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Design and Dynamic Response of an Office Building with Shear Wall by Using Staad Pro

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Abstract
During ground motions, many reinforced concrete buildings in urban areas that are located in active seismic zones may sustain moderate to severe damage. Buildings frequently use shear walls to resist earthquake-induced lateral loads. Shear walls have a strong resistance to wind and seismic forces, and they can even be built on soils with weak bases by using various ground improvement techniques. The construction process is quick, and the strength parameters and ability to withstand bare horizontal loads are very high. Due to their superior load-carrying capacity, shear walls are frequently utilized in earthquake-prone areas. These shear walls are able to absorb not only the loads caused by earthquakes but also the loads caused by winds, which are quite high in some zones. Even though these kinds of structures were first used in western countries in the early 1990s, this ideology changed quickly and quickly spread all over the world. In the context of Indian construction, the form work utilized in this type of construction is novel. In recent years, certain patented systems based on imported technologies have entered the Indian market, including the "Mascon System" from Canada and the "Mivan System" from Malaysia. Walls and slabs are cast in one operation at the site using specially designed, light-weight, pre-engineered aluminum forms that are easy to handle (with minimal labor and no equipment) and eliminate the need for traditional column and beam construction. In order to anticipate how forces and deformations will be distributed during an earthquake, it is necessary to investigate the actual seismic performance of buildings with shear walls

1. Introduction

Shear walls are the walls in a building that can withstand lateral loads brought on by wind or earthquakes. These RCC structural elements frequently account for a significant, if not the entire, portion of a building's lateral load and the load's horizontal shear force. Concrete walls enclosing stairways, elevated shafts, and utility cores can serve as shear walls or they can be added solely to resist horizontal force. Shear walls not only have a high in-plane stiffness, making them very effective at resisting lateral loads and controlling deflection, but they may also play a role in ensuring that all of the structure's plastic hinge locations develop before failure. The addition of masonry walls to the rigid frame could be an alternative means of mitigating these loads.

If inter-storey deflections caused by lateral loadings are to be controlled, certain high-rise buildings require the use of shear walls or equivalents. During moderate seismic disturbances, well-designed shear walls not only provide adequate safety but also offer a significant degree of protection against costly non-structural damage. When it comes to high-rise structures, the term "shear wall" is actually a misnomer because, when subjected to lateral force, a thin shear wall primarily exhibits moment deflections and only very minor shear distortions. Shear wall analysis may become a crucial design component as a result of the increasing height and slimming of high-rise buildings. Numerous openings are typically present in shear walls. Coupled shear walls are the name given to such shear walls. Short, open-deep beams that are a part of the wall, floor slab, or both connect the walls on both sides of the openings. If these walls are arranged in a systematic manner, the structural engineer has his work cut out for him. The book's scope restricts the discussion to shear walls with no room for discussions

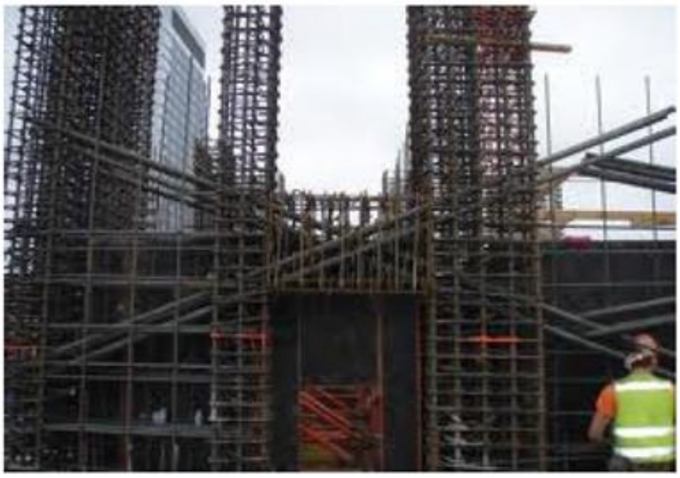

Fig.1 RC wall

2. Literature Review

The vertical components of the horizontal force resisting system are shear walls. A structure's lateral load is mitigated by the construction of shear walls. Shear walls are straight exterior walls that typically form a box and provide all of the building's lateral support in residential construction. Shear walls will have the strength and stiffness to withstand the horizontal forces if they are constructed and designed correctly.

