Journal of Asian Scientific Research
ISSN(e): 2223-1331/ISSN(p): 2226-5724

journal homepage: http://www.aessweb.com/journals/5003

EFFECTS OF VECHICLES VELOCITY IN TRAFFIC NOISE IN HIGHWAY

Ali Mansour Khaki [1] --- Amir Esmael Forouhid[2†] --- Hootan Chegini[3]

[1]*Professor of Civil Department, School of Civil Engineering, Iran University of Science & Technology, Narmak, Tehran, Iran*

[2]*Phd Student, Road & Transportation Engineering, School of Civil Engineering, Iran University of Science & Technology, Narmak, Tehran, Iran*

[3]*MS Student in Road and Transportation Engineering, Azad University of Tehran-South Unit, Tehran, Ahang, Iran*

ABSTRACT

This paper is case study of noise emission of one of the most crowded highways in Tehran city. At first, equivalent noise level model of this area will be presented. Then required data for this model which were gathered, and its final output will be shown. It is concluded that in rush hours, when vehicles are in low speed and street is congested, equivalent noise emission increase dramatically. Average noise level of this highway is calculated with velocity of vehicles and the distances 24 ft from the center line of the highway. Finally, presented model will be analyzed and compared to observed values.

Keywords: Model, Noise pollution, Volume, Case study, Velocity, Traffic noise.

Contribution/ Originality

This study uses new estimation methodology for calculating equivalent noise emission due to velocity of vehicles and the distances from the center line of the highway and presented a model between these parameters.

1. INTRODUCTION

Noise emission in environment or in another word noise pollution, become one of the most important issues in cities with high population. Noise pollution issue will be more important when health of its citizens reach in hazard zone. Deceases like hearing problems, neurological and psychiatric disorders, tiredness and impatience, insomnia and its side effects become more due to noise pollution in residential zones. With population growth in crowded cities and crossing

† Corresponding author
DOI: 10.18488/journal.2/2015.5.3/2.3.143.148
ISSN(e): 2223-1331/ISSN(p): 2226-5724

highways along residential areas, noise pollution level rises dramatically. Thus, authorities describe standard levels in different areas to prevent noise pollution side effects for citizens. Many researchers conducted studies to understand noise behavior and its relation to traffic characteristics and there are many mathematical models to calculate noise with traffic parameters like average velocity of vehicles and highway capacity.

Different models are presented for noise pollution calculation. Each of these models evaluated and are precise. Their differences are their parameters that they use for their calculations. There is one standard method that is used by United States and many countries use this method as their standard model. It is called FHWA and it is become popular among other standard models. Jao et al presented a model for non-straight roads. They modified FWA model and change some of its parameters to predict sound level in non-straight roads [1]. Some researchers, related pavement conditions to noise pollution and made a model to determine sound level of the area [2]. Also, role of porous asphalt in noise emission is considered [3]. Watts, et al. [4] conducted a comparison between sound barriers and porous asphalt effects in noise level of the area and applied a correction parameter to mathematical models of noise calculations [4].

To calculate noise pollution level of the area with use of physic and wave relations, complex equations are resulted. Therefore, possibility of error is higher and measuring of wave parameters (like wavelength) are more difficult. For better results, equations have been made to calculate noise pollution level with use of traffic parameters. These equations are easier to conduct and are shown better results. Different models are defined in each country. These differences are due to various factors that have unique effect in each region.

Some models can calculate equivalent noise level base on flow-speed diagram [5]. This diagram has many applications in noise emission models such as annual noise level calculation in urban areas [6]. Another model presented by Ramirez is based on random road traffic for calculating noise level [7]. There are some other models using genetic algorithm for calculating noise level [8]. Neural system models also has been applied to calculate noise level in some areas [9]. In conclusion, there are numerous models to calculate noise level base on various traffic parameters. Most studies show that these models are applicable with insignificance difference between the results if model assumptions are applied correctly [10].

