

THERMAL COMFORT OF INDOOR ENVIRONMENT OF BUILDINGS AND ENERGY REQUIREMENT

Ingrid Šenitková, Silvia Vilèeková
Technical University
Vysokoškolská 4
042 00 Košice
Slovak Republic
Phone: +421 95 6024262
Fax: +421 95 6333303
E-mail: Ingrid.Senitkova@tuke.sk

Thermal comfort

One of the main objectives in building construction objects and renovation of existing buildings is to ensure optimal thermal conditions of indoor environment. When ensuring thermal comfort in buildings, quality of indoor air is to be guaranteed. Individual requirements and ideas of users on thermal comfort call interested experts to complex analysis of the system building – environment – human from the point of view of comfort and safety of indoor environment.

Decrease of energy requirements in buildings is mostly achieved by improving thermal-insulation characteristics of building constructions and by decreasing air change. Problems connected with air change with relation to quality of indoor environment and with energy requirements and thermal comfort are necessary to be evaluated and solved complex. When designing buildings it is therefore necessary to use theoretical knowledge respecting energy saving and environmental rules of creation of optimal conditions of indoor building environment. System perception of building with individual elements and their relations. It relates especially interactions between subject of environment, sources of effects and area of their distribution.

One of deciding parameters of comfort perception in indoor building environment is thermal comfort. Its characteristic from view of criteria and different requirements of individual subject categories, i.e. users of buildings is not clear. Perception sensitivity rate and need for heat for thermal comfort is significantly individual. From view of hygienic requirements on indoor building requirement parameters of thermal-

humid microclimate are defined, which have to be kept in all rooms with permanent stay.

Apart from this for apartment buildings and family houses air temperatures are designed in range of minimal and optimal values according to character of indoor space. Usually it is 20-22°C (bathroom 22-24°C, WC 18-20°C [1]). According to experience based on processing of subjective evaluation of thermal condition of indoor space these values usually do not respond real feeling of thermal comfort. Subjective feeling of thermal comfort significantly depends on current physiological condition of a building user. Terms as minimum, maximum or optimum loose their real justification when creating and evaluating thermal condition of environment.

Energy requirement and thermal comfort parameters

In relation to solution of concrete thermal condition of environment satisfying requirements of certain user it is necessary to analyse interrelation of thermal comfort parameters of environment and energy requirement for heating. When analysing the problem of range of real parameters of air temperature it is not possible to ignore their relation to thermal-insulation characteristics of coating constructions and thus energy requirement.

It is generally known, that with improving thermal-insulation characteristics of coating constructions energy requirement for heating has decreasing trend. When analysing thermal comfort parameters attention was paid to an effect of average heat transfer coefficient as a coefficient acting in monitored interaction, to energy requirement and to assumed range of temperatures of most frequent stay. It could be predicted that increase of energy need by change of indoor temperature of 1°C will not be constant, as majority of authors say, but it will depend on rate of energy efficiency of design of building coating constructions.

For closer explanation of this dependance energy balance of chosen object by defined range of indoor air temperatures was realised. The analysis was carried out by means of simulation calculations by variation of average heat transfer coefficient and heating period. Dependance of thermal losses and energy needs by change of inside parameters of air temperature was monitored for proposed standard values of

heat transfer coefficient valid in last three thermal standards, i.e. ÈSN 73 0540 valid from 1979, STN 73 0540 change 4 valid from 1992 and STN 73 0540 change 5 valid from 1997 [2,3,4]. Simulation evaluation of monitored building from view of energy need for heating was based on thermal-technical characteristics of an object necessary for definition of thermal losses according to STN 060210 in line with valid methodology. Energy need for heating was set for range of indoor temperatures 20-24°C. This range was chosen based on data of building users, who characterised thermal comfort status by their own optimal air temperature. Interaction of parameters of environment thermal condition, thermal-insulation characteristics of coating constructions and energy need for heating as well as appretiaton of possibilities to ensure individual requirements for thermal comfort in relation to energy needs in indoor environment of buildings is illustrated in Figure 1.

