# NOISE PROBLEMS AT THE CITY PARKS: TRABZON CASE

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## 1. INTRODUCTION

Noise is one of the environmental problems caused by rapid urbanisation and industrialisation. It has lots of distressing effects ranging from inadvertence, tiredness, psychological problems, nervousness, dizziness, pain in the ear to temporary and permanent hearing lost.

City parks are the places for the leisure of people.As noise sensitive areas,the noise should not exceed some certain levels. According to the Turkish Noise Control Regulations(1) which is compatible with ISO recommendations (2) the Equivalent Continous A Weighted Sound Level ($L_{eq,A}$) should not exceed 35 dB(A) at noise sensitive areas. At the city parks of many Turkish towns, which were surrounded by motor vehicle traffic,the noise levels exceed this level as much as six folds. It is possible to reduce this noise considerably,by the use of noise barriers around the parks

In the study, the measurement of noise levels at the city parks of Trabzon,the design of noise barriers to reduce this noise and their use at other noisy city parks will be discussed.

## 2. THE METHOD

The noise measurements were taken with BrÜel&Kjaer Precision Sound Level Meter. 1 inch microphone, random incidence corrector and sponge type wind shield were used with the sound level meter Equivalent continuos A weighted sound level ($L_{eq,A}$) was selected as the measurement unit because the Turkish Noise Regulation provide criteria in this unit. The city parks of Trabzon vary in dimension and layout. However, in order to compare the results, the measurements were taken at 15 or 30 m. away from the main traffic road, within the sitting area and at 1.2 m. above the ground.This is the average ear height above the ground of people sitting on chairs. All the measurements were taken when the wind was relatively calm.(Beufort scale 0-2). However, lapse rate was not taken into account in this study.

In a previous analysis, it was found that the noise levels at Trabzon increase on Mondays.The peak occurs at 07.00-09.00 hours in the morning and at 16.30-18.30 hours in the evening. In order

to compare the results, all the measurements were started on Mondays at 12.00 o'clock and lasted for an hour.The results were listed in TABLE 1.

TABLE 1. The noise levels at the parks of Trabzon at 12.00 o'clock on Mondays.

| PARK | DISTANCE m. | MEASURED $L_{eq,A}$ dB(A) | COMPUTED $L_{eq,A}$ at 15m dist. dB(A) |
|---|---|---|---|
| Atapark | 30 | 81.17 | 87.17 |
| 100.Yıl | 30 | 73.94 | 79.94 |
| Meydan | 30 | 85.10 | 91.10 |
| Dalyan | 15 | 95.36 | |
| Fatih | 30 | 78.75 | 84.75 |
| Note: Wind velocity: calm, Sky conditions: open | | | |

According to the Turkish Noise Control Regulation, city parks are allocated for the leisure of people.Therefore they are noise sensitive areas, and the noise levels in equivalent continous A weighted sound level should not exceed 35 dB(A).Every 10 dB(A) increase of A weighted sound level is heard twice louder. So the noise at the city parks of Trabzon is 3 to 6 times the maximum allowable level. It is economically very difficult to reduce the noise levels to 35 dB(A). The Regulation allows higher noise levels at areas near the main roads. The maximum allowable noise levels are; 60 dB(A) at areas adjacent to heavy vehicle traffic, 55 dB(A) at town centers, 50 dB(A) at the suburbs of towns. It was intended to reduce the noise levels at the city parks of Trabzon below these levels.

Traffic noise is a combination of the sound emitted from the engines, tires and the reflection,diffusion,diffraction of these sounds. Frequency measurements of various traffic noise which were reported by other research workers were evaluated by the author using the Noise Rating method (3). It was found that the maximum annoyance occured at 250-2000 Hz frequencies. TABLE 2.

The noise barriers could be made of materials like earth, stone, concrete, plastics etc, provided that their surface density are above 10 kg/m² (4). There are a number of methods to predict the extent of attenuation of sound due to noise barriers.(3,4.5,6,7) KURZE who had made a comparison of these methods found that the difference between them was not more than 5dB. (8). Thus in this study, the method in reference (3) which is suitable for the units of the selected criteria was used for the prediction of sound attenuation. (FIGURE 1).