1.1. Case-Study Information

The Azadegan Highway was selected for this study from the highways located in Tehran City. The reason was that this highway hosts the traffic of different types of vehicles (e.g. trailers and trucks) and thus it demonstrates a higher level of noise pollution. This highway is connected to the Tehran-Karaj intercity corridor from the northwest and thus it accommodates a high level of intercity traffic of vehicles. Moreover, noise pollution is an issue in the West of Tehran Azadi Square due to the presence of residential units and the necessity of ensuring the convenience of citizens.

Azadegan Highway is a highway in Tehran City. It stretches from the northwest to the southeast of this city. This highway starts from the Tehran-Karaj freeway in the northwest and ends to Serah Afsarieh (Basij) in the southeast. Following its intersection with Tehran-Karaj freeway this highway meets the following highways along the southeast lane: Shahid Lashghari Highway, Fath Highway, Tehran-Saveh Freeway, Ayatulla Saeed Highway (Saveh Road), Khalij-e Fars Freeway (Tehran-Qom) in Jihad Square, Beheshte Zahran Highway, Shahid Rajai Highway, Dowlat Abad Highway (underconstruction), and Serah-e Afsarieh (Basij). Therefore, this highway is linked to Shahr-e Rey through the Shahid Rajai Highway. Azadegan Highway is located in the north-west zone of the city and stretches from northwest to southeast. It also ends to Tehran-Karaj freeway in the northwest and ends to Serah-e Afsarieh (Basij) in the southeast. Azadegan Highway crosses Tehran-Karaj Freeway in its path. It also crosses the following highways and freeways along its south-east lane: Shahid Lashgari, Fath, Tehran-Saveh, Ayatullah Saeedi (Saveh Road), Khalij Fars (Tehran-Qom) in Jihad Square, Behesht-e Zahra, Rajai, Dowlat Abad and Serah-e Afsarieh (Basij). In traffic terms, this highway is known as a superhighway. It is also considered among the inlets and outlets of the capital (Tehran). Azadegan Highway is connected to Shahr-e Rey through Rajai Highway. It is, therefore, a substantial route for passengers aiming to travel beyond Tehran and its boundaries. The main traffic load of this highway occurs in vacations and weekends.

1.2. Noise Level Measurement in the Area

The street was in fact a bridge on Azadegan highway with an island separating the two sides of the street. It had a width of 16 meters with two lanes in each direction.

The noise level was measured in the sides of street in 5-min intervals. In other words, first, measurements were conducted by a device in one side of the street for 5 minutes. Then, the same device was used for the 5-min measurements in the other side. This was because in one side, new asphalt had been distributed, and there were new materials, while in the other side, there was an old asphalt. This made it possible to make a general comparison between noise propagation in new and old asphalts. A boulevard was also located in the middle of the street which somewhat helped distinguish the sound propagation.

The data collection was performed in Sanaye-e Havaii Street in 5-min intervals. The collected data were then compared, and the effect of pavement type on the noise propagation and the mathematical model used in the study was investigated.

According to the results, which will be described in the following sections, a coefficient was considered for pavement in the mathematical model which gives the modified noise according to the measurements.

1.3. Traffic Statistics of the Area

To calculate the noise in the area, it was necessary to collect traffic data including the average speed of the passing vehicles and the volume of passing traffic by each type of vehicles. Accordingly, the data was received from the Traffic and Transportation Organization of Iran and was used as the input in the calculations.

Figure 1 shows the number of passing vehicle in a week in the area by light, medium, and heavy vehicle. Light vehicles had the heaviest traffic, thus, the light vehicle traffic parameters in terms of passing speed and number had a greater weight in the model.

