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Analysis and Design of Multistorey Building with R.C.C Shear Wall using STAAD PRO

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ABSTRACT

In seismic design of multistoried building, shear walls are most common structure adopted to make the structure earthquake resistant. These are constructed to counteract the lateral loads caused by wind load and seismic loads. Shear walls provide adequate stiffness to the structure. So that the lateral drift will be in limits. Generally shear walls are the vertical cantilever which acts as a Column. After many practical studies it has shown that use of lateral load resisting systems in the building configuration has tremendously improved the performance of the structure in earthquake. Shear walls are mainly flexural members and usually provided in high rise buildings to avoid the total collapse of the high rise buildings under seismic forces..

KEYWORDS: IS codes, loads, STAAD Pro, AUTO CAD.

INTRODUCTION

Shear wall are one of the excellent means of providing earthquake resistance to multistoried reinforced concrete building. The structure is still damaged due to some or the other reason during earthquakes. Behavior of structure during earthquake motion depends on distribution of weight, stiffness and strength in both horizontal and planes of building. To reduce the effect of earthquake reinforced concrete shear walls are used in the building. These can be used for improving seismic response of buildings. Structural design of buildings for seismic loading is primarily concerned with structural safety during major Earthquakes, in tall buildings, it is very important to ensure adequate lateral stiffness to resist lateral load.

The provision of shear wall in building to achieve rigidity has been found effective and economical. When buildings are tall, beam, column sizes are quite heavy and steel required is large. So there is lot of congestion at these joint and it is difficult to place and vibrate concrete at these place and displacement is quite heavy. Shear walls are usually used in tall building to avoid collapse of buildings. When shear wall are situated in advantageous positions in the building, they can form inefficient lateral force resisting system. In this present paper one model for bare frame type residential building and three models for dual type structural system are generated with and effectiveness has been checked Adequate stiffness is to be ensured in high rise buildings for resistance to lateral loads induced by wind or seismic events.

DEFINITION FOR SHEAR WALLS

- Shear wall is a vertical structural element used to resist the horizontal forces such as wind force, seismic force. These forces act parallel to the plane of the wall. Shear walls are generally used in high rise buildings where effect of wind forces and seismic forces is more.
- Shear walls provide large strength and stiffness to buildings in the direction of their orientation, which significantly reduces lateral sway of the building and thereby reduces damage to structure and its contents. Since shear walls carry large horizontal earthquake forces, the overturning effects on them are large.
- Shear wall purpose is a structural member used to resist lateral forces i.e. parallel to the plane of the wall. For slender walls where the bending deformation is more, Shear wall resists the loads due to Cantilever Action. In other words, Shear walls are vertical elements of the horizontal force resisting system.

OBJECTIVES

- The aim of this project is to determine the solution for light frame shear wall location in multi storey building. Providing shear walls at adequate locations substantially reduce the displacements due to earthquake. Hence accounting shear wall in a building will form an efficient lateral force resisting system. We design for Reinforced cement concrete (R.C.C) shear walls for multi storey buildings.
- A shear wall resists loads parallel to the plane of the wall. Shear walls are typically light-framed or braced wooden walls with shear panels, reinforced concrete walls, reinforced masonry walls, or steel plates.

TYPES OF SHEAR WALLS

- 1. Reinforced Concrete Shear Wall.
- 2. Concrete Block Shear Wall.
- 3. Steel Shear Wall.
- 4. Plywood Shear Wall.
- 5. Mid-Ply Shear Wall.

1. Reinforced Concrete Shear Wall.

Reinforced concrete shear walls are widely used shear walls for residential buildings. The reinforcement is provided in both horizontal and vertical directions. But at the end of each wall, bars are closely spaced and anchored. So, the end zones of RC shear wall is called as boundary elements.

Fig 1.Reinforced concrete shear wall

2. Concrete Block Shear Wall.

Concrete block shear walls are constructed using Hollow concrete blocks along with Steel reinforcement bars. Reinforcement is generally used to maximize the effect of concrete block masonry against seismic loads.

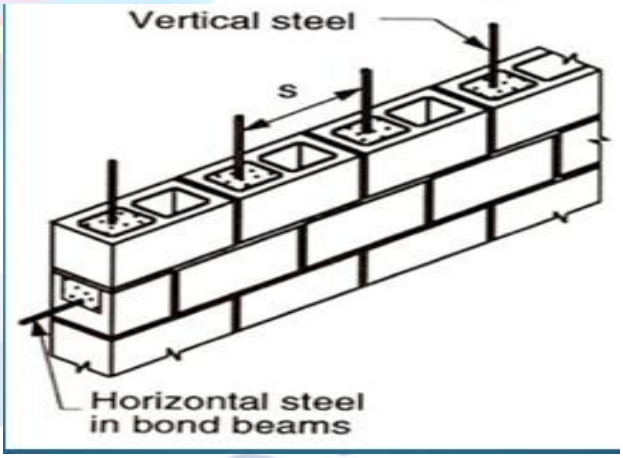


Fig 2.Concrete shear wall

3. Steel Shear Wall.

Steel shear wall consists of a steel plate wall, boundary column and horizontal floor beam. The action of steel shear wall is more like a plate girder. Steel plate wall acts as web of plate girder, boundary columns acts as flanges and horizontal beams acts as stiffeners of plate girder.

