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BUILDING REGENERATION FROM ACOUSTIC POINTS OF VIEW

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Building Regeneration from Acoustic Points of View

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Abstract:

The growing standard of living is evident in many countries all over the world. This trend brings some positives for our society but it can also cause difficulties for individuals. It is beyond doubt that one of the darker sides is a threatening danger of destroyed environment. An unprecedented expansion of traffic causes an enormous increase of noise strain. This conference paper deals with the possibilities of decreasing harmful effects of noise in internal building environment. The latest surveys indicate that people spend 90% of time inside of buildings.

1. Introduction – sources of noise

The noise strain of our population comes from working environment (40% in average) and from the other environmental types (60% in average). In towns the noise of traffic is dominant (75-85%), it reaches the levels of 70-85 dB (A) on main roads. In constructions, complaints from tenants are usually oriented towards inner sources of noise (elevators, boiler rooms, transformer stations, heating, cooling, ventilation) and neighbourly noise (loud voices of tenants, sound reproducers, bathroom operations, toilets, sewage system, refrigerators, digesters, hung gas boilers etc.). [1]

1. 1. Living environment

The researches and surveys of WHO (World Health Organization) show that most people in developed countries of Central Europe spend up to 90% of time in closed inner space of buildings. For the benefit of health protection it is aimed at creating as ideal interior conditions as possible, such as noiseless surrounding.

1. 2. Noise reception

The auditory analyzer carries out a function of the alarming organ. Auditory impulses are biologically more effective than visual. People receive vast majority of alarming impulses from the surrounding by ears. The organism has no possibility of putting hearing out of operation physiologically. As we do not have "ear lids", our ears are "open" even when sleeping and central nervous system processes all sound impulses. Alarming noise that is experienced on daily basis (e.g. noise of approaching lorry) is identified as dangerous even during sleeping and subconsciously activation of stress reaction occurs. [1]

1. 3. Noise limits

The level of acoustic sound pressure should not exceed the value of 65 dB during days and 55 dB at nights in the long term. Long-term stay in places with higher level of sound pressure provably causes health problems.

1. 4. Monitoring

The monitoring of noise coming from an external environment includes 24 hour-measuring in 42 basic areas selected in 21 cities in the Czech Republic. From the below displayed maps follows that the limit of acoustic pressure is exceeded very often.

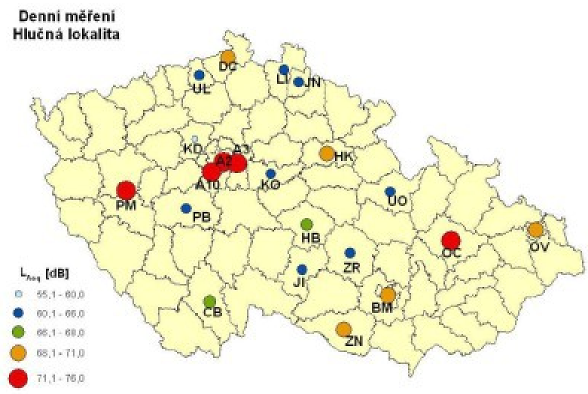

Fig.1. Day measuring in a noisy area. Source [2]

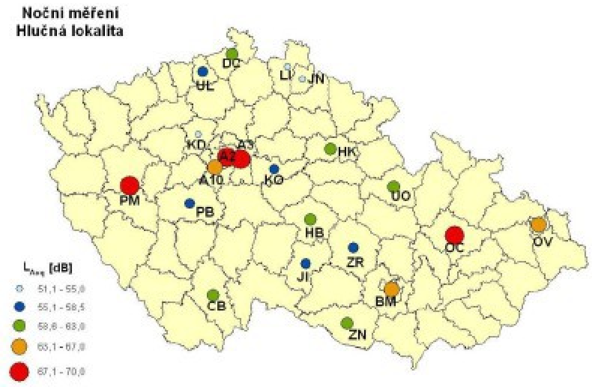

Fig. 2. Night measuring in a noisy area.

1. 5. Noise damping

The most effective way of disinhibation of noise sources is to place an insulant as close to the source as possible. Considering the traffic noise it is difficult to damp down the rolling noise of passing cars. Therefore nothing more remains to be done than environmental protection of inhabitants by high quality acoustically protective building structures.

2. Regulations and norms

In the Czech Republic, health protection against the inconvenient impact of noise and vibrations is solved by the goverment regulations No.148/2006 Code.

The value of building balanced sound-transmission loss R´w is the most crucial parameter for assessing the acoustic comfort in interiors. The sound transmission loss is a quality of a building construction which is expressed by the loss of an acoustic output by the air transmission by force of a construction [3]. The higher the figure of a construction is, the better sound insulation occurs.

The limits required in flats are displayed, reffering to [4] :

Tab. 1 The limits of the sound transmission loss.

Residential houses – a flat	ceilings R´w (dB)	walls R´w (dB)	doors Rw (dB)
All rooms of other flats	52	52	-
Public spaces of the house (staircases, halls, corridors, terraces)	52	52	32
House spaces not used publicly (e.g. lofts)	47	47	-
Passages, underpasses	52	52	32
Gateways, subways, garages	57	57	-

3. Damping structures

3.1. Vertical structures – walls forming a jacket of a construction

When choosing a material the most crucial parameter from the aspect of building acoustics is its basis weight. The higher it is the better the structure damps the sound transmission through the air. The materials used for this type of structures nowadays are in most of the cases acoustically suitable.

