Toward Railway Innovation

# Ascent

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## Preface



## Special Features / Railway Safety for Natural Disasters



## Contribution



## International Activities



# New Dimensions of Railway Safety for Natural Hazards

**Mr. Ryuji Tsuchiya**
Managing Editor
(Director, International Division, RTRI)

The 21st century has been seeing a marked increase in natural hazards across the world that are causing tremendous damage.

In recent years, average temperatures are rising, typhoons are becoming more significant in size and strength and heavy rain events are occurring more frequently, all on a global scale. Those and other similar events have prompted experts to alert us to the underlying climate change associated with global warming. The ever-increasing severity of those natural hazards poses a significant threat to railways.

Damage done to the railways in Japan because of natural hazards include a derailment and overturning event caused by gusts of wind (December 2005), a derailment event caused by slope failure (December 2015) and a severed route event in a heavy rain disaster of extreme severity in Hokkaido (August 2016).

Japan is also known for a high frequency of earthquake occurrences. Two of the most recent major earthquakes to hit Japan, namely the 2011 off the Pacific coast of Tohoku Earthquake (March 2011) and the 2016 Kumamoto Earthquake (April 2016), caused significant damage to the local railway systems.

Railway safety has largely been ensured through years of everyday effort on related fronts. With natural hazards likely to continue to grow in intensity and frequency, however, the conventional approaches and measures appear not enough to effectively ensure railway safety in more events than ever.

With the above in mind, this issue of Ascent features an overview of some of the new fronts RTRI has been pursuing to cope with ever-intensifying natural hazards.

This issue also presents an article on risk management contributed by Professor Anson Jack at the University of Birmingham in the UK.

We hope you will find this issue of Ascent interesting.

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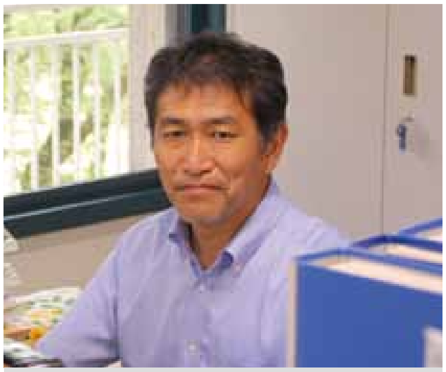
# Further Improvement of Railway Safety Against Cross Wind

**A mock-up of train consisted of three vehicles is installed on an eight-meter viaduct of single track to measure acting force due to natural wind. This site, Shimamaki village, Hokkaido, is known as an area of strong wind.**



**Dr. Katsuhiro Kikuchi**
Laboratory Head
Vehicle Aerodynamics

In order to operate railway vehicles safely and stably, it is important to stay alert to various meteorological phenomena that can possibly affect railway operation, predict the occurrence of disaster beforehand, and implement operation control such as speed control, train service cancellation, etc. Among meteorological phenomena, cross winds are one of the causes that can lead to a rollover accident of railway vehicles. In addition, the recent trends of weight reduction and speeding up of railway vehicles have created greater challenges for the cross wind stability of vehicles.

## Full-scale model tests and wind tunnel tests

Unlike aircraft, railway vehicles run near the ground, so the wind that they receive under a cross wind is not a uniform but turbulent flow that is subject to temporal and spatial change.

With that in mind, in order to help develop a wind tunnel test method that considers natural wind conditions, Railway Technical Research Institute (RTRI) conducted field tests using full-scale models of a viaduct and vehicles in Shimamaki Village, an area where strong winds blow in Hokkaido. Researchers spent about two years observing natural winds and aerodynamic forces acting on vehicles.

At the same time, RTRI began to simulate natural winds corresponding to those in the field tests using full-scale models in wind tunnel experiments. Spires and blocks, which help generate turbulent flow, were installed inside a large-scale low-noise wind tunnel measurement unit. Through this experiment, a method was developed to generate airflows (turbulent boundary layers) similar to the natural winds observed in the field tests. As a result of the measurement of aerodynamic force acting on the vehicles due to the generated turbulent boundary layers, the aerodynamic force obtained in the

**Four kinds of objects (white barriers, green spires, blue and red blocks) can generate an airflow similar to the natural turbulence. Models of a viaduct and vehicles with a scale of 1 /40 are installed on a turntable which allows to blow in different attack of angles on them. A balance set inside one of vehicle models measures forces acting on it. The wind tunnel test are in agreement on measured forces with that of the full-scale models in the field.**

