CONSEQUENCES OF LOW BASIC NOISE LEVEL IN AN AREA

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1. INTRODUCTION

The noise is one of principal problems of today. It occurs at all places where the man stays and lives. The noise influences the man's working capacity more than any other factor. It reduces the man's concentration, it causes damages or loss of hearing and various nervous illnesses, it increases the blood pressure etc. The illnesses are caused not only by the high, but also by the too low level of the noise in area where people stay.

The harmful influence of the high noise level was established some time ago. This lead to sharpening of the existing and adoption of new legal prescriptions and reduction of limit values. It is incontestable that the high noise level is harmful and this will no more be discussed hereinafter.

The influence of the low noise level is mainly of secundary nature. The low noise level and its negative consequences are less known and are almost not dealt with.

2. LOW NOISE LEVEL

The low noise level is meant to be the noise level lower than 25 dB(A). Today this is in the same time the limit value for sounds coming by night from a factory into the dwelling rooms of a neighbouring flat. This noise level does not relate only to the situation in the dwelling and working rooms, but also to the situation in health resorts and other places where man stays and lives.

The low level of the basic noise comprises all noise sources which are not taken into account in the high noise level and to which not enough attention is paid. They were taken into account only after reduction of the basic noise level. Further improvement of the situation could not be made without elimination or reduction of their influence.

Similar cases of wrong evaluation of the existing situation and wrong evaluation of the nature of the individual noise sources occured also in range of high noise level. A typical example of wrong evaluation of the existing situation and influence of the individual noise sources is the external noise level on motor

LOW BASIC NOISE LEVEL

vehicles and development of their limit values. As late as in the seventies and in the beginning of eighties it was considered that the principal noise source of each motor vehicles was its driving engine. Encasement of the engine should solve this problem. This point of view influenced not only adoption of future limit values, but also working out of rules and regulations for measuring the external noise of motor vehicles. It is incontestable that on the utility vehicles with 90-91 dB(A) external noise level the noise level of the driving engine was highest while the other noise sources were less important, Figure 1. However, when the external noise level on the utility vehicles was reduced to values smaller than 85 dB(A), the influences of the transmission and tyres became more important. On the utility vehicles with 80 dB(A) external noise level the influence of these noise sources is stronger than the influence of the driving engine /1/. The effect of these findings was that in mid-eighties the anticipated max. limit values of 80 dB(A) were increased again to 83 and 84 dB(A).

CATEGORY OF VEHICLES	LIMITS 1970	LIMITS 1980/82	LIMITS > 1986*	LIMITS > 1986
PASSANGER CARS	82	80	75	77
BUSES TO 3,5 t	84	81	76	79
BUSES ABOVE 3,5 t	89	82	80	80
BUSES ABOVE 147 kW	91	85	80	83
UV TO 3,5 t	84	81	78	79
UV ABOVE 3,5 t	89	86	80	83
UV ABOVE 147 kW AND ABOVE 12 t	91	88	80	84

*old limits

Fig. 1: Limits of external noise of the vehicles in dB(A)

It is a great difference between situation with high and low noise level. In case of high noise level the high frequency noises occur in addition to low frequency noises, Figures 2 and 3. In most cases the share of high frequencies is predominant, Figure 2.

In case of low noise level only the low frequency noises occur. Although these low frequency sounds are felt and cause bad fecling and pressure in ears to many people, they remain mainly neglected because they are not in the A-value of the measured noise level. Such cases occur very frequently. Such an example is the noise of streaming in the components of central heating, system of ventilating and air conditioning of rooms, Figure 3. The noise level of these noise sources need not be high, but in case of low level of the basic noise in the room any increase in the noise level is very important. It is felt considerably more in-

tensively in an area of low level than in area of high level of basic noise.

3. COORDINATION OF EXISTING AND FUTURE STANDARDS

Today many standards and rules are available for solving various problems concerning the noise. Work is being carried cut on new standards and rules which are not always coordinated with the existing standards. Such an example are the low frequencies. On one hand, standards are available for solving the question of passage of sound in air and sound due to walking through various construction elements such as walls, floors, ceilings, doors etc. /2/. On all these elements the degree of damping of sound transmitted by air is very important; in case of floor also the degree of damping of sound caused by walking is important.