A rigid vertical diaphragm that can transfer lateral forces from exterior walls, floors, and roofs to the ground foundation in a direction parallel to their planes is used in building construction. The vertical truss and reinforced concrete wall are two examples. In addition to the weight of the structure and its occupants, lateral forces brought on by wind, earthquake, and uneven settlement loads; create powerful forces of twisting (torsion). A building can literally be torn apart by these forces. By attaching or placing a rigid wall within a frame, it is possible to keep the shape of the frame and prevent rotation at the joints. In high-rise buildings that are subjected to lateral wind and seismic forces, shear walls are especially important.

Shear walls have become an essential component of mid-rise and high-rise residential buildings over the past two decades. These walls are placed in building plans to reduce lateral displacements under earthquake loads as part of an earthquake-resistant building design. As a result, shear-wall frame structures are created.

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The plan and elevation of shear wall buildings are typically uniform. On the other hand, some buildings have larger plan dimensions at the lower floors because those floors are used for business. In other instances, obstacles exist at higher floor levels. Shear walls are designed not only to resist gravity and vertical loads (due to their self-weight and other living and moving loads), but they are also designed to withstand lateral loads from earthquakes and winds. Shear wall buildings are typically used for residential purposes and can house anywhere from 100 to 500 people per building. Providing the building structures with three-dimensional stability, the walls are structurally integrated with roofs, floors, and other lateral walls that cross at right angles.

Stable structural systems for shear walls exist. Because, in contrast to RCC-framed structures, their supporting area (total cross-sectional area of all shear walls) is relatively larger in relation to the building's total plans area. Walls need to be able to withstand the forces of uplift brought on by the wind's pull. Shear forces that attempt to move walls must be resisted by walls. The wind's lateral force, which tries to push the walls in and pull them away from the building, must be resisted by the walls.

Because formwork is used to concretize the members during construction, shear walls are constructed quickly. Because the wall itself provides such a high level of precision that it does not require plastering, shear walls do not require any additional finishing or plastering. The input and output conventions used correspond to common building terminology. The models in STADDPRO are logically defined as ground-with-the-beneficial aid of way of ground, column-with-the-beneficial aid of way of column, bay-with-the-beneficial aid of way of bay, and wall-with-the-beneficial aid of wall, rather than as a stream of non-descript nodes and elements as in massive reason applications. As a result, the structural definition is clear, concise, and extensive.

Fig.2 Plywood wall

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3. Proposed System

There are two forces that shear walls can resist: uplift forces and shear forces. Accelerations caused by ground movement and external forces like wind and waves generate shear forces in stationary buildings. Between the top and bottom shear wall connections, this action causes shear forces to be applied throughout the wall's height.

Because the horizontal forces are applied to the top of the wall on shear walls, there are uplift forces. The goal of these uplift forces is to raise one end of the wall and lower the other.

There are times when the uplift force is so great as to tip the wall over. When compared to low long walls, tall short walls experience greater uplift forces. Because shear walls are able to resist uplift thanks to gravity loads, bearing walls have less uplift than non-bearing walls. When the gravity loads are unable to withstand all of the uplift, shear walls require hold-down devices at each end. The uplift resistance that is required is then provided by the hold down device.

Every level of the structure, including the crawl space, should have shear walls. Equal length shear walls should be symmetrically placed on each of the building's four exterior walls to create an effective box structure. When the building's exterior walls aren't strong enough or stiff enough, shear walls should be added inside.

Shear walls work best when they are supported by foundation walls or footings and aligned vertically. Other areas of the building will require additional strengthening if the exterior shear walls do not provide sufficient strength. Consider the typical situation in which there is no continuous footing beneath an interior wall that is supported by a subfloor over a crawl space.

