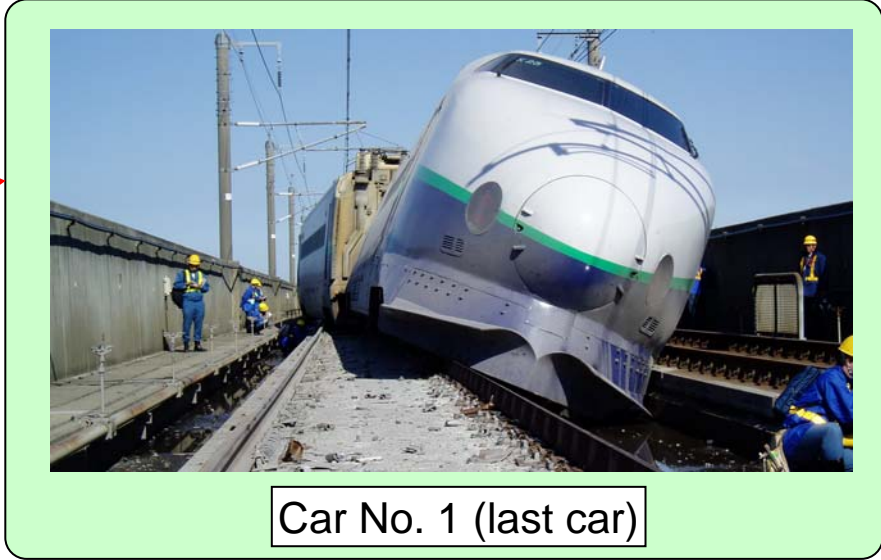
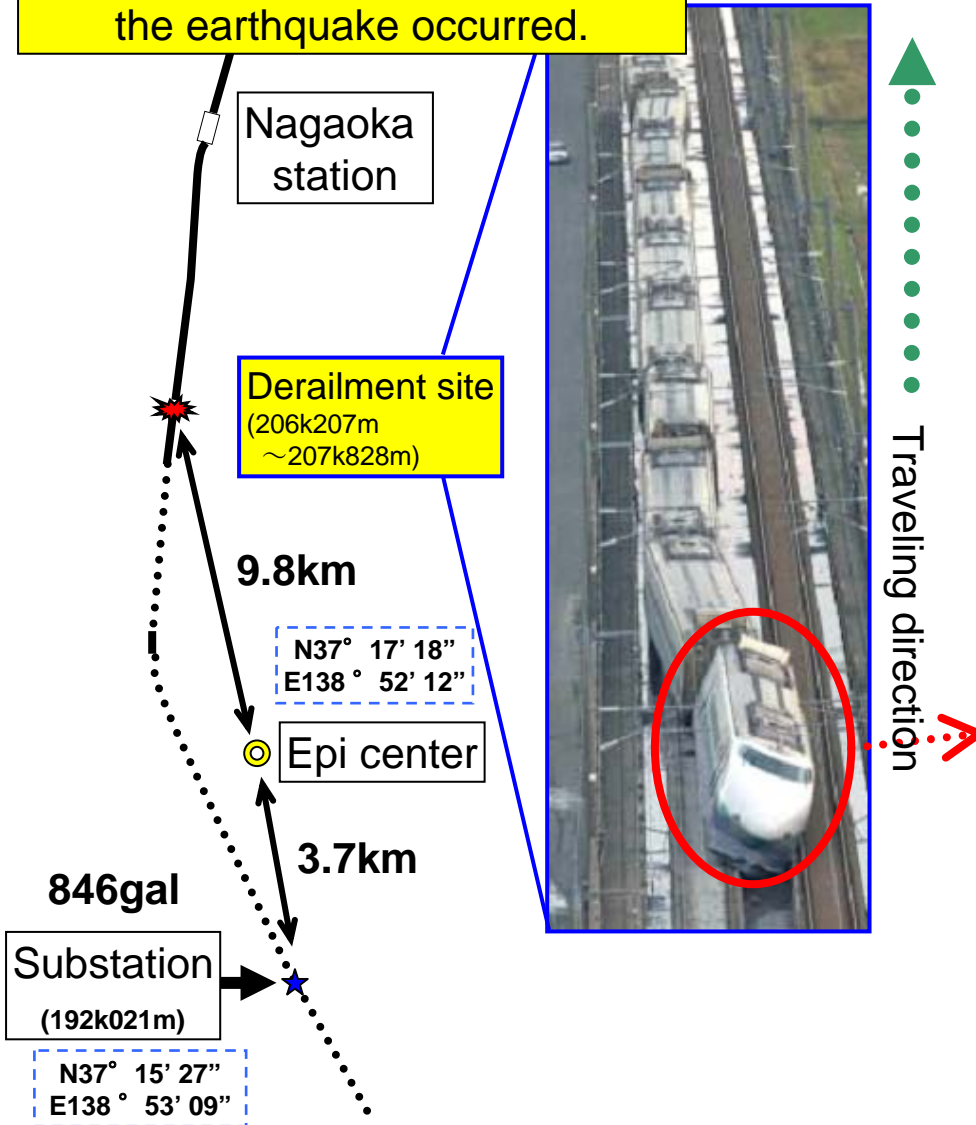


