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Evolution of Noise Variation with Vehicular Speed on Rigid and Flexible Pavements

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ABSTRACT

Consequences of noise pollution and urban sprawl were foreseen a long ago, but with dramatic explosion in the number of road transport vehicles, It is coming up as one of most contributing environmental factor for the exposed urban population, especially those near highways. The objective of this research study is to analyze the variations in noise produced by a two wheeler vehicle at different speeds, on rigid and flexible pavement, namely NH56 (Rigid pavement)& NH31 (Flexible pavement). In the research study the observation of noise produced by the vehicle at different speeds are taken with the help of controlled pass-by method (CPB).Further, five different readings at consequent intervals of 10 km/hr, are taken and the mean is used in to carry out comparative analysis of noise produced among both type of pavements. It is found that the level of noise produced is directly dependent on the speed of vehicle and the nature of pavement. The average of five readings at every 10 km/hr interval for both type of pavement is shows that the difference among the level of noise produced is increasing in an escalated manner for rigid pavement. On an average there is difference of 10dBA of noise produced among both national highways.

Keywords-controlled pass-by method, Rigid pavement, Flexible pavement, tyre-pavement noise, regression analysis

1. INTRODUCTION

In the present scenario the roadway transportation benefited us in many ways. Furthermore roadway transportation has a dark side in the form of nuances of tire-road noise with increasing traffic condition. India which is developing country and is in the race of growing country the problem of noise pollution is noticeable. Roadway noise is a type of noise which is different to other amiable

noise which disturbs residents near the roadway. The roadway noise is rapidly increasing problem. The main objective of this research study is to create an idea to analysis the tyre- road noise on the two different types sort of road in Jaunpur, measuring of rigid & flexible pavement in Jaunpur city at various traffic speed from 10 kmph to 80 kmph. Urban areas are mostly cope with this problem where traffic volume on road is growing at accelerated manner. To look into this matter the central pollution control board setup the benchmark related to noise produced by vehicle, which is to be less than 75dB for two wheeler vehicles.

2. STUDY AREA

Jaunpur district is one of the prime districts in the Indian state of up. It is located 228km south east from state capital Lucknow. To perform the test two location is selected, first is NH-56 (Rigid Pavement) near Lakhauan and other one is NH-31 (Flexible Pavement) near Sikarara. Lakhauan and Sikrara is the two location where urbanization and traffic load increases simultaneously.

3. STUDY METHODOLOGY

In this study controlled pass- by method (CPB) are adopted. It is a method of measuring noise at a particular section in an controlled manner. Controlled manner implies that the vehicle is fixed and the measurement of noise is taken at desired speed. In CPB method all type of noise produced by a running vehicle is taken into consideration such as exhaust, engine, aerodynamic noise & tyre-pavement noise.

In this methodnoise level was measured w.r.t. instantaneous speeds. Noise level was measured with the help of sound pressure level meter where measuring microphone was placed at a distance of 7.5m from the center of side lane of road and 1.2m above the ground level. Digital speedometer installed in the vehicle was used to determine the speed of the vehicle at the location. The observation were taken when the vehicle exactly passed from the midpoint of site location and SPL meter measured Lmax at that time.

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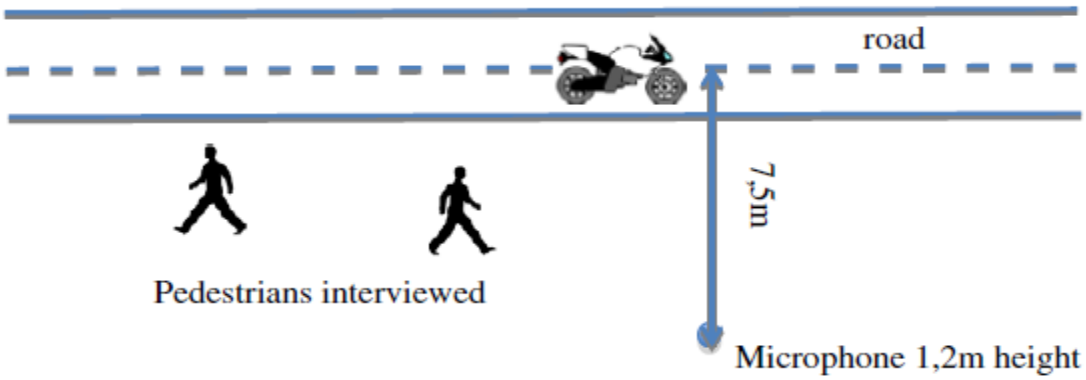

Fig. 1. Layout the test section.

