GEOGRAPHIC INFORMATION SYSTEM FOR NOISE POLLUTION IN RELATION WITH BUILDINGS CLASSIFICATION

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***Abstract**: Geographic Information System database for noise pollution have to contain all the elements required in order to combine the field of transportation with those of phonic pollution and land measurement. The information provided by the GIS and the one obtained using the modeling software, determine more efficient monitoring and more accurate assessment of the noise impact on the environment and human health.*

This paper presents the way of improving the database with new elements by classifying the buildings and handling the noise maps. These new elements are necessary to achieve optimal action plans at the lowest cost.

***Keywords:** GIS, noise maps, noise pollution, action plans*

1. Introduction

There are four principles which manage the whole policy for reducing noise pollution and protection measures: environmental noise monitoring, control of the noise pollution sources and their effects on environment, public information and consultation, a long-term EU strategy on noise pollution.

At least three of these principles is using Geographical Information Systems. GIS are increasingly used in the fields which need the use of maps and plans. These can be updated in a short time by the introduction of new elements into a data base, graphical and textual all the same.[7]

The noise pollution monitoring is done using GIS; the topographic elements included in the database are: geometric grids, elevation data, station point etc. For example every level curve contains attribute data, as for example information about the elevation. The elevation datasets are necessary to obtain the digital terrain model, essential for the noise modelling.

The aim of the paper is to update an existing Geographical Information System with new elements by classifying the buildings and handling the noise maps. These new elements are necessary to achieve optimal action plans and at the lowest cost.

2. The inventory of buildings and their classification

The CNOSSOS-EU methodological framework specifies the need of mapping the noise in residential areas. The representation of data regarding schools and hospitals on strategic noise map is also required, information to be reported to the European Commission.[6] Buildings like schools, libraries and other educational institutions, hospitals or care facilities are more susceptible to noise because of the activities occurred inside the building, so information although not mandatory, it becomes mandatory in the 2017 reporting process (the date of coming into force of CNOSSOS-EU) and must be monitored from now on.

Noise mapping is a new way to comprehend phonic pollution. An acoustic map has as the main purpose the identification of the strategic points, where pollution reaches peak levels, the identification of the noisiest zones and also of the non-impact areas, where pollution caused by road traffic is neglectable. [4]

As it was mentioned before, the documentation and mapping of noise are necessary for the implementation of rules regarding noise control and monitoring. Information technology, as Geographic Information Systems, comes to support the traffic efficiency policies, according to the needs and health demands of local communities. GIS provide the maps necessary to achieve the strategic plans. These plans shall be used to tackle noise pollution and to develop proper urban planning projects.

Specific data for a construction introduced in GIS are about land survey of existing buildings, representing their footprints and entering data regarding the number of floors, in other words the height regime of buildings, data on the number of residents. [5]

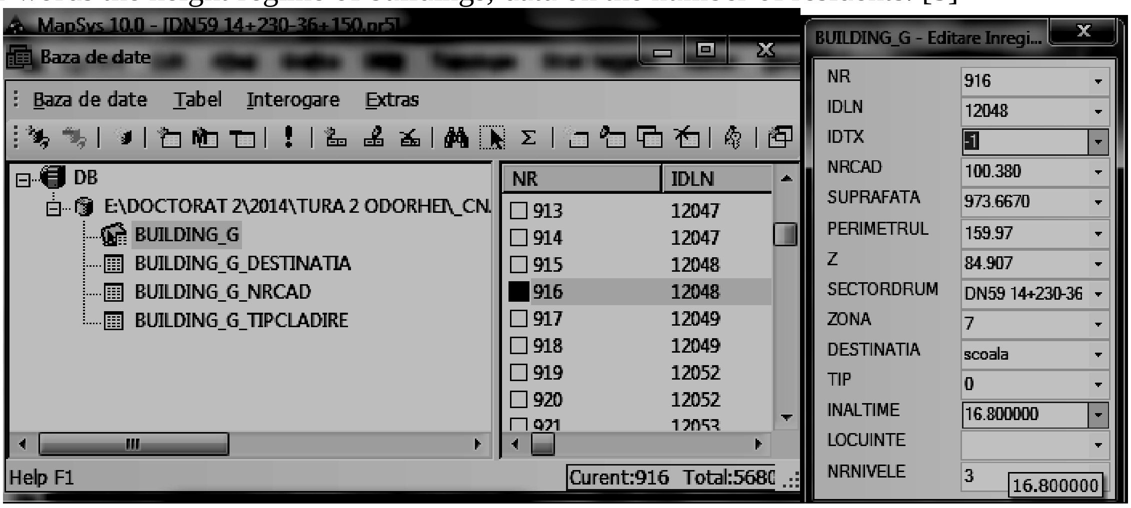

Fig. 1. Querying the BUILDING database

The inventory of buildings and photographing them were used for mapping the sound insulation of existing buildings on the site.