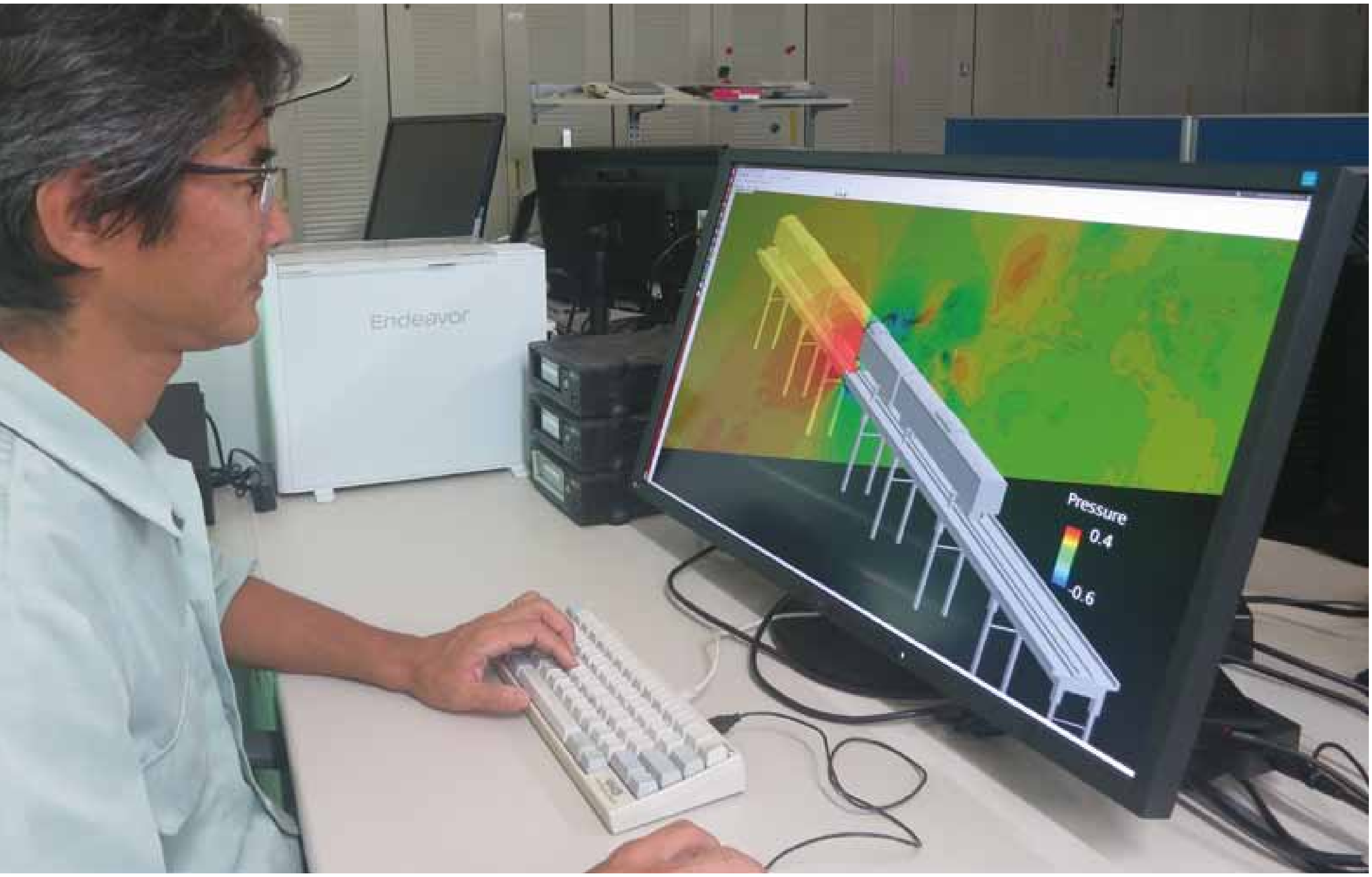

**The numerical simulations are executed on RTRI's supercomputer named " 究 " (Kyu). This Chinese character stands for "learning thoroughly". This is one of two characters which compose the word " 研究 " (Ken-Kyu), "Research" in Japanese.**

wind tunnel experiment was found to be in good agreement with that of the field model tests.

Also, since the aerodynamic force acting on vehicles depends not only on the shape of vehicles, but also on the shape of their structural parts, wind tunnel tests were also conducted on the combinations of five representative shapes of vehicles and seven representative shapes of structures. These tests led to successfully obtaining aerodynamic force coefficients and it became possible to estimate the aerodynamic forces for various combinations of vehicle shapes and structure shapes.

## Numerical simulation

As described above, wind tunnel tests are used to understand the effect of aerodynamic force acting on railway vehicles under cross winds. Meanwhile, due to recent improvements in computer performance and the development of calculation algorithms, numerical simulation has become increasingly effective as a tool for research and development. Numerical simulation is expected to become an effective method to simulate situations which are difficultly replicated in a wind tunnel test, and to acquire detailed data from an unsteady three-dimensional flow field in the future. Therefore, RTRI has proceeded with the research and development of numerical




**This screen shows a pressure distribution around the center of train. The higher pressure region (red colored) is on the upper stream side of the train. Numerical simulation is expected to become an effective method to acquire detailed data from an unsteady three-dimensional flow field.**

simulation in using supercomputers, viewing it as a complementary method to wind tunnel tests that are conducted to predict the aerodynamic force acting on vehicles due to cross wind.

## Research activities in the future

In order to accurately evaluate aerodynamic forces acting on vehicles due to the generation of crosswinds, it is important to measure the aerodynamic force in a condition close to that of an actual phenomenon. Therefore, RTRI developed a moving model rig that creates relative movements between vehicles and the ground during wind tunnel tests. This will more closely represent actual service conditions and enhance the measurement of aerodynamic force.

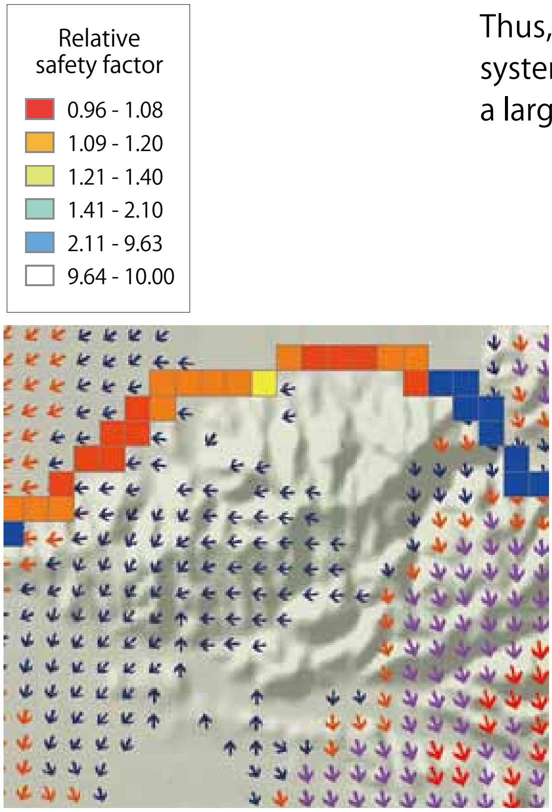
RTRI will continue to make efforts to improve technologies for estimating aerodynamic force due to the generation of cross winds, with the aim of improving the safety of railway.

# Meteorological Disaster Hazard Map System


**Dr. Naoyuki Ota**
Director
Disaster Prevention Technology Division


Global warming is said to be responsible for climate change. For example, in Japan there have been increasing numbers of heavy rainstorms that fall on a limited area (with a diameter of several kilometers) in a short period of time. If this type of rain hits a mountainous area, large scale landslide disasters such as a debris floods can occur. In order to prevent such landslide disasters, conventionally it is necessary to conduct slope investigations and identify potentially hazardous locations, and then take countermeasures there before a slope failure occurs. However, large scale landslide disasters like a debris flood often occur at locations far from the railway track. Therefore, in order to identify potentially hazardous locations, extensive investigation has to be conducted, which requires much time and cost.

Thus, Railway Technical Research Institute (RTRI) has developed a system to create a meteorological disaster hazard map that covers a large area and can be used for different potential disasters.




