



Implementation of Directive 2002/49/EC in EU Candidate State: Experience in Croatian noise mapping projects

Alan Štimac

Brodarski institut, HR-10 000 Zagreb, Ave. V. Holjevcica 20, alan.stimac@zg.t-com.hr

The transposition of the Environmental Noise Directive (END) in the Republic of Croatia was performed through the Noise Abatement Act (NAA) from 2003. The basic terms, duties and responsibilities are generally determined, but the bylaws with the noise mapping guidelines and their interaction with the land use management still missing. In such case, when modified national noise regulations don't exist, the use of the END and "Guidelines on the revised interim computation methods ..." 2003/613/EC is logical solution. This paper presents our experiences during most recent noise mapping projects in Croatia (City of Varaždin and City of Pula), covering all phases of the noise mapping project (collecting data, transforming/cleansing the data according to the good practice, model building and deployment), through the application of the noise map as a very useful tool for municipal planning, in coordination with environmental management. Special attention has been paid to the annoyance analysis and the applicability of the various known algorithms. The both projects shows that there is a need for slightly adaptation of the END (national definition of the agglomeration, quiet area, action planning, etc.) and national consensus for the guidelines and interim computation methods.

1 Introduction

Based on the EC Green Paper on Future EU noise policy [1], on 25 June 2002 the European Parliament and Council adopted Directive 2002/49/EC relating to the assessment and management of environmental noise (referred here as an Environmental Noise Directive - END); [2]. Republic of Croatia and the EU signed a Stabilisation and Association Agreement (SAA) in October 2001, a general framework with mutual rights and obligations towards the Croatian way for the EU membership. The SAA has served as a powerful catalyst for the ongoing legislative reform. Croatia is now focused on aligning its legislation with the *acquis* and has started to implement an ambitious programme for the integration of Croatia into the European Union which also include general noise abatement policy. In the Republic of Croatia there are two documents dealing with the issue of protection from noise.

- National Environmental Strategy and National Environmental Action Plan (NEAP), [3].
- Noise Abatement Act; (NAA), [4].

The NEAP determines the objectives and measures in the environmental noise management for the next 5 years. In compliance with END, the obligations from that document have been adopted, while the deadlines have been postponed. The priority objectives set out are:

- Preparation of the noise maps and action plans with complete exposure analysis, and establish the number of inhabitants and housing units in agglomerations threatened by excessive noise level.

- To upgrade, complete and continuously harmonise the legislation pursuant to EU requirements.
- Establish the scope and responsibility at all levels in the chain of implementation of protection from noise.
- To draw up education programmes for the participants in implementation of noise protection and to initiate education.
- Synchronise the activities in respect of noise with other harms.

According to the settled objectives by the NEAP, the NAA proclaims three main feature:

- Introduction of preventive action regarding the emergence of excessive noise levels defined by regulatory provisions that elaborate in detail the specific groups of activities (physical planning, construction, protection at work, handicrafts, industry, outdoor sources of noise, music, sport, recreation).
- Obligation to prepare noise maps and action plans.
- Introduction of legal framework for permanent verification and supervision of the state of noise as well as the identification of subjects responsible for implementing noise protection measures.

The first feature of the NAA is mainly transposition and adaptation of the other noise related EU directives (86/594/EEC; 89/629/EEC; 98/37/EC; 2000/14/EC ..), while the other features mainly laid on the END. Therefore, the transposition of the END will be detailed managed by the bylaws and ordinances. The transposition of the END with the different perspective (political, legal, administrative and technical) will directly affect all the participants in the future management of the environmental noise so it is

reasonably to expect number of challenges and problems. This article presents our experiences of the END application in the first Croatian noise mapping project of the urban city, performed with the requirements of the END and 2003/613/EC [5].

2 END vs. National Noise Abatement Act

2.1 Action proposed by the END

In order to define common approach across the EU with the intention of avoiding, preventing or reducing on a prioritised basis the harmful effects, including annoyance, due to exposure to environmental noise following actions are currently implemented:

- Determination of exposure to environmental noise, through the preparation of strategic noise maps for large urban areas, major roads, major railways and major airports, by methods of assessment common to the Member States.
- Informing the public about environmental noise and its effects.
- Preparing action plans based on the results of the noise mapping results. Such plans shall aim to manage and reduce environmental noise where necessary, and preserve environmental noise quality where it is good.

Beside these actions, establishing of the harmonised noise indicators and assessment methods for environmental noise has been proposed.

For the effective and easier application of the END, basic definitions and terminology were presented (annoyance, noise indicator, assessment, L_{den} , L_{day} , $L_{evening}$, L_{night} , agglomeration, quiet area, major road, railway and airport, action planning, noise mapping, strategic noise map, limit value, acoustical planning, public). The experiences from the EU MS shows that national definitions of basic concepts and terminology of the END in most of the cases are different, so the minimum definitions for producing final individual national definitions were suggested [8].

