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SOUND INSULATION GLAZING

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ABSTRACT
This paper describes the characteristics of sound insulation glazing, glazing composition (glass packages), and possible improvement of the quality of sound insulation glazing, measurement methods of the sound insulation. Furthermore, the influence of sound frequency on sound insulation glazing is elaborated, and the characteristics of the most frequently used glazing system are given. Moreover, the increasing problem of human environment is highlighted with reference to an increasing threat to people's health, caused by noise. Considerable importance is attached to the improvement of noise protection.
Key words: sound insulation, glazing, frequency

1. INTRODUCTION

Noise is one of the most frequent causes of men's stress and hearing loss. According to the World Health Organisation the level of noise of 65 dB presents the limit beyond which the noise may be dangerous for health. The noise of 35 dB is upper limit for pleasant stay within certain premises.
At the moment, the noise is one of the main problems of human environment, especially from the point that health of people and primarily nervous system are greatly exposed to noise, which is greatly increased by industrialisation, transport, urbanisation and over-populated cities. For example, noise caused by traffic today is eight times bigger than the noise thirty years ago, and the noise caused by airplane motors is thirty times bigger. Due to its influence on people's health, along with disturbance of people's comfortableness, the noise is one of the major discomforts of contemporary life. Sound from environment, which causes unpleasant feeling with people, can be eliminated by usage of sound insulation glazing. The negative influence of noise on people's health is manifested in several ways: hearing impairment to partial deafness, anxiety, heartbeat disturbance, stomach trouble, mental instability, insomnia, communication problems, etc. The type of sound insulation i.e. the type of glazing and making airtight depends on each particular case. It is worth mentioning that poor sound insulation may cause the a/m problems, while on the other hand the excessive sound insulation is not cost effective due to high prices. Annual costs in fighting the noise in Germany are estimated on over 15 billion of EURO. Smaller part of costs is related to individual buildings and disturbance of population's peace. In addition, there is an evident need for promoting the field of protection from the noise caused by traffic and industrial facilities.

2. GLASING FOR PROTECTION FROM NOISE

The power of sound insulation glazing is determined as shown by the following formula:

$$R_W = L_1 - L_2 + 10 \log S/A,$$

R_W – insulation glazing capacity
L_1, L_2 – mean sound level in the transmission and reception room, dB
S – partition surface area, m^2
A – total absorption by the receiving room, m^2

Sound insulation values for different types of glazing are presented in the table 1.

Table 1. Sound insulation value

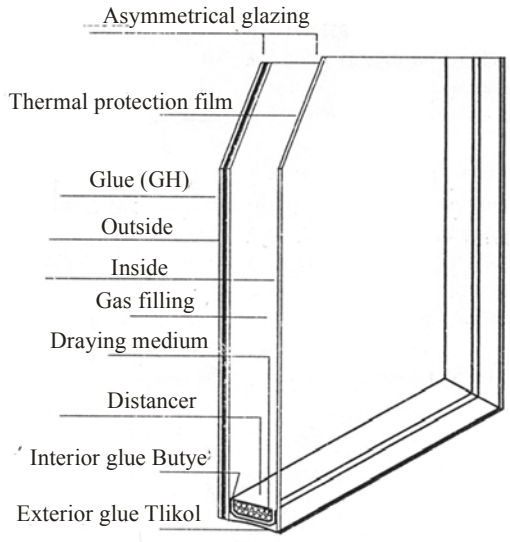
Type of glass	Thickness (mm)	dB
One layer glass	2 - 3	20
One layer glass	4 – 6	24
One layer glass	10 – 12	28
Two layers insulation glazing filled with dry air	4 + 15 + 4	35

The most critical parts of noise protection are windows and partition walls. Moreover, angle joints of profiles as well as the window to wall joints are of significant importance, too. Glass plays significant role which is why the glazing, which offers good protection from noise, is used today.

Sound and thermal glazing protection is based on asymmetric composition of glass parcels with inserted low-emission thermo insulation glass (Figure 1). Glazing of this type is titled as so called 'valuable pair', which provides information on sound and thermal insulation. As a result of having two interdependent values, both of them are changed simultaneously.

In its function to protect from noise, the glazing characteristics are based on the following:

- Asymmetric thickness of glass (thicker glass is inserted on exterior side and if the thickness proportion of glass is 2:1, it is recommended to harden thin glass),
- Two layers glass or laminated, along with law emission glass,
- Thickness and filling of space between two layers of glass (gas filled with increased value of sound insulation Rw of 2 to 3 dB).



There is a very frequent need to put passive protection from noise to building using sound insulation glazing. Contemporary sound insulation glazing need to have wide spectre of sound protection characteristics (up to Rw = 56 dB) as well as capacity to contribute to significant reducing of thermal loss through glass.
There is a need to take care of the entire building when planning the sound insulation. Attention is exclusively devoted not only to sound insulation of the window wing and insulation glazing, but to sealing of joints along with frame of the opening.

Figure 1. Cross section of sound insulation glazing

3. IMPROVEMENT OF SOUND INSULATION GLAZING

Improvement of sound insulation is possible to gain through purchase of glazing with good sound insulation for frequencies with biggest noise. Good sound insulation is obtained through modification of system and glass of given glazing type. For the reason that, the situation when glazing is specified for improvement, without previous knowledge on certain characteristics or source of noise, may lead to unnecessary investment and bad effect of sound insulation.

