STUDY ON THE LOCATION OF SHEARWALL IN A STRUCTURE USING ETABS NONLINEAR

[1]CHITHAMBAR GANESH.A, [2]JAGAN.S, [3]MUTHUKANNAN.M

[1,2,3]CivilEngineering,Department of Civil Engineering Kalasalingam University
E-mail: [1]chithambarmailid@gmail.com

Abstract- Shear wall systems are one of the most commonly used lateral-load resisting systems in the high-rise buildings. Shear walls are usually provided along both length and width of buildings. Shear walls are like vertically-oriented wide beams that carry earthquake loads downwards to the foundation. Shear wall, in building construction, a rigid vertical diaphragm capable of transferring lateral forces from exterior walls, floors, and roofs to the ground foundation in a direction parallel to their planes. Lateral forces caused by wind, earthquake, and uneven settlement loads, in addition to the weight of structure and occupants; create powerful twisting (torsional) forces. These forces can literally tear (shear) a building apart. Reinforcing a frame by attaching or placing a rigid wall inside it maintains the shape of the frame and prevents rotation at the joints. Shear walls are especially important in high-rise buildings subject to lateral wind and seismic forces.There are lots of literatures available to design and analyze the shear walls. However, the decision about the location of shear wall in a multi-storey building is not much discussed in any literatures. There are many software packages that are available to locate and design the shear wall in a structure such as ETABS, SAP, STAAD PRO, etc. In this paper, therefore main focus is to determine the solution for the shear wall location in multi-story building in Etabs nonlinear for a reinforced concrete building.

Keywords- Shear Wall, Story Drift, Shear Wall Location, Etabs non linear

I. INTRODUCTION

Reinforced concrete framed buildings are adequate for resisting both vertical and horizontal loads acting on them.Shear wall 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 and for short walls where the shear deformation is more it resists the loads due to Truss Action. These walls are more important in seismically active zones because during earthquakes shear forces on the structure increases. Shear walls should have more strength and stiffness. When a building has a story without shear walls, or with poorly placed shear walls, it is known as a soft story building. Shear walls provide adequate strength and stiffness to control lateral displacements. Concrete Shear wall buildings are usually regular in plan and in elevation. Shear wall buildings are commonly used for residential purposes and can house from 100 to 500 persons per building. Horizontal and vertical distributed reinforcement (ratio 0.25%) is required for all shear walls.

Story drift is the drift of one level of a multistory building relative to the level below. Inter story drift is the difference between the roof and floor displacements of any given story as the building sways during the earthquake, normalized by the story height.

Consequently, this paper has been depicted to focus the correct area of shear walls focused around its versatile and elastro-plastic behaviors. In this respect, ETABS NONLINEAR programming software is considered as the instrument to perform shear forces, bending moments and story drifts have been figured to discover the area of the shear wall in a structure.

II. METHODOLOGY

In this paper, a 5-story building with 3.0 meters height for every story is chosen the analysis. These structures were composed in understanding with the Indian Code.The buildings were assumed to be fixed at the base and the floors acts as rigid diaphragms. The areas of structural components are square and rectangular and their measurements are steady for all the models.The buildings were modeled using the software ETABS Nonlinear v9.7.1.Four models were constructed with diverse introduction of shear walls in a building. Models were studied in zone III, comparing parameters such as base shear, lateral displacement, story drift and beam moments for all models.

2.1. Load Conditions

The dead load condition for all the different models is 1KN/M.

The live load condition for all the different models is 3KN/M.

Lateral load is the earthquake load as per IS 1893(PART 1):2002 and is applied to the mass centre of the building.