Proposal of innovation:
In noisy localities it is very convenient to build a sandwich skin wall formed of mineral wool covered by suitable covering weather-proof materials. By this measure also thermal-technical aspects will be improved, which has a positive effect on the amount of consumed energy needed for heating.

3.2. Vertical structures – walls dividing inner spaces

This type of structures, in case it separates flats of different users, seems to be the most problematic type in practice. When designing interapartmental walls and partitions it is important to pay heightened attention to its ability to damp external noises. Experience from constructions proves that tenants are disturbed by noisy activities of their neighbours. Measurements we conducted often showed that the desired value R´w = 52 dB was not reached.

Proposal of innovation:
It is important to install so called sound-insulating sandwich skin wall that consists of acoustically absorbent materials (mineral wool) and material boards (plasterboard, wood-cement chipboard). It is crucial to install the wall the way it is not tightly connected with the original wall and also it is separated from surrounding structures, e.g. by elastic bearing of the girders.

3.3. Windows, doors

These elements significantly decrease sound insulation of a whole building structure into which inbuilt. They are usually the weakest (the least material) element, moreover with number of unsealed joints.

Proposal of innovation:
During selection of window types it is recommended to request the value of TZI (category of sound insulation) or Rw from the producer. The higher the declared value the better insulating

parameters the product has. We also recommend precise sealing of joints, e.g. with silicon profiles fixed into cut-outs.

3.4. Horizontal structures – floorings and ceilings

This type of structures is characteristic by insufficient protection against impact noise, which is evoked by spreading sound wave from the fall of objects onto floor covering. The use of dustless surfaces of floorings (laminate, paving) has become very trendy. However they make a great number of reflecting surfaces and the resulting space is difficult to be damped.

Proposal of innovation:
It is possible to adjust the existing noisy flooring (ceiling) by acoustic deck. Plaster-boards are commonly used materials with absorption pad.

4. Practical examples

On the basis of complaints of tenants of a residential house in Frýdlant nad Ostravicí, we made measurements of sound-transmission loss of interapartmental walls and partitions in March 2006. It is a five-storey house built from Porotherm system elements.

4.1. Measured building structure

The subject of measurement was an interapartmental wall type Porotherm 24 P+D 240 mm thick. Its acoustic parameters are as follows:

- according to the producer R´w = 50 dB
- calculated value by index method R´w = 48 dB
- calculated value by progressive method R´w = 48 dB
- our measured value **R´w = 44 dB**

The normative requirement for this structure is R´w = 52 dB. The structure is thus unsuitable for interapartmental partition. The reasons of relatively big differences between values declared by producers and calculation can be as follows:

- Conditions in the laboratory are always ideal and do not take into consideration external effects;
- none of calculation methods can include all side ways of noise spreading;
- very low value acquired on the construction field is caused by imperfect execution and conducting installations in the partition, which makes it weak.

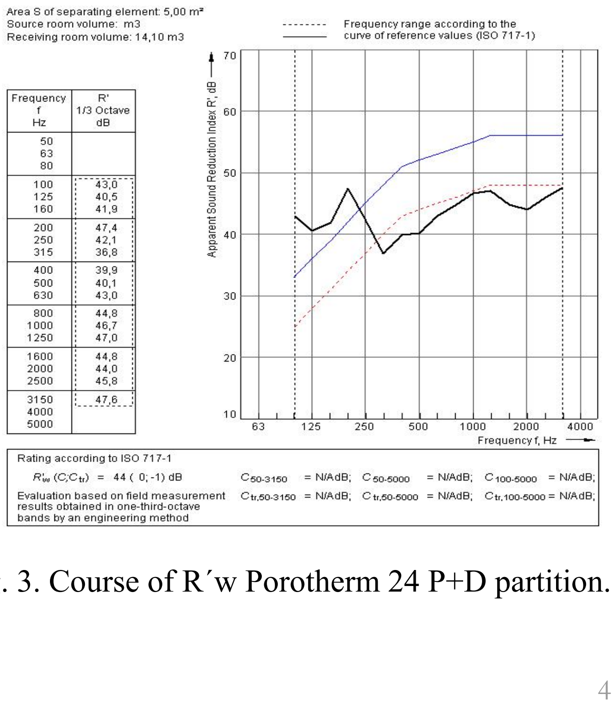

Fig. 3. Course of R´w Porotherm 24 P+D partition.

5. Conclusions

On currently built constructions, mainly residential houses, we can see pursuit of as great utilisation of the built-on areas as possible. This trend leads to design of thin partitions so that the useful area of flats was as large as possible. However in such cases it is very risky to rely only on the values of sound insulation declared by producers. In practice, even the least essential intervention, such as conduction installation in the wall, have significant effect on decrease of damping protection of the structure. During additional measures, when applying acoustic brick veneers and acoustic decks in the interior, the process of buildings and annexation of saved flooring area gets a bit complicated. Therefore even in the project preparation it is necessary to remember the acoustical protection of construction users.

The Faculty of Civil Engineering in Ostrava disposes of top measuring device by Danish company called Bruel & Kjær that enables to measure various parameters of building acoustics. Our goal is to analyze sound parameters and on the basis of measurements to propose effective acoustic treatments.

Sources:

[1] http://www.szu.cz/chzp/hluk/ dated on 19.3.2007
[2] http://www.szu.cz/chzp/hluk/monitoring-hluku/hlucnost-v-cr.html dated on 19.3.2007
[3] ČECHURA, J. *Stavební fyzika 10*, *Akustika stavebních konstrukcí,* Praha : ČVUT Praha, 1997, ISBN 80 – 01 – 01593 - 9
[4] ČSN 73 0532:2000 Acoustics – noise protection in buildings

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