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Seismic Analysis of Regular Tall Buildings with Shear Walls and without Shear Walls at Different Locations

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Abstract: ***In the previous amount of research was conducted and an attempt has been made to analyse the structure behavior and compare the results of buildings with shear wall and without shear wall. So we thought to use staadpro V8i to analysis the regular tall building with shear walls at different locations. It is relevant that tall buildings are increasing day by day hence it is the study necessary for development of architectural point of view. To make the structure economical and efficient by locating shear wall and see what the effects on structure are? Very little work is found related to regular tall building three buildings with same plan and different storey's with two configurations. The storey's of lateral displacement are obtained and compared to Each other for different models to meet the shear wall effect in four different zones as per Code IS 1893-part1 2002.The Study Involves The Orientation Of Shear Wall. The Buildings Are Modeled With Floor Area Of 20mx30m. With 4 Bays Along 20 Span And 6Bays Along 30m And Each Bay Width Of 5m .The Lateral Displacement Of The Structure Is Compared In with shear wall and without shear wall And The Lateral Displacement Values Of Current Floor Level To Another Floor Level Should Reach Storey Drift .The Design Loads Values Are Calculated From The Standard Is Codes Of IS 456-2000, IS 1893- IN 2000.The Analysis Is Done In Staadprov8i.***

I. INTRODUCTION

A large portion of India is in danger to damaging levels of seismic hazards. Hence, it is necessary to take into account the seismic load for the design of high-rise structure. In present study, the earthquake analysis of G+5, G+10 storied building was done by Seismic coefficient method. The main parameters considered in this study to compare the seismic performance of different Zones i.e. II, III, IV, and V are lateral displacement. The building frame is modelled with a dimensions of 20mx30m having columns & beams with a slab panel of 5m x 5m the model is made using STAAD.PRO Software. In case of building with shear wall the building frame is modelled as above dimensions only with alternate shear wall using 4 node plate proposed thickness of 150 mm along the height of the structure. The new zone map places this area in zone III. The new zone map will now have only four seismic zones – II, III, IV and V. The areas falling in seismic zone I in the current map are merged with those of seismic zone II. Also, the seismic zone map in the peninsular region is being modified. Madras will come under seismic zone III as against zone II currently. The national Seismic Zone Map presents a large scale view of the seismic zones in the country. Local variations in soil type and geology cannot be represented at that scale. Therefore, for important projects, such as a major dam or a nuclear power plant, the seismic hazard is evaluated specifically for that site. Also, for the purposes of urban planning, metropolitan areas are micro zoned. Seismic micro zonation accounts for local variations in geology, local soil profile, etc.

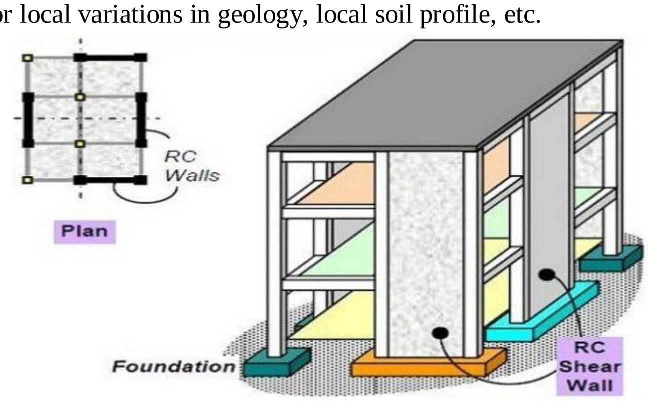

Fig 1 Typical example of Shear Wall

A. Definitions

1) *Storey*: when the multi-story building or the residential building is constructed in that when the floor to floor gap will be there that is the story
2) *Soft storey*: A soft storey is one in which the lateral stiffness is less than 70 percent of that in the storey above or less than 80 percent of average lateral stiffness of the three storey above. The stiffness is less as compared to the above storey due to no in fills at that storey level.