Fig.2. House – type 1

The AAC masonry has a density about 400±30 kg/m^3 or even 300±25 kg/m^3. This density of the masonry provides the absorption of airborne noise and the Weighted Sound Reduction Index depends on the wall weight.

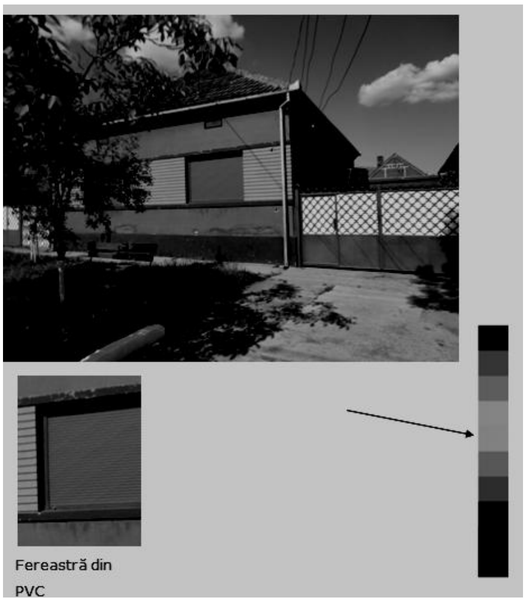

Fig. 3.House – type 2Well maintained building, plastered, old rooftop

Fig.4. House – type 3 Old house of unfired bricks, damaged plaster, PVC window, old rooftop

We identified construction similarities that we have categorized as you can see in Fig. 2,3,4. For this classification we have used the "Normative document regarding acoustics in structures and urban areas, code C 125/2013. Design and implementation of sound insulation measures and acoustic work in buildings". [3] On the selected area of interest, every building was customized with particular hatches, depending on Rw index, which represent the Weighted Sound Reduction Index.(table 1)

Table 1. Weighted Sound Reduction Index specific for different type of construction material

Structure	Total weight (kg/m^2)	Rw index (dB)
Unplastered concret slab 20.5 cm	512,3	55
Unplastered concret slab 23 cm	575	56
Reinforced concrete walls – thickness 11 cm	313	51
Masonry with fired clay bricks (1600 kg/m^3) with the following dimensions (2 cm + 29 cm + 2 cm)	532	54
Blocks approx. 630 kg/m^3 plastered on both sides, with the layer of plaster of 2 cm; = 1700 kg/m^3 (2cm + 24 cm +2 cm)	224	47
Pitched roof (no tiles)		41
Pitched roof (fired clay tiles)		50
Pitched roof (metal sheet roof)		51-55
Windows (4-6-10mm glass) The glass sheets must have different thickness The bigger the space between the panes of glass, the more efficient is the window. The replacement of air with Argon increases the insulation efficiency		31-40
Structure: AAC (autoclaved aerated concrete) strip – 12.5 cm; porous plates – 4 cm; air – 6 cm; AAC strip – 7.5 cm	135	53

The presented pictures show the buildings' condition from the selected area of interest, put into a .dxf file. Fig. 5.

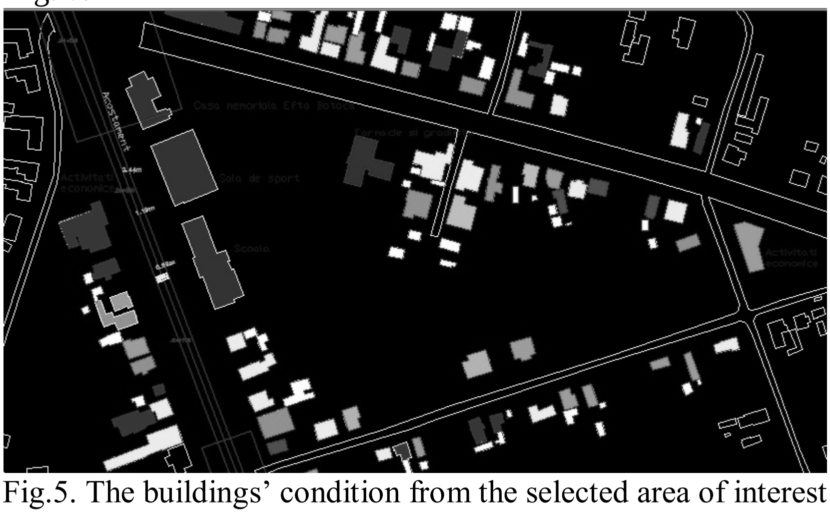

Fig.5. The buildings' condition from the selected area of interest

GIS use digital information, for which various digitized data creation methods are used. One method is digitization, where a hard copy map or survey plan is transferred into a digital medium through the use of a computer-aided design program, and geo-referencing capabilities. Digitizing involves the tracing of geographic data directly on top of the aerial imagery instead of by the traditional method of tracing the geographic form on a separate digitizing tablet.[2]

In order to analyze the situation on the field, we have georeferenced the 2012 noise map to add the information in Stereo 70 cartographic projection.(Fig.6) Georeferencing an image involves aligning it to a defined coordinate system in this case Stereo 70.

