Parametric investigation of the cyclic response of hysteretic steel dampers in braced buildings

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Abstract

Hysteretic steel dampers have been effectively used to improve the seismic performance of framed buildings by confining the dissipation of seismic energy into sacrificial, replaceable devices which are not part of the gravity framing system. The number of cycles sustained by the dampers during the earthquake is a primary design parameter, since it can be associated to low-cycle fatigue, with ensuing degradation of the mechanical properties and potential failure of the system. Current standards, like e.g. the European code EN 15129, indeed prescribe, for the initial qualification and the production control of hysteretic steel dampers, cyclic tests in which the devices are assessed over ten cycles with amplitude equal to the seismic design displacement $d_{bd}$. This paper presents a parametric study focused on the number of effective cycles of the damper during a design earthquake in order to assess the reliability of the testing procedure proposed by the standards. The study considers typical applications of hysteretic steel dampers in low- and medium rise steel and reinforced concrete framed buildings and different ductility requirements. The results point out that the cyclic engagement of the damper is primarily affected by the fundamental period of the braced building and the design spectrum, and that, depending on these parameters, the actual number of cycles can be substantially smaller or larger that that recommended by the standards. A more refined criterion for establishing the number of cycles to be implemented in testing protocols is eventually formulated.

Full Text

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