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# IMPACT OF ENVIRONMENTAL NOISE BARRIER ON NOISE REDUCTION AND FREQUENCY SHIFT

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## ABSTRACT
Noise barriers are exterior structures provided to protect sensitive land uses from noise pollution. In fact, noise barriers are the most effective tools of mitigating roadway, railway, and industrial noise sources. But, the construction of the noise barrier, and the measurement of the effectiveness of the noise barrier is a difficult task. The way of increasing (propagating) or decreasing (attenuating) of noise between the source and the receptor is dependent on various factors such as location of barriers and receptors, height and materials of noise barriers etc. In the present study, an attempt has been made to assess the noise levels as well as frequency shift, before and after installation of environmental noise barriers. The noise measurement, sonogramme and waterfall analysis have been carried out at IFFCO Chowk near metro curve, where etching noise was a major problem. It has been found that before construction of noise barrier etching noise was observed to be 2k hz to 10k hz, however, after installation of noise barrier, the frequency shifted from 50hz to 200hz. The sonogramme and waterfall analysis has also supported the findings of present study i.e., reduction in noise levels and the frequency shift.

***Key Words:** Noise Barrier, Sonogramme, Waterfall, Reflective, Etching Noise*

## INTRODUCTION
Noise barriers are exterior structures provided to protect sensitive land uses from noise pollution. In fact, noise barriers are the most effective tools of mitigating roadway, railway, and industrial noise sources. But, the construction of the noise barrier, and the measurement of the effectiveness of the noise barrier is a difficult task. The way of increasing (propagating) or decreasing (attenuating) of noise between the source and the receptor is dependent on various factors such as location of barriers and receptors, height and materials of noise barriers etc. A number of studies have been conducted on barrier designs by researchers around globly, usually involving mathematical calculations of noise reduction benefits. Several studies have been conducted in Japan (Matsumoto *et al.*, 1994); Australia (Alfredson and Du, 1995); France (Berengier and Anfosso-Ledee, 1998); United States (Suh *et al.*, 2001); (Mongeau *et al.*, 2003) and (Suh and Badagnani *et al.*, 2003). In Netherlands, research has primarily focused on developing a quieter pavement surface (Hofman, 2005) a research has also concentrated on innovative barrier designs, specifically T-top profiles with absorptive materials (Nijland *et al.*, 2003 and Ooststroom, 2005). The Government of Hong Kong has centered on specific applications of noise abatement in highly urbanized areas, identifying several innovative and rather extreme techniques to reducing roadway noise in tunnels (Hong Kong Special Administrative Region, 2005). In Canada, researcher identified some specific potential application scenarios for some of the barrier designs (May and Osman, 1980a). In United Kingdom researcher conducted full-scale controlled tests of multiple-edge barriers, T shaped barriers and double barriers, showing attenuation of 1.4 to 3.6 dB(A) in compared to a single vertical reflective barrier (Watts *et al.,* 1994). In Japan researcher also examined various types of barriers with reflective and absorptive materials, an absorbing barrier's performance in better design, and at the top modification provided slight changes in performance i.e. T-shaped barrier provided the best performance (Ishizuka and Fujiwara, 2004).

In United Kingdom, the study provided a series of noise barrier profiles, described the effects of ground and climate conditions, identified the types of barriers commonly used in practice. Ekici and Bougdah, (2003) and Cohn and Harris, (1993) for the Washington Department of Transportation, conducted a similar study of various noise barrier designs. The study was followed by two phases of research into a short-list of barrier designs (Cohn and Harris, 1995) and scale modeling designs (Cohn and Harris, 1996). In the present study an attempt has been made to assess the noise levels as well as frequency shift, before and after installation of environmental noise barriers.

