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Flexural Performance of Built-Up Weld-Free Columns Using Ultra-High-Strength Steel

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Application of ultra-high strength steel is promising in reducing the size of structural components for the same capacity or making stronger components without enlarging the size. HSA700, one of the new high-strength steels, has a yield strength of about 780MPa and there are no weld materials that can match the strength. To avoid difficulties in welding and reduce energy consumption in fabrication process, a novel built-up weld-free column, made up of HSA700 steel plates, is developed for low- and mid-rise frame buildings. The “plate only, bolt only” strategy is implemented, and the column is built up with two plates, two cold-formed channels and high-strength bolts, as shown in Fig.1

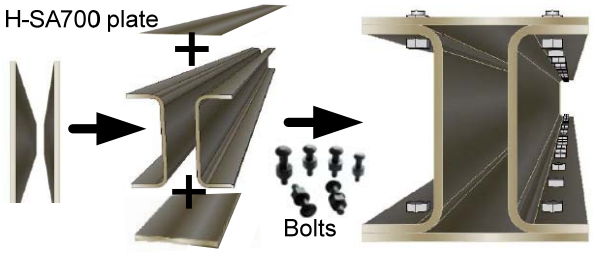

Fig.1 Fabrication of column

Three column specimens are tested with static cyclic loading to investigate the flexural performance of the proposed HSA700 column. One uses the high strength steel with standard bolt arrangement; another is a pilot column using mild steel and the last uses the high strength steel but with a larger bolt pitch. Global behavior such as the elastic section stiffness, yield bending moment, overstrength and deterioration are investigated. The HSA700 column remains elastic under the 4% story drift angle, which is more than twice the yielding drift of the conventional column with mild steel. An example of the moment-rotation relationship of column is shown in Fig.2.

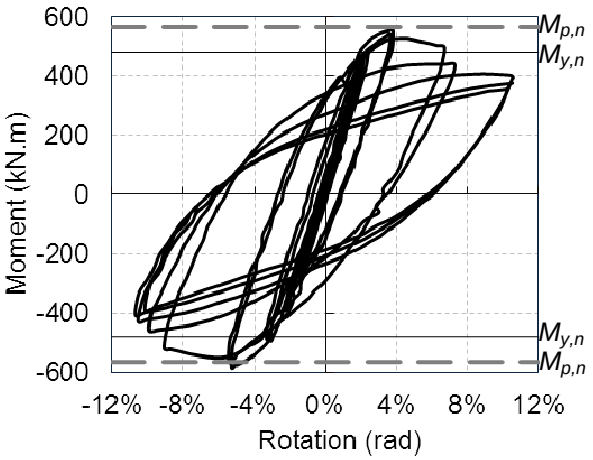

Fig.2 Moment-rotation relationship (HSA700)

Yielding along the column length and strain distribution along the section are examined to check the plane section assumption and yield zone in the column. The results show that the plane section assumption is valid in the elastic stage, and the column is able to develop a long yielding zone due to the bolted connection. A finite element model (Fig.3) that allows for the bolt slippage and local buckling behavior is proposed, and the usefulness is verified.

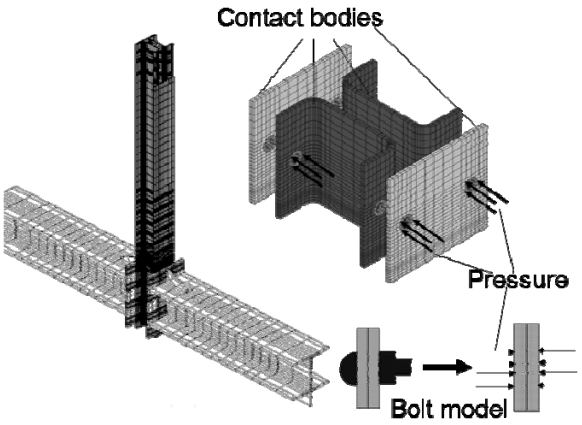

Fig.3 Finite element model