inter.noise 2000
The 29th International Congress and Exhibition on Noise Control Engineering
27-30 August 2000, Nice, FRANCE

I-INCE Classification: 0.0

NOISE MITIGATION FOCUSED FOR TOWN PLANNING

S.-L. Paikkala

Ministry of the Environment, P.O. Box 380, FIN-00131, Helsinki, Finland

Tel.: +358 9 1991 9734 / Fax: +358 9 1991 9716 / Email: sirkka-liisa.paikkala@vyh.fi

Keywords:
URBAN PLANNING, ABATEMENT MEASURES, LOCAL LEVEL

ABSTRACT
Environmental noise is one of the main local environmental problems in Europe, especially in densely populated urban areas. According to various estimations around 20 % of European citizens suffer from noise level that are considered to be unacceptable. Therefore, noise abatement should be an integrated part of urban planning. The aim of this presentation is to provide an overview of the noise mitigation methods within urban planning.

1 - NOISE IS PROBLEM AT LOCAL LEVEL

As noise is sound spreading in waves to the environment, the harmful effects of noise on human beings are found in the vicinities of noise sources. Therefore, noise is mainly a local problem and it would be natural that it should be solved at the same level.
Noise reduction at the source is generally approved to be the most preferred abatement method. However, despite of setting emission standards for vehicles, machines and other noise emitting sources, the noise emissions as well as the noise levels have continuously increased following e.g. the increase in volume of transport. Therefore, there is a need for secondary measures, such as limiting noise propagation and protective measures at the receiver, which are the main instruments of urban planning when aiming at reducing the noise. Moreover, there are various economic and social measures aiming at reducing the environmental noise.
There are several noise abatement instruments available in town planning such as

- limiting noise propagation;
- protecting the receiver; and
- economic and social measures.

2 - MEASURES AT LOCAL LEVEL

Limiting noise propagation: Limiting noise propagation consists of various measures aiming at placing barriers between the source and people affected. The major elements are land use planning, community development and transport system planning as well as noise screening.

2.1 - Land use planning, community development and transport system planning

Land use planning, community development and transport planning have a reciprocal relation between each others and therefore, the local authorities responsible for these tasks should work in close co-operation. The starting point for all these measures is that spatial separation is given full consideration at the local administration when imposing zoning policy. Land zoning and spatial separation should contain clearly defined noise abatement targets. Such a policy should contain at least following elements:

- placing as much distance as possible between the noise source and the noise-sensitive activity;
- placing noise-compatible activities such as parking bays, open spaces, shopping areas and commercial facilities between the noise source and the noise-sensitive areas;

- adopting cluster development concepts for housing as opposed to more conventional grid patterns or 'ribbon' development where the first row of houses tends to take the full impact of the noise;
- using the natural land and built form, and plantings as barriers to screen sensitive areas;
- using distance to the traffic route from the area to be protected, e.g. doubling the distance will generally lead to a 3−5 dB level reduction from a given traffic flow depending on the attenuation of the ground between the road and the receiver point; and
- no housing is allowed within certain distance from the motor ways and apartments within adjacent zone have to have additional insulation. Dwellings can be protected from traffic noise by setting them well back from the transport route or line.

Even though there is zoning policy with clearly defined noise abatement targets, the problem is often that there is not enough demand for noise compatible land use to afford adequate protection for every community. Moreover, the existing community structure and transport infrastructure set the limits for the spatial separation. The strip zoning may also not be compatible with other plans for the growth and development of the community.
There has been a lot of discussion on increasing the density of community macrostructure which should be based to greater extent on public transport system. Even though compact community macrostructure based on public transport should promote the other environmental objectives there is not consensus whether this would diminish noise. According to certain studies compact cities are not noisier than sprawled ones.
Furthermore, public transport may not be less noisy. The key issue here is connected with the introduction of new equipment for public transport. Local authorities should clearly define noise targets when vehicles and systems are planned and purchased. When developing the transport system, more emphasis should be given to developing light transport, i.e. promoting walking and cycling which are low-noise means of transport. Even though compact city structure is not unambiguously considered to be less noisy than sprawled city, at least there are better possibilities to promote walking and cycling in a compact city structure.