## MATERIALS AND METHOD

### *Location Map*

Three locations have been identified at IFFCO Chowk, where train is taking turn near Essel Tower. In Down ward operation from Jahangir puri - IFFCO Chowk
Location-1; At starting point of turning
Location-2; At the middle point of turning
Location-3; At the last point of turning


**Route of Metro Train**

**Location-1 at 7m Distance from Metro at Track Level**

**Location-1 at 14m Distance from Metro at Track Level**

**Location-1 at 28m Distance from Metro at Track Level**

CSIR-CRRI has monitored noise at three different locations of IFFCO chock, near Essel Tower at 7m, 14m & 28m distance at rail level in up (IFFCO Chowk-Jahangir Puri) & Down (Jahangir Puri - IFFCO

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Chowk) condition. CRRI has also monitored the different parameter of noise i.e. sonogramme, waterfall, 1/3 octave & FFT analysis to find out the frequency analysis of metro engine noise and rail noise before & after installation of noise barrier. 2m height of reflective noise barrier of 8mm polycarbonate sheet slightly curve has been installed at curve portion of IFFCO chowk metro corridor. Noise is unwanted sound. It is a pollutant and a hazard to human health and hearing. Noise levels are measured in decibels. The decibel (dB) is a unit which expresses the ratio of the sound pressure level being measured to a standard reference level. The higher the decibel level, the louder the noise.

## RESULTS AND DISCUSSION

After installation of noise barrier, the etching noise from rail has been control drastically. But at location-2, it has been found that there is dhar-dhar – dhar-dhar types of sound has been increased in location -2, when train is moving from IFFCO chowk to Delhi.

**Table-1: Comparision of Sound Levels at all Point Before and After Installation of Noise Barrier**

| | LAeq Before Noise Barrier | | | LAeq After Noise Barrier | | |
|---|---|---|---|---|---|---|
| **Distance** | **Location1** | **Location 2** | **Location3** | **Location1** | **Location 2** | **Location3** |
| **7m dn** | 68.7 | 72.5 | 74.1 | 68.2 | 67.8 | 66.7 |
| **7m up** | 73 | 80.7 | 76.4 | 69.8 | 67.2 | 66.4 |
| **14m dn** | 57.4 | 61.4 | 65.9 | 67.3 | 67.4 | 64.9 |
| **14m up** | 58.9 | 67.5 | 65.8 | 64.8 | 66.5 | 64.5 |
| **28m dn** | 59.1 | 63.8 | 63.1 | 66.4 | 65.2 | 59.5 |
| **28m up** | 59.9 | 66.7 | 65.4 | 66.7 | 67.4 | 60.6 |

