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THE ASSESSMENT OF EFFECT OF SELECTED ELEMENTS ON THE HEAT LOSSES

The paper presents the results of investigations on building's heat losses. The heat balance conditions in selected buildings were observed. The factors which influence on heat losses in analysed buildings were identified. The changes of value of these quantities on the influence of individual factors were estimated. Figures illustrate the formation of values related to heat losses in given buildings depending on the selected factors. Regression equations correlations and coefficients were determined.

Keywords: heat losses, heat balance conditions, heat consumption for heating buildings, single-family buildings

INTRODUCTION

Heat losses in a building result from heat penetration through external and internal partitions as well as from heating up the air exchanged in the ventilation process. Heat lost on penetration has been up till now the highest value in the annual loss account [1, 2]. With low thermal insulation of partitions it amounted to 80%. The observed and predicted increase of thermal insulation of external coating of buildings causes high dependence of heat losses on the ventilation needs. Heat lost on ventilation with air-tight enclosures amounts to 70÷80% [3]. Wind is a significant factor intensifying losses. At the speed of 3 m/s heat losses increase by 2%, and with 6 m/s exceed by 25% the value of losses as compared to the windless weather. The shape and location of a building has a considerable influence on the whirl and wind velocity. The shape of the building determines as well its energy properties. Precipitation causing dampness of partitions and deterioration of their thermal insulation increases heat losses [4].

1. THE RESULT'S OF INVESTIGATION

Research was conducted in a dozen or so single-family one- or two-storey buildings, built in traditional technology. Two buildings had a complete basement, but only one basement was heated. One building had a partial basement. The buildings were situated with minimal glazing facing north and maximal - south.

It was determined: window's surface Po, wall's surface Ps, heating surface Pu, cooling partition's surface A, heating cubic capacity V, shape's coefficient A/V, glazing's surface Po/Ps, window's surface/heating surface Po/Pu, window's surface/ /heating cubic capacity Po/V, air change's quantity to ventilation and person quantity. Selected statistical indexes of parameters which characterized research buildings and quantity of people which used these buildings are presented in Tables 1 and 2. ($\bar{x}$) is arithmetic mean, (H) is harmonic mean and (s) is standard deviation.

Table 1. **Air change's quantity to ventilation and person quantity**

Statistical Indexes	Air change's quantity to ventilation	Person quantity
$\bar{x}$	1.1	5.9
s	0.4	1.4

Table 2. **Parameters of research buildings**

Statistical Indexes	Po	Ps	V	Po/Ps	Po/V	A/V
	m^2	m^2	m^3	%	–	m^{-1}
$\bar{x}$	39.6	199.3	581.9	20.2	6.9	–
H	–	–	–	–	–	0.9
s	11.3	57.8	110.1	3.7	1.8	0.1

2. THE ANALYSIS OF HEAT LOSSES

The heat losses in research buildings was determined. The results are shown in Table 3. (H) is harmonic mean and (s) is standard deviation.

Table 3. **Heat losses in research buildings**

Statistical Indexes	Heat losses	
	[kWh/year]	[GJ/year]
H	34 646.3	124.8
s	7555.1	24.1

Figures 1-6 illustrate the formation of values related to heat losses in given buildings depending on the selected factors. Regression equations correlations and coefficients were determined. Only dependencies for the factors for which correlation coefficients remained at the level 0.5÷1 were presented. For the rest of factors, correlation coefficients were below 0.3.

