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# Assessment of Highway Noise and Predictive Models along NH-316

**Bijay Kumar Swain, Shreerup Goswami[1*] and Madhumita Das[2]**
P.G. Dept. of Botany (Environmental Science), Utkal University, Bhubaneswar, Odisha
[1]P.G. Dept. of Geology, Ravenshaw University, Cuttack, Odisha
[2]P.G. Dept. of Geology, Utkal University, Bhubaneswar, Odisha
✉ goswamishreerup@gmail.com

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**Abstract:** Noise pollution has become a major concern of communities living in the vicinity of highways/road corridors, and intersections. The recognition of highway noise, as one of the main sources of environmental pollution led to design models that enable us to predict traffic noise level. Several models have been developed to predict traffic noise along the highways from fundamental variables such as noise descriptors. Experimental data are gathered for seven squares along the National Highway-316 (connecting Bhubaneswar to Jagannath Dham, Puri) in the present study. Noise pollution was analysed in seven different squares (road sections) during morning, afternoon and evening to assess the level of noise pollution along this road. A methodical comparison of simulated and experimental data is made, in order to test the perfection and behaviour of the models in different studied sites in an Indian road condition. Co-relation coefficient is applied to infer the level of significance.

**Key words:** Road corridors, national highway, Puri, noise descriptors, noise modelling.

## Introduction

Vehicles produce sound. This includes engine noise, noise due to tyre-pavement interaction, body rattling, vibrations, horns etc. Road types and operating conditions are also other characteristics on which the sound level depends. Under same type of operating conditions, similar types of vehicle may or may not emit similar sound due to difference in their speed. Vehicle detection and classification have been carried out in many ways. For traffic and speed management, classified vehicle count, traffic signal time optimization and gap/headway measurement; vehicle detection is a prerequisite parameter at the time of motion. Vehicle detection techniques are in a stage of continuous improvement (George et al., 2013). Thus, noise pollution has become a major concern of communities living in the vicinity of highways/road corridors, and intersections (Swain et al., 2012a and b; Swain and Goswami, 2012, 2013a and b, 2014a).

Sleep disturbance is a major component of the health issue of transportation noise (Berguland et al., 1999; Fritschi et al., 2011). The physiological effect of transportation noise on human sleep may depend more on the level and number of noise events in traffic streams than on energy equivalent measures (Griefahn et al., 2006; Pirrera et al., 2010). The emergence of noise annoyance may also be determined, at least in part, by noise events, which distract attention and interfere with activities (Bjorkman, 1991; Sato et al., 1999; De et al., 2009). Also, there are many auditory and non-auditory health effects on communities living in close proximity to busy road highways (Ohrstorm and Rylander, 1990; Babisch, 2005, 2000; Rylander,

*Corresponding Author

2004; Golmohammadi et al., 2007; Ljungberg and Neely, 2007; Pirrera et al., 2010; Mohapatra et al., 2010; Goswami and Swain, 2012a and b, 2013; Pradhan et al., 2012a and b; Sahu et al., 2013, 2014; Goswami et al., 2013a and b; Swain et al., 2012a and b; 2013; Swain and Goswami, 2014a). Thus, to reduce road traffic noise many countries have introduced noise emission limits and legislations for vehicles (Ross and Wolde, 2001; Stefano and Morri, 2001; CPCB, 2000). On the other hand, road infrastructures and vehicles number are increasing day by day, where transport facilities are improving in order to support the economical and industrial growth of the country.

The recognition of highway noise, as one of the main sources of environmental pollution led to design models that enable us to predict traffic noise level. Several models have been developed from fundamental variables such as the traffic flow, speed of vehicles, volume of the traffic and sound emission level using regression analysis of experimental data (Stefano and Morri, 2001; Golmohammadi et al., 2007; Guarnaccia et al., 2011; Kumar et al., 2011). Roadside measurements along real traffic streams demonstrate differences in noise emission levels (due to age, maintenance, modifications, driving style etc.) between different vehicles within a single vehicle class (Watts, 2012; Brown and Tomerini, 2011). Maximum levels obtained by the models may thus misrepresent reality. For accurately predicting the occurrence and strength of noise events caused by road traffic, the influence of vehicles that are producing more/less noise than the average vehicle has to be taken into account (Coensel et al., 2012; George et al., 2013).

