Low-Noise Moving Model Test Facility Completed at RTRI

A low-noise moving model test facility was newly completed at RTRI. This testing facility, featuring the world's highest class performance, is capable of running a 1:20 scale model train at the maximum speed of 400 km/h and accurately reproducing the air flow and turbulence created by a running train. It was completed on July 10, 2020 and testing was started on October 29, 2020.

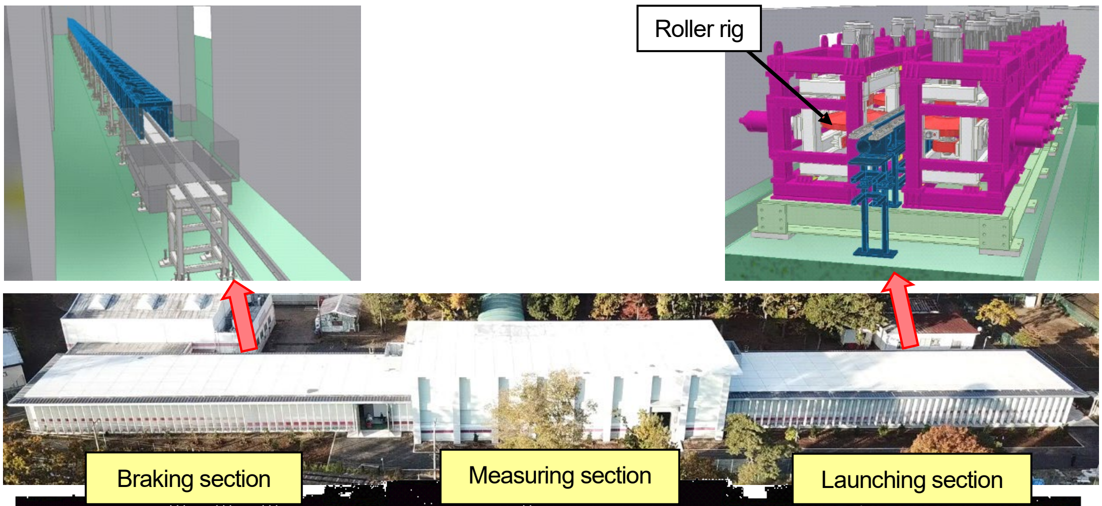
[Overview of low-noise moving model test facility]

- This testing facility consists of three sections: launching section, measuring section, braking section (Fig.1)

- In the launching section, a 1:20 scale model train is launched and accelerated to maximum 400 km/h by a roller rig. (upper right of Fig. 1) The model train has a streamline nose shape replicating an actual train's front shape (Fig. 2).

- In the measuring section, the model train coasts in order to reduce background noise. This section is a semi-anechoic chamber and its walls and ceilings were covered with sound-absorbing material to reduce reflected sound (Fig.2). This semi-anechoic chamber enables measuring of pressure fluctuation in an open section of a tunnel (low-frequency-range aerodynamic noise generated by a train). In addition, by mounting a tunnel model in this chamber, micro-pressure waves propagating from tunnel ends and pressure and wind speed fluctuation in a tunnel can be reproduced.

- In the braking section (upper left of Fig.1), the model train runs into foamed polystyrene beads placed in the 32 meter-long section and comes to a stop.



[redacted]

Maximum speed	400 km/h (length of model train 2.5 m) 360 km/h (length of model train 7.5 m)
Scale of model train	1/20
Length of model train	Maximum 7.5 m (corresponding to 150 m train)
Total length of facility	125 m (Launching section: 42 m, Measuring section: 40 m, Braking section: 43 m)

