Study Regarding the Simulation of Urban Traffic Noise in Braşov City

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Abstract: - Traffic noise tends to be a dominant noise source in the urban environment that's why so important to study it. The present research paper intends to make a noise map in the centre of Braşov city: Toamnei Street, M. Kogălniceanu Blvd. and 15 Noiembrie Blvd.; then it will be possible to propose to the local authorities measures for reducing the noise level, protecting the exposed population in this area, at the same time encouraging them to make an impact study before implementing the adopted solution.

Key-Words: - urban traffic noise pollution, traffic flow, urban mobility, sustainable transportation, noise map, road traffic noise measurement.

1 Introduction

For making the traffic analysis in the studied area there was established six observation points. The traffic flow in these intersections forms a big roundabout because the traffic flow at Toamnei, Bd. M. Kogălniceanu and Bd. 15 Noiembrie Streets runs in one way only.

Fig.1 Studied area

The studied area is formed from streets of category I (15 Noiembrie Blvd., M. Kogălniceanu Blvd.), streets of category II (Toamnei Street, Griviței Blvd.) and streets of category III (Bihorului Street) every street having a "U" type profile.
The traffic in this area is jammed from many reasons:
✓it is a residential area;
✓it is an administrative and economic area (BCR, BRD, CEC, College „Dr.Ioan Meşota")
✓it is a sport and breaking area
✓three of the intersections in the studied area allow also the entrance and exit from national highways:
- Calea Bucuresti Street allows the entrance and exit to **DN 1** (Braşov – Ploieşti – Bucureşti) national highway
- Harmanului Street allows the entrance and exit to **DN 11** to **(**Sfântu Gheorghe city)
- Bd. Griviței Street allows the entrance and exit to **DN 13** (Feldioara - Hoghiz - Rupea – limit of Mureş county)

In the table bellow is presented the weight for each type of area.

Tabel 1

Type of area	Weight
Mixed area	20.2 %
Residential area	15 .3%
Road area	25.2%
Parking area	17.8%
Green area	17.9 %
Sport area	3.2 %

2 Measurement and calculation methods

Calculations are carried out according to the following steps:

a) Decompose the sound sources into point sources;

b) Determine the sound power level of each source;
c) Search for propagation paths between each source and the receivers;
d) On each propagation path:
✓Calculate the attenuation with favorable conditions;
✓ Calculate the attenuation with homogeneous conditions;
✓Calculate the long term level from favorable level, homogeneous level and occurrence of favorable conditions;
e) Sum the long term sound levels for each path, then calculate the total sound level at the receiver.

For a sound point source S_j of power L_{AWj} and for a specific octave band, the continuous equivalent sound level at the receiver R with given atmospheric conditions will be obtained according to following formula [10]:

$$L_{eq,LT} = 10\lg\left[\sum_i 10^{0.1L_{iLT}} + \sum_{i'} 10^{0.1L_{i'LT}}\right] \quad (1)$$

Where:
i – denotes all the point sources
i' – denotes all the images sources from reflections on vertical obstacles
Total sound level at the receiver for a specific octave band is obtained by summing the sound contributions of all the point sources and their possible image sources.
Percentage of occurrence of favorable conditions in the case of a path which is reflected on a vertical obstacle will be considered identical to the one relative to the direct path: if S'_j is the image source of S_j then occurrence p'_j relative to path (S'_j,R) will be taken equal to occurrence p_j relative to path (S_j,R.)
In the same manner will be calculated the long term sound level at the receiver R in dB(A) according to following formula[10]:

$$L_{Aeq,LT} = 10\lg\left[\sum_i 10^{0.1L_{eq,LT(j)}}\right] \quad (2)$$

Where: suffix j denotes the six octave bands from 125 to 4000 Hz.
This level $L_{Aeq,LT}$ is the wanted final result that is the long term sound level at the receiver point.
The attenuation due to geometric divergence takes into account the effect of decreasing of the sound level due to propagation distance. For the point sound source in free field the attenuation (in dB) is given by [10]:

$$A_{div} = 20\lg(d) + 11 \quad (3)$$

Where: d – direct distance between source and receiver (distance without any diffracting obstacles) in meters.
The attenuation due to atmospheric absorption during propagation through a distance d is give by [10]:

$$A_{atm} = \alpha d / 1000 \quad (4)$$

Where: d – direct distance between source and receiver, in m
a – air attenuation coefficient (in dB/km) at the nominal midband frequency of each octave band in accordance with Table 2.

Table 2

Midband frequency (Hz)	125	250	500	1000	2000	4000
a(in dB/km)	0.3	1.1	2.3	4.0	8.7	26.4

The values of a are given for a temperature of 15 C° and a relative humidity of 70%. They are in accordance with values provided by ISO 9613-1.
The attenuation due to ground effect is caused by the interference between the sound reflected on the ground and the sound that propagates straight from the source to the receiver. It physically depends by the nature of the ground above which propagation takes place. But it is also deeply linked with air conditions appearing during propagation in the sense that the curvature of the rays modifies the height of the path above the ground and give more or less significance to the terrain located near the source, near the receiver or between the two.
Using the BZ 5503 software utility from Bruel & Kjaer hand held analyzer, the measured data could be easily stored and visualized as you can see in the figure bellow.