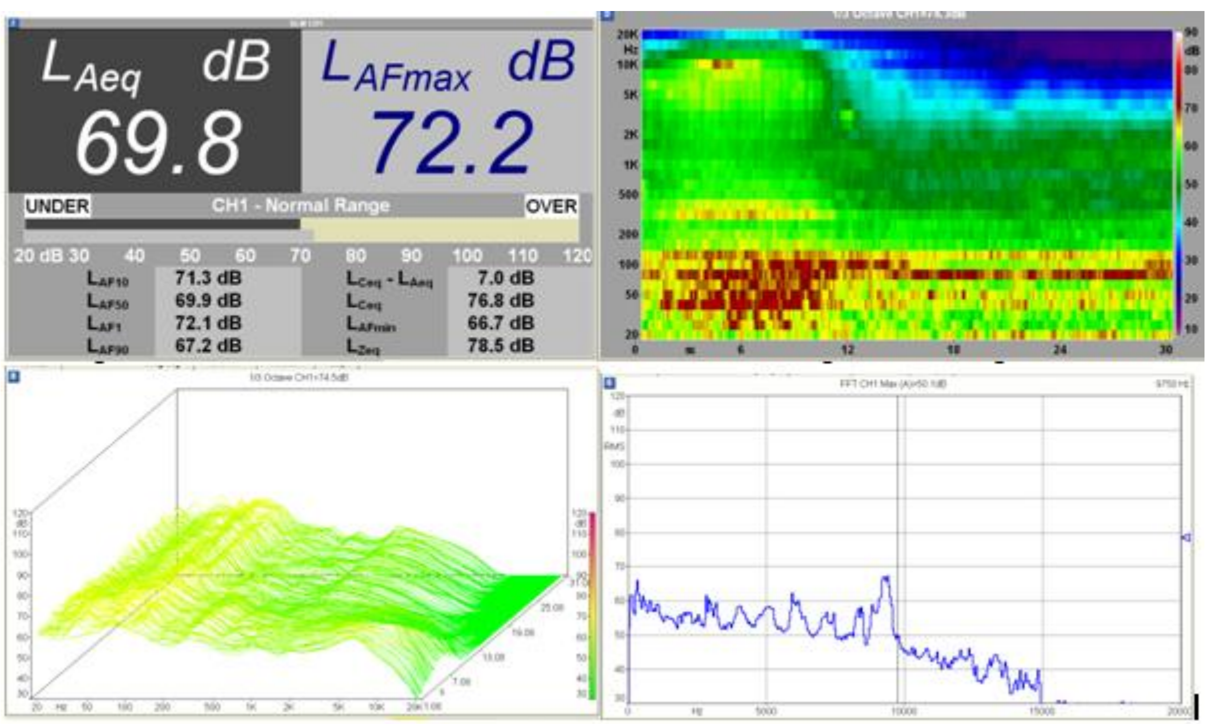


**Figure- L1-7: Towards Delhi**
**(a)** Different Sound Parameters**, (b).** Sonogramme**, (c).** Waterfall Analysis, **(d).