Analysis of Noise Pollution Impacting Educational Institutes near Busy Traffic Nodes in Chittagong City

Md Mustiafiz Al Mamun [1], Arpan Shil [2], Amit paul [3] & Pranjib paul [4]

[1]*Department' of Architecture, Chittagong University of Engineering & Technology (CUET), Chittagong-4349, Bangladesh,* E-*Mail: mustiafiz@gmail.com*

[2] *Chittagong University of Engineering & Technology (CUET), Chittagong-4349, Bangladesh.*
E-Mail: arpan.shil@gmail.com

[3] *Chittagong University of Engineering & Technology (CUET), Chittagong-4349, Bangladesh.*
E-Mail: amit003paul@gmail.com

[4] *Chittagong University of Engineering & Technology (CUET), Chittagong-4349, Bangladesh.*
E-Mail: yahoo777y@gmail.com

Abstract: *Education is the key prerequisite for any sustainable development. As better educational environment allows every student to acquire knowledge, talents, attitudes and values necessary to shape a sustainable prospect. The necessity of better educational environment for teaching-learning needs a suitable location and surrounding environment. Unfortunately, nearly all the educational institutes are located adjacent to the busy places such as main streets, public areas, nodal points, where several levels of noise pollution are occurred by horn of vehicles and various sound systems. From previous established researches, it is found that students exposed to elevated noise level are suffering from decreased attention, social adaptability and increased opposite behaviour relation to other people and especially disturbs teaching-learning process, reduces capacity of work efficiency and causes health hazard gradually. Ideally, the sound level should be about 35 dBA (BNBC 2006) in an educational institution, particularly in classrooms. As number of traffic volume is increasing day by day, the problem of traffic noise is also becoming unbearable. This study were carried out at three educational institutions of Chittagong city situated at similar busy urban nodes .To evaluate the deviation from standard noise levels, measurements were taken at schools from 9.00 AM to 12.00 PM using a Noise Dose Meter (TES-1355) in several points and different interval of time and different distance from roadside. This paper has also conducted a comparative analysis by questionnaire survey among students and teachers to establish in-depth qualitative analysis. The study found that the intensity of noise level was higher in horizontal and diagonal directions than vertical distance from the noise sources. Literatures were reviewed for reliability and as a guideline of land use planning to illustrate how to reduce noise level by resilience parameter for the existing urban context.*

Keywords*: Busy Traffic Street, Educational Institute, Noise Dose Meter, Noise Pollution, Urban Street Node.*

1. INTRODUCTION

Noise is unwanted sound and it has undesirable physiological or psychological effect on people (Guidelines for community noise by WHO, 1999). It is generally accepted that the learning and performance of school children is depreciated by noise and the older children in this age group are more affected than the younger children (Guidelines for community noise by WHO, 1999), (Institute for Environment and Health, 1997). Previous established research found that students suffer from several complexity like decreased attention, social adaptability and increased opposite behaviour relation to the other people because of exposition to elevated noise level (Ismail *et al.*, 2015) and it also disturbs teaching-learning process, reduces capacity of work efficiency and causes health hazard gradually

(Shield *et al.*, 2002), (Shield & Dockrell, 2002), (Alam *et al.*, 2006), which can be observed in many urbanized city. Being victimized by the rising degree of air and water pollution, the inhabitants of Chittagong city are also being exposed to high level of noise pollution (The Daily Star, 2013). Due to fast urbanization in the city of Chittagong, educational institutes are forced to be located adjacent to the busy places in urban areas, such as main streets, public areas and nodal points. The noise from road vehicles is mainly generated from the engine, from frictional contact between the vehicle and the ground and from the horn of vehicles (Pall & Bhattacharya, 2015). However, those noise pollution adversely affects educational environment (Hodgson *et al.*, 1999), (Debnath *et al.*, 2012), (Maxwell & Evans, 2000) .In this study, the primary aim was to find and modulate existing information about noise status and assessment of impacts on teaching learning process during the school hours.

