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NEW ACOUSTIC MAP OF MADRID

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ABSTRACT
To complete the acoustic data that the Municipality of Madrid obtains by means of its network of noise measuring stations, a contract has been concluded with the Instituto de Acústica to update the data of the acoustic map of the central part of Madrid, realized during the period 1986-1991, and to extend the measurements to the 23 municipal districts of the town. The study also intends to find relationships between traffic data and noise levels, including parameters depending on the topography of the streets, pavement, number of traffic lanes, etc., and to estimate the exposition of the population to the environmental noise. The measuring stations are placed at the vertices of a lattice of variable width, depending on the characteristics of the urban district and of the traffic densities. Complementary measuring points are situated along main ways that could not be covered by the points of the lattice.

1 - INTRODUCTION

During the years 1986 to 1991 the Municipality of Madrid entrusted the Instituto de Acústica the realization of an Acoustic Map of Madrid, limited to the central area of the town circumscribed by the peripheral high way M 30. In a total of 840 measurement points, the daytime L_{eq} levels in dBA were measured, from 9 to 18 hours, and the traffic flows in front of the microphones were counted.
The measurement points were located at the intersection points of a square network, 250 by 250 m^2 placed on a map of the town, or at the nearest accessible point, at a height of 1.2 m, at the border of the pedestrian walk.
A decade later, the Municipality has installed 25 permanent noise measuring stations in strategic points with high traffic flows, and decided to complete its data with the results obtained from a new Acoustic Map, covering the full area of the town. This study has been entrusted to the Instituto de Acustica by means of a contract for a period of two years.
The town of Madrid covers an area of the order of 250 km^2 and is administratively divided into 23 districts. The four million inhabitants are not evenly distributed, diminishing the density of population from the center towards the periphery. Also, the traffic flows are concentrated along the north-south and west-east axes, as well as along the two peripheral high ways M 30 (nowadays well inside the town) and M 40.
The measurements made up to now confirm that the main noise source in Madrid, during daytime is the traffic of vehicles.

2 - INSTRUMENTATION

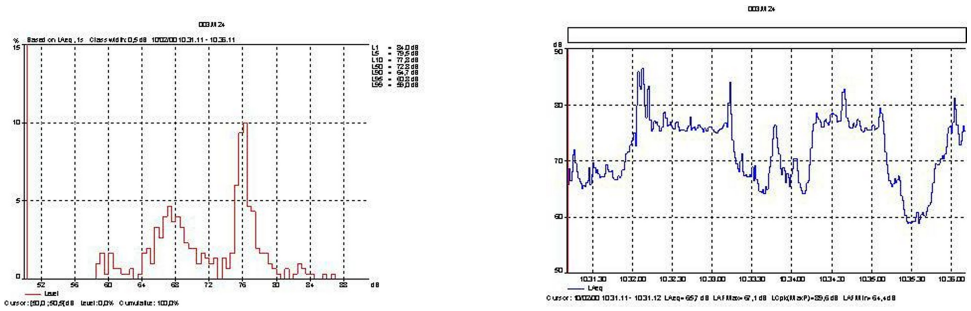
For the study it have been prepared six measuring mobile laboratories, each one equipped with a Brüel & Kjaer sound level meter Mediator, type 2238 F001 with logging module BZ7124, programd to store L_{eq}, L_1, L_5, L_{10}, L_{50}, L_{90}, L_{95} and L_{99} in dBA, and to measure and store data during five minutes (300 periods of one second).
The microphone of the sound level meter is placed at a height of 3 m above the ground, by means of a mast placed on the roof of a small vehicle (Figure 1). All the vehicles are linked via radio, so the operators of the sound level meters are able to start the measurements at the same time. During the measurements, the operators count manually the vehicles passing in front of the microphone, distinguishing among light and heavy vehicles, and motorcycles.

Figure 1: View of a mobile laboratory.

To locate the measuring stations as accurately as possible, a portable GPS is used.
The measuring stations are located at the intersection points of a square network of variable dimensions, 200 by 200 m^2 up to 300 by 300 m^2, depending of the building density. In special cases, and for studying some main streets with important traffic flows, additional measuring stations will be implemented.
A measurement is made during the first five minutes of every half an hour, and eight measurements are made in each measuring point. In the points that coincide with the measuring points of the municipal measuring network, the results of the study will be compared with its 24-hour measurements, allowing to deduce the evolution of the noise levels during the whole day.
The noise data measured are stored in a computer by means of the program Brüel & Kjaer Evaluator 7820/7821. The data are stored both as time-level recordings or as statistical distributions of levels, and can be treated as individual recordings or as summed up recordings for chosen periods of time.

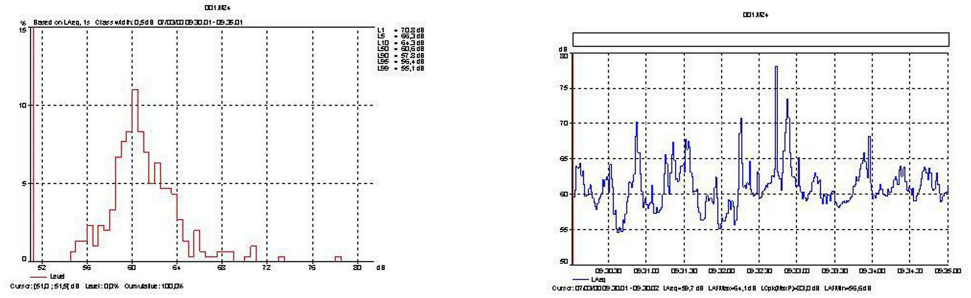
3 - FIRST RESULTS

In the next figures some examples are shown corresponding to very different types of streets: wide street with high traffic flow and narrow street with scarce traffic, but with background noise produced by an important street.



(a) **(b)**

Figure 2: Statistical distribution and time vs level of traffic noise in a main street of Madrid; L_{eq} = 75.2 dBA; pavement: asphalt; two-way traffic, six lanes, three in each direction; street width: 100 m; traffic flow: 7224 vehicles/hour; percentage of heavy vehicles: 6 %; the peaks of the statistical distribution correspond to the near and far traffic lanes.



(a) **(b)**

Figure 3: Statistical distribution and time vs level traffic noise in a small street of Madrid; L_{eq} = 62.7 dBA; pavement: asphalt; one-way traffic, one lane; street width: 15 m; traffic flow: 252 vehicles/hour; percentage of heavy vehicles: 0 %.