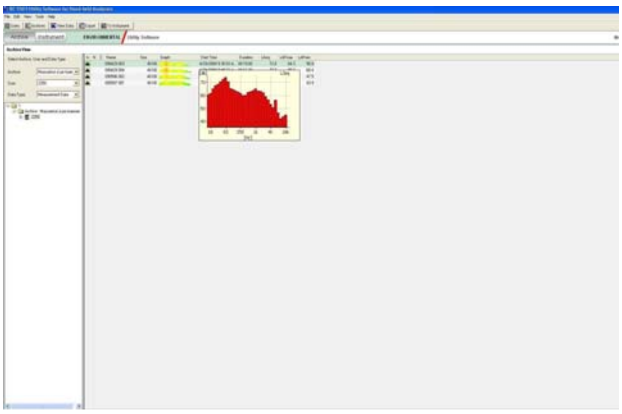

Fig.2 BZ 5503 software utility

The noise measurements duration it was an hour, time when the traffic volumes also were be taken.

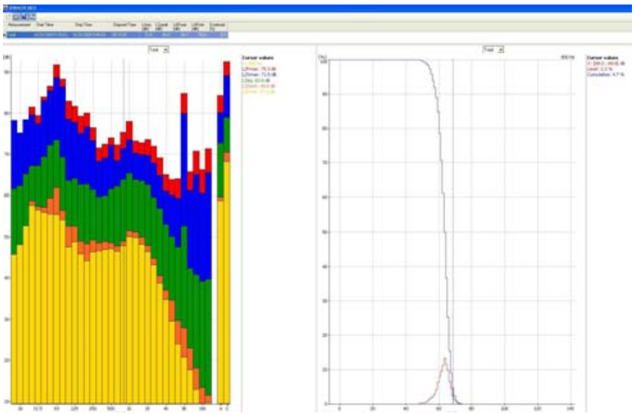

Fig.3 Day noise measurement in octave bands

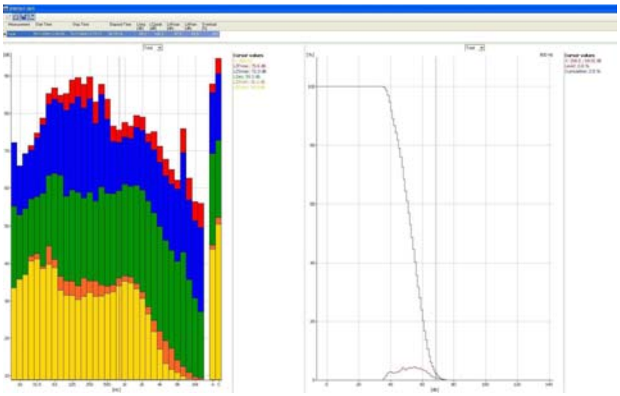

Fig.4.Evening noise measurement in octave bands

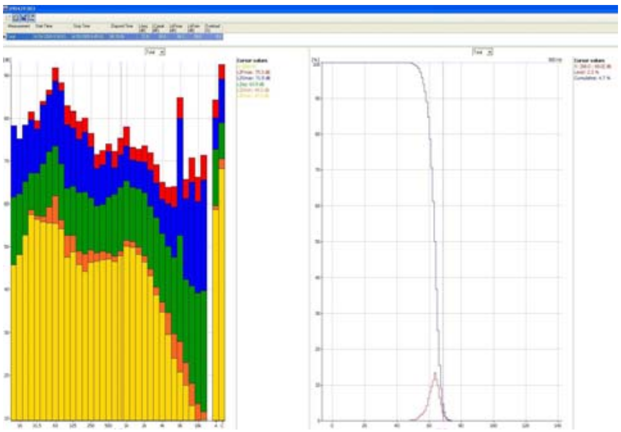

Fig.5.Night noise measurement in octave bands

After processing the acquisitioned data the next step was to create the .mdb format; in this way the data could be easily imported.
The city map was made in AutoCAD including the building and roads geometric characteristics, so the .DXF format could be easily converted in .BNA noise mapping software format.