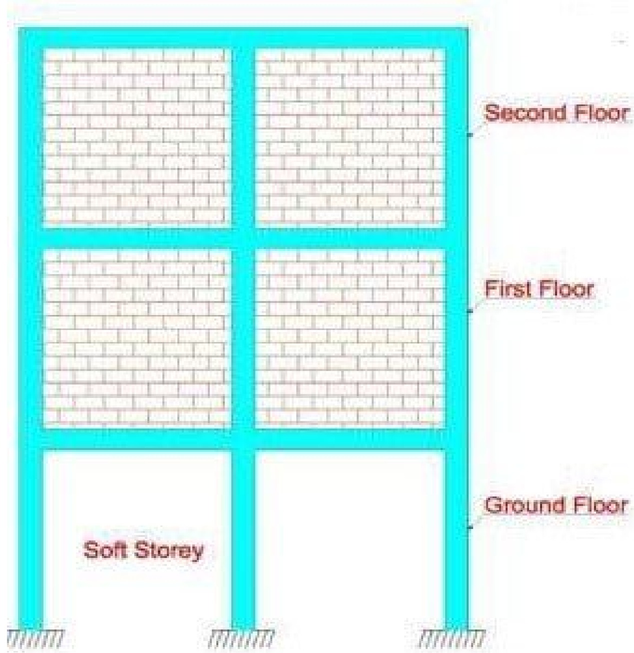

Fig 2 soft storey

3) *Story Drift*: is defined as the difference in lateral deflection between two adjacent stories. During an earthquake, large lateral forces can be imposed on structures; Lateral deflection and drift have three primary effects on a structure; the movement can affect the structural elements (such as beams and columns); the movements can affect non-structural elements (such as the windows and cladding); and the movements can affect adjacent structures. Without proper consideration during the design process, large deflections and drifts can have adverse effects on structural elements, nonstructural elements, and adjacent structure

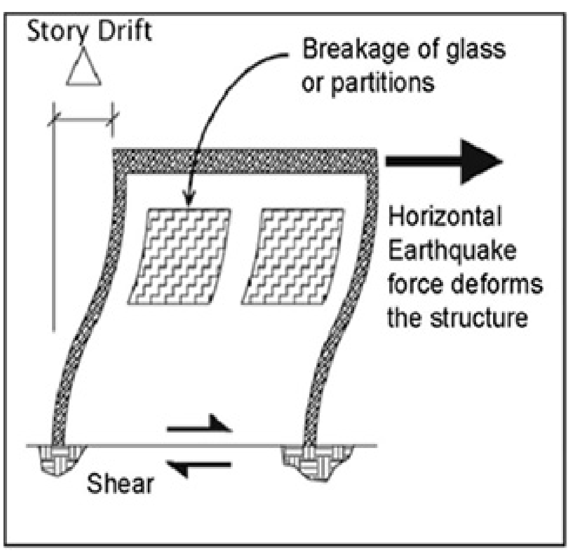

Fig.4 Storey Drifts

4) *Base shear*: Is an estimate of the maximum expected lateral force that will occur due to seismic ground motion at the base of a structure

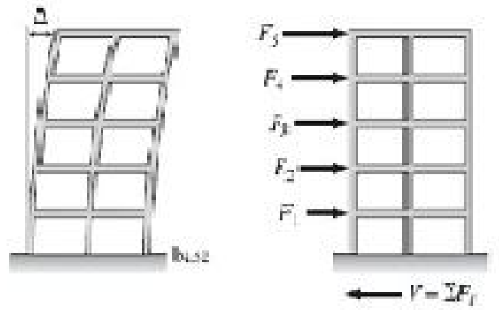

Fig 3 Base Shear

B. Objectives

1) To analyse a model for earthquake resisting structure.
2) The model structure is located in Zone-II, , Zone-IV.
3) To calculate the Lateral Displacement, on buildings using equivalent static method. By using STAAD pro.
4) And make a comparative analysis between with shear wall and without shear wall Structure in Seismic Coefficient method.
5) Comparison between G+5, G+10.
6) To identify the storey drift where there is exceeds its permissible values of storey drifts i.e.0.004h.
7) To promote safety without too much changing the constructional practice of reinforced concrete structures.