The heavy vehicles such as trucks and buses play a major role in road traffic noise in urban areas (Bodsworth and Lawrence, 1978; Swain et al., 2012). Several models have been developed for predicting noise levels generated by urban road traffic, as they predict the sound level caused by road traffic (Griffths and Langdon, 1968; Lyons, 1973; Radwan and Oldham, 1987; Steel, 2001; Stefano and Morri, 2001; Li, 2002; To et al., 2002; Parida, 2003; Tansatcha et al., 2005; Lam et al., 2009) These established models are reviewed (Steele, 2001; Golmohammadi et al., 2007). A statistical model of road traffic noise in an urban setting which is based on the fact that percentage of heavy vehicles plays an important role over road traffic noise emission was developed by Calixto et al. (2003). Models are generally used to predict sound pressure levels specified in terms of Leq, $L_{10}$, $L_{50}$, $L_{90}$ etc. (Golmohammadi et al., 2007; Swain et al., 2012; Goswami et al., 2013a). Finally, models for the prediction of road traffic noise are increasingly used for urban planning and soundscaping.

In this paper, the different noise models have been quantitatively described and compared in function of the number of vehicles. The comparison is here extended to experimental measurements. The behaviour of the models in different sites and in different hours is sketched. The present study is an attempt of comparison of simulated and experimental data monitored along NH-316 (Bhubaneswar to Puri) with an objective of identifying the best predicted traffic noise model(s) in the Indian conditions.

## Review of Some Traffic Noise Models

In this section, some of the most used TNMs (Traffic Noise Models) are briefly sketched.

### Annon, 1952

One of the first models, developed in 1952, was reported in Handbook of Acoustic Noise Control (Annon, 1952). This model states that the 50 percentile of traffic noise for speed of 35-45 mph (about 55-75 km/h) and

**Table 1: Acceptable noise level standards for residential areas as per IS: 4954-1968 in India**

| *Sl. No.* | *Location* | *Acceptable noise levels in dB (A)* |
|---|---|---|
| 1 | Rural | 25-35 |
| 2 | Suburban | 30-40 |
| 3 | Residential | 35-45 |
| 4 | Urban (Residential and business) | 40-45 |
| 5 | City | 45-50 |
| 6 | Industrial area | 50-60 |

**Table 2: The ambient noise standards followed in India for different types of areas (CPCB, 2000; Jain and Parida, 2001)**

| *Sl. No.* | *Area* | *Leq in dBA Day time* | *Leq in dBA Night time* |
|---|---|---|---|
| 1 | Industrial area | 75 | 70 |
| 2 | Commercial area | 65 | 55 |
| 3 | Residential area | 55 | 45 |
| 4 | Silence Zone | 50 | 40 |

Day time—6 am to 9 pm (15 hours); Night time—9 pm to 6 am (9 hours); Areas up to 100 m around certain premises like hospitals, educational institutes and courts may be declared as silence zone.

distances greater than 20 feet (about 6 metres) is given by:

$$L_{50} = 68 + 8.5 \log Q - 20 \log d$$

where $Q$ is traffic volume in vehicles per hour and $d$ is the distance from observation point to centre of the traffic lane, in feet; no specification is included about vehicles and roads type.

**Burgess, 1977**

$$Leq = 55.5 + 10.2 \log (Q) + 0.3P - 19.3 \log (d)$$

This model was used first time in Sydney in Australia, which is one of the first models for equivalent noise level Leq applied in Australia. Leq is the equivalent noise level, '$Q$' is the vehicles flow, '$P$' is the percentage of heavy vehicles and '$d$' is the distance of source to receiver.

