APPROACHING NOISE POLLUTION FROM THE POINT OF VIEW OF THE ELEMENTS INTRODUCED IN THE SPECIFIC DATABASES

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***Abstract**: In order to render possible the mapping of traffic noise, it is necessary that the quality and efficiency of the studies on the harmful effects resulting from traffic be improved. The correlation between the information obtained through the GIS systems and the data collected by means of using the noise mapping computer software would determine a more efficient monitoring and evaluation of the impact noise has on the environment and on people's health.*

Thus, the drawing up of a database using geographic information, which is meant to create strategic noise maps, is essential. If the database in question is created properly, through a collection of layers, which designed for each distinct element, the areas where the noise level exceeds the accepted European limit can be outlined through modelling.

***Keywords:** database, topography, acoustic maps, road traffic*

1. Introduction

Starting 2002, the European Commission has approved the framework Directive concerning the ambient noise, directive which establishes the means of evaluation and reduction of noise level. Consequently, as reflected in specialized literature, the drawing up of some "acoustic maps" or "noise maps" has been brought into discussion, in an effort to monitor all the means of transport, maps that are to be drawn up and made available to various public institutions, entrepreneurs or even the general public. The drawn up maps are found across the E.U. (Fig.1), at a national level, as well as within the conurbations.

Fig. 1.Map of Europe in 2007 showing the number of persons/km exposed to noise pollution with a noise level ≥75 dB[6]

In 2006, in Romania, one has started to study and collect all the data necessary for the evaluation and administration of the noise caused by the biggest generator of noise, namely the road traffic.

The national roads having at least an annual rate of 6.000.000 vehicles became the object of analysis. The completion of the study, in 2007-2008, has led to a first evaluation of the level of noise pollution. The second study was initiated as a continuation of the first one, being brought to date first, and then developed through the monitoring of all the road sections with an annual rate of 3.000.000 vehicles. The drawing up of the database was completed in 2012-2013, but it was not made available to the general public, except for data related to some particular road sections. [4]

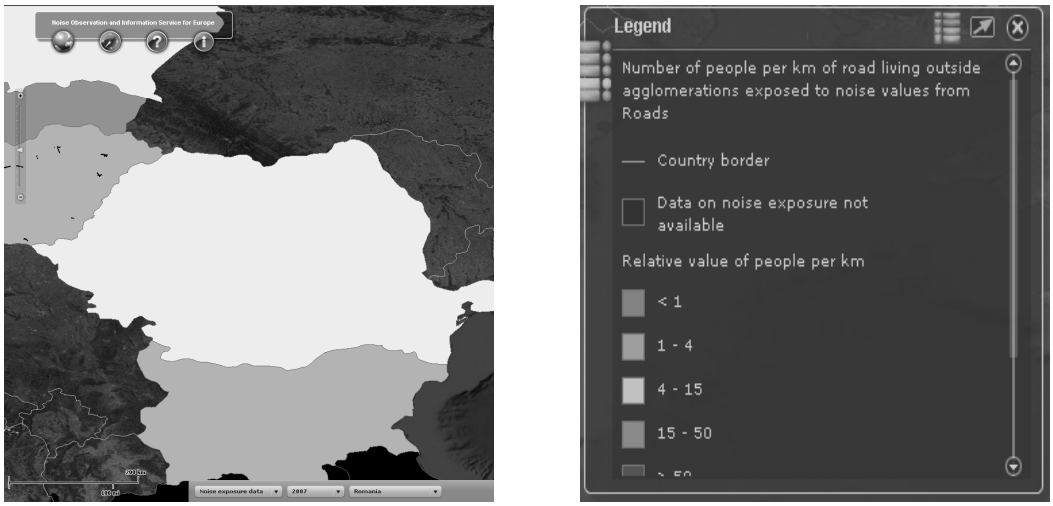


Fig. 2. Map of Romania in 2007 showing the number of persons/km exposed to noise pollution with a noise level ≥75 dB [6]

