International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 06 Issue: 03 | March - 2022 ISSN: 2582-3930

BEHAVIOUR OF MULTI-STOREY BUILDING WITH SHEAR WALL ARRANGEMENTS AT DIFFERENT LOCATIONS

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Abstract - From the past records of the earthquake, the demand of earthquake resisting building has been increased which can be fulfilled by providing the shear wall in the structure. Shear wall is that type of structural system that provides lateral resistance to a structure. Shear walls also have high stiffness and strength which can be used to resist horizontal loads and gravity loads making them quite useful in much structural engineering design. In this paper two G+20 multi storey building is analyzed for Storey drift, storey displacement and base shear with shear walls present at perimeter and corner respectively. For analysis the buildings with seismic loading for zone IV is considered. The analysis is done by using STAAD-pro software. The IS codes used for designing and analysis is IS 1893(part-1):2016 {criteria for earthquake resistance and design of structure} and IS 456:2000 {plain and reinforced concrete}

Key Words**:** Shear wall, STAAD-pro, Storey drift, storey displacement and base shear.

1 INTRODUCTION

SHEAR WALL: It is defined as the vertical structure member which can resist a combinations of the shear, moment and axial load induced by the gravitational load and lateral load transfer to wall from other structural members.

1.1 Forces acting on a shear wall:-

There two types of forces acting on a shear wall that it tries to resist are namely shear forces and uplift forces. Shear forces are generally generated in the buildings by acceleration resulting from the ground moment or by the external forces (wind, waves etc). Uplift forces exist in the shear wall because of the horizontal forces that are applies at the top of the structure. These forces try to lift the one end of the wall and push the other end down.

1.2 Functions of shear wall:

i) Shear wall provides lateral strength to resist the horizontal earthquake forces.

ii) It also provides lateral stiffness to the floor or roof from the excessive side sway.

iii) If the shear wall are stiff enough, then the can also prevent the roof and floors framing members from moving away from their supports.

1.3 Problem Statement:

Now a day the high rise buildings are mostly provided with the soft storeys which are mainly for parking purposes. If these buildings are in the earthquake prone area then they may be subjected to the heavy lateral forces and when soft storey is present in such building the lateral load resisting capacity of the structure decreases thereby decreasing the lateral stiffness of the building This leads to the sudden failure of the building/structure. To increase the stiffness and lateral strength of the structure shear wall is provided so that the buildings can sustain the seismic loads

2 LITERATURE REVIEW

2.1 **Anshuman. S, D. Bhunia, B. Ramjiyani, International Journal Of Civil And Structural Engineering ISSN, 2011**: In this paper, the main aim was to find the best solutions for the different shear wall locations based on its both elasto-plastic and elastic behaviour in a multi storeyed building. The seismic loads were evaluated and the building was design for the zone IV. The analysis was done by using SAP and STAAD pro software packages. After the analysis we can say that shear wall location should be in the shorter direction of a building, as the building has more length compared to width.

2.2 **Er. R. Kumar, Er. S. Singh Sidhu, International Journal of Engineering Technology, Management and Applied Sciences; ISSN July 2014, pp.28-38:** The study of average displacement, storey drift, Member forces were analysed by Seismic coefficient method using STAAD pro software was carried out in the paper.

Two reinforced concrete framed regular buildings (that is seismic-zone v) were considered with different locations of the shear wall. Ten and fifteen storey buildings were considered with shear wall locations at core perimeter and internal frame were taken into consideration. The study concludes that the storey drift is at minimum were shear wall is provided at the internal frame of the building.

