Numerical Study of Composite Shear Wall

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Shear walls are one of the most common structural systems to resist lateral loads. The shear wall is often designed and executed in two types of concrete shear walls and steel shear walls. But in high-rise buildings that carry large lateral loads, the use of conventional shear walls cannot be a good option as a lateral load resisting system, because the use of concrete shear walls causes thickening of the wall and thus reduces the useful space and increases the weight of the structure and the use of a steel shear wall is also not a good solution to resist the lateral loads in high-rise buildings due to weakness in areas under compressive stress and buckling that reduce the lateral load resistance and absorption energy capacity of the wall. An effective solution can be the use of concrete and steel plates in term of the composite shear wall, which has the advantages of concrete and steel plate at the same time and due to its high shear strength and high ductility capacity under high compressive and cyclic loads, it can be a suitable lateral load resisting system for high-rise buildings. In this thesis, the types of composite shear walls are described and due to the great advantages of composite shear walls made of in-fill concrete and steel face plates, Such as: Providing confinement for in-fill concrete by steel face plates and protecting concrete against environmental factors, this type of composite shear wall is chosen for this study. A specimen of this type of composite shear wall have been evaluated using a nonlinear finite element analysis with the ABAQUS software and the effects of different parameters including the diameter of the tie bars and their spacing, compressive strength of the concrete, thickness of the in-fill concrete, axial force ratio, thickness of the steel face plates, local strengthening and the presence of the opening, its position and dimensions on the performance of composite shear walls have been investigated. According to the study, the diameter of the tie bars has a slight effect on the performance of the composite shear wall, but the increase in the spacing of the tie bars reduces its ductility. By assessment the effect of in-fill concrete thickness, compressive strength and thickness of steel face plate, it can be concluded that the main role of the in-fill concrete is to prevent the buckling of the steel face plates. Also, by strengthening the bottom region of the wall as long as the strengthened part does not provide a support performance for the upper part, the behavior of composite shear walls improves, but if this part produces a support performance for the upper part, the ductility of the wall reduced severely. The presence of openings reduces the lateral resistance and increases the ductility of the composite shear wall. The inner corners of the opening due to the stress concentration are the weakness of the openings, which the wall's behavior improves with strenghening these positions by adding the triangular steel plate.

Keywords:

Composite shear wall, ABAQUS, nonlinear finite element analysis, numerical simulation.