EFFECT OF SHEAR WALL CONFIGURATION ON SIESMIC BEHAVIOR OF A TYPICAL RC TALL BUILDING

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Abstract

Application of shear wall are most appropriate structural form that is designed to resist shear i.e, the lateral force causes the severe damage on the structural elements during earthquakes. The aim of this work is to study the structural behavior of an RC Building with G+19 stories are to be considered for lateral forces using different shear wall configuration. Non-linear analysis was done in the CYPE-CAD to check the lateral force resistant behavior of structural system. This analytical investigation on RC shear wall systems for lateral load resisting is compared with ordinary RC structures. By providing shear wall the lateral forces are resisted by the structural system which have increased stiffness, deformability and decreases drift. The analytical investigation of the ordinary RC structures and shear wall systems has been done using the parameters – storey displacement, storey drift, and base shear. Also, the forces on the columns has been studied.

Keywords: *Shear wall configuration, displacement, drifts, shear force, Bending moments, etc.*

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1. INTRODUCTION

Earthquakes are natural hazards under which disasters are mainly caused by damage to or collapse of buildings and other man-made structures. So,it is very necessary to keep in mind the hazards due to seismic effects and should adopt the necessary assumption before design. Because the structures are vulnerable to severe damages due to earthquake.

A Tall building are the demand of present situation. As the height of structureincreases, lateral forces due to seismic becomes predominant. The major portion of these shall be resisted by the structural elements. Shear wall system are one of the most commonly used lateral load resisting in high rise building.

Most of the previous investigators have analysed frame-wall system by adopting 2D model for analysis. As the structure chosen was symmetrical and often not very tall, however, 2D analysis cannot adequately take into account the torsional affects and asymmetric effect induced due lateral force.

2. LITERATURE REVIEW

Shahzad Jamil Sardar (2013) [1]: Explains that shear wall is a structural element used to resist horizontal forces parallel to the plane of the wall. Shear wall has highly in plane stiffness and strength which can be used to simultaneously resist large horizontal loads and support gravity loads. Shear Walls are specially designed structural walls include in the buildings to resist horizontal forces that are induces in the plane of the wall due to wind, earthquake and other forces.

Karthick S (2016) [2]: Explains the analysis of RC building for seismic analysis using different type of structural systems. Shear walls and bracing systems are the most appropriate structural forms in the recent decades. A shear wall is a wall that is designed to resist shear i.e. the lateral force that causes bulk damage to the structures during earthquakes. Bracing is also a highly efficient and economical method of resisting horizontal forces in a frame structures.

Shivanand C. Ghule et al (2015) [3]: Explains the Failure of reinforced concrete structures during the past earthquakes has taught us the importance of evaluation of the seismic capacity of the existing buildings. Presence of irregularities is considered as a major deficiency in the seismic behaviour of structures. Introduction of bracings and stiff shear walls are the popular methods of strengthening the buildings against their poor seismic performance.

Raghavendra et al (2016) [5]: The this study author made an attempt to understand the effect of earthquake on building frames resting on sloping ground with shear walls and bracings under severe zone. The computation models of ordinary moment resisting frame was developed in SAP2000 as 3D space frame to carry the seismic analysis as per IS 1893 Part (I) -2002. This study may help to understand the effect of buildings on sloping ground under seismic forces to suggest the efficient lateral force resisting configuration based on parametric study.

3. OBJECTIVES

(i) To investigate the behaviour of RC Tall Building with different structural configuration in Zone-V.
(ii) To studythe parameters such as displacement, drift, base shear of structural configuration with bare frame.

(iii) To study the column forces of the structural configurations.
(iv) Ranking of configuration investigated.

4. MODELLING

The analysis of all the structural configurations and bare frame for the (G+19 storeys) have been analysed for lateral loads. CYPE-CAD has been used for the modelling and to carry out the analysis. The analysis results are obtained for seismic zone V.

