A STUDY ON THE INSERTION LOSS EFFICIENCY WITH RESPECT TO HEIGHT OF NOISE BARRIERS INSTALLED ALONG FLYOVERS IN THE CITY OF LUCKNOW

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ABSTRACT

It has become essential to construct noise barriers along traffic roads in order to decrease the intensity of noise to an acceptable level in nearby residential areas. Residents living near urban roads and major highways have become concerned about noise pollution. There are different zones in Lucknow city based on its land use in order to study the noise levels due to vehicle movement. The noise data analysis also take other factors into account, including terrain, traffic speed, cross sections, and traffic composition. This paper highlights the noise levels at the fly over situated on Talkatora road(D1), Tulsi Das Marg(D2) and Nirala Nagar(D3) (Lucknow, UP, India) are selected for the study and the heights of the noise barrier installed were 1.35m ,0.62m, and 1.22m (with edge 0.24m) respectively. Barrier height, type of traffic, ground equivalence, height of measuring instrument and barrier material are taken into consideration. The readings were taken at one side of barrier and traffic noise source was chosen. The pavement material is same and instrument has been kept 5m behind the barrier and then 5m at open space where barrier was not present. This experiment has been done on all the three sites. Due to the presence of noise barrier the reduction in noise as insertion losses with respect to presence of barrier were found to be upto 8 dBA at site D1(barrier height = 1.35 m), upto 6 dbA at site D2 (barrier height =0.62m),) and upto 13 dbA at D3(barrier height = 1.22m with edge 0.24m). Also it was inferred that due to presence of edge on site D3, there is less diffraction of sound waves from the top edge of barrier. This result was compared with CPCB and all the three barriers have proved to be efficient as they are reducing the noise of more than 5 decibels.

Keyword :-*Insertion loss, Noise barrier along flyovers, Noise levels*

1. INTRODUCTION

Traffic noise is a significant supporter of by and large noise pollution. Traffic noise from expressways makes issues for encompassing territories, particularly when there are high traffic volumes at high speeds. Vehicular traffic noise is fundamentally contributed via autos, for example, vehicles, bicycles, trucks what's more, transports.

Noise caused by traffic is proportional to the magnitude of traffic volume which further depends upon urbanization, industrialization and growth in population. All automobiles generate noise. Various factors that affect the magnitude of noise includes size of the engine, maintenance of the engine, speed of vehicle, tyre quality, type of Fuel and road condition.

The barrier for reducing noise along the road will provide noise protection to areas nearby. The reduction of noise from the traffic will allow for the creation of communallandscape areas for people to relax and socialize without

disturbance from the vehicular movement.

Table 1 Ambient Noise Standards (India)

Sl. No	**Category**	**Leq dbA**	
		Day Time	**Night Time**
1.	Industrial	75	70
2.	Commercial	65	55
3.	Residential	55	45
4.	Silence	50	40

Table 2 Noise Level Standards for Residential Area in India

Sl. No	**Location**	**Acceptable Noise Level in dB (A)**
1.	Rural area	25 to 35
2.	Suburban area	30 to 40
3.	Residential area	36 to 45
4.	Urban area (Residential and Business)	40 to 45
5.	City	45 to 50

2. OBJECTIVES OF THE STUDY

The specific objectives to this study will be to:

- To determine the efficiency of various noise barriers constructed along flyover
- To study the insertion loss of the sound wave after striking with the barrier.
- To examine influence of noise level conditions in different time intervals in a day.
- To study the intensity of noise levels with and without barriers.
- To check the resultant attenuations and its dependencies with respect to barrier height

3. DESCRIPTION OF STUDY AREAS

A) FLYOVER AT TALKATORA ROAD (D1)

The locality Talkatora falls in Lucknow district situated in Uttar Pradesh state having area isof 1.53km^2 and contains a population of 11523(in 2020) with population density of 7551 people per km^2. It is of two lane and constructed on Vikram cotton mill marg. The coordinates are latitude 26°49'09.5"N and longitude 80°53'53.9"E.

