Introduction of Overseas Technologies to JR East Track Maintenance

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Introduction

JR East makes great efforts in track maintenance to ensure stable transport, especially in the Tokyo capital area and on shinkansen. This is our social mission, and we carry it out giving top priority to the safety of customers, employees, track maintenance worker, and others. We have been introducing large track maintenance machinery since the days of the Japanese National Railways (JNR) era. Following the privatization, we have actively introduced a broad variety of technologies both from within Japan and from abroad, as demonstrated by examples such as new rail fastening systems and new track structures. This article explains some topics in track maintenance at JR East along with some examples of technologies introduced from abroad.

Countering Transport Disruptions

JR East focuses closely on preventing rail failures that severely disrupt transport. The company has increased the number of deployed rail grinding cars and rail flaw detection cars while also tightening rail-welding standards. As a result, the number of rail failures network-wide in FY2011 was the lowest on record, demonstrating progress made.

In FY2012, we focused further efforts on track failures and turnout malfunctions, based on the transport disruptions in FY2011.

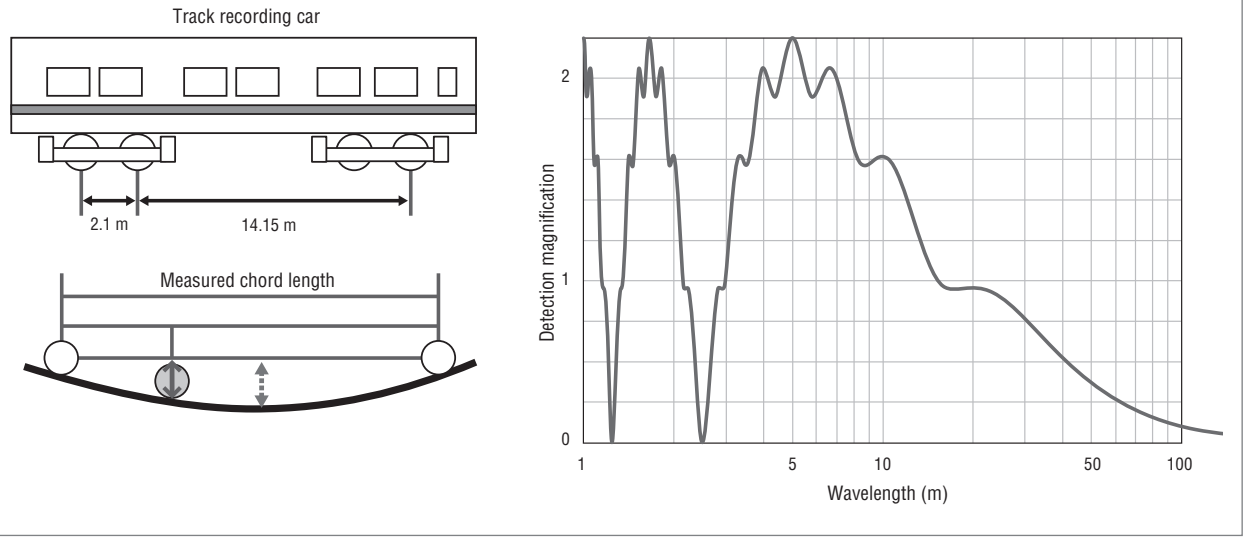
Increasing Shinkansen Speeds

JR East is increasing the operations speed of the Tohoku Shinkansen to 320 km/h at the end of FY2012, so improved ride comfort at high speeds is an important issue. With this objective in mind, we are making efforts to alleviate high-frequency vibration by managing long-wave track irregularities using asymmetrical chord offset data (Fig. 1) and new ride comfort filters employing an automatic vibration meter first introduced in FY2011. We are also improving track inspection devices and their deployment to take quick action in the event of earthquakes or other disasters.

Equipment Enhancement

Equipment is being enhanced according to priorities based on line conditions. An example of part of the plan is explained below.

Figure 1 Shinkansen Track Management using Asymmetrical Chord Offset Data



Promoting labour-saving track construction (Tokyo area)

TC-type labour-saving track (Fig. 2) was developed for the Tokyo area to reduce maintenance work related to ballast and sleepers that causes noise and vibration at night. The first TC-type was laid in FY1998, and the third stage of construction is underway through to FY2013.