4. TEST CONDITION

Maximum of 5 dB disturbance in readings due to wind was tolerated while taking readings with the help of sound pressure level meter. Temperature at the time of measurement varied between 5 to 30ºC. In this research paper specially two wheeler vehicle were used once at a time at selected road section and max soundpressure level was collected for each pass – by using sound level meter. While taking reading there should not be any vehicle within selected area. For dealing with this situation two volunteer were present at 500m distance from the location where the reading were taken and extra effort was laid on taking reading without any external disturbance like as wind and other vehicle.

5. RESULT AND ANALYSES

All the controlled pass - by information were examined and dissected as per the set up, and logically based technique as recently talked about in the examination approach. A linear regression was fit usingL_{max} collected by max sound pressure level meter and speed of the vehicle for two wheeler vehicles to comprehend the connection between the noise pressure level and vehicle speeds.

The noise pressure level for rigid pavement was examined from the noise information acquired from NH-56 test segments. Lmax for individual vehicle was acquired, and after that linear regression analysis was directed betweenL_{max} and speed v for two wheeler vehicles. It comprehended the reliance of the noise pressure level on the vehicle speed with the help of coefficient of determination (R^2) as appeared in

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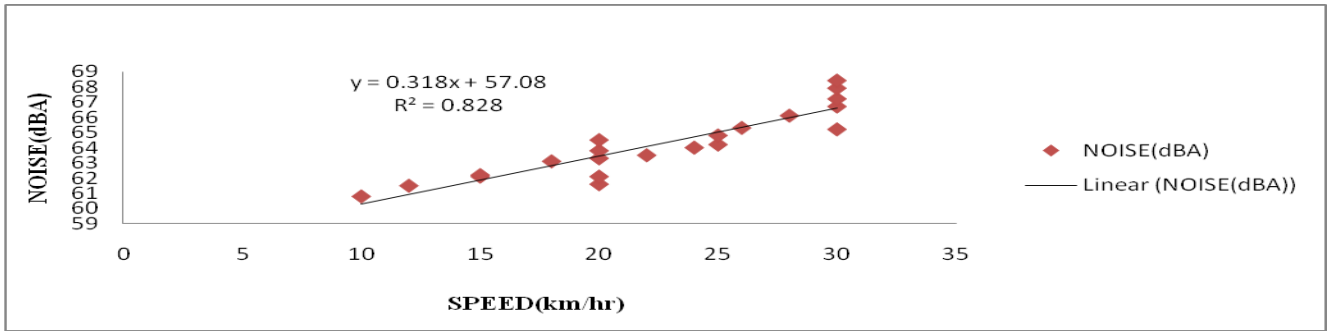
Figure 2. The variety of Lmax was observed to increment with an increment in vehicle speed, which can be comprehended by the slant of the relationship. It was watched that for an adjustment in speed v, L_{max} for the three categories low, medium and high expanded.

Fig. 3 demonstrates connections of Lmax versus v at low,medium, and high speed conditions for flexible pavement area on NH-31. The variety of L_{max} was observed to increment with an expansion in vehicle speed, which can be comprehended by the incline of the relationship. It tends to be seen that the Lmax for the two wheeler vehicle shows similar reliability like the rigid pavement but the max noise level are differ.

Nonetheless, all in all, for both the pavement types,noise pressure level expanded with expanding vehicle speed. The connections among L_{max} and v were examined distinctly for low,medium, and high speed conditions.