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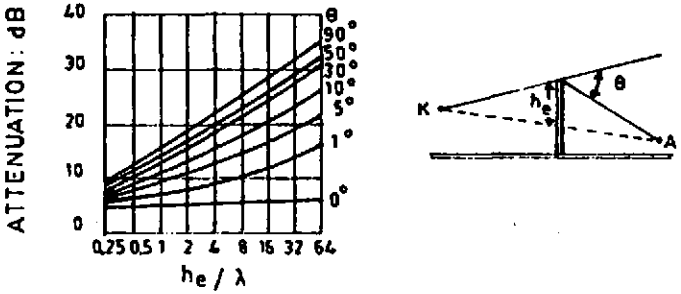


λ = wavelength of the sound =(340 m/s)/frequency,Hz

FIGURE 1.Attenuation due to long noise barriers. SZOKOLAY(3)

TABLE 2.Motor vehicle traffic noise reported at various sources and the results of Noise Rating evaluation by the author.

| FREQUENCY, Hz | 125 | 250 | 500 | 1000 | 2000 | 4000 |
|---|---|---|---|---|---|---|
| Automobile56km/hr* Sound Level,dB | 65 | 61 | 62 | 61 | 57 | 53 |
| " " Noise Rating,NR | 50 | 53 | 59 | 61 | 59 | 58 |
| Automobile88km/hr* Sound Level,dB | 71 | 68 | 66 | 68 | 66 | 60 |
| " " Noise Rating,NR | 55 | 60 | 63 | 68 | 68 | 64 |
| Truck 56km/hr* Sound Level,dB | 87 | 84 | 81 | 78 | 74 | 70 |
| " " Noise Rating,NR | 75 | 78 | 79 | 78 | 76 | 74 |
| Truck 88km/hr* Sound Level,dB | 87 | 85 | 87 | 82 | 77 | 73 |
| " " Noise Rating,NR | 75 | 80 | 85 | 82 | 80 | 77 |
| Istanbul Traffic Noise,** dB | 88 | 85 | 79 | 75 | 77 | 65 |
| " " Noise Rating,NR | 75 | 80 | 75 | 75 | 80 | 70 |

* The measurements were taken at 1.2 m above the ground and 15 m away the source. SHARP ve DONAVAN (9).
** The measurements were taken at 1.5m above the ground and 7.5m away the source at Mecidiyeköy,Istanbul. KURRA (10)

In general, the noise barriers are designed as sound reflecting elements. The reflected sound in town centers increase the noise in the environment. So the noise barriers designed for the city parks, should not only reduce the noise levels behind them, they should also absorb the noise. This could be achieved by using Helmholz resonators (cavity absorbers) on the road side of the noise barriers. An array of Helmholz resonators can attenuate sound at their resonant frequencies. (FIGURE 2.)

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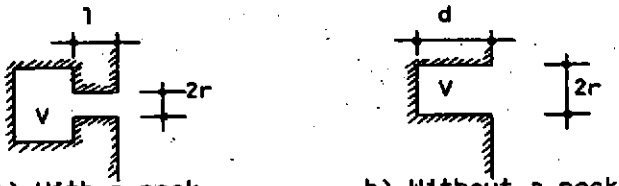


a) With a neck b) Without a neck

FIGURE 2.Sections of Helmholz resonators (cavity absorbers).

The resonant frequency of a neckless Helmholz resonator is given by the following equation.

$$f_r = \frac{340}{2\pi}\sqrt{\frac{2r}{V}}$$

$f_r$ : resonant frequency, Hz
r : radius of the cavity opening, m
V : volume of the cavity, $m^3$
d : depth of the cavity, m.
$\pi$ : Pi number.

Helmholz resonators for the noise barriers can be designed to be effective only at 1000 Hz or both at 500 and 1000 Hz frequencies since the traffic noise causes annoyance mainly between 250-2000 Hz. Thus according to the above equation the effective Helmholz resonator sizes are for 1000 Hz r=0.10 m d=0.06 m,and for 500 Hz r=0.25 m d=0.09 m.

At the city parks of Trabzon the ground is not flat as shown on the cross sections in FIGURE 3. The attenuation achieved by 2 m high noise barriers, built between the road and the park, were computed and given in TABLE 3.

TABLE 3. Sound attenuation at various distances of 2 meter high noise barriers for the city parks of Trabzon.

| FREQUENCY,Hz | 500 | 1000 | 2000 |
|---|---|---|---|
| DISTANCE FROM THE SOURCE, m | 30 20 15 13 10 | 30 20 15 13 10 | 30 20 15 13 10 |
| PARKS | ATTENUATION, dB | | |
| Atapark | 16 15 16 | 19 18 19 | 21 20 21 |
| 100.Yıl | 16 16 | 19 19 | 21 22 |
| Meydan | 15 16 19 | 18 19 22 | 20 22 25 |
| Dalyan | 15 18 | 18 21 | 21 24 |
| Fatih | 16 17 18 | 18 19 21 | 21 22 24 |

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Besides the technical requirements, the noise barriers for city parks should not isolate the green of the park, should have an acceptable appearance, and should preferably be used in combination with the urban furniture. According to these requirements and the technical findings a number of designs were produced by the graduate students of Karadeniz Technical University Dept. of Architecture, Trabzon, Turkey. FIGURE 4.

