# Development of Heterogeneous Traffic Noise Level Prediction model and Los at Arterial Road of Nadiad City

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***Abstract*** **–** In developing countries like India, the nature of the composition of traffic is heterogeneous .A heterogeneous traffic flow consists of vehicles that have different sizes, speeds, vehicle spacing and operating characteristics. As a result of the widely varying speeds, vehicular dimensions, lack of lane discipline, honking becomes inevitable. Nadiad city has evidence a very rapid growth in urbanization which resulted in increased demand for transportation and at last it resulted in increased rate of noise pollution. Therefore, the traffic prediction models that are used for heterogeneous traffic conditions are nor applicable in heterogeneous traffic conditions. To increase the accuracy of noise prediction models, in depth understanding of heterogeneous traffic noise is required. Understanding the real traffic noise characteristic requires quantification of some of the basic traffic flow characteristics such as speed, flow, level of service, and density. In a given roadway, the noise level changes with density and level of service on the road. The noise prediction model will be developed based on various factors affecting noise.

***(Key Words*** **– Environment, Urbanization, Noise, Pollution*)***

## I. INTRODUCTION

In HCM (1985), density was selected as the primary measures for performance assessment and correspondingly five LOS were proposed.HCM (2000) suggested average travel speed as the exclusive parameter for assessment of LOS of urban street. Six LOS criteria were proposed on the basis of ATS value for four urban street classes individually whereas urban street class was determined based on the free flow speed. Noise is defined as any unwanted and unpleasant sound. Noise can also be defined as the level of sound that exceed the acceptable level and creates an annoyance. Nowadays Noise is one of the most significant sources of environment pollution in urban area. Noise pollution has many negative impacts on human beings, other living and Non-living things, is as below.

1) Effect of Noise interference with people life
a) Physical effects such as hearing defects.
b) Physiological effects such as increased blood pressure.
c) Psychological effects such as sleeplessness, annoyance and stress.
d) Effect on work performance such as reduction of productivity.
e) Effect of communication.
2) Effects on other animals and other living things.
3) Effects on Non-living things.

Table no.1 Noise permissible limits for different areas, as per Indian standards

| Sr.No. | Area category | Limits in db | |
|---|---|---|---|
| | | Day time | Night time |
| 1 | Industrial | 75 | 70 |
| 2 | Residential | 65 | 55 |
| 3 | Commercial | 55 | 45 |
| 4 | Silence zone | 50 | 40 |

(Day Time shall mean from 6.00 a.m. to 10.00 p.m. , Night Time shall mean from 10-00 p.m. to 6.00 a.m)

## II. OBJECTIVES OF STUDY

- To develop correlation between noise level and traffic parameter.
- To identify los at selected stretch.
- To develop noise level prediction model with correlation of los.

## III. LITERATURE REVIEW

*R.kalaiselvi & A.ramchandraiah studied on "Honking noise corrections for traffic noise prediction model in heterogeneous traffic condition like India"-(2016)*

They have done the study of traffic noise in Chennai city in engaged areas of the they have city which peak traffic flow in peak hours outcomes obtained in the study shows that the whole city is affected heavily by noise pollution and in mostly 90% of the

area prevailing noise was measured at every 15 minutes interval and traffic volume, speed, number of honking events and Level of service was also measures. The results obtained in the study it's very evident that the city is suffering from noise pollution. The horn correction values can be incorporated in traffic noise models such as CRTN, FHWA and RLS90, while heterogeneous traffic condition. The suitable remedial measures are also suggested in this study.

*Solanki R. & Patel B.studied on "Estimation of capacity and level of service for urban arterial road-A case study of Rajkot city"(2017)*

Provides the process for capacity estimation of urban arterial road under mixed heterogeneous traffic conditions in Rajkot urban road and calculated the influencing factors which affect the capacity of road. Traffic flow data and Average speed for all type of vehicles are collected through video graphic at five minute interval in peak hour. Factors influencing capacity are classified volume of vehicle, average speed and Density. Level of service is found out from density and speed. Various speed-density relationships have been established in this study. Speed, flow and density data are trained in MATLAB using Artificial Neural Network. The actual capacity analysis is fundamental to plan and improve the existing traffic facilities. Capacity is increases with increase in width of carriageway for selected different road section and level of service is increase with the decrease in the width of carriageway.

