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Design and Analysis of Educational Building Using ETABS

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ABSTRACT:An earthquake is the shaking of the surface of the Earth, resulting from the sudden release of energy in the Earth's lithosphere that creates seismic waves. Earthquakes can range in size from those that are so weak that they cannot be felt to those violent enough to toss people around and destroy whole cities. Earthquakes are one of the most devastating and frightening natural disasters a person can experience. They happen without warning in areas all around the world. Earthquakes can cause major damage and fatalities in populated areas, but the earthquake itself is not always to blame. Other natural disasters can be caused by earthquakes. In the present analysis, a Educational building is analyzed with columns, columns with shear walls for G+9 building. The building is analyzed in static analysis and the results of axial force were compared for different load combinations in static. The building is analyzed in condition i.e., in ZONE- 2 & 5 in three soils and the results of different heights are noted as stated above. these can be equally, and sometimes more, destructive. The results from the analysis are obtained in static method and are presented in tabular form and the results are compared using graphical form.

KEYWORDS: ETABS, Educational building, shear walls.

I. INTRODUCTION

Adequate stiffness is to be ensured in high rise buildings for resistance to lateral loads induced by wind or seismic events. Reinforced concrete shear walls are designed for buildings located in seismic areas, because of their high bearing capacity, high ductility and rigidity. In high rise buildings, beam and column sizes work out large and reinforcement at the beam-column junctions are quite heavy, so that, there is a lot of clogging at these joints and it is difficult to place and vibrate concrete at these places which does not contribute to the safety of buildings. These practical difficulties call for introduction of shear walls in High rise buildings.

Concrete or masonry continuous vertical walls may serve both architecturally as partitions and structurally to carry gravity and lateral loading. There will be no architectural difficulty in extending them through the height of the building; their very high in plane stiffness and strength had proved them to be ideally suited for resisting lateral loads. Compared to frame type structures, shear-wall structures offer less distortion and less damage to nonstructural elements. Care shall be taken to have symmetrical configuration of walls in the building so that torsion effect in plan could be avoided.

In a shear wall structure, shear walls are entirely responsible for the lateral load resistance of the building due to seismic and wind loadings. These shear walls act as vertical cantilevers in the form of separate planar walls, and also as non planar assemblies of connected walls around stair case, elevators and service shafts. Shear walls are much stiffer horizontally than rigid frames. Shear walls are much economical up to about 35 stories. In contrast to the rigid frames, the shear walls' solid form tends to restrict open internal spaces where required. However, they are well suited to hotels

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and residential buildings where the floor by floor repetitive planning allows the shear walls to be vertically continuous. They also serve excellent acoustic and fire insulators between rooms and apartments.

Structural forms:

Lateral loads can develop high stresses, produce sway movement or cause vibration. Therefore, it is very important to have sufficient strength for the structure against vertical loads. Earthquake and wind forces are the only major lateral forces that affect the buildings. The function of lateral load resisting systems or structure form is to absorb the energy induced by these lateral forces by moving or deforming without collapse. The determination of structural form of a tall building or high rise building would perfectly involve only the arrangement of the major structural elements to resist most efficiently the various combinations of lateral loads and gravity loads. The structural considerations strongly influence the selection of structural form. The ability of the structural system and material to deform and absorb energy without collapse or fracture is termed as ductility. All these structural forms resist force in three basic ways: bending or flexure, shear and axial tension or compression. The selection of structural forms is strongly influenced by the

following range of factors that has to be taken into account:

1. The internal planning
2. The material and the method of construction
3. The nature and magnitude of the horizontal loading
4. The external architectural treatment
5. The height and proportions of the building and
6. The planned location and routing of the service systems

II. RELATED WORK

Shear walls:

Shear walls are vertical elements of the horizontal force resisting system. Shear walls are constructed to counter the effects of lateral load acting on a structure. In residential construction, shear walls are straight external walls that typically form a box which provides all of the lateral support for the building. When shear walls are designed and constructed properly, and they will have the strength and stiffness to resist the horizontal forces.

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. Examples are the reinforced-concrete wall or vertical truss. Lateral forces caused by wind, earthquake, and uneven settlement loads, in addition to the weight of structure and occupants; create powerful twisting (torsion) 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 subjected to lateral wind and seismic forces.

In the last two decades, shear walls became an important part of mid and high-rise residential buildings. As part of an earthquake resistant building design, these walls are placed in building plans reducing lateral displacements under earthquake loads. So shear-wall frame structures are obtained.