2.2 Action proposed by the NAA

The requirements of the END is partially adopted into the NAA through the following actions:

- Preparation of the noise maps for the counties, City of Zagreb, cities and municipalities until the mid February 2006.
- Preparation of the action plans for the counties, City of Zagreb, cities and municipalities until the mid February 2008.

The corresponding bylaw that will regulate and standardize the preparation of the noise map is not yet officially published, despite the existing draft mainly leans on the END and the guidelines on the revised interim computation methods [5]. This temporary stagnation of the END transposition into the Croatian legal system didn't stop the responsible persons in the City of Varaždin in their striving to apply best practice in the field of the environment protection so they contracted Brodarski Institute for the preparation of the traffic noise map.

3 Identified issues "caused" by the application of the END in the Croatian noise mapping projects

3.1 "Noise map" – what is it ?

During 2004, Brodarski institute perform some preliminary survey upon the practical implementation of the noise map processes, mainly through the telephone calls, survey E-mail form or during the organized workshops. Such survey was performed in the 3 counties (of total 21) covering 27 towns (of total 122) and performed in the 55 municipalities (of total 424). The results shows that the term "noise map" are generally misunderstood, as it is often treated as textual/graphical presentation of the (computer calculated) noise level in the given area without knowing any possible application in the everyday life. Therefore it was obvious that the first and most important is education of the responsible persons in the competent local authorities. Without national adoption of the END scope, the success in producing noise maps according to Article 7 and Annex IV of the END is very doubtful.

3.2 Assessment Methods

Hence the Croatia doesn't have their own national methods (by the term "developed in Croatia") and the fact that ISO/EN or DIN standards are adopting as a national standards, the use of the [5] was logical solutions.

3.3 Noise mapping area

The Croatian legislation doesn't recognize the term agglomeration, so the approximation of the noise mapping area with the existing administrative boundary of the local authority shows as a good and logical solution. In some of the cases (due to the financial budget), the noise mapping area were shrunked to the urbanised area (>300 people/km²) [7].

3.4 Data collecting and determination of the noise levels

The noise mapping project of the City of Varaždin were divided into 5 phases:

- Data collecting.
- Calculation of the road traffic noise map
- Calculation of the rail traffic noise map
- Short-term validation of the road traffic noise map
- Annoyance analysis.
- Presentation of the results to the City council and to the public.

It is well known that the results of the noise map made by the computational interim methods strongly depend upon the quality of the input data. Such data were generally divided into several different groups:

- Input data about the geographical issues (contour lines, slope edges, ridges or fraction edges,

punctual height information, type of ground with the respect to the possible absorption, obstacle plan view and the corresponding heights, meteo data, ...).

- Input data about road traffic (traffic composition for the day, evening and night, type of flow, position of the traffic-lights, traffic speed)
- Input data about rail traffic (traffic composition for the day, evening and night, train speed, rail type.)
- General urban-spatial planning data about the noise mapping area including demographic data (land use map of the area, population data, the data about the noise collecting procedure).

The most of the data and the corresponding sources used for the City of Varaždin – Noise map project are presented in the Table 1. Our further experiences shows that the necessary data for the noise mapping process exists (especially in the large cites), but with the enormous inconsistency and dispersion.

Table 1: The input data used for the City of Varaždin noise-mapping project

Description of the necessary data	Source of the used input data
Terrain topography data (contour lines, slope edges, ridges or fraction edges, punctual height information) Type of ground with the respect to the possible absorption Obstacle plan view and the corresponding heights, type of obstacles	Croatian base map Digital ortophoto Morphological map Proposal of the General town plan On-site review
The width and the midlines of the road traffic lanes	Croatian base map Digital ortophoto
Road traffic data	Development conception of the traffic system The previous measurements of the number of vehicles.
Rail traffic data	Croatian railways
Train traffic data	Croatian railways
Classification of the traffic lanes	Development conception of the traffic system Proposal of the General town plan
Type of road traffic lane surface	Inaccessible
Demographic data	Demographic study of the City of Varaždin
Meteo data	State Meteorological and Hydrological Service

The quoted sources for the input data are more or less same in all contacted authorities, but the greatest problems were notified with the road traffic data. In such case, the recommended toolkits from the [7] were used with the satisfied results. The main set-up for the calculation of the sound immision contour maps (SICM) was:

- SICM were calculated on the basis of the input data, with the grid of 5 x 5 m with a calculation height 4 m above terrain.
- The calculated noise values of the SICMs represents free field noise levels.
- The road traffic lanes were divided into two groups. The first one, with the known (measured)

traffic data, and the second, with the derived (calculated) traffic data.