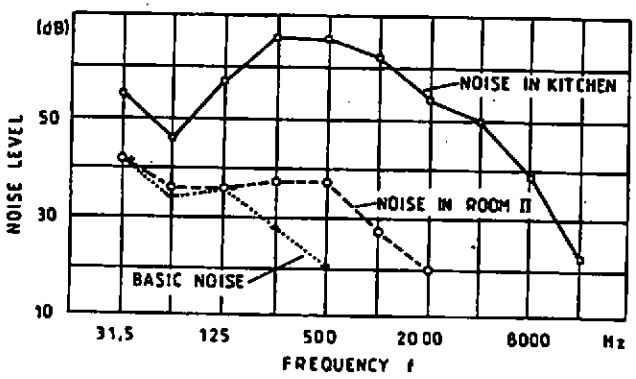

Fig. 2: Basic noise level in a living room

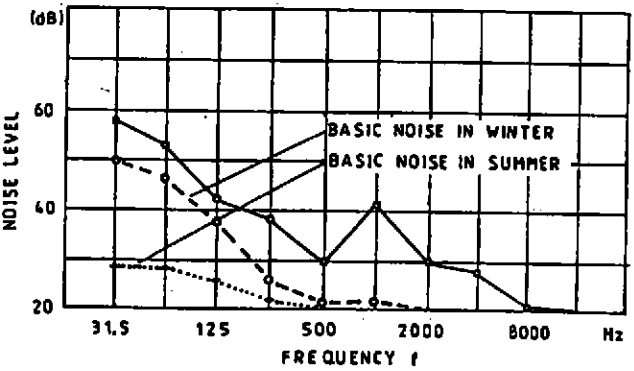

Fig. 3: Basic noise level in a room

Figures 4 and 5 indicate the frequency curves for the degree of damping of the sound transmitted by air and damping of the sound caused by walking. It is characteristic of both curves that the lowest frequency of the noise is about 100 Hz. This is not unusual since it corresponds to the technical possibilities of reduction of the low frequency noise.
The same standard indicates the permissible noise level by day and night in the rooms of a flat which is transmitted from neighbouring rooms of an office, factory, institution, pub etc.
The limit values have also been specified for the joint system

of ventilation of a dwelling building, which is considerably higher than the permissible level in the dwelling rooms by night.

At present, work is being carried out on adoption of a new standard which would serve for solving problems concerning the noise in the range of low frequencies lower than 100 Hz /3/. No strict requirements are in force for the manufacture of construction components concerning efficiency of damping of the sound transmitted by air and sound caused by walking with respect to low frequencies, Figures 4 and 5, and existing limit values for the noise level of the system of the joint ventilation of a dwelling building. That is so much more incomprehensible because on all noise sources of low noise level the influence of low frequency noises is very important. This can be seen in Figure 2 shows the resalts of the frequency analysis of noises produced by one ventilator. The ventilator were located in the neighbouring room. In addition to the noise level of the ventilator in the kitchen also the noise levels of the ventilator in room II and of the basic noise in room II are indicated.

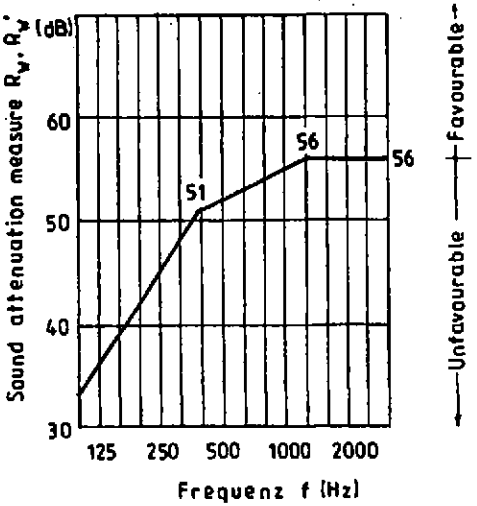

Fig. 4: Silencing of the noise transmitted by air

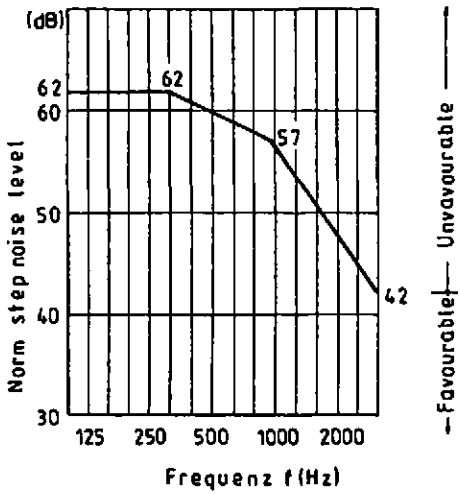

Fig. 5: Silencing of the noise transmitted by walking

4. LIMIT VALUES OF NOISE LEVEL IN THE ROOMS OF FLATS

In Germany it is foreseen by standard /2/, rule /4/ and TALärm /5/ that the noise level in the dwelling room where people stay, live and sleep mus not exceed

by day	35 dB(A)
by night	25 dB(A).

