Newsletter on the Latest Technologies Developed by RTRI

Railway Technology Avalanche

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2-8-38 Hikari-cho, Kokubunji-shi
Tokyo 185-8540, JAPAN
URL: http://www.rtri.or.jp

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GENERAL INFOMATION

ARTICLES

In Pursuit of Future Railway Technologies

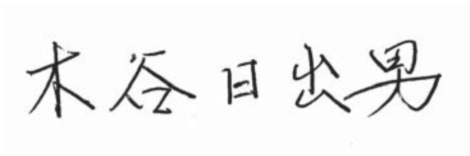
Hideo KIYA
Director, Planning Division

The Railway Technical Research Institute (RTRI) has drawn up the New Master Plan, RESEARCH 2010 (for details, refer to the next page) and activities have been based on the new five-year plan since April, 2010. In drawing up this Master Plan, the difficult conditions in which railways are currently operating were also considered, such as the decreasing numbers of passengers associated with the world recession, something which is occurring simultaneously with the acceleration of falling birthrates and the aging population. However, at the same time there is a worldwide trend to re-evaluate railways from the viewpoint of global environmental protection and economic revitalization. On that basis, RTRI has set out to pursue sustainable development of Japanese railway industries, and it has drawn up the basic concept as well as the procedure for activities to be carried out during the period. Several features of the New Master Plan are shown as follows:

"Simulation technologies": RTRI has been engaging in the research and development of simulation technologies because of the advantages that accrue from being able to reproduce a given situation and change the conditions and other variables without the difficulty of using an actual test vehicle. In this Master Plan, for example, one of the targets that has been set is to construct prototypes of the Virtual Test Line to permit comprehensive investigation into the development of rail vehicles and similar work. This will be done not only by using sophisticated equipment and developing simulation technologies that respond to the individual problem, but also by combining simulation technologies covering the mutual relationship of various relevant phenomena.

"Cultivation of human resources": For RTRI's researchers, understanding the situation in the field is essential. For this reason, in the new Plan, personnel exchanges, etc. with the respective JR companies where RTRI staff can gain various experiences on a working railway are considered to be more important than ever. Moreover, RTRI is planning to work on enhancement of its training system, and to make other improvements to develop human resources in various ways.

The role of RTRI consists in improving the convenience of rail travel based on its advantages such as safety, energy saving and the ability to handle large numbers of people. For this reason, RTRI considers it particularly necessary to promote its role as a powerful organisation able to undertake research across the whole railway spectrum, by developing its plans with stronger co-operation between its respective research sections and experts.



RTRI's New Master Plan (RESEARCH 2010)

Naoto FUKUMURA
General Manager, Planning Division

A five-year master plan covering the activities of the Railway Technical Research Institute (RTRI) has started. Since April 2010, RTRI's research and other activities have been based on the New Master Plan.

The name of the New Master Plan has been defined as "RESEARCH 2010 − In Pursuit of Sustainable Development for Railways". By reflecting the progress of research and development and changes in the circumstances surrounding railways, this New Master Plan is aimed at effectively promoting activities to fulfil RTRI's commitments to various industries. The Plan aims to ensure that RTRI will carry out a comprehensive range of activities as a railway technical research institute and pursue sustainable railway development. For this purpose, RTRI has set out the following basic policies:

(1) Creation of new technologies aimed at sustainable development of railways
(2) Accurate and quick response to demand
(3) Information transmission and dissemination of results from its activities
(4) Inheritance of railway technologies and using foundation technologies as the basis for more advanced research
(5) Demonstration of expertise in research across the whole railway engineering spectrum as a railway engineering group

Moreover, for targets of research and development,

In the area of railways, RTRI will further pursue:
- Improved safety
- Harmony with the environment
- Low cost
- Improved convenience

At the same time, RTRI will expand its specialist area by making greater use of simulation technologies. Figure 1 shows research and development activities in the New Master Plan. Regarding research and development for the future of railways, five major themes have been set, as shown in Fig.2, and several sub-themes composed of multiple research/development topics have been set within the respective themes. Each sub-theme has been determined so as to promote a systematic way of working, according to targets set within the major themes.

For the operational side, RTRI will make special efforts for the inheritance of railway technologies to ensure that knowledge of railway technologies acquired in the past is transferred to today's research teams, so that technical gaps will not open up between old and new generations. In 2010, the first year of the Master Plan, a new organization, the Railway International Standards Center, has been established, and RTRI will support this new organization.