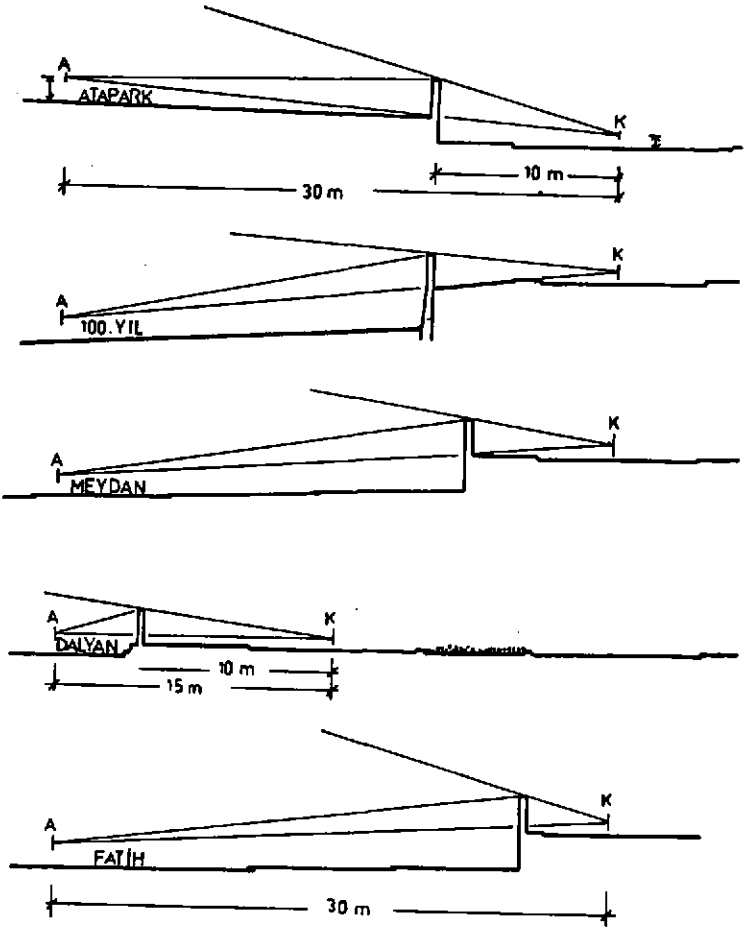
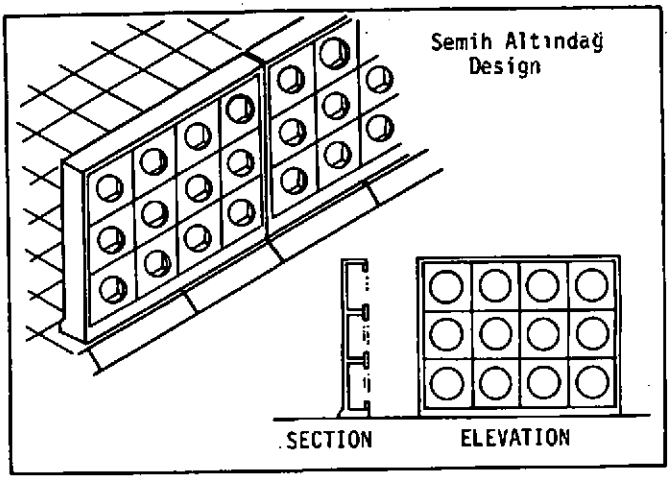



FIGURE 3. Ground vertical sections of the Trabzon's parks.



