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ACOUSTIC IMPACT OF A COMMERCIAL CENTER

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ABSTRACT
The development of new city areas is promoted by the construction of commercial centers where citizens can enjoy a whole range of services: supermarket, cinemas, fashion-shops, etc. However, one of the main disadvantages is that these centers are acoustic pollution sources, not only the centers themselves but the also traffic due to the public that goes there. This article describes the acoustic pollution generated by the establishment of a commercial center in the north zone of Zaragoza city (Spain). The first step has been to determine the following levels: L5, L95 and Leq, during different days of the week and at several times. Next, the sonic map elaborated with these data has been compared with the previous values before the center was constructed, obtaining a Leq increase between 3 and 6 dBA. Finally, the attitude of the neighbors has been tested by means of a poll.

1 - INTRODUCTION

The promotion of a new city area of Zaragoza (Spain) has been helped by the construction of a commercial center that offers a whole range of services to improve the life of the neighbors.
This fact causes acoustic pollution, [1] that has been evaluated in a quantitative and psychological way. The center is placed between two roads (see Figure 1), and the noise is mainly produced by the customers that go there on foot, by car or public transportation.

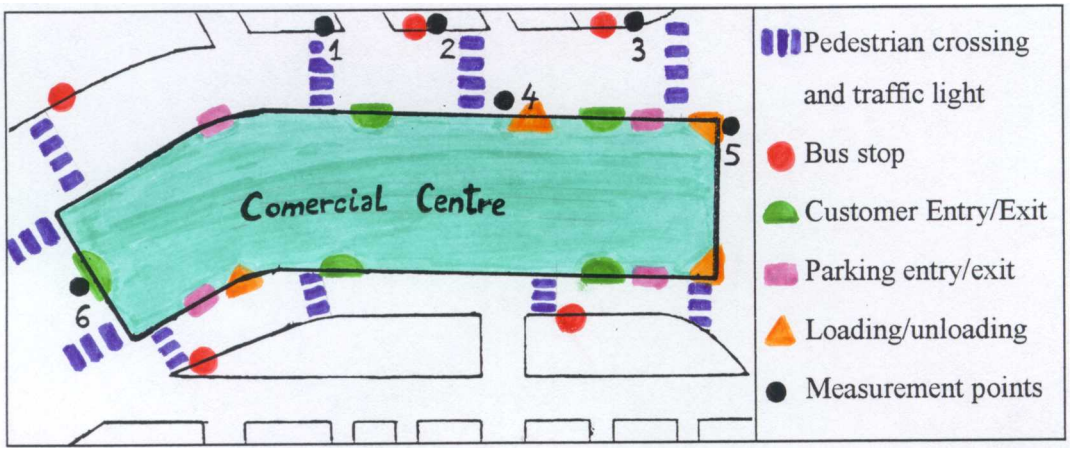

Figure 1: Measurement points.

The more important acoustic sources are:

- Six entries/exits of people
- Four loading and unloading platforms
- Five bus stops

- Four parking entries/exits
- Ten pedestrian crossings and traffic-lights

The target is to produce a sonic map of the area during a working day and on Saturday, and to know the public opinion about the noise emitted by this center.

2 - MEASUREMENT METHODOLOGY

First, it was necessary to measure in different positions to choose the measurement points that are shown in Figure 1. It can be considered that the values obtained at each side of the center are very similar, so the chosen points are representative of the acoustic level of the area.
The measurements were carried out from Monday to Saturday, at the time intervals of Table 1. A precision sound level meter was used to obtain the acoustic levels L_5, L_{95} and L_{eq}, (dBA); during these intervals, being the measurement time equal to 5 minutes.

Time Intervals						
$7'^{00} \div 10'^{00}$	$10'^{00} \div 12'^{00}$	$14'^{00} \div 16'^{00}$	$16'^{30} \div 18'^{00}$	$18'^{30} \div 19'^{30}$	$19'^{30} \div 21'^{00}$	$21'^{00} \div 22'^{30}$

Table 1: Time intervals.

Finally, the neighborhood attitude is tested by means of several questions about the noise emission.

3 - RESULTS

As several measurements were recorded at each point, a data average has been calculated according to Equation 1.

$$L_P = 10\log\left(\frac{1}{N}\sum_{i=1}^{N} 10^{0'1L_{pi}}\right) \tag{1}$$

Figure 2 shows how the acoustic levels vary at points 1, 2, 3 during a working day.

