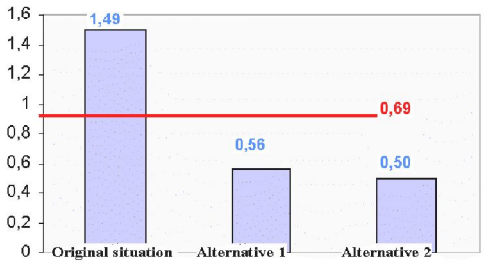


Fig.1. A graph of average overall heat transfer coefficient U_{em} [$W \cdot m^{-2} \cdot K^{-1}$] arising from the initial state and two alternatives of proposed building measures of residential panel house of T06B type series compared with the norm requirement. [1]

Buildings from the aspect of building services

The conception of building technical services and its constituent parts, such as heating systems, comply with technical and economical conditions in time of the house construction, when the price of heat energy was much lower than today. Partial or complete reconstruction of heating systems must play its role there then. If air-conditioning devices used for heating the house ale located in the object adjustment of their service must be done too. Therefore it is necessary to follow this procedure when over-cladding:

a) It is necessary to recalculate thermal losses for new thermal-technical values (in all rooms);

b) To evaluate the measure of overdesigning of heating bodies in separate rooms;

c) On the basis of evaluation b) it is necessary to determine a new rated temperature drop of heating water. New computational temperature parameters of heating water for the house must be set on newly designed central regulator in connecting knot of the building footing – see e): low-temperature operations;

d) For the possibility of change to low-temperature operation of heating it is necessary to install central regulating knot of equithermal regulation of heating water temperature for the house section handled;

e) It is needed to check functionality of current thermostatic valves for new operating conditions, or to carry out relevant measures (addition of regulation fittings, use of electronically controlled circulating pump in the regulation knot etc.);

f) Installation of automated system of control (installation of inner temperature sensor in separate flats (rooms), automated control of the main regulation knot and the central computer, the system works exactly to the demands of users).

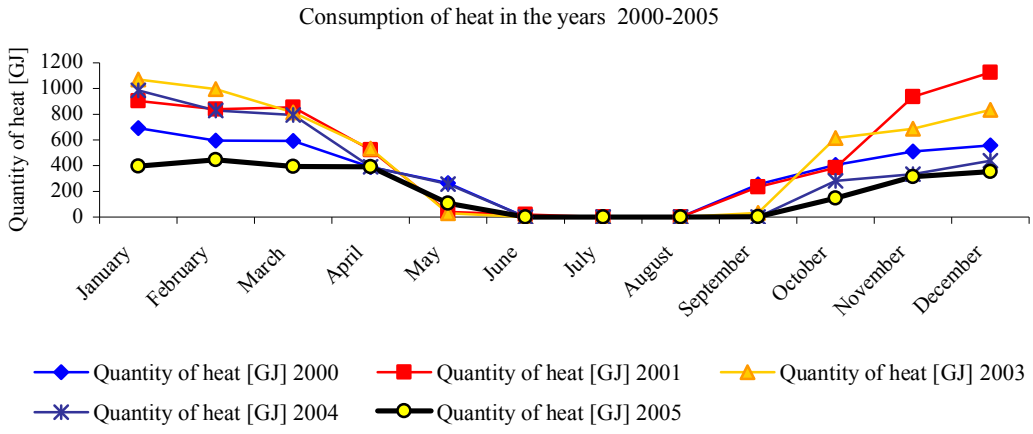


Fig.2. Consumtion of heat in the object type MS-OB in 2000-2005
Comment: data from 2002 were not available in time of elaboration

Above mentioned procedure is the basic necessity for acquiring economic consumption of heat energy for heating of a building.

Conclusion

During our work on the adjustments of one of the objects (MS-OB) we acquired following results. Not only the interior thermal comfort has increased but mainly the energy performance of the building has decreased (see Fig.2). It is clear that the consumption of heat energy came down by almost 42 %. The main and the most important modification of this thermal system was the introduction of interactive system of control and regulation. This system enables to regulate the thermal system in the real time according to our momentary demands. Thus the delivered heat energy will be used the best way. Further also the energy management was introduced. It should prevent rise of heat consumption as a result of operational failures in the next years. Energy management is the controlling instrument for sustainable consumption of energy. It works on the principle of watching the energy consumption and average outdoor temperature periodically.

Two studies of complex rehabilitation of buildings have already been created in Cideas research centre. More information can be found in particular studies (www.cideas.cz).

The energy consumption still increases. The energy means further development of the human kind. However it is necessary to economize with it. The best energy is the one, which is not produced in vain.

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LITERATURE

[1] ČSN 73 0540 Thermal protection of buildings (2005).

[2] ČSN EN ISO 13789 Thermal performance of buildings (2002).

[3] ČSN 06 0210 Calculation of heat losses in buildings with central heating (1994).