MADRID
inter.noise 2019
June 16 - 19
NOISE CONTROL FOR A BETTER ENVIRONMENT

# Noise evaluation of developed egg shaped sound-proofing wall for high speed railway by field test

**Masao Myouken[1]**
**Kenichi Kuribayasi[2]**
**Takeki Saito [3]**
**East Japan Railway Company, Japan**

**ABSTRACT**

**Considering speed increase in the future, noise prevention is a major issue for railway enterprises. In general, railway enterprises build higher sound proofing walls as a countermeasure to increased noise.**
**In this paper we propose a method to derive noise absorbing material and noise absorbing device. we measure noise evaluation of viaduct for high speed railway by field test.**

**Keywords:** Noise measurement, Field test, High speed railway, viaduct and tunnel
**I-INCE Classification of Subject Number:** 13

## 1. INTRODUCTION

Considering future Shinkansen speed increases, development of noise reduction devices is a major issue for railway operators.[1)] increasing sound barrier height is the usual measure employed to reduce noise. However, there are limits to how much the wall height can be increased due to yield strength of the viaduct and passenger dissatisfaction with poorer view from train windows that come with higher walls. In light of those, we need to develop a new sound absorption panel to be attached to the inside of viaduct sound barriers and to use that in optimized combination with edge-modifiedbarriers where acoustical devices are attached to the top of sound barriers. (Fig. 1)

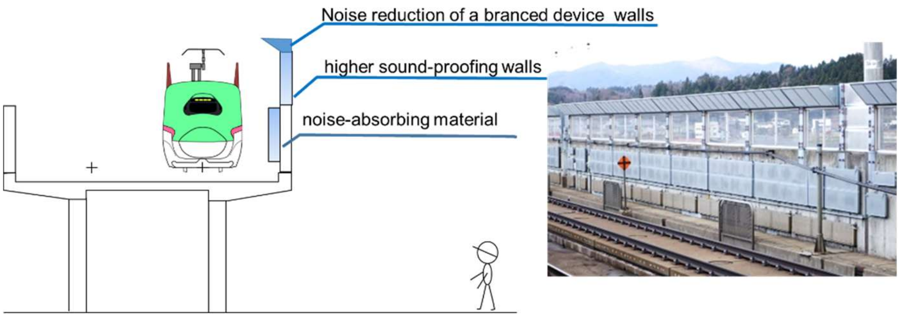


Fig1 Example of noise reduction

1 myouken@jreast.co.jp
2 k-kuribayashi@jreast.co.jp
3 take-saito@jreast.co.jp

## 2. 2 Target of development

### 2.1 Shinkansen noise sources

In general, Shinkansen noise sources are classified into four major categories: structure noise, noise from lower parts of cars, aerodynamic noise, and pantograph noise.

The main function of installing tunnel hoods is to reduce micro-pressure waves. the faster high-speed train travel, the louder the noise caused by train traveling becomes. To travel faster, even traveling noise from side wall slit windows should be controlled. Therefore the main target in this project is to reduce the traveling noise from egg shaped soundproofing walls and enhance workability at seting exist wall.

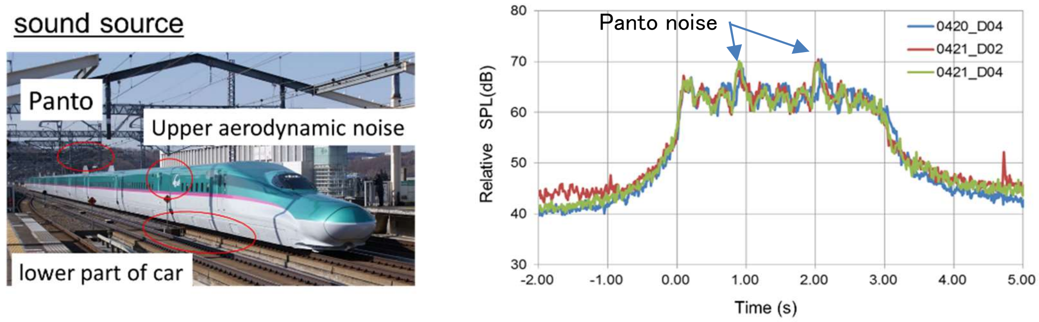


Fig2 Example of Shinkansen noise

## 3. Development of noise reduction devices

### 3.1 Development of noise reduction devices by Full-scale Models

A typical viaduct has sound barriers made of cast-in-place concrete to a height of 2 m from the rail level. However, we adopted a structure where sound barriers including bases can be replaced in order to handle testing with sound barriers being replaced. Due to restrictions in design wind load, barrier height can be up to 2 m from the rail level when not used in tests.

