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Svetlana Kovinskaya

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Traffic noise maps as an assistance for urban planning

Rudolf Liegl Mochler + Partner Consulting Engineers Munich, FRG

1. Introduction

Today's situation of urban living is characterized by traffic noise pollution of widespread areas. Although efforts have been made to reduce the noise emission especially of automobiles, the growing number of vehicles and covered distances have even intensified the problem.

Many residential areas are situated immediately beneath highly frequented roads, railway networks or airports, where esp. recreation, communication and sleep is seriously disturbed.

Particularly with regard to healthy living conditions urban planning has to consider the aspects of noise pollution control in order to avoid cost-intensive making up of noise barriers or soundproof windows.

This paper intends to present possibilities of noise prediction and visualisation along roads or railways and to propose guidelines for urban planning in noise-polluted areas. The actual road and railway noise maps of the city of Munich, FRG, are presented.

2. Noise prediction

Noise maps intend to describe either actual or future situations.

In principle, a description of actual situations can be derived from measurement results. Anyhow representative measurement results that are not falsified by accidental changes of traffic flow or weather can hardly be obtained reliable along main roads and railway lines. Therefore a comprehensive analysis of a city's traffic noise situation should usually not be based on measurement results.

Preferably noise situations are to be described by the results of acknowledged numerical procedures that calculate the noise-emission of traffic ways and allow the prediction of sound propagation towards critical localities.

The input values of those calculation procedures (for instance number of vehicles per hour / day, speed of vehicles, distance of critical localities referred to the noise source) are typically obtained more easily and reliable than measurement results.

Based on these input values the noise situation throughout a city's roads and railway lines can be obtained. Varying input data, for instance increasing traffic flows, can be flexibly taken into consideration. Future developments can be predicted.

In the Federal Republic of Germany the Traffic Noise Protection Order (16. BImSchV) [1] describes procedures, that allow calculation of road and railroad emission data as well as noise immission levels. Results are given separately for day and night periods.

Table 1 shows a small cut of the data set of the road noise map of Munich [2] which was worked out by order of the administration of the city of Munich.

Allacher Straße [84] name and signature of the street						
9702 x1	13361 y1	9982 x2	13261 y2	Gauss-Krueger-coordinates		
vehicles per day	lorries per day	velocity in km/h	surface	classification	noise emission dB(A)	
					day	night
40000	3000	50	Asphaltbeton	Gemeindestraße	68.9	59.1
sound propagation					noise immission dB(A)	
direction	distance	height			day	night
links	18	9.0			72	62
rechts	18	6.5			72	63

Table 1: Data set of the Munich road noise map (example)

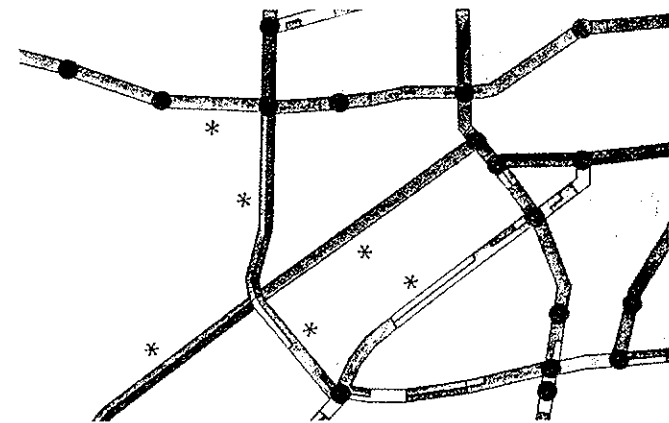
The values in table 1 have been calculated in accordance with the instruction RLS-90 [3] which is part of the 16. BImSchV.

The data set includes values for approximately 250 main roads of Munich with a traffic load of more than 5000 vehicles per day.

3. Visualisation of noise situations

An optimum survey of a cities traffic noise situation is given, if the results of the noise prediction procedure are plotted to a map of the city.

The following pictures 1 and 2 are presenting parts of the road and the railroad noise map [2.4] of the city of Munich. The full size maps cover the whole area of the city.



Picture 1: Noise situation along main roads

This map shows noise immission levels for buildings next to the roads in classes of 5 dB(A), plotted as coloured stripes onto the corresponding main roads of the city map. With reference to the black/white picture above, areas of high noise levels are plotted darker than areas of lower noise pollution. Plotted stars indicate that no buildings exist beneath the road (therefore the emission noise level is plotted). All calculations have been done in accordance with the instruction RLS-90.