Fig 3.Steel shear wall

4. Plywood Shear Wall.

Plywood shear walls are traditional type walls which are also called as timber shear walls. It consists of plywood sheets and studs. Plywood sheets transfer shear force while studs resists the tension or compression.

Now a day's plywood shear walls are redesigned using new technical advancements. Steel sheets, sure boards etc. are using in place of plywood.

Fig 4.Plywood shear wall

5. Mid-Ply Shear Wall.

Mid-ply shear wall is an improved version of normal plywood shear wall. In this case, extra plywood sheet is arranged at the centre of normal plywood wall and series of pairs of studs are positioned on the both sides of mid-ply. Studs joint the mid-ply with outer plywood sheets. Here, Studs are rotated to 90o relative to those is plywood shear wall.

Fig 5.Mid ply shear wall

Seismic Zones of India:

The varying geology at different locations in the country implies that the likelihood of damaging earthquakes taking place at different locations is different. Thus, a seismic zone map is required to identify these regions. Based on the levels of intensities sustained during damaging past earthquakes, the 1970 version of the zone map subdivided India into five zones – I, II, III, IV and V. The seismic zone maps are revised from time to time as more understanding is gained on the geology, the seism tectonics and the seismic activity in the country. The Indian Standards provided the first seismic zone map in 1962, which was later revised in1967 and again in 1970. The map has been revised again in 2002, and it now has only four seismic zones – II, III, IV and V.

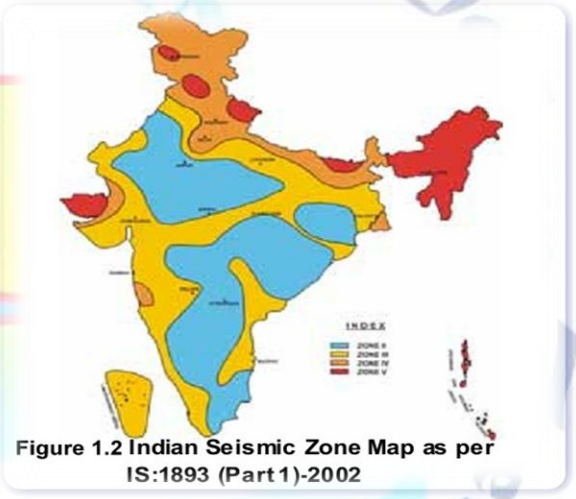


Figure 1.2 Indian Seismic Zone Map as per IS:1893 (Part1)-2002

preliminary data:

- Type of frame : Ordinary RC moment resisting frame fixed at the base.
- Seismic zone :III, IV, V
- Number of storeys :4
- Floor height :3 m
- Depth of Slab :125 mm
- Spacing between frames :3m along both directions
- Live load on floor level :3 kN/m^2
- Live load on roof level :1.5 kN/m^2
- Floor finish :1.0 kN/m^2
- Terrace water proofing : 1.5 kN/m^2
- Materials : M 20 concrete, Fe 415 steel and Brick infill
- Thickness of infill wall : 230mm (Exterior walls)
- Thickness of infill wall :150 mm (Interior walls)

- Density of concrete : 25 kN/m^3
- Density of infill : 20 kN/m^3
- Type of soil : medium
- Response spectra :As per IS 1893(Part1):2002
- Damping of structure : 5 %
- Dimensions of beams : 0.4*0.32 m2
- Dimensions of column : 0.3
- Thickness of shear wall : 0.12 mt
- Dimensions of shear wall : 6* 15 mts

Load calculations

In Staad-pro we need not calculate the self weight of frame members. This will automatically include the self-weight of structural members in the analysis based on present specific weights given in function of the material type.

