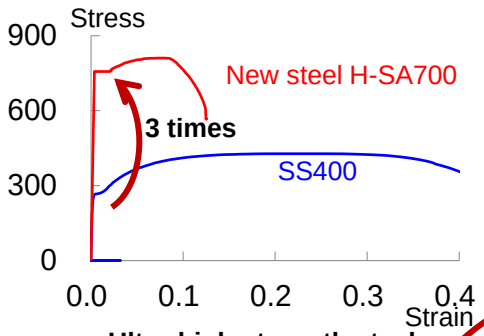
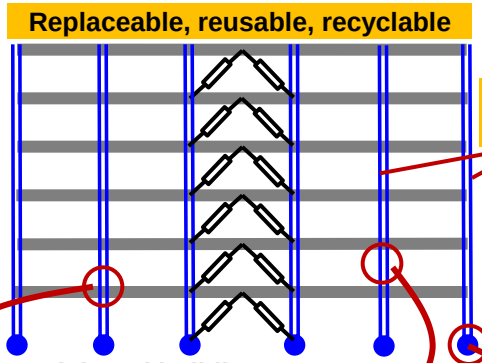
Development of Building Structures Using Ultra-high Strength Steel

Background: H-SA700 steel is a new ultra-high strength steel, which achieves very high strength without significantly altering its chemical compositions and without introducing intensive heat treatment. The research target is to develop a new steel structural system by extending the benefits offered by this steel. A system is sought that (1) minimizes energy consumption during manufacturing, fabrication, and construction, (2) maximizes reusability and recyclability, and (3) enables continuous use after major earthquakes.

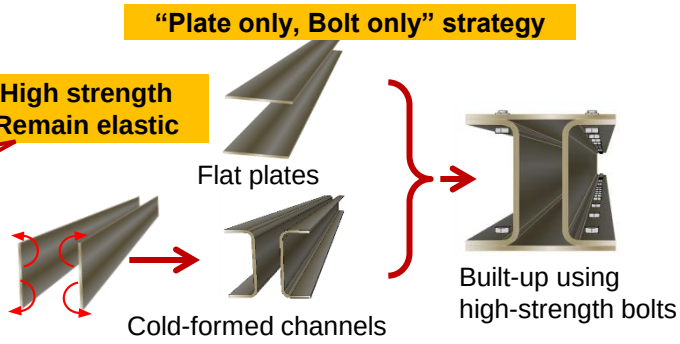
Methodology: The structural system is achieved by connecting columns, beams, and dampers using only bolts, so that all the components can be replaced, reused, and recycled. The columns are built up from H-SA700 steel plates, and provided with sufficiently large strength to keep them elastic under very rare earthquake events, which enable a longer life cycle, and less repair cost. A series of experiments and numerical analyses were carried out to address the research issues associated with the new structural system, columns using ultra-high strength steel, and connections for the columns.



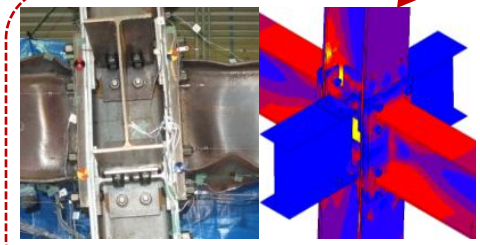
Ultra-high strength steel



Envisioned building system

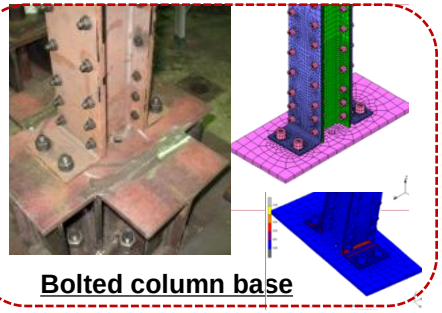


Fabrication of the column



Bolted beam-to-column connection

Bolted built-up column



Bolted column base

Conclusion: The design and fabrication methods for the structural system, columns and connections were examined. The proposed column achieved a very large elastic deformation capacity of 0.02 rad. Compared with the conventional braced frame, the proposed system using H-SA700 steel can reduce the maximum story drift by 60% and the residual deformation by about 80%.