Journal of Civil & Environmental Engineering

Al-Mutairi, J Civil Environment Engg 2012, 2:1
DOI: 10.4172/2165-784X.1000105

Research Article Open Access

Assessment of Traffic Noise Pollution Impact of Residential/Commercial Development

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Abstract

This paper the findings of an environmental impact study aimed at determining traffic-generated noise pollution impact of new Township Redevelopment Project in Ahmadi, Kuwait. The specific objectives of the study were no measure traffic flow variables; Traffic-generated noise; examine and compare noise pollution compliance with the EPA standards; and recommend mitigation measures. Eight representative roadway locations were systematic – randomly selected for monitoring traffic flow and noise levels. At each monitoring site, the study variables were monitored during six daily peak periods. In addition, data were also collected on atmospheric conditions – temperature, wind velocity and direction and humidity for each monitoring day.

Keywords: Environmental impact study; Noise pollution; Mitigation measures

Introduction

This paper presents the findings of an environmental impact study aimed at determining traffic-generated noise pollution impact of the New Township Redevelopment Project in Ahmadi, Kuwait.

Noise is undesirable/unwanted sound, extended exposure to which has been shown to produce physical and psychological damage. Because of its annoyance and disturbance implications, noise adds to mental stress and thus affects the general well-being of exposed urban population [1-4]. In non-industrial nations, in general, and in the oil-rich nations of the Persian Gulf, in particular, rapid growth in income, car ownership and inexpensive fuel have combined to result in a large number of daily trips and thus exacerbate the problem of traffic noise pollution in expanding urban areas of the region [5].

The study area

The study area is located in Ahmadi, an oil township located some 50 Km to the south of the capital – metropolitan Kuwait. The main aim of the Ahmadi Township Redevelopment is to carry out a total re-construction of all Kuwait Oil Company (KOC) housing and to provide with all amenities necessary for a modern residential development. The redeveloped township will include 3500 houses and the supporting retail and recreational facilities. The area of the redevelopment project is nearly 2.7 million square meters, with an additional 2.18 million square meters for future expansion.

Materials and Methods

A reconnaissance survey was undertaken to select representative roadway sites for monitoring traffic flow and noise levels. A total of eight representative roadway locations were selected to monitor flow and noise. These roadway locations were selected to represent roadways of different type (functional classification), serving different commercial industrial and residential land-uses. Traffic flow variables (volume and mix) and noise levels were measured simultaneously at each selected roadway site during the morning and the afternoon peak periods, repeated three times each.

In addition, to traffic flow, noise and air pollution, data was also collected on atmospheric conditions during the measurement periods. These included temperature, wind velocity, and humidity. These data were utilized to examine relationships with traffic noise as well as their potential employment in the noise model.

Result and Discussion

Traffic flow measurement

A summary of the traffic flow measurements is presented in Table 1, which indicate that traffic flow at a given roadway location did not vary significantly over the measurement time period, and it was heavier during the afternoon peak hour at all roadway locations. Also noticeable is the volume of heavy trucks and buses at roadway location 4 and 5, and to some extent at location 1. With the consideration of the number of lanes per direction (2), and the percentage of heavy trucks, roadway location 5, 4, and 1 are presently operating at level of service between C and D. Future increase in traffic volume on these roadways may result in heavy congestions during the daily peak hours.

Traffic noise measurement

Traffic noise was measured (simultaneously with traffic flow) at the selected roadway locations during the peak hours of the day, repeated 3 times. Measurements were taken at approximately one-meter distance from the pavement edge. For each measurement period, the equivalent noise level (L_{eq}), and the standard deviation of noise levels were computed, as presented in Table 2.

As the noise levels in Table 2 show, the problem of traffic-generated noise pollution is present at nearly all roadway monitoring sites and during both morning and afternoon peak hours of the day. Noise levels are higher in the afternoons due to heavier traffic volumes during these periods. With the exception of roadway location no. 7, traffic noise is way above the maximum permitted outdoor standard level of 75 (dBA). At roadway location no. 5, 4, and 1, the level of noise pollution is in the upper 80 dBAs, causing annoyance, fatigue and disturbance. Certainly, the increase in noise levels due to increases in traffic volume

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Received November 01, 2011; **Accepted** January 07, 2012; **Published** January 09, 2012

Citation: Al-Mutairi N (2012) Assessment of Traffic Noise Pollution Impact of Residential/Commercial Development. J Civil Environment Engg 2:105. doi:10.4172/2165-784X.1000105

Roadway	Morning Peak (veh/hr/dir)					Afternoon Peak (veh/hr/dir)			
Location	Small	Medium	Heavy	Total		Small	Medium	Heavy	Total
No. 1	1108 1682 1259	904 970 1086	38 16 33	2050 2668 2378		2089 2278 1881	1660 1905 2018	79 72 81	3828 4255 3980
No. 2	436 382 409	300 266 271	14 21 12	750 669 692		269 261 239	216 164 198	12 23 12	497 448 449
No. 3	373 330 405	235 285 262	11 9 8	619 624 675		223 289 405	304 285 262	13 11 12	540 585 679
No. 4	372 403 399	266 204 275	62 55 64	700 662 738		223 281 275	209 272 240	58 44 46	550 697 561
No. 5	956 1035 1026	842 647 872	83 54 86	1881 1736 1984		1481 2178 2002	1245 1287 939	88 54 66	2814 3519 3007
No. 6	312 242 322	138 119 154	7 5 4	457 366 480		Dust storm/traffic detour			
No. 7	168 131 201	96 134 67	2 3 1	266 268 269		125 84 74	104 141 58	3 1 3	232 226 135
No. 8	402 392 472	270 261 349	3 1 4	675 654 825		268 143 278	265 209 258	2 3 5	535 355 541

Table 1: Traffic Volume by Mix, Time and Roadway Location.