*Keeranthana & Gobinath R. studied on "An analysis of noise pollution in Tirupur city"(2013)*

They have done the study of traffic noise in Tirupur city in the engaged areas of the they have city which have peak traffic flow in peak hours outcomes obtained in the study shows that the whole city is affected heavily by noise pollution & in mostly 90% of the area prevailing noise was measured at every minutes for 15 minutes interval & traffic volume, relative humidity a temperature was also measured The results obtained in the study its very evident that the city is suffering from noise pollution. This high-level attributed to vehicular traffic specially auto-rickshaw with ineffective silencer a frequent use of pressure horn by buses, wagons & tracks etc. The suitable remedial measures are also suggested in this study.

## IV. DATA COLLECTION

For In this study an effort is made to compare the noise level in some main areas of Nadiad city during the morning hour and evening hour traffic using sound level meter. Since noise level varies with atmospheric conditions, in each area respective temperature and wind velocity has also been recorded. The reading were taken during early hours of the day(9.0 to 12.0) and during evening rush hours(5.0 to 8.0) .in each area for each a 5 minutes reading were taken. The following parameters like,

1. Total vehicle volume per hour
2. Atmospheric temperature
3. Wind velocity
4. Noise level in that area

## V. DATA ANALYSIS

It is noticeable that the major part of the populations exposed to noise levels greater than 65 dB everyday .Although heavy vehicles are not permitted to enter the city in the daytime 06.00-22.00.High level of noise pollution due to Poor maintenance and old technology. Basic value of L10 L50, and L90 calculated for each locations as per below.