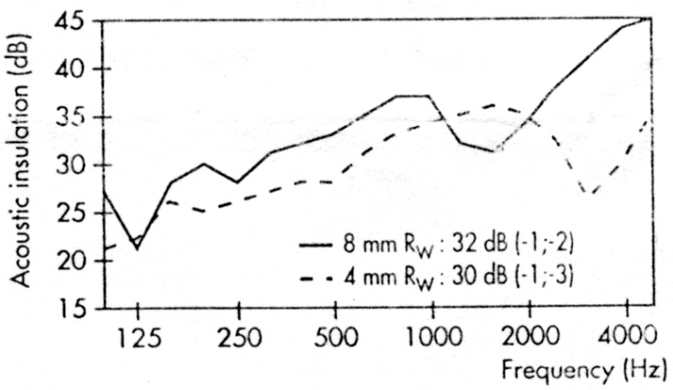


Figure 2. Relation between sound insulating glazing (thickness 8 and 4 mm) and sound frequency

There is a need to use correction factors with calculation of sound insulation. That's why the correction factors and indexes Rw (C, Ctr) are applied. The correction factor Ctr is used in cases when noise is caused by street traffic, while the application of the correction factor C is recommended for accompanying outdoor structures of noise. Generally, both corrections are negative and are being deducted from Rw, along with definition of possibilities to reduce noise of construction elements. Their values are obtained through laboratory researches and are deducted from Rw value.

For example:
According to EN 717-1 the pattern is:

$$Rw(C; Ctr) = 37 (-4; -9)$$

Consequently, the sound insulation of the facade is 37 dB, and it is reduced for 9 dB for the street traffic. In some countries, the result is given directly:

$$R_A,tr = 28 \text{ dB, to je } 37 - 9$$

The same calculation is applied for C:

$$Ra = 33 \text{ dB, which is } 37 - 4$$

The critical sound frequency, which has low sound reduction (Figure 3.), is characteristic feature of all glazing types. Light vibrations, which produce noise more frequently, exist on these frequencies and random resonances. Improvements on sound insulation are effective up to 10 – 15 dB.

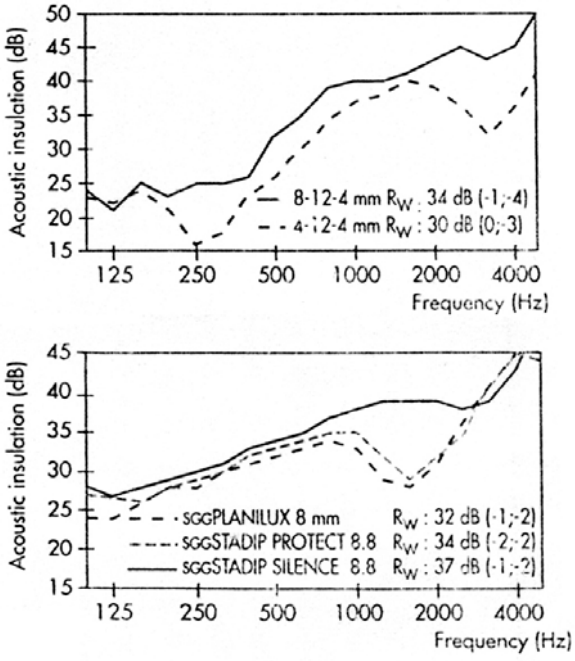


Figure 3. Relation between various sound insulating glazing and sound frequency

The critical frequency of 3000 Hz is for ordinary glass (thickness 4 mm) and 3200 Hz for 13 mm glass. Enlargement of glass thickness is followed by resonance descending towards lower frequencies. At the present time, the critical frequencies are eliminated by development of new type of glass with polyvinyl butirol (PVB) film.
Sound insulation characteristics of the most commercial glazing are presented in the table 2.

Table 2. Sound insulation glazing

Article	Article No.	Thickness mm	Mass kg/ m^2	Sound insulation Rw (dB)
Planilux	4	4	10	30
Planilux	6	6	15	31
Izo-staklo	4+12+4	20	20	32
Izo-staklo	6+12+6	24	30	33
Visarm	33.1	6/7	15.5	32
Visarm	44.1	8/9	20.5	33
Visarm antirumore	LAM 53	8/9	20	33.5
Visarm antirumore	64.S	11/12	25	37
Stadip silence	33.1°	6/7	15	36
Stadip silence	55.1°	10/11	25	39
ISO-silence	40/21	21	35	40
ISO-silence	43/31	31	45	43
Contrasonor	38	23	41	39
Contrasonor	50/40	42	49	50
Climasonor	38/19	19	30	38
Climasonor	49/41	41	50.5	49

4. CONCLUSION

Sound insulation of insulation glazing primarily depends on the following factors:

- Glass mass: the heavier the glass, the higher the value of sound insulation
- Glass flexibility: the more flexible glass, the better sound insulation. This cognition is applied with usage of GH glass (glass connected through GH procedure). As a result of joining two thin glasses glued with bitumen, there is a GH glass, which is manifested with higher mass and lower bending firmness. Such insulation glasses have better sound insulation. The best manifestation of this improvement is in low and high frequency field.
- Glass composition: Thickness of outdoor and indoor glass has to be different, the higher difference of glass thickness, the higher value of sound insulation Rw.
- Inter-glass space width (MSP): The wider MSP, the better sound insulation. Increasing the width leads the resonance of the empty space towards the lower frequencies. As most of insulation glasses have both sound and thermal insulation, it is worth mentioning that each MSP change leads to changes of the k-value.
- Filling of MSP with gas: When heavy gas replaces air in MSP, the sound insulation increases for 2-3 dB, and this kind of filling press the resonance frequency to lower area. Gas, which is used to MSP (SF6, argon, krypton or gas mixtures), usually has an impact on thermal and sound insulation.

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