**Griffith and Langdon, 1968**

$$Leq = L_{50} + 0.018 (L_{10} - L_{90})^2$$

where the statistical percentage indicator are evaluated with the following formulae:

$$L_{10} = 61 + 8.4 \log (Q) + 0.15P - 11.5 \log (d)$$

$$L_{50} = 44.8 + 10.8 \log (Q) + 0.12P - 9.6 \log (d)$$

$$L_{90} = 39.1 + 10.5 \log (Q) + 0.06P - 9.3 \log (d)$$

## Materials and Method

The present study was conducted along NH-316 (Hitech square, Uttara square, Pipili by-pass, Satasankha square, Sakhigopal square, Grand road square and Bus stand) of Puri (Figure 1) during May, 2015. Puri is located at 19° 48' North Latitude and 85° 52' East Longitude. The basic data were gathered using digital maps and field observations. The noise levels were measured following standard procedure using calibrated sound level (dB) meter (Model LUTREN, SL-4010) (Goswami, 2009, 2011; Goswami and Swain, 2011; Goswami et al., 2011, 2012; Mohapatra and Goswami, 2012a, b; Swain et al., 2011, 2012, 2014; Swain and Goswami, 2012, 2013, 2014b). Altogether 28 measuring points were selected along the highway of seven selected sites. The sampling time in each site is 30 second i.e., 60 measurements in 30 minutes. The days and hours of sampling were random.

In this study, the A-weighted continuous equivalent sound level values (Leq), Lmax, Lmin and statistical levels of $L_{10}$ (peak noise), $L_{50}$ and $L_{90}$ (background noise) were manually measured at each site separately. Equivalent noise levels (Leq) represent the equivalent energy sound level of a steady state and invariable sound. It includes both intensity and length of all sounds occurring during a given period. The noise levels of different squares in different time intervals were predicted along with their equivalent noise levels (Leq). The value of Leq in dB (A) unit is calculated by using the formula $Leq = L_{50} + (L_{10} - L_{90})^2/56$ (Robinson, 1971). Similarly, Noise Climate (NC), Traffic Noise Index (TNI) and Noise Pollution Level (NPL) are calculated (Robinson, 1971; Goswami et al., 2013a). Thus, experimental data (Leq) are gathered for the investigated sites along the National Highway No. 316 in the present study. Simulated data (Leq) are derived by applying a number of already discussed Traffic Noise Models (Annon, 1952; Grifth and Langdon, 1968; Burgess, 1977). A methodical comparison of simulated and experimental data is made, in order to test the perfection and behaviour of these models in different studied sites in an Indian road condition. The measurements were taken on various days of the week, except Sunday. Experimental data have been gathered in absence of rain, with a wind speed below 5 m/s and relative humidity below 80% (maximum value).


**Figure 1: Map of India showing the study area (Bhubaneswar and Puri).**

## Results and Discussion

In this section a quantitative comparison between TNMs (Traffic Noise Models) and experimental data is performed. Of course, since the experimental setting is the same in each site, one should expect a similar behaviour of data. This is not always true because the acoustical measurement is, in general, strongly influenced by propagation effects and environmental influence.

The average noise level at different time interval is represented in Figure 2. The average maximum and minimum noise level were 81.3 dB (morning, at Hitech square) and 68 dB (evening, at Uttara square) respectively. Table 3 depicts variations of noise descriptors at different studied squares.

During morning, maximum noise climate (NC) was at Pipili bypass road (19.9) and was minimum both at Uttara square and Grand Road square (10), respectively. Similarly, maximum and minimum noise pollution level (NPL) were found at Pipili bypass road (99.1) and Grand Road square (84.6) respectively while traffic noise index (TNI) was maximum at Pipili Bypass Road (109.2) and was minimum at Grand Road square (79.2). During afternoon, the maximum level of NC (19), NPL (99.6) and TNI (120.2) were observed at Saata Sankh square, respectively. Similarly, the minimum NC (10.5) was observed at Uttara square, minimum NPL (87.5) was monitored at Grand Road square and minimum TNI

