COMPARATIVE STUDY OF CONVENTIONAL AND RCC SHEAR WALL STRUCTURE BY PUSHOVER ANALYSIS USING ETABS

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Abstract : The objective of this paper is to select an appropriate type of residential building structures for moment resisting frame and rcc shear wall at different positions for different storey. ETABS software will be used to analyze and design the residential building. Buildings needs to withstand dead loads, live loads, seismic loads and wind loads. For evaluating seismic loads nonlinear static method is used with IS: 1893(Part 1)-2002. The shear wall is provided for studying lateral forces. This paper highlights the conventional and rcc shear wall structure by pushover analysis. The comparison has been done for base shear, displacement, drifts, pushover curve and performance point.

***IndexTerms*-Shearwall,Non-linearstaticmethod,ETABS,Baseshear,Displacement,Pushovercurve.**

I. INTRODUCTION

Recently there has been a considerable increase in the tall buildings both residential and commercial and the modern trend is towards more tall and slender structures. Thus the effects of lateral loads like wind loads, earthquake loads and blast forces are attaining increasing importance and almost every designer is faced with the problems of providing adequate strength and stability against lateral loads. This is the new development as the earlier building designers designed the buildings for vertical loads and as an afterthought checked the final design for lateral loads as well. Now the situation is quite different and a clear understanding of effect of the lateral loads on the building and the behaviour of various components under these loads is essential. Structural design of buildings for seismic loading is primarily concerned with structural safety during major earthquakes, but serviceability and the potential for economic loss are also of concern. Seismic loading requires an understanding of the structural behaviour under large inelastic deformations. Behaviour under this loading is fundamentally different from wind or gravity loading, requiring much more detailed analysis to assure acceptable seismic performance beyond the elastic range. Some structural damage can be expected when the building experience design ground motions because almost all building codes allow inelasticity.

II. REVIEW OF LITERATURE

P. Marry Williams and R. K. Tripathi (2016) has presented a study on geometrically symmetrical building structure with asymmetric loading. Its behaviour has been studied with various positions of shear wall. They study the behaviour of RCC frame structures with effect of shear wall location on the linear and nonlinear behaviour of eccentrically loaded buildings with asymmetric distribution of mass in plan, a 24m x 24m grid, G +14 storey RCC bare frame has been used. The shear wall is modelled using shell elements. A total of 40 models, have been analysed. Two sets of models, one with shear wall and one without shear wall has been analysed. Linear and nonlinear static pushover analysis is performed to investigate the behaviour of the building frame. Pushover analysis procedure is followed as per the prescriptions in ATC-40. The hinge properties are applied by default method as per codal provisions in FEMA 356. They concluded that the provision of shear wall improves the lateral stability of the building especially for asymmetrical structures. When shear wall is provided at the core as a box, the displacement, drift and torsion reduces by a larger value. Since provision of a box type shear wall at the core is practically not preferred, providing shear wall on the outer edges is the next best option. Base shear increases when shear wall is provided and it is maximum when shear wall is provided at the core. Reduction in the time period of the structure is due to the presence of shear wall. Buildings with shear wall show more plastic behaviour in the middle stories. As the position of shear wall varies, the only difference is that the beams and columns near the shear wall come into plastic stage first.

N. M. Nikam (2016) carry out the seismic analysis of building with and without shear wall, the building with G +15 and G + 20 stories are considered. These G +15 and G +20 storey buildings are analysed for different location of shear walls using pushover analysis. The provision of shear wall increases the global stiffness of building. Among four different locations as mentioned periphery and corner shear wall proves better in increasing the stiffness of building as it is provided along the peripheral outer side of building and after applying target displacement pushover analysis is carried out and it is found that building with shear wall performs well than bare frame.

Patel Jalpa R. et al. (2016) they have designed two different models in the software a bare frame and frame having shear wall. The material properties and geometrical properties of structural elements were defined in to the software. The orientation of columns was provided and the beam offsets were also given as per the drawings. Typical storey height was taken as 3.0m and base storey height was taken as 3m. The beams were created as per the location in drawing and corresponding properties of beams and columns were assigned. All the slabs were 115mm thick and the slabs were taken as Rigid Floor Diaphragm. For pushover analysis, nonlinear hinges were to be provided to the frame structural elements. All the beams were provided with default moment

(M3) hinge and default shear hinge at both the ends. All the columns were provided with default PMM hinge. The size of beams, columns and the reinforcement provided into the software. Depending upon this data the program will calculate the yield moments and corresponding displacement which is used for nonlinear static analysis. The pushover analysis was carried out effectively to re-strengthens the existing building and from the analysis we conclude following an existing building made without considering shear wall shows its performance in IO-LS in push X i.e. building is called safe against predicted earthquake. Even though an existing building is safe for predicted earthquake, some of the members which yielded extensively need an immediate attention - either retrofit or re-strengthens. An existing building made with considering shear wall shows its performance in IO range in Push X i.e. building is called safe against predicted earthquake. Results and behaviour of existing building observed were nearly same as new building.

