Special Topic 2

10 Years of Research and Development

10th Anniversary of the establishment of the Research & Development Center of JR East Group

The Research & Development Center of JR East Group celebrated the 10th anniversary of its foundation in December 2011. At the time of its foundation, the Center began with two new organizations: the Frontier Service Development Laboratory and the Advanced Railway System Development Center, and two previously established ones: the Safety Research Laboratory and the Technical Center. In 2006, the Center newly established the Disaster Prevention Research Laboratory, and in 2009, the Environmental Engineering Research Laboratory. In this section, we introduce the major achievements of the Research & Development Center of JR East Group to date.

1. Development of Environmental Technology

(1) Research and development aimed at the reduction of our environmental impact

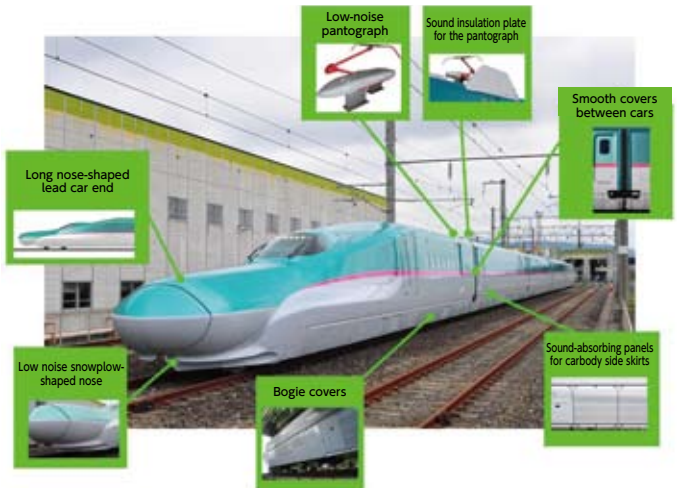
NE Train, JR East's test railcar, was the first to introduce a hybrid system to a railway. The next step in reducing the railcar's environmental impact was to replace the NE Train's engine and generator with fuel cells, remodeling the NE Train as a fuel cell hybrid railcar. In FY2008, JR East conducted test runs of this fuel cell hybrid railcar on the Shin-etsu Main Line.
In FY2010, JR East commenced test runs of its high-capacity storage battery-equipped NE Train, Smart Denchi-kun. Smart Denchi-kun which consumes less energy than diesel railcars has advantages as a reduction in CO_2 emissions and zero exhaust gas. In February and March 2012, in the final stage of its testing, JR East conducted test runs for the charge-discharge of its battery system on the non-electrified Karasuyama Line and confirmed that the system had no problems with practical performance.

Smart Denchi-kun

(2) Research and development aimed at increased speed for the Shinkansen

① Development of Rolling Stock

With the FASTECH360, a Shinkansen high-speed test train manufactured with the objective of increasing the operational speed of the Shinkansen, the Center has been working on technological developments to accommodate wayside environments, such as measures against noise and micro-pressure waves (air compression waves generated when trains enter tunnels at a high speed). The results obtained from this research are reflected in the E5 Series, which is used for Tohoku Shinkansen Hayabusa trains, and are planned to have an increased operational speed of 320km/h after the end of FY2014. In the future, the Center aims to continue its research and development in order to achieve further speed increases for its Shinkansen.



Research and development for speed increases in the Shinkansen, and reflections on the development of the E5 Series

② Development of ground facilities

In aiming for speed increases for the Shinkansen, JR East has pursued measures to reduce micro-pressure waves and noise at its ground facilities.
To reduce the micro-pressure waves, JR East developed and introduced reduced length tunnel hoods by installing the duct into the hood, tunnel hoods made of lightweight panels, and a Shinkansen noise reduction device (NIDES) which is installed in the upper part of soundproof walls as a countermeasure for noise.

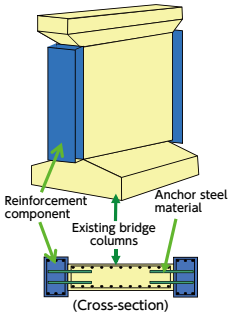
Tunnel hood with a duct

Shinkansen noise reduction device (NIDES)

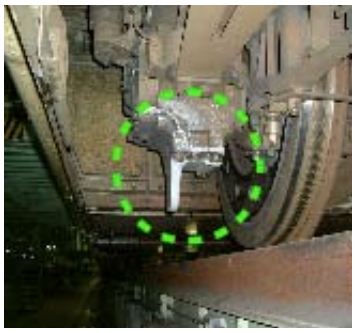
2. Research and development related to safety

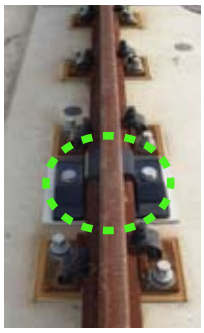
(1) Measures against earthquakes

As countermeasures against earthquakes, JR East has pursued measures to heighten the quake-resistance of its structures, to stop trains as quickly as possible when an earthquake strikes, and to greatly reduce the amount of damage resulting from an earthquake.
In particular, JR East has developed and introduced a seismic reinforcement measures to help counter earthquakes through the introduction of reinforced concrete components to the side surfaces of bridge columns, L-shaped car guides to prevent Shinkansen trains from going to the side if they derail at the time of an earthquake, and countermeasures to prevent rails from overturning.



