Urban Corridor Noise Pollution: A case study of Surat city, India

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Abstract. Traffic related noise pollution accounts for nearly two-third of the total noise pollution in an urban area. Noise, a byproduct of urbanization, industrialization and motorization, is increasingly recognized as an environmental nuisance that affects human health and wellbeing. Traffic noise on existing urban roadways lowers the quality of life and property values for persons residing near these urban corridors. Surat is now the tenth largest city of India having an estimated population of 40 lakhs plus at present. An inconceivable population growth rate of 76.02 % was observed in the last decade as a result of rapid industrialization. Surat is well known as diamond city and is also famous for silk and jari industry. Owing to its rapid industrialization and better job opportunities, observation is made for the migration from all over India and particularly from Orissa, U.P., M.P., Bihar and Rajasthan. Due to explosion of population and rapid industrialization the transportation in the city increased to unimaginable heights, but due to the want of efficient Mass Transit System, individual vehicular growth also touched escalating heights. As on 31-12-2006, the vehicles registered at R.T.O. is 13 lakhs plus. This is equivalent to the highest growth rate of Delhi. Thus the explosion of population, rapid industrialization and highest growth rate in vehicle population made the traffic problems complicated. This research paper highlights the noise pollution study carried out on three of the busiest urban corridors of Surat city.

Keywords: Urban corridor, noise pollution, traffic noise

1. Introduction

Due to urbanization, there is a huge increase in the vehicular population on the urban corridors. In India, transportation demand in urban areas continues to increase rapidly as a result of both population growth and changes in travel patterns. During the first decade of the 21st century only, the urban areas in the country confront a historic transportation crisis that has become a planning war against increasing mobility gridlock and noise pollution. Due to absence of a good, convenient and efficient public transport system in urban areas, there has been a need to develop the major corridors of the cities.

Traffic related noise pollution accounts for nearly two-third of the total noise pollution in an urban area. Traffic noise on existing urban road-ways lowers the quality of life and property values for person residing in vicinity of these urban corridors. Thus, the study of road traffic noise in big cities is an important issue. Due to limited availability of land resources and finances, many highways and important roads are in the residential and commercial areas. Hence there will be some adverse and environmental effects including psychological and physiological effects to those living to proximity of these corridors.

The recognition of road traffic noise as one of the main sources of environmental pollution has led to develop models that enable to predict noise level from fundamental variables. Traffic noise prediction models are required as aids for urban corridors and highways. In addition, sometimes these models are used in the assessment of existing or envisaged changes in traffic noise conditions.

So the present study was carried out to analyze the present state of noise pollution in three major corridors of the Surat city and to develop a linear regression model to analyze the corridors and to suggest proper measures to reduce the noise within permissible limits.
2. Study Area Profile

In India, geographical point of view Surat city is 260 km north of Mumbai city and 224 km south of Ahmedabad city. On map it is located at Latitude 210o 12’ N, Longitude 72o 52’E near bank of river Tapi. Surat is a city located on the western part of India in the state of Gujarat. It is one of the most dynamic cities of India with one of the fastest growth rate due to immigration from various parts of Gujarat and other states of India.

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Due to explosion of population and rapid industrialization the transportation in the city increased to unimaginary heights but due to the want of efficient Mass Transit system, individual vehicular growth also touched the heights. As on 31-12-2006, the vehicles registered at R.T.O. is 13.00 lakhs plus. This is equivalent to the highest growth rate of Delhi (capital of India) Thus the explosion of population, rapid industrialization and highest growth rate in vehicle population made the traffic problems complicated.

Surat city is an outcome of the expansion of the city’s limits at various intervals geared to accommodate the additional population and the increasing economic activities. In the year 1664, the city was limited to the inner walled city covering an area of 1.78 sq. kms. In 1707, with the construction of the outer wall, the area of the city increased to 7.36 sq. kms. For the next almost 250 years the increase in the city area wasn’t very significant and in 1963 the city covered an area of 8.18 sq. kms. In the same year 13.77 sq. kms. was added to the city area, increasing its total area to 21.95 sq. kms. From 112.27 sq. kms, the present area of Surat city is 326.515 sq. kms. Surat’s population has grown drastically. In the year 2001 the population of the city was around 25 lakhs and at present it is 40 lakhs plus. (As shown in Fig-1)

![Fig. 1: Year wise population of Surat city](image)

Source: Surat Municipal Corporation (SMC)

