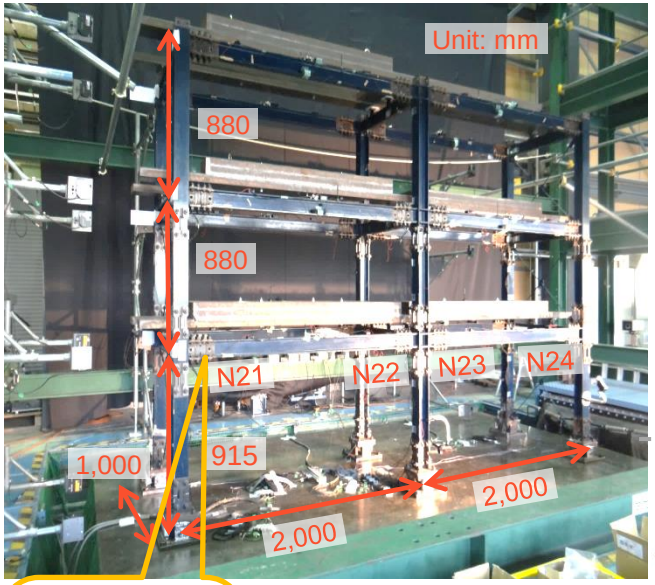
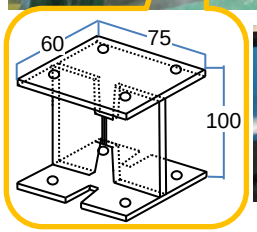
Strain-Based Local Damage Detection and Seismic Performance Evaluation

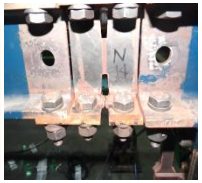
Background and Objectives: Knowing the extents and locations of earthquake-induced damage allows rapid post-earthquake damage assessment and safety evaluation on buildings. The primary objective of this research are to develop a method of estimating the residual capacity of earthquake-affected steel moment-resting frames and verify it through a large-scale testing.

Methodology: A local damage evaluation method using dynamic strain responses under ambient vibrations is applied to a series of shaking table testing on a three-story steel frame testbed. In the testbed, beam fractures are induced to embedded beam-end links by strong ground motions. The identified damages are included in the analysis model of the frame using a model-updating method and the residual performance of the damaged model is estimated by a static non-linear pushover analysis.





Damage link (axonometric)

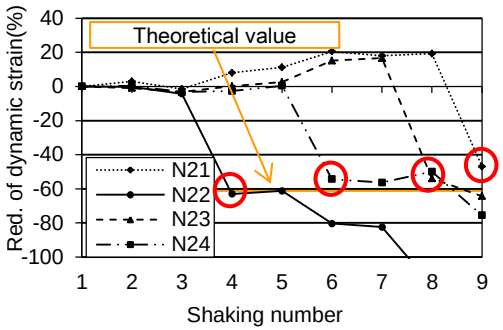


Bottom flange fracture

Web fracture

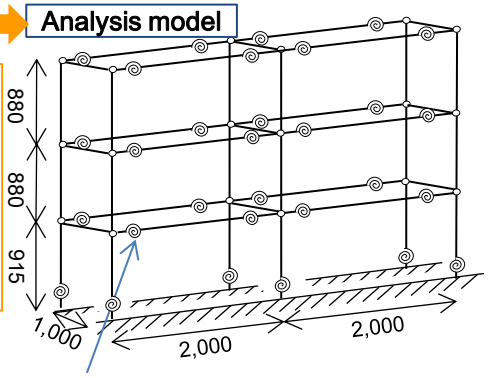
Reduction of dynamic strain at N21~N22

○ : Bottom flange fracture



Reflect the results

Analysis model



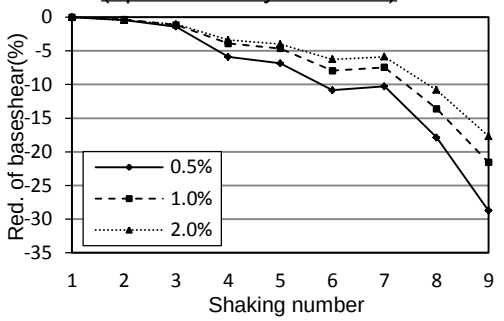
Rotational spring: reflecting the damage by reducing the rotational stiffness

PVDF sensor (dynamic strain sensor)

NARADA (wireless module)

Collect the dynamic strain data by wireless system

Reduction of the base shear of roof drift 0.5%,1.0% and 2.0% (updated analysis model)



Outcomes: In the shake table testing, the damage extents of beam fractures were successfully identified using the reduction of dynamic strain responses at damaged beams as a damage index. The static analysis of the damaged frame model that was updated using the identified damage index provided reasonable estimates on the reduction of the lateral stiffness and strength of the frame.