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## ROAD TRAFFIC NOISE REDUCTION STRATEGY IN CLUJ-NAPOCA - A BRIEF ANALYSIS

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***Abstract:** The road traffic noise reduction strategy in Cluj-Napoca is integrated into the strategic development plan of Cluj metropolitan area and takes into account the results of the noise maps developed in 2007 and 2012 and the accompanying action plans. The paper discusses the main proposals included in the two action plans for preventing and reducing road traffic noise, indicating their degree of achievement. A SWOT analysis of the noise reduction strategy at the city level is carried out, in the context of European and national legislation. In order to improve the urban noise control, the idea of carrying out the spectral analysis of traffic noise is sustained.*

***Key words:** urban noise, noise reduction, SWOT analysis, road traffic noise, noise spectra*

### 1. INTRODUCTION

The noise in urban agglomerations is quantified by the degree of annoyance it produces to the inhabitants. Its periodic assessment, imposed by European and national legislation, is only the first step in the process of increasing the comfort of the inhabitants and ensuring a healthy, safe and clean environment for them. As the main source of noise is the road traffic, efforts are generally focused on reducing it. The issue is complex because it has to be framed in the regional development model and linked to the urban plan, the sustainable urban mobility plan, the health strategy, and other regional planning documents.

The urban noise reduction strategy in the city of Cluj-Napoca takes into account the assessments and noise maps previously made, but also the specific road traffic situation of the city and the region in which it falls. It is closely linked to Cluj-Napoca's strategy for the period 2014-2020 and to the sustainable urban mobility plan for the Cluj metropolitan area, related to the 2016-2030 period, focusing on the creation of a sustainable transport system with five main objectives: accessibility, security, environment, economic efficiency and urban environment quality.

### 2. CLUJ METROPOLITAN AREA

The city of Cluj-Napoca, residence of Cluj county, is one of the seven national growth poles, economically and culturally developed and recognized for the quality of medical services and educational outcomes. World Bank studies place Cluj-Napoca on the third place in the country, considering the number of employees in high-wage sectors after Bucharest and Timișoara, which makes Cluj-Napoca one of the highest levels of living in the country. At present, Cluj-Napoca is a service city rather than industry. The service and commerce sectors generate over 50% of the total turnover of the companies in the municipality [8].

The population of Cluj had a stabilizing trend in the last years [5]: 317953 stable population at the census in 2001 and respectively 324576 at the 2011 census, according to data provided by the National Institute of Statistics. Seasonal fluctuations are mainly due to students from the ten local universities but also to tourism, which has started to grow in recent years. The city "lives" through and for its inhabitants, therefore ensuring a quality living environment for them is one of the top priorities of the local administration.

Cluj-Napoca, together with 18 surrounding villages, forms the Cluj-Napoca Metropolitan Area, established as an association at the end of 2007 and having the following objectives:

- Sustainable development of its whole territory;
- Economic and social development;
- Increasing the quality of environment and life.

The total area of the metropolitan area is 1630 sq. Km, representing 24% of the county's total area and including 55% of the county's total population. In this context, the traffic situation in Cluj-Napoca must be viewed and analysed from the point of view of the development of the metropolitan area, noting that the inappropriate development of the peri-urban settlements may create a traffic problem in the city centre [9].

### 3. NOISE MAPS AND ACTION PLANS FOR CLUJ-NAPOCA

In recent years, the level of concern and dissatisfaction of the inhabitants of Cluj-Napoca about the noise and noxes generated by the road traffic in the urban area has increased. This has generated a higher interest in conducting city noise assessments, as well as finding alternative solutions to reduce the risk

of exposure to urban noise [1], [3], [4], [6]. The problem was taken over by the city hall with the entry into force, in 2002, of the legislative provisions on the elaboration of strategic noise maps in the European cities with over 250 thousand inhabitants.

The noise maps developed for Cluj-Napoca during the years 2007 and 2012 [10], in accordance with the requirements of the European Commission Directive 2002/49/EC and the corresponding national legislation (HG 321/14.04.2005, OM 678/1344 /915/1397-2006, OM 1830/2007, OM 152/558/1119/532-2008, OM 831/1461-16.07.2008), were followed by the elaboration of strategic action plans for the prevention and reduction of urban noise. They are available on the mayor's website: <http://www.primariaclujnapoca.ro>.

