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THE BUDAPEST NOISE MAPPING PROJECT – NOISE MAP OF THE CITY CENTER OF BUDAPEST

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Directive 2002/49/EC of the European Parliament and Council relating to the assessment and management of environmental noise aims to ensure that 'Strategic Noise Mapping' is carried out by Member States for major agglomerations and transport infrastructures.
The primary aim of Hungarian legislation concerning environmental noise is to control and examine noise emissions of certain activities, industrial sites and transport infrastructure and to assess the impact of noise levels potentially dangerous to human health. This led the Hungarian Ministry of the Environment and Water Management to publish a public call for tender for the development of a "Guideline on Noise Mapping and Action Planning according to Directive 2002/49EC" in 2003. The contract was let to LÄRMKONTOR GmbH and successfully accomplished in December 2003.
This paper presents the main goals and achievments of the project **Phare – HU – PAO Strategic Noise Mapping in Hungary**.
The first main point in this project was to clarify which assessment methods can be used for the task "strategic noise mapping in Hungary". It was decided instead of using the INTERIM methods to use the hungarian assessment methods. These methods were developed to fit the properties of the local traffic (road and rail). In a comparison the INTERIM methods under-estimated the noise emission for both noise sources.
The second main part was to get an overview over the available input-data for Budapest to calculate noise levels accordingly and to define an area for a pilot which is representative for the City of Budapest. The decision was to split up the pilot area. According to the local cirumstances the city center of Budapest (V. district) representing the agglomeration was taken as pilot area for traffic noise, industrial facility was maped in a border district (XI. district) and major transport infrastructures were mapped in the agglomoration of Budapest (Budaörs).

1 Introduction

Directive 2002/49/EC of the European Parliament and Council relating to the assessment and management of environmental noise (also referred to as the Environmental Noise Directive (END) [1] aims to ensure that 'Strategic Noise Mapping' is carried out by Member States for major agglomerations and transport infrastructures.

The END requires Member States to use the results of their strategic noise mapping to inform the public about levels of noise pollution to make available to the public data on noise exposure and to develop action plans for noise management that shall include noise reduction conceptions, where necessary, and the protection of quiet zones.

The noise mapping requirements of the END are a challenge for the new Member State Hungary where these techniques were not practised so far and only limited practical experience exists. This is especially true for large-scale strategic noise mapping of agglomerations as required by the END. In Hungary, the largest agglomeration targeted by the END is the City of Budapest. Furthermore, at a national level the production of a comprehensive noise map of the City of Budapest is judged to be of primary importance.

Both the urgent need to catch up in noise mapping and the pressure coming from the requirements of the END for mapping of large agglomerations are perceived. This led the Hungarian Ministry of the Environment and Water Management to publish a public call for tender for the development of a "Guideline on Noise Mapping and Action Planning according to Directive 2002/49EC" in 2003. The contract was let to LÄRMKONTOR GmbH and successfully accomplished in December 2003..

In this paper the main working steps, goals and achievements of the project **Phare – HU – PAO Strategic Noise Mapping in Hungary**. are described.

2 Pilot area

2.1 Requirements

First step in the project was to define the requirements for a pilot area. The basic conditions for a pilot area was, that it should be representative for Budapest and it must include all ground-borne noise sources (road- and railway- as well as industrial noise). Furthermore, an area should be defined, where the effects of these noises (different types of roads, different building-up

methods, different railway/tram lines), shielding of ground effects (significant difference in altitude) can be well illustrated, and it has at least one IPPC-classified industrial facility.

2.2 Suggestion for pilot area

In close close co-operation with the Department of Air Quality Management and Noise Control of the Hungarian Ministry of Environment and Water Management areas suitable for the pilot study were identified.

According to the requirements above, possible pilot areas are in principle:

Budapest, III. District:

good data availability, no industry

Budapest, V. District:

relatively good data availability, all sources are present

Budapest, XI. District:

excellent data availability, but already calculated in the framework of another contract

Budaörs:
situated outside of Budapest, has good data availability, highway and railway as sources, business area, no industry

Szentendre:
situated outside of Budapest, has good data availability, no industry

Both Szentendre and III. District of Budapest do not fulfill the requirements, primarily because industrial areas are missing.

The XI. District of Budapest should not be considered, because this area has already been under examination in the framework of another mapping project.

Basically, Budaörs is suitable although the following problems have been identified:

The building structure and the use of the buildings cannot be seen as representative for the City of Budapest, since large parts of Budaörs are predominantly rural.

The characteristics of the road network (e.g. in terms of traffic density, numbers of lanes, road surface conditions) are not representative of those of Budapest's road network. Currently, in Budaörs many streets are under construction, so is the main road. Subsequently, lacking data cannot be collected within the time frame of this project. From the data and the experience gained from the Budaörs pilot area, a serious prediction of the costs for noise mapping of the entire City of Budapest cannot be done on a reliable basis.