2.3 **P. P. Chandurkar, Dr. P. S. Pajgade, (IJMER) May - June 2013:** In this paper the the perimeters like Storey drift, Lateral displacement, and the total cost of the ground floor when the column was replaced with the shear wall were taken into consideration. For the study a ten storey buildings was framed and analysed by ETAB software. The buildings were evaluated in the four zones and comparison was done for lateral displacement, storey drift concrete percentage required, total cost etc. From analysis, it is concluded that in 10 story building, provision of shear wall in short span at corner is economical as compared to other building model

2.4 **V. R. Harne,International Journal of Civil Engineering Research, Number 4 (2014)**: In this paper a G+15 RCC buildings was framed which was located in Zone II and earthquake load were applied. The Earthquake load was analysed by seismic coefficient method and the analysis was done by using the STAAD pro software. In this the different shape of shear wall (box and L-Shaped) were applied at different locations i.e at periphery corner and at middle positions. The evaluations of performance of the building was done in term of lateral force, storey drift etc at different storey level. . It was concluded that, Hence, building with shear wall at the periphery is more efficient than all other positions of shear wall in a building.

3 OBJECTIVE:

To design a G+20 Reinforced concrete building frame using STAAD software and then to analyze the effect of shear walls on the structure when provide at two different locations i.e at perimeter and at corner. The parameters on which the analyzing is done are storey drift, storey displacement and base shear.

4 METHODOLOGY

In the present study the behavior of multi-storeyed frame structure under seismic loads have been analyzed for various location of shear walls .ie at perimeter and at corners. An analysis of multi-storeyed frame of G+20 stories has been carried out for displacement storey drift and base shear. The buildings were assumed to be residential building and located in seismic zone IV. The shear walls were provided at different locations of the multi storey structure i.e at corners and perimeter. The analysis of the building has been carried out by static method or equivalent lateral force method approach using STAAD pro V8i SELECT series 4. The size of the building plan is (16*16) m. Height of each storey is 3 m. The Size of column and the size of beam is (500*500) mm and (450*450) mm respectively. Shear wall thickness is 260 mm. Concrete mixes used is M25 and steel is Fe415The different MODELS of buildings are given below:-

1. G+20 Building with shear wall
   1.1. CASE 1: When shear wall is at perimeter.
   1.2 CASE 2: When shear wall is at corner

Table1: Structural property of the building

Type of Building	Residential
Length of the building	16 m
Width of the building	16 m
Height of the building	63 m
Height of each storey	3 m
Number of storey	G+20
Beam size	(450*450)mm
Column size	(500*500)mm
Surface thickness	260mm
Concrete grade	M25
Steel reinforcement	Fe415
Zone	IV
Soil type	Hard
Damping Ratio	5%
Concrete cover	30 mm
Storey drift	0.004
Dead load	25 KN/m^2
Live load	3 KN/m^2
Support Condition	Fixed

