Metrologia
Fortaleza - CE 2017

Pressure Sound Level Measurements at an Educational Environment in Goiania, Goias, Brazil.

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Abstract: In this work, twenty five points located on the ground floor of the Federal Institute of Education, Science and Technology of Goias - IFG - Campus Goiania, were analyzed in morning periods of two Saturdays. The pressure sound levels were measured at internal and external environments during routine activities seeking to perform an environmental monitoring at this institution. The initial hypothesis was that an amusement park (Mutirama Park) was responsible for originating noise pollution in the institution, but the results showed, within the campus environment, sound pressure levels in accordance with the Municipal legislation of Goiania for all points.

Keywords: Sound Pollution, Equivalent Sound Pressure Level Measurements, Environmental Modeling.

1. INTRODUCTION

The noise pollution is the undesired noise released into the environment, without the perception of its damage and the negative results that it can cause to human health [1].

Many researchers [2, 3] showed that the Noise Pollution is constantly and repeatedly delivered, making people not aware of the harmful consequences of high Sound Pressure Levels (SPL) toward their health.

Therefore, in classroom environment, high levels of noise bring serious damages to the teachers as to the students. Consequently, in educational facilities, people can be under Noise Pollution and its hazards, but not noticing its complications. Thus, the environment monitoring of educational places is justified and has the objective to quantify through the Equivalent Sound Level (LAeq) the pollution levels to which the population are exposed to. Then, with the measurements performed with LAeq (the weighted continuous sound pressure level on the A scale), it is possible to establish new strategies seeking for adjustments into the cases where the sound levels do not agree with the standard limits proposed by the Regulatory Agencies. In addition, with the identification of irregularities it will be possible to trace actions against negative recurrences of noncompliance institutions [3].

Environmental monitoring consists in the accomplishment of specific measurements and/or observations, benchmarked in front of

some indicators and parameters, in order to verify if certain environmental impacts are occurring. As a result, it will be possible to estimate its magnitude and to evaluate the efficiency of any possible preventive measures, and it can be used in the diagnosis of noise pollution [1].

In this sense, this work aims to carry out the environmental monitoring of the (LAeq) levels and to evaluate the measured sound levels accordingly with the current limits of Noise Pollution proposed by the Brazilian government.

2. MATERIAL AND METHODS

For data acquisition and analysis, the authors followed the environmental monitoring techniques proposed by Zannin et al [3].

The research was carried out at the IFG - Campus Goiânia, during the period of normal activities, from 7:00 am to 9:00 am, in the last Saturday of February and in the first Saturday of March in 2015, trying to interfere as little as possible on the administrative and schooling activities during the monitoring time.

To perform the measurements, a sound level meter with data logger, model DEC-490 (INSTRUTHERM), and an acoustic calibrator CAL-4000 (INSTRUTERM), both with calibration certificates, were utilized.

Analyzing the Brazilian legislation, it was possible to extract the Level of Evaluation Criteria (LEC), shown in Chart 1. The determination of the LAeq, Eq. 1, obeyed the norm NBR 10151/2000 [4].

$$LAeq = 10\log\frac{1}{n}\sum_{i=1}^{n} 10^{L_i/10} \qquad (1)$$

where LAeq [dB (A)] is the A-weighted equivalent sound pressure level, L_i is the sound pressure level in dB (A) taken in fast response every 5 s during the noise measurement, while n represents the total number of recorded measurements.

Chart 1. Brazilian Levels of Evaluation Criteria (LEC) [4].

Environment	Level of Evaluation Criteria - LEC
External Environment	55 dB(A)
Internal environment with open windows	45 dB(A)
Indoor environment with closed windows	40 dB(A)

For each point, three measurements were taken (triplicate) at different times, the LAeq was calculated through equation (1) and, afterwards, the average LAeq obtained in each situation was determined. The corrected noise level (Lc) was applied in cases where there was a need for the results obtained experimentally compared with the Level of Evaluation Criteria of Chart 1.