The subfloor and its connections will need to be strengthened close to the wall in order for this wall to be used as a shear wall. Existing floor construction is difficult to modify for retrofit work.

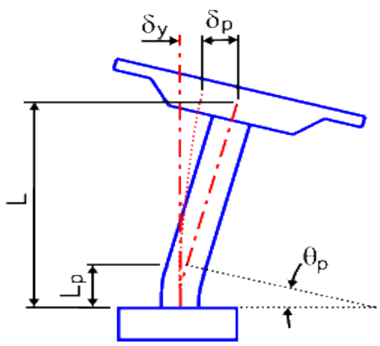

Fig.3 deformation

S. A. Freeman created the capacity spectrum method (CSM) for frame buildings. The CSM is a rough method for analyzing a structure's seismic response using nonlinear static analysis. The CSM makes it possible to effectively describe a structure's seismic performance and aids in the analysis of a structure's seismic response in terms of forces and displacement. The assumption that the maximum lateral story drifts accurately describe the seismic building response is the foundation of the CSM theory. The following assumption is that fundamental mode deformations of the initially elastic system dominate the maximum lateral story drifts.

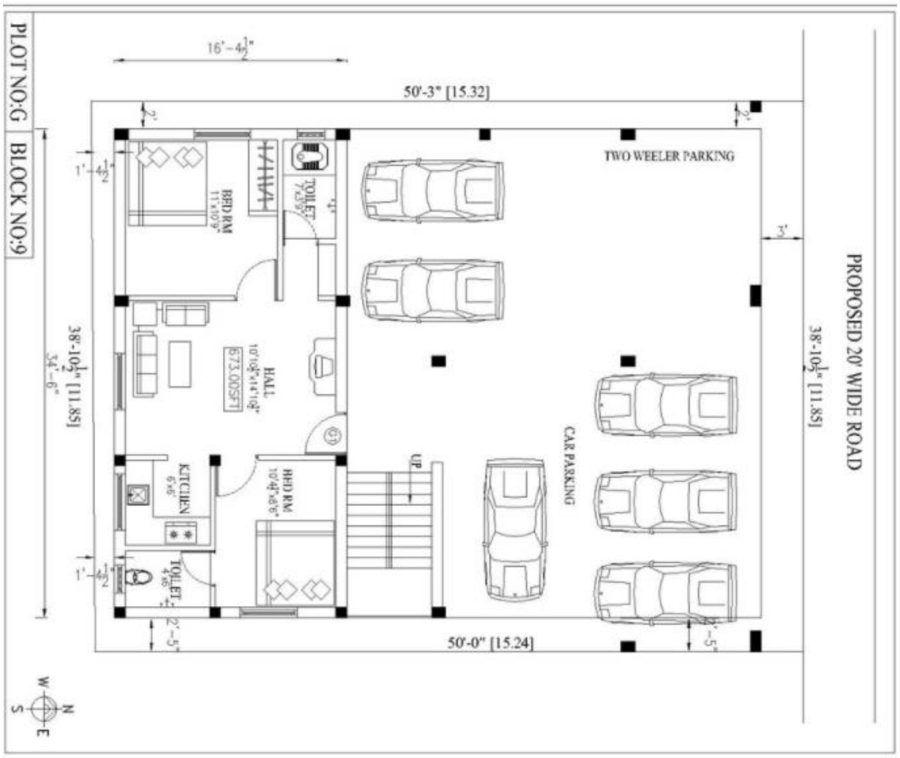

Fig.5 Floor plan

5.Conclusion

To avoid unusually thin sections, the shear wall should not be thinner than 150 mm. In regions where inelastic cyclic loading may need to be sustained, very thin sections are susceptible to lateral instability. The effective flange width for the flanged wall section should be one tenth of the total wall height and at least half the distance to an adjacent shear wall web. In the wall's plan, the minimum reinforcement in the longitudinal and transverse directions ought to be distributed uniformly across the wall's cross-section and equal to 0.0025 times the gross area in each direction. Controlling the width of inclined cracks caused by shear is made easier with this.

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