The measurement and analysis of the New-Type guideway

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Abstract

The super-conducting MAGLEV system installs the coil on the ground surfacing the super-conducting magnet equipped beside the vehicle. In the Yamanashi test line, three types of guideway have been verified their propriety. This time, the New-Type one has been installed for further cost reduction and functional improvement. Various results of measurement are reported in this study to verify its practicability.

1 In the beginning

As for the development of the superconducting MAGLEV in Yamanashi Test line, a running test started in April 1997, and it is about 370,000km in the accumulation of the mileage as of June 2004 with attaining 581km/h in December 2003 as well as 552km/h in April 1994. The examination still proceeds smoothly.It was evaluated technically practical in March 2000 as mass transport system from the Ministry of Transport (Ministry of Land, Infrastructure and Transport) MAGLEV Technological Practicality Evaluation Committee. The opinion of "Further verification by the running examination is necessary to solve the subject for the characteristic improvement that to be left like long-term durability, a cost decrease and the aerodynamic performance of the vehicles." is shown at the same time, too. And it continues a development, running examination for five years from April 2000 to solve the subjects above.

This time, a new-type guideway shown in the figure-1 was installed in Yamanashi Test line with the aim of more cost decrease and the functional improvement. It is reported in this paper that various measurement of the new-type guideway was carried out in Yamanashi Test line and performance was confirmed.

2 Guideway

In MAGLEV system, a lot of ground coils are installed as equipment that levitate, guide, and propel vehicles. The guideway of 3 variable forms (panel type, beam type, direct mounting type) is developed as the way of furnishing the ground coil, and the validity of their design and safety are confirmed in Yamanashi Test line by the test run. The characteristics of these 3 forms are followed.

2.1 Panel type guideway

It is the form that a panel is installed on the sidewall composed of cast-in-place concrete. The panels (Made of the pre-cast concrete: 12.6m per unit) are produced in local yard and plural ground coils are fixed on them. As for this form, it is possible to fix guideway difference due to the displacement of the structure.

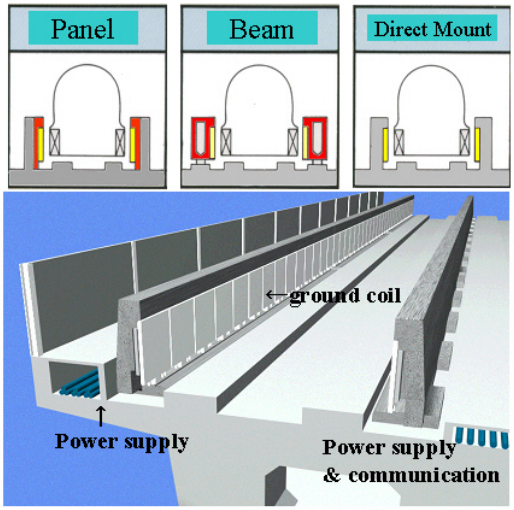

Figure-1 Existent and New-type

2.2 Beam type guideway

A beam (Made of the pre-cast concrete: 12.6m per unit) is made as well as the panel form in production yard. It is the form on which plural coils are fixed and is installed on the support part in the structure. A beam is supported in both two ends and it can be fixed by adjusting only two parts to the guideway confusion due to the displacement of the flooring and the structure.

2.3 Direct installation type guideway

It is the form that coils are fixed directly on the side wall (composed of cast-in concrete) where high precision is given. This form can be applied where the displacement of base concrete is small, and adopted mainly in the tunnel section as for Yamanashi Test line.

3 The characteristics of the new-type guideway

3.1 Structure

Making the guideway section reverse "T" enables itself to stand independently and enhances the efficiency of its construction, adjustment, and substitution. A coil adjustment function in the unit was secured by taking a pre-cast member structure. Reinforced concrete structure was adopted to prevent a bend due to pre-stress, while it is introduced for the crack prevention. As for reinforcing material, lightweight Compound Fiber Reinforced Plastic (referred to CFRP hereafter) was adopted as well as low magnetic re-bars used in the Yamanashi Test line from the viewpoint of the magnetism anti-power decrease. As for the strain material as well, the CFRP is adopted as well as PC strand from the same viewpoint as the reinforcing bars.

Figure-2 New type guide-way

3.2 Weight

It worked for the reduction of weight itself with a new form guideway by the rational design not only to lighten a dead load but also improve their workability, adjustability, and replacement process. Moreover, it is adopts light weight concrete composed of lightweight aggregate as well as high-early-strength concrete and confirm its merits including but not limited to workability and property.

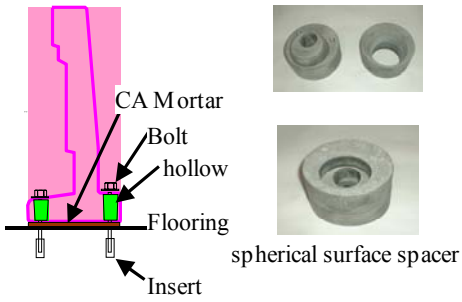

Figure-3 Support structure

3.3 Support structure

CA mortar is installed with securing precision in the up-down direction between the guideway and the flooring to disperse the load and transmit it to the flooring. Anchor bolt is adopted as the connection between the guideway and flooring considering its workability, possibility of precise execution, and easy maintenance. In order to fill up the hollow between the guideway and the bolt in its adjustment, such special spherical surface spacer is developed as enable easy installation, removal and recycle, while grouting is partially adopted.