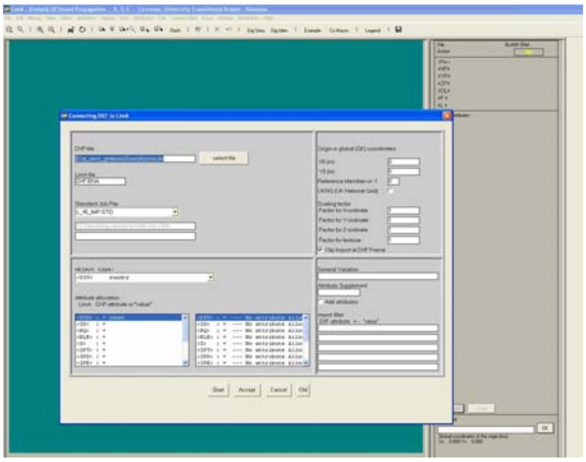

Fig.6 Transforming the .DXF format into .BNA

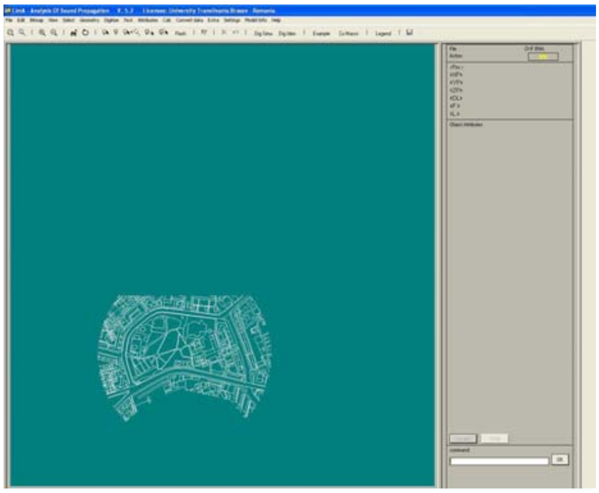

Fig.7. Introducing the height of the buildings

The road network was created in the noise mapping software and traffic data was imported from .mdb database.

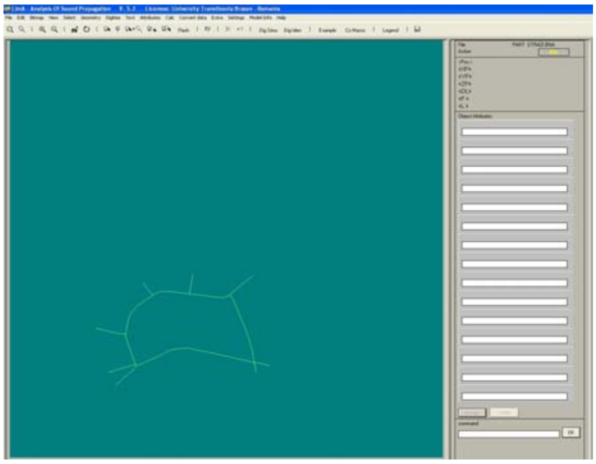

Fig.8 Creating the road network

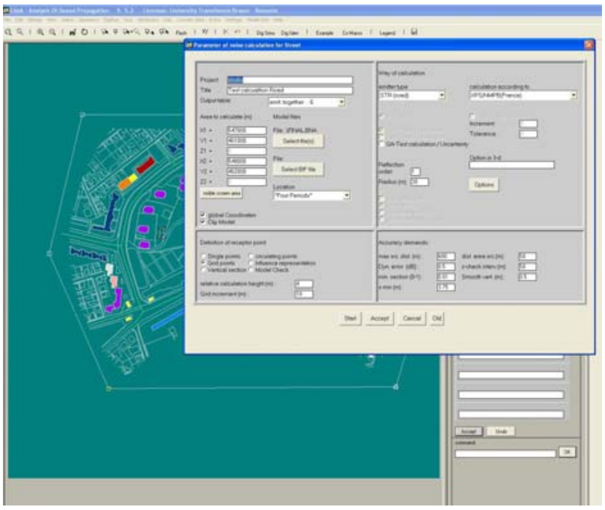

Fig.9.Preparing for graphic results

Fig.10. L_{night} noise map of studied area

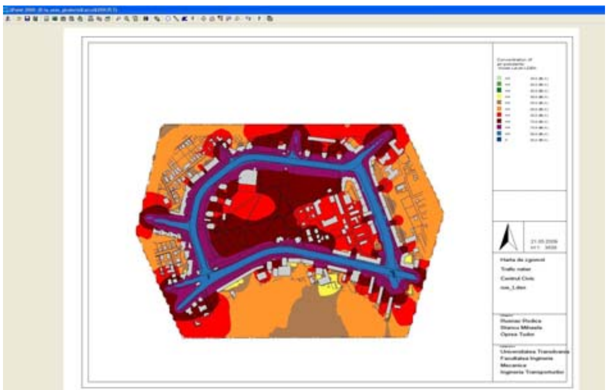

Fig.11. L_{DEN} noise map of studied area

According to Directive 2002/49/EC for the European Parliament and of the Council the noise level for day, evening and night (L_{DEN}) in decibel (dB) could be calculated with the formula presented bellow [6]:

$$L_{DEN} = 10\lg\frac{1}{24}\left(12\cdot 10^{\frac{Lday}{10}} + 4\cdot 10^{\frac{Levening+5}{10}} + 8\cdot 10^{\frac{Lnight+10}{10}}\right) \quad (5)$$

In the Table 3 are represented the three noise indicators estimated by the LimA soft and the measured values. The difference between the measured and estimated values is less than ±3 dB.

Tabel 3

Indicator	Measured db(A)	Soft estimated db(A)
L_{day}	72.8	74.5
$L_{evening}$	72.9	71.1
L_{night}	69.3	66.5

3 Conclusions

As a final conclusion it can state that the studied area is highly affected by the traffic noise. It is strongly recommended that the local authorities to take measures of reducing the noise in this way protecting the exposed population in this area. One of the main problems are that our local authorities does not making an impact study before implementing a newly adopted solution.

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