

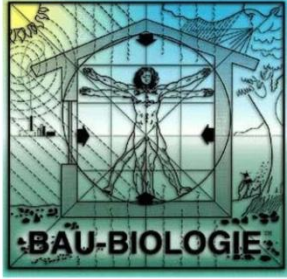
International Institute for
Bau-biologie® & Ecology

IBE 204.7

IBE 204.7 Noise Protection



**BRINGING TOGETHER TECHNOLOGY AND DESIGN
METHODS TO PROVIDE THE INFORMATION
NEEDED TO CREATE HEALTHY HOMES AND
WORKPLACES**



Noise Protection – IBE 204.7

Welcome

*Thank you for choosing IBE for your educational needs. Current environmental realities demand a new approach to ensuring that our homes, schools and office buildings support the health and wellness of all who dwell there. We strive to provide the latest information and cutting edge methodology on the vital, complex relationship between the natural and the built environments. May you find your educational experiences enlightening, and take this knowledge out into your community for the benefit of all. **Michael Conn**, Executive Director, Institute for Bau-Biologie & Ecology.*

Course Navigation

You will find that it is very easy to navigate through this course.

- Progress through the lessons using intuitive navigation tools. When you study, make sure to be aware of and use all supporting materials, such as pdf files, video and audio clips, links to other websites or relevant articles or papers, as well as the online forum.
- The last lesson will give you the option of downloading an electronic version (PDF) of the course. Please be aware that this information is copyright protected.
- When finished, you will be ready for the test. These tests are "open book" and are designed to help you evaluate your understanding of the subject.
- When you have finished the entire Course Pack, a Certificate of Completion is available online.

By using the Forum feature, students can share information and solve problems. We would like to see truly interactive discussions take place.

Please be advised that links to third party information may not reflect or support the Building Biology viewpoint. However, it might be of some interest to see how other people, groups, institutions, etc. argue the same subject.

Copyright

Bau-Biologie is a registered trademark of The Institute for Bau-Biologie & Ecology, Inc.
©Institute for Bau-Biologie & Ecology, Inc., 2002-2010.

Direct all inquiries to:

General Information: infopod@buildingbiology.net
Technical Support: techsupport@buildingbiology.net

Phone: **1-866-960-0333** (toll-free in US & Canada)

Table of Contents

Cause and Effect of Sound	3
The Problem of Sound in General	3
Health and Sound	4
Noise and Jurisdiction	7
Sources of Sound and Sound Intensity	8
Metering of Sound Level.....	12
Noise Abatement.....	13
Constructive Sound Insulation.....	13
Sound Absorption and Architectural Acoustics (Space Acoustics)	26
Sources of Noise and Noise Protection in Offices	28
Vibrations and Noise	29
Measures Against Noise from the Neighborhood	32
Final Consideration.....	33
Glossary	35
Summary of Literature.....	36
Sound Intensities (From Basic Building Data by Don Graf)	37

Cause and Effect of Sound

The Problem of Sound in General

"One day people will have to fight noise as we must fight cholera and pestilence now." Robert Koch¹

What was envisaged by Robert Koch many years ago has long become a reality. It would be much more sensible, however, to take measures against noise from the beginning rather than fighting it afterwards. But in this respect civilization, technology, economy and the law makers have failed altogether.

In Baubiologie, noise abatement is one of the more important topics as this nuisance, coming from the surrounding environment, is affecting everybody directly every day. And the reason why, people do not react much more strongly must be seen in the fact that the development of this problem has advanced to such a degree that a sensible solution can hardly be seen. One tries to adjust to such an outrage.

Reasons for the growing noise problem:

- With regard to the development of technology after the second World War and the fast happening reconstruction (in Europe) peoples health was not the most important topic; the advancement in technology, science and economy blindfolded everyone in terms of holistic and humane environmental design.
- Guiding activities of state and local government aimed at preventive measures for survival and order with regard to hazardous acoustic environmental problems has basically failed (surveys in governmental agencies (in Germany) has confirmed this.
- In the process of establishing laws, policies, norms, rules and standards about noise thresholds the interests of those subjected to noise was not properly considered (only the interest of institutes and government institutes, with no public health specialists were involved).
- In West Germany the money spent on noise protection is only 0.04% of the gross national product; but 1% at least would be necessary to control this problem within one generation.
- The research with regard to the hazardous direct or indirect impact of noise is far behind the technical and economic development.
- The technical and structural possibilities of minimizing noise in traffic, in industry, and in home construction was not sufficiently utilized. A survey with manufacturers of building materials revealed that only 10 to 20% of the manufacturers have acoustical data on their products.
- Existing policies and guidelines regarding noise control are only compromising solutions because they tend to satisfy technological and economical purposes rather than health and survival problems.
- One allowed the traffic to grow without applying plans and goals which resulted in destroyed villages, settlements and landscapes (25% of the roads in West Germany are situated in built-up areas).
- When building roads, residential and industrial developments the noise factor was very much neglected; and often existing oases of silence were thoughtlessly destroyed.
- As the population and industry was concentrated and mass quarters grew to huge sizes sources of noise grew and were concentrated.
- After the war in Europe in that hectic building period one could not be bothered with quality. Quantity was the magic word and consequently many mistakes were made in the planning and implementation in the field of architectural acoustics.
- The successful attempt to create the fully automatic dwelling (appliances, installation, technical hobby gear, radio, TV, telephone, etc.) helped to increase noise sources and consequently molestation; the same is true for the work place, offices, hotels and even for the so called recreation resorts.
- Also, the entire impact of civilization on the human being (of which a large amount is noise) makes people more sensitive to any kind of noise.