We, the staff members of RTRI, are determined to make efforts to support and develop the Japanese railway industry and so contribute to the development of Japan's social economy. This role goes back to the principle of establishing the Research Institute when reforms associated with the privatization of JNR were introduced. Now, RTRI is at the stage of implementing wide-ranging advanced research and development, working from basic research to sophisticated applications, while promoting close co-operation with railway companies and enterprises.

We ask for your support and encouragement.

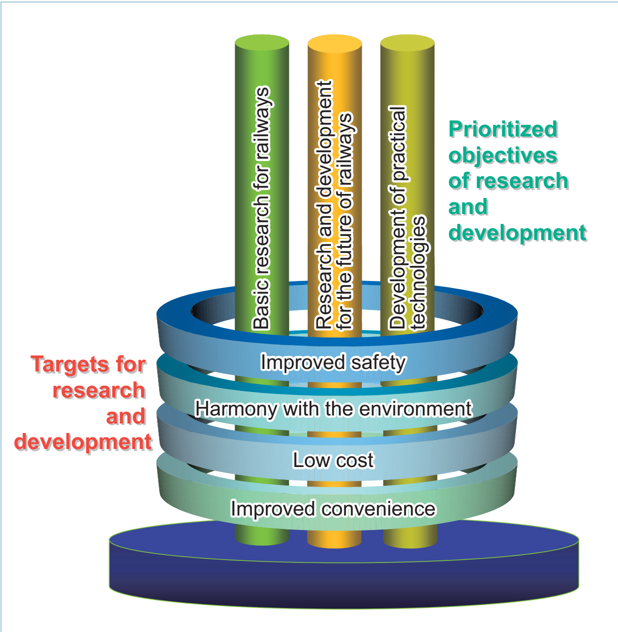


Fig.1 Research and development activities of RTRI

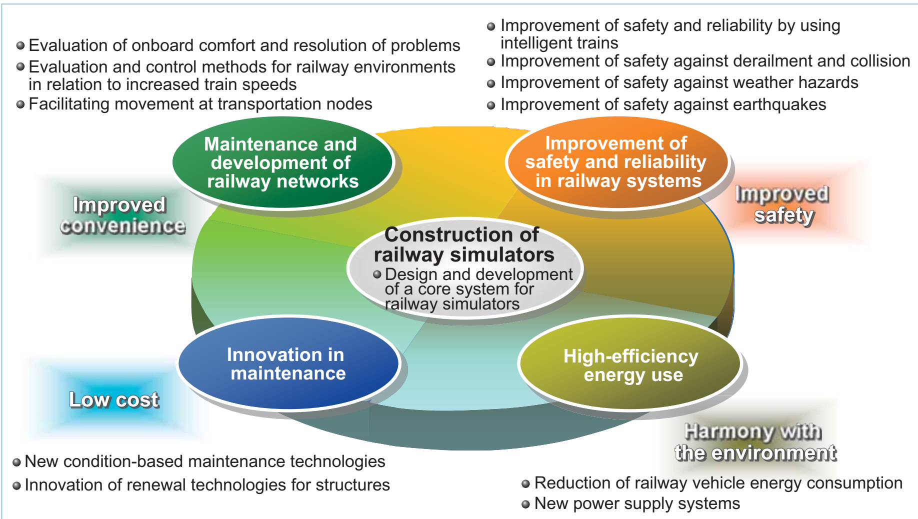


Fig.2 Research and development for the future of railways

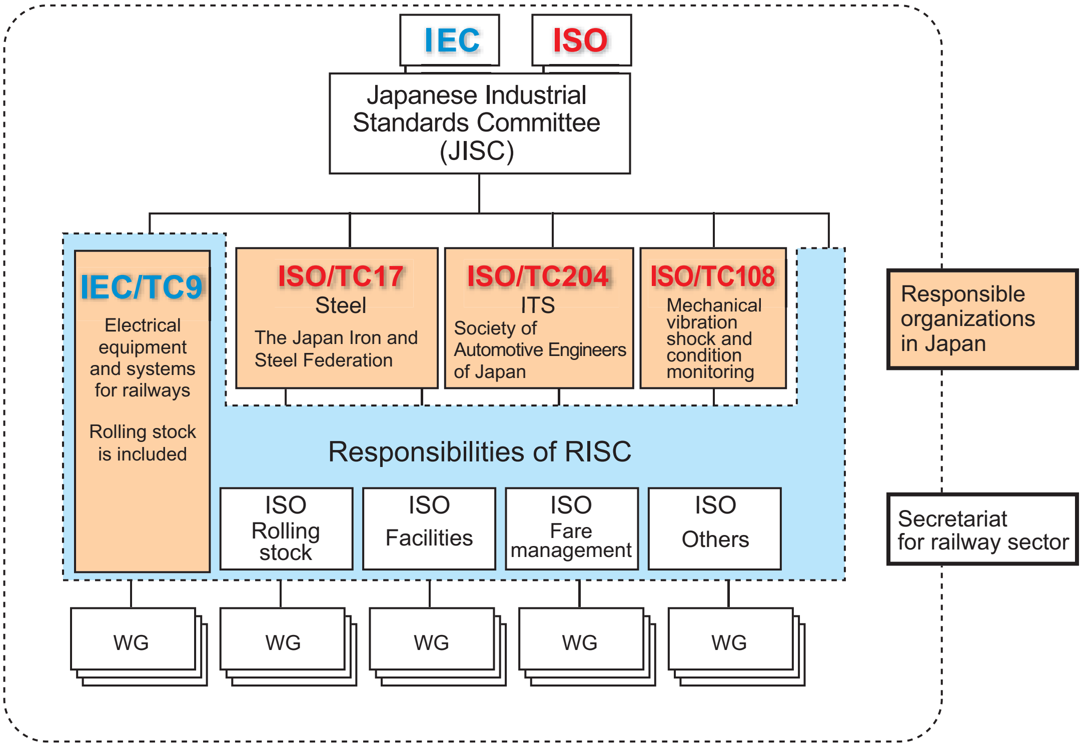
Establishment of the Railway International Standards Center

Hiroshi TANAKA
Director, Railway International Standards Center

The Railway International Standards Center (RISC) was established as part of the Railway Technical Research Institute on April 1st, 2010, when it began its programme of activities. Up to now, RTRI's role has been as a domestic council organization of IEC/TC9 (Electrical Equipment and Systems for Railways). Accordingly, RTRI has been getting to know the general circumstances with regard to IEC standards in the railway field and promoting council activities. However, in relation to the ISO standards, since there is no Railway Technical Committee in ISO, railway-related standards have been distributed under many technical committees, and management and discussions have involved different council organizations. This also applies in Japan. Thus, it has been difficult to grasp the railway-related ISO standards because they are not available in an integrated format.

The movement to promote international standardization is becoming increasingly active against a background of globalization of information and efforts to promote intra-European standardization as part of the process of European integration. Accordingly, there is a need to understand the circumstances surrounding international standards and to take prompt responses and actions in a timely manner, as this will work to the future advantage and further development of the Japanese Railway Industry. Ways to respond to international standards were examined mainly by the leadership of the Japanese government, and now the RISC has been established in the premises of RTRI with the agreement of the government, railway enterprises, railway-related industries, and standards-related technical associations.