II. METHODOLOGY AND MATERIALS USED

The (without shear wall & with shear wall) structures of G+5, G+10, storied building is shown in Fig 1. The seismic analysis of building is done by Seismic Coefficient with given above procedures for Zone II, III , IV& V. The obtained results of all structures are compared with each other. As per IS 1893 (part1)-2002, Seismic Coefficient analysis Procedure is summarized in following steps a) Design Seismic Base Shear:- The total design lateral force or design seismic base shear (VB) along any principal direction of the building shall be determined by the following expression VB= Ah W Where Ah = Design horizontal seismic coefficient W = Seismic weight of the building. b) Seismic Weight of Building: - The seismic weight of each floor is its full dead load plus appropriate amount of imposed load as specified. While computing the seismic weight of each floor, the weight of columns and walls in any storey shall be equally distributed to the floors above and below the storey. The seismic weight of the whole building is the sum of the seismic weights of all the floors. Any weight supported in between the storey shall be distributed to the floors above and below in inverse proportion to its distance from the floors. c) Fundamental Natural Time Period-: The fundamental natural time period (Ta) calculates from the brick filling, then the fundamental natural period of vibration, may be taken as Ta = . / √ d) Distribution of Design Force: - The design base shear, VB computed above shall be distributed along the height of the building as per the following expression i =VB ² ∑ ² The total base shear and lateral force is calculation by STAAD Pro

A. Analytical Modeling – STAAD PRO V8i.

The STAAD PRO software is used in the present investigation to develop RC frame Model and to carry out the analysis. To resist the lateral displacement of the structure in different locations. Linear dynamic analysis of the building Models is performed on STAAD PRO. For the Modeling of the G+5,G+10, storey RC building with shear walls , were consider line element was used for beams(230mmx300mm)andcolumns(450mmx450mm)without shear wallandwithshear wall (550mmx550mm)concrete element for slabs in the present investigation, Brick materials are used for masonry infill as internal walls(115mm) and external walls(230mm). The base of structure was fully fixed by constraining all the degrees of freedom. An RC building code comparison of Indian and American codes on medium soil was analyzed and the displacement, storey drifts, and base shear, the mode shapes around the structure due to different load combinations were obtained. Linear dynamic analysis was performed using response spectrum method

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B. Building description

The Modeling of the G+5,G+10 storey with shear frame, and without shear frame with slab element, full wall element structure, first soft storey

Model 1: ordinary moment resisting frame(without shearwall)

Model 2: special moment resisting frame.(Shear wall)

Model 3: comparison of model 1 and model 2 in zone II and Zone IV.

C. Analyzing the data

Linear dynamic analysis has been performed as per IS 1893 (Part 1): 2002 for each model using ETABS analysis package. Lateral load calculation and its distribution along the height are done.

Table 1 Data Relation To The Rc Frame Building Models

Type of frame	Ordinary moment resisting RC frame OMRF) fixed at the base
Seismic zones	II,IV
Number of storey	G+5,G+10,storey
Floor height	3 m
Depth of Slab	150 mm
Size of beam	(400 × 300) mm
Size of column	(550 × 550) mm
Spacing between frames in x-direction	5m
Spacing between frames in y-direction	5 m
Materials	M 25 concrete, Fe 415 steel and
Infill	Masonry
Thickness of external infill walls	230 mm
Thickness of external infill walls	115 mm
Density of concrete	25KN/m^3
Density of infill	20 KN/m^3
Type of soil	Medium soil
Seismic zone	As per IS (1893-2002)
Seismic zone factor, Z	For zone II: 0.10, IV: 0.24
Importance Factor, I	1
Response spectrum analysis	Linear dynamic analysis
Plinth height above ground level	3 m
Type of the building	OMRF(Ordinary moment resisting RC frame)

D. Materials used

1) *Concrete:* Concrete with following properties is considered for study.
a) Characteristic compressive strength (f_{ck}) = 25 MPa
b) Poisons Ratio = 0.2
c) Density = 24KN/m^3
d) Modulus of Elasticity (E) = 5000 x $\sqrt{f_{ck}}$= 25000 MPa
2) *Steel:* Steel with following properties is considered for study.
a) Yield Stress (f_y) = 415 MPa

b) Modulus of Elasticity (E) = $2x10^5$MPa

3) Masonry infill

a) Clay burnt brick, Class A, confined unreinforced masonry

b) Compressive strength of Brick, f_m= 10 MPa

c) Modulus of Elasticity of masonry (E_i)= 550 x f_m= 5500 MPa

d) Poisons Ratio = 0.15

E. Analyzed Building Models

1) Model 1: ordinary moment resisting frame

2) Model 2: special moment resisting frame.