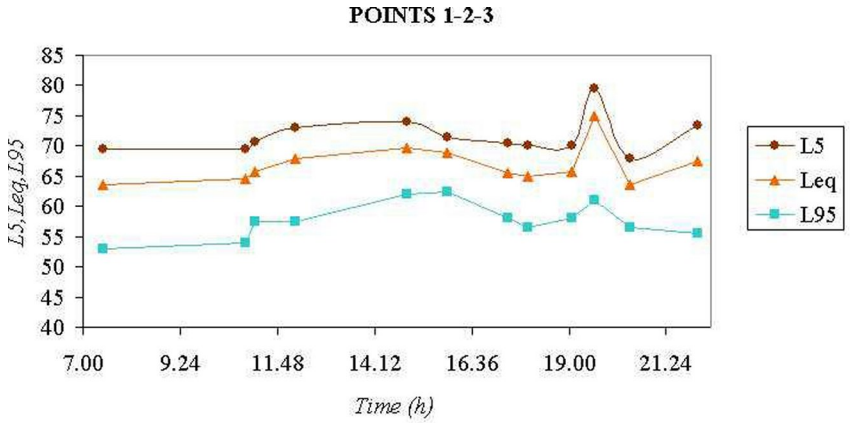

Figure 2: Acoustic levels at points 1,2 and 3.

From $7'^{00}$ to $11'^{00}$ h, the acoustic levels are constant and increase gradually until $15'^{00}$ h because of the traffic rise at this period. From this time to $19'^{00}$ h, the three levels decrease and rise at $19'^{30}$ h due to the great number of people and buses.
At point 4 the three acoustic levels do not change so much as at the previous points. The data average is 67'8 dBA, lunchtime being the less noisy.
The biggest noise values corresponding to point 5 have been obtained from $6'^{00}$ to $10'^{00}$ h, during the loading and unloading schedule. From this time up to $22'^{00}$ h the three levels are quite steady.
Finally, at the main entry of the center, point 6, the noise levels evolution is similar to the one recorded at point 4, except that around 19'00 h the levels increase due to a circus that was placed in front of this entry.
On Saturday the noise levels evolution is similar to the working days, except that at the entries the levels are bigger due to the influx of customers.
Figure 3 shows the sonic maps at working days and on Saturday.
Public opinion was checked with the next questions:

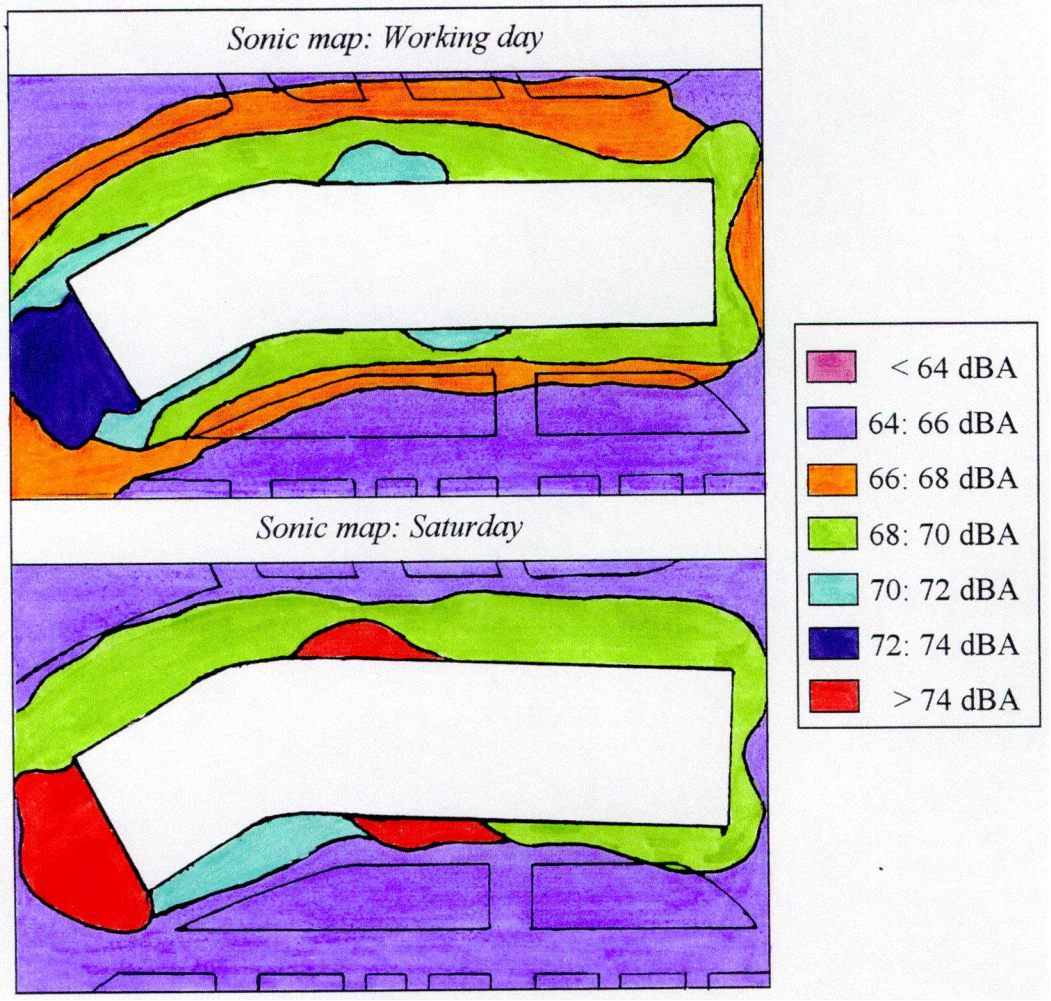

Figure 3: Sonic maps.