Approximately 228 km of this track has been laid by late FY2011, marking 89% completion of the planned target for stages one to three.

Promoting low-cost PC sleepers (conventional lines)

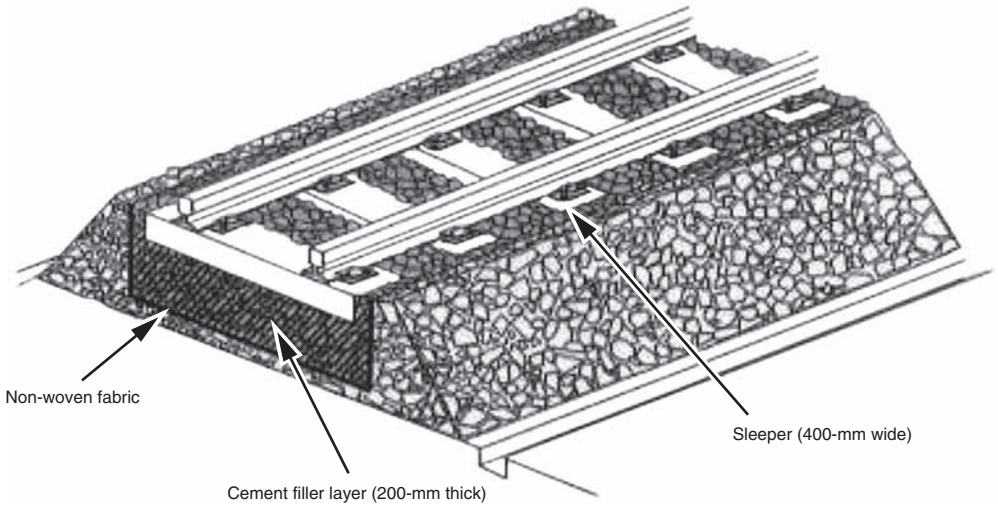
JR East uses about 15 million sleepers on its conventional lines. Trunk lines use pre-stressed concrete (PC) sleepers, but most local lines (<2 million annual passing tonnes) still use wooden sleepers. However, wooden sleepers decay and deteriorate over time, decreasing the ability to support rails. Therefore we have developed low-cost PC sleepers for local lines, and have been introducing 130,000 a year on local lines since 2005 in order to enhance track stability and cut maintenance costs.

Efforts for Future

Track maintenance efforts at JR East are focussed on assuring stable maintenance and safety well into the future, despite the declining workforce due to Japan's aging society. Some of these efforts are described below.

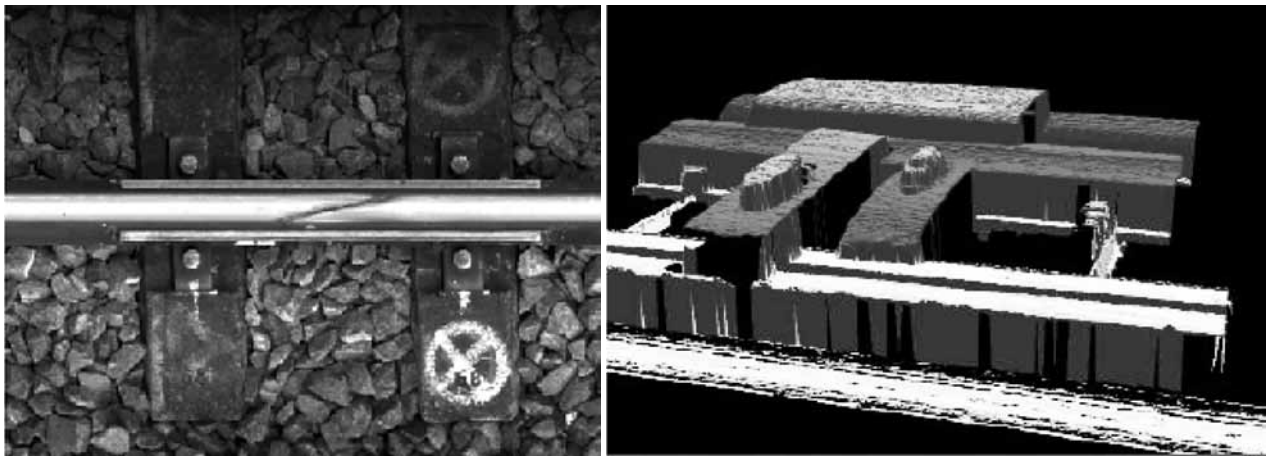
To increase the inspection frequency, we are researching how to monitor track irregularities and condition of materials using commercial train operations. The inertial versine method is being considered for monitoring track irregularities and a combination of grey-scale and range imaging for monitoring track materials. Train tests have produced some results and the next plan is to mount

