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Design Methodology for Cold-Formed Steel Wall Framed Buildings under Lateral Loadings

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Abstract

Being light in weight, fast to construct, non-combustible, durable, recyclable etc. Cold-Formed-Steel (CFS) Wall Panels fabricated with lipped C-sections and sheathing boards are widely utilized in low & mid-rise buildings, often as structural element with lateral/seismic loads. Design guidelines for CFS buildings are not well developed for different sheathing boards against axial (gravity) and lateral loads, which hampers the adoption and application of the CFS wall-framed construction technology on the field at a large scale. In CFS shear wall panels (CFSSWP) with lateral eccentric load, end studs of the assembled frame will be under tension or compression as the assembly in whole try to show resilience against the load applied. Therefore, CFS end studs' axial strength (generally compression) is pivotal for estimating lateral strength of a CFSSWP. In the present study, modified approach for assessing the lateral strength of CFSSWP is validated with existing experimental studies given by Rogers (2004) and compared with approximate method proposed by Lei Xu (2006). Direct strength method (DSM) based on AISI S100-16 is engaged here for evaluating axial capacity of CFS wall. According to this methodology Local (P_{crl}), Distortional (P_{crd}) and Global (P_{cre}) Elastic buckling loads obtained will be utilized to get the actual buckling loads as per procedure detailed by Vieira & Schafer 2013 [7] and Sonkar et. al. 2020 [3]. Further, a modified approach for assessing the lateral capacity of CFSSWP is also proposed and validated. The modified approach considers broad range of parameters that might affect the resilience (stiffness) and capacity of CFSSWP, namely: material configuration, geometric configuration of studs (framing members), Assembly configuration of CFSSWP, and details such as size and spacing of the sheathing to frame fastening assembly. The adopted methods provide a ready tool for practitioners and designers for assessing the axial and lateral strength of CFSSWP for designing a CFS wall framed building. The estimated results agree well with the experimental results with a standard deviation of 4-5%.

Keywords: Cold-Formed-Steel (CFS), Lateral strength, Axial capacity, Direct strength method, CUFSM