COMPARATIVE STUDY ON VARIATION OF NOISE LEVEL ON BALLASTED AND SLAB RAILWAY TRACK

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ABSTRACT

In conventional railway tracks, the tracks are supported by a bed of crushed stones. These stones are of varying sizes of 1.9cm to 5.1cm, known as ballast. The stone of size greater than 5.1cm is usually not preferred due to the poor interlocking property. This gave birth to the slab track system. In recent few decades concrete slab tracks are being constructed, considering its suitability for high speed trains. At the same time the slab tracks are considered noisier than the ballasted track. To study the characteristics features of noise radiation of ballasted and slab track, sound level verses varying distance from track such as 10m, 20m, 30m, 40m, 50m has been tabulated and it is found that the level of noise varied with the increasing distance from track. The slab track acting like a reflective surface for noise and radiate 1dB(A) to 3dB(A) more noise than the ballasted track. As in ballasted track system most of the noise is absorbed, diffused and the rest is reflected in the surroundings, thereby lesser level of noise is measured at same distance from track, although the speed of train was approximately same on both the tracks.

Keyword: - *Interlocking property, Reflective surface, Radiates, Absorbed, Diffused.*

1. INTRODUCTION

Traditionally, sleepers were laid on the small rock pieces known as ballasts. In the construction of advance rail-lines, however, concrete slab tracks have become common. A significant problem is their noise and its radiation by the use of ballasted or slab track, as slab track is commonly considered to be noisier than ballasted track. When operating at speed greater than 250 Km /Hr, passenger trains are called high-speed trains (HST). In Japan, HST has been operating for above sixty years [3]. High-speed rail networks are currently in service in more than 15 countries especially in the Europe and a host of new projects in middle-east countries and south Asian countries are expected. HSTs operate on a dedicated HST in all countries. Infrastructure of commercial speeds is from 250 to 320 Km / Hr. Most of them often run at lower velocity on a classical infrastructure. The tracks, with various fastening mechanisms, are also a combination of ballast and slab tracks. Then, these variations in operation of high speed trains with the track system produces noise.

2. STUDY AREA

For this study two sites were selected. The purpose of selecting these sites is the regular movement of trains to and fro as Lucknow is the capital city of Uttar Pradesh, most of the trains stops at Lucknow. The two sites that were chosen on the basis of different track system types and the expected train speed on the track, locations were considered. Although the position is taken into account, it is presumed that trains usually pass quickly in an open area rather than near or at train stations and crossings, so these locations are selected for study. Gomtinagar railway station is a station where the slab track has been identified. Two positions were located between stations where ballast tracks were found. Table 2.1 shows the coordinates of sites where Noise Level is measured. In fig 2.1 the positions marked with yellow star showing the location of noise level measurement

Gomtinagar railway station

At Janeshwar Mishra Park – Lucknow-Gorakhpur Line

Table-2.1: Coordinates of Location for Noise Level measurement.

S. No.	Location	Track System	Latitude	Longitudes
1	Gomtinagar Railway Station	Slab Track System	26.860660	81.001797
2	Janeshwar Mishra Park	Ballasted Track System	26.838564	80.985030

Fig-2.1: figure marked with yellow star showing the location of noise level measurement

3. METHODOLOGY

The instantaneous speed of train was estimated with the use of Bushnell's speed gun (Radar), at the same time the noise was estimated at with the help of sound level meter. The readings were taken for two trains running on ballasted track and slab track for every areas. For the correlation of noise, the areas picked were of ballasted railroad track and slab track system. The objective of the study was to estimate the noise radiated by ballasted and slab tracks generated by train with varying speed of train. At the location of noise measuring five points (10m, 20m, 30m, 40m and 50m) with increasing distance from track centre-line is estimated. When the train was moving with some speed the noise at all the five points with 10 meter of distance between them and from track centre-line was measured with

the noise level meter simultaneously. Compared to ballasted track the slab track being more geometrically stable, produces higher noise radiation at the same distance from the track centre-line with train running at approximately same speed [3]. The background noise was least around then of estimation and consequently background noise was disregarded while estimating the noise level created by the moving train.