Fig 1. Image of Talkatora marg flyover

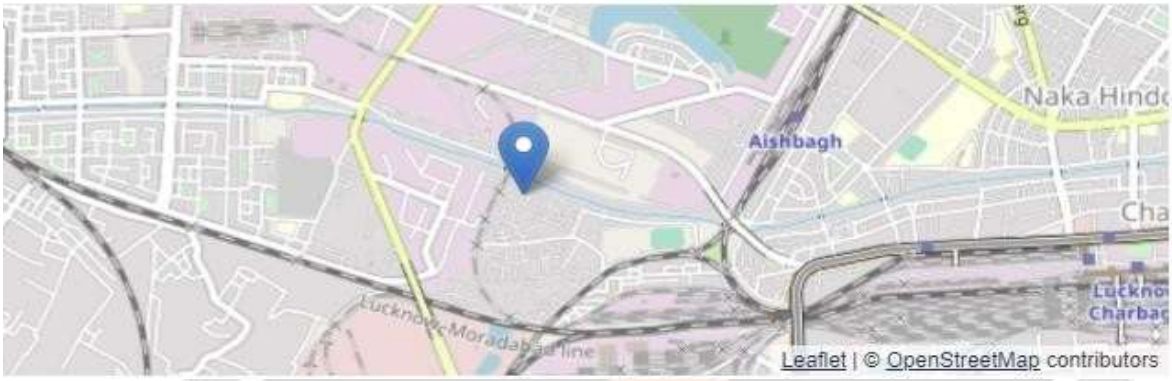

Fig 2. Google map of Talkatora marg flyover

B) TULSIDAS MARG FLYOVER (D2)

Lucknow Chowk falls in Lucknow district situated in Uttar Pradesh state, with a population300749 (in 2020). Population Density of 7743 people per km^2.

Fig 3. Image of Tulsidas marg flyover

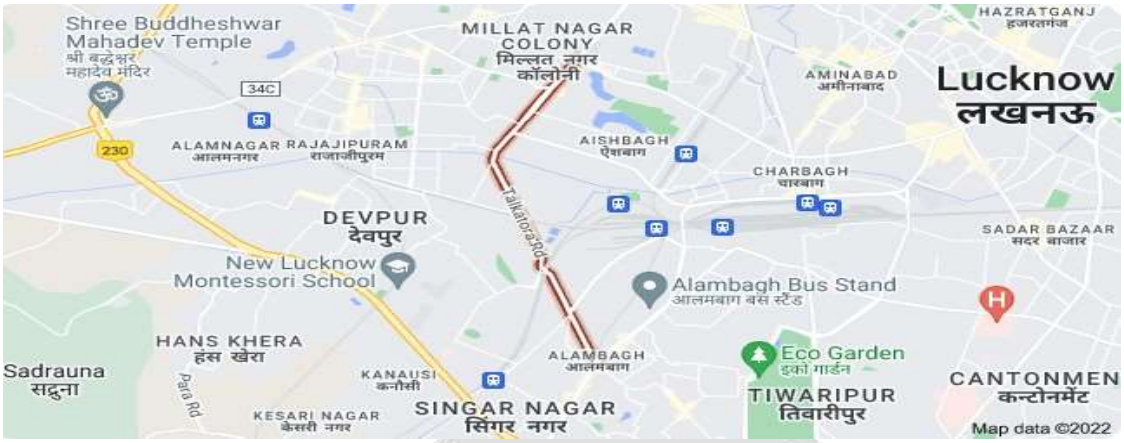

Fig 4. Google map of Tulsidas marg flyover

C) FLYOVER AT NIRALANAGAR (D3)

The locality Nirala Nagar falls in Lucknow district situated in Uttar Pradesh state, with a population 23290(in 2020). The size of the area is about 1.9 square kilometer with population density of 12262 people per km^2. The coordinates are latitude 27°45' and longitude 81°57'.

Fig 5. Image of Nirala nagar marg flyover

Fig 6. Google map of Nirala nagar marg flyover

4. RESULTS AND DISCUSSIONS

4.1 READINGS OBTAINED FOR SITE D1, D2 AND D3

On the flyover bridge, there is a noise barrier located at the end. It is decided to have one reception point behind the barrier and one reception point away from the barrier i.e. later represents the open space behind the barrier and is situated so that there are no obstacles in the sound propagation. The instruments were kept at 0.8 m high platform where it has to be set up. The measuring stations were chosen one behind the barrier and other behind the open space on the same line parallel to the first instrument. Flyover bridges are the only structures with this type of barrier. A variable traffic noise source of different frequencies and different intensity were used as the noise source i.e., for measuring in the presence and absence of the noise barrier. The acoustic equivalent is used for calculating the insertion loss of the noise barrier. Noise intensity depends upon ground equivalency and height of receiver so all the sites have bituminous pavement road and height of the instrument was kept same. The flyover platform distance which supports the barrier was also kept same from where the SLM was placed i.e. 5m. Eighty readings of noise levels were obtained every hour. Two readings were taken at every minute at an interval of 15 seconds one with barrier and other without barrier. L(A- weighted equivalent) values were obtained for every hour. At every location 960 total reading were obtained for 12 hours. Further, Equivalent readings were obtained for different time zones in a day i.e. for morning, afternoon and evening separately. Comparison chart is shown among various noise levels obtained and CPCB standards.