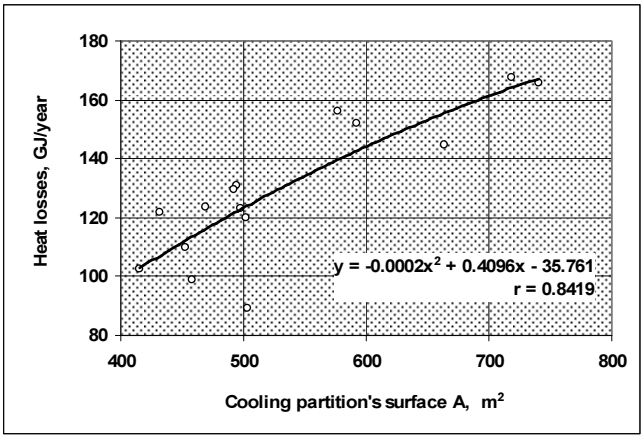

Fig. 1. The cooling partition's surface influence on heat losses

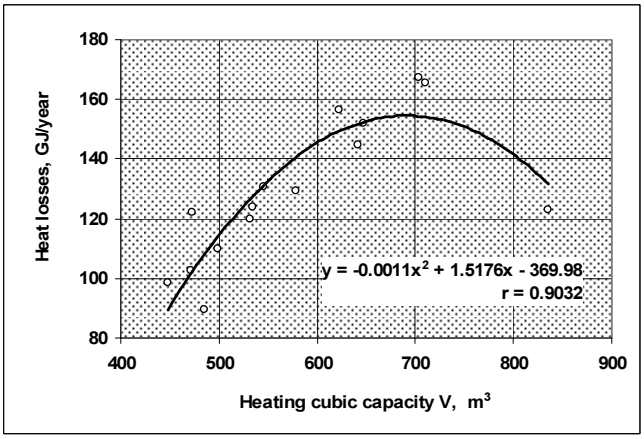

Fig. 2. The heating cubic capacity influence on heat losses

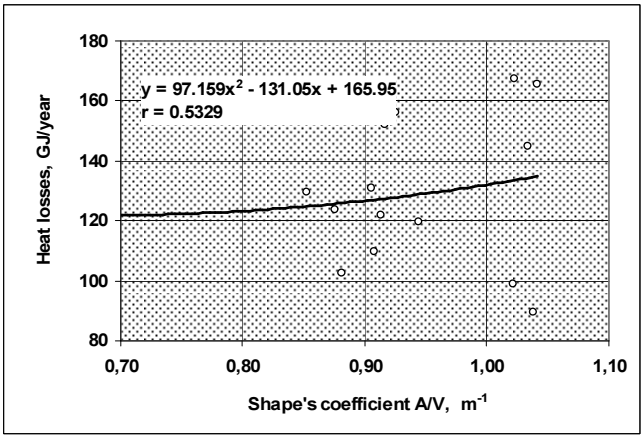

Fig. 3. The shape's coefficient influence on heat losses

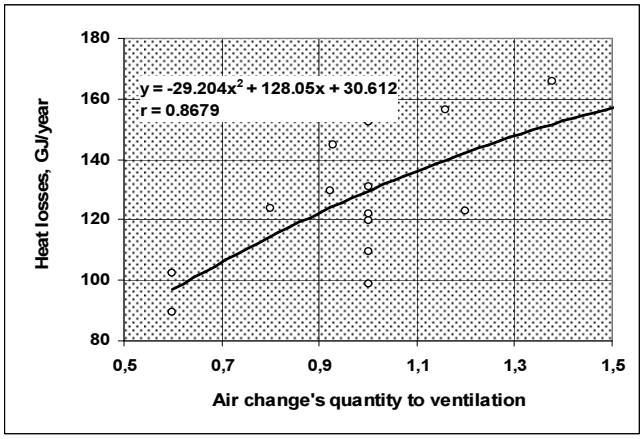

Fig. 4. The air change's quantity to ventilation influence on heat losses

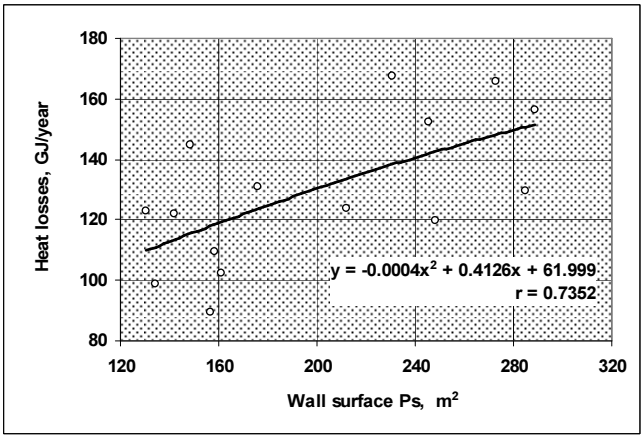

Fig. 5. The wall surface Ps influence on heat losses

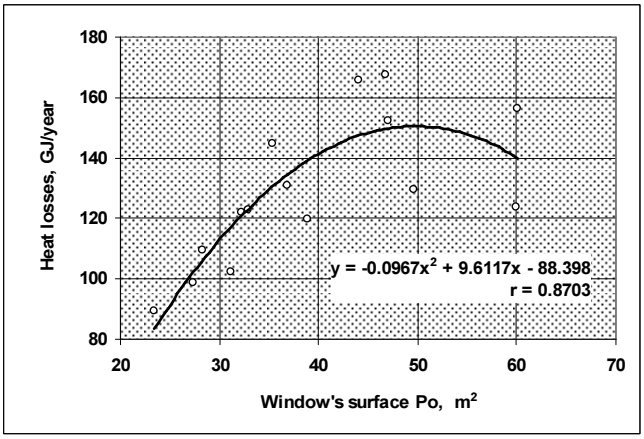

Fig. 6. The window's surface Po influence on heat losses

SUMMARY AND CONCLUSION

The amount of heat lost through partitions mainly depends on their surface area, heat-insulating properties and the temperature difference. For the sake of energy management a bigger density of the building's solid is advantageous, however a shape factor has a direct and more significant influence on heat consumption than exclusively on its losses. A more significant relation was obtained for the analysis of the influence of the surface of cooling partitions. Increasing in a certain bracket the insulation thickness influences to a small extent the percentage increase of capital spending, however after having reached a certain value further increase of insulation thickness does not result in the noticeable economic effects, but it becomes a source of construction problems. Analysing the heat losses it is more beneficial to use only the window surface, and not the elevation glazing. In the first case a clear correlation was noticed, while the changes in elevation