Dead Load:

Floor finish : 1.5kN/m^2
Internal wall load : 2.7x0.15x20 = 8.4KN/m
External wall load: 2.7x0.23x20 =12.82KN/m
Parapet Wall : 1x0.15x20= 3KN/m

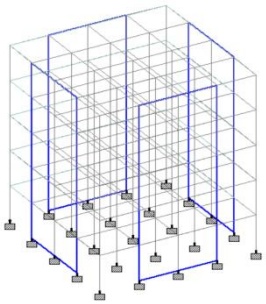
Live load:

For typical floors : 3kN/m^2
For top floor : 1.5kN/m^2

Load Combination:

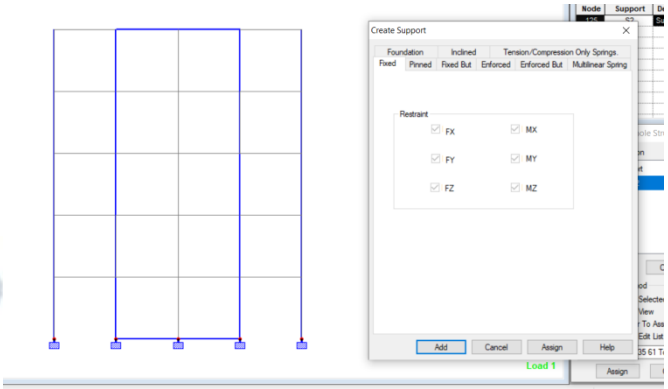
In this Project 13 Load Combinations are considered.

However there has been little to no work put into the viability of image processing to achieve electronic automated invoicing.