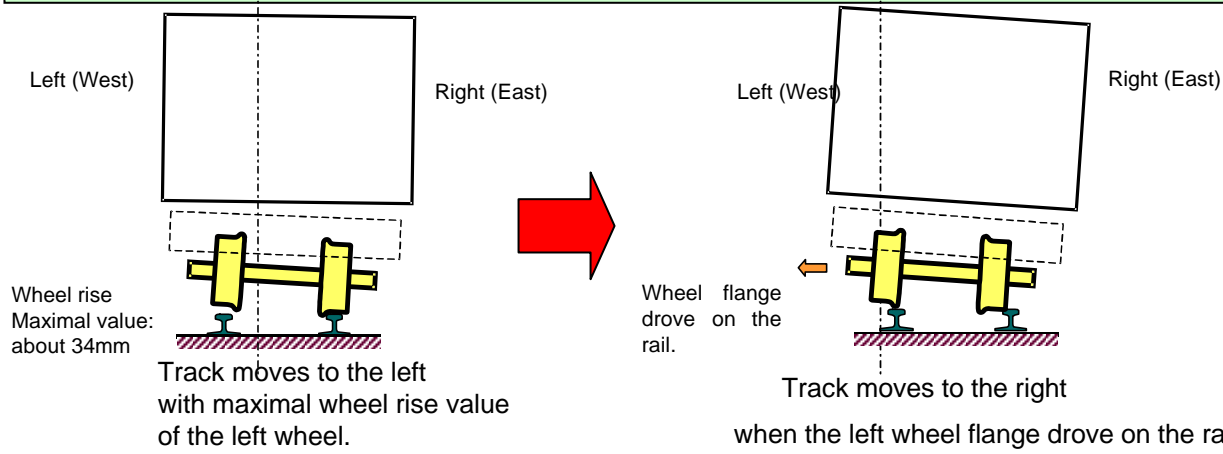
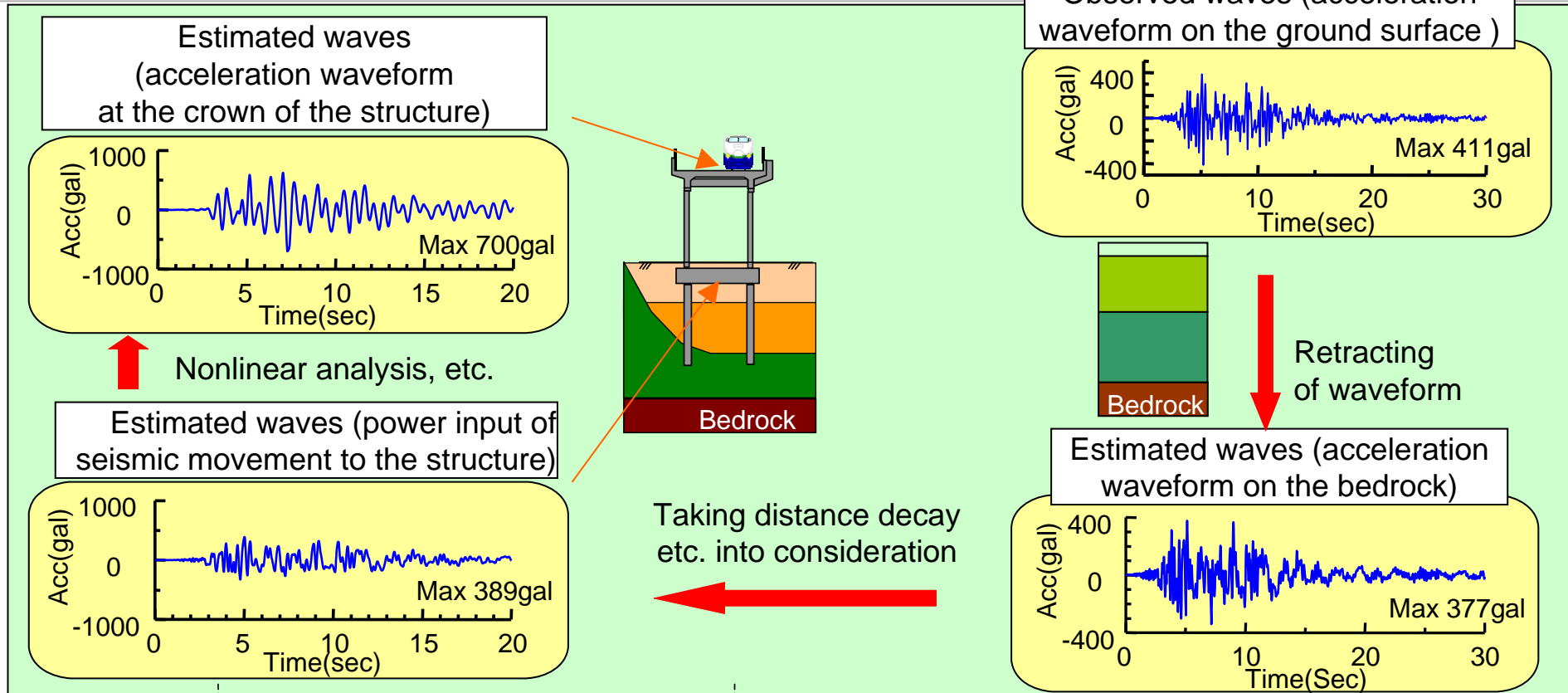
The Derailment of a Shinkansen Train During the Niigata Chuetsu Earthquake

