Journal of Traffic and Logistics Engineering, Vol, 1, No. 1 June 2013

Evaluation and Mitigation of Road Traffic Noise in Amman, Jordan

K. Jadaan
University of Jordan/ Civil Engineering Department, Amman, Jordan
Kjaddan @gmail.com

A. Al-Dakhlallah (Tomah)
Applied Science University Architecture Department, Amman, Jordan
aymantomah@hotmail.com

J. Goussous and H. Gammoh
University of Jordan/ Architecture Department, Amman, Jordan
jawdatgoussous@hotmail.com, Gammohhala@yahoo.com

***Abstract*—This study provides an evaluation of road traffic noise pollution in Amman, the capital of Jordan through measuring and predicting the statistical noise index L10 (18 hr) at selected sites using the British CRTN method after validation. The measured and future noise levels were found high and exceed the maximum allowable limit of 63 dB(A) at all survey sites calling for the need to apply mitigation measures. The effectiveness of noise barriers in reducing noise levels was investigated and 3-5 m noise barriers were found appropriate.**

***Index Terms*—CRTN, Jordan, mitigation measures, traffic noise.**

I. Introduction

Road traffic is the dominating source of noise [1] and more interfering than other types [2]. Social surveys cited road traffic noise (RTN) as the major source of nuisance and annoyance [3]-[5] and affects the physical and mental health of people.

Jordan with an area of 93000 sq. km. has a total population of about 6 million, 85% of which live in urban areas and over half live in the capital city, Amman which posses about 85% of the total large industrial development and 71% of small ones.

This study aims to quantify the current and future noise levels along urban arterials of Amman in order to provide a better understanding of the noise issue and its impact. It also identifies the need for, and the type of required noise mitigation measures.

II. Methodology

Measurements of traffic noise levels and affecting factors were collected at seven sites adjacent to selected arterial roads in Amman (Fig. 1).

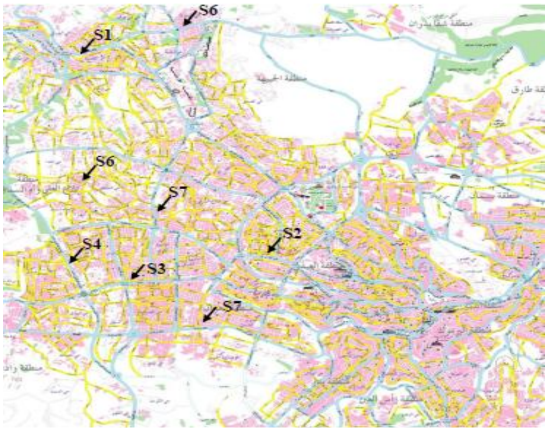

Figure 1. Location of the selected sites

The sites were chosen where the noise levels were believed to be significant and the view of the roads is substantially unobstructed. The sites shown in Fig. 1 are described as follows:

S1. Queen Rania Al-Abdullah St. in front of agriculture municipalities.

S2. Ibin-Sinna Street, (Wadi Saqra), approximately 150 meters away from tunnel toward city center.

S3. The Seventh Circle in front of the Modern Education School.

S4. King Abdullah Al Thani St. beside fastlink company.

S5. Al-Istiqlal Street, in front of Al Amanna building "Health Sector".

S6. Abu-Nsair Street, beside Flona Nursery.

S7. Al-Madina Al Munawarra St. Approximately 500 meters away from Suhayb mosque toward Kilo Bridge.

The collected data included the geometrical and surface features of the site, gradient, traffic volume, speed, and percent of heavy vehicles.

The measurements of traffic noise levels were recorded using a sound level meter type 407764. The instrument was calibrated before use and all readings were taken on

Manuscript received July 1, 2012; revised January 18, 2013.

doi: 10.12720/jtle.1.1.51-53

the "A- weighting" frequency network to simulate human ear response. Noise level measurements were made for 18 hours from 6 am to midnight, with a microphone mounted on a tripod 1.5m above the road surface. A (TRAX-11) instrument was used to measure the number of vehicles (traffic flow) while the number of heavy vehicles was counted manually. Road traffic speed data was collected using a laser speed radar meter. The measurements of all traffic data were concurrent with measurements of traffic noise at each site. The British Calculation of Road Traffic Noise (CRTN) method [6] was used to predict RTN levels at the studied sites.

III. Results and Discussion

The measured traffic noise levels at all sites given in Table I show little variation ranging from 72.7 to 78.5 dB (A).

The CRTN method was used to predict noise levels at the sites where noise levels were measured. The method was evaluated by comparing the measured and predicted levels. The prediction difference, which is the predicted minus the measured values was calculated and the results are shown in Table I.

However, in order to be reliable, the performance of the CRTN method under traffic conditions of Amman was evaluated by statistically examining the accuracy of the method in predicting measured noise levels over the complete range of situations covered by the method. Using this set of measured and predicted data, the accuracy of the prediction method can be defined by the mean of the prediction difference which found to be 2. 2 dB(A) and its standard deviation of 0.96 indicating that CRTN can be used satisfactorily to predict traffic noise levels in Amman.

TABLE I. Measured and Predicted Noise Levels L10 (18 HR)

Site Number	Current measured levels (X)	Current predicted levels (Y)	Prediction differences (Y- X)
S1	76.6	79.2	+2.6
S2	78.5	79.9	+1.4
S3	72.7	75.7	+3.0
S4	77.8	81.2	+3.4
S5	75.8	77.0	+1.2
S6	74.6	78.2	+3.6
S7	75.1	78.3	+3.2

The CRTN method was also applied to estimate future traffic noise levels in 2020 at the same studied sites and the results are shown in Table II which demonstrates that all noise levels will also exceed the maximum acceptable limit of 63 dB (A) adopted in Jordan calling for the need to apply necessary noise mitigation measures.