The RISC is a membership organization consisting of members from a wide range of bodies related to railway technologies. The RISC examines and proposes plans and strategies regarding international standards which are useful for the future development of the Japanese railway business. It also manages and reviews all activities relating to international standards in the railway field in a comprehensive way. Further, the RISC will also handle the collection and transmission of information, and support the future development of human resources related to international standards.



Review system for IEC/ISO standards in Japan

4th Phase Final Seminar of the SNCF-RTRI Collaborative Research Programme

Masamichi SOGABE
Manager, R&D Planning, Research & Development Promotion Division

On April 13 to 14, 2010, the 4th Phase Final Seminar of the SNCF(French National Railways)-RTRI Collaborative Research Programme was held in Paris, France. About 30 researchers and engineers from SNCF and RTRI participated. In this seminar, an outline of achievements of the seven collaborative research themes and two information exchange themes which had been implemented during the 4th Phase SNCF-RTRI Collaborative Research Programme were reported; the Programme covered the period from 2007 to 2009. Above all, it was confirmed that excellent results were obtained regarding the two themes, "Behaviour of Overhead Contact Line and Pantograph at High Speed" and "Ride Comfort for Passengers".

In this seminar, SNCF and RTRI agreed to work together in the 5th Collaborative Research Programme, which is scheduled to cover a further two-year period.

SNCF and RTRI are planning to engage in the three collaborative research themes: "Inspection and Predictive Maintenance Strategies for Overhead Catenary Systems", "Ride Comfort for Passengers", and "Application of a Wireless Sensor Network". During the 5th Collaborative Research Programme, they also plan to work together on several information exchange themes.