A Brief Overview of the Niigata Chuetsu Earthquake & Derailment Conditions

About at 17:56 on Oct. 23rd, 2004
the earthquake occurred.



The Derailment Simulation Method & Results

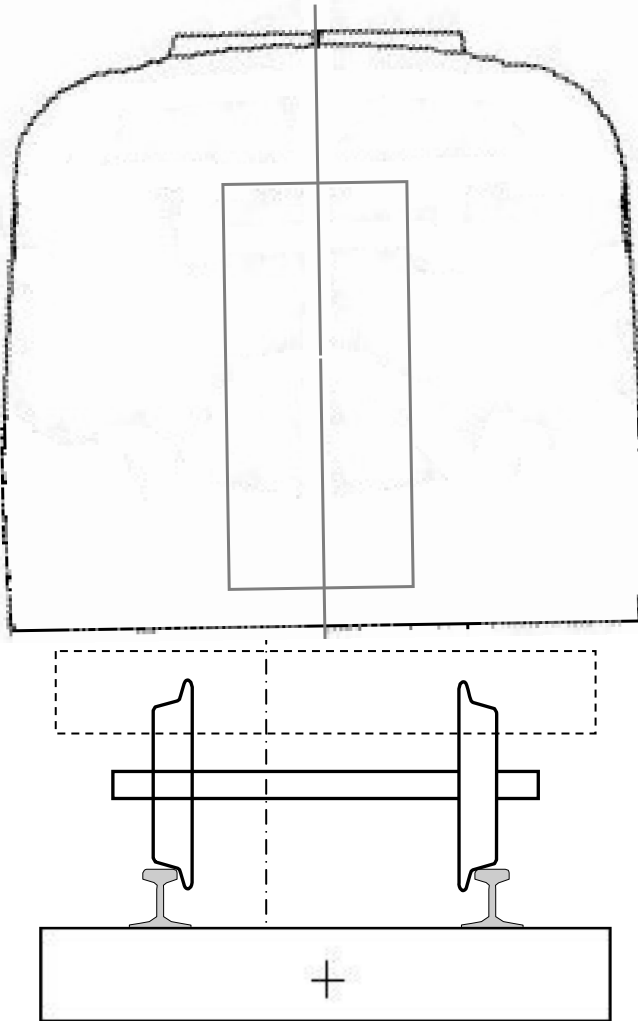


- Due to seismic movement, a maximal lateral movement of approximately 700gal was estimated to be generated.
- As a result of vehicle motion simulation, the possibility of a major derailment with wheels completely leaving the rails could be confirmed.

Simulated Movements of a Railcar (5.0-6.0s)

Right

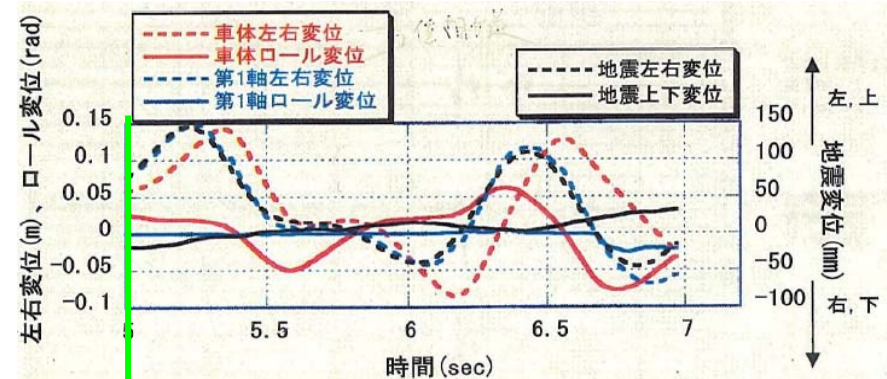
Left



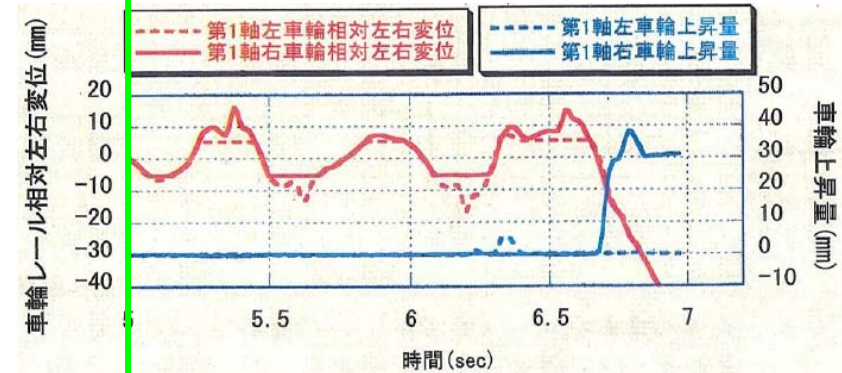
View from the Niigata side

The time scale has been increased 12 times.

