Newsletter on the Latest Technologies Developed by RTRI

Railway Technology Avalanche

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FOREWORD

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The Mid Niigata Prefecture earthquakes of October 2004 struck from directly under the region with a maximum magnitude of 6.8 and caused numerous casualties, destroyed many houses and disrupted traffic and utility networks. The seismic activity also derailed a Shinkansen train — this was the first time, since the Tokaido Shinkansen began commercial operations in 1964, that a Shinkansen train had ever derailed.

The cars that derailed continued moving a certain distance with parts of their undercarriage appearing to hug the rails. Luckily, the train stopped without leaving the track dangerously or overturning, and there were no casualties among the hundreds of passengers. But the derailment was a wakeup call to the operators of the Shinkansen system and the country as a whole. It also imposed two vital tasks on those of us engaged in rail research and development.

One of those tasks is to identify the mechanisms involved in an earthquake-induced derailment. This involves a number of steps. First, the seismic waveforms at the ground surface near the derailment are hypothesized from the waveforms recorded at the station that monitors seismic activity. Next, track surface vibrations are hypothesized from the nature of elevated bridge vibrations. Then, the vehicle dynamic behavior in response to significant track displacements during an earthquake is analyzed to determine the probability and nature of a derailment.

The other task is to take all possible measures to avoid derailment. These measures include:

- safeguarding the tracks and other infrastructure from destruction or damage;
- developing more sophisticated systems for early earthquake detection;
- installing rail guards to prevent a future derailment.

However, if the quake is extremely severe, it may not always be possible to completely avoid a derailment even where the railway infrastructure is sound. It is therefore necessary to implement extra measures so that even if a train derails it will not fall off the track bed, overturn, or collide with an oncoming train.

Japan is an earthquake-prone country, and it is fully recognized that rail infrastructure must be sufficiently strong to withstand seismic activity. Although ensuring the running safety of trains during and after an earthquake is a technical problem that must obviously be fully addressed, it is no easy task in view of the difficulty of identifying all relevant dynamics, and the huge cost of implementing effective safety measures. Railway Technical Research Institute considers rail transport safety to be its most vital research and development aim, and will continue tackling rail safety issues in order to develop effective, practical solutions.

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