INTERACTION OF ENVIRONMENTAL NOISE AND BUILDING CONSTRUCTION

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Summary

Article is about noise impact on environment and its influence to the building constructions. Incident sound waves in certain conditions can influence heat flow density values of exterior constructions. This actuation can influence values of heat transmission coefficient U or change surface temperature of construction. The subject of the article is analysis of noise influence to the selected transparent constructions in dependence on noise character. Conclusions will be documented by measurements during winter seasons of the year. Finally paper will point out differences building qualities positioned in silent, eventually noisy environment.

Keywords: noise, heat flow density, transparent construction, non-transparent,

1 Environmental noise and building transparent construction

1.1 Determination of heat transfer coefficient "U" in situ

Exterior building constructions are separating internal environment of the building from external environment. In these separating constructions, heat conduction is the most common type of the heat propagation. Necessary condition of the heat conduction is gradient between two environments. Heat flow density and temperature measurements and consequent determination of heat transmission coefficient U (W/m^2K) can be calculated in two ways according to the equations (1), (2) [1]:

$$U = \frac{q}{\theta_{ai} - \theta_{ae}} \quad [W/m^2K] \tag{1}$$

$$U = \frac{1}{1/h_i + 1/\Lambda + 1/h_e} \quad [W/m^2K] \tag{2}$$

$$\Lambda = \frac{q}{\theta_{si} - \theta_{se}} \quad [W/m^2K] \tag{3}$$

where:

q = density of heat flow (W/m^2)
$\theta_{ai} - \theta_{ae}$ – air heat difference in outer and inner side of the construction (°K)
Λ – surface heat transmissivity (W/m^2K)
h_i, h_e – heat transfer coefficient in inner and outer side of the construction
θ_{si} ,, θ_{se} – heat of the surface on inner and outer side of the construction (°K)

Heat transmission coefficient U (W/m^2K) represents heat flow propagating from interior into exterior through $1m^2$ of the construction at unit difference between temperature of interior and exterior. It is important parameter when assessing energetic properties of the building. Real values "U" of the building constructions are during in situ measurements often different because of the influence of various environment factors. The subject of this article is assessment of noise load influence of the environment to the alternation of the glass window plate heat flow density. Subsequently "U" values on the transparent part of the window construction are measured during non-stationary conditions. For measuring of corresponding parameters, ALMENO 2290-8 was used for continual recording of the measured values of the temperatures and heat flow density.

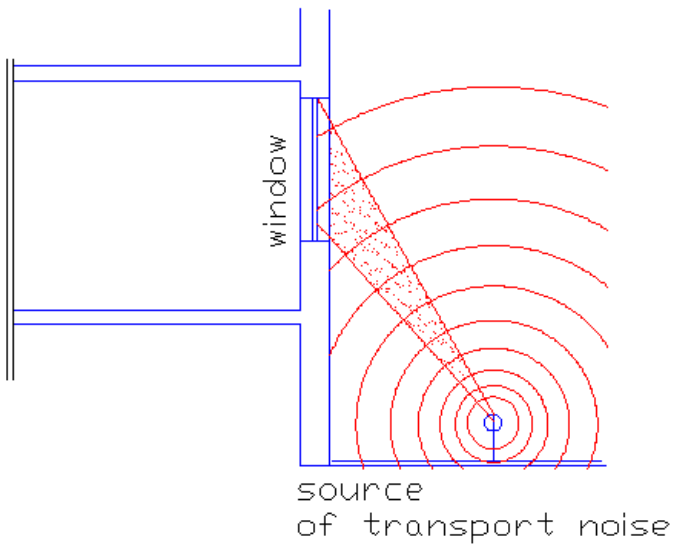

Fig. 1 Interaction scheme between internal, external environment and window construction

1.2 Action of environmental noise

Environmental noise has various character of influence therefore we can divide due to:

- sort (traffic, industrial, municipal…),
- character (changeable, stable),
- reference time of exposition (day, evening, night),
- exposition – time of the exposition,
- location in the relation to the surrounding constructions (in interior and exterior),
- direction and distance of the influence in the relation to the surrounding constructions.