TABLE 1: Preparatory Data of the structure considered:

Type of the structure	Framed structure
Number of storeys	G+4
floor to floor height	3.0m
Response reduction factor R	5.0
Plinth height	2.5m
Wall thickness	230 mm
Grade of concrete	M 30
Grade of steel	Fe 415
Size of the columns	400mmx400mm
Size of the beams	230x400mm
Slab thickness	150mm
Thickness of Shear Wall	230mm
Type of soil	Medium
Zone	3.0

The plans of the building model are given below:

Model:1

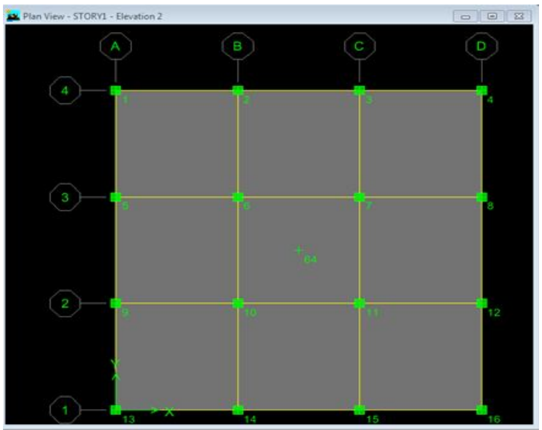

Figure:1
Plan of normal building without a shear wall.

Model:2

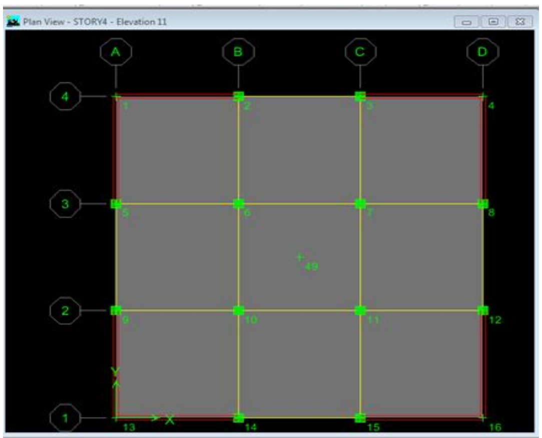

Figure:2
Plan of the building with L-shaped shear wall

Model 3:

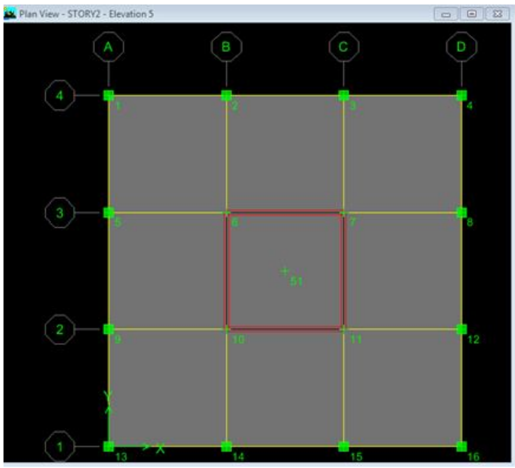

Figure:3
plan of the building with shear wall at the center

Model 4:

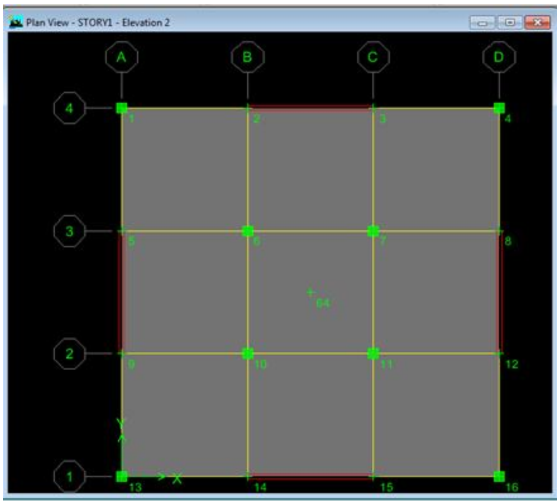

Figure:4
plan of the building with shear wall at the edges

The elevations of the given building plan are shown below:

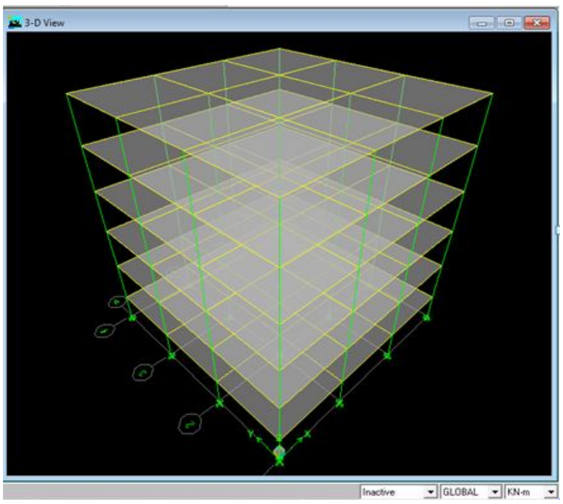

Figure:5
Elevation of plan 1(normal building)