According to the Indian Standard Recommendation for Noise Abatement Town Planning, March 1979 (IS 4954-1968) [5], the train noise limit principles have been arranged for freight trains moving with various speed. At the point when the speed of train is between 25 kmph to 45 kmph the noise level at 6m from track centerline ought to be approx 90 dB(A) and at 150m from track centerline, it ought to be around 77 dB(A) for trains of 900m to 1200m long. For freight trains running at 65 kmph, the noise level ought to be roughly 96 dB(A) for trains of 900m to 1200m long. The Engine noise level under all activity conditions will be 97 dB(A) to 105 dB(A) at 15m from track centre-line. Whistle noise level will be 110 dB(A) at 15m away from track centre-line.

As per the IS4954-1968 the limit of noise level has been laid down for various freight trains depending upon their speed and operating conditions is shown in table 3.1

Table-3.1: Table showing typical noise level generated by Trains under conditions

Train	Operating condition	Standard Noise Level
Freight trains (900m to 1200m long)	25 to 45 Kmph	90 dB(A) at 6m, 77dB(A) at 150m from track centre-line
Freight trains (900m to 1200m long)	At 65 Kmph	96 dB(A) at 7.5m from track centre-line
Engine Noise	Under all operating conditions	97 dB(A) to 105 dB(A) at 15m
Whistle Noise	Under all operating conditions	110 dB(A) at 15m.

Source: IS 4954- 1968

4. RESULT

The noise level generated by train and the level of noise at all the five points with 10 meter distance between them from the centre-line of track is shown in figure, for all the two locations where trains were running at different speed. There are graphs showing how the noise differs and is reducing with the increasing distance from track centre-line while the train is moving at a certain speed. Separate graphs for both ballasted and slab track has been shown below for all the distinct locations.

Trains passing through at Janeshwar Mishra Park (Ballasted Track system)

Case A		Case B	
Speed= 77 KMPH		Speed= 81 KMPH	
Distance m	Noise dB(A)	Distance m	Noise dB(A)
10	89.2	10	90.1
20	85.6	20	86.4
30	82.3	30	84.6
40	80.1	40	82.4
50	77.4	50	80.2