Behavior of Overhead Contact Lines and Pantographs at High Speed

Ride Comfort for Passengers

A scene of seminar

Participants in seminar

Confirmation of minutes of meeting

10th International Workshop on Railway Noise (IWRN10)

IWRN10
Nagahama 2010

Hisashi TANAKA
Manager, International Affairs

The workshop will provide an opportunity for presentations and discussions about the latest domestic and international technologies with regard to railway noise and vibration. Topics will include sources of railway noise (the sound between wheels and rails, aerodynamic sound, structural sound, tunnel micro-pressure waves), ground vibration, prediction tools and theoretical models, measurement technologies, noise/vibration reduction technologies, legal regulations, perception, etc. The submission of summary papers closed in January 2010, and about 100 presentations are scheduled. Also included in the IWRN10 programme are a technical exhibition and a technical visit to the Wind Tunnel Technical Center. We expect many people to participate.

1. Workshop dates: October 18 (Mon.) to October 22 (Fri.), 2010

Programme for IWRN10

October 18 (Mon.)	Registration, Welcome reception
October 19 (Tue.)	Presentation session
October 20 (Wed.)	Presentation session
October 21 (Thu.)	Presentation session, Official dinner
October 22 (Fri.)	Presentation session (AM), Technical visit (PM)

2. Venue: Nagahama Royal Hotel, Nagahama-city, Shiga prefecture, Japan
3. Organizer: The Railway Technical Research Institute (RTRI), supported by the Ministry of Land, Infrastructure, Transport and Tourism, and the Ministry of the Environment
4. Method of application: Please register online by visiting http://www.rtri.or.jp/IWRN10/.
5. Registration fee for participation:
   ¥85,000 (including tax, by May 31, 2010)
   ¥95,000 (including tax, June 1st, 2010 or later)
6. Inquiries: IWRN10 Secretariat, International Affairs Division, RTRI

E-mail: iwrn10@rtri.or.jp

Wind Tunnel Technical Center

Approach to the Geological Survey of Sandy Ground in Consideration of the Stratigraphic Classification

Takeshi KAWAGOE
Senior Researcher, Geology, Disaster Prevention Technology Division

1. Preface

When the New Austrian Tunnelling Method is being used to excavate tunnels in sandy ground, there is a risk of water seepage causing the working face to collapse where the degree of ground compaction is weak and the groundwater level is high. For this reason, when railway tunnels are being constructed through this type of ground, the tunnel alignment is divided into several sections according to the physical properties of the ground and the ability of the working faces to withstand water seepage. The level of difficulty of the tunnel excavation is evaluated on the basis of the rock classification. However, as the physical properties of the ground have spatial variations, it is sometimes difficult to determine the physical properties that are applicable to the rock classification. The Railway Technical Research Institute (RTRI) has therefore researched the relationship between the characteristics of sandy strata and the variations in the physical property values of the ground. RTRI has also researched geological survey methods that are suitable for evaluating the variations in the physical properties of the ground at the planning stage.

2. Stratigraphic classification and variation in physical property values

Here we show an example of the sandy strata of Pleistocene Age (Nos 1 formation) found in the Tohoku district which illustrates the relationship between the variation in physical property values and the unit of ground classification. The Nos 1 formation can be further classified into three strata: Nos 1-1 to Nos 1-3 on the basis of the difference in each facies. The degree of variation (variation coefficient) in physical property values of the Nos 1 formation and those of the three strata (Nos 1-1 to 1-3) is shown in Fig 1. When comparing the variation coefficient of the Nos 1 formation and that of each of the three strata (Nos 1-1 to 1-3), it can be seen that most physical property values of each of the individual strata are smaller than those of the Nos 1 formation. Generally, strata formed in rivers and shallow marine areas show different facies depending on each sedimentary deposition environment. For this reason we consider that physical property values are best obtained by fractionalizing the geological strata on the basis of observed differences in particle size, sedimentary deposition and structure.