For the vehicle model part, we modeled a Shinkansen vehicle (Fig. 3)[2]. On the measurement side of the model, we secured a distance between the car bottom and the track concrete slab the same as that with a Shinkansen car in order to reproduce noise from the lower part of cars. In contrast, on the other side of the model, the car bottom and the track concrete slab is connected to prevent noise leak. In order to handle acoustic tests of pantographs and bogies, we divided the lower and upper parts of the model car and made them removable. For workability while producing, we divided the vehicle into three parts in the direction of travel.

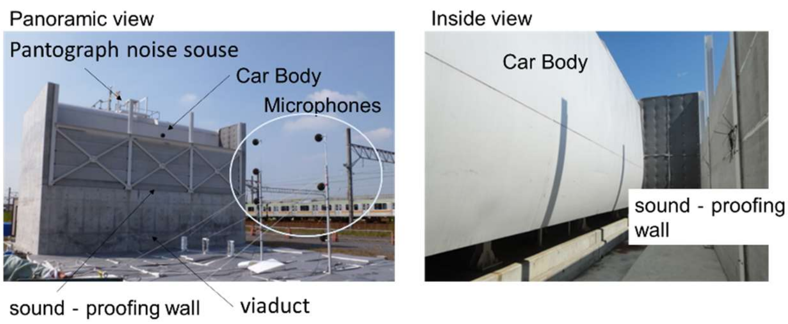


Fig. 3 Placement of Sound Sources and Microphones

Fig. 4 shows an example of the placement of microphones in the measurement with noise barriers of a height of 3.5 m from the rail level using microphones for the source of noise from lower parts of the car, upper aerodynamic noise source, and pantograph noise source. Height from the ground at the rail level of the full-scale viaduct model is 3 m; however, we chose the heights of 9 m, 6 m, and 3 m from the ground to simulate typical viaduct heights from diverse heights of Shinkansen viaducts. Standard height of measurement on the ground in field running tests is specified as 1.2 m from the ground at 25 m from the center of the track. With this full-scale model, however, we set a microphone each at an angle adjusted for of each viaduct height at 10 m, 12.5 m, and 15 m from the center of the track. Noise level at 25 m from the track was estimated based on the measured value taking into account range attenuation.

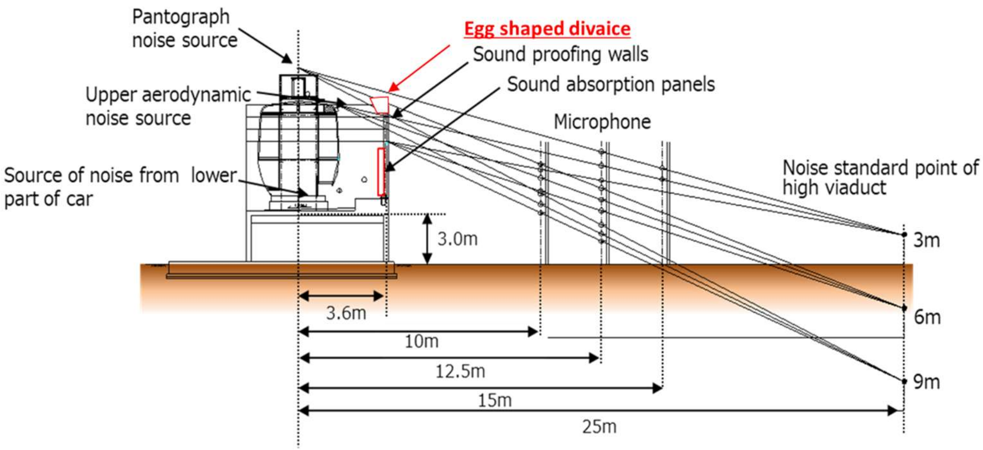


Fig. 4 Placement of Sound Sources and Microphones

### 3.2 Measurement Test Examples

We tested three types egg shaped soundproofing walls. To improve workability and high noise abusorving egg shaped divaise (Fig.5 ), other type is existing product egg shape divaise and vertical-stlaigt wall(in general used).

Table 1 shows the tested three types egg shaped soundproofing walls

Tab 1 Test divaise

| | shape | material | weight | object |
|---|---|---|---|---|
| **typeA** | Egg shaped | aluminum | 60kg | improve product |
| **typeB** | Egg shaped | steel | 160kg | existing product |
| **typeC** | stlaigt | concrete | 100kg | basis for comparison |