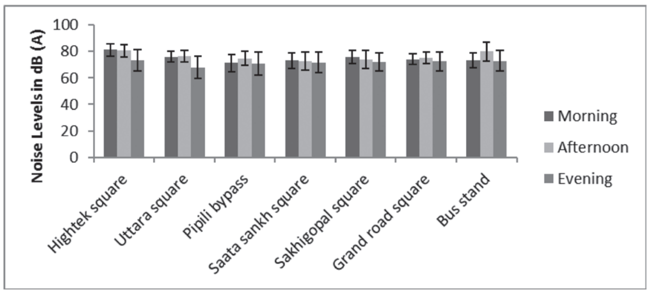


**Figure 2: Mean average noise levels of different squares in different time interval in dB (A).**

(82.8) was found at Grand Road square. During evening the maximum level of TNI (115.3) and NC (21.9) were found at Uttara square, while maximum level of NPL (97.2) was observed at Bus Stand, respectively. Thus aforesaid data revealed that the value of TNI and NPL will increase as the difference between peak noise level and background noise level will increase. The collected traffic volume data at 15 minute interval for complete duration in peak and non-peak hours at interrupted flow condition is processed and presented in Table 4 to study the % composition of traffic. It is observed that, at all approaches, the most dominant mode of transport is two wheelers followed by bus/truck, light vehicles and others.

The maximum noise level (Lmax) was found to be highly affected by the existence of heavy vehicles in the traffic passing the intersection. Table 5 shows the comparison between the maximum noise levels versus the number of heavy vehicles. The correlation coefficient for the peak hour i.e., the afternoon hour is 0.75. The correlation coefficient indicated a good relationship between the two parameters. It is inferred that Lmax is increased with increasing number of trucks/ buses. This is due to the fact that heavy vehicles have larger engines and exhaust systems, which result in high noise emissions levels. The comparison between heavy vehicles and Lmin; and heavy vehicles and Leq are presented on Tables 6 and 7 respectively. In addition, it was found that the equivalent noise levels and minimum noise levels were less affected by the number of heavy vehicles. The correlation coefficient between Leq and heavy vehicles is 0.514, while it is 0.1 between Lmin and heavy vehicles. The less effect of heavy vehicles on Leq is due to the less number of heavy vehicles in the traffic composition causing little effect on measured Leq. In the case of significant numbers of heavy vehicles in the traffic stream, the heavy vehicle is expected

**Table 3: Noise descriptors (TNI, NPL, NC) variations at different squares along NH 316 connecting Bhubaneswar and Puri**

| *Name of squares* | *Morning* | | | *Afternoon* | | | *Evening* | | |
|---|---|---|---|---|---|---|---|---|---|
| | *NC* | *NPL* | *TNI* | *NC* | *NPL* | *TNI* | *NC* | *NPL* | *TNI* |
| Hitech square | 13.5 | 97.1 | 100.6 | 12.9 | 95.6 | 97.2 | 18.2 | 96.6 | 106 |
| Uttara square | 10 | 87.6 | 80.4 | 10.5 | 88.4 | 83.4 | 21.9 | 96.8 | 115.3 |
| Pipili Bypass road | 19.9 | 99.1 | 109.2 | 11.2 | 88.9 | 84.2 | 18.4 | 94.8 | 104.4 |
| Saata Sankh square | 16.8 | 94.3 | 101.8 | 19 | 99.6 | 120.2 | 19.6 | 97.5 | 108.3 |
| Sakhigopal square | 12.5 | 89.8 | 90.7 | 17 | 96.6 | 102.4 | 18.1 | 93.2 | 102.9 |
| Grand Road square | 10 | 84.6 | 79.2 | 10.8 | 87.5 | 82.8 | 19.5 | 95.8 | 108.9 |
| Bus Stand | 13.7 | 88.5 | 91.3 | 15 | 91.1 | 106.1 | 19.7 | 97.2 | 110.5 |