**Strong wind hazard map**

**Wind observation is indispensable to creating hazard map system for strong wind. In order to validate the simulation result for meteorological phenomena, we measure the velocity and the direction of wind which blows in the target areas by propeller anemometers.**

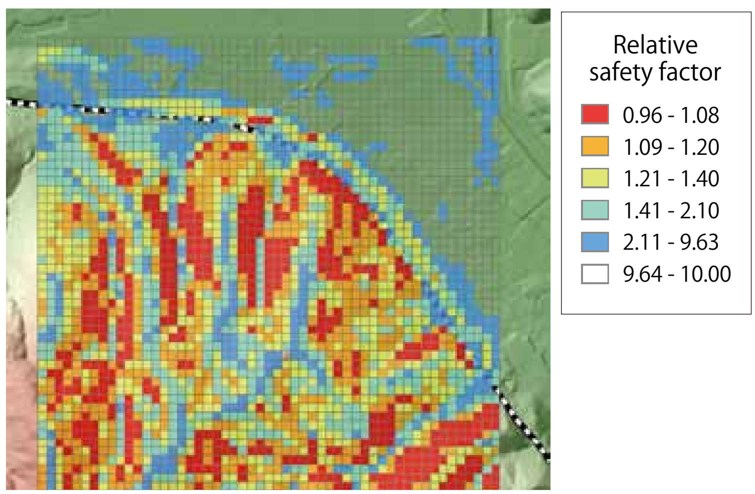
## Examples of hazard map

### Strong wind disaster

To assess a strong wind hazard, persons in charge of disaster prevention first of all analyzes the past data on a wide range of weather conditions by using a weather simulation model. Next, after extracting the results on the railway track from the entire analysis results, wind conditions are analyzed at an interval of 250 m by using an air-stream model. Based on the data obtained on past wind conditions, the occurrence probability of a wind of arbitrary strength is calculated. In this system, by entering an arbitrary strength of a wind as a reference value, persons in charge of disaster prevention can show the occurrence probability of winds with the strength exceeding that reference value along the railway truck on the map. This evaluation result is used for the selection of locations where countermeasures against strong wind should be preferentially implemented.

### Landslide disaster

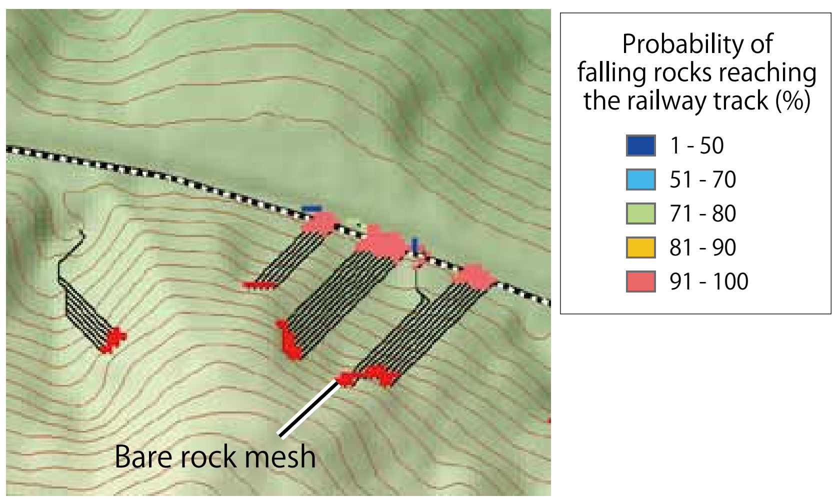
This system to create a hazard map performs a two-step analysis: the primary processing and the secondary processing. In the primary processing, the risk of a mass failure is analyzed at an interval of 1 m on the basis of the data of slope inclination, the shape of a horizontal cross-section, vegetation status, etc.. After studying the results of the primary processing, a system user can select places where the risk of mass failure due to heavy rainfall should be evaluated. When the user enters the data on the temporal change in rainfall into the system, the system calculates the change in the stability of the slope according to the intensity of rainfall and displays the result of the secondary processing on the screen at intervals of 10 m on the slope. By using this system, persons in charge of disaster prevention can extract locations to be watched with extreme caution in response to the expected rainfall. This evaluation result is used for the selection of locations requiring further detailed examination and the selection of places where countermeasures need to be preferentially implemented.




**Landslide disaster hazard map**

**Investigation of the slope conditions in the target areas is indispensable to creating hazard map system for landslide. In order to validate the result generated by the system, we compare it with the result of investigation of landslide traces.**

**Hazard map system for rockfall identifies the areas where the probability of rockfall is relatively high. In order to validate the result generated by the system, we investigate the stability of the bedrocks in the target areas.**

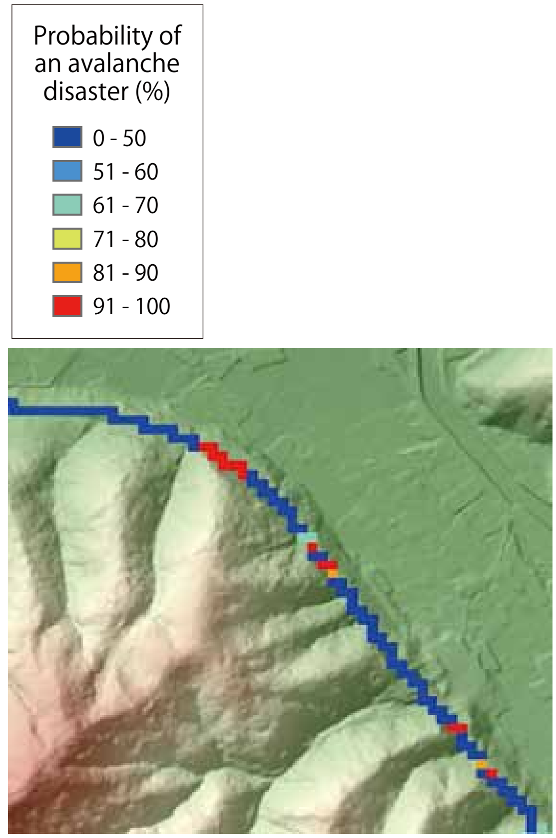



**Rock fall hazard map**

## Rockfall disaster

This system calculates the curvature and inclination of the slope by using topographical information obtained from the data on the slope that was measured at intervals of 1 m, and then, selects the locations where bare rocks are present on the basis of the result. Next, based on the data on the inclination of the slope, the system identifies falling paths that masses of rock go through when they fall off the bare rocks. Based on the path information, the system creates a two-dimensional cross section that simulates the positions that falling rocks will reach in the event of rockfall. The system shows the paths of falling rocks and the probability of those rocks reaching the railway track. This evaluation result is used for the selection of locations where countermeasures should be preferentially implemented as well as for the determination of position where countermeasure work has to be implemented.

In order to build a model for evaluating the stability of the accumulated snow, we investigate the depth, weight, granularity and shape of snow particles on the slope with accumulated snow and measure the shearing force on the contact surface between accumulated snow and the ground. This model is used to evaluate the risk of avalanche occurrence.




Avalanche disaster hazard map

## Avalanche disaster

This system calculates the probability of an avalanche based on the inclination of the slope, the density of trees, and the probable maximum snow depth obtained from past data. Also, it calculates an avalanche track by the same method for the evaluation of rockfalls, and calculates the probability of the avalanche reaching the railway track based on the relative positions of the avalanche occurrence location and the location of the railway track. The risk of an avalanche is determined based on its occurrence probability and the possibility of it reaching the railway track.

