

inter.noise 2000

*The 29th International Congress and Exhibition on Noise Control Engineering
27-30 August 2000, Nice, FRANCE*

I-INCE Classification: 6.0

NOISE PROBLEMS CAUSED BY ROAD TRAFFIC IN CLASSROOMS

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Keywords:

NOISE, TRAFFIC, CLASSROOMS, ANNOYANCE

ABSTRACT

Road traffic noise is one of the most important factors that harms the excellency of the educational process in classrooms. In this context, effects of road traffic noise has been investigated at primary schools selected among schools situated at the various noise zones in Istanbul. Outdoor and indoor measurements were carried out at the mostly effected classrooms of the schools. The results of the measurements were evaluated according to the National and International regulations, and high noise levels and long reverberation times have been determined. On the other hand, surveys have been realized on the users of the classrooms. High noise levels caused annoyance, poor intelligibility and adverse effects both on students and teachers.

1 - INTRODUCTION

Human learning depends strongly on verbal learning. Research has shown that the quality of the acoustical environment is a significant element of the verbal learning. One of the most important factor that harms the excellency of the acoustics is noise. This fact motivated an impressing and growing body of research on the harmful effects of the noise throughout educational process. However the importance given to the detrimental effects of noise in educational spaces differs highly upon countries.

Road traffic is generally the most important one, among different noise sources that affect classrooms. Many research done on the subject has shown the adverse effects of the road traffic noise, and the clues to avoid or diminish the annoyance. However the most important issues continue to be the planning of a special building on a special environment and the selection of the construction technologies and materials upon requirements.

On the other hand, at Turkey, state schools built after a certain date, have similar project types, applied with minor differences to the land; moreover construction technologies and materials are similar as well. This fact shows that nor in the planning neither in the selection of materials, noise has been taken as a design parameter in a lot of cases. It is obvious that this will cause a lot of adverse effects, which one of the most important is poor intelligibility. Therefore a study aiming to investigate the situation on the schools having similar project types are carried out. The effects of road traffic noise has been investigated by outdoor and indoor noise measurements and surveys realized on the users of classrooms, at schools selected among various noise zones at Istanbul.

2 - METHOD AND MATERIAL

To determine the effects of road traffic noise in the classrooms, objective and subjective evaluations were planned. Outdoor and indoor measurements were carried out in order to determine the levels that exceed the acceptable levels given at the National and International Regulations. For a more accurate determination of noise effects, the annoyance from the traffic noise have been inquired by a questionnaire survey. Finally, by evaluating the results of measurements and questionnaire survey, the degree of the disturbances occurred from noise have been investigated.

The steps explained above have been realized by sampling process. Road traffic being the dominant noise source was taken into consideration in the selection of the school samples and four schools have been

selected. Besides measurements and surveys on users, the architectural properties of these classrooms were also investigated. Floor, wall and ceiling surfaces of the space are covered with reflective materials such as plaster and PVC. The calculated reverberation times were clearly higher than optimum levels, showing a typical increase at lower frequencies. Related information about schools are shown in Table 1.

School number	School Name	Building envelope			Calculated average transmission loss (dB)	T60 (s)	Dimensions
		Window	Wall	Window / Wall (%)			
1	İntaş	Double glass	1 1/2	25	36	(approx.) 500 Hz	6,9 × 6,9
2	F.R.Unat		Brick				6 × 6,8
3	Kenan Evren	Single glass	+	50	28,5	1,06	6 × 6,8
4	Örnek		plaster				6,9 × 6,9

Table 1: Information on selected schools.

3 - MEASUREMENTS

To evaluate the noise effects, outdoor and indoor measurements were carried out, for the schools shown in Table 1. Frequency and statistical analysis are done and Leq (A) day time are measured. The results are shown in Table 2 and Table 3.