3) Model 3: Bare frame with slab elements and Infill wall (Soft story)

4) All the models are analyzed with IS codes by the method of Response Spectrum Analysis(RSA

Fig 5 plan of the building

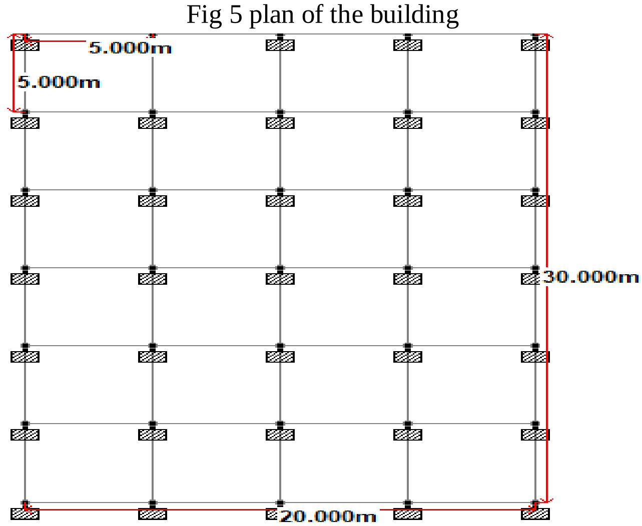

Fig 5 model 1: frame

Fig 5 model 2: bare frame with slab element

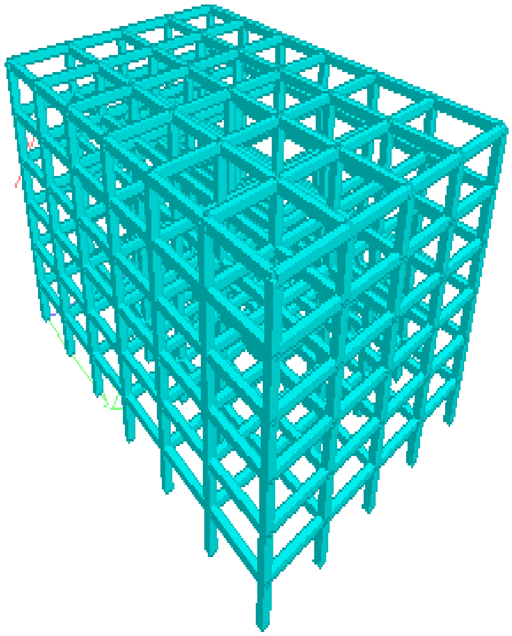

Fig 6 model 3:Frame without shear wall of G+5

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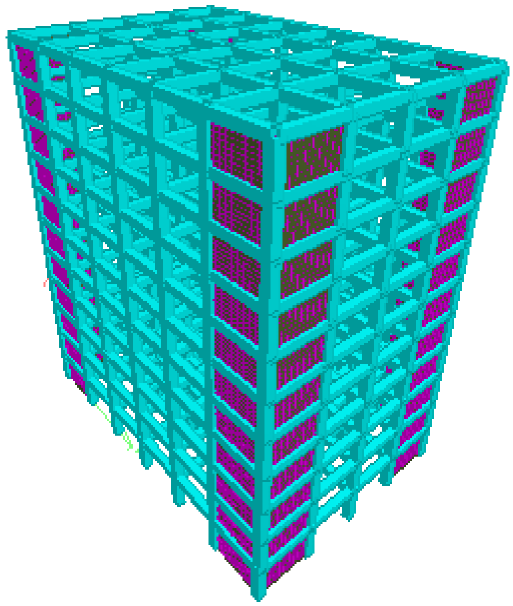

Fig 7 model 3:bare frame with shear wall of G+10

III. RESULTSANDDISCUSSIONS

A) Following are the lateral displacement values of buildings with different storey's (G+5, G+10,) in various seismic zones, buildings having shear wall and without shear wall.