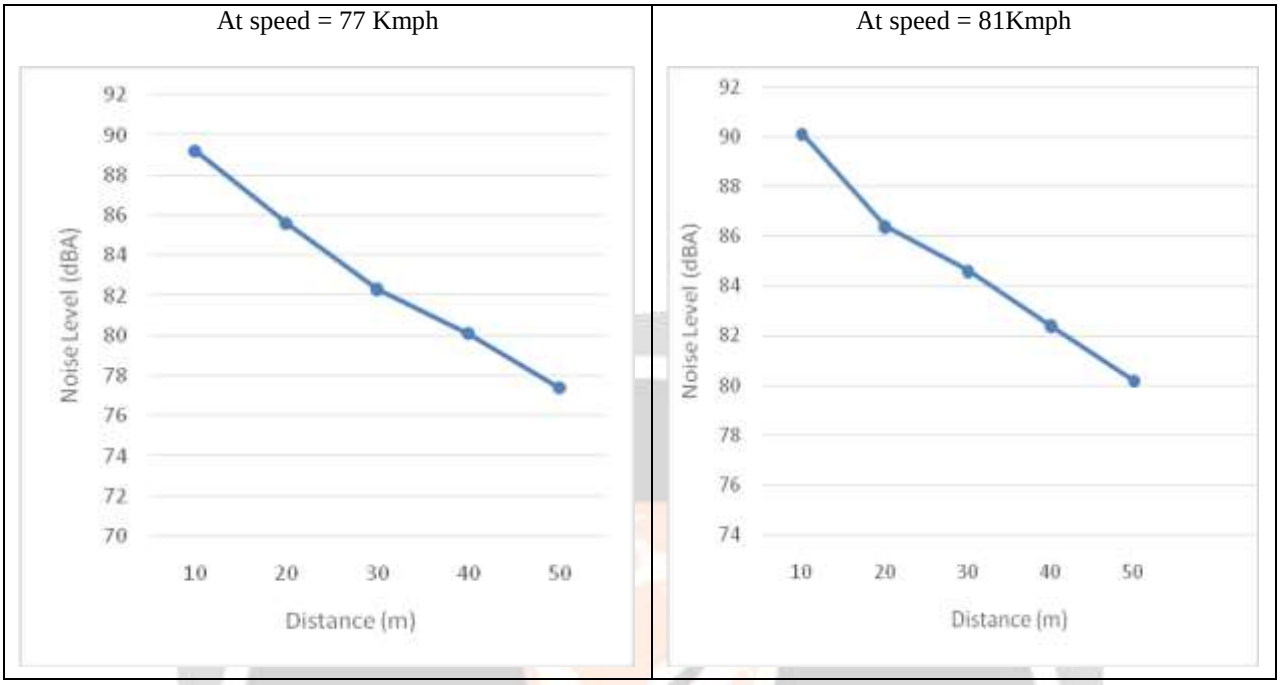

Fig-4.1: Figure showing the variation of noise with distance from track

Figure 4.1 shows the variation of noise level with respect to the increasing distance from track centre-line at a ballasted track at Janeshwar mishra park when the speed of train was 77 kmph and 81 kmph. At 77 kmph the noise level at 10m from track centre-line was recorded to be 89.2 dB(A) and gradually it decreases to 77.4 dB(A) at 50m from track Centre-line. The difference in variation in noise level at every 10 meter increase in distance from track ranges from 2.2 dB(A) to 3.6 dB(A). The over-all decline in noise level from 10m to 50m is recorded to be almost 11.8 dB(A). In another case when the speed of train was 81 kmph, the noise level at 10m from track centre-line was recorded to be 90.1 dB(A) and gradually it decreases to 80.2 dB(A) at 50m from track Centre-line. The difference in variation in noise level at every 10 meter increase in distance from track ranges from 1.8 dB(A) to 3.7 dB(A). The over-all decline in noise level from 10m to 50m is recorded to be almost 9.9 dB(A).

Trains passing through at Gomtinagar Railway Station (Slab Track system)

Case A		Case B	
Speed= 79 KMPH		Speed= 81 KMPH	
Distance m	Noise dB(A)	Distance m	Noise dB(A)
10	90.0	10	92.1
20	89.3	20	91.1
30	88.1	30	90.2
40	86.2	40	89.1
50	85.5	50	87.2