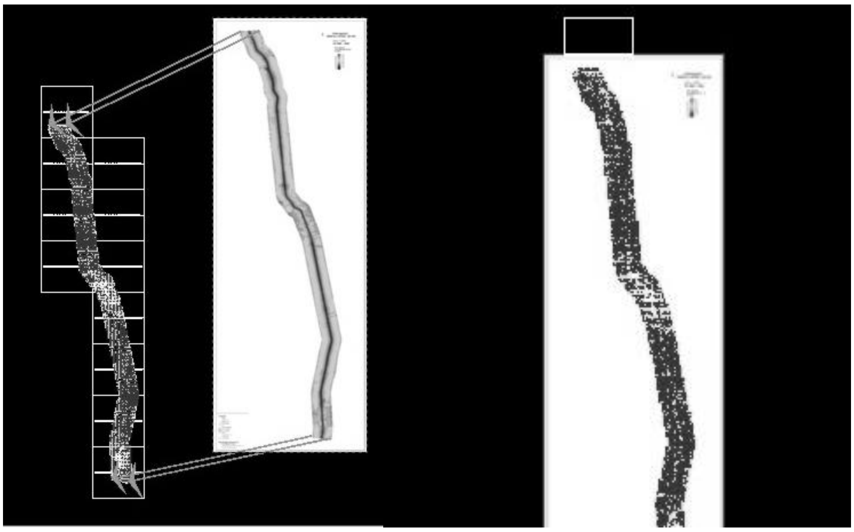

Fig.6. The georeferenced map noise

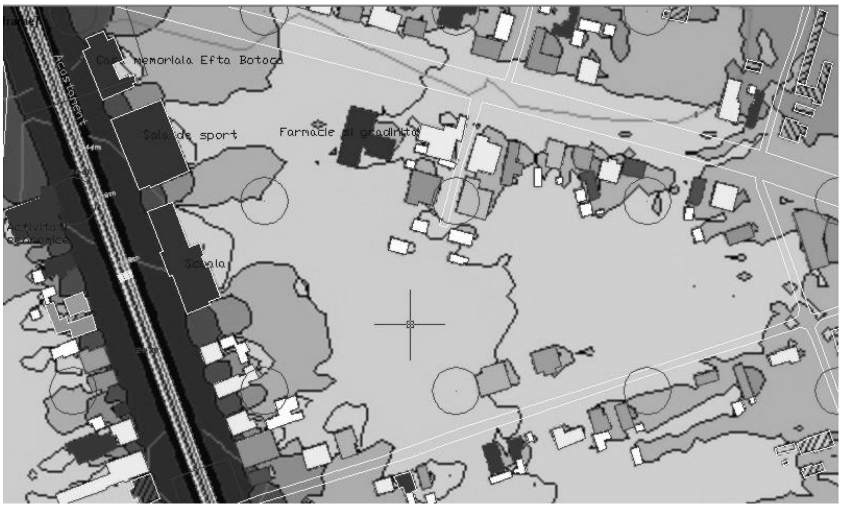

Fig.7. Overlapping of building classification on the noise map

The figure representing the overlapping of building classification (Fig. 7.) on noise map reveals:

- Noise sensitive buildings (like kindergartens, schools, cultural buildings) – with black hatching;
- Industrial buildings – with blue hatching;
- Household annexes, important for noise modelling, but have no effect on residents noise exposure – with white hatching;

- House type 1 – using green colour scale (3 different shades) for visualization of residential buildings with noise mitigation measures;
- House type 2 – using yellow-orange colour scale for visualization of well maintained buildings, with a proper Rw index;
- House type 3 – using red colour scale for visualisation of damaged buildings.

3. Conclusions

We consider that the overlapping of the building classification on the noise map and the existing dataset periodically updated with noise datasets (measured by experts in strategic points) will create more accurate noise map. With the development of information system and data collection technique, it is possible to create a 3D digital model. This 3D information plays an important role in recording and documenting buildings which are considered sensitive.[1] Having close to reality results, than the action plans for reducing the road traffic noise would be realistic, meaning that it would ensure that money invested in both the study and the mitigation measures will yield results. The effect will be the decreasing of people exposed to noise, therefore the improving of human health and quality of life in urban areas.

4. References

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