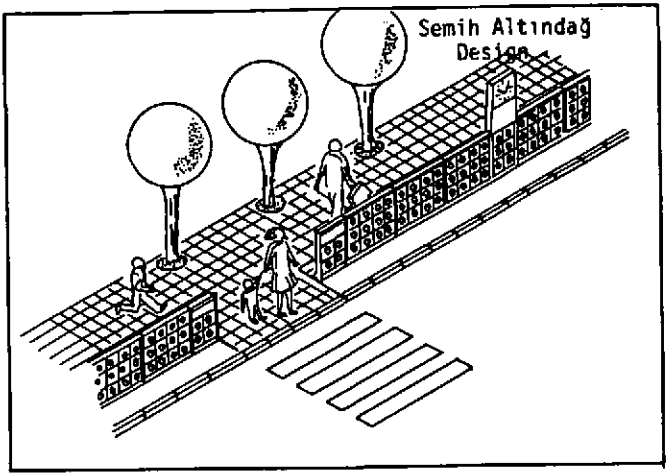




FIGURE 4. Noise barriers designed by the graduate students of KTU Department of Architecture according to this study.

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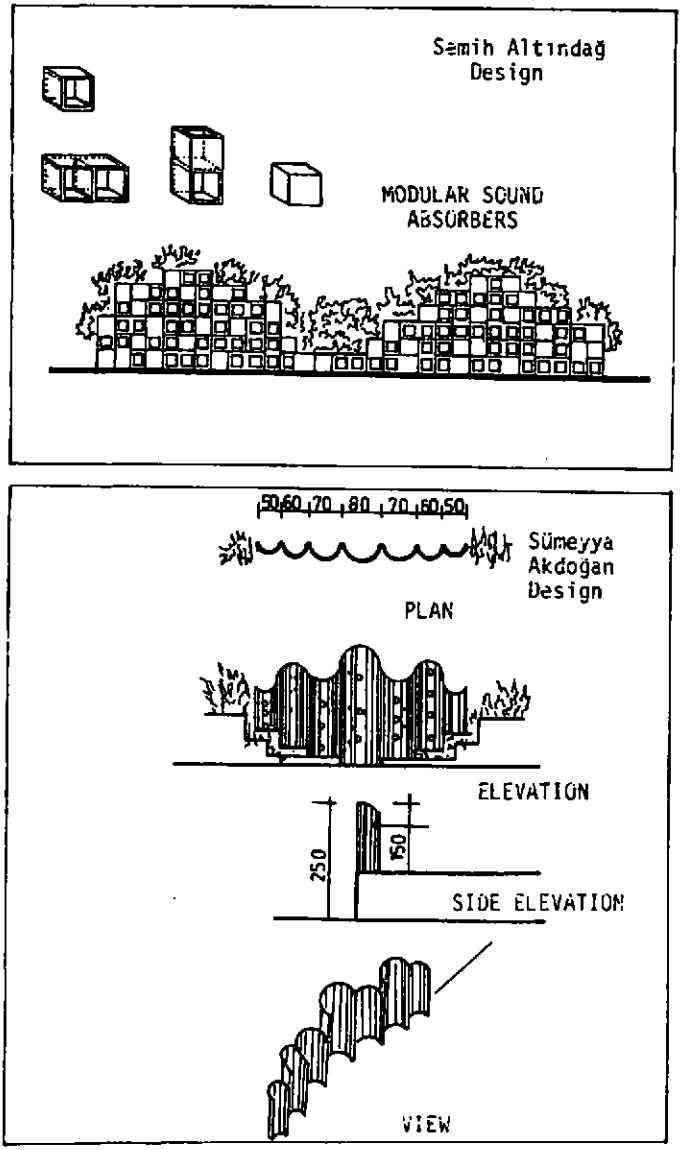


FIGURE 4.(Continued)

## 3. RESULTS

It was computed that 2 m high noise barriers built around the city parks of Trabzon will reduce the equivalent continuos A weighted sound level ($L_{eq,A}$) at the sitting area, to 62 dB(A) at Atapark, to 55 dB(A) at 100.Yıl Park,to 67 dB(A) at Meydan Park, to 77 dB(A) at Dalyan, to 60 dB(A) at Fatih Park.

The noise will be reduced below the acceptable levels only at Fatih 100.Yıl and Parks, with noise barriers at this height.At Dalyan which is located near the state highway with heavy vehicle traffic,it is not possible to reduce the noise to the acceptable level with the low noise barriers.It was recommended to move the sitting area of this park near the seaside which is 2.5 m. lower than its present location. At the other parks the noise levels will be reduced considerably,but not below the acceptable levels. More attenuation is possible with higher noise barriers.

By combining the noise barriers with the urban furniture they can be used around all the noisy city parks and even at the sidewalks of noisy roads.Besides the noise barriers; smoothening the surface of the roads, reducing the number of bus and shared-taxi stops, using downward one way traffic at the inclined roads should also be considered in order to reduce the noise levels.

## 4. REFERENCES

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