## Addressing the challenges of disaster prevention in Japan

As described in the beginning, it is thought that the forms of disasters will change due to climate change; therefore, disaster prevention engineers need to adapt to such change. Also, it is expected that the number of engineers to evaluate slopes will decrease in the future. There is a concern that a decrease in the number of engineers may bring about a decline in the accuracy of examination, which may result in the occurrence of a disaster at places where no disasters have taken place in the past. The introduced technique for hazard map creation is recognized as an effective tool for the prevention of disasters caused by climate change and the problems of a decline in the accuracy of examination. Further efforts should be made in the future to advance research and development with the aim of solving issues associated with disaster prevention.

# Earthquake Early Warning System

**Dr. Shunroku Yamamoto**
Laboratory Head
Seismic Data Analysis

Japan is located in one of the areas with the highest earthquake frequency in the world. Under such a natural environment, it is considered to be extremely important to take earthquake countermeasures for the safety of the railways. However, even if full-scale countermeasures such as earthquake-resistant design and anti-seismic reinforcement for railway structures are implemented in advance, it seems to be dangerous for trains to continue running at a high speed during the tremor of an earthquake. If the speed of trains can be reduced as soon as possible at the occurrence of an earthquake, in addition to taking sufficient measures in advance, it will contribute to further improvement of the safety of railways during an earthquake. To that end, an earthquake early warning system for railways was developed.

**Seismometers developed for the early-warning purpose are installed at each of the detection points of the Earthquake Early Warning System. These seismometers are composed of sensors and data-processing devices which process the P-wave data detected by the sensors and issue warnings.**

## Overview of an earthquake early warning system

The earthquake early warning system consists of multiple dedicated seismographs that are connected on a network. In order to be able to output a warning as quickly as possible when responding to an earthquake, each of the connected seismographs are designed to separately perform seismic observation and independently execute warnings. A number of seismographs are placed along railway tracks or in other positions to ensure that a railway network is covered. At the time of an earthquake, a seismograph closest to an earthquake center detects tremors and outputs a warning earlier than the other seismographs.

In addition to having functions to issue a warning after detecting large tremors, each seismometer has a specific function called a P-wave warning function, which can issue a warning by analyzing preliminary tremors (P-waves) that arrive prior to large tremors (S-waves). The greatest feature of the earthquake early warning system lies in its ability to issue P-wave warnings.

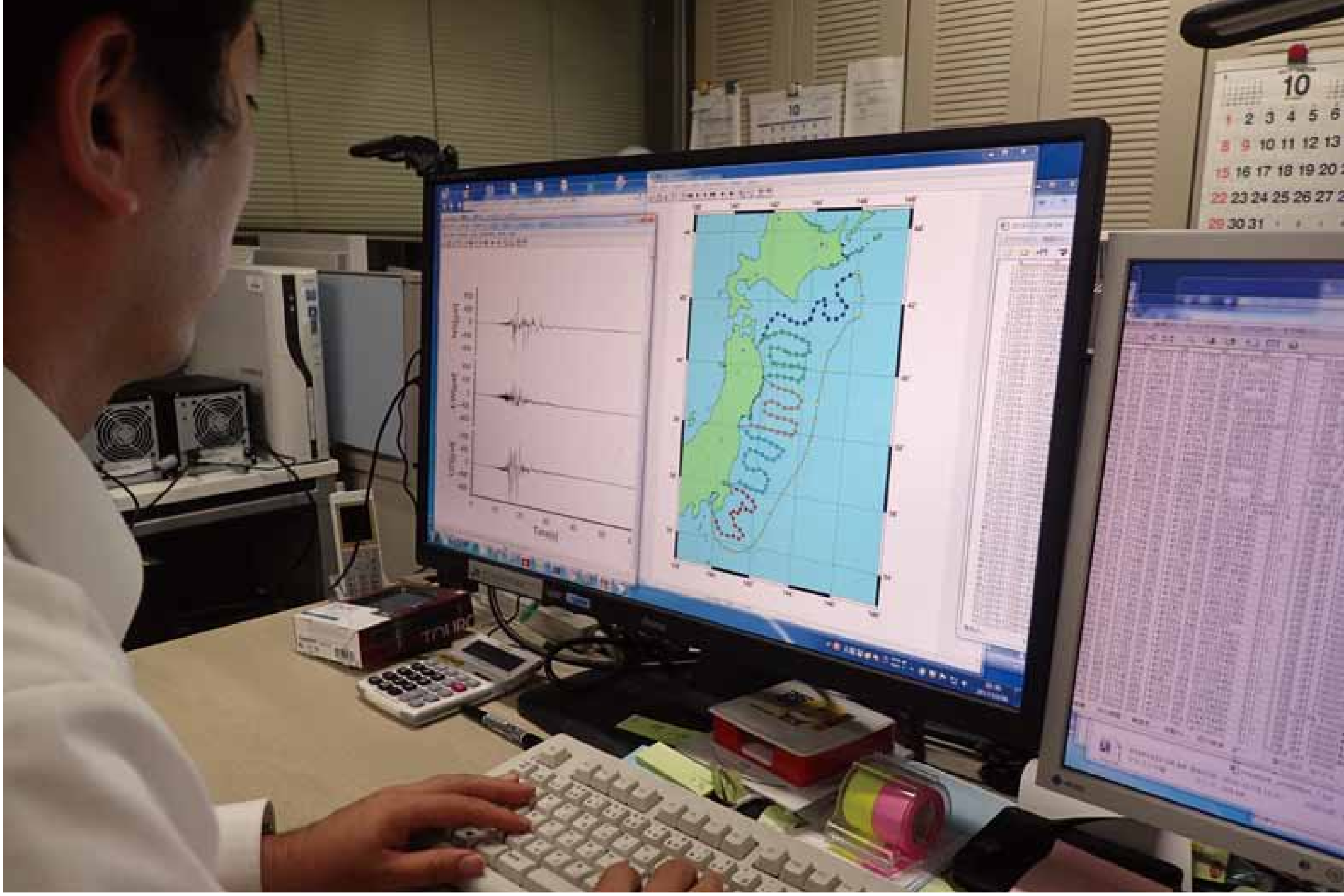
After detecting P-waves, the seismograph estimates epicentral distance, epicenter azimuth and magnitude from the initial motion part of the P-waves, determines the extent of damage and outputs a warning in one second at the fastest rate. In particular, one of the core technologies of the P-wave warning is a method called B-Δ method, which enables epicentral distance to be estimated based on the growth rate of the P-wave amplitude observed in a short period of time. This method was developed through analyzing data on seismic motions. This method is also used by the Japan Meteorological Agency as one of the methods to process Earthquake Early Warning.