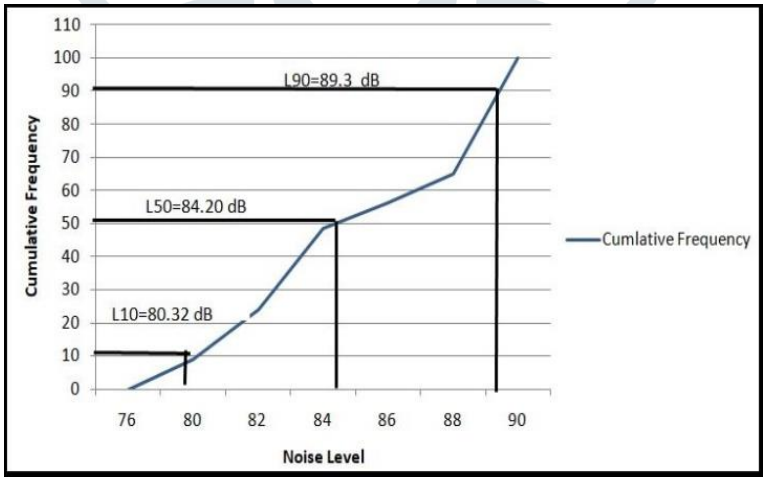


Figure1:Noise vs. Cumm. Frequency at Virgo complex

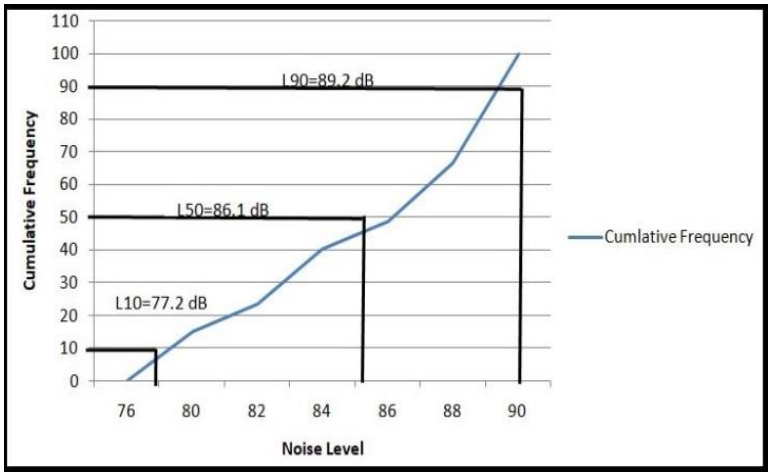


Figure2: Noise vs. Cumm. Frequency at Jayant Shah Hospital

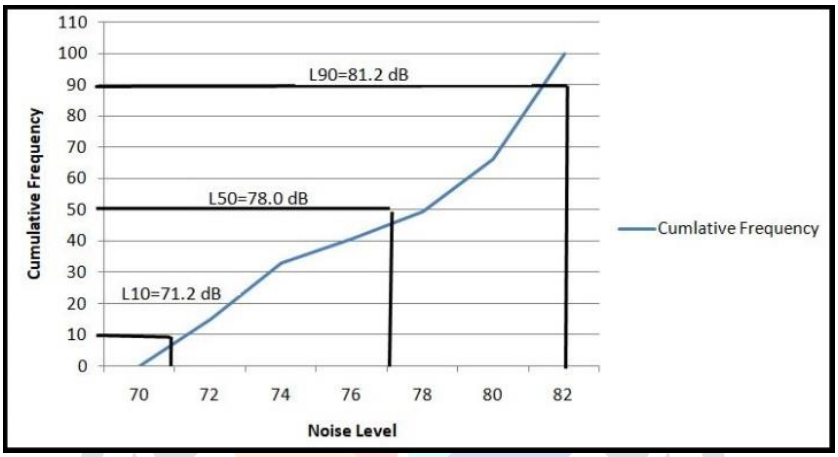


Figure3: Noise vs. Cumm. Frequency at Mahagujrat Circle

A level of service is defined based on the measure of Effectiveness0. Parameters such as travel time, speed density and delay are considered with respect to LOS of a road. Since level of service affects the ability of drivers to maneuver in the traffic stream.

## Noise vs PCU

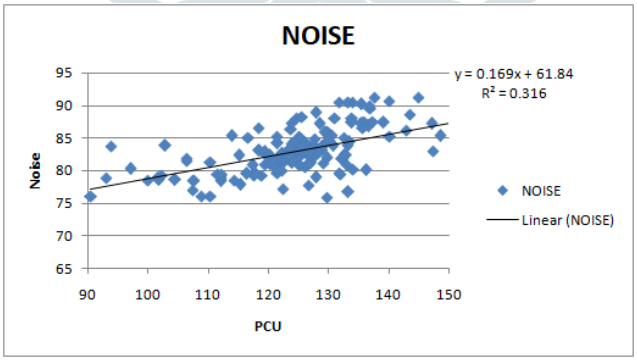


Figure4: Noise vs. PCU Virgo Complex

In Virgo complex R2 value is 0.316. This is indicating that noise generated is not only depending upon pcu.others parameters such as nearest commercial shops, markets, pedestrian etc.

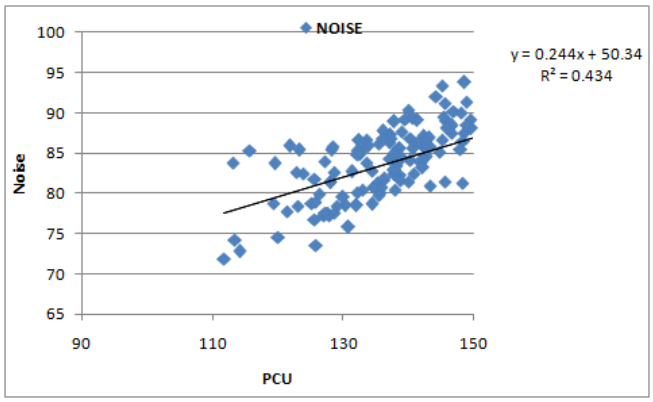


Figure5: Noise vs. PCU of Jayant Shah Hospital

In jayant shah hospital R2 value is 0.434.This is indicating that noise generated is partially depending upon pcu.

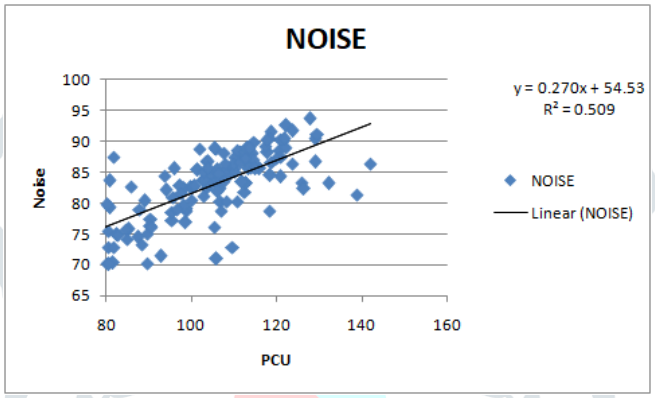


Figure6: Noise vs. PCU of MahaGujrat Circle

In Mahagujarat circle R2 value is 0.509.This is indicating that noise generated is depending upon only pcu.not others parameters affect like pedestrian, commercial shops, markets etc.

## VI. DEVELOPMENT OF MODEL

The LINEST function calculates the statistics for a line by using the "least squares" method to calculate a straight line that best fits your data, and then returns an array that describes the line. You can also combine LINEST with other functions to calculate t he statistics for other types of models that are linear in the unknown parameters, including polynomial, logarithmic, exponential, and power series. Because this function returns an array of values, it must be entered as an array formula.