It was decided to map the following areas:

V. district – City Centre of Budapest was chosen as the main pilot area, for the reason that it is representing a typical urban situation with masses of traffic.

XI. District of Budapest, was chosen as an additional example for industrial noise

Budaörs was chosen as an additional example for a major road and a major railway outside agglomerations (or as an example for suburbs) according to Directive 2002/49EC

3 Calculation method

For the first round of noise mapping the Member States may use the recommended interim noise computation methods, as set out in Annex II of the END. The requested adaptations of the interim calculation methods for industrial noise, aircraft noise, road traffic noise and railway noise, and related emission data methods have been published by the EC [2].

Alternatively, member States may use their existing national noise computation methods, adapted to the definition of the noise indicators as set out in Annex I of the END. There are existing Hungarian calculation methods for road traffic noise (emission side) [3], rail traffic noise (emission side) [4] and for industrial noise calculation [5-8]. Furthermore, a Technical Proposal [9] has been worked out for the noise emission models of the relevant noise sources, and the propagation method [5] was recommended for all earth-bound source types (road-, railway-, industrial noise). The use of Hungarian noise emission models is necessary for road and railway noise, because it is important to take into account the particulates of the Hungarian national situation, different vehicle and railway fleet, different brake systems, etc.

3.1 Recommendation of calculation methods for Hungarian use

The Hungarian Guidelines on Noise Mapping and Action Planning make reference to the official

assessment methods compliant with the END. An analysis of the Hungarian guidelines with regard to their applicability on the demands of the END has come to the following conclusions:

The Hungarian methods as described in the Technical Proposal 'Preparation of the calculation method to be used in Hungary concerning different noise sources' [9] will be used as relevant assessment methods for noise sources according to the END within this project.

The use of a common noise propagation method for all three earth-bound source types (road-, railway-, industrial noise) [5] is also recommended, but for long term Hungarian average the formula below was modified as follows:

$$K_h = C_0\left(1-10\frac{h_Q + h_A}{s}\right)\text{dB},$$

where

K_h correctional factor to determine long-term levele

H_Q altitude of noise source

h_A altitude of the point of detection

s projection of the distance between point of detection and noise source

and

	Local time	C_0
Day	06:00 – 18:00	**3,0 dB**
Evening	18:00 – 22:00	**1,5 dB**
Night	22:00 – 06:00	**0,0 dB**

3.2 Calculation Software

The current version of IMMI noise mapping software was updated with the implementation of the according Hungarian emission calculation models [3-5] by WÖLFEL Meßsysteme · Software GmbH & Co KG. Sound reflection was taken into account until the 1st order. For calculating facade noise level, the component for reflection from the facade was not taken into account.

4 Input data

4.1 Information on location and geometrical data:

The Ministry of Environment and Water Management doesn't dispose of digital maps. These have to be bought from Hungarian companies specialized in geo-referencing, because of the enormous pricings it was decided with the agreement of the Ministry to digitize the areas based on a bitmap. This bitmap constitutes the actual city-map included the ground elevation and the building heights in form of a colour scale. Despite its duration digitizing according to this bitmap is good way to collect the geometrical input data.

Traffic controlling measures, noise barrier information and detailed information on pavement was collected by in field walk troughs.

4.2 Traffic data and information on inhabitants

Both information on traffic data and information on inhabitants were supplied by subcontractors of the Ministry of Environment and Water in form of Ms Excel worksheets.

Traffic data and vehicle speed data was collected for all major urban roads, for all routes of the public transport, for all non-major roads with high traffic density and for all roads surrounding the V. district including roads on the Buda side of the Danube. In Budaörs traffic data was acquired for the railway BP-Törökbálint and the motorway M1/M7. Those data was collected respective to the directive 49/2002/EC for day (06-18), evening (18-22) and night (22-06).

Information on inhabitants was delivered, by The Hungarian Central Statistical Office. It was provided by the number of inhabitants per living unit.

Since traffic data and information on inhabitants was not supplied in a GIS database, it was very time consuming, to implement these data in the noise model.

Noise emission data of the IPPC facility in the XI. district was gathered by measuring around the facility. Measurements were carried out by Vibrocomp Ltd. according to directive 2002/49/EC.

5 Evaluation noise protection recommendations

V. district

In the V. district, traffic noise situation is dominated by the main urban roads, passing across and at the border of the district. Those living areas are affected by high noise levels both day and night. From the conflict map the urgency of noise reduction measures can be seen, these are the areas, where the noise level excess is more than 10 dB. These areas are along Kossuth Lajos str., Kecskeméti str., Bécsi str., Szent Istvan bvld., Irányi str., Október 6 str., Szemere str., József A. str., Bajcsy Zs str. Since this district is the centre of Budapest there are not many ways of effective noise protection. The best way is by installing high insertion loss windows, or HGV bans.

It is also important to mention, that the V. district is pioneer in assigning quiet areas, for example the centre of the district the Szabadság tér.

