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NOISE FROM AMUSEMENT ACTIVITIES: AN ENVIRONMENTAL IMPACT STUDY

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ABSTRACT
A passive noise control solution for a particular amusement attraction of the "Gardaland" Park (Italy) is presented following the previous study presented at the ICA Conference in 1998. The final solution approved by the Management of the Park consists in an acoustical barrier and an electronic device devoted to the control of noise from the acoustic amplification system. As a new attraction equipment will be built inside the Park, similar to an analogous plant working at the Efteling park (NL), an environmental noise impact study is required. In this paper a procedure for the acoustic characterisation of the amusement plant during normal operation in presence of visitors, is presented. The expected noise map is then presented.

1 - INTRODUCTION

The noise emissions produced by amusement activities in open area from attraction parks is now of topical interest in some urbanised areas, specially due to the increasing both of new attraction equipment and number of visitors. Noise control procedures are often difficult to develop due to the complexity and variability of noise sources:

- mechanical noise sources in permanent running (HVAC systems, air compressor, etc.) which are the main cause of background noise;
- different attraction equipment working only for specified time intervals;
- reproduced music and live performances.

Moreover, speech and shouts of people are also important noise source varying continuously inside the park, depending from the area where spectacular or amusing equipment are located at the moment. Identification and evaluation of acoustic emission of these noise sources are sometimes the main problem in the noise assessment evaluation due to the impossibility to have technical data or to measure directly the noise emission of each one.
Furthermore, the characterisation of noise distribution in the surrounding area must be correlated to national noise regulation in order to comply to specified noise limits.
In this paper a simple approach for a noise control procedure is discussed related to a particular study case, the "Gardaland Park, a big entertainment park near the Garda lake in Italy. As a new attraction equipment will be built inside the Park, an environmental noise impact study must be developed.

2 - NATIONAL REGULATION

The problem concerning the control of noise emission from different noise sources (fixed or movable) is directly connected to the actual national regulation [1] which prescribe limit values (for day-time and night-time) to be respected for every new activity that could increase the environmental noise. In the Italian regulation for each area with different destination of use two different limits are defined: the noise emission limit, concerning the maximum noise level emitted by a single noise source measured near the source itself, and the noise "inflow" limit concerning the maximum noise level measured in the disturbed area (see table 1).

Another national regulation [2] defines measurements methods to quantify this parameters, but the evaluation of noise emission to be compared with noise limits is sometimes difficult owing to the large variability of noise levels emitted during different periods of its activity. Then a correct choice of parameters is to be done in order to characterise the most representative situation of noise disease.

Class – Destination of use	**Emission limits**		**In-flow limits**	
	06.00-22.00	*22.00-06.00*	*06.00-22.00*	*22.00-06.00*
I – protected area	45	35	50	40
II – residential area	50	40	55	45
III – mixed area	55	45	60	50
IV- intense human activity area	60	50	65	55
V – mostly industrial area	65	55	70	60
VI – exclusively industrial area	65	65	70	70

Table 1: Noise limits for different area (dBA).

3 - NOISE SOURCE IDENTIFICATION

Environmental noise impact study, noise map and noise control procedure or devices must be developed only after a correct identification and characterisation of noise sources. In the case of amusement park the identification of noise sources is sometimes the main problem within the acoustic characterisation of the area under investigation. As an example in this paragraph the approach used for the identification of a single noise source is discussed.

As a new attraction equipment will be built inside the Park, the only way to evaluate the noise emission was to analyse a similar plant working at the Efteling Park in Holland. Furthermore, in the particular case of amusement parks it is quite impossible to make sound measurement with the single noise source on, the background noise being negligible. Therefore it needs to approach the problem in a different way, analysing different acoustical parameters.

The case study deals with a particular attraction equipment inside the Park, composed by a circular platform supported by a 50 meter long steel lever arm hinged on a static basement (fig. 1). This lever arm, moved by an oil-pressured system, lifts and places down the platform during about 1 minute during each phase. The main identified noise source is the oil pumping system placed near the basement and the shouts of people staying on the platform.

In order to evaluate the mechanical system noise and owing to the impossibility to make measurement in absence of tourists, different parameters were investigated. Measurement were made near the noise source (where any other background noise would be negligible) and at different distance from the plant and L_{Aeq} and L_{min} parameters (slow constant set-up) were investigated during operation period of the attraction (1 minute). As the oil-pressure system noise is proved almost constant during lift ad put down, it was correlated to L_{min} values at distances far from the plant. In this way it would be possible, within some approximation, to keep apart from the measured global noise that produced by people shouts, varying continuously with the number of people. This argument was also supported by analysing the decay of L_{min} with distance from the source: the founded L_{min} values confirm the geometric divergence attenuation.

4 - NOISE MAPPING AND PROCEDURES

The evaluation of global noise emission from amusement activities of Gardaland Park is supported by different in situ measurement and analysis of different parameters:

- evaluation of noise emission of single noise source by direct measurements of noise levels emitted by the plant or by deduction from analysis as stated in the previous paragraph;
- measurements of L_{Aeq} parameter in different positions in the surrounding area,
- correlation (in different way for different receiver positions) of L_{Aeq} and L_{min} values in order to obtain the contribution of noise caused by speech and shouts of people.