The goal of the following experimental measurement in situ is assessment of the influence of the changeable traffic noise during the day period on the glass part of the window (double glass 4/16A/4TPS)

2 Experimental measurements

Measurement of the transparent part of the construction on isolation double glass in the office on the third floor was carried out according to the Fig 2 and Fig.3, during influence of exterior noise level from the traffic. Measurement results have been recorded by Investigation 2260 B&K. Visualization of the 1/3 octave spectrum analysis of the traffic noise is shown on the Fig.4. Measured values and calculation of U value was made according to equations (1) and (2). Final calculated values are shown on the Tab.1.

Fig. 2 View of measurement in situ from interior

Fig. 3 View of measurement in situ into exterior

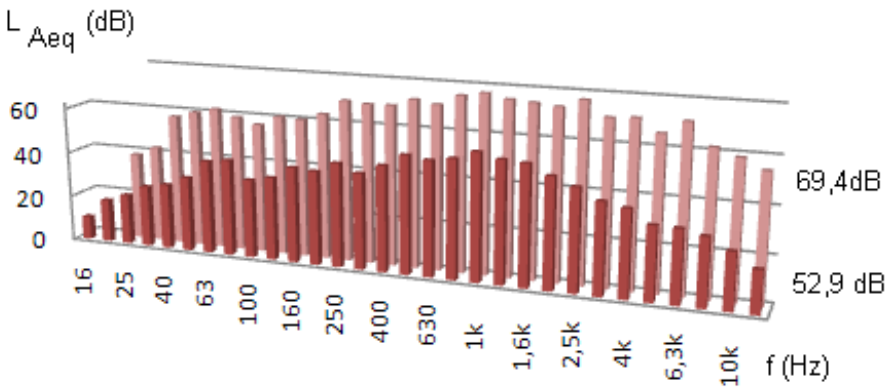

Fig. 4 1/3 octave spectrum analysis of the traffic noise – without traffic L_{Aeq} = 52,9 dB (background) and maximal traffic noise measured on 8.3.2010 o 7:00 -7:05 L_{Aeq} = 69,4 dB

Tab. 1 Experimental measurement results

measurement numb.	**1**	**2**	**3**	**4**
average value U (W/m^2K) according to equation (1)	1,44	1,427	1,32	1,31
standard deviation (s)	0,019	0,011	0,035	0,0211
average value U (W/m^2K) according to equation (2)	1,44	1,43	1,36	1,35
standard deviation (s)	0,0259	0,015	0,046	0,036
L_{Aeq} (dB) - traffic	52,9	58,1	65,9	69,4

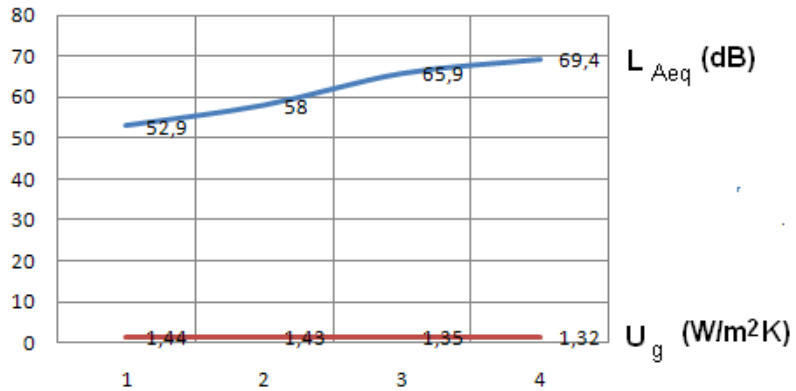

Fig. 5 Dependence of U_g value on equivalent band pressure level L_{Aeq}

3 Conclusions

Influence of noise from environment on the transparent constructions can be described following:

- Dependence of U_g value decreasement to increasement of noise from environment (traffic noise) in exterior of the building was proved.
- Irregularity of noise level is dependent on intensity of traffic, direction of noise propagation, time of exposition and location of the inhabitable room.
- Exposition of traffic noise can cause differences in real U_g value and its decrasement up to 10% in compare with windows situated to the reverse side of the traffic noise.

References

[1] *Almemo – manual (For all ALMEMO measuring instruments up to version 6) p.3-2-1*