World Academy of Science, Engineering and Technology
International Journal of Geotechnical and Geological Engineering
Vol:13, No:01, 2019

Development of Equivalent Inelastic Springs to Model C-Devices

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Abstract : 'C' shape yielding devices (C-devices) are effective tools for introducing supplemental sources of energy dissipation by hysteresis. Studies have shown that C-devices made of mild steel can be successfully applied as integral parts of seismic retrofitting schemes. However, explicit modelling of these devices can become cumbersome, expensive and time consuming. The device under study in this article has been previously used in non-invasive dissipative bracing for seismic retrofitting. The device is cut from a mild steel plate and has an overall shape that resembles that of a rectangular portal frame with circular interior corner transitions to avoid stress concentration and to control the extension of the dissipative region of the device. A number of inelastic finite element (FE) analyses using either inelastic 2D plane stress elements or inelastic fibre frame elements are reported and used to calibrate a 1D equivalent inelastic spring model that effectively reproduces the cyclic response of the device. The more elaborate FE model accounts for the frictional forces developed between the steel plate and the bolts used to connect the C-device to structural members. FE results also allow the visualization of the inelastic regions of the device where energy dissipation is expected to occur. FE analysis results are in a good agreement with experimental observations.

Keywords : C-device, equivalent nonlinear spring, FE analyses, reversed cyclic tests
Conference Title : ICEESD 2019 : International Conference on Earthquake Engineering and Seismic Design
Conference Location : Dublin, Ireland
Conference Dates : January 30-31, 2019

Open Science Index, Geotechnical and Geological Engineering Vol:13, No:01, 2019 publications.waset.org/abstracts/95702.pdf