Roadway	Morning Peak Hour			Afternoon Peak Hour	
Location	Small	Medium		Medium	Heavy
No. 1	86.4 83.7 86.4	2.4 4.1 2.4		86.9 86.1 85.3	3.4 3.7 5.1
No. 2	83.1 81.4 81.5	5.3 5.5 4.1		83.4 84.5 85.4	6.2 4.2 4.3
No. 3	83.6 81.4 81.3	4.3 4.9 2.5		83.4 84.5 84.9	6.2 4.2 4.3
No. 4	84.9 83.6 84.6	6.3 6.4 4.1		85.2 87.1 86.4	6.3 4.1 4.6
No. 5	86.8 86.9 86.4	4.3 4.3 5.4		86.1 87.1 88.0	4.8 4.9 3.9
No. 6	77.4 74.8 77.7	3.7 6.1 4.2		Detour/Dust storm	
No. 7	71.6 72.3 73.2	4.9 4.8 5.6		76.5 74.6 74.7	5.1 3.8 5.0
No. 8	78.6 80.3 79.2	4.4 5.3 5.8		81.6 83.0 81.1	5.2 5.7 5.7

Table 2: Traffic-Generated Noise levels by Time and Monitoring Location.

in the future will present a major problem to the community, both at work and at home.

Correlation analysis

A person correlation analysis was performed on the data to determine the degree of association between traffic-generated noise and causal variables. The resulting correlation coefficients conformed to expectations. The equivalent noise level, L_{eq} was positively and significantly (at the 95% significance level) correlated with the volume of small vehicles ($\gamma_{xy} = 0.562$), medium-size vehicles ($\gamma_{xy} = 0.555$), heavy vehicles ($\gamma_{xy} = 0.702$), and obviously, with the total volume of traffic ($\gamma_{xy} = 0.575$). The L_{eq} was also positively and significantly associated with temperature ($\gamma_{xy} = 0.256$). Wind velocity and humidity did not demonstrate a significant correlation with the L_{eq}.

The trend relationship between the L_{eq} and the volume of heavy vehicles as well as with temperature are presented in Figure 1 and 2. The data show that as the volume of traffic increased from less than 10 trucks/buses per hour, to more than 50 trucks/buses per hour Figure 1, the equivalent noise level increased from 77.6 (dBA) to 85.5 (dBA) – an increase of nearly 8 (dBA). The effect of temperature on noise level was obviously less pronounced as the data in Figure 2 indicate.

Conclusion

Heavy and continuous reliance on auto as the favored mode of

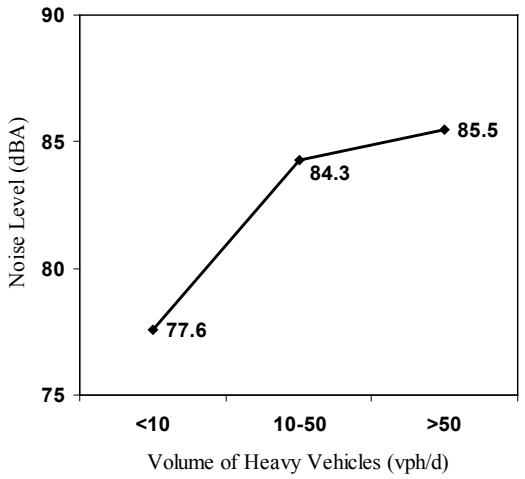

Figure 1: Volume of heavy vehicles and noise pollution level.

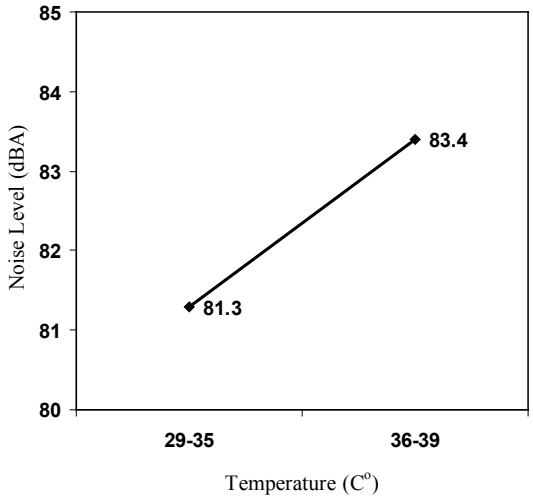

Figure 2: Temperature and noise pollution level.

urban travel has resulted in daily congestion, noisy urban environment and has deteriorated the quality of urban life in Kuwait. The findings of the study have shown that traffic volumes on the roadways of Ahmadi are heavy and include a significant percentage of large trucks which transport materials for the booming construction industry in Kuwait. Consequently, the level of noise pollution from traffic even at the present time, exceed the outdoor standard limit by a significant margin. Additional growth in normal traffic plus that resulting from the redevelopment project will certainly create a disturbing noise environment in Ahmadi.

Traffic-generated noise at roadway locations number 1, 3, 4 and 5 is excessively high. It is recommended that no residential, hospital, school developments should take place on vacant lands adjacent to these roadways. Instead, a green band of trees/plants should be established on both sides of these roadways. This, would, at least psychologically, reduce the annoying impact of high noise level on the commercial land uses alongside these roads.

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