Figure 2: Noise situation along railway lines

This map presents noise levels in a distance of 25 m to the railway lines. The width of the stripes is a measure of the level's height. Next to the stripes the value of the noise level in dB(A) is plotted. All calculations have been done in accordance with the instruction Schall 03 [5] which is part of the 16. BImSchV.

Both pictures are presenting the noise situation in the neighborhood of the traffic ways. The corresponding input data set is existing as electronic data bank, a fact that facilitates updating and plotting of data.

4. Planning guidelines

Based on traffic noise maps, areas of high noise pollution are identified by comprehensible criterions and adequate noise prevention is facilitated.

Further on urban planning may consider aspects of noise pollution in early stages. Possibilities to ensure healthy living conditions are given by

- erecting residential houses separated from areas of high traffic noise immission
- arranging buildings with lower noise protection demands (e.g. buildings of commercial enterprises) in front of residential areas
- arranging rooms with lower noise protection demands (e.g. bathrooms, stairwells) towards traffic noise sources and rooms with high recreation demand in quiet parts of a building.

5. Summary

Traffic noise maps facilitate comprehensible surveys of a cities noise situation. Noise levels should be calculated based on acknowledged numerical procedures to facilitate convenient updating of the input data set.

Based on traffic noise maps, adequate noise prevention can be done and urban planning is put in a situation to ensure healthy living conditions.

References

- [1] Sechszehnte Verordnung zur Durchfuehrung des Bundes-Immissionsschutzgesetzes (Verkehrslarmschutzverordnung - 16. BImSchV) vom 12. Juni 1990
- [2] Laermuntersuchung fuer das Hauptstrassennetz der Landeshauptstadt Muenchen 1991 im Auftrag der Landeshauptstadt Muenchen Baureferat Abteilung Strassenplanung, Mochler + Partner, Muenchen, 1992
- [3] Richtlinien fuer den Laermenschutz an Strassen RLS-90, Ausgabe 1990
- [4] Laermuntersuchung DB-Schiennetz im Bereich der Landeshauptstadt Muenchen im Auftrag der Landeshauptstadt Muenchen Planungsreferat - Umweltschutzreferat, Mochler + Partner, Muenchen, 1993
- [5] Richtlinie zur Berechnung der Schallimmissionen von Schienenwegen (Schall 03), Ausgabe 1990

EVALUATION OF THE ACOUSTIC ACTION OF THE TRANSPORT SYSTEMS IN THE CITIES

N. Kirushina
Moscow, Russia
E. Klimova
Moscow, Russia

Transport systems, as a part of the structure of the cities, include streets and roads, objects of the peripheral transport and support the life of the cities.

But at the same time, transport system is a source of negative influence on the environment. The noise influence is the main one, acting on the buildings placed near the transport objects.

The analysis of more than 30 noise plans of the cities included in the general plans of different cities, helped to estimate that 20-60% of the population of the cities live now in the zone of noise pollution, made by transport sources. The equivalent noise levels at the transport set of the cities differ in a wide range from 65 to 85 dBA. 71-75 dBA range level is the most characteristic one. Sound levels at the line of development situated along the main road are 5-20 dBA higher than the normative ones (the admissible level is 55 dBA).

The given values depend on several factors, first of all on the size of the city, its transport structure, level of the motorization, streets' and roads' parameters.

The worse living conditions are in the central parts of the old cities. The transport set is very intensive, streets are narrow, traffic is very intensive. As a rule there are no space between buildings what increases the noise level in the houses oriented to the highways. In addition, buildings prevent the noise propagation inside the development area.

In case when the buildings stand separately, the depth of the noise propagation is approximately 200 m. So, the main territory along the highway is in the area of noise pollution. It can be decreased by the special noise-protection technologies.

The most effective and economically advantageous method of the noise protection is the increase of the intra-road territories. It decreases the percentage of the population living in the uncomfortable area and decreases the noise-protection expenses. The wide set of rail-ways is characteristic feature of Russia. The rail-way traffic is heavy day and night and paying attention to the fact that the freight traffic is heavier in night time, the level of the railway is higher in the night time.

Railway stations and other objects at the station area are also the sources of noise. In comparison with the high-ways the rail-ways are the sources of noise and uncomfortable acoustic conditions to the limited part of population (about 10-12% of the whole population live in uncomfortable conditions).

The air-transport is a noise source for 5-7% of population, but this value can be higher for large cities, with several air-ports, working in the night time. The technical services located at the territory of the air-ports are also the noise sources for the nearest buildings.

Projecting new cities and living areas and changing the plans of existing ones it is necessary to pay attention to the noticed influence of transport systems to make comfortable living conditions.