3. Geological survey at the planning stage

A flowchart of the geological survey at the planning stage covering the facies of the different strata and the variation in physical property values is shown based on the result of Chapter 2 (Fig.2). First, documentary research and a geological survey of the land surface are carried out (Fig.2 (1)). Using these results, sample bores are taken at suitable locations to complete the geological survey (Fig.2). Next, the strata is classified on the basis of observed differences in the facies of the strata using criteria such as particle size and sedimentary structure taken from the geological survey (Fig2 (3) and Fig.3 (a) to (c)). The respective physical property values are obtained using soil tests for each individual stratum (Fig.2 (1)).
In this instance the geo-technical features of the ground can be more clearly shown by clarifying the degree of variation in each of the physical property values and by assessing the physical property values in terms of particle sizes (such as the fine fraction content and the uniformity coefficient) which have a comparatively large variation coefficient (Fig.1).
Moreover, if the various physical property values of the different strata exhibit average values and similar variations, we consider the strata to have similar geotechnical features; they can therefore be treated in technical terms in the same way (Fig.2 (5), Fig.3 (c) to (d)). It is important to determine the physical property values that apply to the rock classification. From now on we plan to examine the accuracy of the survey according to the scale of the structures involved.

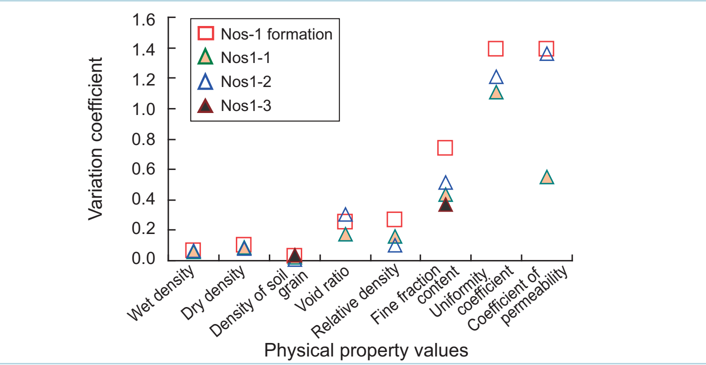


Fig.1 Degree of variation in physical properties per each geological stratum

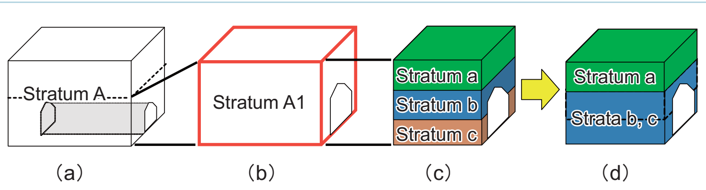


Fig.3 Concept of fractionalizing sandy ground

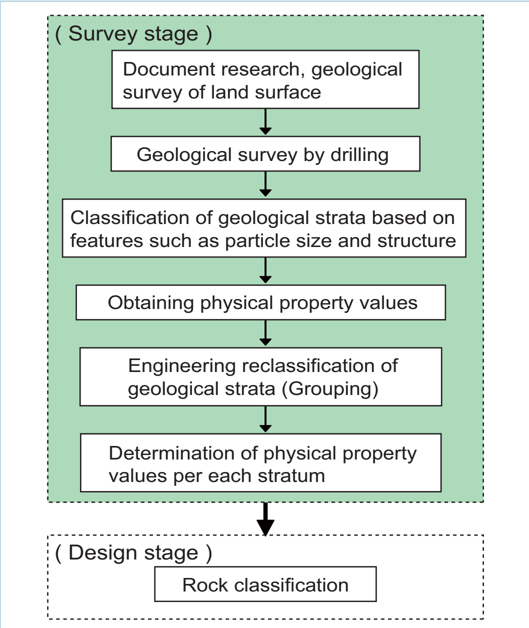


Fig.2 Flowchart of the geological survey

Improving the Reliability of Aluminothermic Welding

Yoshihiro TERASHITA
Assistant Senior Researcher, Rail Welding, Track Technology Division

The aluminothermic welding method adopted in the JR group is the SkV method introduced from Germany in 1979, and in recent years about 25,000 welds per year have been executed. Figure.1 shows the number of aluminothermic welds executed on tracks within the JR group, the number of fractured welds and the causes of the fractures. Around 1988 when continuous welded rails began to be adopted on conventional lines, there was a rapid increase in the number of welds. However, fractures occurred at the base of the rails, and these were caused by lack of fusion. By introducing the application of ultrasonic inspection using the double-probe technique to detect the lack of fusion, the Railway Technical Research Institute (RTRI) succeeded in preventing the fractures. Measures were also taken to ensure that the welding process was carried out correctly, such as prescribing the adjustment method of preheating flames. However, fractures due to centerline shrinkage in the central part of the weld metal at the base of the rails occur almost every year, and measures to deal with this problem were requested. Figure.2 shows an example of the appearance and the fracture surface of an aluminothermic weld that has broken on a conventional line. The fracture occurred in the central part of the weld metal, and centerline shrinkage has been generated at the lower rail fillet, which was rusted in black.