To prevent false alarms, it is also important for the system to have a function to distinguish seismic motions from vibrations. The seismographs incorporate an algorithm to identify seismic motions by the characteristics of observed waveforms.

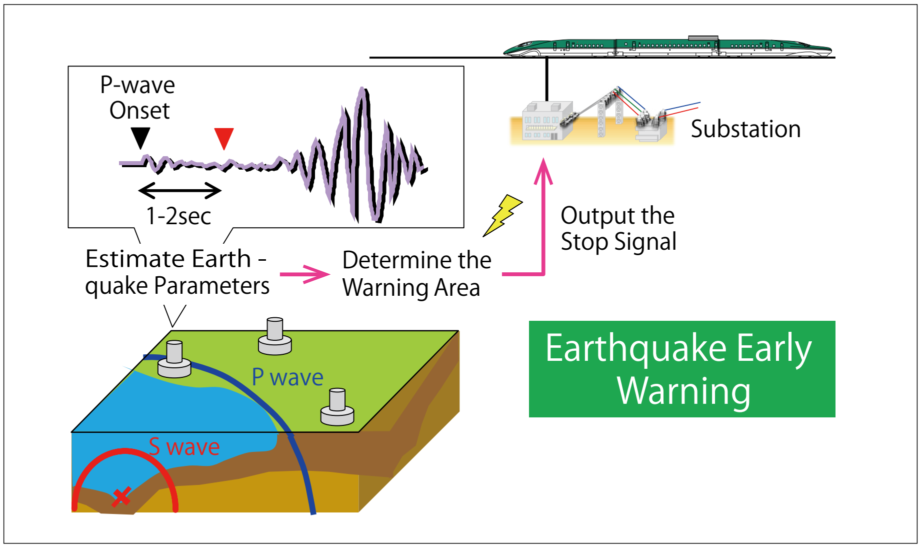
## Utilization of the earthquake early warning system

The earthquake early warning system has been installed in the Kyushu Shinkansen since 2004, and presently it is being utilized in the Shinkansen throughout Japan. At the time of the 2011 off the Pacific coast of Tohoku Earthquake (moment magnitude:

**Detection points are located along railway tracks or quiet places distant from tracks. Constant temperature and humidity are maintained inside the buildings housing seismometers in order to ensure stable operation of the seismometers over a long period.**



**RTRI is also developing an early-warning system directly using the data of ocean-bottom seismometers placed by governmental organizations so that warnings can be issued as quickly as possible at the time of major ocean-bottom earthquakes.**




**This system instantly estimates the epicenter and the areas expected to suffer damage by analyzing the data of initial tremors of P-wave and issue warnings immediately to the areas.**

9.0), this system successfully output a warning before a large tremor reached the Shinkansen.

Currently, the system is being utilized as an important system to protect the safety of railways in Japan. At the same time, great expectations have been placed on its performance improvement. In response to such expectations, RTRI will proceed with technological developments to further improve the accuracy and promptness of the earthquake early warning system.

# Converging Routes Toward Total System Safety

**Prof. Anson Jack**
International Railway Benchmarking, University of Birmingham, UK

Over many years within the railway sector, it has been both a privilege and pleasure to experience both the British and Japanese railway systems. Although always based in the UK there have been many opportunities to meet with Japanese railway people and to learn about the differences and similarities between our two countries. This article reflects on that experience and what I have learned about the different approaches each country takes to safety, concluding that there are different ways to achieve safety but they all revolve around the human.

One of my first encounters with Japan and its railways was through the annual 'pilgrimage' that the leadership of RTRI make to the UK. Working in a country that may have invented railways 200 years ago, but rather lost its way in the 20th Century, it was a surprise to me that Japan, the country that led the way toward the future of railways after the Second World War, could think that it had anything to learn from us. And yet Japan and Japanese railway people seem to show much more respect and interest in what goes on in British universities and railway companies than their British equivalents do in the other direction.

To discover that RTRI places its own people in various academic institutions in the UK and that its President and Senior Vice Presidents visit them annually to review their activity and to show support, was one of the great learning experiences of my career. It told me that the constant pursuit of improvement should have no barriers or limits, and that improvement comes about from looking around and finding who does things the best. Most of all, it aroused my interest in the Japanese approach. British railway managers, and particularly those who have been lucky enough to travel to Japan and experience the system, have tended to admire, but assume that things are so different that there is not really anything we can learn from it. "The Japanese invest so much in high speed rail", "run their trains totally on time," "have zero tolerance of accidents" etc. These are all highly desirable objectives but from where British Rail was in the 1990s (cash starved; investing below the rate needed to maintain assets; no prospect of any high speed rail beyond the link to the French System via the Channel Tunnel; running only about 80% of trains within 5 or 10 minutes of their scheduled time; and experiencing an average of two accidents a year that cause fatalities, plus around 10 employees a year dying at work) it seemed so unattainable that it was not worth starting the journey.

Well how thinks can change in 20 years! In the last year, the UK railway saw:

- The passing of a Bill to build a new high speed railway from Birmingham to London, with the political commitment to continue north to Manchester and Leeds
- The first delivery of a fleet of nearly 1000 new passenger vehicles for 200kph operation on the existing network from a Japanese manufacturer who is assembling the trains in a new manufacturing plant in Britain
- No fatalities to passengers or staff in train