2. CLASSROOM NOISE LEVELS AND IMPACT

The external noise level in school yards should not exceed LAeq 55 dB (Ismail *et al.*, 2015), (The American National Standards Institute, 2002), (Krishna *et al.*, 2007), (Moodley, 1989). Shield and Dockrell (2002) found that the ambient noise level in an occupied primary school classroom was closely related to the pupil activity. The measured activity levels ranged from 56 dBA (silent activity) to 77 dBA LAeq when the pupils were engaged in noisier activities involving group work and movement around the classroom. BNBC (Acoustic, Sound Insulation and Noise Control, 2006) guides an occupied classroom noise levels should not be greater than LAeq 35 dB (Shield & Dockrell, 2003). Additionally, ASHA suggests that the speech-to-noise ratio (SNR) at the child's ears should be at least +15 dB. Several recent studies have investigated the effects of noise on student's reading, numeracy and overall academic performance (Shield *et al*., 2002). Hetu *et al.* (1990) found a significant drop in student's performance, particularly in learning to read, when the background noise level interfered with speech.

3. STUDY AREA

To measure noise level at educational institute, this study was surveyed three different High Girls School in two different areas placed adjacent to node point of busy road in the city of Chittagong, where two schools (School-X and School-Y) are situated in the same boundary (Fig. 1, Fig. 2& Fig.4).Observation nodal point as (N_A) Amtola Bus Stand, (N_B) KC-Dey Road and Nandankanon Road intersection, and (N_C) Jubili Road and Nandonkanon Road intersection. Besides, another one (School-Z) is in a different location (Fig. 3& Fig. 5), where nodal point as (N_D) Kaptai Raster Matha, Chittagong-Kaptai Road, where N is mark as node point.

Fig.1. KrishnoKumari City Corporation Girls' High School, Newmarket, Chittagong.

Fig.2.AparnaCharan City Corporation Girls' High School and College, Newmarket, Chittagong.

Fig.3. City Corporation Girls' School and College,Kaptai Raster Matha, Chittagong.

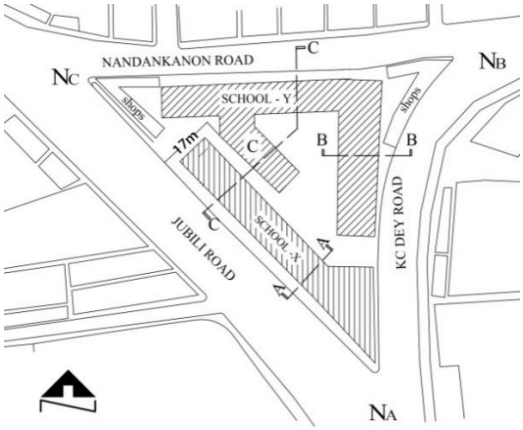

Fig. 4.Study Area 1 (School X & Y), located at the intersection of three roads: Jubili Road, Nandankanon Road and KC-Dey Road.

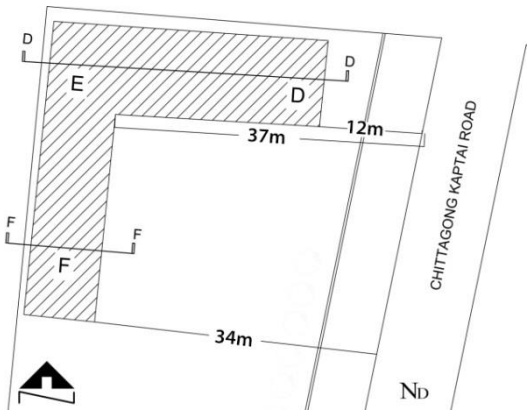

Fig. 5. Study Area 2 (School Z), adjacent to Chittagong Kaptai Road.