Relations among earthquake & car body displacements and wheel rise level



(b) 車体と第1軸の左右変位とロール変位、地震変位

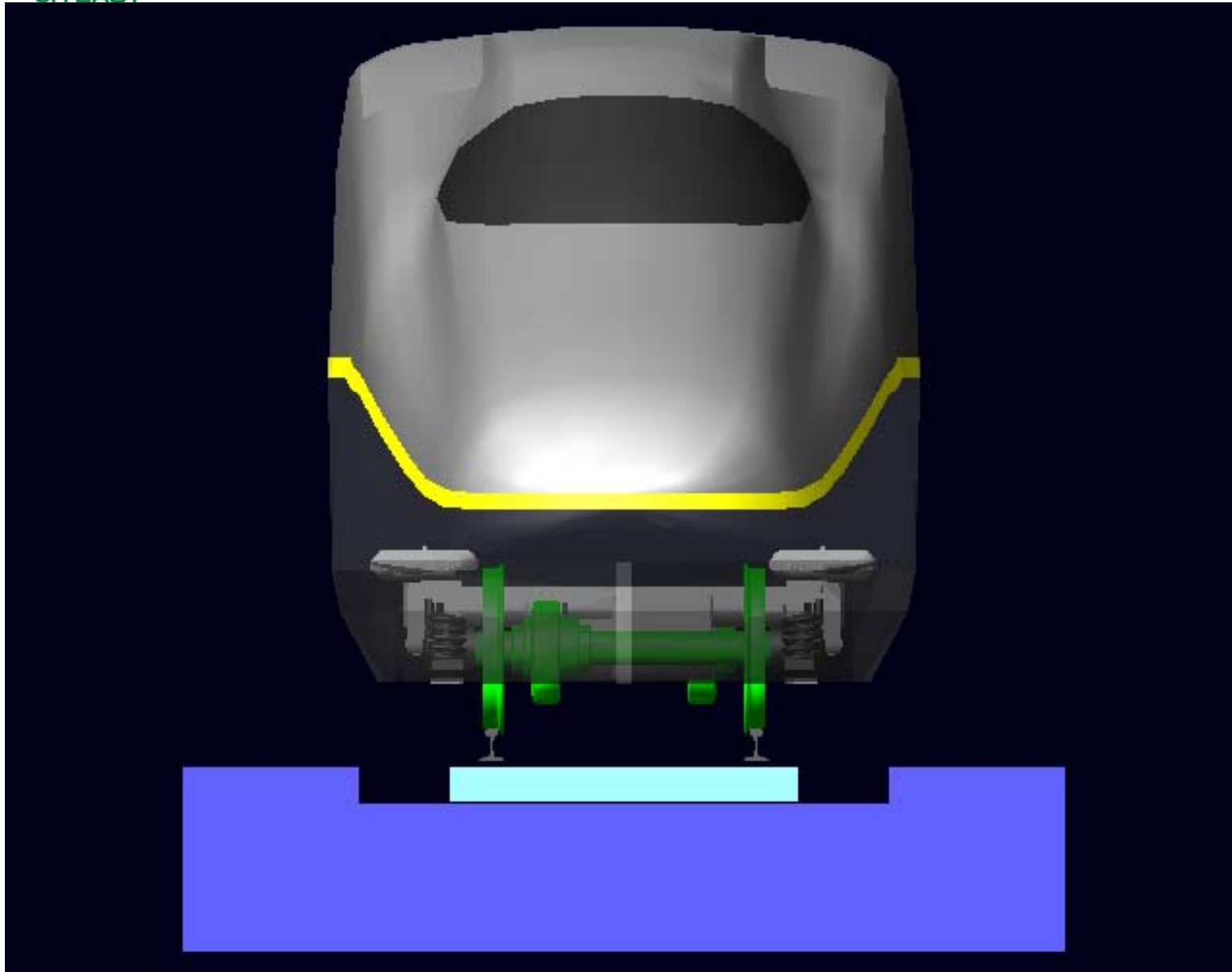


(c) 第1軸左右車輪の車輪/レール相対左右変位と車輪上昇量

図 7. シミュレーション結果時系列 5~7.2sec の拡大 (JN2 波 十日町 R3)

Present time

Simulated Movements of a Railcar



© RTRI

Derailment Conditions for the Lead Coach (Car No. 10)

After the derailment, the rails guided the train and prevented it from deviating from the tracks before largely stopping.