An action plan is designed to manage the noise issues in a particular region in order to ensure the necessary comfort for the inhabitants and to protect quiet areas against excessive noise. Two action plans have been developed on the basis of strategic noise maps: in 2010 and 2014, including proposals to reduce the exposure of inhabitants, which can be achieved by 2020. Table 1 contains a selection of these proposals, strictly related to road traffic noise, and their state of completion [11], [12].

Table 1

**Selection of proposals related to road traffic noise reduction for Cluj-Napoca, from the Action planes**

Proposals	State of completion
<b>Action plan 2010</b>	
- separation between local and transit traffic by completing Vâlcele-Apahida belt-road	- achieved, the belt-road is operational starting with November 2011
- construction of the belt-road between Muncii Blvd. and Apahida village	- the belt-road was opened in July 2011
- setting up two ring roads around the village of Floreşti, north and south	- not achieved, the exit road Cluj - Floreşti is still very crowded
- reorganizing traffic on the streets around the railway station	- achieved, in front of Piaţa Gării the traffic was organized on a single-lane road
- development of the public transport, favoring its use through attractive measures	- not achieved, this proposal is also included in the 2014 Action Plan
- re-planning and widening of roads along the urban passenger transport routes	- dedicated public transport lane on east-west axis, 21 Decembrie 1989 Blvd. between Petofi Sandor Street and Memorandumului Street; - an additional lane in the Cipariu Sqr. - additional lane in the roundabout between Observator Street and Viilor Street - a new roundabout between Mehedinti Street, Izlazului Street and Mogoşoia Street - the reorganization of the roundabout in the Marasti area (additional runway on the right-hand

	side)
- creating new bus lines between city districts	- partially achieved, some bus lines were extended (ex. Line 19) or some new have been introduced (ex. Line 5)
- building of parking lots on the outskirts of the city, near public transport routes	- not achieved, this proposal is also included in the 2014 Action Plan
- increasing of pedestrian areas inside the city	- new pedestrian zones were built in Piața Unirii and Piața Gării
- construction of underground garages in the city center	- not achieved, this proposal is also included in the 2014 Action Plan
- limiting the running speed to 30 km/h in traffic areas between main and collecting roads	- speed restrictions imposed on several streets (ex. on Splaiul Independenței and Oașului Street )
- the renewal of the public transport fleet	- 50 new buses, 15 new articulated buses and 20 trolleybuses have been purchased
- changing of roads wear layer	- roadworks are being continuously carried out
<b>Action plan 2014 (new proposals)</b>	
- supporting the idea of using bikes for urban transportation, by providing a public bicycle park and building bicycle track	- 43 bicycle rental stations were built in Cluj-Napoca, 4 stations in Florești village and 3 stations in Apahida village, totalling 540 bikes
- the use of electric buses for urban passenger transport	- 10 electric buses were purchased
- the use of ecological buses	- 10 ecological minibuses were purchased
- increasing the pedestrian areas inside the city	- partially achieved, new pedestrian areas were built in Piața Unirii and Piața Gării
- underground parking spaces provided at the basement of new buildings	- partially achieved, some new buildings have underground parking for their residents. Thus, the problem of parking was solved, but the problem of traffic in newly built and over-populated areas in the city center was not solved
- building a road passage that will cross over the railway in the Tăietura Turcului area, and also a road passage in the area of Mărăști market.	- the projects are in the phase of feasibility study

#### 4. SWOT ANALYSIS – URBAN NOISE REDUCTION STRATEGY IN CLUJ-NAPOCA

##### Strengths

- There is a legislative framework at EU and national level that provides support for the development and implementation of the strategy;
- The Cluj-Napoca noise map and the action plan on urban noise reduction were developed and updated at the deadline set by the legislation;
- There is interest and involvement from local government;
- The reduction of urban noise is an objective included within the Cluj county Development Strategy 2014-2020 [8];
- Good collaboration with experts from the Cluj-Napoca universities;
- Unity and collaboration of the elements involved in the metropolitan area of Cluj;

- The investments already started by the City Hall and the Urban Transport Office (RATUC) for the rehabilitation of the road infrastructure and the modernization of the urban transport of passengers;
- Increase in the number of silent buses;
- Areas with priority lanes for buses and trolleybuses, starting with 2016;
- The bike sharing project, Cluj-Bike, which has been implemented since 2015;
- Removing heavy traffic from Manastur and Zorilor districts, starting with 2009, by completing the Turda-Gilau motorway;
- The Valcele-Apahida belt-road, which facilitated the redirection of heavy traffic on Buna Ziua Street, as well as in the Gheorgheni and Marasti districts starting with 2011.