glazing influenced the changes in heat losses only in 7%. Excessive size of transparent surface area is to a larger extent a source of increased heat losses than the factor generating considerable gains. In summer, however, it causes the overheating of rooms and the loss of thermal comfort. Keeping the required parameter values of microclimate, and especially of temperature, also influences the heat losses. Lowering the temperature from 20°C to 18°C causes the heat drop by about 8.5%.

REFERENCES

[1] Košičanová D., Sedláková A., Energy precautions in buildings in dependence on energy consumption of buildings, [in:] Budownictwo o zoptymalizowanym potencjale energetycznym, ed. T. Bobko, J. Rajczyk, Wyd. Politechniki Czestochowskiej, Częstochowa 2010, 146-150.

[2] Perez-Lombard L., Ortiz J., Pout Ch., A review on buildings energy consumption information, Energy and Buildings 2008, 40, 394-398.

[3] Wolski L., Kamiński A., Efektywność energetyczna - dążenie do zmniejszenia zużycia energii, Ciepłownictwo, Ogrzewnictwo, Wentylacja 2009, 6, 15-19.

[4] Lis A., Ocena poziomu zużycia ciepła w budynkach, Czasopismo Techniczne 2009, 5, 157-165.

OCENA WPŁYWU WYBRANYCH PARAMETRÓW NA STRATY CIEPŁA

W pracy przedstawiono rezultaty badań dotyczących strat ciepła z budynków. Analizowano bilans cieplny wybranych budynków mieszkalnych jednorodzinnych. Określono parametry wpływające na straty ciepła z budynków. Oszacowano wpływ wybranych parametrów na zmiany wartości strat ciepła.

Słowa kluczowe: bilans cieplny budynków, straty ciepła, zużycie ciepła do ogrzewania budynków, budynki mieszkalne jednorodzinne