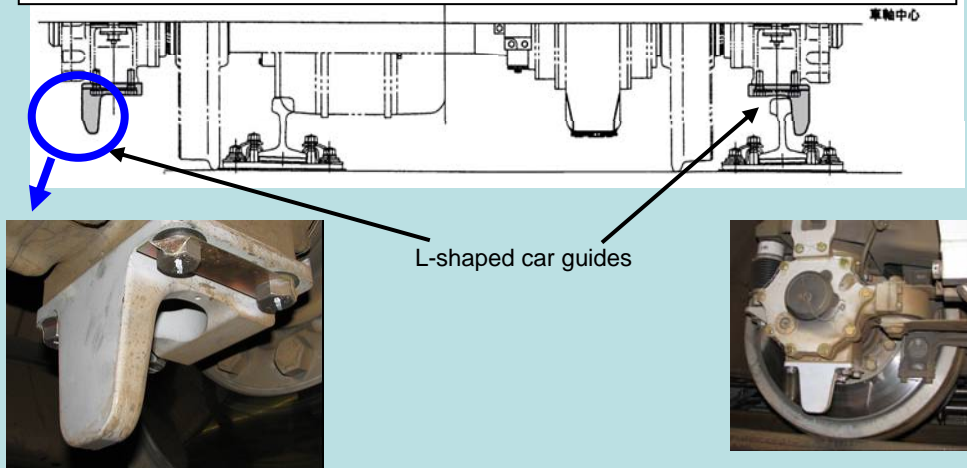
Front axis (Car No. 10, Axis No. 4)
right wheel



Front axis (Car No. 10, Axis No. 4)
left wheel

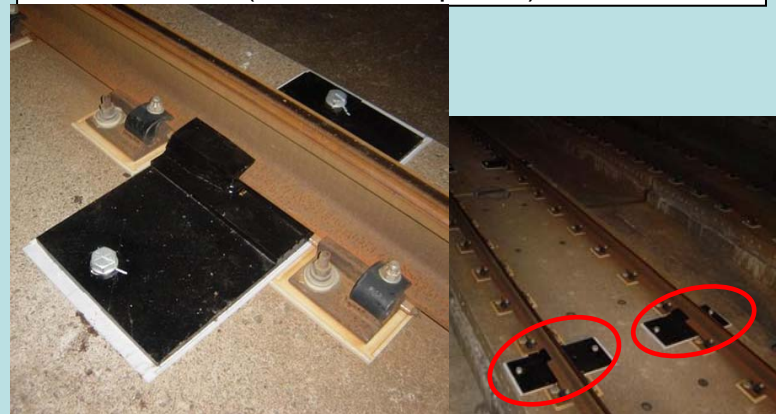
Earthquake Countermeasures

L-shaped car guides to prevent the car from straying too far from the rails in the event of a derailment
(started introduction in fiscal 2006)



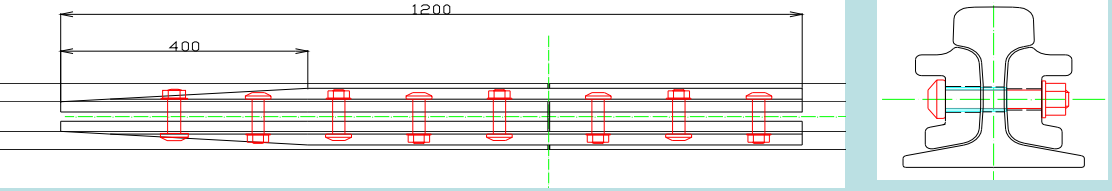
- L-shaped car guides have been installed on the underside of bogie axle boxes.
- The guides limit the amount of sideway wheel movement if a car is derailed.

Rail anti-toppling devices
(under development)



- The rail anti-toppling device restricts any lateral movement of the rails through lateral pressure provided by the derailed wheels and L-shaped car guides.
- These devices will not break when hit by derailed wheels.

Prevention of rail breakage of glued insulated joints (IJ)
(started introduction in fiscal 2007)



Newly-shaped glued insulated joints (IJ) have been developed so that L-shaped car guides can function well even when hit by derailed wheels.