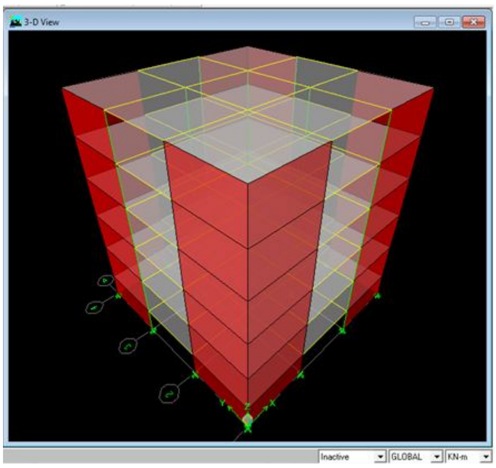

Figure:6
Elevation of plan 2(with L-shaped shear wall)

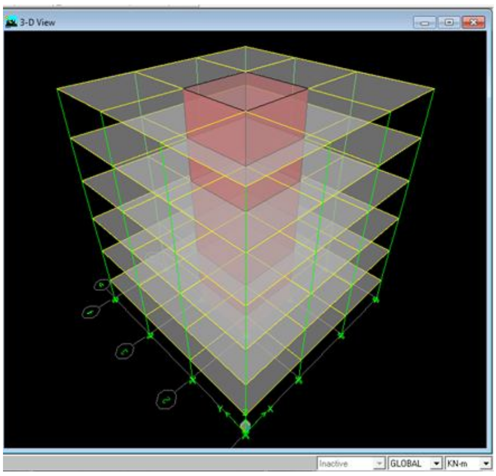

Figure:7
Elevation of plan 3(with shear wall at the center)

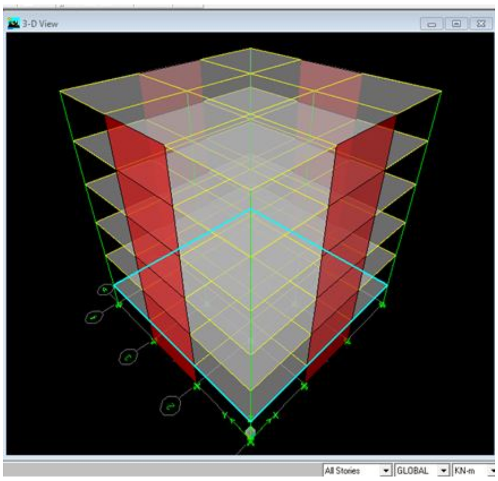

Figure:8
Elevation of plan 4(with shear wall at the edges)

III. RESULTS AND DISCUSSION

Form the analysis of the various models in the etabs,it is observed that themaximum bending moment in a normal building is 113.657KNm and the maximum shear force in a normal building is 122.94KN.

The maximum bending moment and the maximum shear force is 131.452KNm and 122.94KN respectively for the building with L-shaped shear wall.

The maximum bending moment and the maximum shear force for the building with shear wall at the center is 159.802KNm and 142.16KN respectively.

The maximum bending moment and the maximum shear force for the building with shear wall at the edges is 147.186KNm and 136.06KN respectively.

