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MECHANICAL RESPONSES OF HIGH STRENGTH S690 STEELS UNDER LOW CYCLE HIGH STRAIN CYCLIC DEFORMATIONS

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ABSTRACT

Steels are commonly adopted as constructional materials in earthquake resistant structures owing to their large ductility and high efficiency in energy dissipation. The Chinese National Engineering Research Centre for Steel Construction (Hong Kong Branch) has conducted a series of experimental investigations into hysteretic behaviour of high strength steels, especially S690 steels under cyclic deformations. Based on these test results, design recommendations for seismic resistant design on ductility requirements will be formulated to facilitate effective use of high strength steels in construction. This paper presents a detailed experimental investigation into mechanical responses of high strength S690 steels under both monotonic and cyclic deformations. A total of 6 monotonic tensile tests were conducted to obtain basic mechanical properties while a total of 36 cyclic tests were also conducted to examine hysteretic behaviour of the S690 steels under various target strains and loading frequencies. In the cyclic tests, most specimens were able to complete 20 cycles and attained target strains ±10.0%. However, some specimens fractured at the 20th cycle under a target strains at ±10.0% irrespective of the loading frequencies. It was clearly shown in these tests that using instantaneous cross-sectional diameters for evaluating true stresses was essential to obtain representative hysteretic curves. Consequently, the importance of establishing seismic ductility requirements based on cyclic tests for high strength S690 steels is highlighted in this study. It also provides a series of hysteretic parameters for possible development of reliable constitutive models for high strength S690 steels under seismic loads.