

Experimental study of the residual fatigue life of reinforcement bars damaged by an earthquake

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Reinforcing bars removed from structural walls that belonged to a damaged building during the 2010 earthquake in Chile are studied under low-cycle fatigue testing. Damage of such walls was characterized by concrete crushing and boundary longitudinal reinforcement buckling.

Reinforcement bars are selected from damaged areas, including reinforcement with and without visible buckling. Cyclic load tests are performed with constant strain amplitude in the plastic range (3% and 5%), using an aspect ratio of 20. Fatigue life loss is observed in specimens from reinforcement bars with visible buckling damage with up to 15 cycles less than unaltered bars (3% amplitude tests), and with a fatigue life reduction of at least 40% for bars with and without observed buckling compared to unaltered bars, which indicates a low remaining fatigue capacity. A strain amplitude model also indicates that for a given number of cycles to fatigue failure, the strain amplitude reduces to 36% when comparing bars in buckled zone to unaltered bars. The seismic displacement demand on the building is of about 5 cycles of large amplitude and considering that some longitudinal bars fractured, it indicates that they could have reached 5% strain amplitude.