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NOISE REDUCTION IN SUBURBS BY SEQUENTIAL LOCATION OF TYPICAL ROAD AND PASSAGE ELEMENTS OF NOISE REDUCTION CAPACITIES

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1. INTRODUCTION

It is possible to arrive at **quiet zones in suburbs** by an intentional acoustic design of a sequences of noise reductions, from the noise source to the area to be protected. In this context, all possible or dominant routes of propagation should be examined. Reduction of noise penetration into residential areas by each sound blocking element along the propagation route adds sequentially to the total noise reduction. Internal noise sources can also be considered by the same approach. Such an architecture becomes acute because of the modern need to isolate ever increasing number of residential areas from the other parts of the noisy city, due to the accelerated growth in the urban population density.

2. BASIC ELEMENTS

Typical noise reducing elements, which include free field, streets, obstacles, junctions, squares, gates, yards, entrances, stairs and balconies are illustrated in Table 1. Other types may be added as well. A sequence of such elements in an ancient and a modern suburb is shown in Figures 1a and 1b respectively.
Noise reduction by such elements was measured extensively. Various types of suburbs were carefully selected for that purpose and the range of reduction was defined for each of basic elements. Combinations of such reductions were measured as well to examine the superposition possibilities.

3. EXAMPLES

Two typical elements are brought here in some more detail. A whole catalogue of noise reductions by various elements can be built, to enable an acoustic design based on measured data.

REDUCTION ALONG A STREET

An example of a road element is shown in Figure 2. The source was located at S and the control points at Ri with i = 1 to 4, and a reference point S5. The distance along the road is measured in meters, up to 16 m. The width of the road is 4 m. The noise reduction along the road depends on the width between the walls on both sides of the road the roughness and the absorption of the involved surfaces. A typical reduction with distance is given in Figures 3a and 3b for roads, the width of which is 2 and 16 m. The narrower the road the smaller is the noise attenuation.

THE "T" JUNCTION

An example of a "T" junction is shown in Figure 4. it combines a road to which another perpendicular road approaches. The width of both roads is 4 m. A sound source was located at S and the control points were R1 and R2 at a distance along the dotted lines of 16 m. The noise reduction behind the corner is to a certain amount higher than that along the road, as shown in the table of Figure 4, and could be expected.

4. CONCLUSIONS

Sequential contribution to noise reduction in ancient cities was verified and the total reduction was obtained. This total reduction was compared to the reduction by a linear sum of the reductions of a sequence of several elements. Noise reduction along several routes was examined as well. In modern suburbs this effect is mostly weak, which results in turn too much noise in many residential areas. This brought us to establish an intentional sequential noise reduction. Such a technique may allow for living in homes where windows can be left open.

The rule of hierarchies in acoustic design can be established due to the following three basic ingredients:

1. The logarithmic scale which simulates the psycho-acoustic hearing role.
2. The total reduction of sound by each element as a scalar quantity. This is a kind of "deafness" of the ear to the shape of the noise reducing element.
3. The effect of each route of propagation of noise can be added by using the logarithmic addition rule.

The elements of noise reduction constitute under this theory the basic "Lego bricks" from which one can build the necessary total noise reduction.

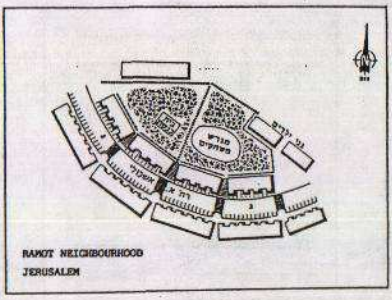

Figure 1b. A modern area

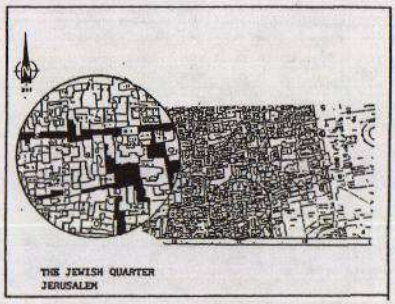

Figure 1a. An ancient area

Reduction Of Sound Level

Street (Leq, dB(A))

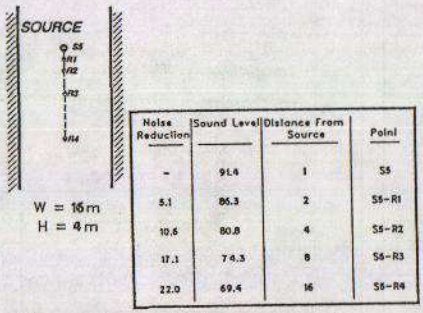

Figure 2. Noise reduction along a typical road

Reduction Of Sound Level

"T" Junction (Leq, dB(A))

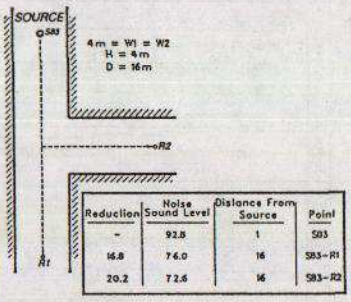

Figure 4. Noise reduction by a "T" junction

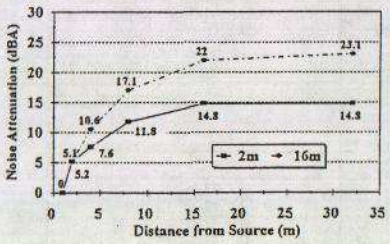

Figure 3a

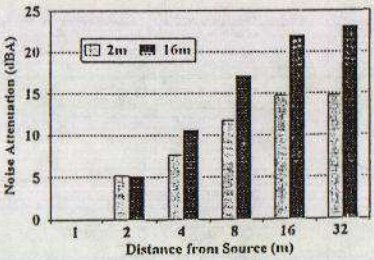

Figure 3b

Figure 3. Reduction of noise along two roads of different width

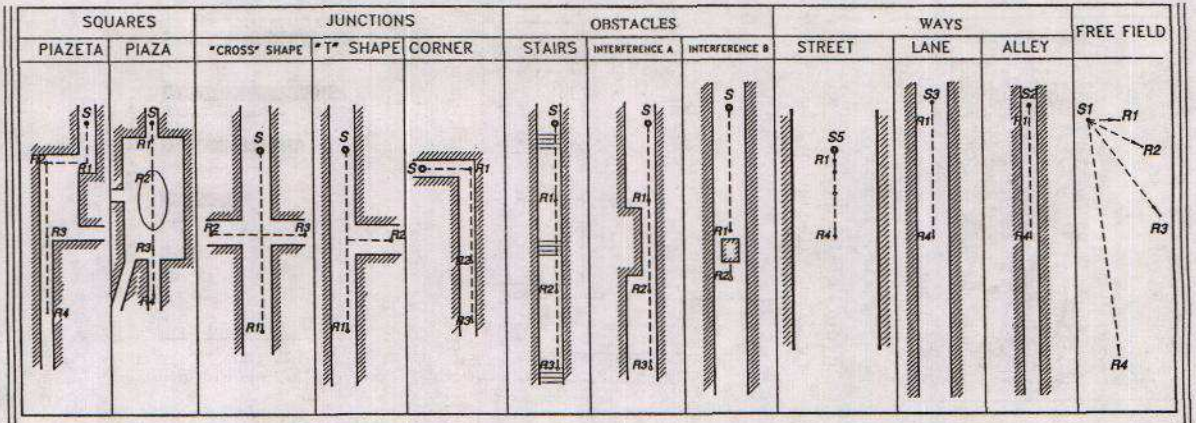

Table 1: Noise reducing elements