The above data is tabulated in Table:2

Table:2 Beam Bending Moment and Shear Force Variation:

Type	Shear Force(KN)	Bending Moment(KNm)
Normal	**122.94**	**113.657**
Shear Wall 1	**134.86**	**131.452**
Shear Wall 2	**142.16**	**159.802**
Shear Wall 3	**136.06**	**147.186**

It is graphically represented in the figure:9 shown below:

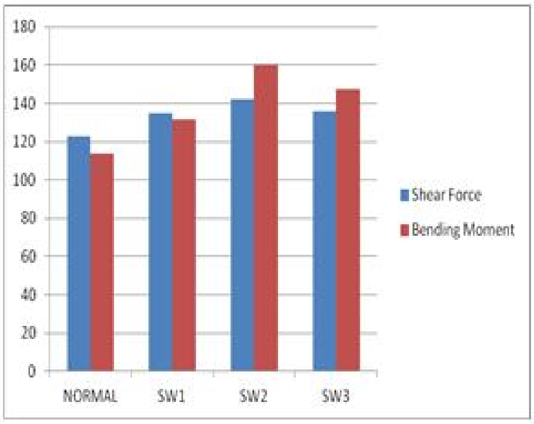

Figure:9

Storeydirft and displacement:

By comparing the analysis of building without shear wall and buildings with shear walls at different locations the following tables can be formulated for story shear for different story.
In the normal building the maximum displacement occurs at storey:6 and maximum drift occurs at storey:3

Table:3 Normal Building:

STOREY	**DISP-X**	DRIFT-X
STOREY6	**0.013045**	0.000452
STOREY5	**0.011689**	0.000742
STOREY4	**0.009464**	0.000934
STOREY3	**0.006661**	0.001022
STOREY2	**0.003594**	0.000930
STOREY1	**0.000804**	0.000402

In the building with the L-shaped shear wall the maximum displacement occurs at storey:6 and maximum drift occurs at storey:4

Table:4 Shear wall Model 1:

STOREY	DISP-X	DRIFT-X
STOREY6	0.000662	0.000034
STOREY5	0.000559	0.000047
STOREY4	0.000419	0.000048
STOREY3	0.000276	0.000040
STOREY2	0.000156	0.000031
STOREY1	0.000061	0.000031

In thebuilding with the shear wall at the center the maximum displacement occurs at storey:6 and maximum drift occurs at storey:5

Table:5 Shear wall Model 2:

STOREY	DISP-X	DRIFT-X
STOREY6	0.001038	0.000068
STOREY5	0.000835	0.000078
STOREY4	0.000600	0.000073
STOREY3	0.000381	0.000062
STOREY2	0.000195	0.000046
STOREY1	0.000056	0.000028

In thebuilding with the shear wall at the edges the maximum displacement occurs at storey:6 and maximum drift occurs at storey:5

Table:6 Shear wall Model 3:

STOREY	DISP-X	DRIFT-X
STOREY6	0.002658	0.000194
STOREY5	0.002075	0.000204
STOREY4	0.001461	0.000190
STOREY3	0.000893	0.000158
STOREY2	0.000419	0.000107
STOREY1	0.000099	0.000050

STORY SHEAR:

Figure:10

NORMAL RESIDENTIAL Building

Figure:11
Building with L-Shaped shear wall

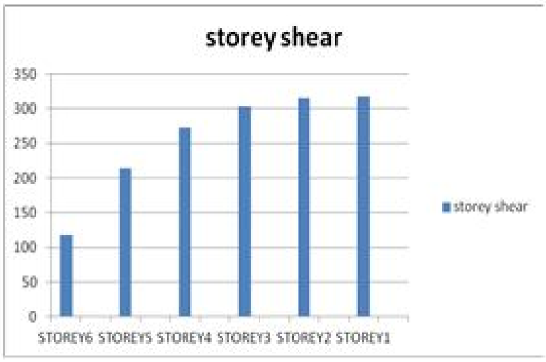

Figure :12
building with shear wall at the center

Figure:13
building with shear wall at edges

CONCLUSIONS

The following conclusions are made based on the analysis and design of multi-storey building with and without shear walls for gravity loads and lateral forces for seismic zone 3 of India. The different shear wall types are also taken into account.

- From the table of storey drift, it has been observed that building with shear wall suffers less drift in x direction when compared to building without shear wall.

- It has also been observed that shear wall model 1 suffers less drift when compared to other shear wall models.
- From the table of storey displacement, it has been observed that building with shear wall suffers less drift in x direction when compared to building without shear wall.
- It has also been observed that shear wall model 1 suffers less displacement in x direction when compared to other shear wall models.

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