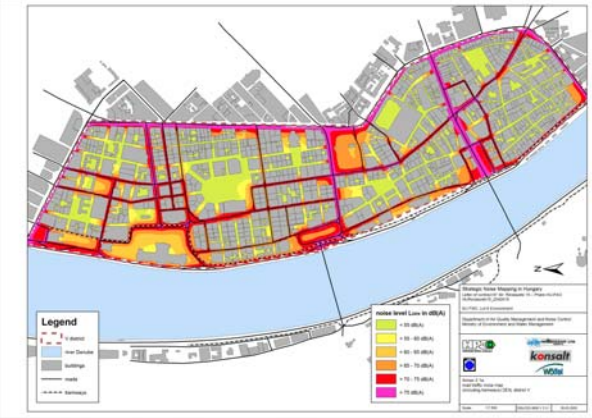

Figure 1. Strategic noise map of the City Center of Budapest (L_{DEN})

Budaörs

Along the motorway, with existing noise barriers there is no noise level excess, along other parts for example at Budaörsi út 107 the noise level excess is significant. Noise level excess is also significant at the commercial and shopping areas close to the motorway, but these areas do not require protection.

Along the railway line the situation is similar to the motorway, at sections with existing noise barriers, there is no excess (for example close to the Törökbálint station). At sections with no noise barriers, there is significant excess.

Both at the motorway, and at the railway there is a little number of annoyed people since only small sections are not protected by noise barriers. For further reduction of the annoyance the most effective way is building more noise barriers. Protection work should be started at sections, where the noise level excess is more than 10 dB, for example at the Budapest section of the motorway and the railway.

Figure 2. Strategic Noise map of the M1M7 motorway . Budaörs section. (L_{DEN})

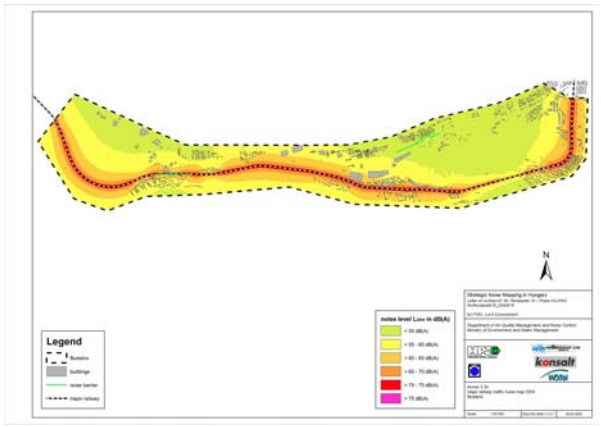

Figure 3. Strategic Noise map of the Bp – Törökbálint railway. Budaörs section. (L_{DEN})

Industry in the XI. District

The main noise source of the investigated IPPC facility was a 25 m high mill. Today the close neighbourhood of the facility is partly unused; most of the buildings are former industrial buildings.

Residential areas are protected by those buildings; conflict will only exist if these former industrial buildings should be converted into residential areas.

Figure 3. Strategic Noise map of the IPPC facility in Budapest XI district (L_{DEN})

6 Summary

Effects and results of different planned noise reduction actions can be well illustrated in the noise map and the most efficient method can be selected. Ready noise maps provide a firm basis for future noise reduction plans. Strategic noise maps according to Directive 49/2002 can, considering Hungarian capabilities and technical possibilities, be prepared.

References

[1] Directive 2002/49/EC of the European Parliament and Council

[2] "COMMISSION RECOMMENDATION of 6 August 2003 concerning the guidelines on the revised interim computation methods. notified under document number C(2003) 2807)", OJEC L212, P.0049-0064.

[3] 'ÚT 2-1.302:2000 Közúti közlekedési zaj számítása Útügyi Műszaki Előírás'

[4] 'MSZ 07-2904:1990 Vasúti közlekedési zaj számítása'

[5] MSZ 15036: Hangterjedés szabadban;

[6] MSZ EN ISO 3744: Akusztika. Zajforrások hangteljesítményszintjének; meghatározása hangnyomás felhasználásával. Műszaki módszer alapvetően szabad térben, visszaverő sík felett (ISO 3744:1994)

[7] MSZ EN ISO 3746: 1999: Akusztika. Zajforrások hangteljesítményszintjének meghatározása hangnyomásméréssel. Tájékoztató módszer visszaverő sík feletti burkoló mérőfelület alkalmazásával (ISO 3746: 1995)

[8] MSZ ISO 8297: 1994 Akusztika. Többforrásos ipari üzem hangteljesítményszintjének meghatározása a környezeti hangnyomásszint becslésére. Műszaki módszer (ISO 8297: 1994)

[9] Preparation of the calculation method to be used in Hungary concerning different noise sources, to be validated by the Commissions of the EU as implementation of the EU directive on environmental noise', Budapest, November 2003