School number	Measurement location	dB.A				
		Leq	Lmax	L10	L50	L90
1	Outdoor	61,5	74,5	64,3	56,8	53,5
	Indoor	46,3	61,7	48,0	41,3	37,8
2	Outdoor	70,0	88,3	71,0	66,5	62,5
	Indoor	53,5	73,0	56,0	51,5	48,0
3	Outdoor	62,0	75,0	63,5	61,0	58,8
	Indoor	52,0	69,0	54,0	50,7	48,7
4	Outdoor	65,4	75,0	67,5	64,2	62,0
	Indoor	47,9	58,7	51,5	48,2	46,5

Table 2: Outdoor and indoor noise levels.

School number	Mea. location	dB								
		32 Hz	64 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
1	Outdoor	69,6	67,5	60,0	55,0	52,5	50,8	51,0	45,0	31,8
	Indoor	64,7	50,0	37,6	36,5	35,2	39,3	39,1	34,2	29,2
2	Outdoor	76,4	80,1	72,0	65,5	63,3	61,0	60,8	51,7	36,5
	Indoor	59,6	64,4	58,9	51,1	46,9	52,4	46,8	38,6	27,8
3	Outdoor	73,4	75,6	68,6	64,0	59,0	56,0	54,2	46,1	29,5
	Indoor	68,5	76,0	58,2	53,5	49,0	48,1	42,6	35,0	27,0
4	Outdoor	78,3	78,5	70,5	64,0	55,8	54,0	53,8	45,2	29,2
	Indoor	69,7	64,0	60,5	53,0	45,0	48,0	41,0	34,1	25,2

Table 3: Octave band sound pressure levels.

As the aim of the study is to determine the road traffic noise effects, measurements have been realized while the classrooms and schools were empty. However it was a regular working day, therefore the traffic circulation was, as always. Outdoor measurements were held at the facades mostly effected from traffic noise, and indoor measurements were held in the classrooms located at these facades. Classroom's dimensions and furnishings were similar.

4 - THE QUESTIONNAIRE SURVEY

Besides the measurements, surveys have been realized on the students and teachers for determining their reaction against traffic noise. A questionnaire has been prepared to determine the general opinion, on the school and the environment. Users of the classrooms where measurements are done, answered the questionnaire. Some of the selected questions of the survey, taken into account for noise evaluation are as follows:

Question 1	What do you think about the environment of your school? (<i>evaluated response alternatives</i>)
	a) Heavy noise with different characteristics
	b) Usual traffic and environmental noise
Question 2	Does the noise coming from outside disturb you while the windows are closed during the lecture?
	a) Yes
	b) No
Question 3	Does any negative effect have been observed on the student or teacher because of the disturbance caused by the outdoor noise?
	a) Yes
	b) No
Question 4	Do the teachers have to speak louder because of the outdoor noise?
	a) Yes
	b) No

Table 4.

Answers given to those questions have been illustrated as bar graphics (Figures 1a, 1b, 1c, 1d).

5 - EVALUATION

Although statistical levels and MaxL have also been measured, evaluations are made upon Leq dBA levels, for it is the only criteria (for schools) taking place at WHO's guideline and Turkish regulation. In Figure 2 outdoor and in Figure 3 indoor acceptable levels are shown comparatively with measurement results for schools. As shown, noise levels exceed the acceptable levels in a considerable amount in all of the schools. Outdoor acceptable levels for schools is 55 Leq (dBA) according to WHO (World Health Organization). In Figure 2, it can be seen that all outdoor noise levels are higher than the acceptable levels. Exceeded amounts for outdoor are between 6,5 and 15 dBA. On the other hand indoor acceptable level for schools is 35 Leq (dBA) according to WHO, and 45 Leq (dBA) according to Turkish Noise Control Regulation. Indoor noise levels exceed the acceptable levels in a considerable amount in all schools, both for the limits of WHO and of Turkish Noise Control Regulation. Exceeded levels are between 11-18 dBA for WHO and 1-8 dBA for Turkish Noise Control Regulation.

In order to visualize the problem, measured octave frequency sound pressure levels are compared with NCB 30 and NCB 40 (acceptable levels for classrooms). Except Intas high school, in all schools, indoor noise levels are clearly higher than acceptable levels. In Intas high school, indoor noise level can be acceptable according to NCB40, but according to NCB30, the noise levels at high frequencies are higher than acceptable levels.

