Snow problems and other natural hazards

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1. Snow problems and JR East’s countermeasures

2. Other natural hazards such as earthquakes and JR East’s countermeasures
JR East

- Established in 1987
- 7,512km network
- 1,689 stations
- 70 lines
- 17 million passengers/day
- 13,000 trains/day

High-speed lines

Tokyo Metropolitan Area
1. Snow problems and JR East’s countermeasures

2. Other natural hazards such as earthquakes and JR East’s countermeasures
JR East's area and snow belt in Japan

- Heavy snow belt
- Snow belt

Tokyo
Snow removal costs

Breakdown

- Main lines (by snow plow machine)
- Level crossings (by workers)
- Switches (by workers)
- Others
**Recent transport disruptions by snow**

- **Number of disruptions by snow**
  (at least 1 service cancellation or delays of 30 min. or more)

<table>
<thead>
<tr>
<th>Year</th>
<th>Number</th>
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</thead>
<tbody>
<tr>
<td>2006</td>
<td>5</td>
</tr>
<tr>
<td>2007</td>
<td>26</td>
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<tr>
<td>2008</td>
<td>58</td>
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<td>2009</td>
<td>37</td>
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<td>2010</td>
<td>58</td>
</tr>
<tr>
<td>2011</td>
<td>70</td>
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</tbody>
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- **Main causes of transport disruptions**
  1. Snow removal work after heavy snowfall
  2. Switch malfunction due to snow dropping
  3. Fallen tree
  4. Snow on pantograph causing loss of contact with catenary

- Impacts on infrastructure are more severe than rolling stock.

- We have taken different measures, based on;
  - High-speed or conventional lines
  - Snowfall or snow lump dropping
## Major countermeasures against snow

### Snow removal equipment

<table>
<thead>
<tr>
<th></th>
<th>High speed Lines</th>
<th>Conventional Lines</th>
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<tbody>
<tr>
<td><strong>Tracks</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Snow fall</td>
<td>Snow accumulation</td>
<td>Snow fall</td>
</tr>
<tr>
<td>Snow Lump dropping</td>
<td>Sprinkler</td>
<td>Snow accumulation</td>
</tr>
<tr>
<td></td>
<td>Ballast flying</td>
<td></td>
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<tr>
<td></td>
<td>Ballast screen</td>
<td>Snow removal machine</td>
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<td></td>
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<tr>
<td><strong>Turnouts</strong></td>
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<tr>
<td>Freezing</td>
<td>Hot water mat melting device</td>
<td>Hot water jet or Air injection</td>
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<tr>
<td></td>
<td>Turnout malfunction</td>
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<td></td>
<td>Hot water jet or Air injection</td>
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<tr>
<td></td>
<td>Turnout malfunction</td>
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<tr>
<td><strong>Rolling Stocks</strong></td>
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<tr>
<td>Snow adhesion</td>
<td>Electric heater</td>
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<tr>
<td></td>
<td>Snow adhesion</td>
<td></td>
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<tr>
<td></td>
<td>Warm water injection</td>
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</table>
Sprinkler

25 minutes later
Air injection snow removal device

Ice lumps at turnout can be removed by air pressure

Development concept: melting snow removing obstacles
Major cold and snow-resistant car body design

for both High-speed trains and Conventional line trains

1 Snow plow (at the front of lead car)
2 Heater to prevent doors from freezing
3 Fully covered under-floor equipment to prevent snow sticking
4 Smoothing car body (to prevent snow sticking to the car body)
1. Snow problems and JR East’s countermeasures

2. Other natural hazards such as earthquakes and JR East’s countermeasures
Damage by the earthquake and tsunami

- Seriously damaged line
- Damaged line
- Little or no damaged
- Shinkansen

- No fatalities or no injuries on trains
- No derailment

Epicenter

Tokyo
Countermeasures against earthquakes

1. Prevent collapse of the viaduct

2. Detect the earthquake and stop the trains as quickly as possible

3. Prevent trains from a large scale deviation in case of a derailment

4. Education and training for staff
Early Earthquake Detection System

When the coastline seismometer detects a primary wave……

Power shutdown

Emergency brakes

Detects P wave

Coastline seismometer

Substation

Primary wave

Secondary wave

Epicenter
Early Earthquake Detection System

Number of Seismometers

- **Seismometers along the tracks**: 81 (Less than 20km intervals)
- **Seismometers along the coast**: 16 (100km intervals)
Two trains running at approx. 270 km/h through the Sendai area were exposed to strong shaking from the earthquake.

The power supply to these trains was cut 9 to 12 seconds before the first vibrations arrived, and their emergency brakes were applied.

The largest shock came to these trains approx. 70 seconds after their emergency brakes were applied. By then, it is likely that the trains had slowed down to a speed of about 100 km/h.
Research and development

The Disaster Prevention Research Laboratory

- Study on mechanism of natural disasters and risk evaluation
- Development of observation and detection methods
- Development of countermeasures and technical standards

Simulation

Hazard map
Conclusion

- JR East’s operation area has severe natural conditions. However, the average delay time per train is only 0.7 minute on high speed lines and 1.3 minutes on conventional lines.

- We have experienced many natural hazards, not only snow but also other ones. We have examined those results and derived lessons from them. And we have made the best use of those lessons for measures such as technological development.

- We will share our experiences with the world and contribute to the safety and reliability of railways.