**RMS value

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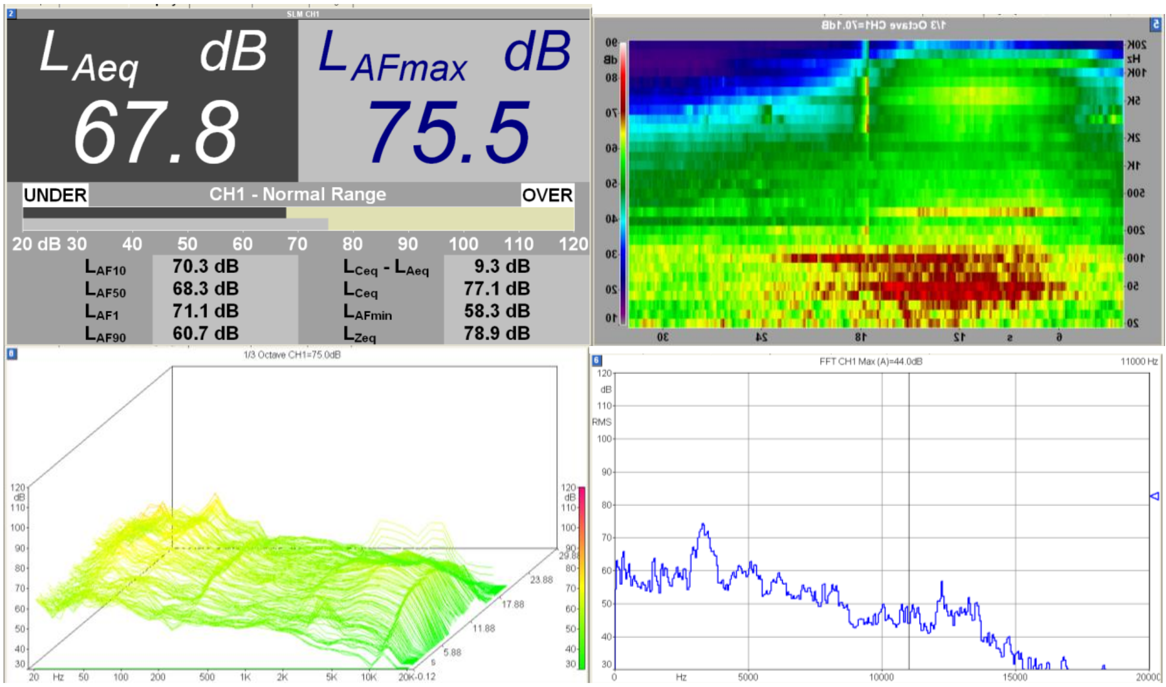
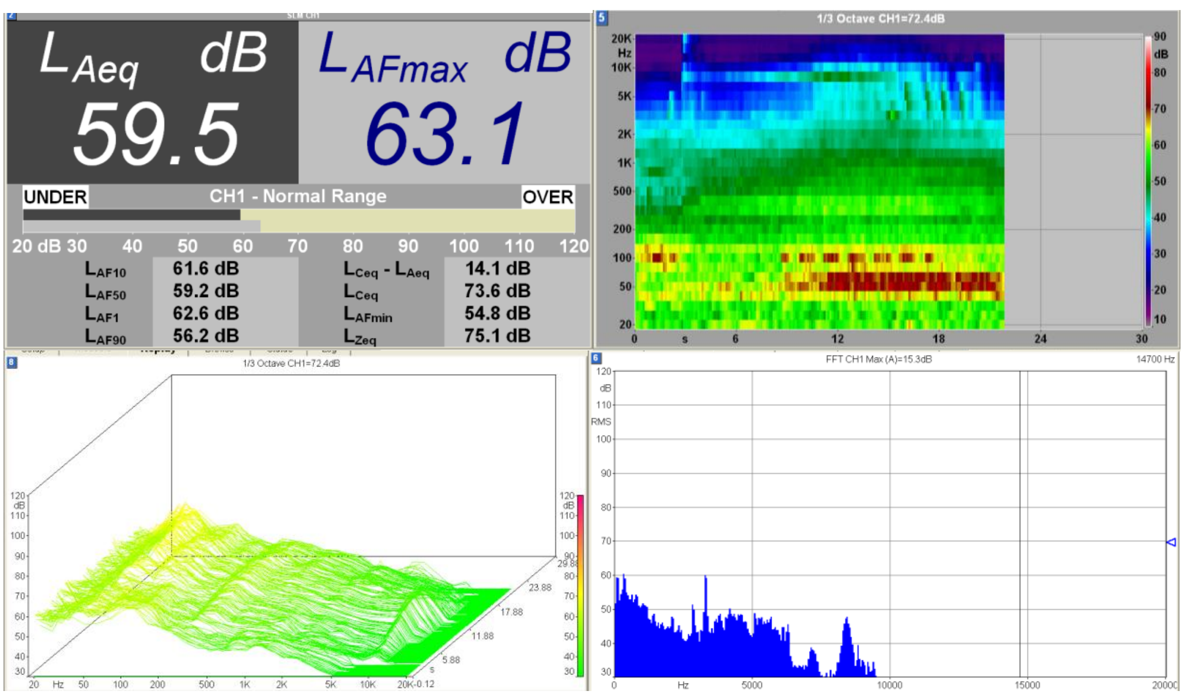



