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Road Traffic Noise Pollution Analysis for Cernavoda City

L. Manea[1], A. Manea[1], D. Florea[2] and S. Tarulescu[2]
[1]Ovidius University of Constanta, Mamaia Boulevard Nr.124, Romania
[1]Transilvania University of Brasov, Eroilor Boulevard Nr. 29, Romania

Abstract. In the present paper was studied the noise pollution in Cernavodă city. The noise measurements were made for nine intersections from different city areas. Noise measurements were taken for three chosen routes with high population density, heavy traffic, commercial and residential buildings. Average, maximum and minimum values were collected and compared with standards. The impact of road traffic noise on the community depends on various factors such as road location and design, land use planning measures, building design, traffic composition, driver behaviour and the relief. In the study area 9 locations are identified to measure noise level. By using sound level meter noise levels are measured at different peak sessions i.e. morning, afternoon and evening. The presented values were collected for evening rush hour.

1. Introduction

Traffic noise is the most rigorous type of noise pollution. Traffic represents a serious problem because of inadequate urban planning of the cities. Residential areas, schools, commercial zones, hospitals, and other community buildings were built close to the main roads without buffer zones or adequate sound proofing. The problem has been compounded by increases in traffic volumes in the last years. This alarming increase in the volume of traffic is actually inversely related to the degradation of the environment. Sound pressure is a measure of the vibrations of air that makes up sound and these levels are measured on the logarithmic scale with units of decibel (dB) [7].

Global, or strategic, noise planning tries to prevent noise issues arising and to optimize the use of limited resources by mapping and managing the noise environment of a large area such as a city. Road traffic noise accounts for more than 90% of unacceptable noise levels (daytime LAeq > 65dB(A)) in Europe [6]. Environmental noise levels can either be assessed by measurement or by calculation. Although a measured level (i.e. the reading of some measurement device) tends to be more convincing to the public than a calculated level (i.e. the output of some computer program) the preferred method is very often the calculation. The reasons for this preference are: the laborious assessment of the exact situation of the source can be avoided; long term average weather conditions can be taken into account directly; noise levels can be assessed even for future developments; possibly disturbing effects of "background" noise can be avoided; detailed information on the contributions of different partial sources can be assessed more easily; different scenarios can easily be synthesized in the case of noise action planning [3], [5].

2. Noise measurement methodology

2.1. Theoretical elements

Environmental noise caused by road traffic is assessed for different purposes:

- to assess the acceptability of new building developments in noisy areas,
- to determine the nature and amount of noise abatement provisions, in case of excess of the limit value,
- to assess the acceptability of a new infrastructure in the neighbourhoods of residential areas,
- to assess the necessity of remedial action in the case of excessive noise in residential areas [1].

For noise measurements was used Sound Level Meter - Type 2250 from Bruel&Kjaêr. This sound meter has been developed specifically for measuring occupational, environmental and product noise, while complying fully with all the relevant national and international standards [2].
The tasks for environmental noise measurements are varied, so the instrument you pick for your measurements needs to be flexible, easy to configure, powerful and accurate. 2250 Light is built on the core platform of the award winning design of Type 2250. It borrows the robust construction, intuitive touch screen interface, and legendary Bruel&Kjaêr measurement accuracy [2].

Figure 1. Analyzed area - Cernavodă road routes and studied intersections (Google Maps)

2.2. The analyzed area

In the Figure 1 are presented the analyzed routes from Cernavodă City. The studied intersections are numbered as follows: 1. Constanței Str. + DN22C Intersection; 2. Nicolae Titulescu Str. + Gării Str. + Crișan Str. Intersection; 3. Nicolae Titulescu Str. + Dacia Str. + Seimeni Str. + Medgidiei Str. Intersection; 4. Medgidiei Str. + Panait Cerna Str. Intersection; 5. Medgidiei Str. + Canalului Str. Intersection; 6. Canalului Str.+ Sălciei Str. Intersection; 7. 24 Ianuarie 1859 Str. + Seimeni Str. + Pictor N. Grigorescu Str. Intersection; 8 Seimeni Str. + Independenței Str. + Gheorghe Doja Str. Intersection; 9. Anghel Saligny Str. + Ovidiu Str. Intersection.
The analyzed route can be separated into three distinct routes: first route includes intersections no.1, 2, 3, 4 and 5 and is the route that connects Cernavodă city entrance with main road that leads to Nuclear power plant, characterized by wide roads with 2 lanes and high traffic flows. The second route includes intersections no. 2, 7, 8 and 9 and is a residential streets route, characterized by narrow roads with 1 lane and medium traffic flows. The third route includes intersections no. 5 and 6 and is the Cernavodă bypass road characterized by high heavy vehicles traffic.