(a)



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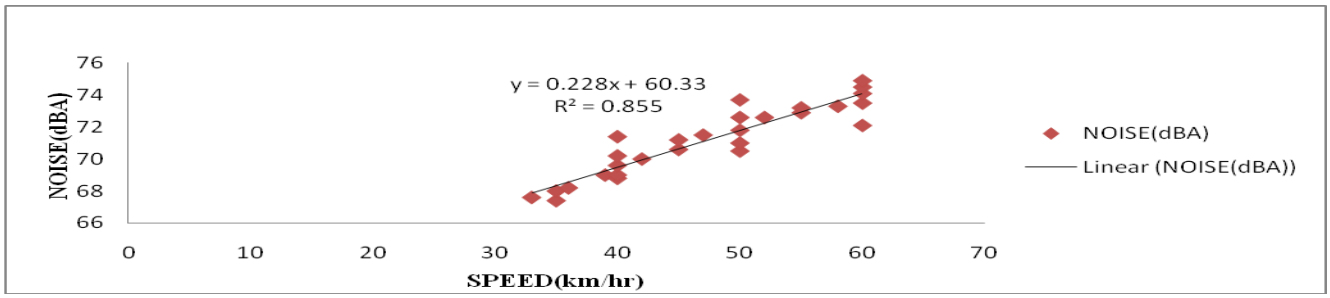

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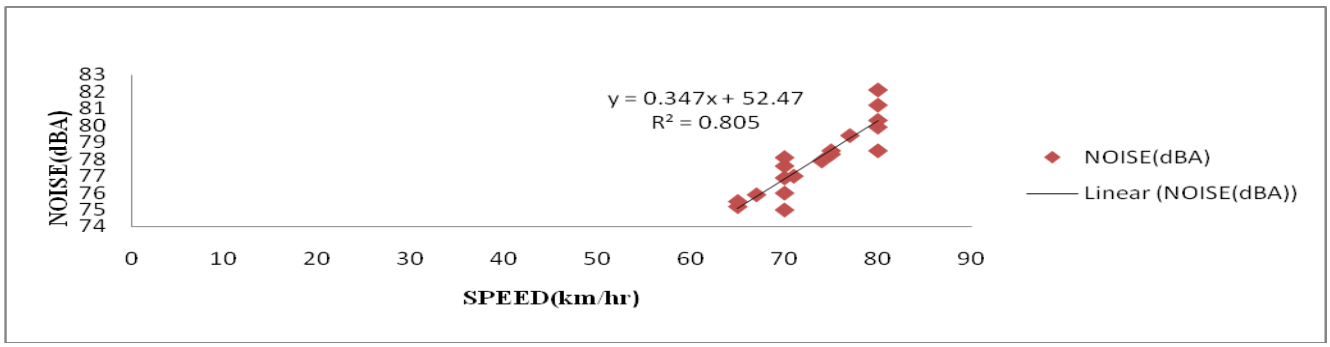
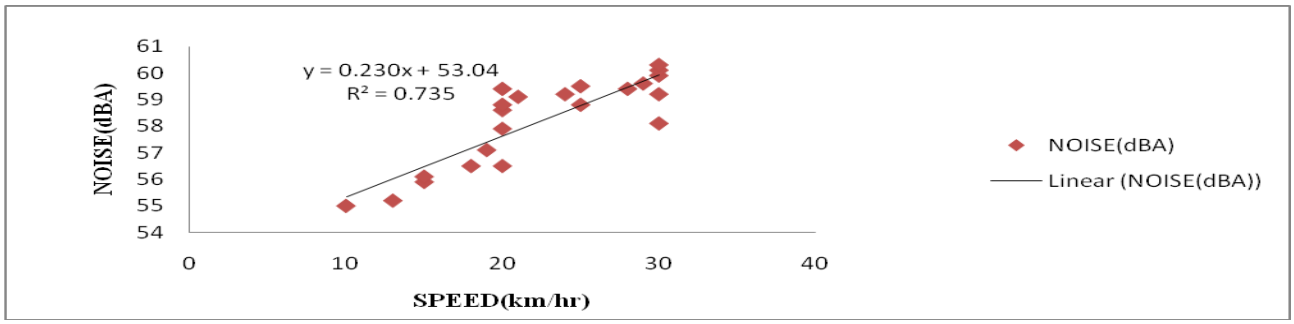


Fig.2. Sound pressure and speed relationship for rigid pavement on NH-56 at: (a) low speed; (b) medium speed;(c) high speed

(a)