2.2 - Noise screening

A cost effective control method for traffic noise is to erect a barrier or screen alongside the road (or railway line). The main requirement is that the barrier should be sufficiently high and long enough to provide a reasonable vertical and horizontal overlap with the line of sight of the road from the receiver point. Barriers can reduce the noise level by up to 15 dB. When the buildings to be screened are close to roads with heavy traffic, the practically achievable noise reduction is usually of the order of 5−10 dB. However, at greater distances the screening potential may be substantially lower.
A wide range of materials have been used for barriers, including earth mounds, wood, steel, aluminum, concrete, masonry block, acrylic sheeting and rubber mats. Absorbing barriers of various constructions are widely used. Absorptive facing on the traffic side reduces reflected sound and is claimed to improve screening. Barriers over 8 m in height have been used for some applications and novel capped barriers, angled barriers and vegetative barriers have been tested.
Additional noise protection can be achieved by arranging the site plan to use buildings as noise barriers. A long building, or a row of buildings parallel to a highway can shield other more distant houses or open areas from noise. A two-storey building can reduce noise levels on the side of the building away from the noise source by about 13 dB. Further rows of buildings may only produce a small additional benefit, e.g. 1−2 dB beyond the second row only.
Screening can also be realised with a combination of a building and a barrier:

- a row of single-family houses combined with a mound or a dike; earth against the totally closed facades on the side of the road (dwellings built into a dike); sound reduction up to 13 dB, depending on the height of the dwellings; and
- a noise screen (of glass) combined with a gallery-type of block of flats (the screen forms the outer facade of the building on the side of the road); sound reduction up to 20 dB.

3 - PROTECTIVE MEASURES AT RECEIVER

In most practical situations the overall effect of controlling noise at source and limiting its propagation are not sufficient methods of control. A further technique, which applies to all transport modes, as

well as other environmental noise sources, is the improved building design and insulation of property to minimise disturbance within buildings.

3.1 - Sound insulation

Especially, aircraft noise requires often additional methods of control, even if significant reductions in exposure have been accomplished through operational procedures. Besides methods related to land use, non-operational aircraft noise controls include the sound insulation of property.
When the noise reduction is to be provided by the building enclosure it is essential that all possible paths for the transmission of sound are considered. The less isolated parts on the outside of the building have to be paid special attention. There may be restrictions and limitations on the lifestyle of the people within the building. For example, windows cannot be opened to provide natural ventilation without reducing the sound insulation.
The sound insulation of new buildings, including means provided by layout, is usually taken care of as parts of the overall design process. Improvements to the sound insulation of existing buildings usually involve some form of retrofit. Often it is not possible to avoid living rooms and bedrooms having windows exposed to high traffic noise. Then the rooms have to be protected sufficiently by sound insulating outer walls and windows. When the outer walls are massive and heavy (concrete or brick walls), the difference between outside and inside noise level is determined solely by the sound insulation of the windows.
Doors and windows provide the most obvious components of low sound insulation in a building. Generally the quality of these components dictate the degree of insulation achieved by the building as a whole. For instance, if an external wall has an opening or gap of about 10 % of its area (a value typical for windows), the overall noise reduction will only be about 10 dB even if the rest of the wall provides high insulation.

3.2 - Building design

At the planning stage of a new building, the shape, orientation and location of the building and the arrangement of the internal spaces should be chosen to reduce potential noise problems. In existing buildings the acoustic environment can sometimes be made more acceptable by altering the use of the rooms.
In some rooms of dwellings, people are less annoyed by noise from outside than in others. As traffic noise is usually only a problem for the rooms facing towards the source, the noise-sensitive rooms should be identified and located on the other side of the building. The less noise-sensitive rooms can then provide a barrier to the penetration of the noise into the other rooms of the building.
The need for expensive construction with high sound insulation can be minimised if the shape and orientation of the building is planned with due regard to the noise sources. The aim is to avoid reflecting sound from surfaces so as to direct it towards the noise-sensitive rooms of the building itself or any nearby building.