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3. Routes analysis

3.1. Routes measurement points

For each route ware selected noise measurement points relevant to the transited area. For residential route the measurement points ware selected in function of pedestrian zones and main socio-commercial objectives. For the main city route, the measurement points were selected in the junction areas, on pedestrian zones. For the Cernavodă bypass road, the measurement points were selected in residential areas and in junction areas.

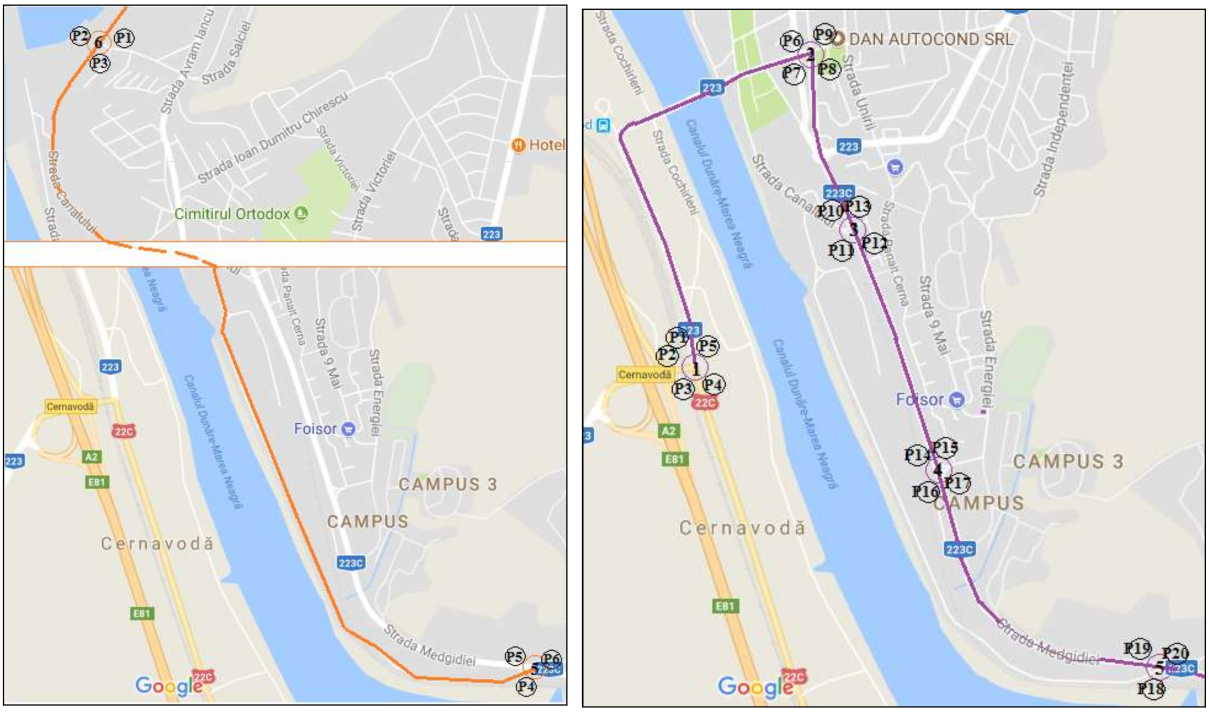

Figure 2. Noise measurement points for: Route 3 (orange - left) and Route 1 (violet- right) (Google)

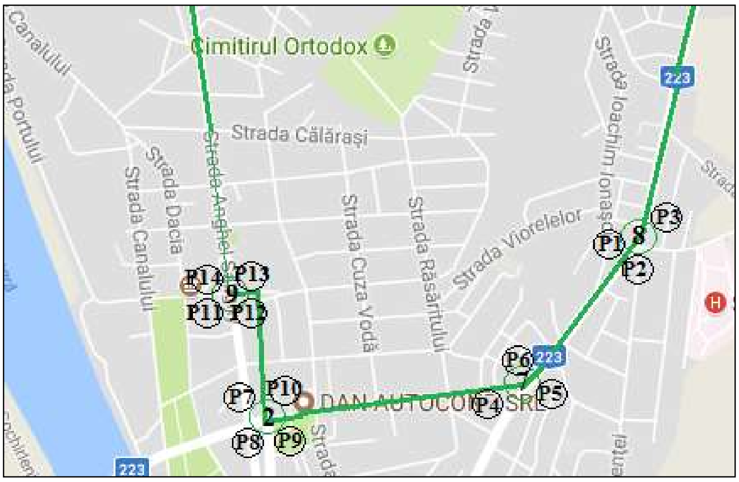

Figure 3. Noise measurement points for Route 2 (green) (Google Maps)

For each of the nine analyzed intersections were centralize the noise average and maximum values over the period of measurements, recorded for evening rush hour interval (15.45 – 16.45).
The noise level for each route (for all measurement points) are presented in the Figures 4, 5 and 6.