**Table 4: Number of vehicles flow in different time intervals**

| *Monitoring sites* | *Morning* | | | | | *Afternoon* | | | | | *Evening* | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Total No. of vehicles* | *Heavy vehicles* | *% of heavy vehicles* | *Two wheelers* | *Light vehicles* | *Total No. of Vehicles* | *Number of heavy vehicles* | *% of heavy vehicles* | *Two wheelers* | *Light vehicles* | *Total No. of Vehicles* | *Number of heavy vehicles* | *% of heavy vehicle* | *Two wheelers* | *Light vehicles* |
| Hitech square | 427 | 120 | 28.1 | 205 | 66 | 419 | 117 | 27.9 | 211 | 56 | 376 | 102 | 27.1 | 182 | 41 |
| Uttara square | 390 | 99 | 25.3 | 157 | 34 | 393 | 93 | 23.6 | 164 | 37 | 351 | 91 | 25.9 | 137 | 30 |
| Pipili Bypass | 402 | 97 | 24.1 | 169 | 39 | 393 | 92 | 23.4 | 171 | 45 | 363 | 93 | 25.6 | 148 | 29 |
| Saata Sankh square | 383 | 103 | 26.8 | 149 | 52 | 406 | 94 | 23.1 | 155 | 36 | 380 | 95 | 25 | 166 | 33 |
| Sakhigopal square | 376 | 108 | 28.7 | 162 | 48 | 387 | 97 | 25 | 149 | 26 | 371 | 97 | 26.1 | 144 | 27 |
| Grand Road square | 385 | 98 | 25.4 | 172 | 41 | 363 | 100 | 27.5 | 189 | 16 | 373 | 92 | 24.6 | 162 | 39 |
| Bus Stand | 405 | 101 | 24.9 | 198 | 41 | 391 | 102 | 26 | 211 | 23 | 390 | 106 | 27.1 | 177 | 48 |

**Table 5: Comparison between heavy vehicles vs Lmax**

| *Monitoring sites* | *Morning* | | *Afternoon* | | *Evening* | |
|---|---|---|---|---|---|---|
| | *Lmax* | *Heavy vehicles* | *Lmax* | *Heavy vehicles* | *Lmax* | *Heavy vehicles* |
| Hitech square | 93.6 | 120 | 93.2 | 117 | 90.3 | 102 |
| Uttara square | 88.4 | 99 | 86.8 | 93 | 82.5 | 91 |
| Pipili Bypass | 82.6 | 97 | 86.4 | 92 | 86.4 | 93 |
| Saata Sankh square | 91.5 | 103 | 90.4 | 94 | 87.3 | 95 |
| Sakhigopal square | 92.6 | 108 | 91.3 | 97 | 88.4 | 97 |
| Grand Road square | 83.9 | 98 | 91.6 | 100 | 85.5 | 92 |
| Bus Stand | 91.4 | 101 | 93.1 | 102 | 91.7 | 106 |

**Table 6: Comparison between heavy vehicles vs Lmin**

| *Monitoring sites* | *Morning* | | *Afternoon* | | *Evening* | |
|---|---|---|---|---|---|---|
| | *Lmin* | *Heavy vehicles* | *Lmin* | *Heavy vehicles* | *Lmin* | *Heavy vehicles* |
| Hitech square | 70.3 | 120 | 54.6 | 117 | 56.6 | 102 |
| Uttara square | 69.1 | 99 | 56.1 | 93 | 57.4 | 91 |
| Pipili Bypass | 53.3 | 97 | 54.8 | 92 | 53.2 | 93 |
| Saata Sankh square | 60.4 | 103 | 52.7 | 94 | 53.7 | 95 |
| Sakhigopal square | 68.8 | 108 | 57 | 97 | 54.1 | 97 |
| Grand Road square | 68.6 | 98 | 60.5 | 100 | 54.4 | 92 |
| Bus Stand | 60.6 | 101 | 61.7 | 102 | 55.2 | 106 |