- Which do you think is the most bothering noise?
- Has the public transportation improved since the construction of the center?
- Which day is the noisiest?

The answers are shown in Figure 4.

4 - CONCLUSIONS

Figure 5 shows the comparison of the Leq obtained in 1999 with the values measured in 1989, [2]. It can be observed that the existence of the center has increased the Leq by 4 dBA.
In general, the neighborhood consider the commercial center as a noise source, being the traffic noise during Friday and Saturday evenings the most bothering, but this inconvenience is compensated for all the services that can be enjoyed.
Proposals to reduce noise are: creation of parks and gardens and placing of fountains to absorb and to mask the noise respectively, modification of the entrances and exits of the parking, construction of underground lanes and improvement of the public transportation system.

REFERENCES

1. **Council of Zaragoza**, *El ruido como agente contaminante en el medio ambiente*, pp. 461-497, 1987

2. **Council of Zaragoza**, Mapa sónico de la ciudad de Zaragoza, 1989

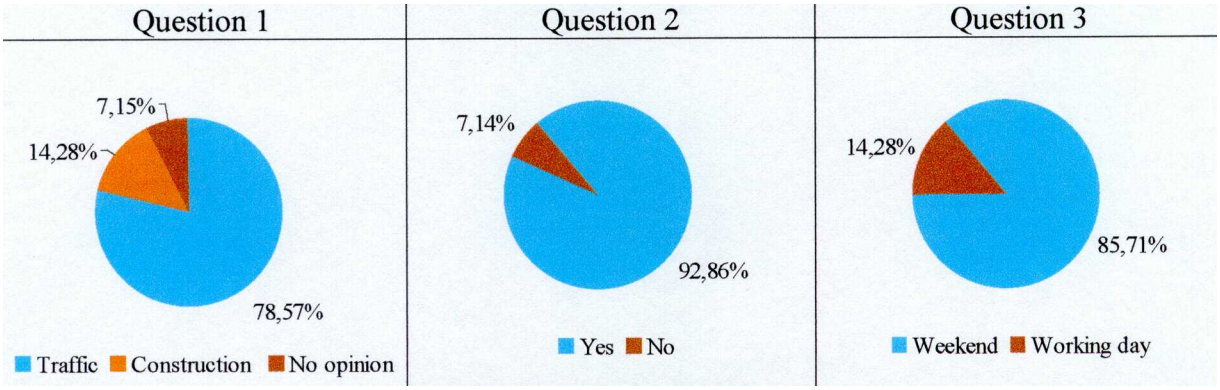

Figure 4: Answer percentage.

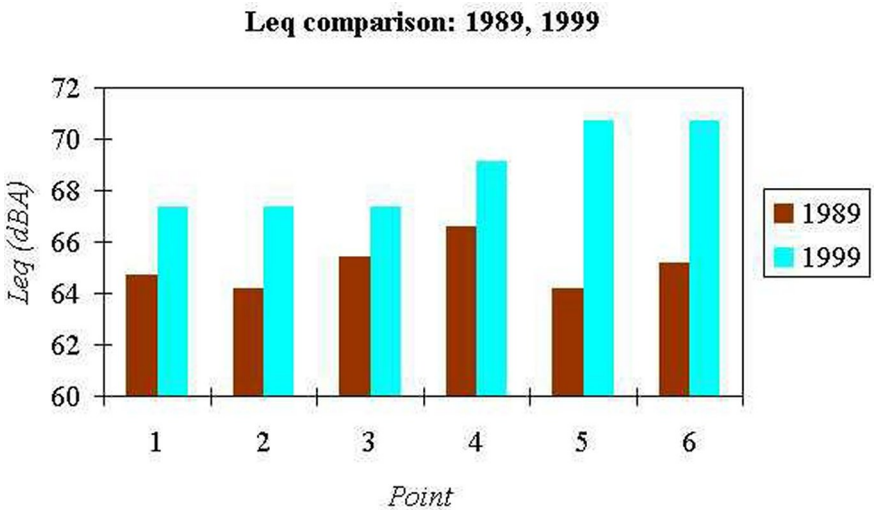

Figure 5: Leq comparison: 1989, 1999.