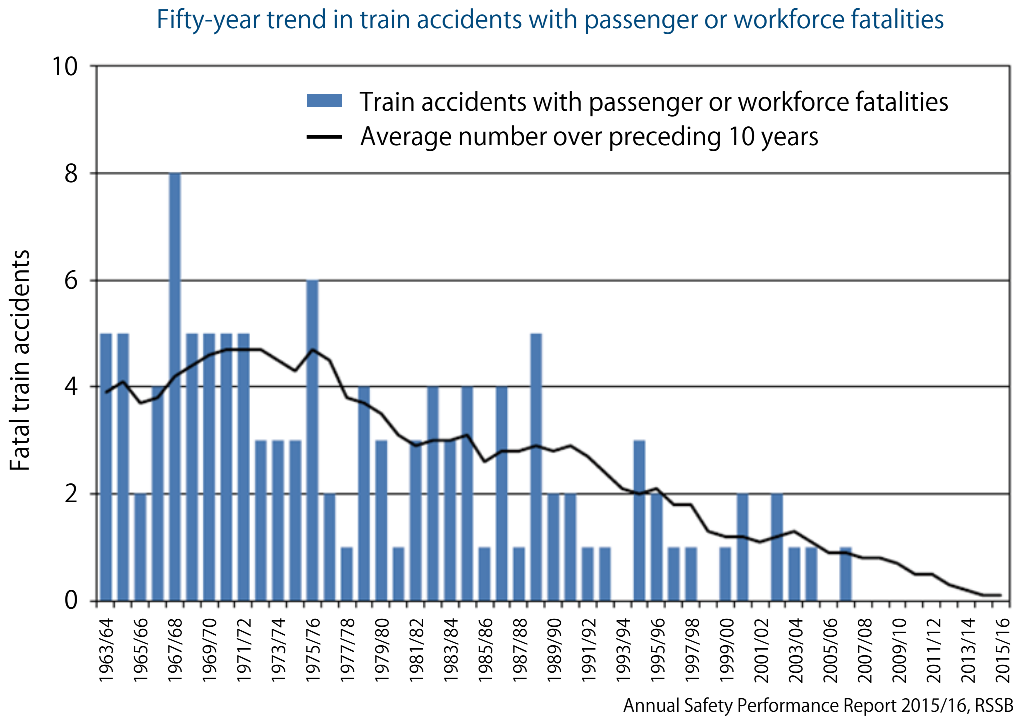



**Fig. 1: Safety post privatisation**

accidents from the tenth consecutive year (see Fig. 1)

- No staff fatalities at work in the year – for the first time ever
- Passenger numbers at over 1.6bn up 100% since privatisation in the mid 1990's (see Fig. 2)
- And although not comparable to Japan punctuality, ran 20% more trains than ten years ago with punctuality around 90% compared to 80%

What lay behind this transformation was a combination of much higher levels of investment, in equipment and people, and a much more proactive approach to safety. To focus on safety, let's look at what lay behind the improvements in the UK. Following a series of high profile accidents around the turn of the century, there were many changes initiated in the UK approach to safety, many of which (ironically) have been adopted across the European Union. Examples where the approach to safety has changed include the introduction of:

- a risk based, collaborative and consensus approach to standards
- safety management systems for all railway operations
- simplification of the 'rule book' which is common to all operators
- a system that reduced the risk from signals passed at danger by over 85%
- a confidential reporting system for safety concerns
- a close call system for all near misses
- Independent investigation of accidents with no role in deciding liability
- an independent industry body that analyses safety data and builds risk models
- a programme of R&D to support standard setting and risk management
- Human Factors/ergonomics as integral to safety management and system design
- the combining of the safety and economic regulators
- scanning and sharing worldwide experience of rail and other accidents

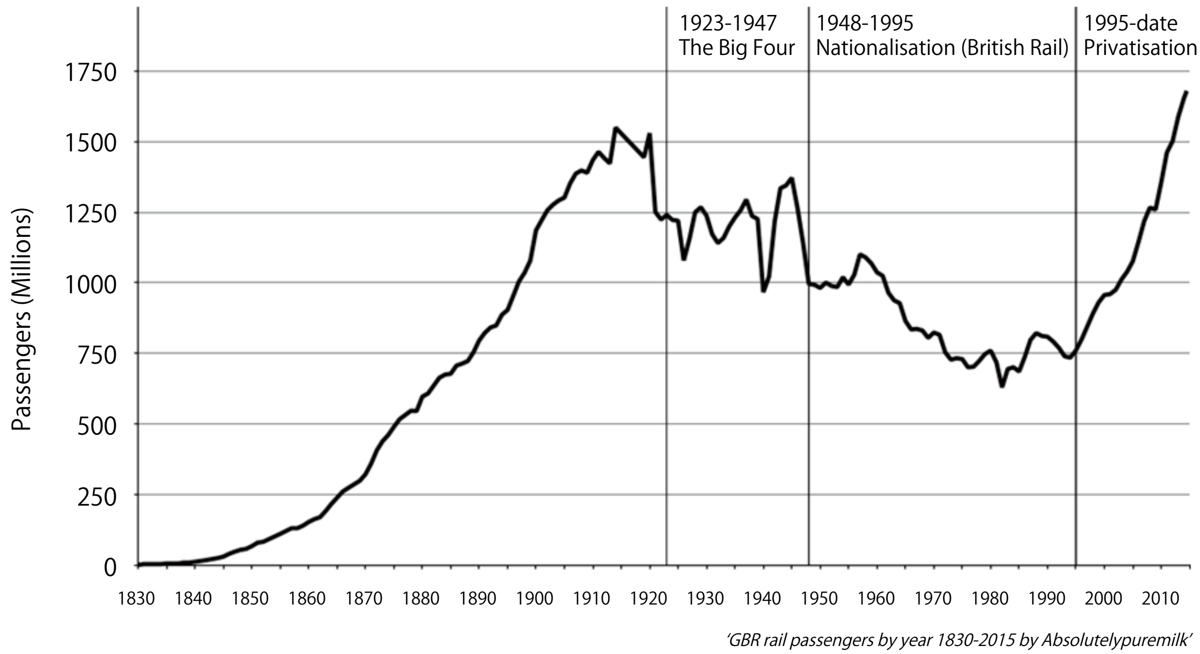



**Fig. 2: Passenger numbers since railways origin**

One common theme, where I see convergence between the Japanese and British is in the attitude of management to staff errors. Both systems used to have rules that tell staff what they can and cannot do, and in the event of an accident, management was able to blame and punish the member of staff that transgressed, whether or not the error was deliberate. Today both countries realise that to be human includes making mistakes through normal behaviour (misreading signals, forgetting a work instruction, getting distracted etc) and that if we punish people for these sorts of errors, they will be less likely to report them and we won't learn all the lessons from what nearly led to an accident. The way to manage such mistakes is to use them all to learn lessons and to use investment and technology to make it impossible to make the same mistake again. The policy of learning lessons, and improving systems to support humans in delivering safe and reliable services to customers is now shared between the railways of Japan and Great Britain and is critical in the continued improvement of safety levels in both countries. It is also a much fairer way to treat staff at all levels, as mistakes can and will be made at all levels.

On a personal level, I have always found that working with colleagues and friends at RTRI to be both a pleasure and enlightening. I commend anyone that gets the opportunity to learn by visiting overseas railways and research institutions to grasp it as they will always yield new ideas and possibilities to improve safety and performance in your own areas of responsibility.

## Biographical Note

Anson Jack has worked for British Rail, Railtrack, Network Rail, RSSB and the World Bank. He is now Professor of International Railway Benchmarking and leads a team that researches many features of the world' s railways within the Birmingham Centre for Rail Research and Education. He was responsible for RSSB Safety, research, development and innovation activity as well as being Deputy Chief Executive from 2007 to 2014. He is a member of the Technical Advisory Board of the International High Speed Rail Association and also advises SNCF on safety.