Shear wall buildings are usually regular in plan and in elevation. However, in some buildings, lower floors are used for commercial purposes and the buildings are characterized with larger plan dimensions at those floors. In other cases, there are setbacks at higher floor levels. Shear wall buildings are commonly used for residential purposes and can house from 100 to 500 inhabitants per build.

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Vol. 7, Issue 4, April 2018

Purpose Of Constructing Shear Walls

Shear walls are not only designed to resist gravity/ vertical loads (due to its self-weight and other living / moving loads), but they are also designed for lateral loads of earthquakes / wind. The walls are structurally integrated with roofs / floors(diaphragms) and other lateral walls running across at right angles, there by giving the three dimensional stability for the building structures.

Shear wall structural systems are more stable. Because, their supporting area (total cross-sectional area of all shear walls) with reference to total plans area of building, is comparatively more, unlike in the case of RCC framed structures.

III. DESIGN OF SHEAR WALLS

Shear walls construction is an economical method of bracing buildings to limit damage. For good performance of well designed shear walls, the shear wall structures should be designed for greater strength against lateral loads than ductile reinforced concrete frames with similar characteristics; shear walls are inherently less ductile and perhaps the dominant mode of failure is shear. With low design stress limits in shear walls, deflection due to shear walls is small.

However, exceptions to the excellent performances of shear walls occur when the height-to-length ratio becomes great enough to make overturning a problem and when there are excessive openings in shear walls. Also, if the soil beneath its footing is relatively soft, the entire shear wall may rotate, causing localized damage around the wall. Following are the design steps of cantilever shear walls

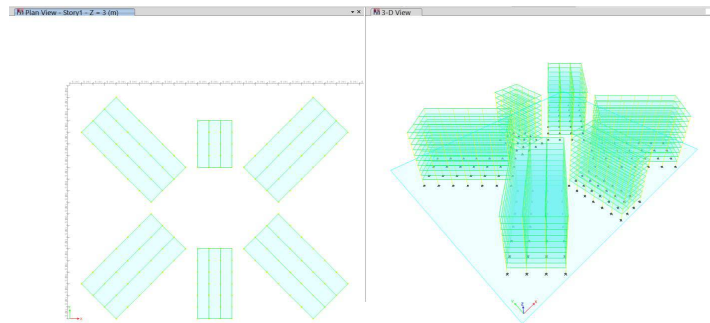
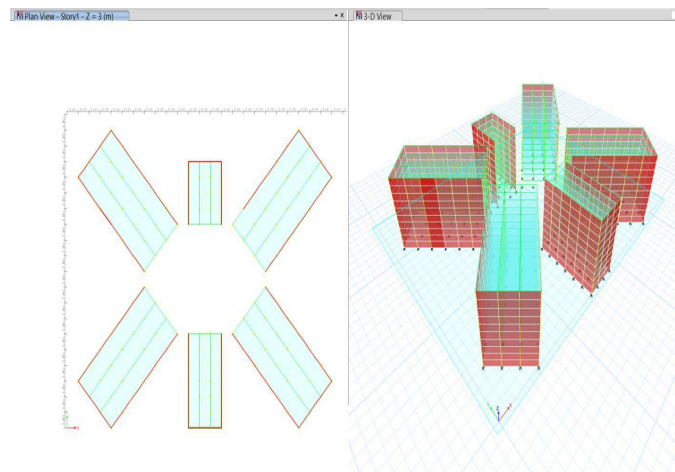


Figure:1. Plan and 3d view of the educational building without shear walls and with shear wall



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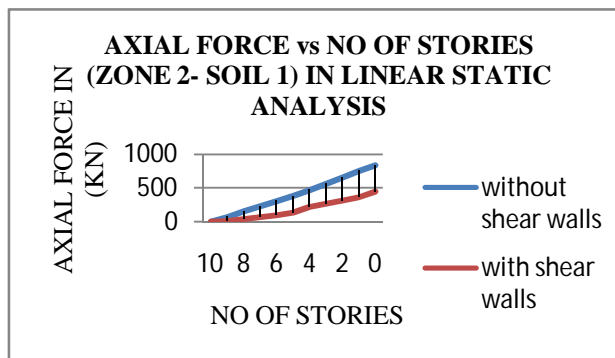
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Vol. 7, Issue 4, April 2018

III.RESULTS

COMPARATIVE VALUES AND GRAPH AXIAL FORCE IN LINEAR STATIC ANALYSIS ALONG ZONE-2, SOIL-1 WITH SHEAR WALLS & WITHOUT SHEAR WALLS

no of stories	without shear walls	with shear walls
10	0	0
9	71.056	12.82
8	148.13	35.19
7	224.8	64.28
6	301.77	96.38
5	378.44	130.73
4	472.37	216.09
3	567.42	263.75
2	660.17	313.58
1	751.58	361.98
0	840.16	447.5



Graph .2: Variation of axial force with shear walls & without shear walls in linear static analysis along Zone-2 soil-1

Comparative values and graph of axial force in Linear static analysis along zone-2, soil-2 with shear walls & without shear walls.