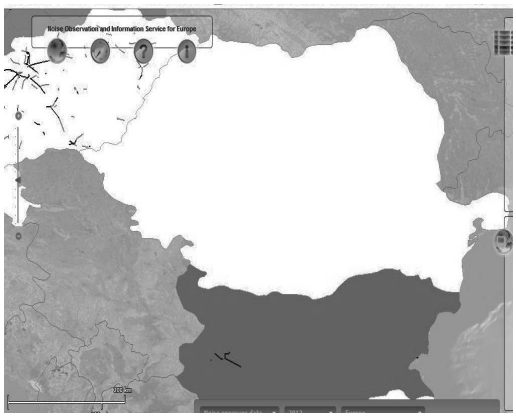
The information regarding the noise indicators and the population is exposure to noise pollution are updated every 5 years by the member states of the European Union, and this information is transmitted to the European Commission. The drawing up of such studies on a regular basis aims at covering the following aspects:

- The evolution of noise level over the years
- The efficiency of the measures undertaken to reduce the noise level
- The search for new methods to reduce the noise both from the point of view of the engines of the rolling stock, but also from that of the rolling surface of tyres. [3]

As can be seen in the following image which shows the data collected in 2012 (Fig. 3), even though the gathering of data was completed, in the sense that the information can be added to the database specific to noise pollution, the data in question have not been processed and made available to the general public. It is noticeable that many member states of the European Union, among which Romania too, have released only part of the collected data. (Fig.4). The noise maps have been processed for only 3 sections: section 1, covering 75 sectors of national roads and 8 sectors of highway; section 2, covering 100 sectors of national

roads, and section 3, covering 78 national roads and 3 sectors of highway, whereas the rest of the data is due during the year 2014.[2]

Fig. 3. Map of Europe showing the state of noise pollution in 2012 [6]



Hărți strategice de zgomot ale drumurilor principale, termen finalizare - 12 iunie 2012 (HG 321/2005)

Informații despre drumul principal				Informații despre sectoarele din drumul principal			Descarcare documente		
Lot	Nr crt	Clasificare drum	Denumire drum	Sector drum (poziții km)	Trafic mediu anual (nr vehicule/an)	Lungime sector (km)	Documentatie Comisie Tehnica	Harti de zgomot	
1	1	Drum national	1	7+470 – 12+461	20519445	5.411	DN1_7+470-53+650	LZEN	LO
1	2	Drum national	1	12+461 – 16+000	20851345	3.539			
1	3	Drum national	1	16+000 – 36+110	12012436	20.110			
1	4	Drum national	1	36+110 – 53+650	15060548	17.540			
1	5	Drum national	1	53+650 – 59+750	7530366	6.100	DN1_53+650-59+750	LZEN	LO
1	6	Drum national	1	59+750 – 67+284	10017277	7.534	DN1_59+750-122+000	LZEN	LO
1	7	Drum national	1	67+284 – 79+580	10371470	12.296			
1	8	Drum national	1	79+580 – 95+450	11363121	15.870			
1	9	Drum national	1	95+450 – 122+000	7563969	26.550			
1	10	Drum national	1	122+000 – 125+900	4005571	3.900	DN1_122+000-125+900	LZEN	LO
1	11	Drum national	1	125+900 – 138+000	7361618	12.100	DN1_125+900-138+000	LZEN	LO
1	12	Drum national	10	2+100 – 7+127	4102877	5.027	DN10_2+100-7+127	LZEN	LO
1	13	Drum national	1A	12+260 – 13+255	6148688	0.995	DN1A_12+260-13+255	LZEN	LO
1	14	Drum national	1A	13+255 – 19+450	4558769	6.195	DN1A_13+255-19+450	LZEN	LO
1	15	Drum national	1A	19+450 – 39+400	3498088	19.950	DN1A_19+450-39+400	LZEN	LO

Fig. 4. Map of Romania and data from CNADR, June 2012 [6] [2]

In a generic sense, GIS applications are tools that allow users to create interactive queries (user created searches), analyse spatial information, edit data, maps, and present the results of all these operations. Geographic information science is the science underlying the geographic concepts, applications and systems. [1]

Beside the ability of producing maps and plans, GIS is the right tool for managing network utilities (water-supply, sewerage system, mains, district heating, roads and railway system etc.), identifying the optimal location for an investment, the study of the impact of a certain objective upon the environment complying with the general policy of sustainable development [5]

The database presented in this paper is drawn up for the road sector DN15 11+600-21+0, where Cluj county borders Mures county.

