[Attachment 3-1]

Strengthening Seismic Observation System

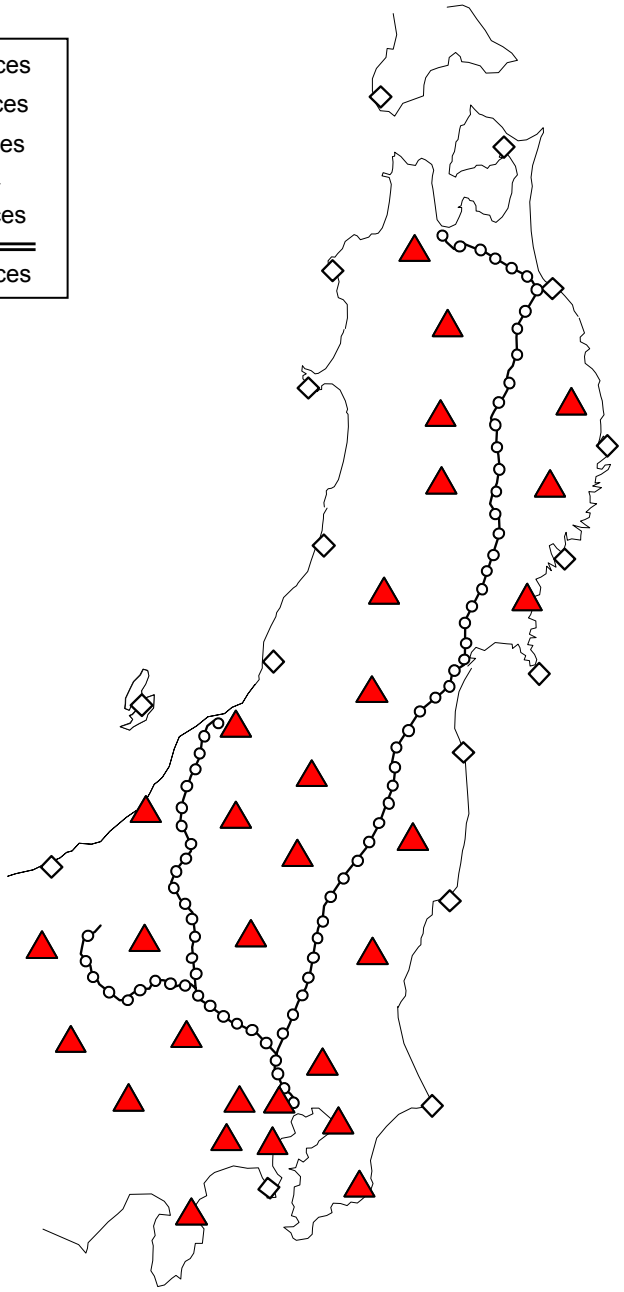
(1) Increasing seismometers in the Tokyo metropolitan region and inland areas

[Planned start of use: March 9, 2012 on conventional lines, summer 2012 on Shinkansen lines]

■Installed seismometers: Total 97 places
- •Trackside seismometers ○: 81 places
- •Seaside seismometers ◇: 16 places

■Increased seismometers ▲: 30 places

Total: 127 places



Anticipated benefit at Tokyo Station from increased seismometers

[Earthquake in northern part of Tokyo Bay]
- •Time from earthquake until warning with existing seismic observation system: about 6.5 seconds
- •Time from earthquake until warning with new seismic observation system: about 4.5 seconds

} About 2.0 seconds faster

[Earthquake in Tachikawa Fault Zone]
- •Time from earthquake until warning with existing seismic observation system: about 6.5 seconds
- •Time from earthquake until warning with new seismic observation system: about 4.0 seconds

} About 2.5 seconds faster

(2) Implementation of early earthquake warnings (Meteorological Agency) on Shinkansen lines

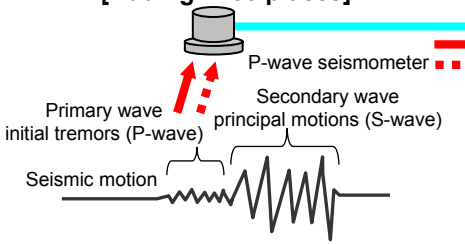
[Planned start of use: autumn 2012]

[Attachment 3-2]

Strengthening Seismic Observation System

Shinkansen early earthquake detection system

Increasing seismometers in the Tokyo metropolitan region and inland areas
[Adding in 30 places]



P-wave seismometer (seaside)

P-wave seismometer (trackside)

Power shutoff, emergency braking

Warning

Substation

Shinkansen early earthquake detection system server [existing]