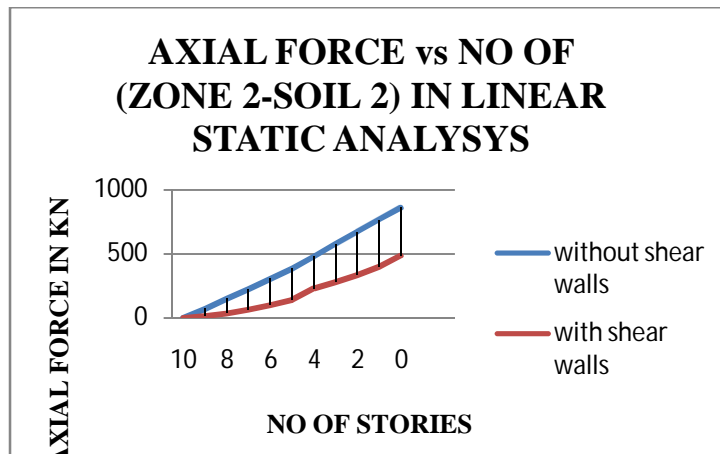
no of stories	without shear walls	with shear walls
10	0	0
9	71.31	12.99
8	148.96	35.94
7	226.51	66.5
6	304.6	100.75
5	382.51	137.84
4	478.52	229.24
3	575.78	281.3
2	670.84	336.06
1	764.85	397.28
0	856.64	483.9

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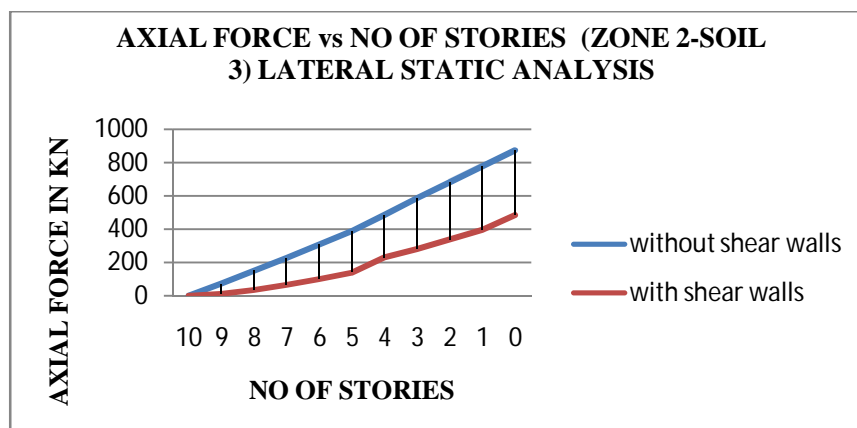
Vol. 7, Issue 4, April 2018



Graph .2: Variation of axial force with shear walls & without shear walls in linear static analysis along Zone-2 soil-2

Comparative values of axial force in Linear static analysis along zone-2, soil-3 with shear walls & without shear walls.

no of stories	without shear walls	with shear walls
10	0	0
9	71.546	12.99
8	149.67	35.94
7	227.99	66.5
6	307.04	100.75
5	386.02	137.84
4	483.82	229.24
3	582.97	281.3
2	680.028	336.06
1	776.28	397.28
0	870.84	483.9



Graph.3: Variation of axial force with shear walls & without shear walls in linear static analysis along Zone-2 soil-3.

International Journal of Innovative Research in Science, Engineering and Technology

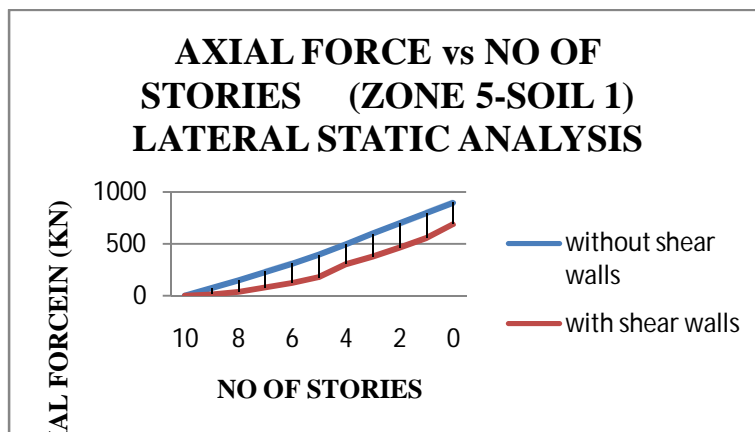
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Visit: www.ijirset.com