4. MATERIALS AND METHODOLOGY

4.1. Survey Process and Technique

For measuring noise level, in this study was conducted mixed method approach for data collection and analysis. The questionnaire survey was done to find out in-depth information on the classroom's teaching-learning environment for qualitative data. For quantitative data, Noise Dose Meter (TES-1355) was used to measure the noise level. Classified recording of hourly volume and composition of the traffic were made. Vehicles in each site were categorized into three node point for Study Area 01 and one node point for Study Area 02. The study was also concerned surrounding vehicular pattern for instance, light vehicles (two-wheelers, auto rickshaw), medium vehicles (car, van, jeep & mini bus).Table1 shows categories of vehicles.

Table 1: Description of Vehicle Categories Prevalent in the Study Area

Vehicle category	Description
2-wheelers	Motorcycles/Scooters/Mopeds on two wheels without side cars;
Light motor vehicles	Motor vehicles on three or more wheels and not in the other vehicle categories, namely, Cars, Vans, Jeeps;
Medium weighted vehicles	Buses including Mini and unarticulated vehicles equipped with one rear axle with four tires;

Source: Field Survey, 2017

4.2. Data Collection and Analysis

As a part of quantitative survey, the noise levels were recorded at twelve points in two schools which are at distances depending on location of the building from the road. Observations are taken during the school hour from 9am-4pm. In every interval it has been considered the average of 5 frequent readings at an interval of 15s. A total of one hundred teachers and students from these two selected schools randomly were questioned by using questionnaire forms. The questions were about different problems they have been facing during the teaching-learning process in the schools, for instance, (1) teaching-learning process, (2) difficulties for discussion and (3) health condition. Recording of data were made by tally markings for each hour to sample the diurnal deviation of existing traffic condition. All measurements were carried out during peak hours (9am-12pm) of working days and under sunny climatic conditions.

4.3. Limitations

This study did not consider fourth floor of School-Z, to maintain comparability among all school structures. Moreover, when noise were being measured, it was not possible to consider accurate traffic volume in every interval due to different locations and various vehicular movement, parking facilities of vehicles. Besides, the density of public access also vary where one site was situated at the city centre and another

located at periphery of the city growth point with high traffic flow for long route.

5. RESULTS AND DISCUSSIONS

Table 2, Table 3 and Table 4 show the situations and the noise levels of the different school areas. Table 2 shows the data of noise level and Fig. 6 depicts Section AA for floor levels with respective points A1, A2 and A3 in School–X. The highest average noise level is observed in 1st floor as 75.6dBA andthe lowest at ground floor. Noise level of 72.8dBA at 2nd floor is comparatively lower than the 1st floor noise level.

Table 2: Measured maximum, minimum and average readings in the Study Area 01 (School-X).

Study area 01	**Observations Sound pressure level in dBA**		
	Min.	Max.	Avg.
A1	63.7	84.1	72.8
A2	69.5	87.1	75.6
A3	64.6	88.9	74.3

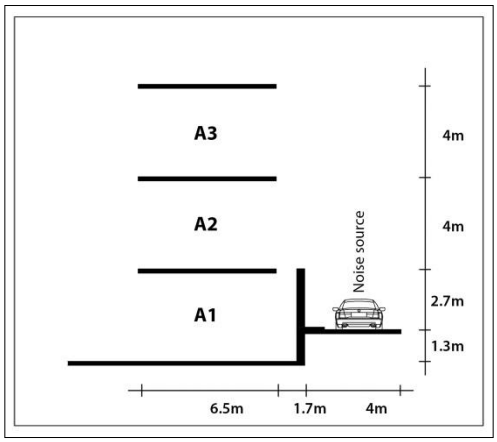

Fig. 6. Section AA

Table 3 tabulates the data of noise levels and Fig. 7 shows Section BB for different floor levels with respective points B1, B2 and B3. As the school is situated adjacent to the road, highest average noise level is observed in 1st floor as about 74.1dBAand then in started decreasing. Relatively lower noise level is found in ground floor level as 72.3dBA. Noise levels at Block B of School–Y follows similar pattern of School-X. The study found that the cause of lower noise levels at ground floors of both blocks were due to the surrounding 2.5 m to 3.0 m high walls and s small shops, which are acting as 'noise barrier'.