4 - ECONOMIC AND SOCIAL MEASURES

Economic and social measures rarely replace direct regulation or other measures that are presented earlier, but more often they are used to supplement the other measures. Many of the economic and social measures are decided and used at the national level, such as taxes, but many of them can be introduced at the local level, e.g. road tolls, noise compensations, training, campaigns and advertising.

4.1 - Economic measures

The adoption of various economic measures is in line with polluter-pays-principle (PPP) when aiming at charging also the external costs what the environmental costs are. Economic instruments are also intended to provide funds needed to finance environmental protection measures, improve the application of direct regulations to which they are linked and stimulate technical innovation. There are several types of incentives and economic instruments used in connection with noise abatement:

- economic incentives, such as grants and subsidies to promote development and use of quiet vehicles;
- charges on noise sources, such as aircraft landing charges or motor vehicle noise charges;
- special taxes on noisy equipment, such as taxes on vehicles the level of which is dependent on their noise category or annual tax dependent on noise category or additional tax on fuels;
- road pricing, inclusion of a noise cost element in the road tolls should be an incentive to reduce noise on these routes; and

- noise compensations, which are more like a financial penalty on those responsible for noise and re-addressing it to those suffering from noise.

4.2 - Social measures

Social measures are non-economic incentives or measures that are primarily used in connection with promoting awareness of the problem and providing information and training. Their function is to provide information, make regulations acceptable or to be an adjunct to policy implementation and enforcement of regulation. Such social measures are e.g. the following:

- training of technical staff e.g. administrative people responsible for urban planning, zoning, transport system planning;
- increasing public awareness, e.g. with the help of consumer information and education, noise surveys, noise labelling, and certificates, noise-related advertising, public purchases, bans of noisy equipment, information of sound insulation;
- local pilot projects for silent towns or city centres, silent days etc.;
- promotion of low-noise products e.g. labelling, advertising and campaigning of low noise products; and
- controlling and generalising use of instruments e.g. creating low-noise standards.

5 - CONCLUDING REMARKS

Town planning is generally a long process. It is aiming at solution lasting a long time, several decades, even centuries. Nowadays it is more actual to draw town planning in already mainly built-up areas. In such a situation noise abatement measures can be used to limited extend. Time scale of town planning means also uncertainties and difficulties concerning exact information on noise levels.

ACKNOWLEDGEMENTS

EU Commission has created technical working groups to assist the preparation of the new EU noise policy. The aims of WG 5 (Abatement) have been to prepare a solid and compiled inventory on the noise mitigation methods on the basis of numerous studies and reference books available as well as to provide an assessment of effectiveness of different measures. The presentation is based in the preliminary findings of WG5's report.

REFERENCES

1. *Transportation reference book*, Ed. P. M. Nelson, 1987
2. *Handlingsplan mot buller. Betänkande av Utredningen för en handlingsplan mot buller [Report of a committee on Noise]*, Statens offentliga utredningar [Swedish government], 1993
3. **T. Kihlman and K. Kropp**, Limits to the noise limits?, In *16th ICA, International Congress on Acoustics, Seattle, 20-26 June 1998*, pp. 2243-2244, 1998
4. **G. Watts**, Acoustic performance of traffic noise barriers, In *The mitigation of traffic noise in urban areas. Eurosymposium 12-15 May 1992, Nantes, France*, pp. 223-250, 1992
5. Technical assessment of the effectiveness of noise walls, *International INCE Publication 99-1, Noise/News International*, Vol. 7(1999)3, pp. 137-161, 1999
6. **L. Schreiber**, Mitigation of traffic noise by urban planning and building design, In *The mitigation of traffic noise in urban areas. Eurosymposium 12-15 May 1992, Nantes, France*, pp. 297-306, 1992