2. The topographical data used for creating a database for monitoring the noise

The creation of databases meant for producing both the strategic noise maps and the strategic plans requires time, equipment, qualified staff from various fields of work. The given paper aims at outlining the importance of the topographer in conducting such a complex and valuable study. The topographical plans have been processed with a high degree of

accuracy within the system of coordinates of the Stereografic 1970 map projection, the most used type of map projection for editing plans and digital maps in Romania.

The raised-relief map of the planimetric elements that were introduced in the database was realised with the newest equipment so as to ensure the precision required by the instructions for thender book of the project, a precision in base topographic plane up to ± 7 cm. The planimetric elements have been edited for the map at a 1:500 scale (Fig. 5.) (bibliography)

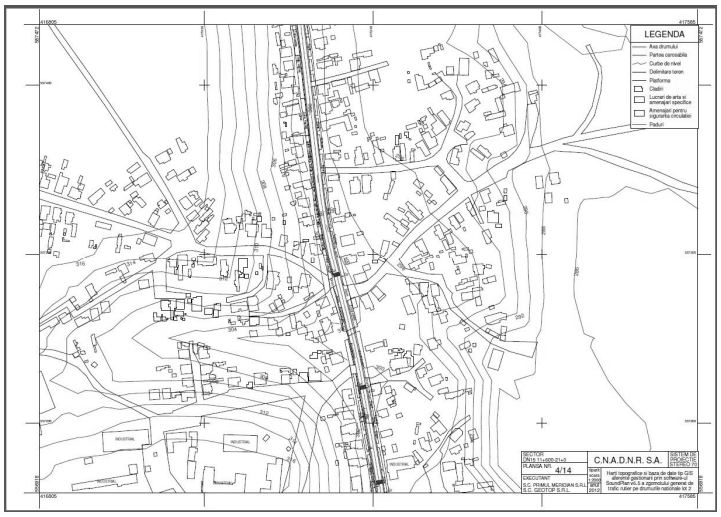


Fig. 5. The situation plan at the established scale.

The field under analysis on section DN15 11+600-21+0 is situated between Turda and Targu Mures, stretching for 9 km and 400 m, distance on which benchmarks were placed so as to facilitate the tracing and updating works required for both the completion of the database and for the development of the topographical works. The average density of points per km, required in the instructions for thender book, at a national level, was 0,5/km, and as a consequence, benchmarks were planted every two kilometres along the road, where and if the field allowed it. In our case, there was no need for alternative solutions, but a choice to reduce this distance of 2 km between benchmarks was given so as to provide a better visibility between them. The benchmarks are to be placed as close as possible to the road, usually in the protection area, aiming at ensuring conditions of stability, accessibility and visibility.

The benchmarks in question helped produce the raise-relief map of all the elements from the field, including the central parts of the towers, the water castles, the transmission towers that are much more taller than the tallest points in the vicinity. These elements were introduced into the database under a distinct layer, a Geo-Text layer. Once the drawing up of the map is produced, it will transmit text information concerning the type and absolute height of the point.

The data collected on the field generated contour lines. This was possible only through interpolation, on the condition that the contour lines should be equidistant from each other for as much as 1 m, as required. Descriptive texts which show the value of the height of the contour line are to be attached to each contour line. The importance of these contour lines is not to be underestimated as they are essential for the drawing up of the digital model of the field. Thus, if between the noise source and the locality there are over 50-100 m, then between the contour lines there can a distance of ≤ 2.5m. (bibliography)

The position of all the constructions typical of a road (bridges, footbridges, viaducts, tunnels, dams, drainage channels, protected slopes, parapets, protective forest belts, passages,

gutters, ditches, etc.), as well as their planimetric shape, was established once some topographical measurements had been made. Every single project form the ones listed above follows a series of technical characteristics established according to the topographical plans (detailed plane). The focus was laid on the accuracy of the data, as once these were introduced correctly, they were expected to offer clear and convincing results. To this aim, the process of mapping involves a constant updating and verification of all the parameters and coordinates from the field.

