

Noise Measurement in Shanghai Maglev Demonstration Line

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Abstract:

Measurement data show that the sound pressure level of Shanghai maglev demonstration line is higher than that of TVE in Germany. This paper presents the comparison noise measurements with the same form of microphone array in TVE and Shanghai. Analysis results have shown that the main reason behind the difference of sound pressure level lies in the different shape of girder. The sound powers of the two systems are basically the same. On the other hand, the configuration of vehicle, lateral and longitudinal gaps on the girder, track number (single track or double track) and propulsion system have no significant influence on the maximum sound pressure level.

Keywords: Maglev, Noise, Acoustic test, Vehicle pass-by

1 Introduction

The noise problem has attracted much attention in the operation of Shanghai Demonstration Line since its trial running at the end of 2002. The preliminary measurement at the distance of 25m from the track centre showed that, at the same speed, the pass-by sound pressure level in Shanghai was higher than that in TVE. In order to find the causes of disparity, comparison measurements have been conducted under different circumstances of vehicle configuration, the cross-section shape of girder, height of the girder and methods of measurement.

German Industry Consortium of Shanghai Maglev project, IABG, Shanghai Maglev Transportation Development Co., Ltd and Shanghai Jiaotong University cooperated with each other and decided to jointly conduct two comparison measurements in TVE and Shanghai Maglev Demonstration Line respectively.

With support from the Ministry of Science and Technology of China and the Ministry of Transportation, Housing and Construction of Germany, the comparison measurements were conducted in Transrapid test facility in Emsland in May 2003 and in Shanghai Maglev Demonstration Line in July 2003. The measurement results have indicated the main cause behind the difference.

2 Condition and method of measurement

In order to measure the influence of the vehicle configuration on noise, two vehicles were used in the noise measurement: a five-section vehicle (PV2) and a three-section vehicle (PV3). The cross-section shape of girder of Shanghai Demonstration Line is shown in figure 1. The vehicle speed starts from

100km/h to the maximum speed of 430km/h. In order to measure the directive and total sound power level, a microphone array was adopted to measure the distribution of noise. At the same time, a sound pressure level measurement was conducted at the distance of 25m from the track center. The measurement points are shown in figure 2 and figure 3. In order to evaluate the influence of propulsion system on noise, the propulsion system was temporarily shut down and sound pressure levels at different speeds were measured.

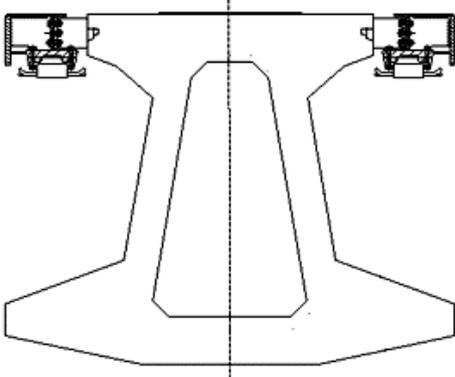


Figure 1: Girder cross-section

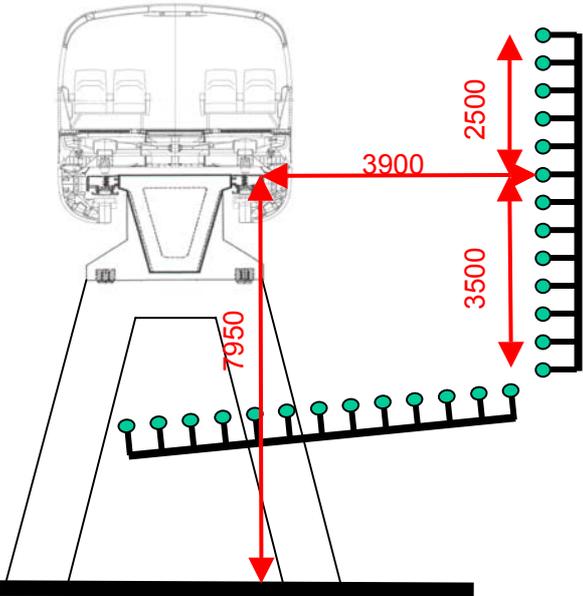


Figure 2: Configuration of microphone array

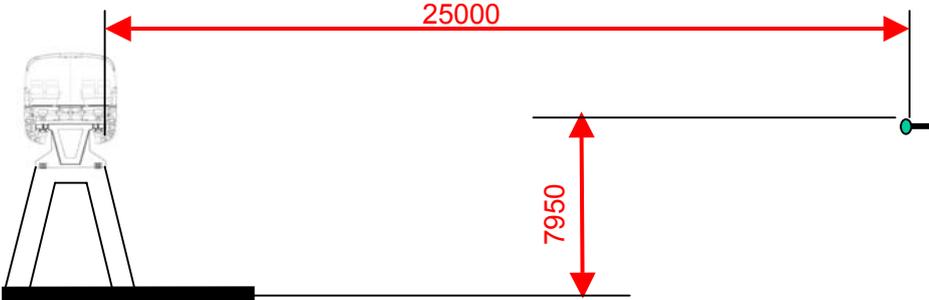


Figure 3: Configuration of measurement points

3 Measurement Results

3.1 Comparison of the sound pressure-level of two tracks

The results of the sound pressure level measurements in TVE and Shanghai Demonstration Line are shown in figure 4. The selected measurement point is 25m away from the track center. In general, the results of “unmodified” track in Shanghai are 5~8 dB(A) higher than those of TVE. Regarding the data with "modified" track, which is covered with absorber material on the side surface, it can be seen that the sound pressure level has been successfully reduced by about 6dB(A) with the help of absorber material.

