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MEASUREMENT OF TRAFFIC NOISE POLLUTION IN URBAN AREAS

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Abstract: Traffic noise is probably the most serious and pervasive type of noise pollution. The studied area, 13 Decembrie Street - Castanilor Street - Iuliu Maniu Street Intersection is situated between two important residential areas of the Brasov city: the Historic Centre and Civic Centre (commercial area). The measurements were made with the 2237 Controller Integrating Sound Level Meter (Bruel & Kjaer). The problem of the traffic noise pollution from the urban areas amplified in the last years. The evolution of the traffic volume values in Brasov is continuously increasing, and for the year 2020 it is forecasted a duplication of this value.

1. ENVIRONMENTAL NOISE PROPAGATION

Traffic noise is probably the most serious and pervasive type of noise pollution. Studies have shown that on a daily basis almost 40 % of population is exposed to undesirable levels of traffic noise and a further 10 % is exposed to excessive levels. Many factors affect the noise level, and measurement results can vary by tens of decibels for the very same noise source.

To explain how this variation comes about, we need to consider how the noise is emitted from the source, how it travels through the air, and how it arrives at the receiver. The most important factors affecting noise propagation are: type of source (point or line), distance from source, atmospheric absorption, wind, temperature and temperature gradient, obstacles such as barriers and buildings, ground absorption, reflections, humidity and precipitation. Sound decreases with distance but this depends on type of source: point source - e.g. voice, printer; area source - numerous close sources; line source - e.g. busy road. For point source, sound intensity varies inversely with square of distance.

Each time distance is doubled, dB decreases sound intensity. For line source (because sound waves are cylindrical), doubling of distance decreases sound intensity by 3 dB. For area source, theoretically no decrease in intensity with increased distance. Traffic noise has become a serious problem now because of inadequate urban planning in the past. Homes, schools, hospitals, churches, libraries and other community buildings were routinely built on main roads without buffer zones or adequate soundproofing.

The problem has been compounded by increases in traffic volumes far beyond the expectations of our early urban planners. At low speeds, most traffic noise is caused by vehicle engines, transmissions, exhausts and brakes. The stop-start braking and acceleration during peak-hour congestion also increases noise levels. On freeways where speeds are high and relatively constant, most noise is caused by a combination of tyre contact with the road and aerodynamic drag over the vehicle [1].

2. CHARACTERISTICS OF STUDIED AREA

13 Decembrie Street - Castanilor Street - Iuliu Maniu Street Intersection is situated between two important residential areas of the Brasov city: the Historic Centre and Civic Centre (commercial area). This area is conveyed through by a large variety of vehicles: cars, common transportation vehicles (simple and articulated buses and trolleybuses), trucks. The highest number is represented by the cars, which are equipped with spark ignition engines. The location of the analyzed intersection is shown in the figure above.

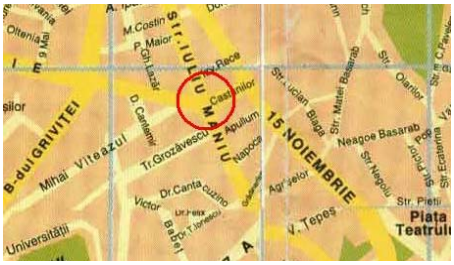

Fig. 1. The area of the studied intersection

The geometrical characteristics of the intersection were determined through measurements with the metric wheel. The intersection was draw with the data from the measurements. The intersection is represented in the following figure:

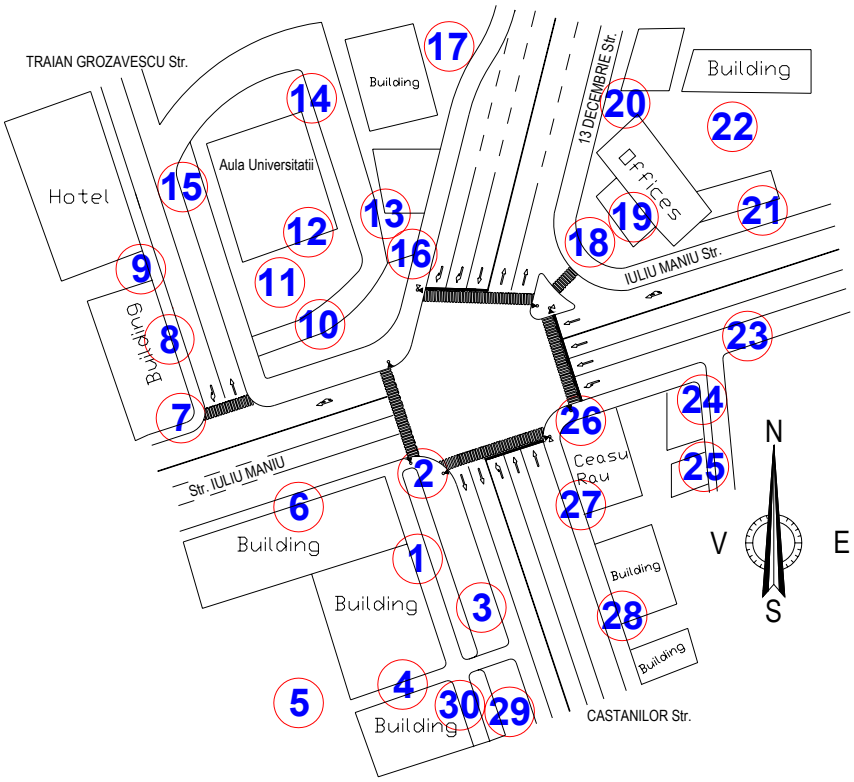

Fig. 2. The location of the measurement points in intersection: 1-30

3. THE RESULTED DATA FROM THE MEASUREMENTS

The traffic noise measurement conditions:
- type of source: line source;
- distance from source = 1 meter to 30 meters;
- measurement interval = 60 seconds;
- wind → medium;
- temperature = (20 ÷ 22) ºC;
- time of the day: 15.00 ÷ 16.00;
- precipitation: none (sunny weather).

Table 1

No.	Time	Range dB	Elapsed Time	MaxP	MaxL	MinL	Leq
1	15.00.00	50 - 120	0:01:00	93.6	67.4	57.6	**62.5**
2	15:01:26	50 - 120	0:01:00	100.1	76.7	66.7	**71.1**
3	15:03:05	50 - 120	0:01:00	103.7	72.8	54.7	**67.2**
4	15.04.44	50 - 120	0:01:00	89.4	64	52	**59.4**
5	15:06:32	50 - 120	0:01:00	89.8	59.6	50	**54.2**
6	15:08:45	50 - 120	0:01:00	99	70	55.8	**65.7**
7	15:10:25	50 - 120	0:01:00	97.4	70.6	59.9	**66.6**
8	15:12:41	50 - 120	0:01:00	104	78.3	62.8	**74**
9	15:14:23	50 - 120	0:01:00	96.3	78.8	61.6	**69.4**
10	15:16:37	50 - 120	0:01:00	96.9	69.1	53.2	**63.6**
11	15.19.23	50 - 120	0:01:00	106.9	73.8	63.9	**67.8**
12	15:21:17	50 - 120	0:01:00	98.3	69.8	58.4	**65.2**
13	15:23:47	50 - 120	0:01:00	94.2	67.3	55.5	**60.5**
14	15:26:52	50 - 120	0:01:00	100	65.3	50.5	**54.7**
15	15:29:33	50 - 120	0:01:00	106.7	69.2	50	**58.3**
16	15:31:08	50 - 120	0:01:00	99.3	74	54.7	**63.3**
17	15:34:31	50 - 120	0:01:00	118.2	79.2	65.1	**72.2**
18	15:36:13	50 - 120	0:01:00	102.1	76.4	59.6	**70.3**
19	15:38:10	50 - 120	0:01:00	98.6	78.8	66	**70.9**
20	15:40:45	50 - 120	0:01:00	98.2	73.8	62.8	**67.4**
21	15:42:42	50 - 120	0:01:00	96.2	70.1	59.6	**65.9**
22	15.44.05	50 - 120	0:01:00	102.3	73.8	59.9	**68**
23	15:46:32	50 - 120	0:01:00	101.3	69.8	52.4	**62**
24	15:48:05	50 - 120	0:01:00	97.5	75	60.7	**68.1**
25	15:49:35	50 - 120	0:01:00	112.2	80.4	54.6	**67.3**
26	15:52:13	50 - 120	0:01:00	104.6	74.2	54.6	**63.6**
27	15:54:13	50 - 120	0:01:00	106.2	78.7	64.1	**73.4**
28	15:56:05	50 - 120	0:01:00	95.8	70.1	60	**65.2**
29	15:58:29	50 - 120	0:01:00	96.1	74	56.4	**66.4**
30	16.00.56	50 - 120	0:01:00	118	86.3	63.1	**73.6**

The measurements were made with the 2237 Controller Integrating Sound Level Meter (Bruel & Kjaer). The parameters have the following meanings:

Leq – Equivalent continuous sound level over the elapsed measurement time. This is the most useful parameter for giving an impression of the average sound pressure level.