Table 3: Measured maximum, minimum and average readings in the Study Area 01 (School-Y).

Study area 01	**Observations Sound pressure level in dBA**		
	Min.	**Max.**	**Avg.**
B1	65.3	84.5	72.3
B2	67.5	85.2	74.1
B3	68.3	86	73.2
C	61.4	74.7	65.2

The block C (Fig. 8) of School-Y, which is situated at the central position of the school and surrounded by other school blocks, is least affected and shows the lowest average noise level of 65.2dBA.

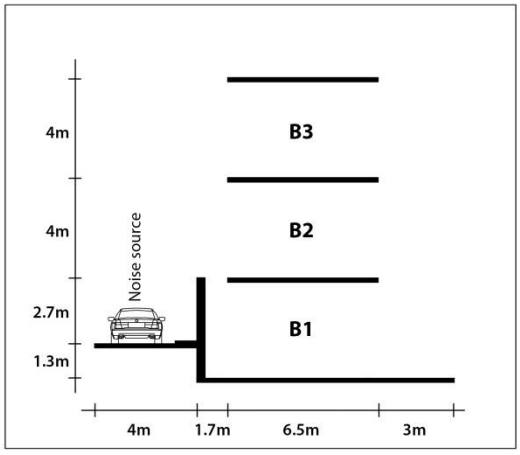

Fig. 7. Section BB

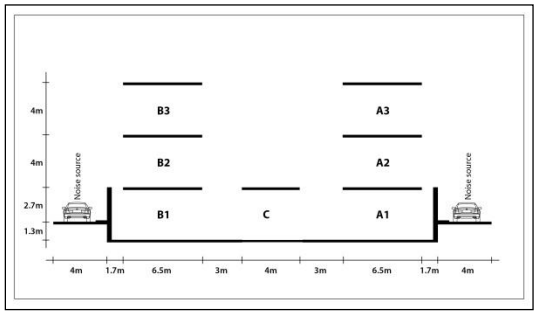

Fig. 8. Section CC

The study site 02 (School-Z) is another girls high school in a separate location, which is an L shaped four-storied building. From Fig. 5, Fig. 9 and Table 4, we may find noise level pattern

similar to those of school-X, while both schools are located adjacent to roads. In School-Z, 1st floor average noise level (76 dBA) is higher than those of ground floor (72.9 dBA) and 2nd floor (75.2 dBA). On the other hand, point E (Fig. 9) and F (Fig. 10) are located at far distances from noise sources and show different results of average noise levels compared to those in preceding discussions.

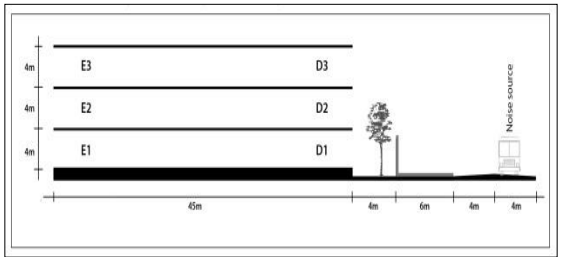

Fig.9. Section D-D

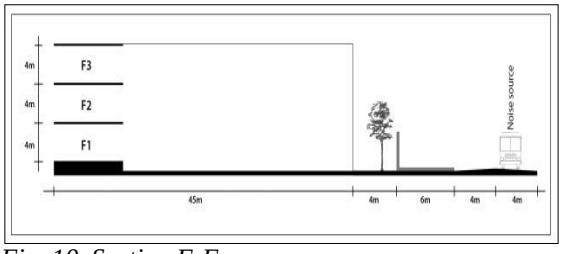

Fig. 10. Section F-F

In Table 4, it is remarkable that noise levels gradually increase from ground floor to upper floors. At Site-2, the minimum noise affected point is E.

Table 4: Measured Maximum,Minimum and Average readings in the Study Area 02 (School-Z).