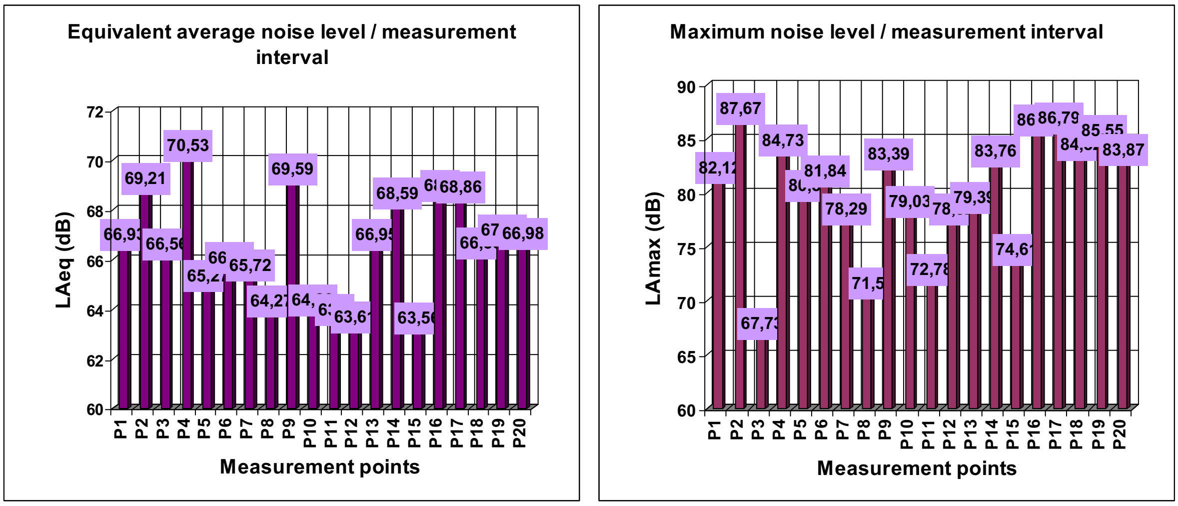

Figure 4. Noise level for Route 1 (LAeq values - left; LAmax values - right)

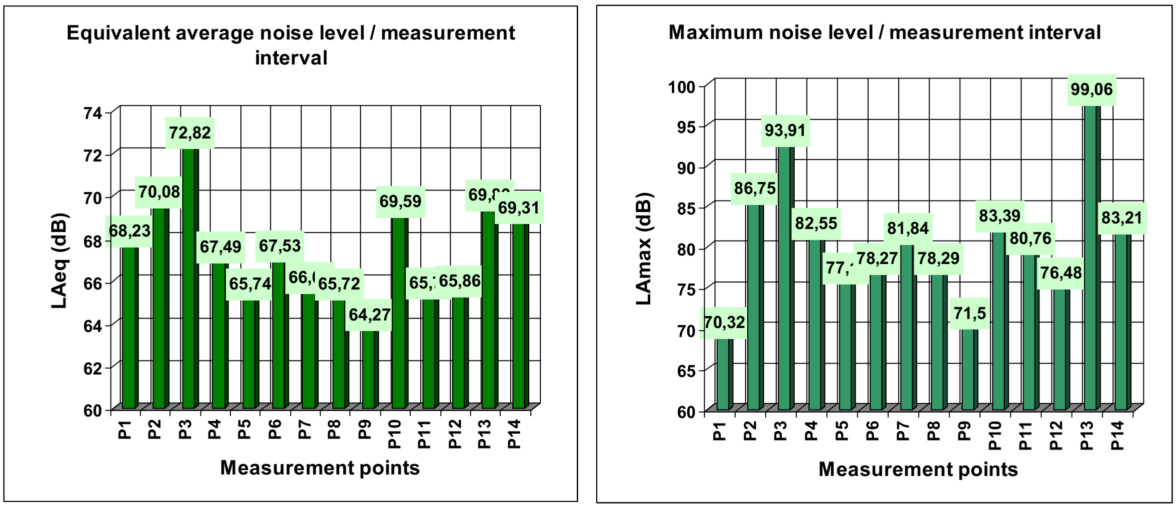

Figure 5. Noise level for Route 2 (LAeq values - left; LAmax values - right)

