Effects of Shear Wall Length and Thickness on Required Column Reinforcement and Lateral Displacement of RC Tall Buildings

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Abstract

Shear walls are structural elements that are built parallel to the direction of the lateral loads. By their resistance to shear forces and overturning moments, they transfer lateral loads, seismic and wind, to the foundation.

In this research, the behaviour of 14-story office building (35m long, 15m wide and 49.5m high) was studied using ETABS 16.2.1 commercial software under different load combinations. The RC frame consists of 200 mm thick flat slabs with 2x2 m drop panels each of 100 mm thick, 32 RC columns each with 550x550 mm, spaced by 5m centre-centre and 400x700 mm spandrel beams. Peripheral, 400mm thick, masonry walls (including 100mm cavity) were placed on top of the spandrel beams. No internal masonry walls were used.

The first model was developed without shear walls, the model was tested twice; one time with the wind applied along the long direction of the building (y), this model was called 1a, and a model with the wind applied along the short direction of the building (x), this model was called 1b. It was found that when wind was applied along the long direction of the building (model 1a), it caused no failure even without shear walls. Contrarily, when the wind was applied in the short direction (model 1b) without the presence of shear walls, it caused failure to some columns and the building lateral displacement exceeded the code limits. Therefore, the wind in the x direction was considered as critical and used for testing and analysis of four different models. With exception of model 1 (no shear wall), each model consists of four different sub-models based on the length and thickness of the shear walls which ranged from 10-30m and 150-400mm respectively.

The concrete characteristic compressive strength was 40N/mm^2, steel characteristic tensile/compressive strength was 460N/mm^2, the factor of safety of concrete was 1.5 and the factor of safety of steel was1.15.

Three load combinations were adopted, as per Euro-code-2004, namely: (1) 1.35 DL+1.5 LL, (2) 1.35 DL+1.5 LL+0.9 WL and (3) 1.35 DL+1.05 LL+1.5 WL. The live load was 3.0 kN/m^2 for general office use, the dead load of the floor and ceiling finishes was 2.5 kN/m^2 and for the masonry walls was 4.275 kN/m^2. For the wind load calculations, a basic wind speed of 31 m/sec was used.