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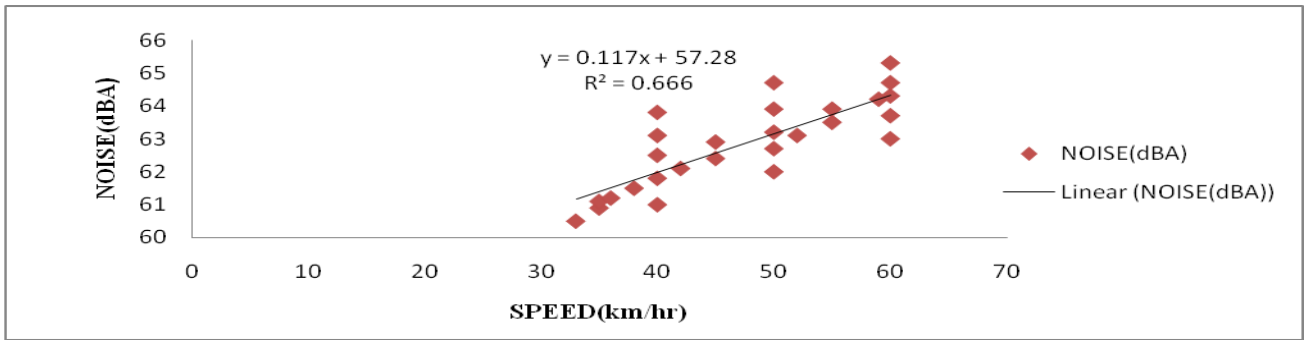

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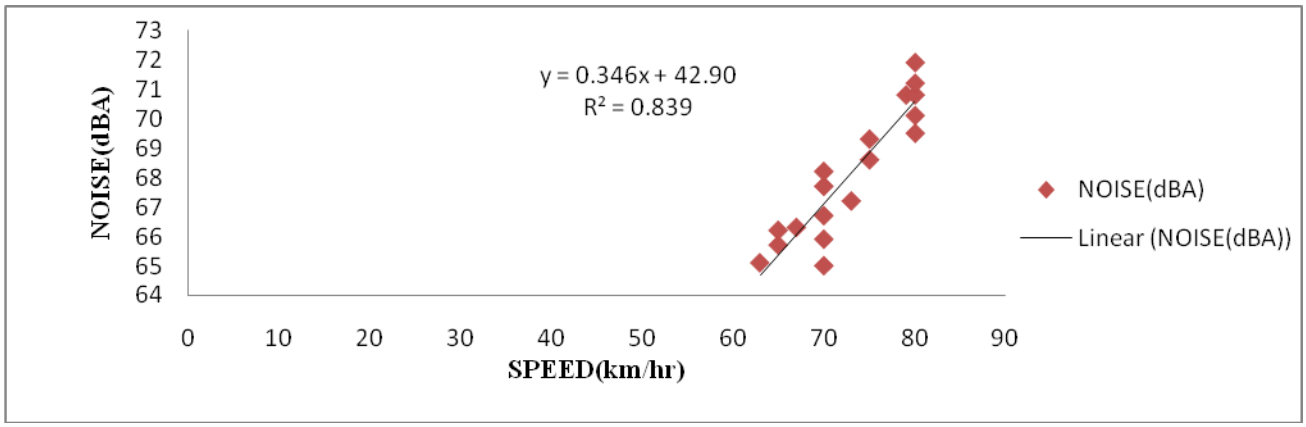

Fig.3. Sound pressure and speed relationship for flexible pavement on NH-31 at: (a) low speed;(b) medium speed;(c) high speed

Comparison of rigid and flexible pavement on the basis of maximum sound pressure level at different fix speed. Five readings were taken of noise at a particular speed and the range of all five noise level at different speed are shown in table no1.

Table 1

Noise levels (two wheeler vehicle) obtained by CPB method.

SPEED(km/hr)	LA_{max} (dBA)						
	20	30	40	50	60	70	80
RIGID PAVEMENT	61.6/64.5	65.2/68.4	68.8/71.4	70.5/73.7	72.1/74.9	75.0/78.1	78.5/82.1
FLEXIBLE PAVEMENT	56.5/59.4	58.1/60.3	61.0/63.8	62.0/64.7	63.0/65.3	65.0/68.2	69.5/71.9

On the basis of all five reading at a particular speed average sound pressure level of noise at all above speedis calculated in table no2.