TABLE II. Future Predicted Noise Level

Site	Future predicted Levels
S1	81.8
S2	80.0
S3	78.3
S4	83.7
S5	79.5
S6	80.7
S7	80.0

Several mitigation measures are available for the control of traffic noise and noise barriers were found to be highly effective and can reduce noise level by an amount ranging between 5 and 20 dB(A) [7]. In addition barriers suit Amman's road network conditions where the right of way along many busy streets is limited.

Various factors need to be considered to produce an acoustically effective barriers i.e. a barrier that provides the required noise reduction without being "over-designed". The noise reduction goal is the first and an important element of the barrier design process which influence the acoustical considerations such as height, length, location and the material of the barrier.

Using 3-m height noise barriers produced the results in Table III which show that barriers are able to reduce the noise level by about 15-20%.

TABLE III. Current and Future Noise Levels with 3-m High Barriers

Site	Current levels	Future levels
S1	62.4	65.0
S2	63.0	63.8
S3	61.1	63.5
S4	65.0	67.5
S5	60.9	62.7
S6	61.1	63.9
S7	61.5	64.0

The following regression model was developed to relate actual noise levels to the predicted levels:

Predicted noise level = 17.77 + 0.801 (actual noise level).

The actual and future noise levels in presence of noise barriers were calculated based on the above relationship and the results are shown in Table III. It can be seen that the use of 3-m barriers can reduce the current noise levels below the permissible limit. However, higher barriers (5m) or additional attenuation measures, such as vegetation for example, are required to achieve the same results in the future.

IV. Conclusion

The results of the study show that the CRTN noise prediction method can be applied satisfactorily under Amman's traffic conditions with a mean prediction difference of only 2.2 dB(A). Current and predicted future noise levels were found to exceed the maximum allowable limit. Noise barriers 3m high were found adequate for the current but not for future conditions when more effective barriers (5m high for example) will be required. However, a more comprehensive study into the present and future magnitudes of the problem, potential mitigation measures and their cost estimates is necessary for appropriate decision-making.

References

[1] A. Skanberg and E. Ohrstrom, "Adverse health effect in relation to urban residential sound-scapes," *Journal of Sound and Vibration*, vol. 250, pp. 151-155, 2002.

[2] P. H. Zennin, F. Diniz, A. Calixto, and W. Barbosa, "Environmental noise pollution in residential areas of the city of Curitiba," *Acoustica*, vol. 87, pp. 1-4, 2001.

[3] G. H. Panadya, Assessment of traffic noise and its impact on the community, *International Journal of environmental studies*, vol. 60, pp. 595-602, 2003.

[4] A. Al-Dakhlallah and K. S. Jadaan, "Attitudes of Jordanian population towards road traffic noise," *Int. J. of Appl. Sci Eng.*, vol.3, pp.145-150, 2005.

[5] Q. Banihani and K. S. Jadaan, "Assessment of road traffic noise pollution at selected sites in Amman, Jordan: magnitude, control, and impact on the community," *Jordan Journal of Civil Engineering*, vol. 6, pp. 267-278, 2012.

[6] Her Majesty Stationary Office, *Calculation of Road Traffic Noise*, London, 1988.

[7] K. S. Jadaan and D. R. Marsh, "Noise impact of urban freeway section: A case study in Wellington, New Zealand," in *Proc. Second Int. Conf. on Environ. Pollution*, Barcelona, Spain, 1993.

Khair Jadaan. Prof. Jadaan born in 1948 earned his Ph.D. degree in traffic engineering and planning in 1975 from the University of Bradford, U.K.

Khair working experience covers a variety of positions in both private and public sectors in various developed and developing countries including New Zealand, Germany, U. K., U. S. A., Kuwait, Iraq and Jordan. He is currently a PROFESSOR of transportation engineering at the University of Jordan. He published over 100 papers in international journals and conferences.

Prof. Jadaan is a Fellow of IHTE (U.K), member of IPENZ(New Zealand), member of ASCE (USA) and Jordan Engineers Association and been awarded a number of honoraries.

Ayman Al-Dakhlalla (Tomah). Dr. Al-Dakhlallah (Tomah) is an associate professor, born in 1966, earned his Ph.D. from Belarusian Polytechnic Academy, Belarus, Minsk, in 1995 in Urban Planning and a Diploma of architecture from the same university in 1990.

Ayman working experience covers a variety of positions in several private universities; He is currently an associate professor at Applied Science University, Amman, Jordan. He published several papers in international journals and conferences. Besides, he established architectural departments in several private universities. He is a Fellow of Jordanian Engineers Association (JEA) and Jordanian Architectural Association.

Jawdat Goussous. Dr. Goussous is an Assistant Professor of Architecture at the University of Jordan. He earned his Ph.D. in 1991 from Kiev engineering institute, and diploma of architecture in 1987 from Kharkov engineering institute, USSR. During his graduate study he obtained for teaching several undergraduate courses. He has extensive academic, consultancy and administrative experience serving as the Head of Architecture Department, University of Jordan for several years and participating in several specialized committees for Greater Amman Municipality (GAM) and Ministry of Public Works and Housing among others. He published a number of papers in his research areas of interest which include heritage tourism, cultural resources management, cultural anthropology, and ethnology

Hala Gammoh. Miss Gammoh born in 1992 is an undergraduate student at the civil engineering department, University of Jordan. She is a MEMBER of the junior research team of the department. Her research interests include traffic safety and environmental impact of transport. Currently she is working on a research project into the social and economic impacts of road traffic noise in Jordan.