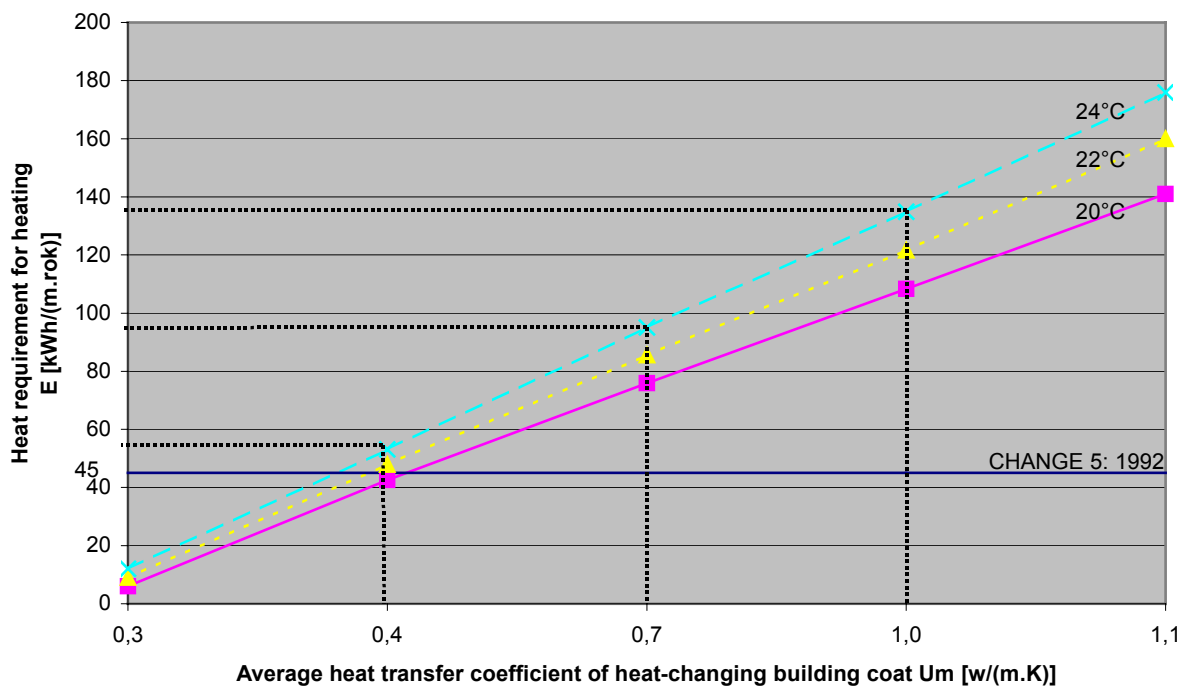


Figure 1 Parameters interaction of thermal comfort, thermal-insulation characteristics of coating constructions and energy requirement

For monitored range of parameters change of air temperature by 1°C with average heat transfer coefficient of heat-changing building coat $U_m = 1,0 \text{ W}/(\text{m}^2.\text{K})$ means percentage change 6-7%. For building constructions designed according to STN 73 0540, change 4 ($U_m = 0,7 \text{ W}/(\text{m}^2.\text{K})$) this percentual change has value about 4-5%.

For currently designed building constructions ($U_m = 0,4 \text{ W}/(\text{m}^2 \cdot \text{K})$) the percentage change decreases to value 2-3%.

Conclusion

From analysis of interaction problems of thermal condition of environment and energy intensity of a building it is clear, that factor of thermal-insulation characteristics of building constructions enters directly into their interaction activity. In term of balancing energy requirement for building heating together with ensuring optimal thermal condition of environment in accordance with requirements of users, it is necessary to respect further factors and to pay attention to necessary air change in relation to assumed appearance of harmful substances in indoor environment of tight buildings.

Controlled quality of thermal condition of indoor environment of buildings contributes to positive energy balance of an object, though under condition of factors interaction of proper treatment of object in terms of appearance of harmful substances.

The article was prepared in the frame of the project VEGA 1/7311/20 Environmental creation of indoor environment of buildings in terms of indicators negatively effecting health.

LITERATURE

1. Návrh Vyhlášky MZ SR, ktorou sa ustanovujú hygienické požiadavky pre vnútorné prostredie budov
2. ÈSN 73 0540 Tepelno-technické vlastnosti stavebných konštrukcií, 1979
3. STN STN 73 0540 Tepelnotechnické vlastnosti stavebných konštrukcií, Zmena 4, 1992
4. STN STN 73 0540 Tepelnotechnické vlastnosti stavebných konštrukcií, Zmena 5, 1997
5. ŠENITKOVÁ, I.: Vzájomná interakcia parametrov tepelno-vlhkostnej mikroklímy v interiéri budov a spotreby energie. In: *Stavebnický časopis*, 1992, roè. 40, è. 5, s. 337-342