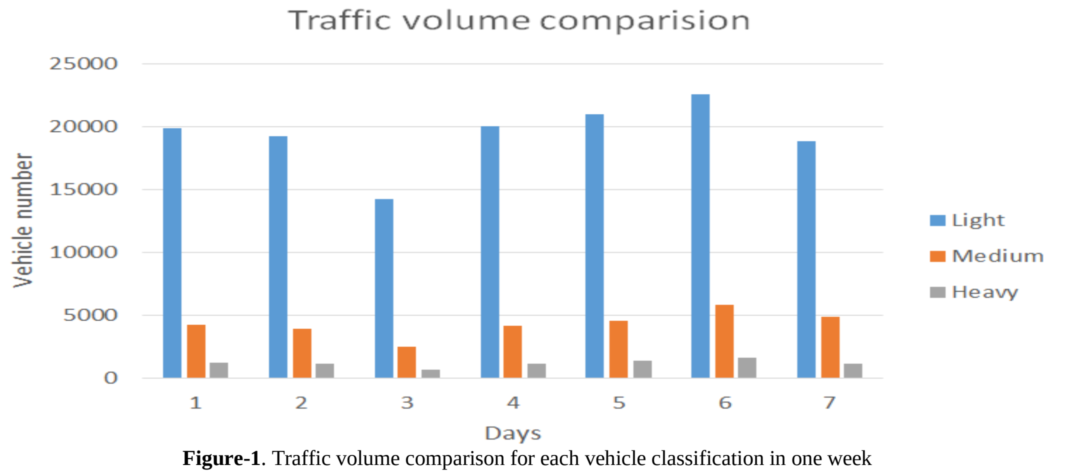

Figure-1. Traffic volume comparison for each vehicle classification in one week

1.4. NCHRP Report 78 Modeling

The study of human response to noise ratio of vehicles checked and mathematical models to predict noise different vehicles provided:

$$L_a = 50 - 20\log(d) + 30\log(V)$$

d = Distance to the vehicle maker (ft)

L_a = Noise level (dba)

V=velocity of vehicles (mi/h)

In the table 1 the values from modeling and measured noise has shown.

Table-1. Noise from model and measuring

Velocity(mi/h)	**50**	**60**	**70**	**80**	**90**
Noise from model (dba)	66.7	69.43	71.4	73.45	74.6
Noise of measuring (dba)	69.5	70.86	74.55	75.10	78.40

2. RESULTS AND DISCUSSION

With use of standard model, the final result for equivalent noise level of Azadegan highway and its comparison to measuring noise for different vehicles velocity is shown in figure 2.