Finally different maps are made adapting a numerical model for outdoor simulation with different measured parameters.
In order to reduce noise emission in the nearest residential area and to respect noise limits, the solution adopted consist in acoustical barriers and in an electronic device devoted to the control of noise emitted from acoustic amplification systems. In fig. 2 the expected noise map after the positioning of barriers is shown.

5 - CONCLUSION

Characterisation of noise sources inside amusement attraction parks can be dealt with particular attention to acoustical parameters measured. In particular the analysis of L_{min}, can be helpful to keeping apart mechanical and human noise sources during normal operation in presence of visitors. Beginning from sources analysis, noise propagation can be hindered with acoustical barriers, while electro-acoustical sources one can easily abate with volume control devices.

REFERENCES

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Figure 1: The "Pagoda", attraction equipment at the Efteling Park (NL).

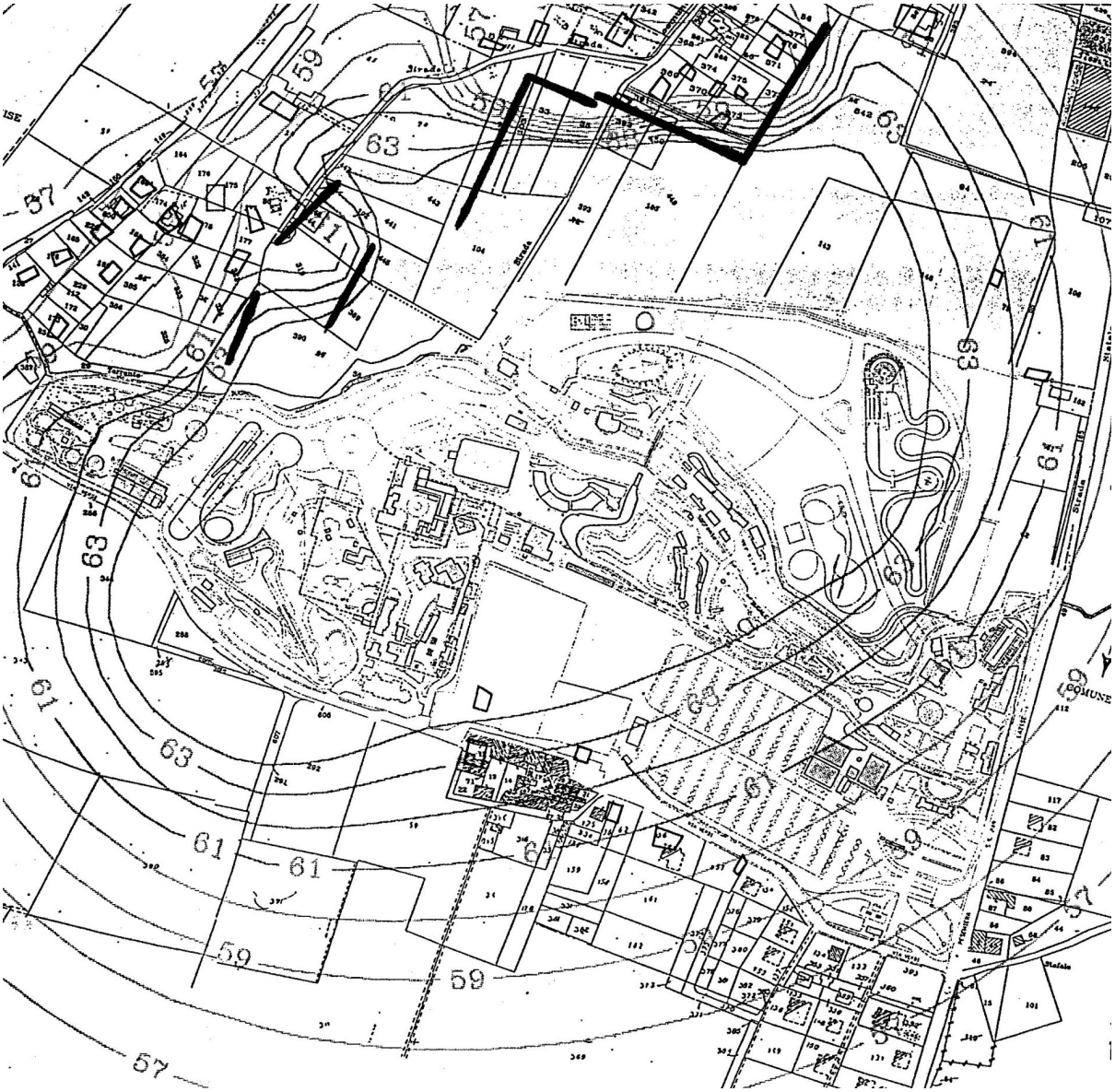

Figure 2: "Gardaland" Park – Noise map with presence of barriers.