HYSTERETIC BEHAVIOUR OF S355 AND S690 STEELS UNDER CYCLIC TESTS WITH CONSTANT AND VARYING STRAIN AMPLITUDES

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Abstract. *This paper presents an experimental investigation into hysteretic behaviour of S355 and S690 steels under both constant and varying cyclic loading conditions. A total of 7 funnel-shaped coupons made of S355 steels and 7 funnel-shaped coupons made of S690 steels were tested under cyclic loading conditions with i) constant strain amplitudes, and ii) varying strain amplitudes. Additionally, 4 monotonic tensile tests were conducted to obtain basic mechanical properties of both S355 and S690 steels for comparison. It should be noted that*

a) In those cyclic tests under constant strain amplitudes, both S355 and S690 steels are able to complete about 15 and 16 cycles respectively under a target strain amplitude at ±5.0 %. However, they can only complete 2 and 6 cycles respectively when the target strain amplitude is increased to ±10.0%.

b) In those cyclic tests under varying strain amplitudes in accordance to FEMA-461, both S355 and S690 steels are able to complete 20 cycles with a target strain amplitude of ±5.0 %. When the target strain amplitude is increased to ±10.0%, both of them can only complete 19 cycles.

It is found that the deformation characteristics of both steels obtained in monotonic tensile tests are very important as they affect their deformation characteristics under cyclic actions significantly. These two testing approaches are able to identify different deformation characteristics of the two steels. While S355 steels are shown to be able to deform consistently after repeated cyclic actions, there is a small amount of strength deterioration in S690 steels under repeated cyclic actions. Moreover, instantaneous diameters should be used to obtain accurate true stresses of critical cross-sections of the coupons when the engineering strains exceed 5%. All of these true stress-engineering strain curves are shown to be symmetrical.