Eight points located in the external perimeter of the institution were chosen to monitor the LAeq outside the limits of the IFG - Campus Goiania, and seventeen points within the institution internal perimeter, with ten points located in external environments and seven points located indoors (classrooms) as shown in Figure 1.

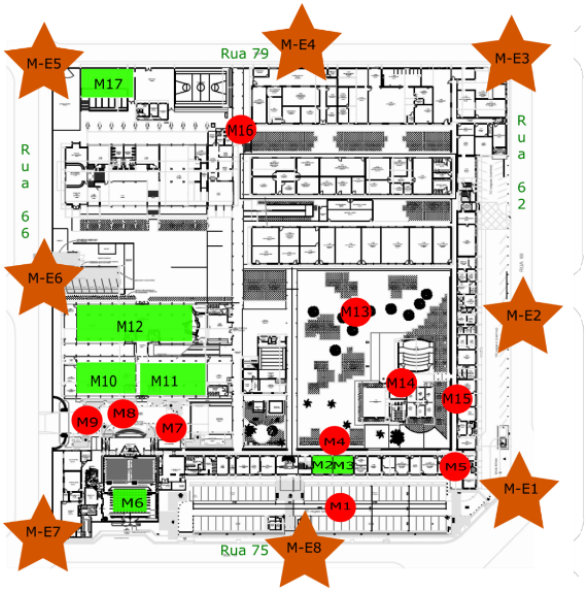

Figure 1. Ground floor of the IFG - Campus Goiania (ground floor above and upper floor below), with the places where measurements were taken. The stars represent the measurements in the outer perimeter, the red circles the measurements in external environments and the green rectangles the measurements indoors.

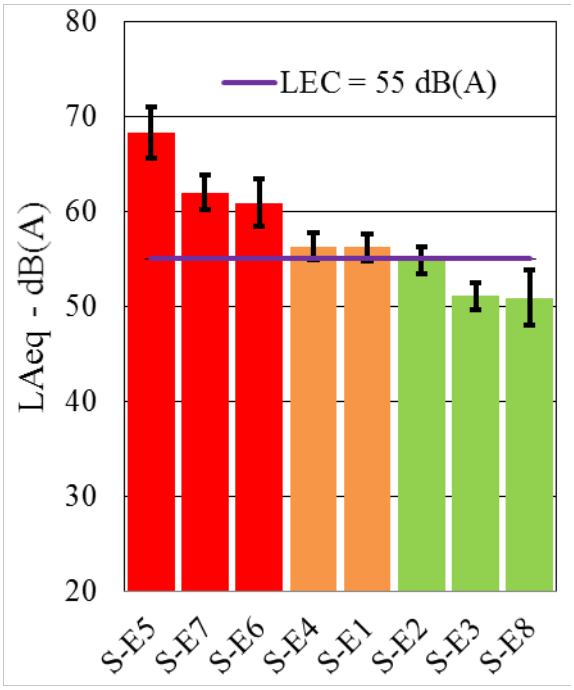

Figure 2. Equivalent Sound Pressure Level LAeq [dB (A)] for points on the external perimeter.

3. RESULTS AND DISCUSSIONS

Eight places S-E1, S-E2, S-E3, S-E4, S-E5, S-E6, S-E7 and S-E8 outside the IFG Campus Goiânia on the Saturday morning were monitored. The results are shown in Figure 2. The uncertainty obtained was lower than 3% in all results.

It can be noted that from the eight points measured in the external area during that Saturday morning, only three presented values above the Evaluation Criteria Levels established in the Brazilian Law, by the NBR 10151/2000 [4].

At the ground level, eleven points S1, S2, S4, S5, S7, S8, S9, S13, S14, S15 and S16 were monitored, including external and internal environments. The results obtained are shown in Figures 3 and 4.

