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# ACOUSTICAL NUISANCE TO THE CITIZEN BY TRAFFIC NOISE

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## 1. INTRODUCTION

Road traffic is a source of nuisance anywhere. We noted that the noise in cities is very different to the noise the control measurement reflects. Some vehicles with the same test sound level [1] can differ appreciably in terms of their subjective noisiness, indicating that the current method of assessment may be insufficient to control the relevant aspects of vehicle noise in all cases. After our measurements, doubts have been expressed about the continuing use of the scale of dBA for traffic noise measurements. We have noted a poor correlation between A-weighted measurements and noise perception of citizen. After observe the shape of the enveloppe of the spectrum averaging of traffic noise, we can see a better correlation between B-weighting measurements and the noise perceived by citizens.

## 2. MEASUREMENT OF TRAFFIC NOISE IN THE CITY

In order to assess our point of view we undertook noise level measurements in some of our city's streets, i.e. in Barcelona. We selected the measurement points considerating traffic intensity both in large and small streets. Three kinds of measurements were made:

a. Noise of streets at five different hours, rush hour, mid-morning, afternoon, night, and early-morning, on six different points and on different days also.

b. Noise of vehicles passing across a one way street, at aproximately, constant velocity.

c. Noise of known vehicles, (our cars and motorcycles).

All of these measurements were recorded on a DAT system, which offers great portability. The recorded signals were taken from a B&K 2230 and a B&K 2235 digital sonometers with two B&K 4155 microphones. Street Noise (traffic noise) was recorded for 12 minutes on each point for every single

measurement, except for the early-morning measurements which were recorded during only 6 minutes. The digital sonometer was situated some 1.5 meters high and about 3.5 meters away from the vehicle, if was possible. We avoided the positions with some obstacles, like cars parked in the street. Microphones were oriented to the street line. Wheater conditions for all the measurements were excellent, no wind and no rain.

Noise of a single unknown vehicle is recorded across a one way street, beginning some 40 meters before the microphone's position and ending the recording when the vehicle was about 40 meters away from the microphone. The microphone was situated some 1.5 meters high and about 3.5 meters away from the vehicle. The noise from known vehicles was recorded in the same way. Obviously the noise levels reached under this measurements conditions differs a little from the noise measurements in some streets, because the distance between the microphone and the vehicle is not the same. All of these records were analyzed with a B&K 2035 spectrum analyzer in 1/3 octave bands from 12.5 Hz to 10 kHz. The traffic noise of different streets was also analyzed with a TEF-20 system for evaluation of noise level vs time, with which we obtained $L_{eq}$, $L_{90}$, $L_{10}$. Finally we analyzed the recorded noise measurements with a B&K 2260 digital sonometer-analyzer to obtain the signals' spectral distribution.

In Fig. 1 we can see an averaged spectrum from the crossing of Balmes-Ronda del Mig streets in Barcelona at rush hour (8:00 AM). Balmes is a two way 5-lane street. Ronda del Mig is a two-way 6-lane street. We can see that the noise level peaks on the 1 kHz band. This spectrum has been obtained with A-weighting. On the right side of the graphic we have the A-level, and the LIN-level. We observe that the noise level on the 63 Hz band is about 10-12 dB lower than the level at 1 kHz. This averaged spectrum results from 10 min. traffic noise measurements, including starts and stops of any kind of vehicles. Up to 630 vehicles were averaged in this measurement. We compared this level chart with others made in different streets, like on Major de Sarrià,121. This is a one way 1-lane street. The traffic density at Balmes-Ronda del Mig is about 3.800 veh./hour at rush hour, and the traffic density in Major de Sarrià, 121 is about 550 veh./hour

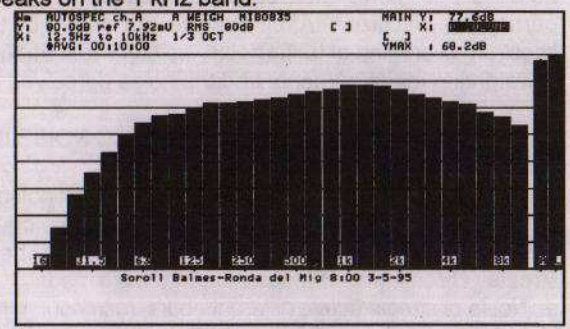


Figure 1. Traffic noise in Balmes-Ronda del Mig.