**Table 7: Comparison between heavy vehicles vs Leq**

| *Monitoring sites* | *Morning* | | *Afternoon* | | *Evening* | |
|---|---|---|---|---|---|---|
| | *Leq* | *Heavy vehicles* | *Leq* | *Heavy vehicles* | *Leq* | *Heavy vehicles* |
| Hitech square | 83.6 | 120 | 82.7 | 117 | 78.4 | 102 |
| Uttara square | 77.6 | 99 | 77.9 | 93 | 74.9 | 91 |
| Pipili Bypass | 79.2 | 97 | 77.7 | 92 | 76.4 | 93 |
| Saata Sankh square | 77.5 | 103 | 80.6 | 94 | 77.9 | 95 |
| Sakhigopal square | 77.3 | 108 | 79.6 | 97 | 75.1 | 97 |
| Grand Road square | 74.6 | 98 | 76.7 | 100 | 76.3 | 92 |
| Bus Stand | 74.8 | 101 | 76.1 | 102 | 77.5 | 106 |

to have a significant effect on the measured Leq as concluded in a study performed by Ramalingeswave and Seshagri Rao (1991). In the present study, in most of the squares, the Leq is directly proportional to the number of heavy vehicles in the traffic stream.

The comparison between Leq and Lmin; and Leq and Lmax is presented in Tables 8 and 9, respectively. The correlation coefficient between Leq and Lmin is –0.744, while it is 0.24, between Leq and Lmax, during the peak hour. Negative correlation means there is no direct relationship between Leq and Lmin. The correlation coefficient between equivalent noise level and maximum noise level is weak and is not directly correlated with each other. The calculated L50 is compared with the predicted L50 (Annon, 1952) (Table 10). In some squares the predicted value is quite similar to that of calculated value, during morning and afternoon time. But the predicted data is slightly more than that calculated value during evening hours. The correlation coefficient is 0.59 during the peak hours and it shows a good relationship between the two. Thus, it can be applied in the Indian condition. Again the calculated equivalent noise level is compared with predicted equivalent noise level and is presented in Table 11. The table clearly demonstrates that Griffth and Langdon's model is more suitable than Burgess Model in Indian road condition.

The present study clearly revealed that the transportation sector is one of the major contributors to noise in National Highway No. 316. Such noise measurements and prediction could be helpful in understanding the problem of noise pollution along the highways. As unplanned highways are passing through heart of most of the cities, by-pass road, over-bridges/flyovers should be constructed to avoid excruciating highway traffic. Design and fabrication of silencing devices and their use in trucks, buses, cars and motorcycles would be an effective measure in abating highway noise. Thus, there should be ban of hydraulic horn and very old vehicles (Pandya, 2001). Noise may cause deafness, nervous breakdown, mental disorder, heart troubles, high blood pressure, dizziness and insomnia. Exposure to noise pollution exceeding 75 decibels for more than eight hours daily for a long period of time can cause loss of hearing. Programmes to monitor and control noisy vehicles on the roads should be launched. Before commencing any highway project, potential sources of noise pollution associated with the proposed project should be identified by the land use planners (Balashanmugam et al., 2013).

**Table 8: Comparison between Leq vs Lmin**

| *Monitoring sites* | *Morning* | | *Afternoon* | | *Evening* | |
|---|---|---|---|---|---|---|
| | *Leq* | *Lmin* | *Leq* | *Lmin* | *Leq* | *Lmin* |
| Hitech square | 83.6 | 70.3 | 82.7 | 54.6 | 78.4 | 56.6 |
| Uttara square | 77.6 | 69.1 | 77.9 | 56.1 | 74.9 | 57.4 |
| Pipili Bypass | 79.2 | 53.3 | 77.7 | 54.8 | 76.4 | 53.2 |
| Saata Sankh square | 77.5 | 60.4 | 80.6 | 52.7 | 77.9 | 53.7 |
| Sakhigopal square | 77.3 | 68.8 | 79.6 | 57 | 75.1 | 54.1 |
| Grand Road square | 74.6 | 68.6 | 76.7 | 60.5 | 76.3 | 54.4 |
| Bus Stand | 74.8 | 60.6 | 76.1 | 61.7 | 77.5 | 55.2 |