Vol. 7, Issue 4, April 2018

Comparative values of axial force in Linear static analysis along zone-5, soil-1 with shear walls & without shear walls.

no of stories	without shear walls	with shear walls
10	0	0
9	71.2	13.95
8	150.81	40.12
7	230.32	78.73
6	310.89	125.14
5	391.57	177.28
4	492.17	302.2
3	594.5	378.63
2	694.54	460.79
1	794.35	554.25
0	893.27	685.79



Graph .4: Variation of axial force with shear walls & without shear wall in linear static analysis along Zone-5 soil-1.

Comparative values of axial force in Linear static analysis along zone-5, soil-2 with shear walls & without shear walls.

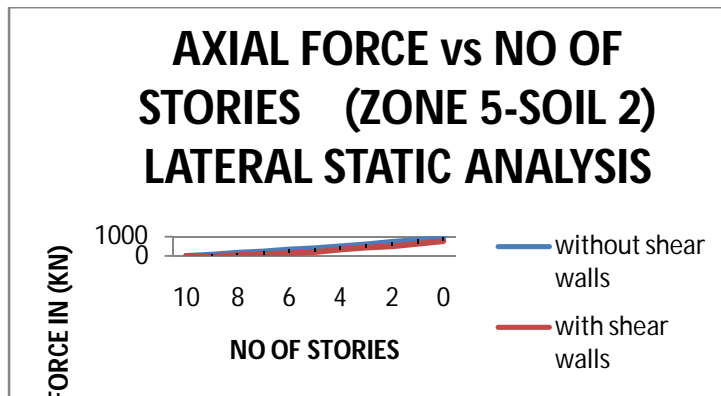
no of stories	without shear walls	with shear walls
10	0	0
9	72.47	14.31
8	152.6	41.72
7	234.017	83.41
6	317.01	134.49
5	400.38	192.4
4	505.486	330.16
3	612.417	415.13
2	717.58	508.6
1	823.015	614.41
0	928.875	763.11

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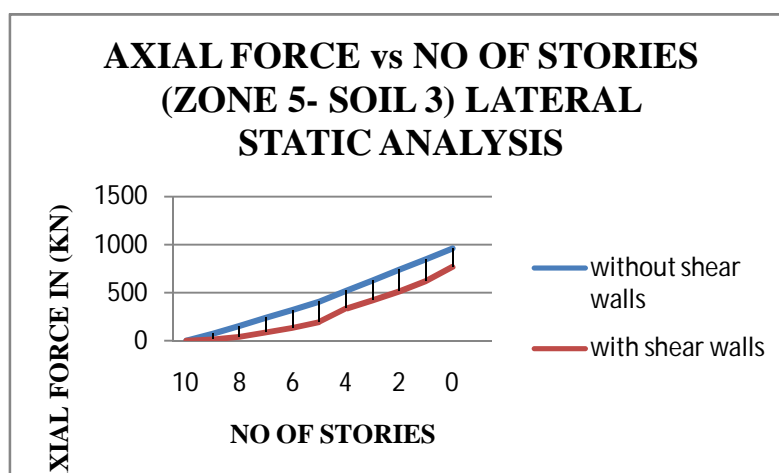
Vol. 7, Issue 4, April 2018



Graph .5: Variation of axial force with shear walls & without shear walls in linear static analysis along Zone-5 soil-2.

Comparative values of axial force in Linear static analysis along zone-5, soil-3 with shear walls & without shear walls.

no of stories	without shear walls	with shear walls
10	0	0
9	72.96	14.32
8	154.15	41.75
7	237.2	83.49
6	322.27	134.64
5	407.96	192.64
4	516.92	330.61
3	627.96	416.54
2	737.425	509.37
1	847.69	615.39
0	959.53	764.41



Graph .6: Variation of axial force with shear walls & without shear walls in linear static analysis along Zone-5 soil-3.

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Vol. 7, Issue 4, April 2018

IV. CONCLUSION

1. The structural performance is analysed in two different models i.e. without shear walls and with shear walls, the axial force of 50% is reduced when lateral system are provided.
2. By providing the shear walls the stiffness of the structure is increased and storey shear is decreased with increase in height of structure
3. Time History analysis is performed for all the models i.e. without shear walls & with shear walls. Base axial force decreased with respect to time for the models

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