Table 3. Hourly noise level readings of site D1 at a distance of 5 m from center of the road (talkatora flyover, Height = 1.35m)

Time	Lmax (dBA)	
	Without Barrier	With Barrier
9am to 10am	98.2	88.3
10am to 11am	95.6	85.3

11am to 12pm	96.6	86.0
12pm to 1pm	99.3	89.3
1pm to 2pm	92.7	82.4
2pm to 3pm	96.1	85.6
3pm to 4pm	94.5	83.3
4pm to 5pm	96.1	85.8
5pm to 6pm	90.9	80.3
6pm to 7pm	97.8	88.0
7pm to 8pm	97.9	87.5
8pm to 9pm	98.4	87.5

Table 4. Hourly noise level readings of site D2 at a distance of 5 m from center of the road (TulsiDas marg flyover, Height = 0.62m)

Time	Lmax (dBA)	
	Without Barrier	With Barrier
9am to 10am	91.2	86.9
10am to 11am	92.6	89.3
11am to 12pm	88.1	84.3
12pm to 1pm	84.5	80.2
1pm to 2pm	97.5	94.5
2pm to 3pm	97.6	93.7
3pm to 4pm	91.3	87.5
4pm to 5pm	86.3	82.3
5pm to 6pm	86.1	81.9
6pm to 7pm	94.5	90.7
7pm to 8pm	94.2	89.8
8pm to 9pm	89.5	85.0

Table 5. Hourly noise level readings of site D3 at a distance of 5 m from center of the road (NiralaNagar marg flyover, Height = 1.22m with edge of 0.24

Time	Lmax (dBA)	
	Without Barrier	With Barrier
9am to 10am	98.2	88.3
10am to 11am	95.6	85.3
11am to 12pm	96.6	86.0
12pm to 1pm	99.3	89.3
1pm to 2pm	92.7	82.4
2pm to 3pm	96.1	85.6
3pm to 4pm	94.5	83.3
4pm to 5pm	96.1	85.8
5pm to 6pm	90.9	80.3
6pm to 7pm	97.8	88.0
7pm to 8pm	97.9	87.5
8pm to 9pm	98.4	87.5

4.2 PARAMETERS USED

Noise equivalent by A- weighted noise level (Leq), different percentile values (L10 , L50, L90), noise climate(NC), Noise pollution level (LNP), and traffic noise index were computed using following equation:

- NC= L10-L90
- Leq = $L50 + NC^2/2$
- TNI = 4 *(NC) + (L90 – 30)
- LNP = NC + Leq

Where,

- NC is Noise Climate; L10 is the level of sound exceeding for 10% of total time of measurement or Peak Noise Level;
- L50 is the level of sound exceeding for 50% of total time of measurement or MeanSound Level;
- L90 is the level of sound exceeding for 90% of total time of measurement orBackground or Residual Noise Level;
- Leq is Equivalent continuous noise level and; Lnp is the Noise Pollution Level.
- The noise pollution level (LNP) is the amount of noise that is given by the combinedeffects of the energy average and the variation characteristics
- Traffic Noise Index (TNI) is a parameter which indicates. the degree of variation in atraffic flow expressed in dB (A).

4.2.1 Average Values of Noise parameters

Here, equivalent noise levels were obtained for successive four hours i.e. 9 am to 1 pm for morning (M), 1pm to 5 pm for afternoon (A) and 5 pm to 9 pm for evening (E). Thus the all parameters obtained from the above formula are mentioned in tables below.

Table 6 . Parameters for Talkatora road flyover site (D1)

	M	A	E
L10	91.5	85.1	86.7
L50	81.2	77.6	79.4
L90	76.8	73.5	73.1
NC	14.7	11.6	13.6
Lavg	104.5	101.1	98
TNI	105.6	89.9	97.5
LNP	99.5015	91.44267	96.08267
Leq	84.8015	79.84267	82.48267

a. Readings taken in the absence of the barrier.