4.1 Model Data

Table 4.1: Details of building model

Building Description	Details
Plan dimension	42mx20m
Story height	3m
Size of beams	250x600mm
Size of corner columns	600x600mm
Size of column	350x1200mm
Thickness of slab	150mm
Thickness of shear wall	200mm
Density of reinforced concrete	25kN/m^3
Density of brick	20kN/m^3
Dead load	1.5kN/m^2
Live load	4kN/m^2
Seismic zone factor	V
Importance factor (I)	1
Response reduction factor (R)	5
Type of soil	Type – 2
Grade of Concrete for slabs and beams	M25
Grade of Concrete for columns and shear wall	M40
Grade of Steel	415

4.2 Structural Configurations of the Tall Building

1. Bare Frame
2. Internal shear wall (ISW)
3. External shear wall (ESW)
4. Lift core wall (LCW)
5. Parallel shear wall (PSW)
6. Centre shear wall (CSW)
7. Corner side shear wall (2CSW)
8. Combination of centre and corner shear wall (CSW & ESW)

4.3 Typical Plan

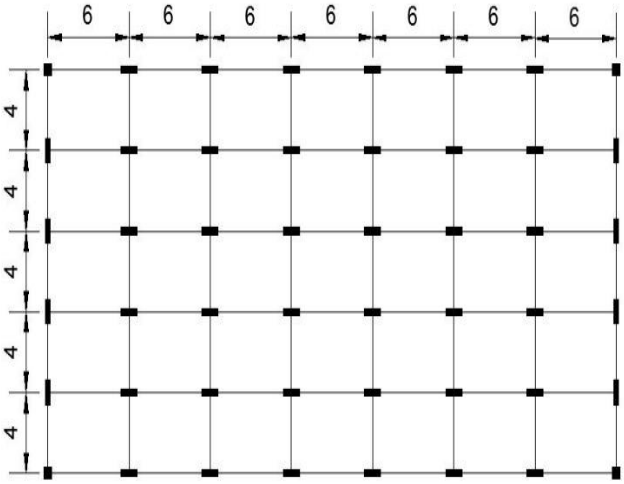

Fig 4.1: Typical layout plan of building

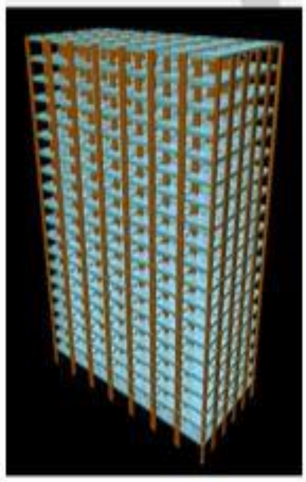

Fig.4.2 Bare frame

Fig. 4.3 ISW

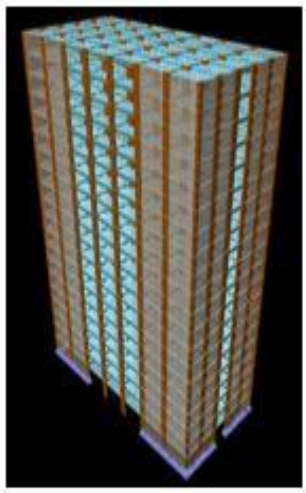

Fig. 4.4 ESW

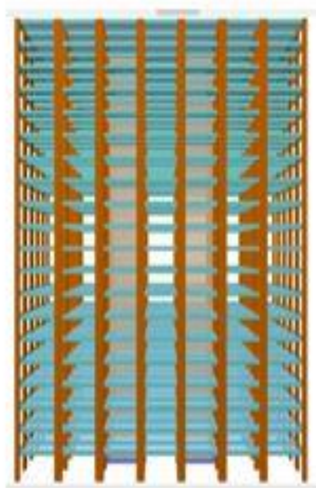

Fig. 4.5 LCW

Fig. 4.6 PSW

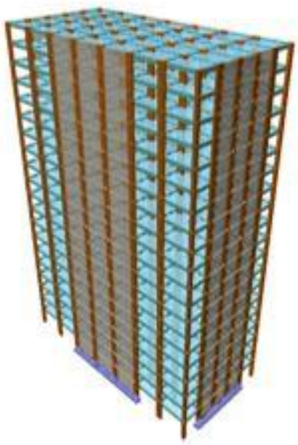

Fig. 4.7 CSW

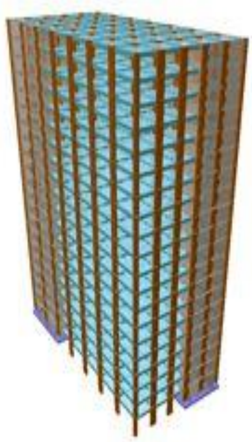

Fig. 4.8 2CSW

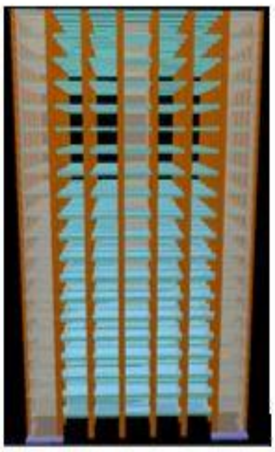

Fig. 4.9 Comb. CSW&ESW

5. RESULTS AND DISCUSSIONS

