Evaluation of Ride Comfort

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Development of technologies to reduce vibration and noise is essential to improve the ride comfort in trains. To set off the next target for development, it will be useful to have an index (scale) to evaluate the ride comfort quantitatively from the viewpoint of passengers. In order to establish the technique to well estimate the ride comfort, therefore, we have been promoting researches on various themes including the following.

EVALUATION OF THE RIDE COMFORT AGAINST VIBRATION

There are a number of factors that influence the ride comfort in trains. Among the studies on these factors, the most remarkable achievement is seen especially in the work on vibration. Since there are different types of vibration, including the lateral vibration caused by the centrifugal force on curves and longitudinal acceleration at braking, that require different prevention measures, various evaluation indices have been developed. As to the ride comfort on curved sections, for example, we have clarified that evaluation close to the actual bodily sensation of passengers is possible when we combine the lateral vibration and the stationary lateral acceleration that is equivalent to the centrifugal force. Figure 1 shows the allowable limits of acceleration/vibration to ensure the ride comfort for standing and seated passengers both. We are now studying measures to investigate the effect of the lateral vibration at extremely low frequencies on motion sickness and determine the vibration characteristics that cause the difficulty to walk on a train.

EVALUATION OF THE AURAL DISCOMFORT CAUSED BY CHANGES IN THE ATMOSPHERIC PRESSURE

High-speed trains that connect cities pass a number of tunnels in mountainous areas in Japan. Quite a few passengers complain the discomfort caused by changes in the atmospheric pressure when the train runs into a tunnel. This requires an allowable limit to be set for pressure changes as a target in adopting measures against this phenomenon. In contrast to the aural discomfort due to the difference in altitude in airplanes and elevators, that on trains is caused largely by the propagation of the pressure wave generated when the train enters a small space like tunnels. As the waveform is extremely complicated in this case (Fig. 2), we had to determine what component would cause the discomfort first and concluded that it was desirable to limit the maximum change in the atmospheric pressure to 2 kPa or less within four seconds after the train gets into a tunnel on the basis of test results.

EVALUATION OF THE COMPREHENSIVE RIDE COMFORT IN TRAINS

We are promoting researches not only into physical factors that influence the ride comfort, but also to develop an index that enables the evaluation of the comprehensive ride comfort in trains. We have developed a riding comfort simulator with a subsidy by the Japanese government that simulates the vibration, noise, temperature, and window scenes experienced on actual trains. Figure 3 shows its appearance. The simulator has a simulated passenger room furnished with 12 seats mounted on a 6-axis motion unit. Since different factors can independently be controlled, the simulator is expected to contribute to the development of the indices to evaluate the ride comfort in trains.

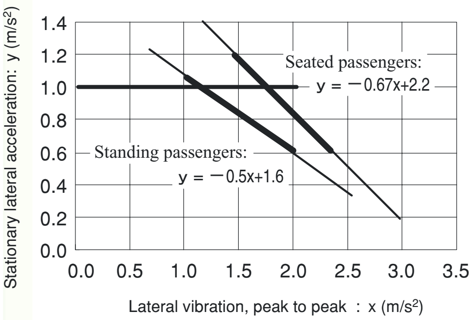

Figure 1. Allowable limit of riding comfort on curved sections.

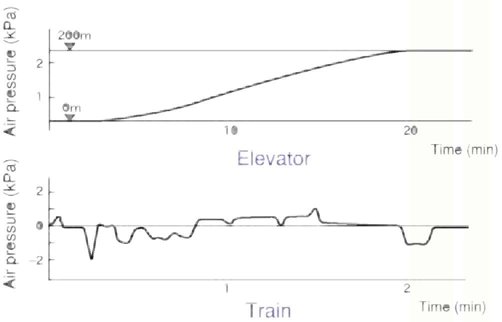

Figure 2. Examples of air pressure change.

Figure 3. Riding comfort simulator.