	M	A	E
L10	83.3	78.1	79.2
L50	74	71.3	72.6

L90	69.5	67.3	65.4
NC	13.8	10.8	13.8
Lavg	101.8	99.07	95.6
TNI	94.7	80.5	90.6
LNP	90.974	84.044	89.574
Leq	77.174	73.244	75.774

b. Readings taken in the presence of the barrier.

Table 7. Parameters for TulsiDas marg flyover site (D2)

	M	**A**	**E**
L10	79	85.3	81.8
L50	73	77.5	74.2
L90	64	69.1	66.4
NC	15	16.2	15.4
Lavg	91.3	96.4	93.5
TNI	94	103.9	98
LNP	106.3	112.6	108.9
Leq	76.7	81.8	78.1

a. Readings taken in the absence of the barrier.

	M	**A**	**E**
L10	79.9	84.7	81.3
L50	68.4	74.2	69.8
L90	59.8	64.3	61.9
NC	20.1	20.4	19.4
Lavg	87.6	92.9	89.4
TNI	110.2	115.9	109.5
LNP	107.7	113.3	108.8
Leq	75.1	81.1	76.0

b. Readings taken in the presence of the barrier.

Table 8. Parameters for Nirala Nagar marg flyover site (D3)

	M	**A**	**E**
L10	87.4	84.1	86.2
L50	82.4	75.2	78.5
L90	71.6	68.8	68.9
NC	15.8	15.3	17.3
Lavg	98.92	96.33	98.34
TNI	104.8	100	108.1
LNP	114.72	111.63	115.64
Leq	86.56067	79.1015	83.48817

a. Readings taken in the absence of the barrier.

	M	A	E
L10	76.8	73.5	75.4
L50	69.7	64.32	68.5
L90	61.2	58.3	59.6
NC	15.6	15.2	15.8
Lavg	88.79	85.78	87.94
TNI	93.6	89.1	92.8
LNP	104.39	100.98	103.74
Leq	69.7	68.17067	72.66067

b. Readings taken in the presence of the barrier.