##### Weaknesses

- The number of vehicles in the car park of Cluj county is steadily increasing;

- The car park is aging: 51.2% of the registered cars are older than 12 years;
- Cluj-Napoca does not have a road infrastructure necessary for a city of its size. The street network is predominantly radial, the main roads passing the city are in the prolongation of national roads and converge to the central area.
- There are limited possibilities of extending and enlarging of the city roads, mainly in the central area. The roads have generally not been designed with the possibility of further enlargement.
- The urban area is very crowded, especially at peak hours; irregular parking; insufficient number of parking spaces. The problem of parking in the city is not solved and becomes more pressing because it limits and endangers the traffic of cars and pedestrians.
- Intensive use of own vehicles for city trips, to the detriment of public transport;
- Insufficient investments in increasing road quality and modernizing the road structure;
- Lack of a solid, consistent and applicable traffic concept;
- The lack of green spaces in relation to the population of a city of Cluj size;
- The bicycle track network is discontinuous and does not cover all districts.

### **Opportunities**

- Defining "noise reduction and exposure" as one of the priority areas of the European strategy;
- Institutional capacity of the city of Cluj-Napoca in terms of increasing the quality of the environment and of the citizens' life as a result of the creation of the Cluj-Napoca Growth Pole and the implementation of the Sustainable Urban Mobility Plan.
- Opening for collaboration from university and business specialists;
- Open and continuous dialogue between representatives of local government and population;
- Involvement of civil society and local community, especially of young people in different projects for Cluj-Napoca;

- The possibility of accessing European funds for projects aimed at improving the road infrastructure and modernizing urban transport, including alternative means of transport.

### **Threats**

- Insufficient financial resources to implement measures to reduce noise pollution
- Failure to comply or insufficiently know the legal provisions on noise limits in urban areas
- Lack of continuity in making and updating the noise map of the city and action plans on noise reduction so that the results obtained are not consistent and comparable to those previously obtained
- Increasing the noise level in certain areas due to the application of measures to streamline urban traffic (for example: setting the night time to supply the downtown shops will result in disturbing the sleep of the area's inhabitants).
- Insufficient information of the population on the noise level in the city and its possible effects.
- Disparities between population needs and measures chosen to reduce noise exposure due to lack of consultation and involvement of residents in decision-making
- Other sources of noise contributing to urban discomfort: Cluj-Napoca airport, whose flights are made at low altitude above the city; the railway passing through the centre of the city; nightlife of the city.

## **5. THE NEED FOR SPECTRAL ANALYSIS DATA**

When applying certain noise control measures in urban areas - for example in the design and construction of noise barriers or noise isolation systems for new buildings, in changing road surfaces, etc. - it is important to analyze the spectra of the traffic noise. The frequency spectrum influences significantly the sound quality and the degree of annoyance it produces. That's why a good strategy for reducing urban noise needs to consider such an analysis. It improves the description of the urban traffic characteristics and, in connection with noise perception, gives a more accurate method for analyzing the impact of traffic noise

management policies [7]. Figure 1 shows a comparative octave band analysis for the road traffic noise measured in five locations in Cluj-

Napoca. Recordings were made during June and July 2017.

Table 2

Measurement locations and results for urban traffic noise in Cluj-Napoca, during June and July 2017