In model 2 displacement IS code is less for G+5 building when compared to model 1 of G+5 building the lateral displacement is less due to shear wall effect.

TABLE 1 LATERAL DISPLACEMENTS FOR IS CODES

MODEL 1 (with shear wall) G+5				
Story	ZONE II	ZONE III	ZONE IV	ZONE V
BASE	0.0477	0.0762	0.0898	0.1198
STORY1	0.1184	0.1772	0.2197	0.2929
STORY2	0.1983	0.364	0.3872	0.4854
STORY3	0.2709	0.4463	0.4931	0.6763
STORY4	0.3457	0.5644	0.6359	0.8479
STORY5	0.4141	0.6626	0.7408	0.9877
STORY6	0.4634	0.7414	0.8144	1.0859

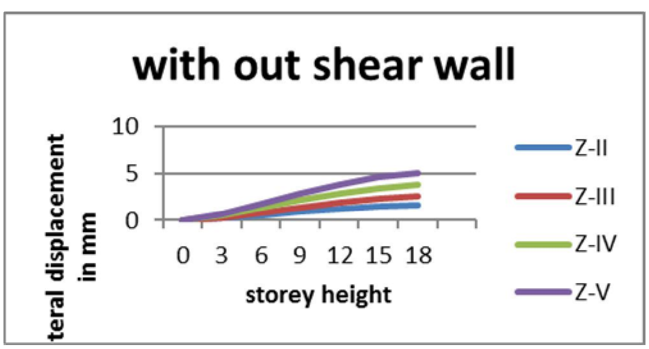

Fig 7

Table 2 Lateral Displacements For Is Codes

MODEL 2 (with out shear wall) G+5				
Story	ZONE II	ZONE III	ZONE IV	ZONE V
BASE	0.0477	0	0.0898	0
STORY1	0.1184	0.32	0.2197	0.65
STORY2	0.1983	0.86	0.3872	1.72
STORY3	0.2709	1.40	0.4931	2.81
STORY4	0.3457	1.89	0.6359	3.79
STORY5	0.4141	2.28	0.7408	4.56
STORY6	0.4634	2.52	0.8144	5.05

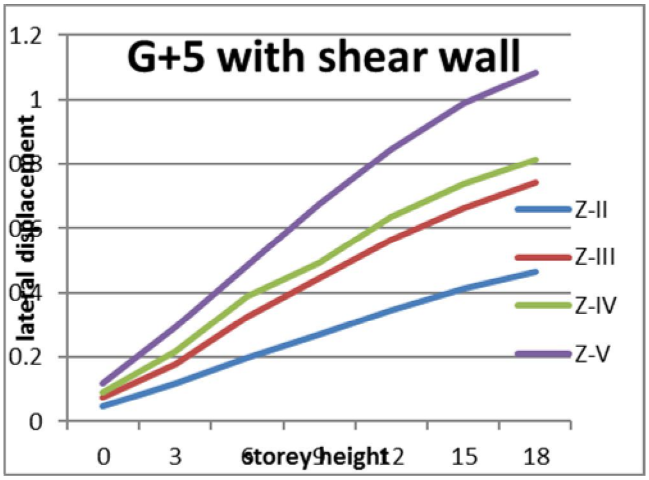

Fig 8

TABLE 3 DISPLACEMENTS FOR IS CODES

MODEL 1 (without shear wall) G+10				
Story	ZONE II	ZONE III	ZONE IV	ZONE V
BASE	0	0	0	0
STORY1	0.07	0.11	0.16	0.22
STORY2	0.23	0.38	0.57	0.76
STORY3	0.46	0.74	1.12	1.49
STORY4	0.73	1.16	1.75	2.33
STORY5	1.0	1.61	2.41	3.22
STORY6	1.28	2.05	3.08	4.10
STORY7	1.54	2.47	3.71	4.85
STORY8	1.79	2.86	4.29	5.73
STORY9	2.0	3.21	4.81	6.42
STORY10	2.19	3.51	5.26	7.02
STORY11	2.35	3.77	5.65	7.54