**L1-14: Towards Delhi**

**(a)** Different Sound Parameters**, (b).** Sonogramme**, (c).** Waterfall Analysis, **(d).** RMS value




**L3-28: Towards Delhi**

**(a)** Different Sound Parameters**, (b).** Sonogramme**, (c).** Waterfall Analysis, **(d).** RMS value

It has been found from sonogramme and waterfall analysis that before installation of noise barrier rail noise (track) etching was more dominated but after installation of noise barrier has been control drastically. Noise monitoring locations have been shown in photo No. 1 to 4, while waterfall

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analysis, Sonogramme, FFT, RMS values and different sound parameters have been shown in L1 to L2 to L3 locations at 7m, 14m and 28m distance.

**CONCLUSIONS**

Noise pollution before and after installation of noise barrier has been compared in this study. Before installation of noise barrier, there was free flow of noise. But after installation of noise barrier high frequency noise (etching noise) i.e. 10k hz has been converted into low frequency noise i.e. 100 hz has been found during monitoring.

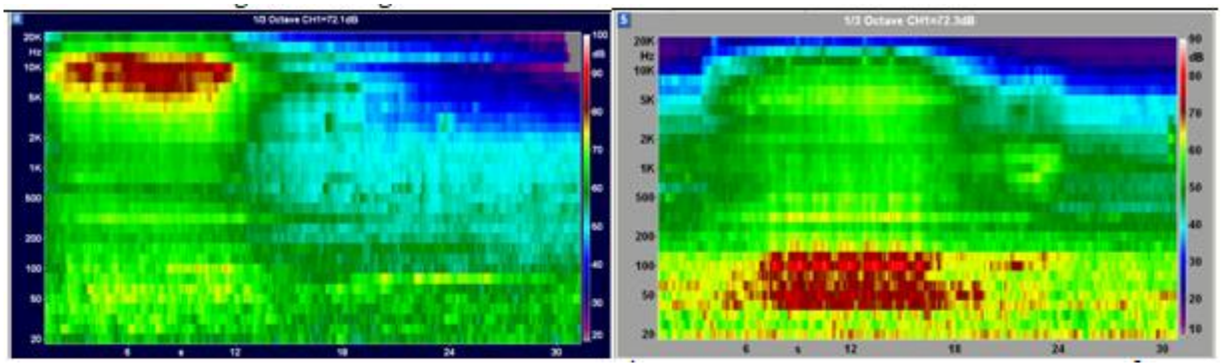

**Figure-L2: (a).**7UP: Sonogramme Data before Noise Barrier. **(b).**7DN: Sonogramme Data after Noise Barrier

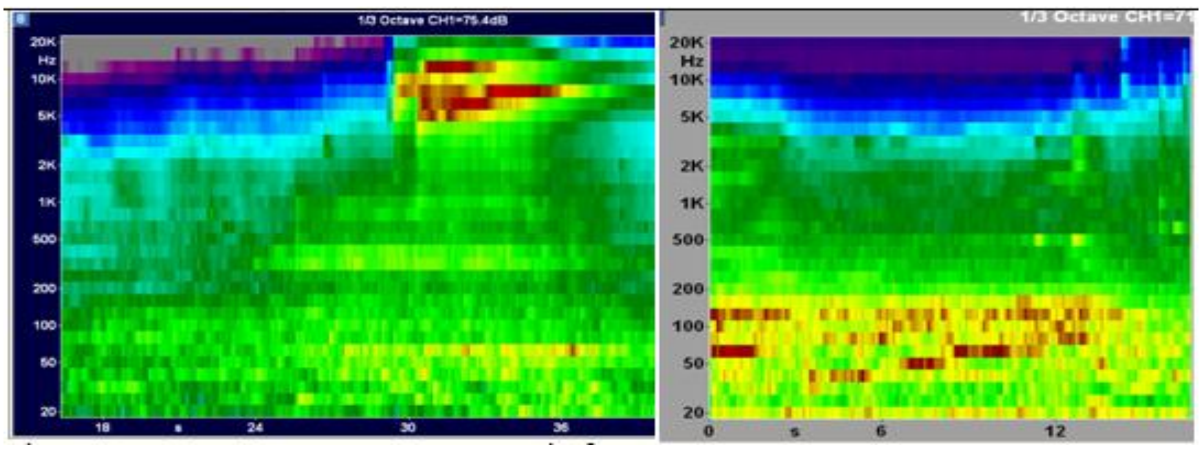


**Figure L3**: **(a).**7UP: Sonogramme Data before Noise Barrier. **(b).** 7DN: Sonogramme Data after Noise Barrier

Even when two trains passing at once, at that time also it was found that high frequency noise is not dominated, it is clearly converted into a low frequency noise as shown in L1-28.

It's fact that low frequency noise is combination of engine noise and etching noise which is coming after reflection of noise, It is less irritating than high frequency noise (etching). DMRC has installed one side (towards Essel Tower) noise barrier, which is residential that is a good initiative because other side is commercial / institutional area.

The maximum noise levels recorded 80.7 dB(A) at location-2 in up-ward condition; While minimum noise level has been recorded 57.4 dB(A) at Location-1 before installation of noise barrier, while noise levels recorded 69.8 dB(A) at location-1 in up-ward condition; While minimum noise level has been recorded 59.5 dB(A) at Location-3 dn-ward after installation of noise barrier.

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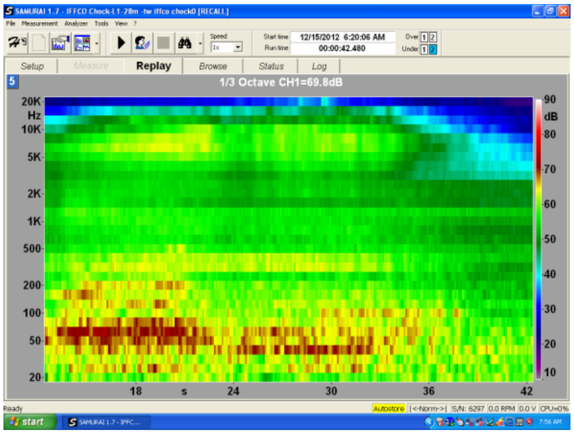


Location -2 & Location-3 are noisier than Location-1, before installation of noise barrier. But after installation of noise barrier noise level have been reduce drastically i.e. approx. 10 dBA from 76.4 to 66.4 dBA at 7m distance.

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