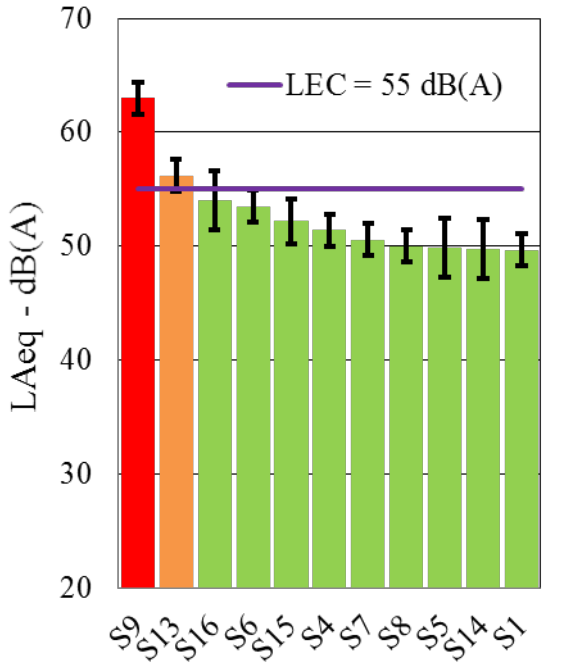

Figure 3. Equivalent Sound Pressure Level LAeq [dB (A)] for the institution ground points.

Measurements were taken in a classroom near the institution entrance, nearest to the Mutirana Park, with open windows; the measurements pointed out LAeq values within the legal limits.

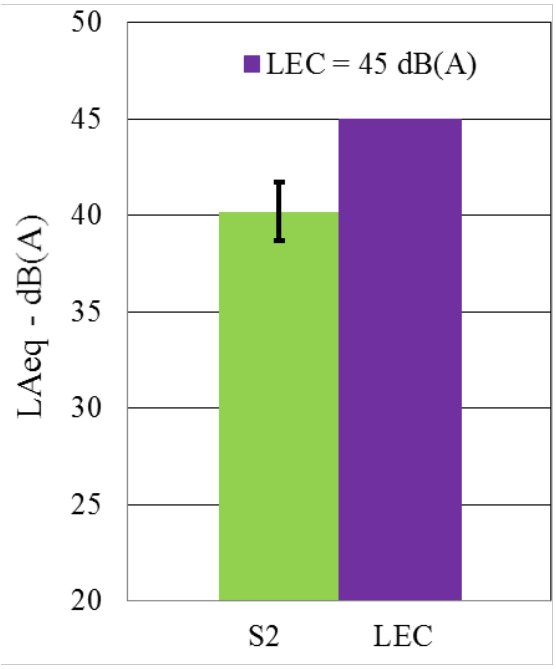

Figure 4. Equivalent Sound Pressure Level LAeq [dB (A)] for classroom on the ground floor with open window.

4. CONCLUSIONS

This work presented partial results of the research carried out, opting for the survey on Saturdays because of complaints from teachers and students that an amusement park next to the institution (Mutirama Park) was responsible for producing the noise pollution.

During this work, measurements were taken on a Saturday morning, on a non-busy day and only one point (S9) presented LAeq above the LEC, at the external yard in front of the arts complex that, at the moment of the monitoring, presented sound coming from musical instruments. The other points monitored on the Saturday morning did not present LAeq in disagreement with the municipal legislation of Goiania.

The situation differs from the rest of the research, when the environmental monitoring in different periods of the work days; at a few points no sound pollution was identified.

The initial hypothesis that the Mutirama Park would be responsible for generating noise pollution in the educational institution was not proven, and it is possible to conclude that points where there are excessive sound pressure levels are a consequence of the human activities at the place.

Acknowledgments

This work was supported in part by the Brazilian agencies: CNPq, under Grants No. 165466/2015-4, 151013/2014-4, and 301335/2016-8, FAPESP and MCTI.

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