$L_{avg} = 20 \log [1/N\sum(10)^{L/20}]$

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Where:

L_{avg} = Average noise levels (dBA)

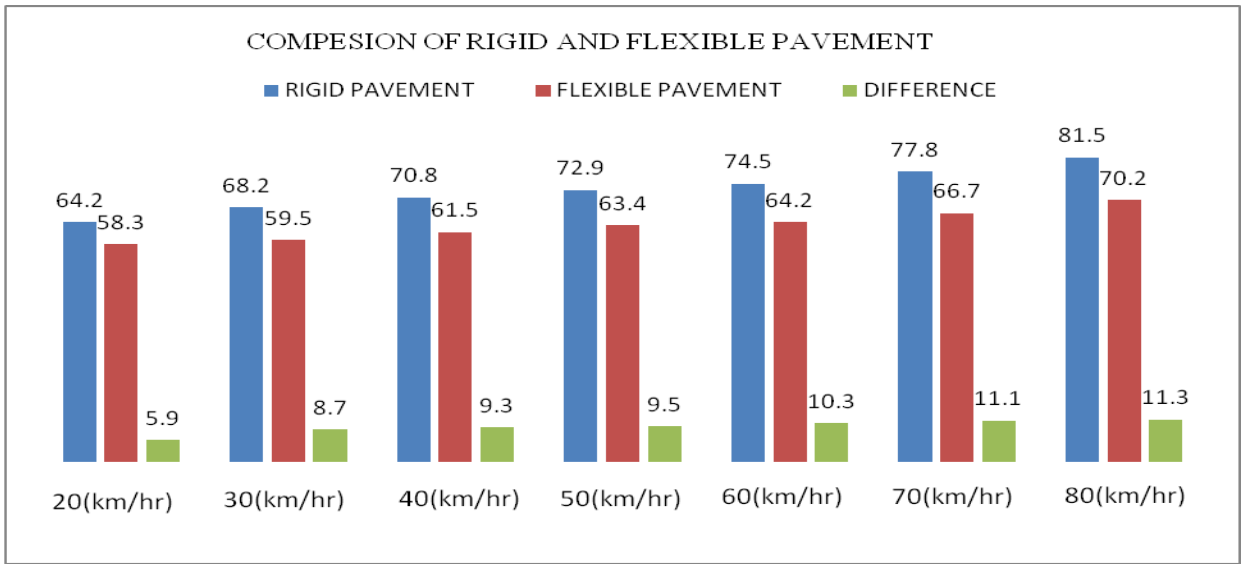
N= Number of reading available

L = maximum sound pressure level

Table 2

Average noise levels (two wheeler vehicle) obtained by above formula.

SPEED(km/hr)	LA_{max} (dBA)						
	20	30	40	50	60	70	80
RIGID PAVEMENT	64.2	68.2	70.8	72.9	74.5	77.8	81.5
FLEXIBLE PAVEMENT	58.3	59.5	61.5	63.4	64.2	66.7	70.2
DIFFERENCE	5.9	8.7	9.3	9.5	10.3	11.1	11.3



In the above chart average noise of five reading and there difference at each particular speed are plotted for both pavement. The above chart represent that the level of noise produced is directly dependent on the speed of vehicle and the nature of pavement as well. The average of five reading at every 10 km/hr intervals for both type of pavement is showing that the difference of level of noise is escalating in an elevated manner for rigid pavement. On an average there is difference of 10dBA of noise produced among both national highways.

CONCLUSION

Moving toward our research from a down to earth perspective, two key elements related to noise moderation should to be considered: pavement type and vehicular speed. Two national highway test areas covering rigid and flexible pavement were selected to do the noise measurements, and after that comprehend the impact of vehicle speeds on the general noise profile. In the research study the observation of noise produced by the vehicle at different speeds are taken with the help of controlled pass-by method (CPB). It is found that the level of noise produced is directly dependent on the speed of vehicle and the nature of pavement and difference among the level of noise produced is increasing in an escalated manner for rigid pavement. On an average there is difference of 10dBA of noise produced among both national highways.

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