3. Vehicular Growth of Surat city

The enormous growth of the textile, diamond, and other Industries within the city, and setting up of large scale industries in Hazira and other industrial pockets around the city have resulted in the increase in trade & commerce activities and uplift of the socio-economic status of the people of Surat city. This is evident from the exponential growth of vehicles; particularly the 2-wheelers and cars (fig 2). The composition of vehicles is shown in Fig 3.
Total there are six corridors in Surat city. These corridors are (i) Kamrej-Varachha corridor (ii) Olpad-Rander corridor (iii) Hazira-Adajan corridor (iv) Sachin-Udhna corridor (v) Kadodara-Sahara corridor (vi) Dumas-Athwa corridor. These six corridors include diversified activities of business, residence, commerce and industries. A mix type of traffic has been observed on these corridors. Different type of land-use pattern has been seen along these corridors. Due to these reasons, out of the six corridors, Athwa, Sahara and Udhna corridors were selected for the study purpose.
4. Materials and methodology

The sound level meter used for this study was model no SL-4001. The step wise procedure followed in the study has been illustrated below:

Profile of the road and its surroundings was prepared i.e. height of the building along the road, open spaces along the road. Different main factors affect the traffic noise generation in most of the cities. In study the main factors like traffic flow (vehicles/min), open space, building height along the road were measured.

The noise levels were measured at rush hours (5-8 pm). The readings were taken on 3 major corridors of Surat city viz. (i) Kadodara-Sahara Darwaja road (ii) Dumas-Athwa Gate road & (iii) Sachin-Udhna Darwaja road. The readings were taken at an interval of 150m. A total of 32 reading (16 on each side) were taken on 1 corridor. Following this procedure a total of 96 readings were taken on the three corridors. The urban corridor noise model was built on the basis of readings of two corridors-sahara darwaja road & athwa gate road and the model was tested on the third corridor- udhna darwaja road.

For a one single corridor, the 1st point was taken as 0 m and the no. of vehicles i.e. no. of 2-wheelers, 3-wheelers, 4-wheelers passing through that section in 5 minutes were counted and a total of 16 readings were taken on one side of the road. Following this procedure, 32 readings on both side of the road were taken for one single corridor. After this the no. of vehicles were converted in Passenger Car Unit i.e. PCU. A factor of 0.75 for 2-w, 1 for 3 & 4 wheelers, 2.8 for buses and trucks respectively was adopted.

5. Results and discussion

Maximum noise was observed on Sahara corridor, the reason for this that on this corridor many business activities take place in addition to that big shopping malls are located. Average noise is highest on Udhna corridor due small scale industries and their related traffic movement. Maximum buildings are on Athwa corridor, which greatly affects the noise produced by traffic. Maximum open spaces are available on Sahara corridor and thus Sahara corridor has minimum average noise produced.

On all study corridors the maximum noise limits were ranging between (112-118) dB which was almost 1.5 times the permissible limits for commercial zone. The minimum noise level values were ranging between (69-78) dB, which was still crossing permissible limits. Average noise level values were between (92-98) dB which was crossing permissible limits.

Multiple linear regression analysis (MLRA) was done for the combined effect of PCU, building height and open spaces. The regression was done by the help of ORIGIN Software. The noise levels were regressed against the different building heights and observed $R^2$ value was found 0.81. This is indicating fairly strong relationship between urban corridor noise and building height. When noise levels were regressed against the
PCU, observed $R^2$ value was found 0.77. This proves existence of direct relation between PCU and corridor noise level. There is an inverse relationship between open space and noise level, with $R^2$ value 0.60.

On the basis of the experimental values, the major parameters PCU, building height and open space were regressed with noise level and regression model was built which is as follows:

$$Y = 73.99 + 0.05 X_1 + 1.14 X_2 - 0.088 X_3$$

Where $Y$ denotes noise recorded in decibels
$X_1$ denotes road PCU per minute
$X_2$ denotes building height along the road side
$X_3$ denotes open space for section considered

This model has $R^2$ value 0.76, which indicates good combined relationship of the three parameters upon noise. If PCU and building height increases the noise increases, but when the open space increases the noise level decreases. When regression was done by keeping noise as dependent variable and building height, PCU as independent variable, the value of $R^2$ obtained is 0.80. This shows that PCU and building height are dominating factor for urban noise.

From the study, it is clearly observed that the contribution of 2-Wheelers and 3-Wheelers in the PCU values are 38% and 43% respectively. This means that the maximum noise is produced by 2-W and 3-W only.

6. References