- The road traffic speed used for the computer model was speed taken from the traffic signs (e.g. speed limit).
- For all obstacles, the constant reflection coefficient was used, except in the cases when the on site review gives the basis for the peculiar value.
- The heights of the obstacles were determined based on the on-site review (numbering of the storeys) or the orthographic images.
- The buildings with the minimum plan area less then 10 m² and height less then 2 m, were not neglected.

- The walls and fences with the height less than 2 meter, and the length less than 10 m are neglected.
- The long-term corrections due to the meteorological conditions were taken into account by using the default EU values for the day (50% favourable atmospheric conditions), evening (75% favourable atmospheric conditions) and night (100% favourable atmospheric conditions) period.

The input data for the rail traffic noise map (characteristics of the track sections, rail joints, vehicle specifications, rolling stock, speed distribution, driving conditions ...) were obtained mostly in the local office of the Croatian railways. Generally, such data exist in every local office of the Croatian railway, but it is important to know that the rail traffic in Croatia isn't very popular and used way of transportation. Hence, the 3-D model of the City was already constructed for the road traffic noise map, the input of data was much shorter. The calculation of the road and rail traffic noise map was performed with the software B&K LIMA 7812, ver. 4.29. The calculation of the traffic noise map is performed by the energetic summation of the results of the partial noise maps (road and rail). The SICM of the traffic noise for the day, evening, night and for the whole day with the appropriate European noise indicator are presented on the Figure 1-Figure 4, respectively.

3.5 Exposure & Annoyance analysis

In every future noise mapping project in Croatia, the exposure analysis can be treated as the easiest part of the process, because the Census of the Population was performed during 2001, so the number of inhabitants with the newly drawn statistical boundaries (mostly available in local cadastre offices) can be easily obtained. By the overlaying the administrative boundaries of the statistical districts with the known number of citizens, area occupation, land use and the acoustical zones, it is possible to calculate very precisely distribution of annoyance. Despite that, similarly to the issues 3.1 and 3.2, in the responsible state and local departments there is not enough essential knowledge upon the meaning and usage of the annoyance analysis, so the whole procedure and results were treated as a big question mark. Despite that, detailed annoyance analysis (desired resolution of the administrative district or city quarter) was always performed, highlighting its importance for the latter preparation and prioritization of the action plans. In all of our projects the method known as a LärmKennZiffer (LKZ)-Method (Noise-Evaluation-Index-Method) was used.

The Croatian Regulation of the highest allowed noise levels in working and living environment [9], classifies the maximum permitted planned values of equivalent noise level, L_{Aeq} with respect to designated land-use

into 5 zones from the 1st zone for large natural parks intended for relaxation and the health needs with in-patient clinic with permitted noise level of 50 dB(A) during the day and 40 dB(A) during the night, to 5th zone for industrial use the noise of which at its boundary must not exceed the levels permitted for the zone adjacent to it and at the boundary line of a building lot no more than 80 dB(A).

The LKZ noise indexes for the Croatian cities are relatively high, but the only reason isn't only noise levels that originate from the noise sources, but also in the poor national legislation. Namely, LKZ index are derived from the product of exceedance of defined allowed noise values depending on different land uses and the number of inhabitants affected by noise exceeding defined allowed noise values. Hence the mentioned Croatian bylaw didn't accept the noise level of 60 dB(A) for the daily period [9] and land-use with the high density of population, the LKZ index are unreasonably high.

3.6 Noise indicators

In the NAA and the first bylaw [9], the allowed noise limits (either existing or planned values) are expressed in the equivalent noise level, L_{Aeq} as described in the ISO 1996, without direct implementation of the European noise indicators, L_{den} , L_{day} , $L_{evening}$, L_{night} . Therefore it is reasonable to expect a certain misunderstanding and misuse, especially in the coordinating noise control measures with land use management.

3.7 Public presentation

In some of the projects, first results were presented to the City Council and expert teams for the land use management and environmental protection. After approval of the project, the most common way of the presentation of the noise mapping project is on the City web site, accompanied with the series of the lectures inside the city quarters. It is reasonable to expect a more intensive public involvement during preparation and prioritizing of the action plans.

4 Summary

This project shows that the transposition of the END in the Croatia is possible, with high degree of similarity with other European countries at the beginning of the noise mapping process. Our experiences, shows high level of misunderstanding of the main aim of the Directive, i.e. road transport noise, railway noise, aircraft noise around airports and industrial noise.