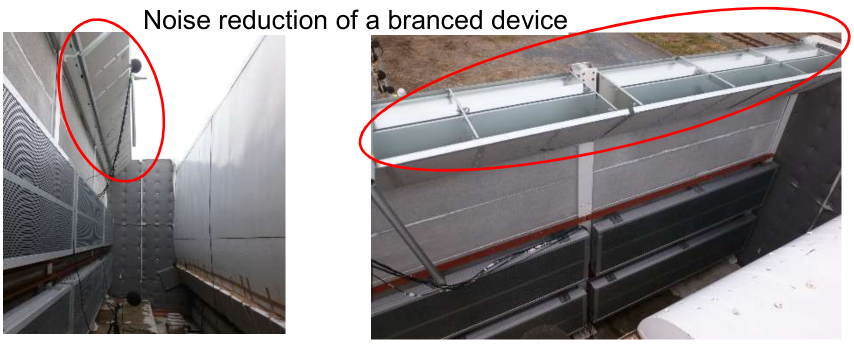


Fig.5 noise abusorving egg shaped divaise (type-A)

Fig. 6 noise abusorving egg shaped divaise. All wall higt is 3.5m. In this figure, Source of noise lowre and upper car results is good sound absorbing the frequency range 250Hz-8 kHz. On the other hand, soruse of noise pantas resolt shows the same relaitive SPL- freqency for all type of soundproofing-wall.In this resout, wall of top(egg-shape divaise) doesn't include a line of a microphone to noise source. Egg-shape divaise has almost no effect on souce of pnata noise.

Fig. 7shows the absorbing effect the tested noise absorbing material As a result, egg-shape divaise was the same sound-absorbing effect. In Conclusions, We did full-scale model experiment, to find out noise decreasing effect of developed egg-shape divaise (ligt-type) is no less than extising-type of sound-absorbing effect.

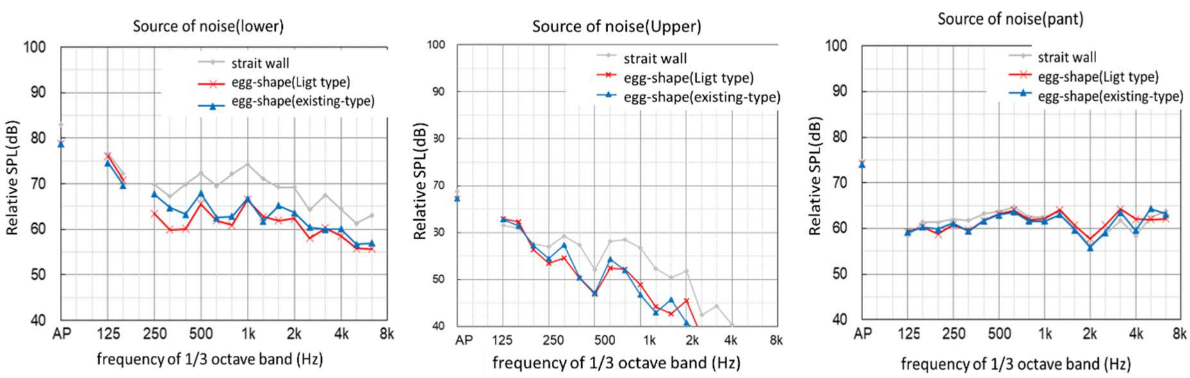


Fig.6 Example of Noise Measurement (viaduct higt: 6m)

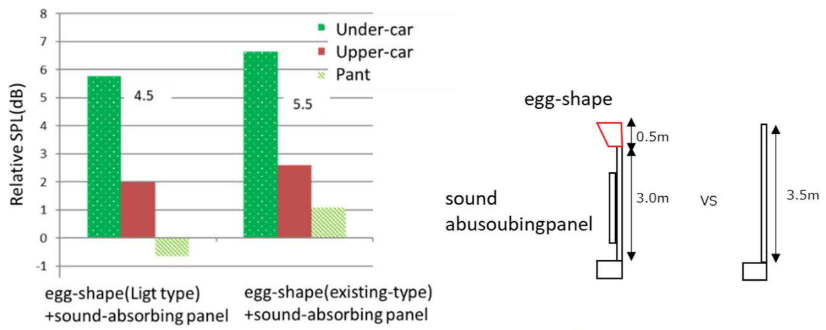


Fig. 7 Noise Absorbing Effect

## 4. Field test of viaduct

### 4.1 Method of the measurements

Figure 8 shows the placement of microphones on a sectional view of on-site measurement. In general, Shinkansen noise is measured at a point 25m away from center of Shinkansen track and 2m above the ground (25m point)[3]. In this study, we measur at a point 25m away from center of Shinkansen track.