Study area 02	**Observations (sound pressure level in dBA**		
	Min.	Max.	Avg.
D1	64.3	80	72.9
D2	64.9	81.2	76
D3	64.5	81.7	75.2
E1	62.2	75.8	68.0
E2	63.1	76.6	69.85
E3	63.5	77.7	70.5
F1	65	81	72.1
F2	66.8	82.9	74
F3	65.2	83.7	74.97

Fig. 11 shows a comparative analysis among noise levels in different floors of three different schools respectively. It is apparent that these three schools experience less noise level at the ground floor whereas School-X and School-Y are recessed from the road level and also surrounded by high boundary walls, trees and roadside shops .In these blocks noise is at highest level at the first floor but that gradually reduces with the increasing vertical height from road side.

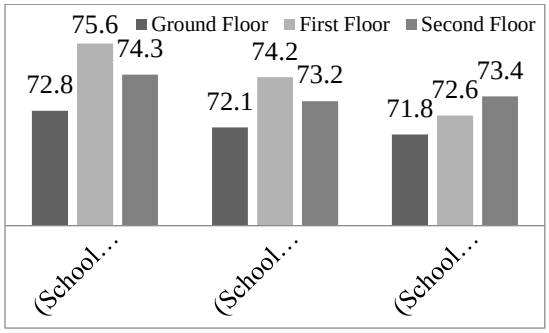

Fig. 11. Comparison of noise level in different floors of threedifferent schools respectively.

In case of C.D.A. Girls High School, the building blocks are placed at a distance from the road and also the school is surrounded by boundary walls are. These reduce the noise level at ground floor and gradually it increases the in upper floors. The low-height boundary wall as well as the low dense trees, which are used as buffer, cannot minimize the noise level. Minimum noise level is observed at the building block C of School Y, which is surrounded by other school buildings in all sides. Among those three schools, maximum sound level is observed in School-X, which is sited at a close proximity with Amtola Bus Stand (N_A) and the distance between road and school building is less than 3 m. As a result, the school is experiencing a high degree of noise pollution. In all cases, the calculated average noise level is above the permissible limit. During day time, the permissible level of noise is 50dBA for 'Quiet Zone', which includes schools (Pall & Bhattacharya, 2015).

After analysing the questionnaires survey, it is found that 60% of respondents agree with noise pollution affected in teaching-learning process in classrooms, 25% stated health problem and 15% pointed out the difficulties of discussion in

classrooms. The results on these questions are summarized and are shown in Fig. 12, based on the percentage of effect created by road side noise sources.

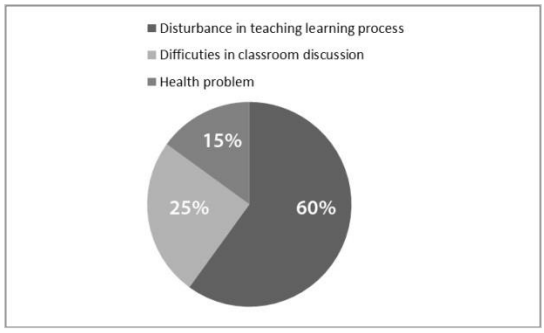

Fig.12. Adverse Effect in percentange of Roadside Noise Sources.

6. CONCLUSION AND FUTURE WORK

From the study, it is observed that noise can only be reduced either by any obstacle such as a 'noise barrier' or by increasing the distance from noise source. Schools in this study are surrounded by boundary walls, roadside shops and trees, which perform as obstacles against noise. Besides, the effect of noise is comparatively lower at upper floors as intensity of noise is reduced inverse squarely with the increase of distance from noise sources (Alam *et al.*, 2006). Chittagong city is rapidly becoming urbanized and over populated area, where educational institutions are being constructed rapidly in an unplanned way, without considering its suitable location and educational environment. Considering current development in Chittagong city, this study recommends that if educational institutes are built beside the busy roads, a wide buffer zone should be considered. The buffer space may have functional noise barriers by placing multi-storeyed commercial buildings, high boundary walls or trees with dense foliage. These may reasonably reduce noise in school premises and as well as in classrooms.

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