Examination of the answers given to questionnaires (Figure 1), shows clearly that users of the classrooms are disturbed by the noise. As the measured levels are clearly higher than the limits, it can be said that results of the surveys are in accordance with measurements.

On the other hand the measured levels at outdoor and indoor, reveals that the noise problem occurs at both sides; outdoor noise levels are too high and building constructions are insufficient to fulfill the

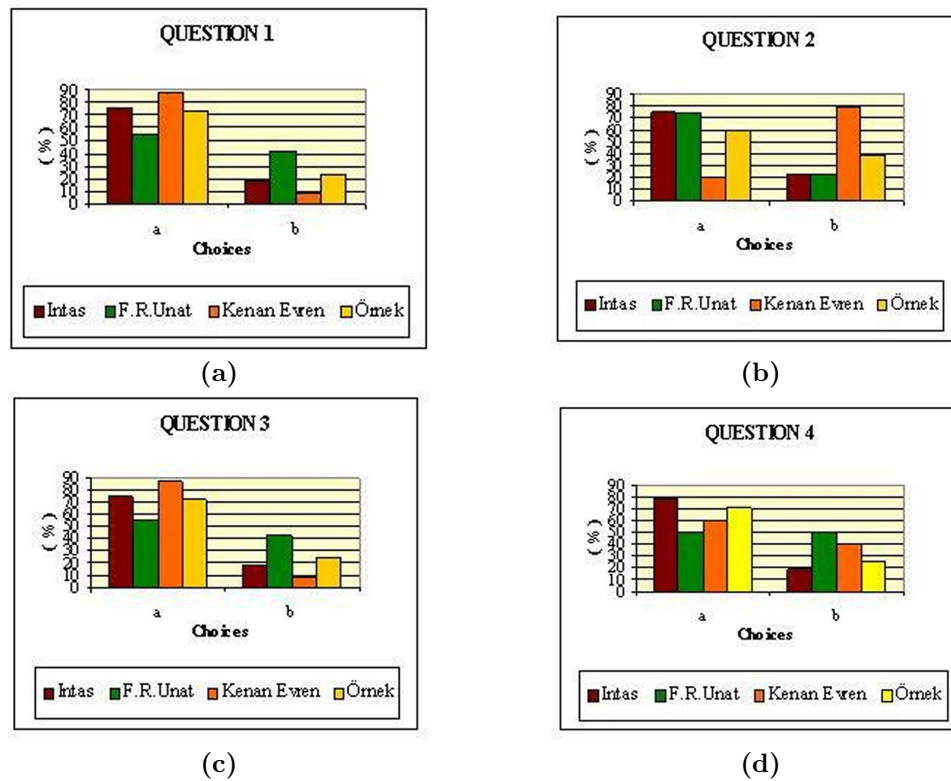


Figure 1: Illustration of the answers given to selected questions of the questionnaire.

required conditions. It is also interesting that exceeded amounts are greater at indoors; this fact shows clearly the insufficiency of the sound insulation of the buildings.

6 - RESULTS

The research has shown that the acoustical environment of the examined schools are clearly below the required conditions; outdoor noise levels are high, sound insulation of the buildings are insufficient and reverberation times of the classrooms are too long showing great differences upon octave frequencies. Combination of these adverse factors causes annoyance among the users, constituting barriers on learning as well as reducing the affectivity of the education. One of the main reasons of this situation is utilization of similar project types that does not allow the constitution of specific precautions taking into account the environmental conditions.

A developing countries, noise is far away to be one of the persistent design and implementation criteria. However, as the development of the communities is highly dependent on to the education, the importance of noise control in educational buildings is of primary importance. Therefore, every opportunity and possibility should be used in order to stimulate the decision makers to evaluate the acoustical environment of the learning spaces.