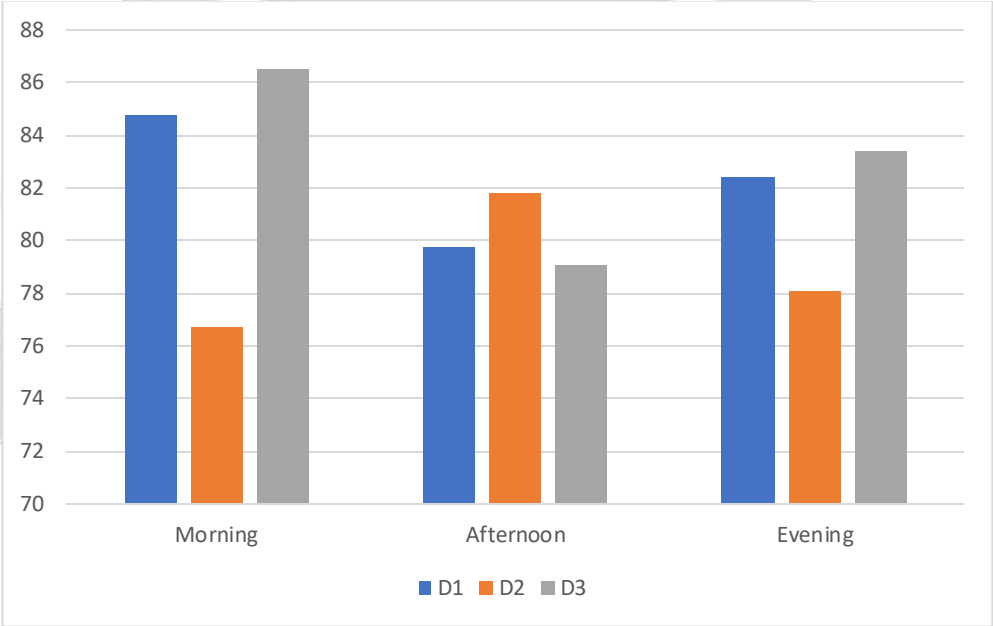

Chart 1. Leq without the barrier

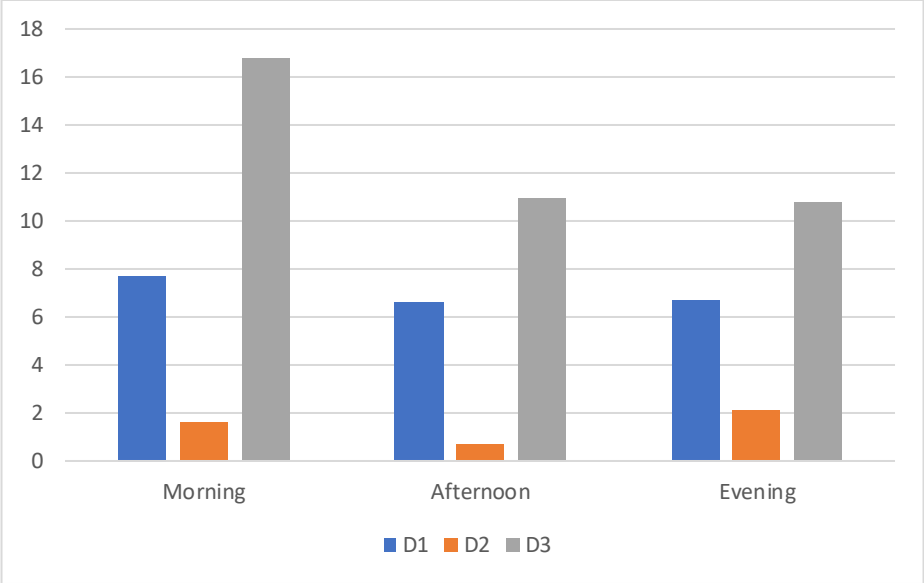

Chart 2. Insertion loss (Leq) With Barrier

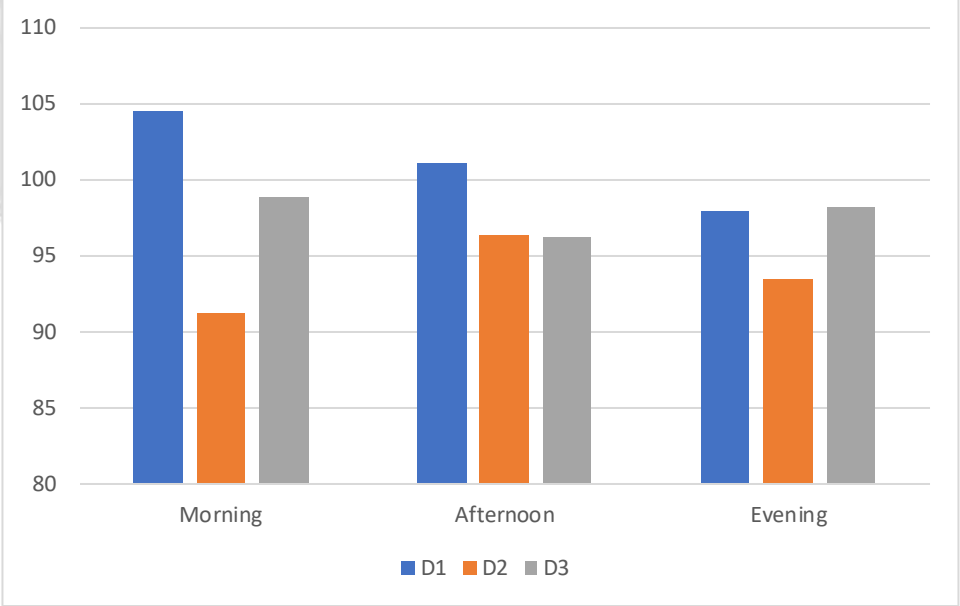

Chart 3. Lavg Without Barrier

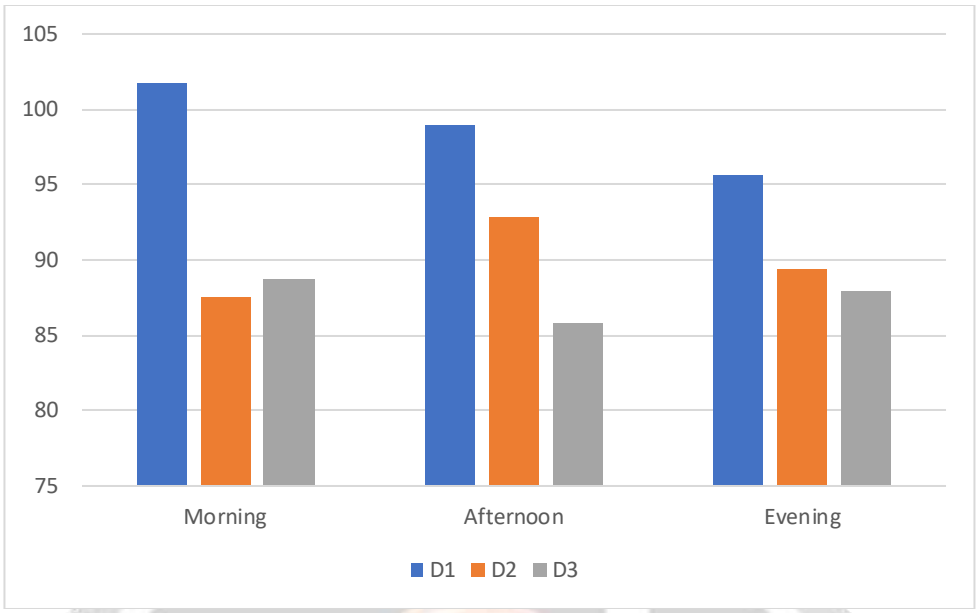

Chart 4. Lavg With Barrier

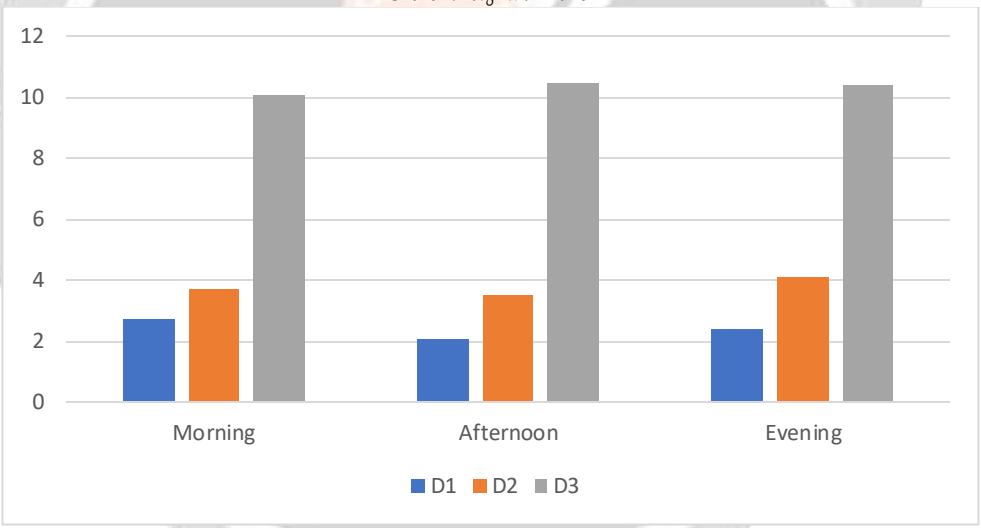

Chart 5. Insertion loss Lavg

5. Conclusion

- The instruments were placed 5m away from each barrier only on one side when the platform supporting the base of the barrier reached at a height of 5m from the road passing under it to keep the height of reception points equivalent as comparing from every site. The pavement material is same (Bituminous Concrete) in all the sites taken into consideration.
- All the three sites have different traffic conditions and volume, so the purpose was to study the overall effect and reduction of noise in the presence of barrier.
- The environment is considered to be in diffused field so noise levels are considered to be same at every point within the overall width of pavement and reflected waves are considered as equally strong as the direct waves.

- The Insertion losses are greatly influenced by frequencies. IC engines and horn sound in vehicles with large frequencies tends to have greater insertion loss and those with low frequencies, the insertion losses are less.
- On site D1, the traffic volume is more and the congestion occurs more frequently, so the noise levels obtained are more and also the reduction is more due to large barrier height.
- It was found that the barrier located at sight D1 is more efficient than barrier at site D2 because height of the barrier at D1 is more (1.35m) than barrier at location D2 (0.62m)
- Further, barrier at site D3 (1.22m, edge = 0.24m) is most efficient despite of its height is less than barrier at site D1 (1.35m) because of the presence of edge on top of the barrier as it reduces diffracted sound waves from the top.

Insertion losses are accordingly:

- Site D1 (1.35mm) = upto 12 dbA
- Site D2 (0.62m) = upto 6 dbA
- Site D3 (1.22m with diffracting edge of 0.24m) = upto 15 dbA

6. References

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