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Impact of Out-of-Plane Stiffness of the Diaphragm on Deflection of Wood Light-Frame Shear Walls

Authors : M. M. Bagheri, G. Doudak, M. Gong

Abstract : The in-plane rigidity of light frame diaphragms has been investigated by researchers due to the importance of this subsystem regarding lateral force distribution between the lateral force resisting system (LFRS). Where research has lacked is in evaluating the impact of out-of-plane raigidity of the diaphragm on the deflection of shear walls. This study aims at investigating the effect of the diaphragm on the behavior of wood light-frame shear walls, in particular its out-of-plane rigidity was simulated by modeling the floors as beam. The out of plane stiffness of the diaphragm was investigated for idealized (infinitely stiff or flexible) as well as “realistic”. The results showed reductions in the shear wall deflection in the magnitude of approximately 80% considering the out of plane rigidity of the diaphragm. It was also concluded that considering conservative estimates of out-of-plane stiffness might lead to a very significant reduction in deflection and that assuming the floor diaphragm to be infinitely rigid out of plan seems to be reasonable. For diaphragms supported on multiple panels, further reduction in the deflection was observed. More work, particularly at the experimental level, is needed to verify the finding obtained in the numerical investigation related to the effect of out of plane diaphragm stiffness.

Keywords : finite element analysis, lateral deflection, out-of-plane stiffness of the diaphragm, wood light-frame shear wall
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