In other rooms slightly higher values by night are allowed and amount to 35 dB(A). This applies to the noises penetrating through the existing construction elements from the rooms of neighbouring offices, factories etc. This is indepent of the fact whether the noise source is located outside or inside the dwelling building. The permissible noise level of the joint system of ventilation of a dwelling building and waterinstallations amounts to 35 dB(A) taking into account that these values can be exceeded periodically for a short time. The values are valid since November 1989.

Previously, since 1962 somewhat higher limit values have been in force. They amounted to

by day	40 dB(A)
by night	30 dB(A).

The noise level due to operation of the joint ventilating system and waterinstallations was not allowed to exceed 40 dB(A).

5. MAIN NOISE SOURCES

In areas where people live there are various noise sources. In general outdoor and indoor noise sources are distinguished. The kind of the noise source depends on the place where it is located or installed. The indoor noise sources are located in a room or on an area where the noise level is measured. In flats these are mainly various household appliances and devices such as the system of heating, ventilation or air conditioning of the flat or individual rooms, all parts of which are located in a room or flat. On cases when only the parts of these devices are located in a room or flat they are called outdcor noise sources transmitting the noise of the devices into the room. Such components are heaters, supply and discharge pipes for heated water in the central heating system or openings for ventilation of rooms, located on the limit area of the room or connected by channels to the ventilating system of the building.

The external noise sources are of two kinds. These are
- the noise sources located outside a flat but located in the dwelling building and
- the noise sources located outside the dwelling building in which the room, where the noise is measured, is located. They comprise also the noise sources located in another building.

The principal ncise sources outside a flat but in the frame of the dwelling building are: lifts, joint ventilating system,

waste collecting system and all those noise sources whose sounds are transmitted from the area of stairways through walls, doors or windows into the rooms of a flat. The kind of the external noise comprises also those noise sources which are located in the neighbouring flats and whose sounds penetrate into another flat through walls, ceilings, floors and windows.

The external noise sources outside a dwelling building are various industrial devices located in factories, offices etc. and vehicles whose sounds penetrate into dwelling rooms through walls, windows and balcony doors. In all these cases the influence of the low frequency noises is very significant. This can be best evaluated during idle running of a diesel engine standing before the building on the road or on the parking ground. Although the noise level of a running diesel engine is low, the sound of the engine is well heard in the dwelling room. The intensity of the noises is higher if the windows are well sealed and if the bacis noise levels in the vicinity and in the room are lower. A similar effect occurs in dwelling rooms when the doors and windows in the living room or in the balcony room a additionally sealed in order to reduce the influence of the traffic noise in rooms. The basic noise level in the room becomes lower. In such a situation the influences of all noise sources from the neighbouring flats, stairways etc. become important while previously they were almost completely unnotized in the rooms. The situation is particularly critical in those rooms of the flat where already by day the basic noise level is $\leq$ 25 dB(A). In the frequency spectrum of the noises only the low frequency noises are exist.

When studying many situations and existing conditions having brought about controversies between the points of view it was realized that many people support more easily the low frequency noises, if also the high frequency noises are present, than if only the low-frequency sounds are in question. This is independent of the fact that in case of sounds of various frequencies the total noise level is for more higher than 25 dB(A). This applies particularly to people engaged in the mental work, whom the low-frequency sounds deconcentrate and disturb. Many misunderstandings and differences occur after the basic noise level is reduced by various measures to below 25 dB(A). The influence of the other noise sources can be reduced only by extensive efforts although there are no legal arguments for this work.

6. BASIC NOISE LEVEL IN SOME DWELLING ROOMS

6.1 Bedroom of a flat

In a bedroom the strokes of the billiard ball. The flat is located at the third floor of dwelling building; the noise source was a billiard table situated in an inn in the basement of a

building. When examining the situation inside and outside building it was established that the interior of the building was directed towards a calm area.