MaxP – Maximum peak level. It is equal to the highest value of Peak since the measurement started.

MaxL, MinL – Maximum and minimum sound pressure level over the elapsed measurement time.

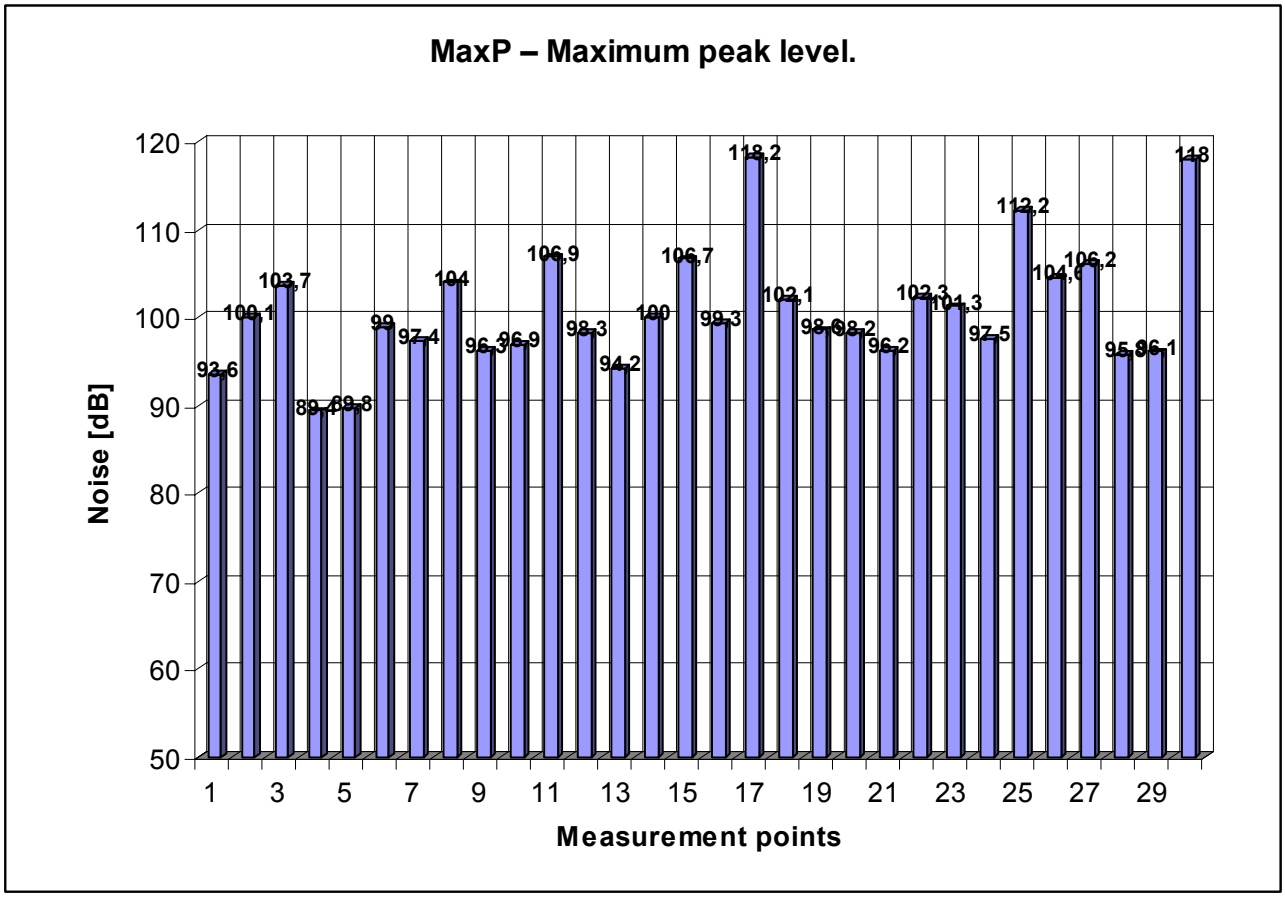

Fig. 3. MaxP – Maximum peak level

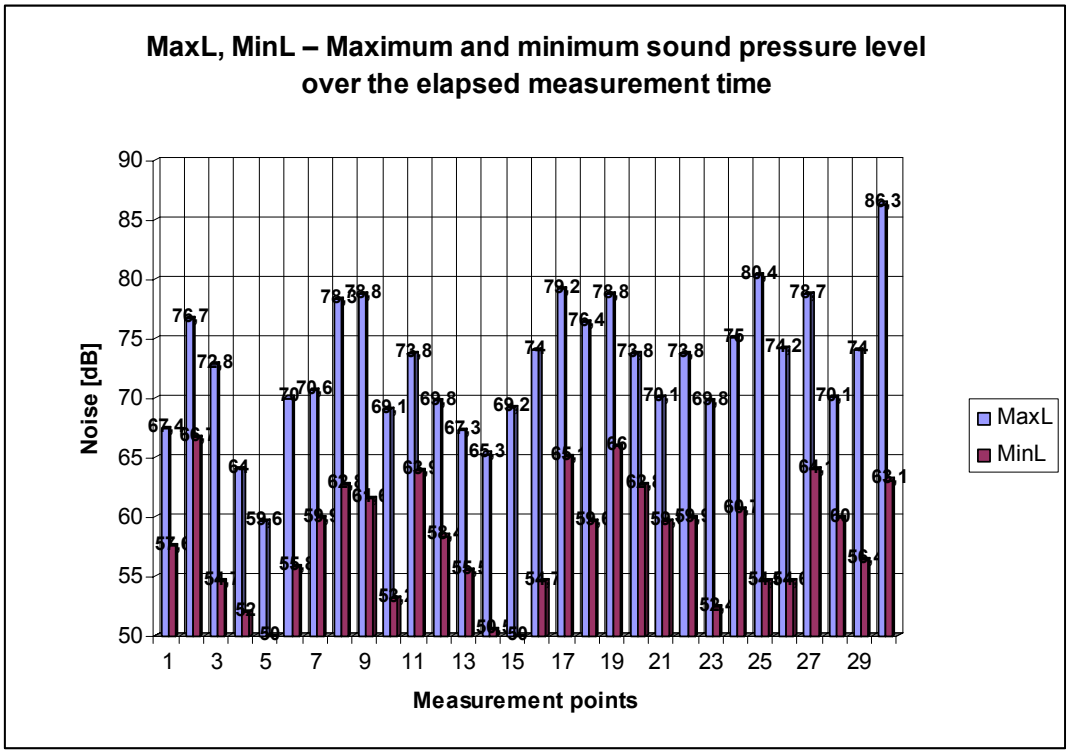

Fig. 4. MaxL, MinL – Maximum and minimum sound pressure level over the elapsed measurement time.