Storey displacement, storey drifts, base shear, Shear force and Bending moments are taken from the software. The comparison between Bare frame and other shear wall structural configurations for the parameters mentioned above presented in tables and figures below.

5.1 Maximum Storey Displacements

The table and Fig below shows the maximum displacement values for the different Structural Configuration.

Table 5.1 Maximum displacement in X and Y direction

Shear wall System		
CONFIGURATION SYSTEM	**LATERAL DISPLACEMENT (mm)**	
	UX	**UY**
Bare Frame	98.47	126.54
ISW	37.68	66.88
ESW	19.18	29.13
LCW	49.31	77.29
PSW	65.08	101.04
CSW	19.93	41.15
2CSW	16.88	29.65
COMB CSW & ESW	38.84	56.32

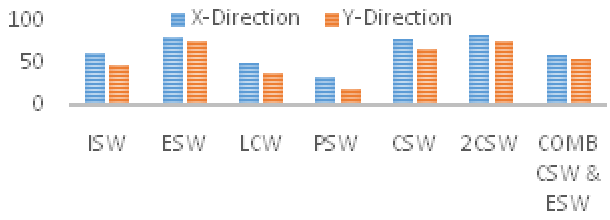

Fig. 5.1 Percentage reduction of lateral displacement

From table 5.1 and Fig.5.1 it can be observed that the lateral displacements along X and Y directions are reduced effectively in all the shear wall configurations. For ESW, CSW and 2CSW lateral displacement has been reduced by around 81%, 80% and 82% respectively in comparison with Bare frame.

5.2 Maximum Storey Drifts

The table and Fig below shows the maximum drift ratios for the different models.

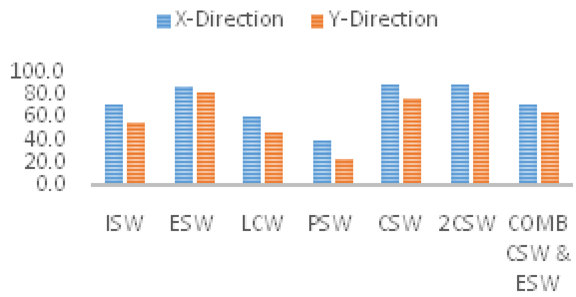

Fig. 5.2 Percentage reduction of Storey drift

From Fig.5.2 it can be observed that the driftsare reduced in all the configurations in the range 50% to 89% along X and Y directions except PSW which reduced by around 38%.

5.3 Base Shear

The table and Fig below shows the base shear values for the different models.