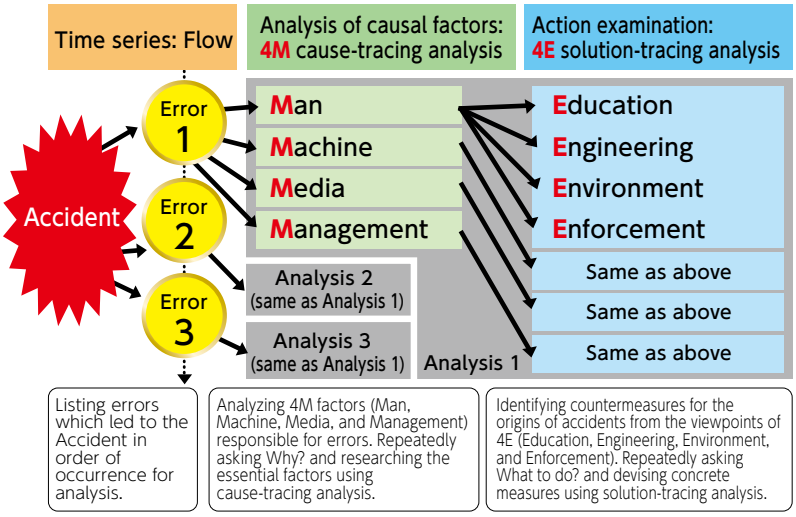
Seismic reinforcement of bridge columns


L-shaped car guide


Rail rollover prevention devices

(2) Human Error Analysis Method

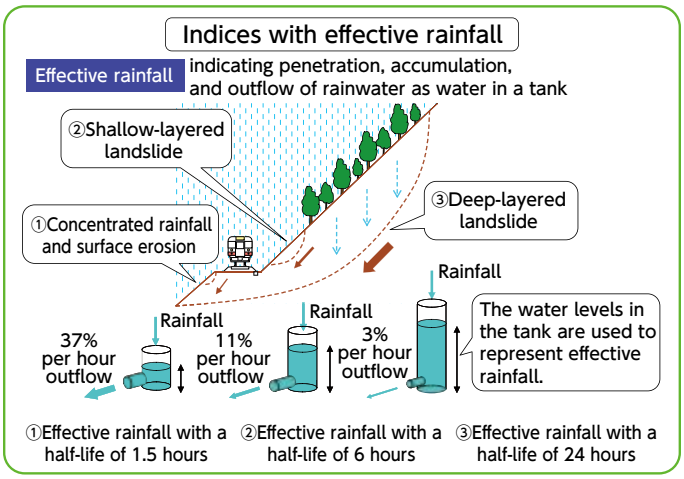
JR East developed the 4M4E analysis method in 2004 to analyze human error-related accidents. The 4M4E method includes a 4M (Man, Machine, Media, and Management) cause-tracing analysis to investigate the origins of accidents multilaterally and a 4E (Education, Engineering, Environment, and Enforcement) solution-tracing analysis to improve countermeasures. In further efforts, JR East developed the Naze Naze Kun (Mr. Why-and-Why) learning materials for personal computers, and the Horisage Kun (Mr. In-depth Study) Analysis Support Tool. Both were introduced in FY2006 for the analysis of events requiring attention, and utilized for the prevention of accidents and improvements to safety.



4M4E analysis method

(3) Operational restriction methods

For operational restrictions during heavy rainfall, JR East has traditionally utilized a calculation that combines the rainfall for the preceding hour and the total continuous rainfall since the start of the rain. However, to more effectively identify danger levels associated with disasters resulting from rainfall, JR East analyzed effective rainfall through changes in water levels, utilizing a tank which modeled how rainwater penetrated into the ground and rainwater outflow. Through the statistical analysis of past rainfall and disaster data, and by utilizing 3 kinds of effective rainfall with half-life periods of 1.5 hours, 6 hours, and 24 hours as indices, it became possible to evaluate the potential danger for various rainfall disasters. And, since June 2008, this system has been introduced to all conventional lines as part of their operational restriction procedures.



Effective rainfall indices

3. Research and development for improvements in customer service

In an effort to provide easy-to-understand operations-related information for customers in the event of transport disturbances, between 2002 and 2006, JR East developed passenger guidance emergency information displays for the visual display of route maps. The displays indicate routes with delayed train operations in orange, and those with suspended train operations in red. In this way, passengers can immediately and visually comprehend the status of train operations in the event of a disruption. Following field tests at Ueno Station and Tokyo Station, the system was installed at Akihabara Station in February of 2007, and is currently being introduced to other stations as well, mainly in the Tokyo metropolitan area.
In addition, JR East is currently developing an on-board personalized information provision system to provide customers real-time information of their actual location through smartphones. With this system, customers can obtain a variety of detailed information according to their needs and, at the same time, their activities after alighting can also be supported. In 2011, JR East field tested a commercial trainset on the Yamanote Line, and aims to commercialize the system after conducting user questionnaires to assess and to verify the services to be provided.

Emergency information display for passenger guidance

On-board personalized information provision system