"Influence of Unconditioned Spaces on the Energy Efficiency Calculation of Buildings"

Ilze Dimdiņa (*RTU, LU*), Andris Jakovičs (*LU*), Staņislavs Gendelis (*LU*), Jevgenijs Džeriņš (*LU*)

***Keywords* – energy efficiency, heat energy balance calculation, heat transfer, unconditioned spaces.**

I. Introduction

This study analyses the influence of assumptions of unconditioned spaces on the heat energy balance calculation model accuracy of non renovated standard residential buildings. In the Latvian legislation the accuracy demand of the heat energy balance calculation model is 10% and ≤10 kWh/m^{2}a. The current research is performed with financial support of ERAF, project realised by University of Latvia, Nr. 2011/0003/2DP/2.1.1.1.0/10/APIA/VIAA/041.

II. Methods

The heat energy balance calculation is done according to Latvian legislation norms (supported to the LVS EN ISO 13790:2008 etc.) and relevant methodological materials [1, 2]. For the calculations application EFA2 is used.

A. Equation

Unheated space together with its external construction adjacent to building can be obtained by correcting the thermal transmittance of constructions between the internal and external environment. For unheated spaces with non-insulated external envelope, simplified calculation procedure is given, obtained by treating the unheated space together with its external construction components as if it were an additional homogeneous layer with thermal resistance R_u. More precise calculation procedure requires the transmission heat transfer coefficient to be corrected with coefficient b_u.

The calculation of the temperature of unconditioned spaces uses the solar heat gains in and through the unconditioned space. Solar heat gains in the adjacent unconditioned spaces are included with coefficient b_u.

B. Assumptions for calculation models

The calculations of current research are made for the non renovated residential building of project type 464 [3], oriented with façade with loggias to the West. The assumptions of the building are following: 60% loggias are glassed; the outdoor temperature 0.0°C; indoor temperature 19.12°C; temperature of lobby 16.0°C.

The different assumptions of calculations are following:

calculation 1 – is used to validate the heat energy balance: solar heat gains in and through the unconditioned space are ignored; the transmission heat transfer between the internal and external environment through the unconditioned space is obtained by correcting the thermal transmittance of constructions between the internal and external environment;

calculation 2 – solar heat gains in and through the unconditioned space are included in the temperature of unconditioned spaces; the transmission heat transfer through the unconditioned space is calculated between the internal environment and environment of unconditioned space and the thermal transmittance of constructions between the internal and environment of unconditioned space is not reduced;

calculation 3 – the same as calculation 1, but solar heat gains are included;

calculation 4 – the same as calculation 2, but solar heat gains are included.

III. Results and analysis

TABLE II

The different parameters for calculations

Calculations number, building element	Factor	U_{iu}, W/(m^2·K)	θ_u, °C
Calculation 1, 3: Ceiling panel to roof space	Ru= 0.38	0.82	0.0 = θ_e
Calculation 1, 3: Glazing to loggia	b= 0.60	1.74	0.0 = θ_e
Calculation 1, 3: External panel to loggia		0.72	
Calculation 2, 4: Ceiling panel to roof space		1.20	6.7
Calculation 2, 4: Glazing to loggia		2.90	9.4
Calculation 2, 4: External panel to loggia		1.20	

TABLE III

Calculations results (with differences from calculation 1)

Calculations number	Q_T, kWh/m^{2}a (%)	Q_{sol}, kWh/m^{2}a (%)	Q_H, kWh/m^{2}a (%)
Calculation 1:	117.7 (100)	10.1 (100)	107.3 (100)
Calculation 2:	115.7 (-1.7)	10.1 (-0.0)	106.1 (-1.1)
Calculation 3:	117.7 (-0)	12.3 (+21.8)	106.1 (-1.1)
Calculation 4:	115.7 (-1.7)	12.3 (+21.8)	106.1 (-2.1)

To compare, if the indoor temperature is decreased by 1°C in the calculation 1, the needed energy for heating Q_H is decreased to 99.9 kWh/m^{2}a or about 7.4 kWh/m^{2}a (-6.90%).

IV. Discussion

To collect the calculations input data for the unconditioned spaces of not renovated standard residential buildings, comparatively large amount of time is needed. The difference between calculation results of the needed energy for heating is not significant. To increase accuracy and simplify the input data of standard buildings, united database is advisable.

V. References

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[3] I. Dimdiņa, Ē.Krūmiņš, A.Lešinskis u.c., "Indoor air quality and energy efficiency in multi-apartment buildings before and after renovation" in The 12th International Conference on Air Distribution in Rooms "Roomvent 2011", Trondheim, Norway, 2011, Paper No:101.