1. A G+20 structure without any shear wall:-

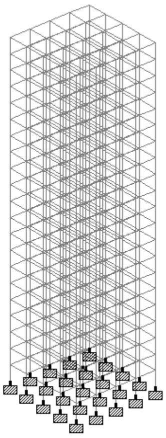


Fig a: Structure without shear wall

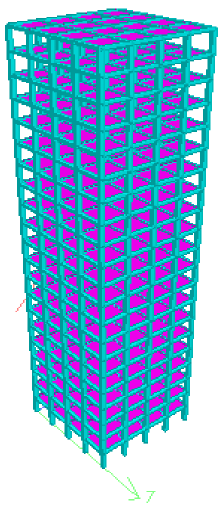


Fig b:3D rendered view

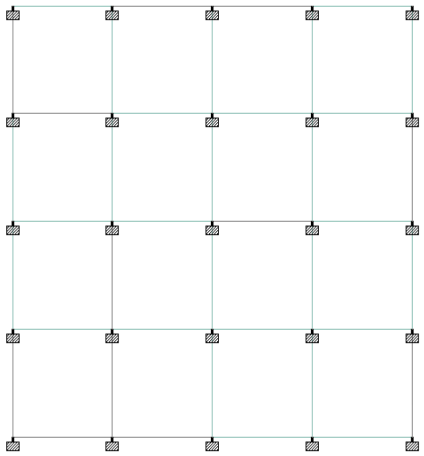


Fig c: base plan view

1.1 When shear wall is at Perimeter

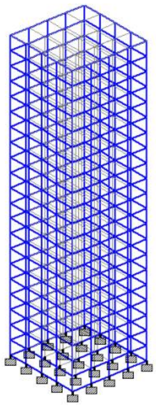


Fig 1.1 a: Structure when shear wall at perimeter

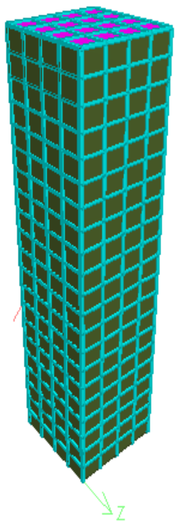


Fig 1.1 b: 3D rendered view

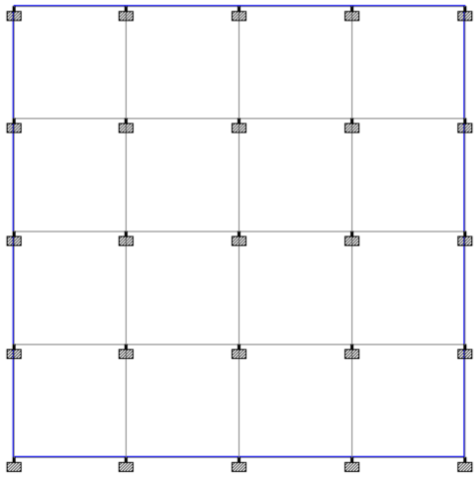


Fig 1.1 c: base plan view

1.2 When shear wall is at corner

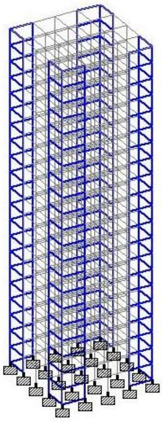


Fig 1.2 a: Structure when shear wall at corner

Fig 1.2 b: 3D rendered view

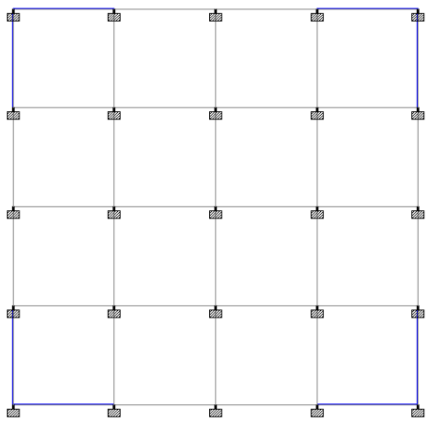
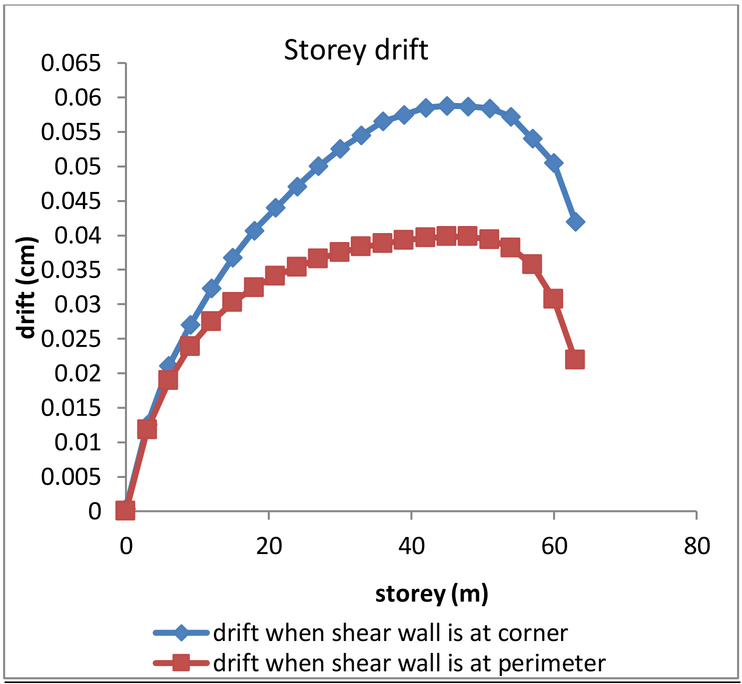