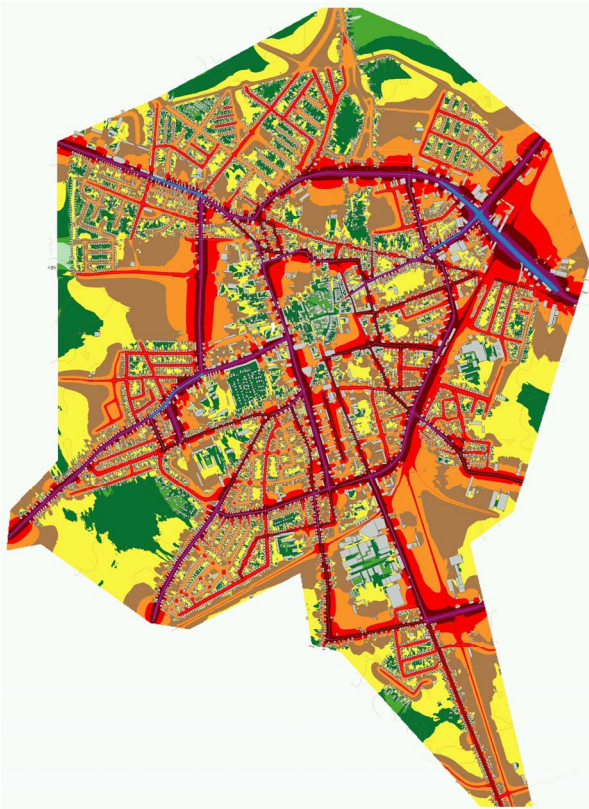


Figure 1: L_{day} SICM of the traffic noise



Figure 3: L_{night} SICM of the traffic noise



Figure 2: L_{evening} SICM of the traffic noise

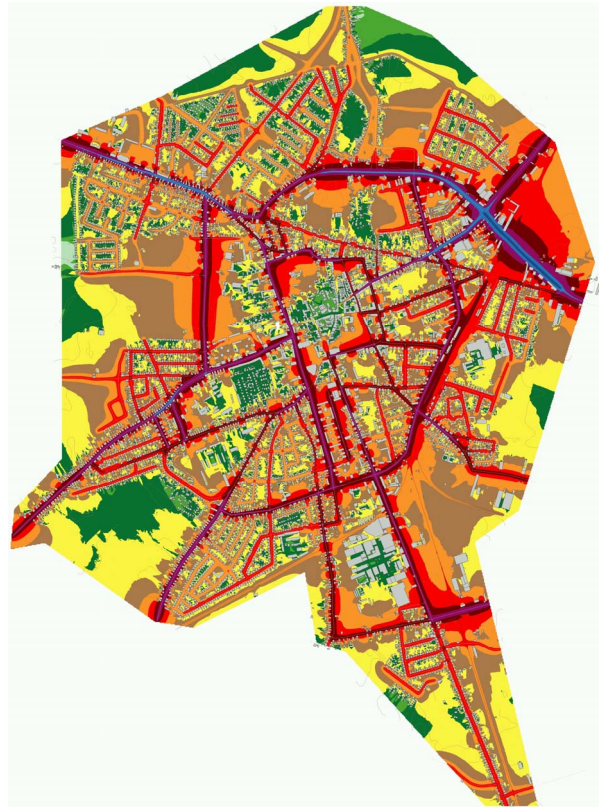


Figure 4: L_{den} SICM of the traffic noise

In most of the legal institutions, general thinking is that the noise maps process covers all noise sources (animals, nature, neighbours, bars etc.) and the creation of the noise maps will solve small scale problems. Therefore, the education of all participants in the noise mapping process (legal institutions, counties, cities, municipalities, acoustic consultants) is high priority task for the responsible government body.

In addition, the necessary data for the production of the noise maps in most of the cities exists, but its dispersion is similar to the other European states in this phase of the END transposition.

The acceptance of the European noise indicator will certainly have impact on noise limits issued by the Croatian legislation. Namely, in the Croatian legal system, the A-weighted equivalent continuous sound pressure level L_{Aeq} is the only valid term. Therefore, the allowed noise limits, either for the present state or future planned values must be expressed in such terms that are comparable to the European noise indicators.

Annoyance analysis, as a substantial part of the each noise mapping process, is one of the major temptations during whole process. First, in Republic of Croatia there is no existing exposure and/or annoyance analysis from the different types of noise sources. Therefore, the one of the existing standardized procedure for the annoyance analysis can be chosen as a "Croatian standard" or the unique procedure can be developed. For both cases, the legal act [9], that regulates highest allowed noise levels in living environment must be immediately corrected at least for following reasons:

- The allowed noise levels and planned values are not harmonized with the European noise indicators.
- The allowed noise levels for the different land use type aren't harmonized with the requirements of the END, so the result of annoyance analysis becomes poor.

Despite that, by the development of the complete legal system, is it possible to expect efficient Noise Abatement Act able to follow the dynamic process of socio-economic development and to perceive, support and promote positive trends in the noise abatement procedures.

References

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