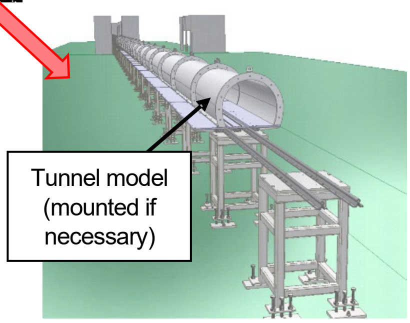


Fig. 1 Low-noise moving model test facility and basic specification

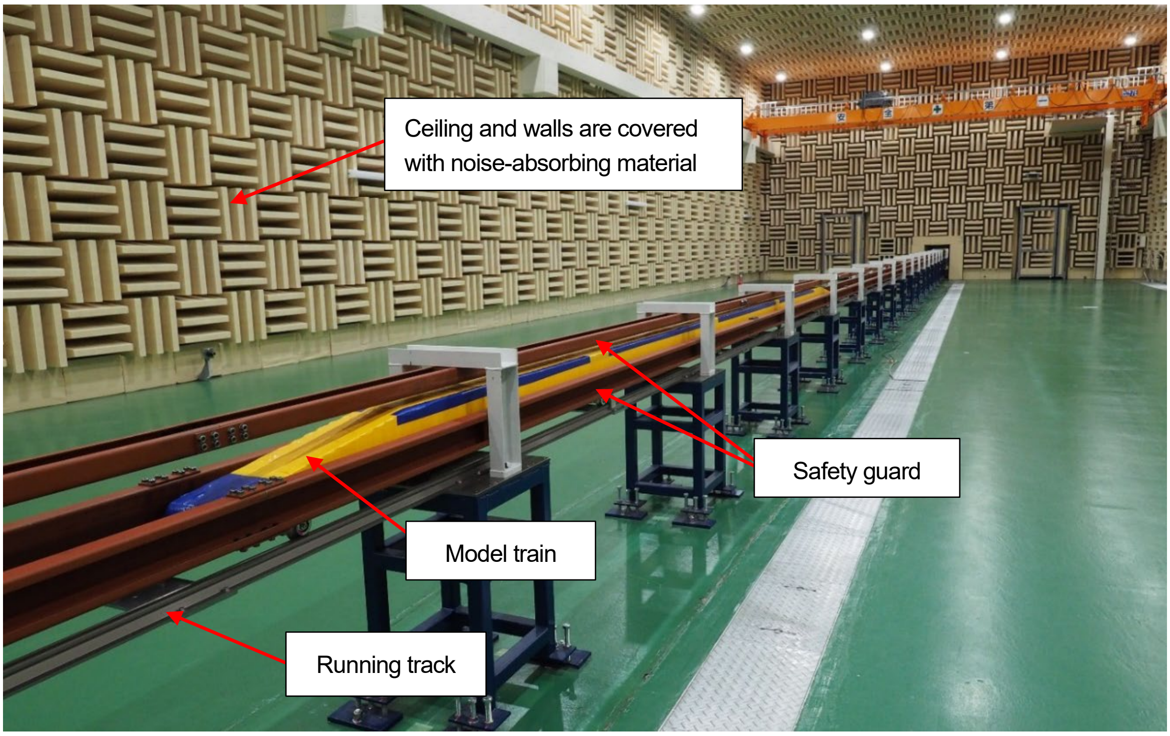


Fig. 2 Measuring section
※Safety guard is tentatively mounted for speed-increase testing

[Planned testing and experiments]

High-speed trains generate turbulent air flow which causes aerodymnamic noise and the pressure fluctuations around the trains have impacts on insulating panels and tunnel walls. The low-noise moving model test facility will be used to analyze these phenomena and to develop measures to solve the problems.

(1) Experiments to analyze the phenomena caused by passing trains.

The research into the mechanism to generate low-frequency-range aerodynamic noise will be implemented and its results will be used to develop mitigating measures and to confirm their effects. By evaluating the impacts on structures including noise-insulating walls, tunnel walls and tunnel hoods, the data will be used for the strength design of structures.

(2) Experiments to reduce micro-pressure waves

When a train runs into a tunnel, micro-pressure waves radiate from the other end of the tunnel. Experiments will be conducted to improve the nose shape of a high-speed train in order to mitigate the micro-pressure wave radiation and to assess the performance of the mitigating hoods mounted to tunnel ends.

(3) Gathering data to develop numerical simulation methods

Using the test data accurately reproducing actual phenomena, we will develop numerical simulation methods to predict precisely the phenomena caused by train passing and radiation of tunnel micro-pressure waves. The simulation methods will be used for strength designs to ensure necessary strength of structures for higher-speed trains and new vehicles and to develop measures to mitigate micro-pressure waves.

[Reference]

RTRI has also had an older testing equipment for the similar purpose with the following performance:

- Scale of a model train: 1/80 to 1/100
- Maximum launching speed: 550 km/h
- Shape of a model train: the model has circular cross-section shape, but the ratio of cross section area to vehicle length is equivalent to that of an actual car (Fig. 3)

Fig. 3 Model train of the older equipment