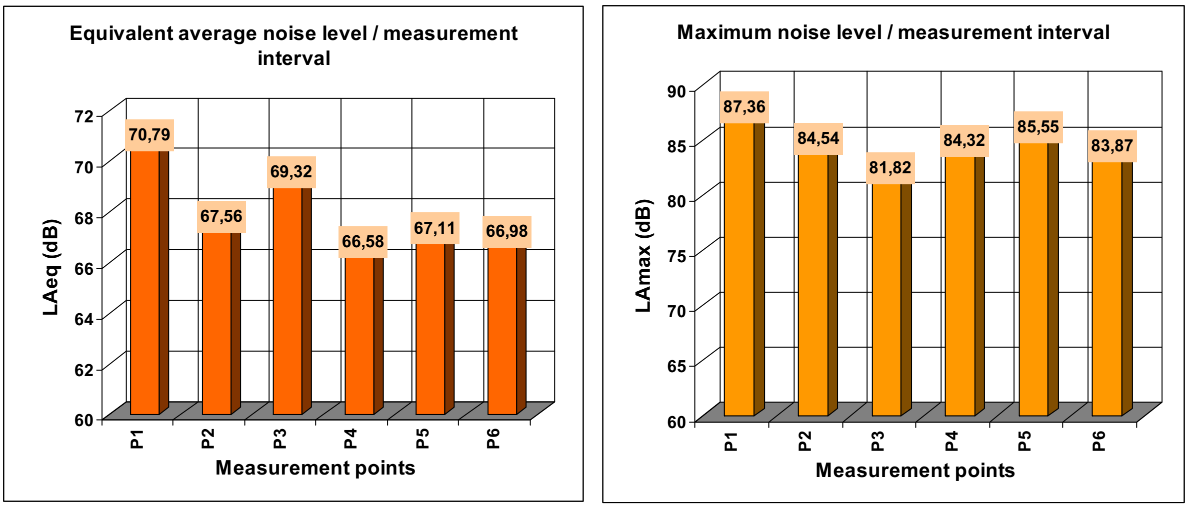

Figure 6. Noise level for Route 3 (LAeq values - left; LAmax values - right)

In the Table 1 are presented the traffic flows parameters for the nine analyzed intersections.

Table 1. Traffic flows parameters (number of vehicle for the evening rush hour and vehicles categories)

Intersection no.	*Light vehicles*	*Vans*	*Buses*	*Trucks*
Route 1				
Intersection 1	325	63	5	66
Intersection 2	695	50	11	2
Intersection 3	837	99	26	1
Intersection 4	807	67	26	1
Intersection 5	656	71	30	6
Route 2				
Intersection 2	695	50	11	2
Intersection 7	252	28	8	3
Intersection 8	360	38	2	1
Intersection 9	427	25	4	3
Route 3				
Intersection 5	656	71	30	6
Intersection 6	198	21	2	27

3.2. Noise data analysis

The values for the three experimentally examined routes differ from one route to another. For the first route, corresponding to the area connecting the city main entrance with the most important local institution (Cernavodă Nuclear power plant), the measured average noise range varies between 63 and 70 decibels. The maximum noise level varies between 68 and 88 decibels. These values have been collected in the proximity of the road, in the intersections access and evacuation areas, where vehicles engines works transient. Another important factor that influences the noise levels is the composition of the traffic flow. Along with cars, buses equipped with compression ignition engines have an important share of influence. For this route we noticed a big buses number, because of the Nuclear power plant commuters. In the case of Intersection 1 - Constanței Str. + DN22C, we noticed a big number of trucks, that transit the national road DN22C, but not enter in the city. Also, for Intersection 2 - Nicolae Titulescu Str. + Gării Str. + Crișan Str. Intersection and Intersection 3 - Nicolae Titulescu Str. + Dacia Str. + Seimeni Str. + Medgidiei Str., the noise peaks ware registered in the proximity of metallic drainage channels.