Centre freq. of octave band [Hz]	Limits of variation of the sound level in octave bands [dB]									
	Fast response setting, 3 hours measurements									
	L <sub>min</sub>	L <sub>Max</sub>	L <sub>min</sub>	L <sub>Max</sub>	L <sub>min</sub>	L <sub>Max</sub>	L <sub>min</sub>	L <sub>Max</sub>	L <sub>min</sub>	L <sub>Max</sub>
63	51.2	101.0	56.3	106.1	45.7	99.3	58.2	99.9	59.1	102.8
125	41.5	97.7	51.9	104.1	41.7	93.9	53.5	99.1	50.4	94.8
250	40.8	93.5	54.3	97.0	39.0	93.4	51.3	95.3	48.1	90.5
500	37.6	103.2	54.2	102.3	92.8	35.5	50.4	97.3	47.1	93.2
1k	36.0	111.4	57.0	104.1	90.8	35.9	50.1	102.1	45.7	103.9
2k	32.1	94.3	53.1	99.2	88.1	31.9	47.5	88.1	41.6	98.3
4k	21.5	78.1	40.9	88.4	86.3	24.1	38.3	91.6	33.6	87.5
8k	10.3	76.7	27.6	84.1	84.8	14.2	23.7	77.6	22.2	82.2
Measurement location	MP1		MP2		MP3		MP4		MP5	
Sreet name	Calea Mănăştur		Calea Turzii		Maramureşului		Fabricii		Aurel Vlaicu	
Light vehicles	8063		7457		2841		4243		7223	
Heavy vehicles	617		418		396		731		726	
Number of passing vehicles during the 3 hours recording period										

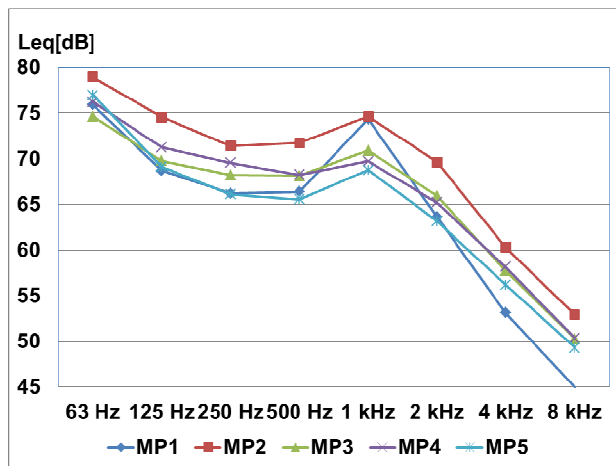


Fig. 1. Measured spectra for urban traffic noise in five different locations in Cluj-Napoca, 2017

The equipment used was a Bruel&Kjaer 2250 sound analyzer, mounted on a stand at a height of 1.2 m above the ground level, outside the car road, set on fast response, “A” weighting. The streets corresponding to the measurement points, the limits of variation of the sound level in octave bands and the number of passing vehicles during the three hours recording period are given in Table 2.

One can observe that the graphics have similar shapes. The noise levels tend to decrease with the increasing frequency, the decrease between the 63 Hz and 8 kHz being of

more than 20 dB for all five points. Graphics show a peak at 1 kHz, which reflects the noise component given by the contact of tires by the road [2]. The 1 kHz peak is more pronounced for MP1, which has the most intense traffic, with a ratio of 13.06 light vehicles versus heavy vehicles, and where the running speed was over 40 km/h.

## 6. CONCLUSIONS

The issues and ideas presented in this paper lead to the following conclusions:

- The strategy for urban noise prevention and reduction must take into account the entire context of the Cluj-Napoca metropolitan area and must be integrated into the other regional planning documents.
- There are discontinuities regarding the method of approach in making noise maps and action plans for noise prevention and reduction. Each noise map should contain a comparative overview of previously elaborated noise maps and each action plan should start from an analysis of the previous one.
- The SWOT analysis presented in the paper allows the adaptation of strengths to opportunities, the minimization of risks and the

elimination of weaknesses, in order to adopt the best noise reduction strategy.

- In the analysis of traffic noise, frequency spectrum should be taken into account, for a more accurate assessment of the traffic influence of the on urban ambient noise.

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### Strategia de reducere a zgomotului de trafic rutier în municipiul Cluj-Napoca – o analiza succintă

**Rezumat:** Strategia de reducere a zgomotului produs de traficul rutier în Cluj-Napoca este integrată în planul strategic de dezvoltare a zonei metropolitane Cluj și ține cont de rezultatele hărților de zgomot elaborate în 2007 și 2012 și de planurile de acțiune adiacente. În lucrare se discută principalele propuneri cuprinse în cele două planuri de acțiune pentru prevenirea și reducerea zgomotului de trafic rutier, indicând gradul lor de realizare. Se face o analiză SWOT a strategiei de reducere a zgomotului la nivelul orașului, în contextul legislației europene și naționale. Pentru îmbunătățirea controlului zgomotului datorat traficului rutier se susține ideea de realizare a analizei spectrale a acestuia.

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