Table-1 Guide-way manufacture

Class	Re-bar	Tension material	Concrete	Support
A	low magnetic	CFRP	high-early-strength	spherical surface spacer
B			lightweight aggregate	
C	CFRP		high-early-strength	
D	low magnetic	normal strand		
E				grouting

4 Guideway production, mounting at site

Partial replacement work was carried out in Yamanashi Test line, and the beam form guideway of an extension 75m section of the open section herein was replaced with the new guideway to confirm its production process and workability. As a result, high precision manufacture was confirmed possible as for the production of the guideway. Operation, workability improved by lightening the guideway makes it possible to build in high precision. It is also constructed in the high precision by jack developed newly to settle it minutely.

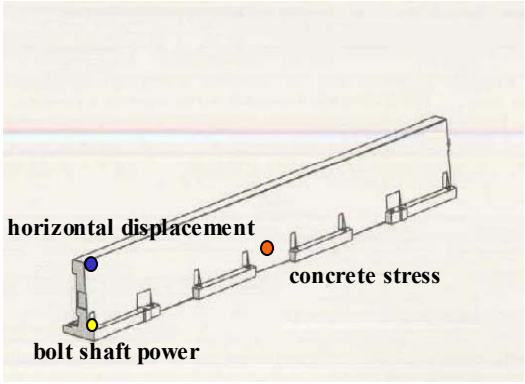

Figure-4 guide-way measuring point

5 Result of measurement

Type of guideway is shown in the table-1. The automatic measurement system was built in the Yamanashi Test line (shown in figure-4) to trace the action of free-standing guideway automatically when vehicles run by. An analysis evaluated a result in every type of each guideway as for such measurement items as guideway displacement, reinforcing bars distortion, bolt shaft power at each speed stage in the test run. Guideway horizontal displacement at train's speed of 500km/h is shown in the figure-5. Guideway horizontal displacement is calculated from the value which can get from the acceleration meter installed in the guideway. Large displacement wasn't recognized in each type or there was no difference compared with an existent form of guideway. Next, a result of measurement about the concrete stress is shown in the figure-6. As for the concrete stress as well, there was no remarkable difference among each type. As for the bolt shaft power shown in figure-7, it was a little value in the test body of the type B compared with other ones. These results show that there is no remarkable difference among each type of guideway. And it has same performance as existent beam and panel form and is confirmed that it has satisfactory room to the designed limit.

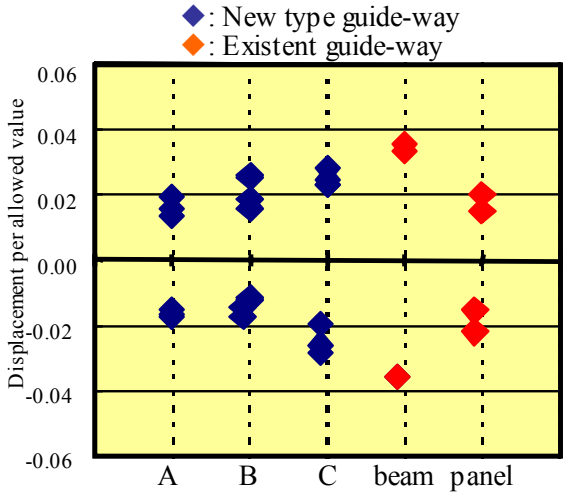

Figure-5 Guide-way horizontal displacement

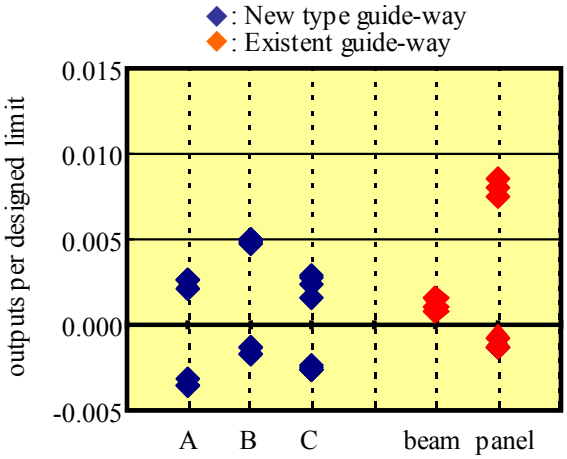

Figure-6 Concrete stress

6 Conclusion

Production, mounting, and measurement of the New-Type guideway in the test run verify the following;

1) Manufacturing, mounting in high precision is satisfactorily possible.
2) It has sufficient room to designed limit.
3) It has the same efficiency as the existing beam and panel form.

In this development, lightweight conversion of the guideway is also assured by the rational design, as well as the improvement of operation is assured by making its shape opposite "T". In reference to these results, pursuit of easier maintenance, optimization of the design, and decrease of more cost are to be executed. Furthermore, it is planed to grasp the dynamic behavior of the whole structure including the guideway at the time of earthquake by measuring the behavior of the structure including elevated bridge.

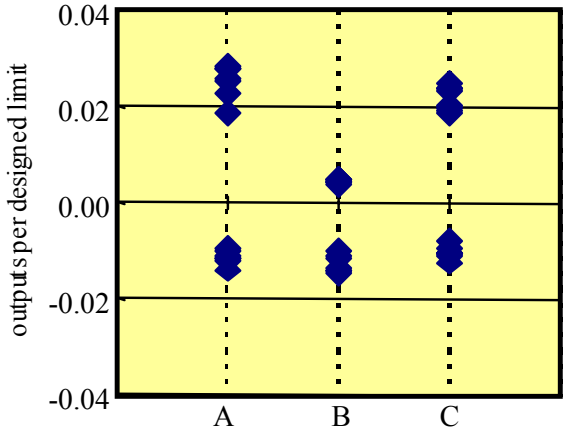

Figure-7 Bolt shaft power

Acknowledgement

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References

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