The Prize of AIJ 2012

Research Theses Division

Development and verification of seismic response-reduction mechanisms and systems for improving safety and functionality of steel structures

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Abstract:
Dr. MIDORIKAWA Mitsumasa is awarded for his research on seismic response-reduction mechanisms and systems that improve the safety, resilience and functionality of steel building structures. The research includes a series of experimental and analytical studies on three subjects: 1) The development of column-base-uplift rocking structural systems which utilize special flexing base plates that dissipate energy with column uplift. The innovative rocking systems resist earthquake ground motions by transforming the input energy into potential energy and damping out vibration through the flexing base plates. These rocking systems are effective to minimize the residual deformation after strong ground motions and achieve highly seismically-resilient buildings; 2) A concept of controlled rocking deformation that resolve the difficulty to apply rocking systems to low-rise buildings. The breakthrough was to add post-tensioning (PT) wires to supplement the lack of self weight in low-rise buildings to overcome the reaction forces of energy dissipation devices. The performance of the controlled rocking systems was validated under various earthquake motions by large-scale shaking table tests; and 3) Prediction of the buckling mode number of the steel core plate in buckling-restrained braces caused by cyclic loading and high-strain conditions. The prediction formulas were used to establish the relationship between the compressive-to-tensile strength ratio and the slenderness ratio of the yielding segment of the steel core. The relationship was used to improve the brace-end-connection design for buckling-restrained braces.