Figure 2 Structure of TC Type Labour-Saving Track



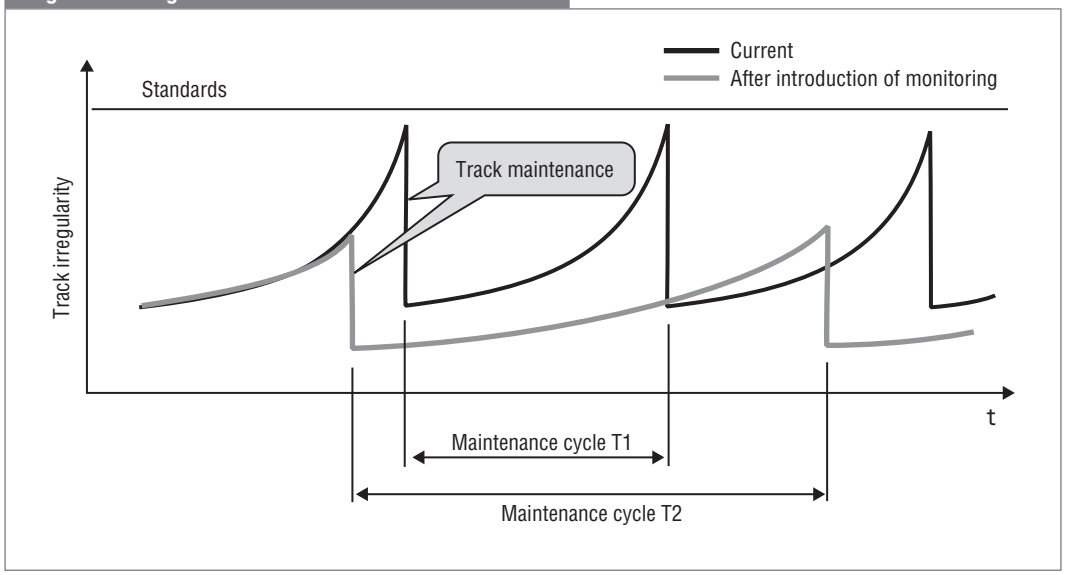
TC Type labour-saving track (background) (JR East)

Low-cost PC sleepers for local lines (JR East)



Grey-scale and range imagery (JR East)

Figure 3 Image of Condition-Based Maintenance



devices on commercial services. We are also researching condition-based maintenance using the obtained data (Fig. 3).

Examples of Railway Technologies Actively Introduced from Abroad

JR East is positive about introducing overseas railway technologies to improve the level of track maintenance. Some examples of such technologies are explained below.

Large track maintenance machinery

Large track maintenance machinery helps maintain track more efficiently, offering benefits such as higher track safety and ride comfort. Specifically, about 50 multiple tie tampers (MTT) to pack ballast and correct track irregularities have been introduced from Austria and Switzerland along with about 30 ballast regulators from Austria for tasks such as ballast trimming after track maintenance by MTTs. A major replacement programme is planned in about 5 years as current machines wear out.

JR East is also increasing the amount of rail grinding—shaving off irregularities on rail surfaces and at rail welds—to extend rail lifespan and reduce noise. To meet this need, we have introduced 10 rail grinders from Switzerland and the USA.