Table 5.3 Base shear

Confg. System	Base shear(KN)
Bare Frame	12329
ISW	12776
ESW	12968
LCW	12296
PSW	12498

CSW	12217
2CSW	12240
COMB CSW & ESW	12261

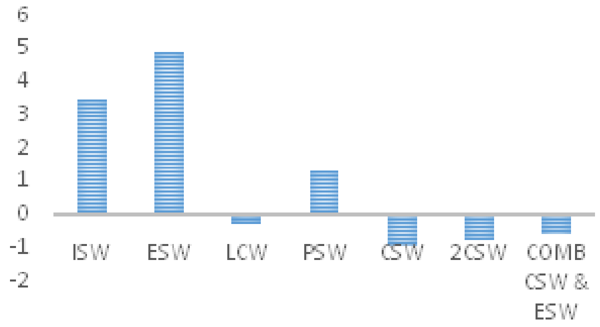

Fig. 5.3 Percentage increase in Base shear

From table 5.3 and Fig.5.3 it can be observed that ISW, ESW and PSW increased its base shear by 3.5%, 5% and 1.2% respectively. While other configurations are reduced in the range 0.5% to 1 % when compared to bare frame.

5.4 Column Forces

The table and Fig below shows the column forces of interior and the column near the re-entrant corner for the irregular models.

Table 5.5: Shear Forces in Selected columns

Shear Force in kN								
COLUMN	**BARE**	**ISW**	**ESW**	**LCW**	**PSW**	**CSW**	**2CSW**	**COMB CSW & ESW**
C1	**103**	**71**	**217**	**135**	**191**	**121**	**305**	**334**
C2	**509**	**176**	**498**	**205**	**457**	**222**	**461**	**609**
C4	**517**	**181**	**228**	**219**	**464**	**595**	**200**	**177**
C31	**497**	**131**	**98**	**698**	**485**	**100**	**288**	**338**
C38	**498**	**117**	**104**	**889**	**484**	**96**	**207**	**422**

Table 5.6: Bending Moment in selected columns

Shear Force in kN(For Bracing System)								
COLUMN	**BARE**	**DBS**	**XBS**	**EBS**	**IVBS**	**KBS**	**VBS**	**COMB DBS &XBS**
C1	**103**	**91**	**82**	**72**	**92**	**91**	**93**	**87**
C2	**509**	**517**	**528**	**527**	**518**	**214**	**522**	**528**
C4	**517**	**532**	**541**	**531**	**533**	**534**	**319**	**535**
C31	**497**	**504**	**510**	**503**	**504**	**506**	**504**	**509**
C38	**498**	**505**	**509**	**502**	**504**	**506**	**504**	**510**

From table 5.5 and table 5.6 it can be observed that shear wall configuration system, the PSW system reduced the BM in the exterior column around 96% (C2 & C4) & about 99% in the interior column (C31 & C38) compared with BF system. The remaining all other shear wall systems reduced the bending moments in both exterior and interior column about 93%. the ISW system reduced the SF in the exterior column around 65% (C2 & C4) & about 76% in the interior column (C31 & C38) compared with BF system.

6. CONCLUSION

1. All the shear wall configuration has given positive effect on the building in all the parameters.
2. In this study ESW, CSW and 2CSW lateral displacement has been reduced by around 81%, 80% and 82% respectively in comparison with Bare frame.
3. The displacement of all the Structural configurations are within the maximum limit prescribed by IS 1893-2002
4. The shear configuration gave a positive result in controlling the storey drifts effectively in the range of 50% to 89% except in the case of PSW where it reduces only 38% when compared to Bare frame.
5. The drift ratios of all the models are found to satisfy the limit prescribed by IS 1893-2002.
6. In this study ISW, ESW and PSW increased its base shear by 3.5%, 5% and 1.2% respectively. While other configurations are reduced in the range 0.5% to 1 % when compared to bare frame
7. Provision of shear wall has improved in reducing the bending moment and shear force effect on the structure by an average of 98% and 86% respectively.

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BIOGRAPHIES

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