**Table 9: Comparison between Leq vs Lmax**

| *Monitoring sites* | *Morning* | | *Afternoon* | | *Evening* | |
|---|---|---|---|---|---|---|
| | *Leq* | *Lmax* | *Leq* | *Lmax* | *Leq* | *Lmax* |
| Hitech square | 83.6 | 93.6 | 82.7 | 93.2 | 78.4 | 90.3 |
| Uttara square | 77.6 | 88.4 | 77.9 | 86.8 | 74.9 | 82.5 |
| Pipili Bypass | 79.2 | 82.6 | 77.7 | 86.4 | 76.4 | 86.4 |
| Saata Sankh square | 77.5 | 91.5 | 80.6 | 90.4 | 77.9 | 87.3 |
| Sakhigopal square | 77.3 | 92.6 | 79.6 | 91.3 | 75.1 | 88.4 |
| Grand Road square | 74.6 | 83.9 | 76.7 | 91.6 | 76.3 | 85.5 |
| Bus Stand | 74.8 | 91.4 | 76.1 | 93.1 | 77.5 | 91.7 |

**Table 10: Comparison between calculated L50 vs predicted L50**

| *Monitoring sites* | *Morning* | | *Afternoon* | | *Evening* | |
|---|---|---|---|---|---|---|
| | *Calculated L50* | *Predicted L50* | *Calculated L50* | *Predicted L50* | *Calculated L50* | *Predicted L50* |
| Hitech square | 80.4 | 72.3 | 79.8 | 72.2 | 72.5 | 71.8 |
| Uttara square | 75.8 | 71.9 | 76 | 71.9 | 66.4 | 71.6 |
| Pipili Bypass | 72.1 | 72 | 75.5 | 71.9 | 70.4 | 71.7 |
| Saata Sankh square | 72.5 | 71.9 | 74.2 | 72.1 | 71.1 | 71.8 |
| Sakhigopal square | 74.5 | 71.8 | 74.5 | 71.9 | 69.2 | 71.7 |
| Grand Road square | 72.8 | 71.9 | 74.6 | 71.7 | 69.6 | 71.8 |
| Bus Stand | 71.5 | 72.1 | 72.1 | 71.9 | 70.6 | 71.9 |

**Table 11: Comparison between calculated Leq vs predicted Leq**

| *Monitoring sites* | *Morning* | | | *Afternoon* | | | *Evening* | | |
|---|---|---|---|---|---|---|---|---|---|
| | *Calculated Leq* | *Burgess* | *Griffth and Langdon* | *Calculated Leq* | *Burgess* | *Griffth and Langdon* | *Calculated Leq* | *Burgess* | *Griffth and Langdon* |
| Hitech square | 83.6 | 73.4 | 73 | 82.7 | 73.2 | 73 | 78.4 | 72.5 | 72.3 |
| Uttara square | 77.6 | 72.1 | 72.2 | 77.9 | 71.6 | 72 | 74.9 | 71.8 | 71.8 |
| Pipili Bypass | 79.2 | 71.8 | 72.2 | 77.7 | 71.6 | 71.9 | 76.4 | 71.9 | 71.9 |
| Saata Sankh square | 77.5 | 72.5 | 72.4 | 80.6 | 71.6 | 72 | 77.9 | 71.9 | 72.2 |
| Sakhigopal square | 77.3 | 72.9 | 72.7 | 79.6 | 72 | 72.2 | 75.1 | 72.1 | 72.2 |
| Grand Road square | 74.6 | 72.1 | 72.3 | 76.7 | 72.5 | 72.3 | 76.3 | 71.7 | 71.9 |
| Bus Stand | 74.8 | 72.2 | 72.3 | 76.1 | 72.3 | 72.4 | 77.5 | 72.7 | 72.5 |

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