1) MODEL-1 (for Virgo complex)
This model is developed for Virgo complex. Model is developed on the basis of data collected at location.

$$Leq=0.014628*(X1)+0.113736*(X2)+0.079717*(X3)+0.526665*(X4)+0.10362*(X5)+0.935014(W)+1.882697(T)+5.45623793$$

Where,
Leq = Noise level in dB
X1 = Volume of two wheeler
X2 = Volume of three wheeler
X3 = Volume of car
X4 = Volume of bus
X5 = Volume of LCV
W = Wind velocity in Km/hr
T = Temperature c°

2) MODEL-2 (Jayantshah Hospital)
This model is developed for Jayantshah Hospital. Model is developed on the basis of data collected at location.

$$Leq=0.03212*(X1)+0.110376*(X2)+0.063959*(X3)+0.586763*(X4)+0.147829*(X5)+1.78200\ (W)+0.150202(T)+43.88441335$$

Where,
Leq = Noise level in dB
X1 = Volume of two wheeler
X2 = Volume of three wheeler
X3 = Volume of car
X4 = Volume of bus
X5 = Volume of LCV
W = Wind velocity in Km/hr
T = Temperature in c°

3) MODEL-3 (Mahagujarat Circle)
This model is developed for Mahagujarat circle. Model is developed on the basis of data collected at location.

Leq=0.080712*(X1)+0.078603*(X2)+0.033806*(X3)+0.871636*(X4)+0.537509*(X5)+1.768819 (W)+0.537813(T)+30.4986597

Where,
Leq = Noise level in dB
X1 = Volume of two wheeler
X2 = Volume of three wheeler
X3 = Volume of car
X4 = Volume of bus
X5 = Volume of LCV
W = Wind velocity in Km/hr
T = Temperature in °c

## VALIDATION OF MODEL

Validation of model using F-test, T-test and Chi-Square test is described below.

Table no.2 Validation of Model

| | R | F observed | F critical | T observed | T critical | Chi observed | Chi critical | Comment |
|---|---|---|---|---|---|---|---|---|
| Model-1 | 0.63 | 1.88 | 1.757 | 0.59 | 0.458 | 1.165 | 1.145 | Accepted |
| Model-2 | 0.64 | 1.77 | 1.757 | 0.79 | 0.493 | 1.308 | 1.145 | Accepted |
| Model-3 | 0.7 | 2.08 | 1.757 | 0.47 | 0.483 | 2.336 | 1.145 | Accepted |

## XVII.CONCLUSION

The study presented in the paper has been conducted to formulate the delay mode of the selected stretch.

Table 3 : Comparison of measured and acceptable value

| Serial No. | Location | Measured $L_{eq}$ (db) | Acceptable outdoor Noise Level in Urban Area |
|---|---|---|---|
| 1 | Virgo complex | 85.58 | 65-55 |
| 2 | Jayant shah Hospital | 88.48 | 65-55 |
| 3 | Mahagujarat circle | 79.68 | 65-55 |

From the above table it is observed that seen that at all the selected location, value of Leq is much higher than the acceptable limits for urban area.

Table 4: LOS of selected stretch

| Road name | Peak Hours | Average speed (Km/hr) | Observed volume (PCU/hr) | V/C Ratio | LOS |
|---|---|---|---|---|---|
| Bus stand to Santram temple | 11.0 to 12.0 | 34.8 | 4082.1 | 0.76 | **D** |
| Jayant shah hospital to Globe | 11.0 to 12.0 | 32.5 | 4091.35 | 0.76 | **D** |
| Mahagujarat to vaniyawad | 11.0 to 12.0 | 27 | 1267.1 | 0.4 | **B** |

- Noise level (Leq) is evaluated at all selected location, as well as the parameters which affect the noise level like wind velocity, Atmospheric temperature, Traffic volume and average vehicle speed are evaluated at each location.
- The average noise levels (Leq) at all location are found and it is much higher than acceptable limits. The selected study area is suffering from very high amount of traffic noise so it is some remedial measures are also suggested in this research work.
- In model 1,2 and 3,the higher positive values of coefficient for bus and Lcv indicates that this two parameter will affect the generation of traffic noise more as compared to other parameters at midblock.
- Developed Models are validated on three statistical tests. The higher value of R2 for Model-3 indicates better prediction quality.
- Level of service of selected road section is calculated by v/c ratio, the observed level of service during peak hour periods is B and D.

## XVIII.REFERENCE

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