A Life-Size Station Building Model

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A principal means of discussing the flow and comfort of passengers at stations has so far been to observe phenomena in actual station yards. In order to elucidate the characteristics of passenger flow in emergency situations, however, experimental tests under various conditions are necessary. Accordingly, the Railway Technical Research Institute (RTRI) has developed a life-size station building model (Figs. 1 and 2) for use in such tests. It can be used to conduct passenger flow tests, evaluation tests for guidance signs or guidance announcements, subjective evaluation tests on the effects of thermal and acoustic environments, and continuous measurements.

The model simulates an over-track station with an internal size of about 15 x 16 m, a ceiling height of 3.5 m (and partially 6 m) and two staircases. The height of the floor from ground level is 4 m, which is approximately the height of the concourse floor in real-life stations from platforms. As the interior materials are those used at actual stations, simulation participants feel as if they are in a real station in terms of visual input.

The experiments that the RTRI has implemented or plans to implement are as follows:

● Passenger flow experiments

The RTRI has conducted experiments on how factors such as congestion density on concourses and staircases affect ease of walking for passengers. In these experiments, the Institute changed congestion density while varying spatial conditions such as staircase widths and obstructions representing small stores or elevators. Based on the test results, the RTRI developed a technique to evaluate passenger flow in stations.

Fig. 1 External view of the station building model

● Evacuation experiments

The RTRI has conducted evacuation experiments related to the inner space of the station building model in darkness, representing a state of power supply failure in an underground station due to an earthquake or other incident (Fig. 3). Although these experiments remain at the basic stage, the Institute plans to advance the development of an evacuation guidance method by utilizing related visual and acoustic information.

●Experiments to evaluate flooring materials

The RTRI has evaluated the relationship between the friction coefficients of surface floor materials and passengers' perception of slipperiness using several types of flooring aligned within the station building model (Fig. 4). The Institute carried out the experiment under dry and wet conditions assuming rainy weather, and proposed values for use as evaluation criteria under each condition.

●Experiments on the ease of hearing public address system announcements

The RTRI is conducting experimental tests on the relationship between the volume of guidance announcements and the ease with which they can be heard, as well as how differences in sound-absorbing materials or speaker arrangement affect ease of listening.

● Experiments on passenger comfort

Regarding factors such as thermal, acoustic and odor environments that affect the comfort of passengers on station concourses, the RTRI is conducting subjective evaluation tests using trial subjects as well as verification tests on the effects of comfort-improving methods. Regarding thermal environments, in order to reduce discomfort in summer without the use of air conditioning, the Institute has conducted a measurement experiment on the effect of the position/size of openings on station concourse thermal environments by creating a number of openings in the station building model.

In order to create safer and more comfortable stations, the RTRI plans to further promote research and development using these experimental facilities.

Fig. 2 Internal view of the station building model

Fig. 3 Evacuation test (walking experiment in darkness)

Fig. 4 Floor material evaluation test (walking experiment on wet floor materials)