at rush hour also. The noise levels ($L_{eq}$) differ in only 0.1 dBA, even with very different traffic densities.
These very similar values are produced by differences in the street's structure. Yet looking at figure 1 we see that the noise level at the 1 kHz band is about 10-12 dB over the noise level at 63-80 Hz band. Figure 1 is A-weighted averaged spectrum. If this figure were to represent our actual auditive sensation, we could not really hear the low frequencies at the level we actually hear them, i.e. this A-weighted averaged spectrum does not reflect our actual hearing perception, since the noise level at lower frequencies is 10-12dB below the level at 1 kHz.
Obviously, everybody can hear the low frequencies in the city when a vehicle starts. We can say that A-weighting does not seem to be quite adequate for our purposes. The A-weighting greatly penalizes the low frequencies. We agree with G.R Watts and P.M. Nelson [2] and G.R. Watts [3] in that the continued use of the maximum A-weighted sound level for control purposes must be questioned.
If we apply Kryter's [4] studies, we reach the level of nuisance.
Figure 2 shows the perceived noisiness in some streets of Barcelona. The $L_{eq}$ for different streets are very much alike, from rush hour to afternoon, with a noise level over 75 dBA.
At night, the level comes down. When there is no traffic in the street, the noise level is about 36 dBA, and with very slight traffic (36veh./hour) the noise level remains at 48 dBA. The noisiness perceived in city streets by day is 32-37 Noys. This value of noisiness is closer to the B-weighting curve, whereas the A- weighting curve is far away (see Fig 3). By night, the noisiness of most of streets, reaches 14-18 Noys. With these values, A-weighting is again far from the reality, while B-weighting is more realistic to simulate the response of the human ear. When the traffic density is very light, lower than 40 Veh./h, the noisiness remains between 2 to 5 Noys, and then the A-weighting is correct to use in this situation only.

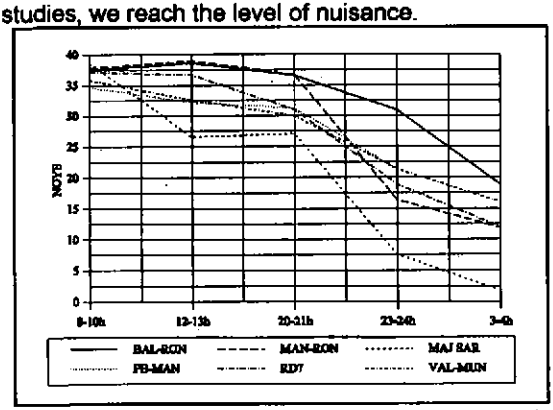

Figure 2. Evaluation of noisiness from different streets in Barcelona city.

## 3. NOISE PRODUCED BY CARS AND MOTORCYCLES ALONE

We want to know if the nuisance produced by one vehicle alone is enough

to apply the B-weighting instead the A-weighting. For this reason two different measurements was made, measurements of traffic noise in city and measurements under ideal conditions at IDIADA center.

Perceived noise in city produced by cars alone, lies between 16.8-18.5 Noys. Perceived noise under ideal conditions lies between 15-22 Noys at 3.5 meters, the same than measurements in city streets.

The noisiness of motorcycles lies between 24-36 Noys. (We not include the motorcycles with modifications in his exhaust).

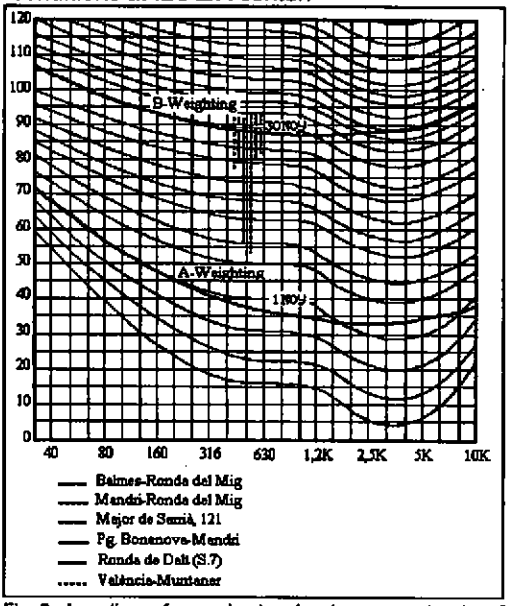


Fig 3. Location of perceived noise in some streets of Barcelona city (24h).

## 7.CONCLUSIONS

1. The A-weighting used to measure traffic noise is wrong in most cases, especially in noise measurements in city because it does not relate to actual nuisance perception, whereas B-weighting is, for that same reason, better. Even with vehicle alone under ideal conditions B-weighting is better than A-weighting.

2. The acceleration from motionless, it is the most usual situation of any vehicle in city. The noise produced in acceleration have more energy at low frequencies. The acceleration from motionless should must to be considered in the control measurement test.

3. We observe also that is very important to take into account, the power to weight ratio in trucks. Is necessary to avoid the measurements with the vehicle empty. The classification by numbers of seats for example, it seems not adequate to analyze the noise produced by this vehicles.

## REFERENCES

[1] Standard 92/97/CEE "Diario Oficial de las Comunidades Europeas".

[2] G. R. Watts & P.M. Nelson "Relationship between vehicle noise measures and perceived noisiness". Journal of Noise and Vibration V.164 n3 Jul 1993 pp 425-444.

[3] G.R. Watts "A comparison of noise measures for assessing vehicle noisiness". Journal of Sound and Vibration V.180 n3 pp 493-512.

[4] Karl D. Kryter "The effects of noise on man" Academic Press 1985.