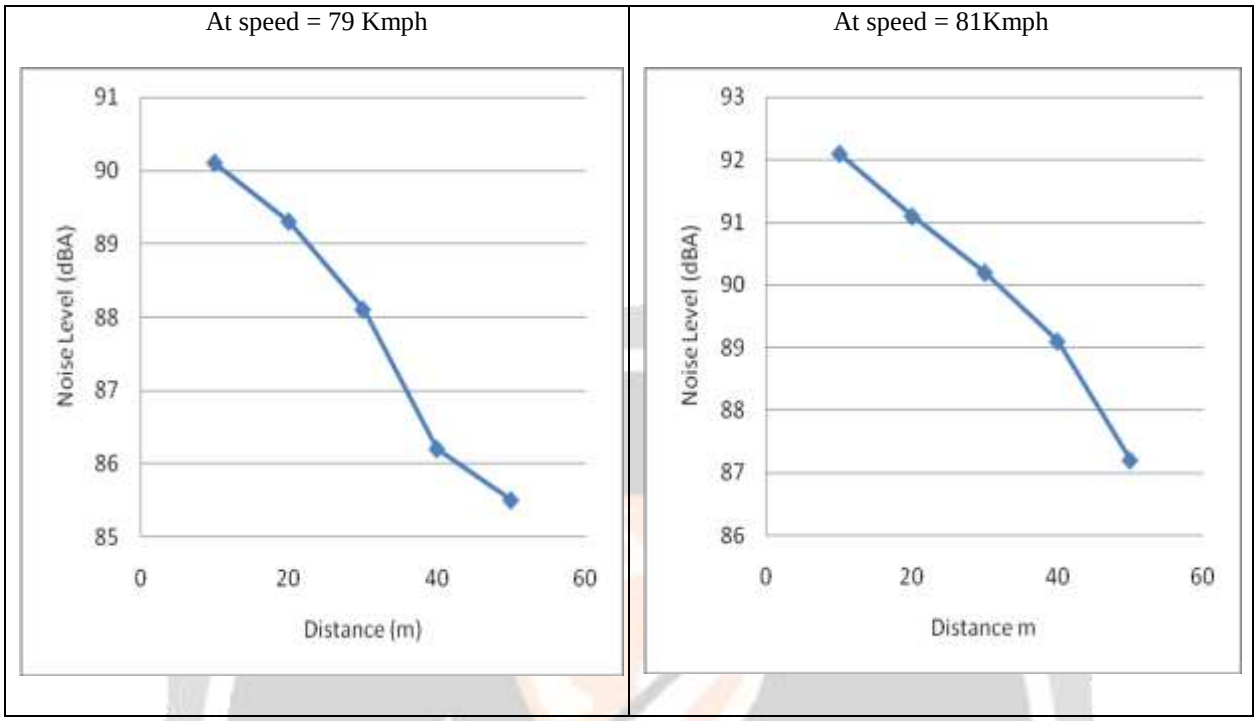

Fig-4.2: Figure showing the variation of noise with distance from track

Figure 4.2 shows the variation of noise level with respect to the increasing distance from track centre-line at a slab track at Gomtinagar railway station when the speed of train was 79 kmph. The noise level at 10 meter from track centre-line was recorded to be 90.0 dB(A) and gradually it decreases to 85.5 dB(A) at 50m from track Centre-line. The difference in variation in noise level at every 10 meter increase in distance from track ranges from 0.7 dB(A) to 1.2 dB(A). The over-all decline in noise level from 10m to 50m is recorded to be almost 4.5 dB(A).In another case when the speed of train was 81 kmph, the noise level at 10m from track centre-line was recorded to 92.1 dB(A) and gradually it decreases to 87.2 dB(A) at 50m from track Centre-line. The difference in variation in noise level at every 10 meter increase in distance from track ranges from 0.9 dB(A) to 1.9 dB(A). The over-all decline in noise level from 10m to 50m is recorded to be almost 4.9 dB(A)

5. CONCLUSIONS

The result obtained from the noise measurement at different locations of ballasted and slab track shows that the noise varies with the speed of train and it also reduces with the increasing distance from track centre-line. But in some cases it is noticed that the speed of train predominates the, leading to higher noise generation. From the above results it is concluded that at ballasted track the noise varied with the range of 1.8 dB(A) to 3.7 dB(A) for every increase in 10 meter distance from the centre-line of track, while overall reduction in noise from 10 meter to 50 meter from track centre-line ranges from 9.9 dB(A) to 11.8 dB(A). And at slab track the noise varied with the range of 0.7 dB(A) to 1.9 dB(A) for every increase in 10 meter distance from the centre-line of track, while overall reduction in noise from 10 meter to 50 meter from track centre-line ranges from 4.5 dB(A) to 4.9 dB(A). This shows that variation in noise level is up to 3.7 dB(A) on ballasted track while variation in noise level is up to 1.9 dB(A) on slab track, which is less by 1.8 dB(A) with increasing distance from track centre-line as the ballasted track being perforated, absorptive in nature absorbs and diffuse the noise leading to lesser noise at 50 meter from track centre-line while slab tracks act as a reflective surface for noise so very less noise is dissipated, diffused from the slab track leading to higher noise even at 50 meter from track centre-line.

Though the slab track provide high geometrical stability to the track but is more responsible for the radiation of noise as compared to the ballasted tracks, where most of the noise is absorbed within the pores and gaps between the ballasts and the noise which is left behind is radiated outwards away from the railway track. Because of the lower construction costs, the ballast track is usually considered to be a safer option for earth structures. On the other hand, the construction of the slab track may be more costly, but the demand for track maintenance is lower for the years and also its high lifetime of serviceability that it is economically more effective in the long run.

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