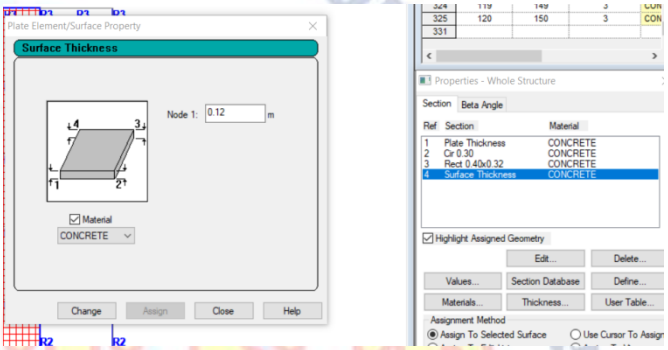


3D Rendered View

Defining Supports



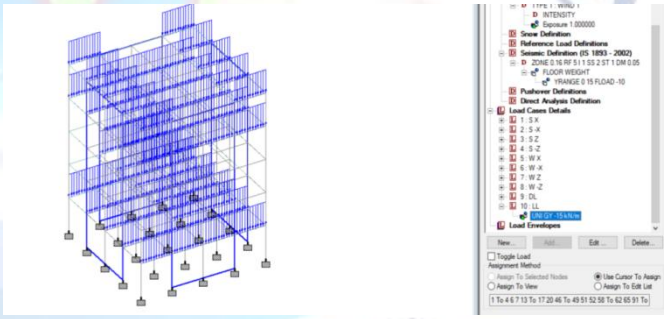
Property definition



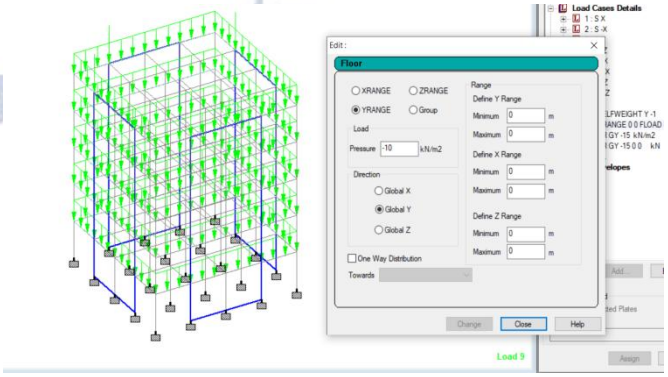
LOADS:-

Load combination

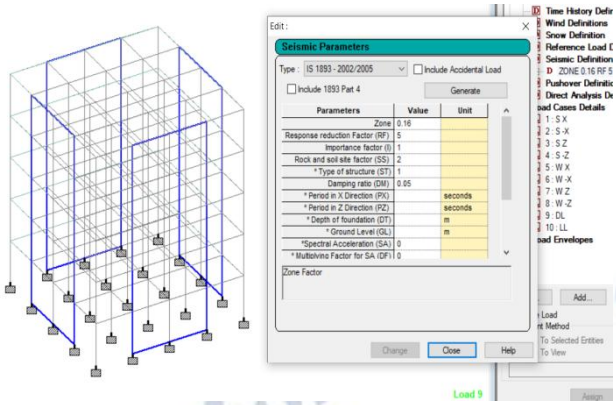
Assigning live Load



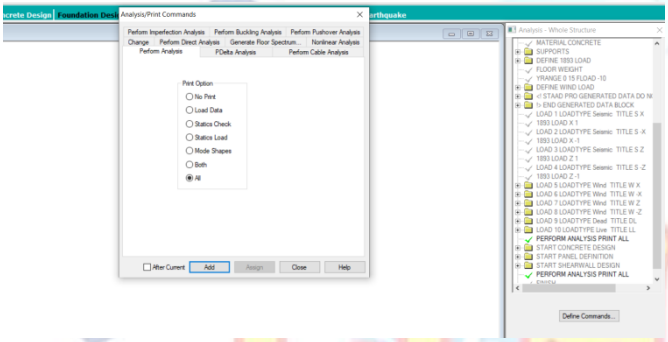
Assigning Slab Load



Defining Seismic load definitions

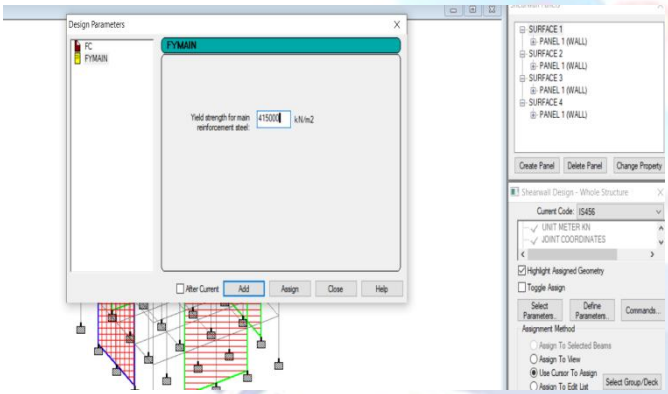


Print analysis command

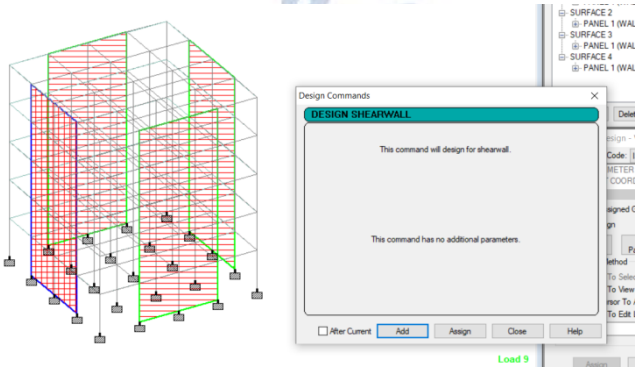


SHEARWALL DESIGN:-

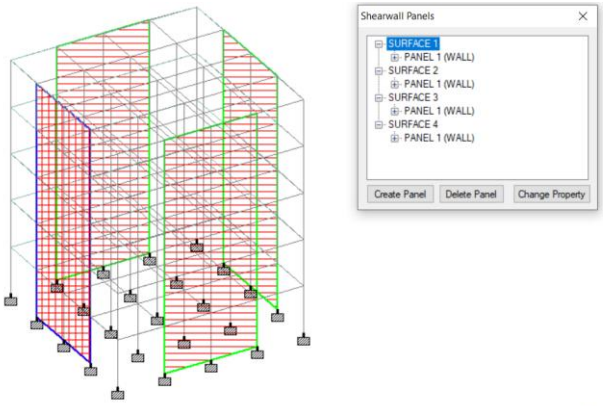
shear wall design parameter



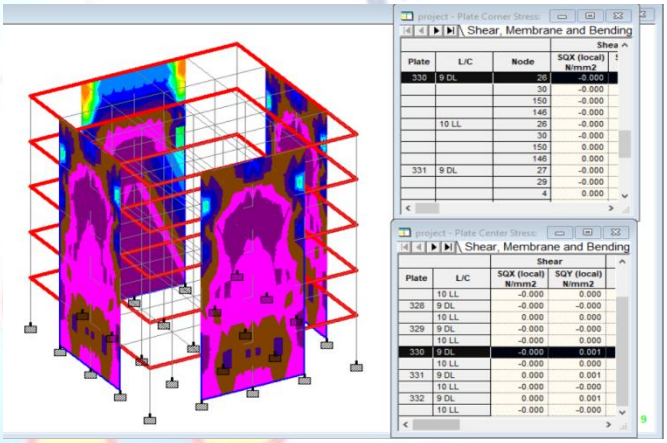
Design Command



Shear Wall Details



Results



FUTURE SCOPE AND CONCLUSION

Shear walls provide large strength and stiffness to buildings in the direction of their orientation, which significantly reduces lateral sway of the building and thereby reduces damage to structure and its contents. Since shear walls carry large horizontal earthquake forces, the overturning effects on them are large.

1.Changing the position of shear wall will affect the attraction of forces, so that wall must be in proper position.

2. If the dimensions of shear wall are large then major amount of horizontal forces are taken by shear wall.

3. Providing shear walls at adequate locations substantially reduces the displacements due to earthquake.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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