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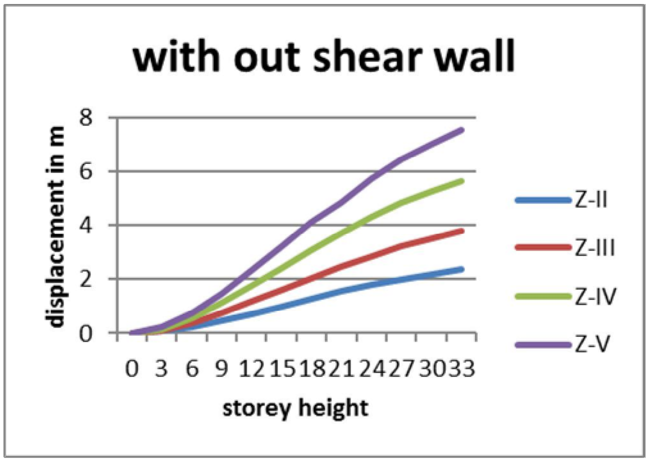

Fig 9

In model 2 displacement IS code is less for G+10 building when compared to model 1 of G+10 building the lateral displacement is less for with shear wall building.

TABLE 4 DISPLACEMENTS FOR IS CODES

MODEL 2 (with shear wall) G+10				
Story	ZONE II	ZONE III	ZONE IV	ZONE V
BASE	0.025	0.04	0.06	0.08
STORY1	0.06	0.10	0.17	0.20
STORY2	0.10	0.17	0.25	0.34
STORY3	0.15	0.25	0.37	0.53
STORY4	0.20	0.33	0.50	0.66
STORY5	0.25	0.42	0.63	0.84
STORY6	0.31	0.50	0.76	1.01
STORY7	0.36	0.59	0.88	1.18
STORY8	0.41	0.67	1.0	1.34
STORY9	0.46	0.74	1.11	1.48
STORY10	0.50	0.80	1.21	1.61
STORY11	0.52	0.83	1.25	1.67

In model 3 we have observe the graph that the lateral displacement is less for shear wall building. displacement values are approximately because of the model 3 bare frame with slab and infill walls so the displacement is compare to other two models. we can see observe the graph base displacement value is more because of no infills base so it is diplace some distance after less displacement

D) Discussions on comparison between G+5 building in zone II, II,III,IVandV with shear wall and withoutshearwall effect and G+10 building in Zone II,III,IVandV with shear wall and without shear wall effect.

IV. CONCLUSION

Zone V:
When coming to G+5 Storey building the variation of Storey drift between with shear wall and without shear wall effect is 0.14%.
Zone V: When coming to G+10 Storey building the variation of Storey drift between with shear wall and without shear wall effect is 0.42%.
Zone IV: When coming to G+5 Storey building the variation of Storey drift between with shear wall and without shear wall effect is 0.10%.
Zone IV: When coming to G+10 Storey building the variation of Storey drift between with shear wall and without shear wall effect is 0.24%.
Zone III: When coming to G+5 Storey building the variation of Storey drift between with shear wall and without shear wall effect is 0.06%.
Zone III: When coming to G+10 Storey building the variation of Storey drift between with shear wall and without shear wall effect is 0.16%.
Zone II: When coming to G+10 Storey building the variation of Storey drift between with shear wall and without shear wall effect is 0.03%.
Zone II: When coming to G+10 Storey building the variation of Storey drift between with shear wall and without shear wall effect is 0.10%.
when compared to Zone II, III, IV and V the lateral displacement is less when compared to with shear wall and without shear wall effect as per IS code methods describing and as per IS 1893-part1-2002 and very According to relative values of all parameters, it can be concluded that provision of infill wall enhances the performance in terms of displacement, Storey drift and lateral stiffness.

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