# Workshop on Micro-Pressure Waves

RTRI and DB Systemtechnik in Germany have been collaborating on prediction of micro-pressure waves (MPWs) since 2014. The purpose of this collaboration is to develop new measures for speeding up of the Shinkansen, to validate applicability of RTRI's prediction tools to overseas tunnels, and to investigate assessment tools of MPWs used in foreign countries. In this collaboration, RTRI sent a researcher to Munich for one year, and DBST and RTRI have analyzed the data obtained in German tunnels and shared knowledge with each other. The results obtained through this collaboration were published in two workshops held by both institutes

**Fig. 2: Workshop on Micro-Pressure Waves at RTRI, Tokyo in 2017**

## Outline of the research collaboration

RTRI has developed a rapid calculation method to predict MPWs based on acoustic theory in order to obtain prediction results quickly. DBST uses the CFD (computational fluid dynamics) technique to predict MPWs and design tunnel hoods.

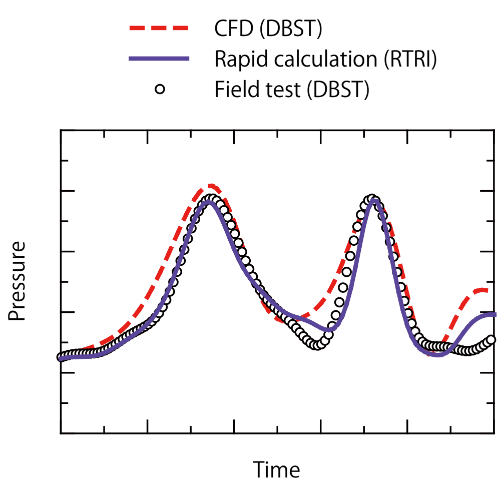



**Fig. 1: Comparison of the MPW prediction results**

We have compared the speeds, accuracy and range of application of both prediction tools with the field tests results obtained in German tunnels. The calculation results were obtained in a few seconds to a few minutes by RTRI's high-speed calculation method, while it took a few days with DBST's CFD. It was also confirmed that, in predicting MPWs under conditions similar to the tunnels in Japan, the results obtained by the rapid calculation have the same accuracy as the one by CFD (Fig. 1). On the other hand, the application range and amount of information by CFD are respectively wider and larger than the rapid calculation. Going forward RTRI will be collaborating with DBST in expanding the coverage? Range of CFD technique, and use the results to enhance the accuracy t of the rapid calculation.

## Workshops on micro-pressure waves

RTRI and DBST hold two workshops on micro-pressure waves to publish results obtained through the collaboration in 2015 in Munich and in 2017 in Tokyo (Fig. 2). Through these workshops, we have developed close relationships with foreign researchers. We plan to continue this collaboration, including other research organizations as well as DBST, and to accelerate research activities.

# Progress of International Standardization Activities at ISO/TC 269

**Mr. Yuji Nishie**
Chair, ISO/TC 269 - Railway Applications
President, Ken-yusha, Inc.
Former Director, Information Management Div., RTRI

International Standardization Organization (ISO) established a Technical Committee for Railway Applications (ISO/TC 269) in 2012, and I was nominated by the German Secretary of ISO/TC 269 and approved by the Technical Management Board (TMB) of ISO to serve as the first Chair. Though my first term as Chair was due to be completed at the end of 2017, during this spring TMB approved the extension of it to the end of 2020.

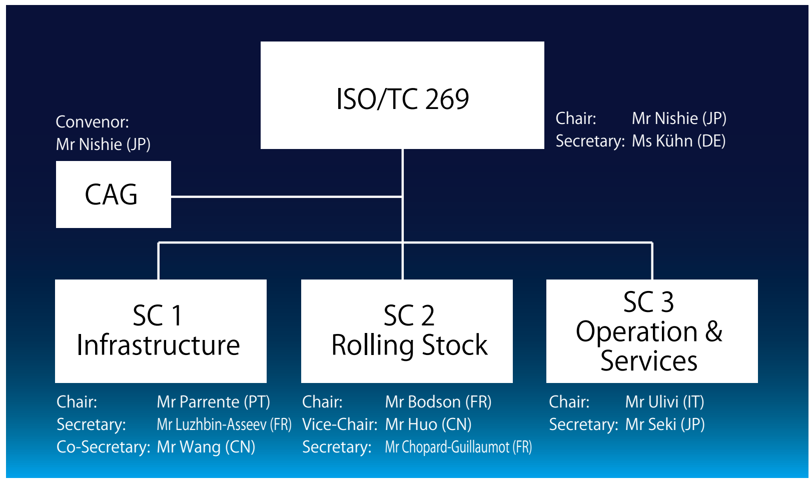



**Fig. 1: Structure of ISO/TC 269**

21 participating countries and 12 observing countries have joined ISO/TC 269 as of July 2017. ISO/TC 269 consists of three Subcommittees (SCs) established last year: SC 1 Infrastructure, SC 2 Rolling stock and SC 3 Operation & Services (See Fig. 1).

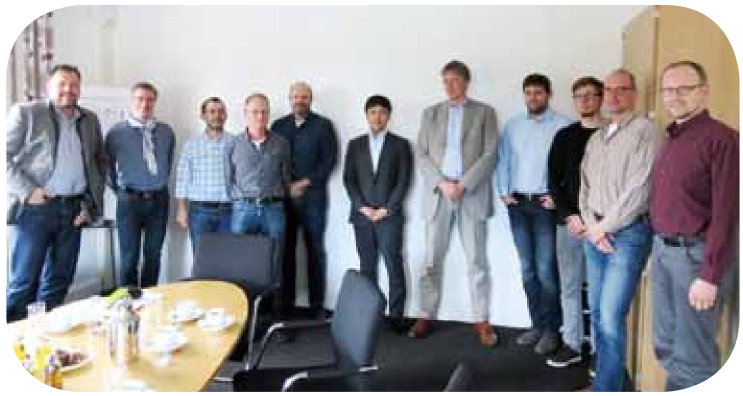
The 6th Plenary Meeting of ISO/TC 269 was held in Suwon, Republic of Korea in June 2017 hosted by the Korean Agency for Technology and Standards and the Korea Railroad Research Institute. 56 participants from 10 countries and three international organizations attended (See Fig. 2).

Four ISO standards have been published by ISO/TC 269 and 11 ISO standards are under development. The latest published standard is "ISO TS 22163:2017 Railway applications -- Quality management system -- Business management system requirements for rail organizations: ISO 9001:2015 and particular requirements for application in the rail sector." Use of this technical specification will result in the improvement of rail services and a stronger industry.

I would like to try to develop ISO standards for Railway Applications together with my colleagues of ISO/TC 269 under the ISO policy of "Global relevance."