- Earthquake information from P-wave seismometers and **early earthquake warnings** received and sent to trackside seismometers
- Earthquake information from receiving P-wave seismometers is received and forwarded to a warning server (conventional lines)

*Earthquake information: hypocenter and scale

Receiving server (Shinkansen)
[Being installed this time]

- Earthquake information is received by early earthquake warning and sent to trackside seismometers

Early earthquake warning (Meteorological Agency)

Conventional line early earthquake warning system

Receiving/warning server (conventional lines) [existing]

- Earthquake information from Shinkansen P-wave seismometers and early earthquake warning received, and warning area decided

Conventional line seismometers

Disaster information system (PreDAS)

Secondary wave principal motions (S-wave)

Warning control system [Existing]

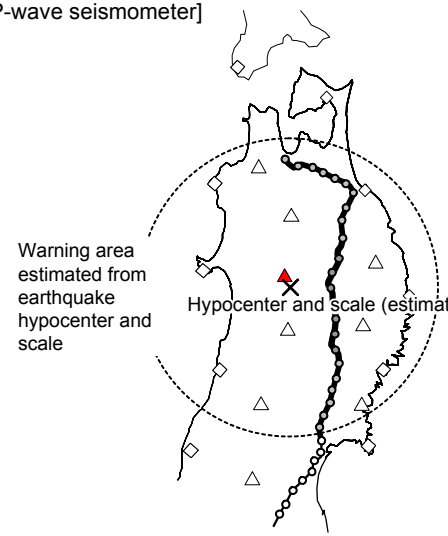
Warning

Train radio

Earthquake occurs, emergency stopping

[Warning control system/train radio]
Automatically instructs crew to make emergency stop

[Estimation of earthquake hypocenter and scale by P-wave seismometer]



Trackside seismometers and power shutoff sections in warning area

- Trackside seismometers
- Seaside seismometers
- Seismometers being added this time

Key

- New equipment
- Flow of train control with existing seismic observation system
- Flow of train control with seismometers added this time [conventional lines] (Usage to begin March 9, 2012)
- Flow of train control by seismometers added this time [Shinkansen lines] (Usage to begin summer 2012)
- Flow of train control with early earthquake warning [Shinkansen lines] (Usage to begin autumn 2012)

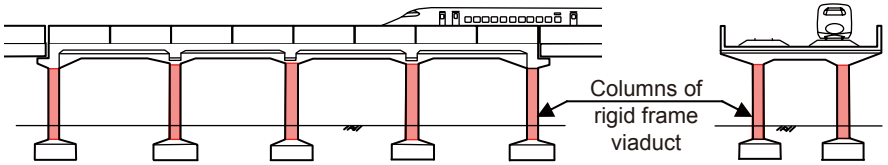
[Reference]

Types of viaducts, etc.

Type

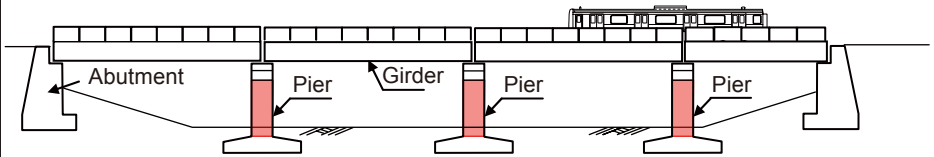
[Rigid frame viaduct column]
A viaduct that is a combination of columns and beams is called a "rigid frame viaduct," or "rahmen" in Japanese.
*"Rahmen" comes from the German word for "frame."

Reinforcement example



[Girder viaduct]
A structure that uses abutments and piers to support girders is called a "girder viaduct."

Reinforcement example



Parts to be reinforced

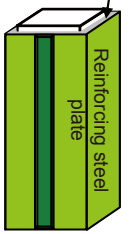
Usage beneath elevated track

[Not used by shops, etc. beneath elevated track]

[Before reinforcement]

[After reinforcement]

Mortar injected



[Used by shops, etc. beneath elevated track]

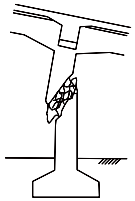
[Before reinforcement]

Removal of interior/ seismic reinforcement [during reinforcement]

Interior restored [after reinforcement]

Damage patterns

[Shear failure occurs first]

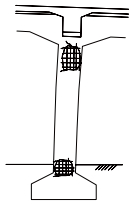


Rendering of damage

Disaster example

Great damage occurs suddenly, without resistance

[Flexural failure occurs first]



Rendering of damage

Disaster example

Risk of damage occurring near edges of columns