Figure 7. High noise sources for Route 1 - metallic drainage channels on the main road (left) and traffic composition: commuting buses (right)

For the second route, corresponding to the residential areas from Cernavodă city, the average noise values vary between 64 and 73 decibels. In the case of the maximum noise values, that's vary between 70 and 99 decibels. Although, compared to the first route, the traffic flow is much smaller; a factor that increases the noise level is the relief of the region (hills), and the geometry of the streets (narrow streets with abrasive pavement). Also, the number of the vans, buses and trucks is smaller then Route 1. The main reason for the higher noise level comparing to the Route 1 is the streets declivity, that force the vehicles to use transient regimes and higher engine speeds.

Figure 8. High noise sources for Route 2 - road declivity (left) and the traffic composition - vans, trucks and old light vehicles (right)

For the third route, corresponding to the Cernavodă bypass road, the average noise values vary between 66 and 71 decibels. In the case of the maximum noise values, that's vary between 82 and 88 decibels. The high noise level, in this case, is produced by the heavy vehicles that use this route, for harbour and Dunăre-Black Sea Chanel activities.

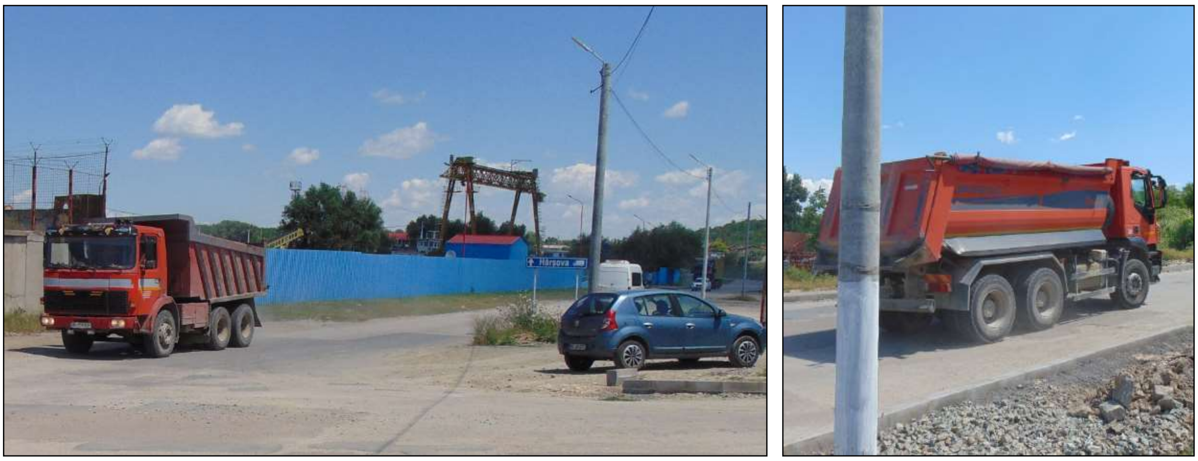

Figure 9. High noise sources for Route 3 - traffic composition - vans and trucks

The European noise standard specify that the daytime average noise level LAeq < 70 dB(A) [4]. For Route 1 the highest average noise level was registered for intersection 1, that is outside the city. For Intersections 2, 3, 4 and 5 the average noise level is smaller than 70 dB. For Route 2 the highest average noise level was registered for intersection 8, that is situated on a high declivity. For Intersections 2, 7 and 9 the average noise level is smaller than 70 dB. For Route 3 the highest average noise level was registered in Intersection 6, because of the heavy vehicles activity.

4. Conclusions

The noise analysis of the Cernavodă city indicated that the noise levels in the region are escalating at a very fast rate with growing population, road infrastructure degradation and heavy vehicles and Diesel buses accumulation. Noise levels obtained at different locations of the city, in commercial, residential, and industrial areas are found to be exceeding the noise level /limits prescribed by the European standards.

This study was made in function of three main routes: first route connects Cernavodă city entrance with main road that leads to Nuclear power plant, characterized by wide roads with 2 lanes and high traffic flows; the second route is characterized by narrow roads, with high declivity, with 1 lane and medium traffic flows; the third route is the Cernavodă bypass road characterized by high heavy vehicles traffic.

It is also observed that noise level is closely related with the number and composition of road traffic. In this case, some measures should be taken to control the level of noise pollution in the city. To reduce noise pollution, several measures can be implemented [7]:

- infrastructure upgrades for most of the analyzed intersections, and also for all main city roads;
- Nuclear power plant transportation system improvement, and fleet renewal;
- Cernavodă bypass road rehabilitation, in order to increase its usage;
- traffic flow management optimisation in residential areas;
- plantation of trees and construction of sound barriers.

Noise pollution is becoming a major health concern with all of its potential biological and social effects (cardiovascular diseases, hearing problems, children performance at school and psychological problems for all age categories.

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