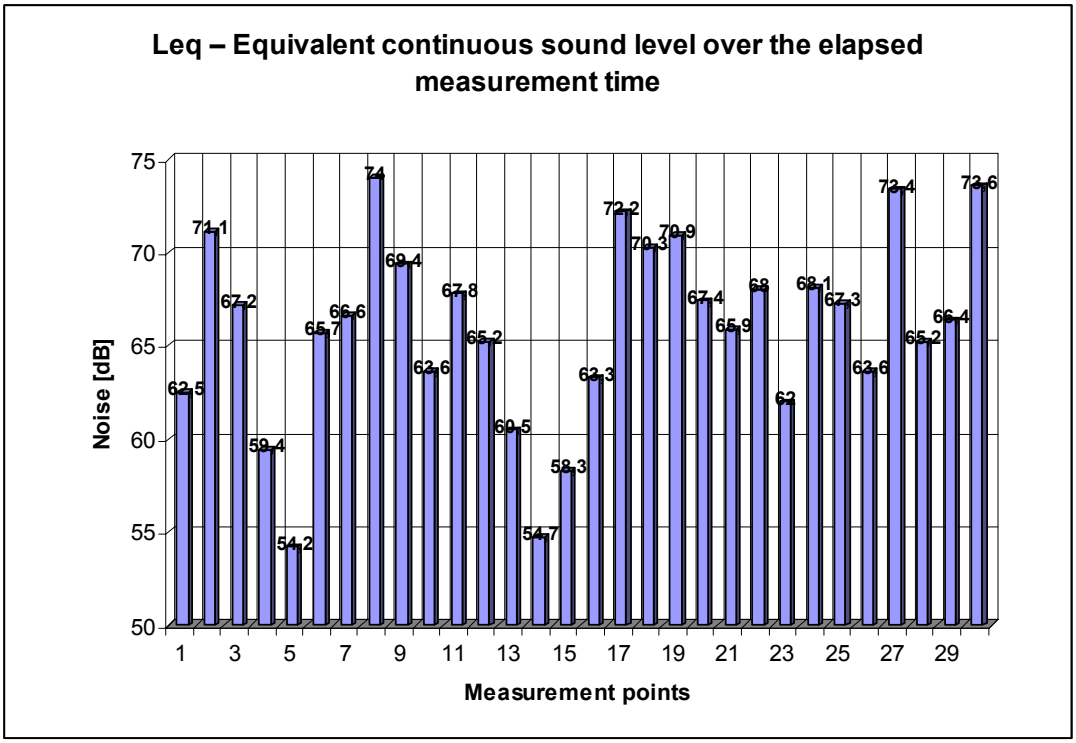

Fig. 5. Leq – Equivalent continuous sound level over the elapsed measurement time

The data regarding the traffic flow were collected during the noise level measurements. The volume of the traffic flow was determined by counting the total number of the vehicles which passed through the intersection during one hour in all ways. The volume of the traffic flow from the intersection is presented in the table below:

Table 2

Hour	Types of vehicles			
	Cars	Buses	Trolleybuses	Trucks
15.00 - 16.00	4576	137	14	53

4. USED EQUIPMENT

Type 2237 A is a Class 1 sound level meter that is designed to be quick and easy to use when making environmental noise and occupational-health related measurements. A large LCD screen displays measurements and includes a quasianalog bar showing the current sound pressure level. The instrument has two parallel, independently weighted detectors that enable it to display RMS and Peak readings simultaneously.

USES:

- Control of noise levels in the workplace
- Environmental noise surveys
- Complaint investigation
- Sound power measurements

FEATURES:

- Conforms to IEC 61672 – 1 Class 1, IEC 60651 and 60804 Type 1
- Conforms to ANSI S1. – 41983 and S1.43 – 1997 Type 1
- Simultaneous RMS and Peak measurements (with independent frequency weightings)
- Measures Leq, Peak, MaxP, MaxL, MinL, SPL, and Inst.
- 40 records of stored results
- Back-lit display
- Five built-in languages: English, German, French, Spanish and Italian.

Fig. 6. 2237 Controller (Bruel & Kjaer), Integrating Sound Level Meter

Fig. 7. Measurement of the traffic noise pollution with the 2237 Sound Level Meter

There are two ways to do the basic measurements. One is to start and stop the sound level meter manually, and the other is to use a pre-established measurement period. In both cases, the sound level meter must be correctly set before starting a measurement. In our case the measurement was made with a pre-established measurement period. The time interval for a measurement was of 60 seconds.

Fig. 8. The 2237 Sound Level Meter's screen

The 2237 Sound Level Meter can save maximum 40 measurements. The records can be downloaded on a computer with the help of a special program. In this way, the measurement can be read, printed and putted on a sheet in any program of Microsoft Excel type.

5. CONCLUSIONS

The measurement of the traffic noise level which conveys through the intersection must be done simultaneously with the measurements of the traffic flow values. The time interval of the measurements is of 60 minutes. For this intersection it was chosen the 15:00-16:00 time interval, this corresponding to the evening rush hour. The points of the measurements were chosen in function of the intersection's geometry and of the buildings' placement from this area. The highest noise level values were measurement in the neighborhood of the lanes for the common transportation vehicles. The most significant noise level values are the ones corresponding to the medium level (Leq).

From the results obtained the following conclusions can be made:

- The traffic volume which conveys through city's historical center area increased in the last years.
- In some of the studied intersections, the medium level of noise pollution (Leq) is frequently over 70 dB.

In conclusion, the problem of the traffic noise pollution from the urban areas amplified in the last years. The evolution of the traffic volume values in Brasov is continuously increasing, and for the year 2020 it is forecasted a duplication of this value. In this situation it will be necessary analysis about noise pollution of the vehicles from road traffic.

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