**Fig. 2: Participants of the 6th Plenary Meeting in Suwon, Republic of Korea in June 2017**

# Collaborative Research with DB Systemtechnik on Braking Systems



At the report meeting held at the end of my stay, with members of the DBST brake department (the author is standing in the middle)

In order to implement a collaborative study titled "A Study on Simulations and Performance Evaluation Methods for Braking Systems," I was temporarily transferred to DB Systemtechnik GmbH (DBST) from April 1, 2016 to March 31, 2017. This was the second case for Railway Technical Research Institute (RTRI) to dispatch staff to DBST, following the implementation of a collaborative study named "Research on Prediction and Assessment of Micro-pressure wave."

In the present collaborative study, techniques used in the test, evaluation and simulation of braking systems in Japan and Germany have been compared, with the aim of acquiring new knowledge that will contribute to the advancement of braking systems.

In Europe, standards for brake performance evaluation exist, and DBST, which is approved as a standard certification body, has performed a number of tests and acquired a great deal of related know-how. On the other hand, RTRI has the advantage of having accumulated knowledge through continuous research and development of braking systems. Through exchanging such acquired information and complementing each other, we have been working hard to produce high-quality results.

In addition, while DBST places emphasis on certification business, RTRI places emphasis on research and development work. Thus, since these companies have different viewpoints, we have gained valuable experiences that broaden our horizons such as the promotion of test efficiency and the pursuit of standards for fair performance evaluation.

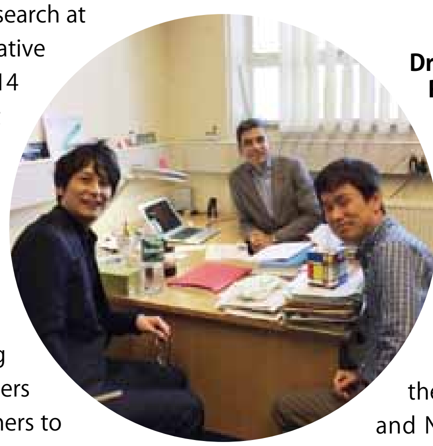
The present collaborative study will last until March 31, 2018. We will make further efforts to enhance research contents so as to create a lasting relationship that is beneficial for both companies.

(**Daisuke Hijikata,** Brake Control)

# Collaborative Research with NewRail on Passenger Safety

RTRI and NewRail (The Center for Railway Research at Newcastle University, UK) conducted collaborative research for about three years from June 2014 to March 2017. NewRail served as Project Leader of "SAFEINTERIORS," which was the EU project of Train Interior passive safety research conducted from 2006 to 2010 that accumulated know-how on how to ensure safety in case of a railway collision accident.

This RTRI/NewRail collaborative research was conducted with the aim of promoting research on "Evaluation of Damage on Passengers in Train Collisions," in which RTRI sent researchers to the UK from the Ergonomics Laboratory and the Vehicle & Bogie Parts Strength Laboratory for two and a half years as visiting researchers.



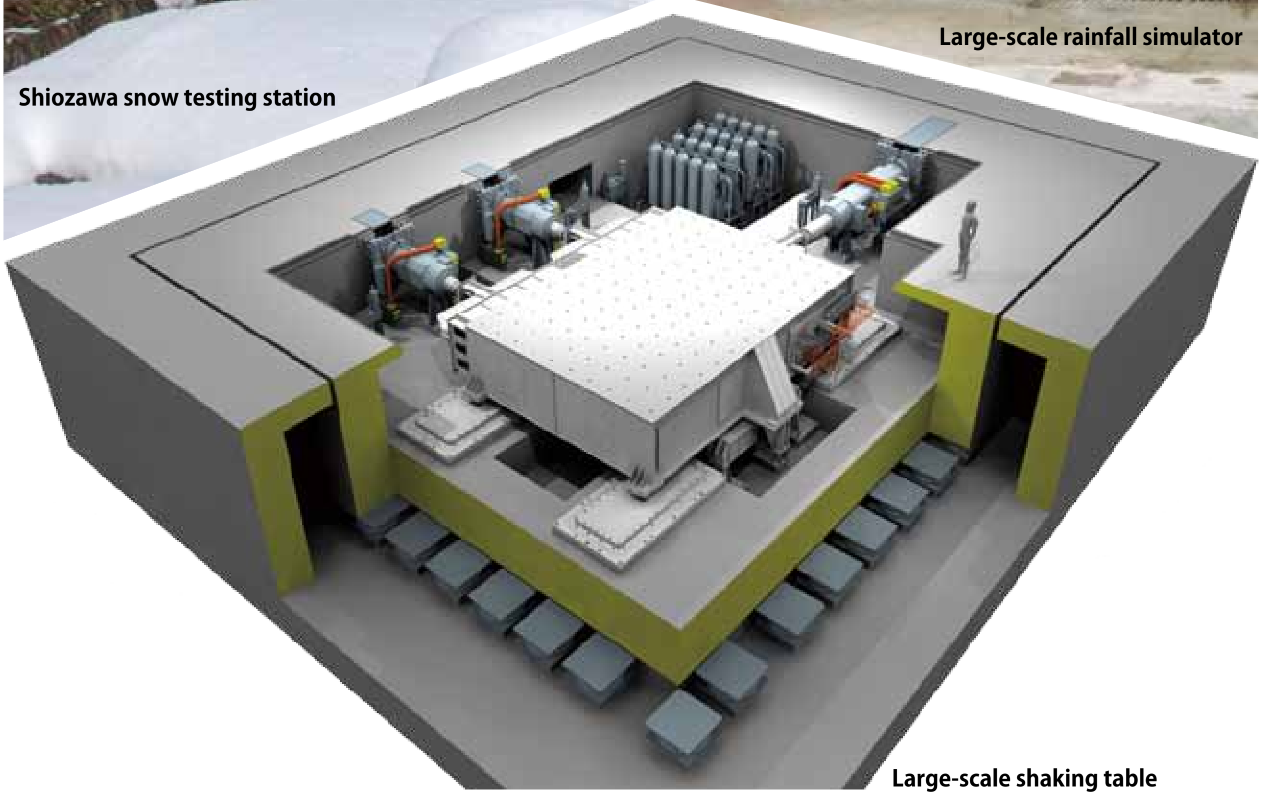
**Dr. Roberto Palacin (Senior Research Associate, Rail Systems Group Leader), Dr. Kazuma Nakai (Ergonomics Laboratory, Human Science Division), Mr. Tomohiro Okino (Vehicle & Bogie Parts Strength, Vehicle Structure Technology Division)**

It was very helpful for us to learn about various initiatives on Passive Safety, which had long been implemented in Europe, including the "SAFEINTERIORS" project. We hope that RTRI and NewRail will continue to conduct research to achieve higher safety of railways, while maintaining a fruitful relationship between the organizations.

(**Tomohiro Okino**, Vehicle and Bogie Parts Strength)

Shiozawa snow testing station

Large-scale rainfall simulator



Large-scale shaking table