In order to further improve the reliability of aluminothermic welding, we simulated the centerline shrinkage in a test and examined the conditions in which this occurred, as well as looking at preventive measures and a detection method. We carried out aluminothermic welding on RTRI's double gauge test track, then carried out a tensile test to forcibly move the welded rail outward at the weld position. This was based on the assumption that the rail would contract as the temperature decreased during the solidification process of the molten aluminothermic steel (between 90 and 160 sec after pouring the molten steel into the mould). As a result, we were able to reproduce centerline shrinkage similar to that which occurred on the main lines. Figure.3 shows the fracture surface of the centerline shrinkage which occurred under the conditions of a time of 100sec after pouring the molten steel into the mould, and the welded rail was shifted outwards by 0.35mm. The fracture surface pattern is similar to that shown in Fig.2 (b). Further, the locations where centerline shrinkage occurred and the area affected were different depending on the elapsed time from the pouring of molten aluminothermic steel to the shifting of the rails, and the amount by which the rails were shifted (Fig.3 (b), Fig.3 (c)). Even when the rail was shifted by 1 mm or more 90 sec after pouring the molten steel, when it is not yet in the final solidification stage, centerline shrinkage did not occur. Nor did centerline shrinkage occur 160 sec after pouring, when the solidification process had finished, again even when the rail was shifted by 1 mm or more. On the other hand, in the case of the rail being shifted 100 to 150 sec after pouring, centerline shrinkage occurred at many welds and the it was transferred from the base of the rail to the web and head in correlation with the passage of time from pouring of the molten steel (Fig.4). This is because the solidification of molten aluminothermic steel progresses from the base of the rail to the web and head. Sometimes, solidification at the lower rail fillet is delayed compared with solidification at the surface layer of the web (for example, Fig.3 (b)), and it is considered that the centerline shrinkage occurs only at the lower rail fillet depending on the timing and amount of the rail being shifted.

Although we are not able to introduce it here, we are proposing ultrasonic inspection as the detection method for centerline shrinkage occurring at the lower rail fillet and at the base of the rail as well as its criteria for ultrasonic inspection. The remaining task is to propose a measure that prevents occurrence of centerline shrinkage beforehand, and we would like to continue making efforts to eliminate breakage of rails from aluminothermic welds.

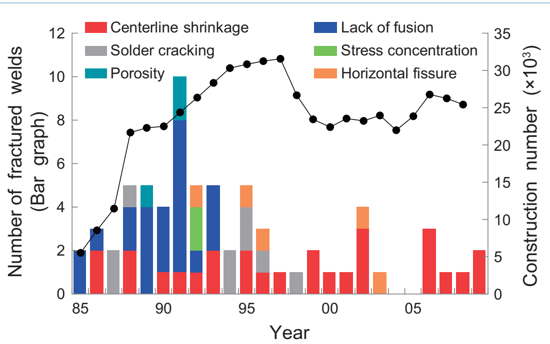


Fig.1 The number of aluminothermic welds executed on JR tracks, and the incidence of fractured welds

(a) Side view (b) Fracture surface

Fig.2 Example of the appearance and the fracture surface at a broken aluminothermic weld

(a)100s−0.35mm (b)110s−1.1mm (c)143s−1.0mm

Fig.3 Example of fracture surfaces of the centerline shrinkage reproduced in a simulation test

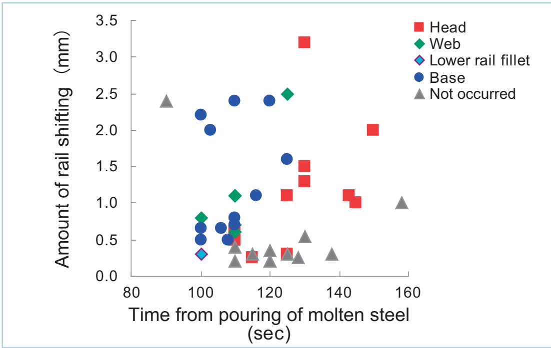


Fig.4 The relationship between the conditions and the affected area of centerline shrinkage occurrences