Inspection machinery

Various maintenance inspections help assure safe train operation and JR East is actively introducing inspection cars from overseas. One example is the rail flaw detection car, using ultrasound to detect flaws in rails continuously. Five such cars cover the JR East network and all but one use the Australian ULTRAWave inspection system.

Rail welding technologies

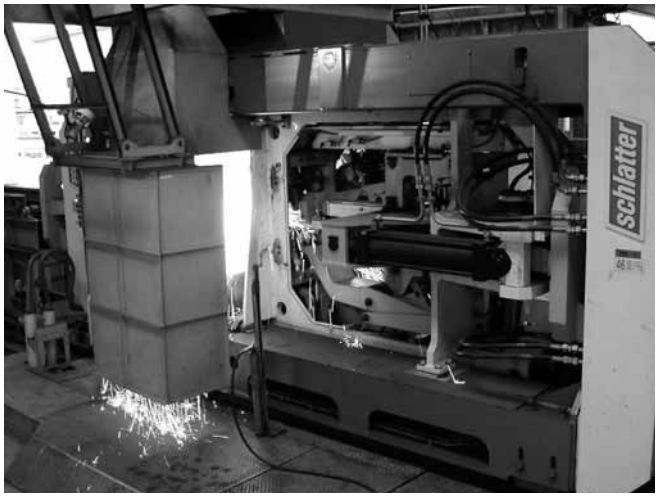
Many world railways use continuously welded rail, and there are many advanced rail welding technologies that JR East is eagerly introducing.

Multiple tie tamper (JR East)

Ballast regulator (JR East)

Rail grinding car (JR East)

Rail flaw detection car (RFD-N) (JR East)



Flash-butt welding machine (JR East)

Thermic welding (JR East)

For example, Swiss flash-butt welding machines are being used at rail works in Tokyo and Sendai to weld the 25-m rails delivered from steel manufacturers into 100 to 200-meter rails. Approximately 5000 of these rail welds are made annually in the JR East area.

Thermic welding developed mainly in Germany has been introduced for on-site welding when replacing existing rails. About 11,000 of these rail welds are made annually in the JR East area.

Spring clip type rail fastening system developed in UK (JR East)

Ball bearing base plate developed in Sweden (JR East)

Next-generation turnout and grid type sleepers (JR East)

Track materials

Traditionally, most track materials have been domestically procured. However, JR East is actively introducing overseas technologies to simplify maintenance and cut costs.

One example is the rail fastening system that conventionally uses plate springs and bolts. However, this old spring-and-bolt system requires periodic maintenance because the bolts gradually become loose. To solve this problem, JR East has been introducing the UK-developed spring clip fastening system since 1988 and about 25% of the JR East network is now using these spring clips, including products made under licence in Japan.

We have also developed next-generation turnouts using technologies from Japan and abroad based on the concept of assuring turnouts requiring less maintenance with fewer failures. Specifically, we have introduced a Swedish bearing base plate to facilitate switching, German elevated bearing plates to fasten rails firmly, and a British spring clip type rail

Flash-butt manganese crossing (JR East)

fastening device. We have also developed our own grid-type sleepers and new tongue rails to enhance the structure. The new turnouts have been introduced from 2006 with about 300 installed so far. We plan to extend the installation area in the future.

Ball-bearing base plates introduced with the new turnouts have also been retrofitted to about 4700 conventional turnouts, or about 40% of all turnouts.

JR East is also working on development of crossings, a component of turnouts, using overseas technologies. Specifically, we have developed a flash-butt manganese crossing incorporating the benefits of both a pressure-welded crossing with a jointless structure and an anti-wear manganese crossing with high failure resistance. This new crossing was tested and applied in 2011. The actual materials are made in Japan, but French technology is used for welding the manganese cast steel and rail steel using stainless steel along with Swiss-made flash-butt welding machines, integrating both Japanese and overseas technologies.

Conclusion

JR East has been actively introducing overseas technologies right from its establishment in 1987. Going beyond track maintenance, in rolling stock, brake devices have been introduced from Knorr-Bremse, and development of shinkansen bogies is underway as a result of technology exchanges with Deutsche Bahn AG.

For the future, JR East is determined to implement state-of-the-art technologies from Japan and overseas to secure safe stable railway transport. ■

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