The strategic noise maps are created on the basis of some geographical information reunited in a collection of layers. The data collected from the field are transposed into a digital format of the field, where the following are marked down: the road, the neighbouring areas having the limits specified in the appendix, the buildings erected in the vicinity. The number of inhabitants living near the road in question, is also mentioned, so as to better estimate the impact noise has on human beings. The digital format of the field under study will eventually be transposed in a .dxf file meant to include each layer separately. The segment we are interested in will be renamed as follows: "sectordrum.dxf".

The data provided for illustration in table 1 include both .dxf files, as well as .dwg ones. The elements presented here include: geographical network, control point, precise reference mark, station point, offshoot points and other detail points.

Table 1. elements introduced in the .dxf file according to the thender book

Layer name	Colour Code	Signification
CAROIAJ_L	7	Geographical network, line or conventional sign
CAROIAJ_T	7	Geographical network, inscription on grid (coordinate values), text 1.5
PUNCTSP_P	7	Control point, Actual point
PUNCTSP_S	7	Control point, conventional sign
PUNCTSP_T	7	Control point (nomenclature), text 1.5
REPNIV_P	1	Precise reference mark, actual point
REPNIV_S	1	Precise reference mark, conventional sign
REPNIV_T	1	Precise reference mark (nomenclature), text 1.5
PUNCTST_P	4	Station point, actual point
PUNCTST_S	4	Station point, conventional sign
PUNCTST_T	4	Station point (nomenclature), text 1.5
PUNCTRD_P	2	Offshoot points and other detail points
PUNCTRD_T	2	Offshoot points and other detail points, (nomenclature, cod), text 1.5
PUNCTCT_P	10	Altimetric point, actual point
PUNCTCT_T	10	Altimetric point (height) text 2.0

For a better administration of the elements drawn from the database, the following colour code was preserved: 1- red, 2- yellow, 3- green, 4- cyan, 5- blue, 6- magenta, 7- black 10- dark brown (Fig. 6.)

Fig. 6. The elements of the reported database with its specific layers –for the area under study.

The databases that assist the Geographic Information System specific to the noise pollution has to include all the elements required so as to combine the domain of transportation to that of noise pollution. The information obtained via the Geographic Information System, along with the results obtained from the calculation software for mapping the noise, determines both a more efficient and concise monitoring and evaluation of the impact noise has on the environment and on people's health.

Some of the negative/ harmful effects the increase in number of dB has on the human factor are presented below:

a) The first noticeable effect is that of the altering of hearing, as the repeated exposure of the eardrum to noise might harm it for a temporary or even permanent period of time;
b) Noise affects sleep, and the worst aspect of this drawback is represented by the high noise pollution near hospitals, where patients are in need of a restful sleep;
c) The heart, the brain and even the liver are the most affected internal organs;
d) The noise creates discomfort that leads to migraines, to the dilatation of the pupils, high blood pressure;
e) The noise has bad effects from both a social and emotional point of view, conversations are interrupted due to noise, people tend to raise their voices so as to be heard by their interlocutors, thus forcing their vocal strings [7]

In order for noise pollution to be reduced, more than one measure could be taken, such as: appropriately keeping in good condition the roads and the vehicles, planting trees, the assembling of some sound absorption panels. Another measure to take into account would be the constant analysis of the traffic and of the way in which it might be kept under control by the road police.

3. Conclusions

The accuracy of the noise maps depends to a great extent on the information collected and introduced into the databases that manage the Geographic Information Systems.

The implementation of the Geographic Information System is important in that it helps identify as accurately and fast as possible the area where the noise pollution reaches the highest level, leading thus to the adoption of specific measures for reducing it.

Raising people is awareness to the negative effects produced by noise pollution is still a future challenge, taking into account the fact that many such studies related to this type of pollution are undertaken.

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