REFERENCES

1. **Z. Karabiber and al.**, Egitim yapılarında gurultu sorunları ve etkileri, In *1. Ulusal Gurultu Kongresü*, pp. 59-68, 1994
2. **Anon.**, Noise control regulasyon of Turkey (in Turkish), *Official journal*, Vol. 19308, pp. 23, 1986
3. **Z. Maekawa and al.**, *Environmental and architectural acoustics*, pp. 47, 1994
4. **D.H. Schwela**, Announcement of new world health organization guidelines on community noise, In *Internoise 99*, pp. 1159-1164, 1999

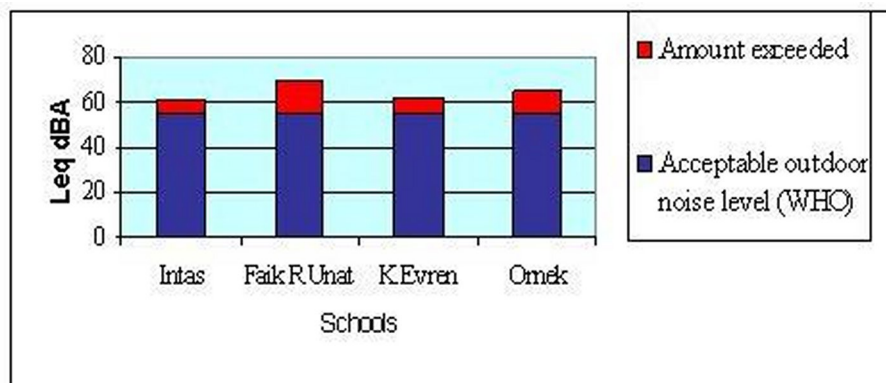


Figure 2: Evaluation of outdoor noise.

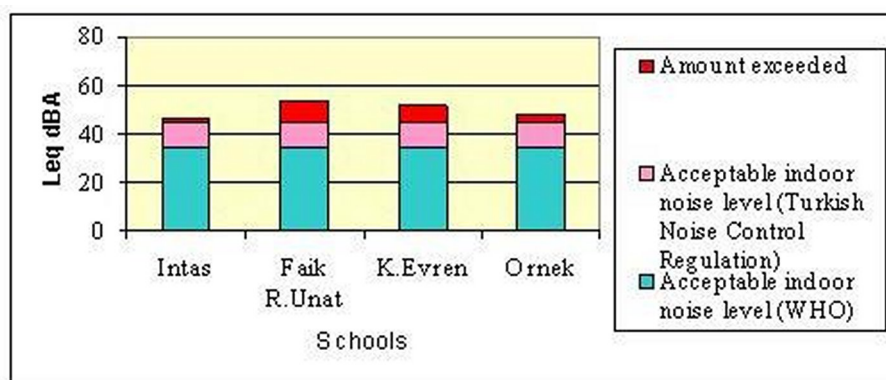


Figure 3: Evaluation of indoor noise.

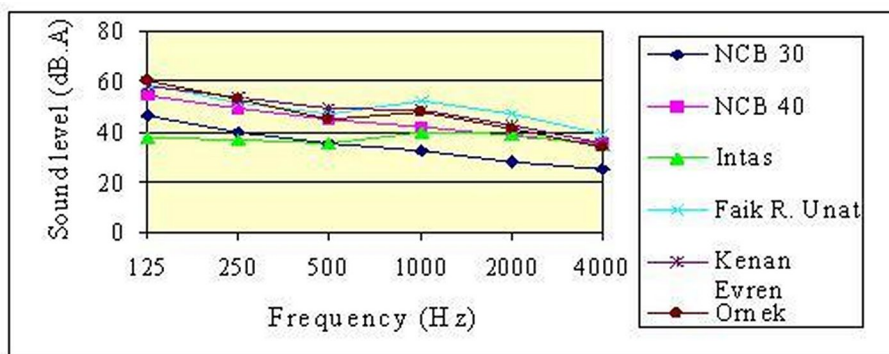


Figure 4: Evaluation of frequency analysis.