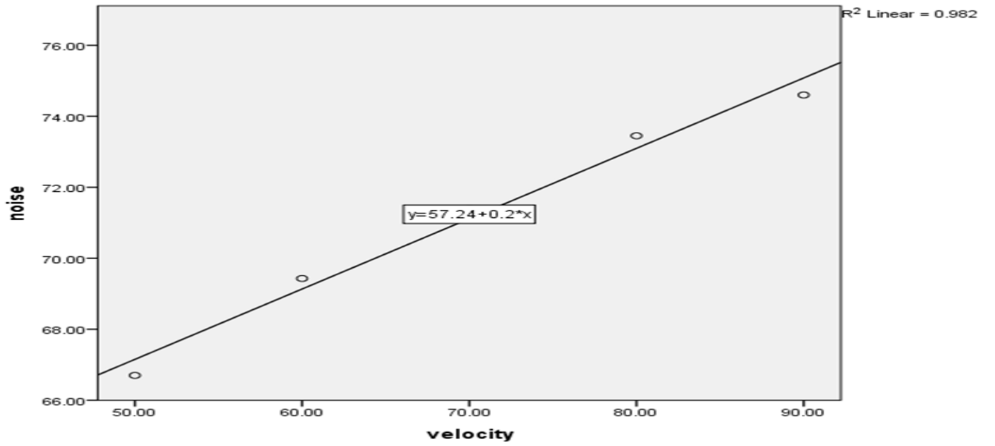

Figure-2. Equivalent noise with model for different vehicles velocity

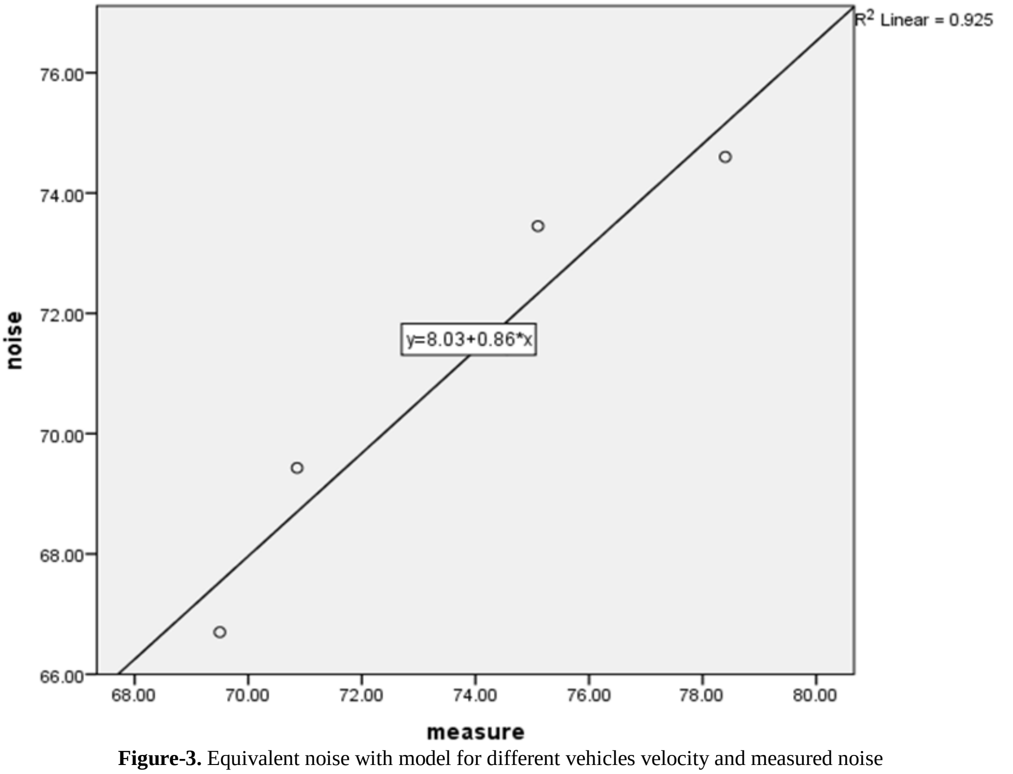

Figure-3. Equivalent noise with model for different vehicles velocity and measured noise

As Figure 2 is obtained from the approximate model is obtained with a correlation coefficient of 0.982 The relationship between vehicle speed and noise show and In Figure 3 the sound from the sound levels obtained with the The model is derived from the measured noise level at a distance of 24 feet from the road. Using linear regression correlation coefficient 0.925 is obtained.

REFERENCES

[1] J. Zhao, X. Zhang, and Y. Chen, "A novel traffic-noise prediction method for non-straight roads," *Xian: Applied Acoustics,* vol. 73, pp. 276-280, 2012.

[2] S. Cho Dae and S. Mun, "Development of a highway traffic noise prediction model that considers various road surface types," *Applied Acoustics,* vol. 69, pp. 1120–1128, 2008.

[3] R. Golebiewski, "Traffic noise reduction due to the porous," *Umultowska: Applied Acoustics,* vol. 64, pp. 481-494, 2003.

[4] J. R. Watts, S. N. Chandler-Wilde, and P. A. Morgan, "The combined e€ects of porous asphalt surfacing and barriers on trac noise," *Applied Acoustics,* vol. 58, pp. 351-377, 1999.

[5] R. Makarewicz and M. Gałuszka, "Road traffic noise prediction based on speed-flow diagram," *Applied Acoustics,* pp. 190-195, 2011.

[6] R. Makarewicz, "The annual average sound level of road traffic noise estimated from the speed-flow diagram," *Applied Acoustics,* vol. 74, pp. 669-674, 2013.

[7] A. Ramirez and E. Domínguez, "Modeling urban traffic noise with stochastic and deterministic traffic models," *Applied Acoustics,* vol. 74, pp. 614-621, 2013.

[8] S. Rahmani, S. M. Mousavi, and M. J. Kamali, "Modeling of road-traffic noise with the use of genetic algorithm," *Applied Soft Computing,* vol. 11, pp. 1008-1013, 2011.

[9] S. Givargis and H. Karimi, "A basic neural traffic noise prediction model for Tehran’s roads," *Journal of Environmental Management,* vol. 91, pp. 2529-2534, 2010.

[10] J. Quartieri, "A review of traffic noise predictive models," *Recent Advances in Applied and Theoretical Mechanics. ISSN: 1790-2769,* vol. 9, pp. 72-80, 2011.