In the bedroom the basic noise level measured by day was 22-23 dB(A). Such was the situation after performing additional measures in the flat and in the bedroom. By night the basic noise level is probably even lower. In order to establish in which direction the strokes of the billiard ball penetrate into the bedroom, the billiard balls were struck with great intensity (higher than during the play) in the room with the billiard table. The A-values of the measured noise level did not change greatly. After long concentrated listening it was possible to feel weak striking of balls. The noise produced was of very low intensity consisting of low frequency noises.

6.2 Living room

The situation in the living room of a flat is indicated in Figure 6. The large window is directed towards a traffic road paved with large granite cubes. The road is uneven therefore the noise level caused by tyres is considerably higher than the noise level on an asphalted road. The influence of the driving engines is not noticed. In the interior the living room have the doors leading to the other rooms of the flat and stairway of the dwelling building. Although the large windows of the living room are well sealed, the influence of motor vehicles in the room is very significant. This can be seen also from the results of the frequency analysis of the basic noise level with and without the influence of the motor vehicles, Figure 7. The measurements were made by night when the number of vehicles was smaller. When the basic noise level without the influence of motor vehicles in the room was low, various noises were heard from the neighbouring flats and stairway. These were mainly the low-frequency noises such as sounds due to walking, opening and closing of lift doors, talking etc. In case of increased noise level in the room, those noises were almost unnoticed. In the neighbouring rooms of the same flat where the influence of the motor vehicles was low not only by night, but also by day, the noises from the neighbouring flats and stairway were

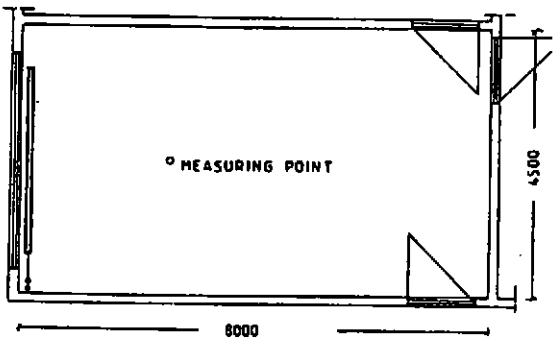

Fig. 6: A living room

more clearly heard.

6.3 Partition wall between two rooms

Figure 2 shows two rooms of a flat, separated only by a light wall. As it can be seen, the noises in the room II were significantly reduced only in the area of high frequencies. In the area of the low frequency noises that increase was insignificant.

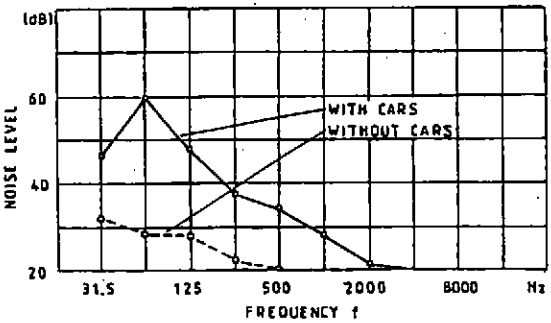

Fig. 7: Basic noise level in a living room

8. CONCLUSIONS

The influences of the low level noise are significant in an area where the basic noise level is lower than 25 dB(A). In case of this noise level, mainly the influences of low frequency noises prevail. These noises cause uncomfortableness to many people. That influence is very significant because these sounds are mainly neglected in the A-values of the measured noise source. On the basis of many observations it was realized that people support loud noises consisting of low and high frequency sounds more easily than the low level noises consisting mainly of low frequency sounds. In case of low level of the basic noise many other noise sources become important, whose sound were almost completely neglected in case of higher basic noise level - mainly the low frequency noises are in question. In the room influenced by the traffic noise it is possible to reach a basic noise level of 25 dB(A) only by additional measures in the area of the door and windows. If the influences of the external noise sources, the influence of the noise sources in the dwelling building is increased, whose noises are for more difficultly supported by the inhibitants than many noises of high level. The introduction of new standards should be coordinated with the existing standards. This applies particularly to the standards in which the limit value in an existing standard is indirectly reduced.

9. REFERENCES

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/4/ VDI-Richtlinie 2058, Blatt 1 (D).
/5/ Technische Anleitung zum Schutz gegen Lärm (TALärm) (D).