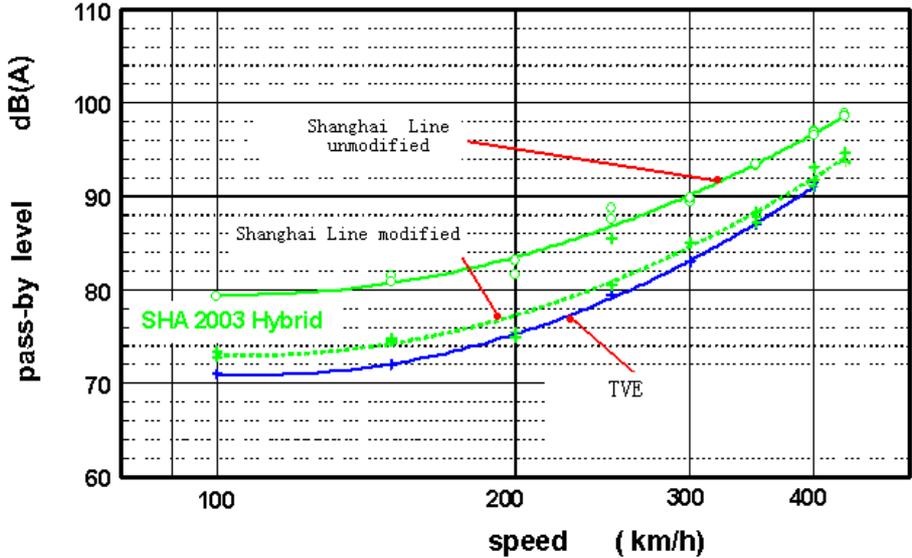


Figure 4: Results of the noise measurements of TVE and Shanghai demonstration line

3.2 Comparison of the noise sound power of two lines

In order to analyze the differences of the noise radiation between TVE and Shanghai Demonstration Line, a microphone array was adopted. Figure 5 shows the measurement results, where figure 5-a and figure 5-b represent the measurement results of Shanghai Demonstration Line and TVE respectively. The radiation of sound power from the lower part of single side of the vehicle was 115.04dB (A) in TVE, and the sound mainly radiates downwards. On the other hand, the radiation sound power from the lower part of single side of the vehicle in Shanghai is 112.28 dB(A), and the sound mainly radiates towards lateral sides.

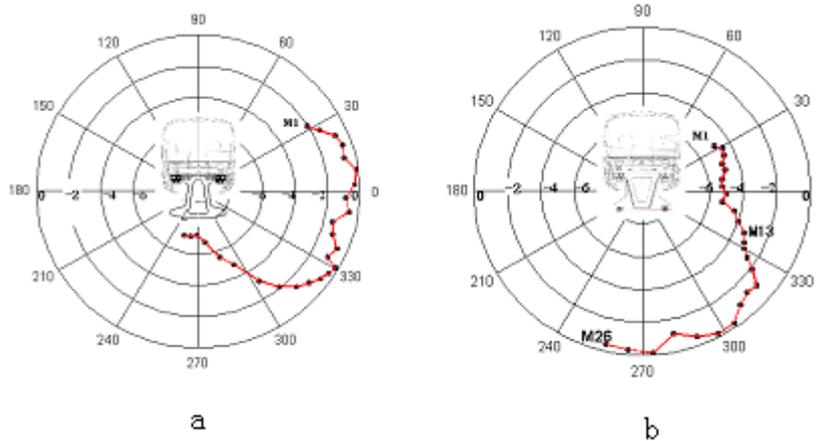


Figure 5: Contrast of the noise sound power of TVE and Shanghai Demonstration Line

3.3 Other results

At the same time, other aspects that may have influence on noise were measured, such as the configuration of a vehicle, lateral gaps and longitudinal gaps on the girder and track number (single track or double track). Some valuable conclusions could be reached based on these measurement results. While these elements mentioned above have no significant influence on noise, further analysis is not available in this paper.

4 Conclusions

The following conclusions could be drawn from the analysis:

- 1) According to the comparison results, the sound power level of Shanghai Demonstration Line is generally the same as that of TVE in the condition of same running speed.
- 2) The difference in the radiation of noise is due to the different cross-section shape of girders in TVE and Shanghai Demonstration Line.
- 3) The sound pressure level has been successfully reduced by about 6dB(A) with the help of absorber material covered on the side surface of girder. It deserves further study in the design of girder in the future.
- 4) The longitudinal and lateral gaps of girder, the configuration of vehicle, propulsion system and track number (single track or double track) have no significant influence on the maximum sound pressure level.