Fig 1.2 c: base plan view

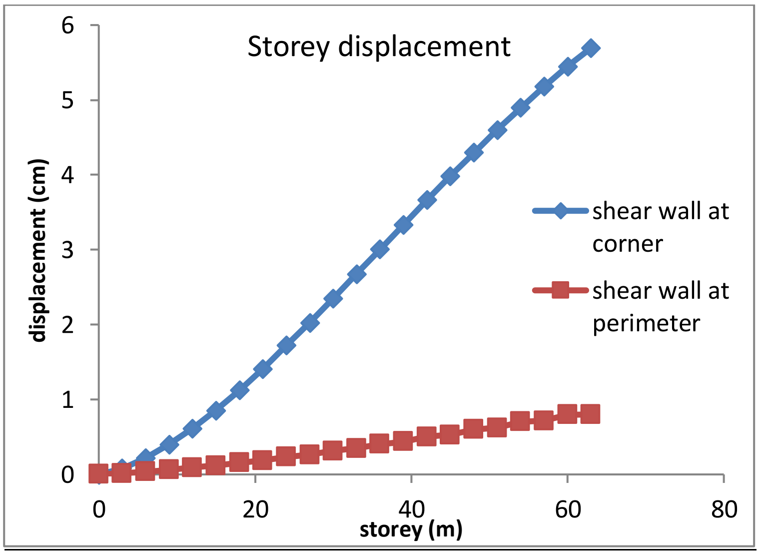
5. Result

Result obtain from the analysis are recorded in tabular form for the different locations of the shear wall i.e at perimeter and at corner.And for the three different parameters the graphs are plotted:

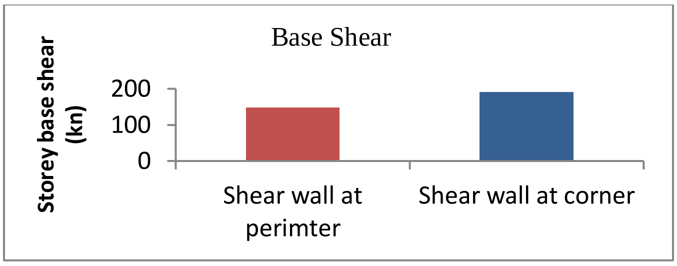
1. Storey drift: Storey drift is the lateral displacement of a floor relative to the floor below, and the storey drift ratio is the storey drift divided by the storey height. The storey drift in any storey with partial load factor of 1.0 shall not exceed 0.004 times the storey height.



2. Storey displacement: Lateral displacement due to earthquake force of a floor relative to floor below. The lateral force-resisting system can limit the excessive lateral displacement of the building.



3 Base Shear: Due to earthquake, ground motion starts. Due to movement of ground, lateral force is developed in opposite direction of motion. That developed lateral force due to seismic activity at the base of the structure is called base shear.



6. CONCLUSIONS

In this project our main aim was to compare the effects of shear wall when applied to a structure at two different locations and the parameter for the compraision was Storey drift, Storey displacement and base shear.
Taking Case I: as When shear wall is applied at corner and Case II: as When shear wall is applied at perimrter, the following conclusions can be drawn:

1. Among all the load combinations, the load combination of 1.5DL+1.5LL is critical combination for both the models.
2. From the graph we can say that the storey drift is minimum when the shear wall is applied at the perimter as compared to when shear wall is applied at the corner.But the difference between the drifts is not much large.
3. The maximum drift on the structure for case I is 0.0584 cm while the maximum drift Case II is 0.0394 cm.
4. The percentile difference between these two drifts is about 32.52%.
5. From the above graph we can also say that the displacement of the structure is maximum when the shear wall is applied at the corners only as compared to shear wall applied at perimter of the structure.
6. The maximum displacement for case II is 5.69 cm while The maximum displacement for case I is 0.8015 cm only.
7. The base shear for case I is 163.952KN and for case II is 120.576KN.

Provison of shear wall at perimeter reults in the reduction of drift,displacement and base shear which means the storey drift, storey displacement and base shear will be minimum of the shear wall is applied at the whole perimeter rather that at corners only.

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