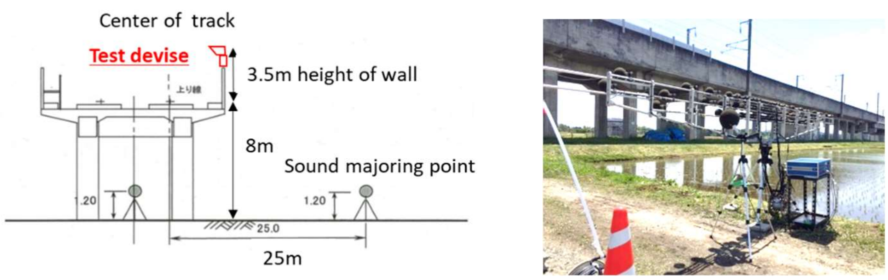


Fig. 8 Microphone set up view

## 4.2 Resolt of the measurements

Table 2 shows the maximum noise measured when a high-speed train passes by the measurement point. The measurement conditions are listed as follows.

1) Measured Train
  - Simple formation Shinkansen (excluding coupled formation for through-operation between Shinkansen and ordinary lines)
  - A train speeding up from 300km/h to 320km/h

2) Type of measured sound-proofing walls
  - Concrete sound-proofing walls without noise absorbing material (standard wall)
  - Concrete sound-proofing walls with ligt-type egg-shaped divaise on the tip, with noise absorbing material (Ligt-type)
  - Concrete sound-proofing walls with existing -type egg-shaped divaise on the tip, with noise absorbing material (existing-type)

Figure 10 shows typical examples of train-speed to noise measured. The horizontal axis is train-speed (km/h), and vertical axis shows noise level (dBA). As a result, Egg-shaped divaise was the highest sound-absorbing effect. And developed light-type divaise is same noise-absorving effect.as existing-type.

Figure 11 shows examples of frequency of sound power of passage of the train. The horizontal axis is freaqency(Hz), and vertical axis shows noise level (dBA). As a result, Egg-shaped divaise is ood sound absorbing properties the frequency range 250-8kHz.

In Conclusions, We did feildtest experiment, to find out noise decreasing effect of developed noise absorbing ligt-type divaise.

Tab. 2 –Decreased noise level measured in this study

| | Wall hight(m) | Decreased noise(dBA) |
|---|---|---|
| **Standard wall** | 2.0 | - |
| **Egg-shaped(Ligt-type)** | 3.5 | 4.4 |
| **Egg-shaped(existing -type)** | 3.5 | 4.4 |

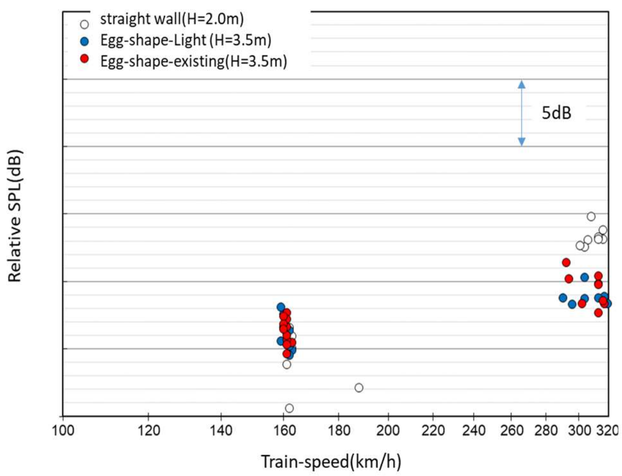


Fig. 9 Noise Measurement (train-speed)

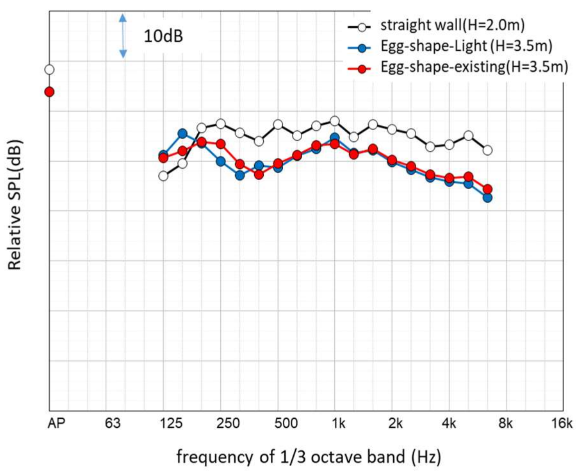


Fig. 10 Noise Measurement (freqency)

## 5. CONCLUSIONS

We obtained the following results through our study.

1) We clarified the effectiveness of noise-absorbing divaice through data measurement with actual trains traveling in high-speed line at 320km/h.
2) We developed a new ligt-type noise-abusouving divise to setted top of sound-proofing wall.

## 6. REFERENCES


1) Toshiki Kitagawa, "Bo'onheki [in Japanese]", RRR, Vol. 74, No. 7 ( July 2017)
2) Takashi Tahara,: Shinkansen Noise Reduction by New Wayside Equipment Development, JR EAST Technical Revew, No.16, 2010
3) Evaluation manual about Shinkansen noise measurement, Ministry of the Environment of Japan (japan)