¹ Robert Koch: Medical Doctor, bacteriologist, Nobel Prize Winner in 1920

This is a rather sad result. It is another example which shows clearly what happens when a development gets out of hand or is not under control, i.e. a missing thorough and holistic planning approach. We would not need an extensive research to find out whether we are masters or slaves of our civilization.

Noise is a manifestation of our time and maybe even an illness:

For most people noise is disturbing, unwanted and/or a health hazard. Almost everyone needs those noisy appliances, vehicles, machines and buildings. It is quite impossible to withdraw from noise; small settlements or villages can be much noisier than some parts of big cities. And finally noise might be called a time phenomenon because many people have become addicted to it; they cannot live without the noise of the town and the constant impact of radio, TV, Walkman, etc. - it looks like an attempt to escape from themselves, from their inner emptiness; it may be just a bad habit or whatever but it results in an 'unhealthy' behavior pattern.

A normally sensitive person would try to escape from a noisy office or work place, from streets and malls and shops to the silence of his home. But even here silence - the element of life - is destroyed, even in one's private sphere. And people who have not lost their sensitivity totally have noticed that human inter-relationships are being destroyed by noise. And the results and problems arising from these circumstances are considerable.

Health and Sound

On the basis of statistical data it is possible to prove how big and how important the impact of noise is:

- 30 million Germans feel that noise is pursuing them from outside to their personal dwelling (1974) and that is an increase of 100% over a period of 10 years.
- 50% of the German people are being disturbed by noise occasionally or continuously (1978).
- In 1977 - according to polls conducted by the Wickert Institute - 70% of the Germans complained about too much noise in their living surroundings (1971 "only" 47%).
- Every third farmer has hearing problems (1976).
- In a neighborhood with heavy traffic flow, 23% of the inhabitants had to see their MD as a result of high blood pressure (Federal Department of Environment 1987).
- In the seventies about 5.7 million Germans (about 10%) were known to have cloth ears (deaf). In 1987 this figure has doubled.
- According to a survey done in 1976 about 90% of industrial workers are subjected to about 90 dB² during the entire day.
- One third of the environmental complaints are referring to noise.

Those figures show the amount of health defects that existed in the past where the impact of noise was less than it is today.

The danger is possibly greater than commonly known or estimated. One is considering that the increasing number of unbalanced children and teenagers, depressed women as well as hardness of hearing with older people has something to do with the noise of our time.

When MDs say that "noise makes ill faster than polluted air" it shows the indirect psychological route of an illness. We are dealing with a creeping development showing the following primary symptoms: stress, tension, anxiety, fear of life, dissatisfaction, resignation, apathy, depression, aggression, neurosis. It is a dangerous and creeping psychological source of illness which works both on the mental and bodily level, being supported by the generally bad health level of our 'civilized' populous. The danger of noise becomes rather vicious as one cannot really get away from it.

The complex effect of noise on the entire organism becomes evident if one looks at hearing anatomically and physiologically. We notice that sound and consequently noise is not only an acoustic perception but

² dB - decibel: a unit for measuring the volume of a sound, equal the logarithm of the ratio of the intensity of the sound to the intensity of an arbitrarily chosen standard sound

affects the entire level of consciousness. It reaches the vegetative nervous centers via the hypothalamus³ which is directing the function of the inner organs and the blood circulation; there is also a close connection to the hypophysis, a gland whose inner secretion steers, besides other things, blood pressure.

The most common psychosomatics⁴ are as follows:

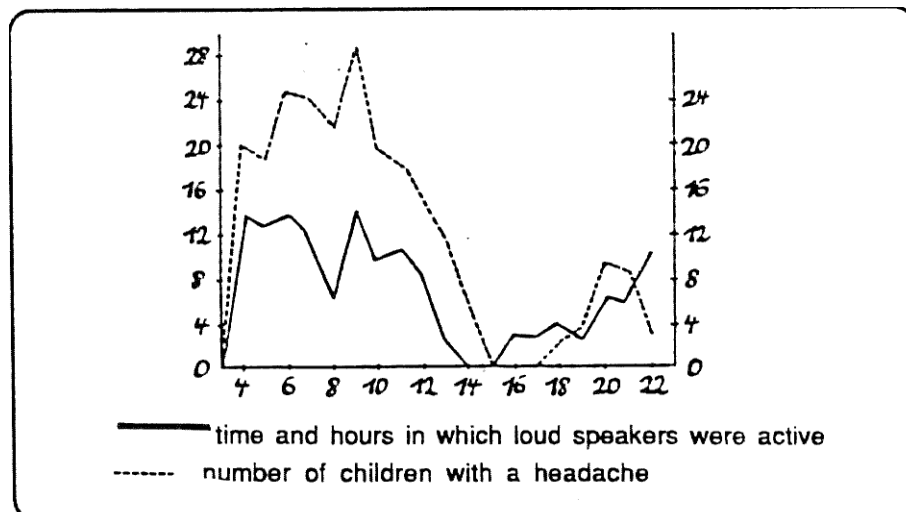
- bad effects on the stomach peristalsis⁵
- irregular breathing rhythm
- ulcers
- colic
- stenosis⁶ of blood vessels
- problems with heart and circulation
- stress reaction (as a result of continuous adrenalin secretions of the adrenal gland)
- reactions of glands with inner and outer secretion
- changing of the electrical skin resistance

This knowledge about the effects of noise is constantly increased by medical observations and scientific research. A Russian test conducted with mice which were injected with carcinogenic substances and subjected to acoustic stress had the following results:

In the neutral group 20% of the mice developed cancer, in the acoustically stressed group 40%.

According to Bulgarian MDs noise also impairs the eyesight which causes accidents at the work place (industrial production and building site) and most probably also in traffic.

Hypertonic⁷ people (about 10% of the population) are hypersensitive to noise. Interesting are the very recent data on heavy music consumption, as presented in the following figure. The curve shows an interdependency between music and headaches.



³ Hypothalamus: A part of the brain concerned with primitive functions such as appetite, procreation, sleep, body temperature and is closely associated with the hypophysis (pituitary)

⁴ Psychosomatic: a chronic pain which amounts to a physical illness with which a person has been afflicted for a very long time.

⁵ Peristalsis: the rhythmic, wavelike motion of the walls of the alimentary canal and certain other hollow organs, consisting of alternate muscular contractions and dilations that move the content of the tube.

⁶ Stenosis: narrowing or constriction of a duct aperture of the body

⁷ Hypertonic: of living tissue: having excessive tone

An occupational illness which increases by 30-60% annually is the noise related hardness of hearing; this illness occupies already the second position of occupational diseases. Depending on the intensity and duration of the noise impact more or less brain cells - designated for hearing - are being destroyed.

It is rather unlikely that such damages are to be expected as a result of music played in homes, except that people subject themselves to high volume pop, jazz, and other music. It has been established that frequent visitors of jazz night clubs, discos and the like, as well as professional musicians (rock etc.) develop illness and have impaired hearing.

A survey with such musicians revealed:

After rehearsals of modern music 82% were nervous, 81% irritable and quarrelsome, 39% had considerable problems with sleep, including headaches and earaches, and 33% were depressed; other problems included pain in the stomach, diarrhea, heart trouble, and impotence. However, with most musicians the mental stress was far greater than the physical strain. Many of them had to retire early.

Similar results can be found in manufacturing areas which have a high sound level. While in this area counter-measures have started to be implemented officially, only tedious discussions about threshold values and educational measures are occurring in connection with high volume music consumption.

The boundaries between nuisance and health damage are fluid. However, in science it seems, one is prepared to adapt the medical realization according to which noise molestation is the physical-mental medium that supports the creation of health problems.

By noise molestation we mean:

1. Sleep disturbances: If the central and vegetative nervous systems are being activated by sound stimuli during the night the result will be: difficulty in falling asleep, impairment of the quality of sleep (depth of sleep), and waking up too early. The needed relaxation may be prevented or may even be changed into tension. Older people are in particular sensitive in that respect. According to some experiments a reduction of the sleeping quality occurs already at a continuous sound level of less than 35 dB. At 35 dB 32% of the people woke up, at 45 dB 42% and at 60 dB more than 80% could not continue to sleep.
2. Noisemaking: Similar to sleeping disruptions interrupted silence is as important a factor in living areas. Somebody who wants to relax at home can be disturbed by comparatively little noise that otherwise would not cause any problem.
3. Impaired understanding (acoustically): Noise makes it very difficult to understand acoustically other people (especially in manufacturing industry, offices, and restaurants).
4. Interruption of attention: Affected are activities that need concentration (intellectual work and application of skill) but also common professional work, home work, and hobby activities. The alarm signals have a disruptive effect. Conducting more difficult tasks one needs greater effort and the application of will power. The disturbance threshold is very close to the perception threshold which is also true for many unpleasant sounds inside a building. Routine work is not so much affected.
5. Vegetative irritant effects:
 - increased blood pressure
 - change of skin resistance
 - disturbance of the function of sleeping and being awake (diminishing of the quality of sleep resulting in chronic health damages if of long duration)
 - release of stress hormones
 - acceleration of heart beat and breathing
 - contraction of the blood vessels under the skin (diminishing of blood supply to the skin)
 - increased metabolism