III. OBJECTIVE OF PAPER

1. The main objective of this project is to compare the simple frame structure and shear wall structure with different parameters.
2. To determine Displacements, Drifts, Base Shear and Pushover curve at different heights for simple frame structure using Pushover analysis in zone III and zone V.
3. To determine Displacements, Drifts, Base Shear and Pushover curve at different heights for frame with middle and corner positions of shear wall using Pushover analysis in zone III and zone V.
4. To study different parameters like P-delta effect and material non-linearity of the structure.
5. To make the structure economical and safe so that loss of life and property will be reduced.

IV. PROBLEM FORMULATION

In previous study researcher used square grid of 20m in each direction of 5m bay in each direction, software used is ETABS. The work has been carried out for the different cases using shear wall for the different heights and maximum height considered for the present study is considered as 15m to 30m and square grid of 25m in each direction. In present study we will use residential building plan with shear wall on different locations for different height to know the effect on symmetrical plan of building.

Structural Modelling

In present research we have use 2 different model special moment resisting frame and shear wall at different locations for different heights. Software used is ETABS. The study has been carried out for the Zone III as specified in IS: 1893(Part1)-2002.

Model description

Type of building	Residential multi-storey building
Type of soil	medium soil
Plan of building	Symmetrical shape
Each bay size	5m x 5m
Floor to floor height	3m
Heights of building	15m
Shear wall thickness	200 mm
Slab thickness	0.150
Live load	2 kN/m^2
Zone	III
Material	M 30
Damping	5%
Seismic Analysis	Linear and Non-linear static analysis

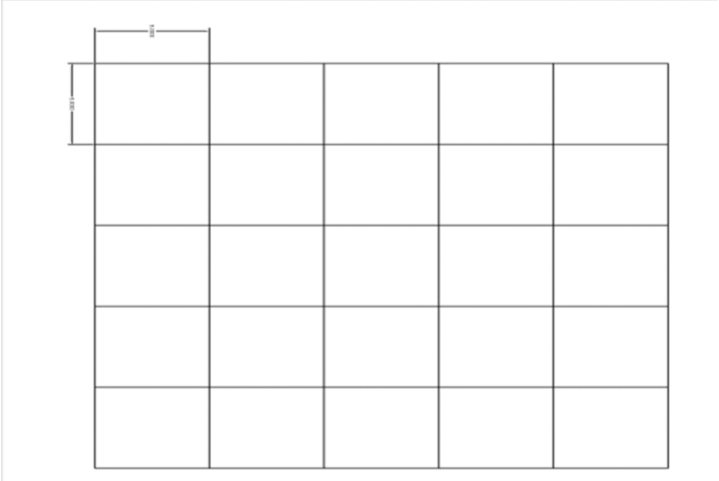

Fig.a Plan for Grid 25m X 25m

Methodology

1. In present research we have used 2 different model special moment resisting frame with and without shear wall at corner and middle positions for different heights.
2. Model the structure in ETABS.
3. Defining the material property for the structure.
4. Assigning beam and column size for different load calculations.
5. Analysing the structure for pushover analysis in ETABS.
6. Run the model to obtain Lateral Displacements, Drifts, Base Shear and Pushover Curve.
7. Observation of result & discussion.
8. Comparing the result with past researches & conclusion.

V. RESULTS AND DISCUSSION

Following results are interpreted from above analysis & design of simple frame & rcc shear wall structure . First Chart (Fig. 1) shows us that base reactions for both the structure are slightly different as their plan dimensions are same. Second chart (Fig. 2) shows story drifts which is having some variation for both structure. Third chart (Fig. 3) shows displacement in different directions. Simple frame structure has more displacement as compared to rcc shear wall structure. This makes rcc shear wall structure more stable in serviceability.

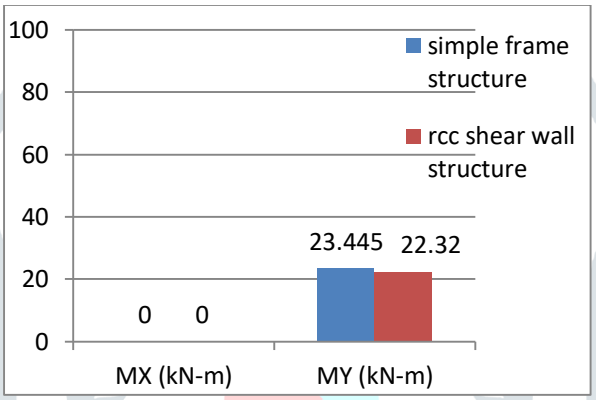

Fig. 1. Base reactions comparison of simple frame & rcc shear wall structure .

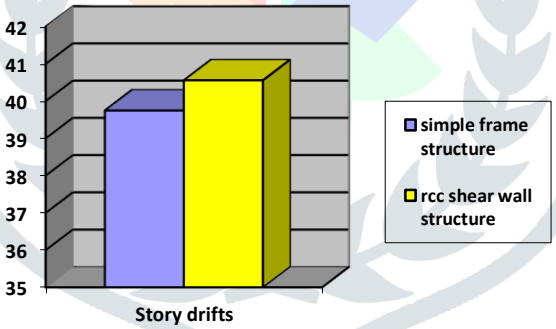

Fig. 2. Story drifts comparison of sipmle frame & rcc shear wall structure.

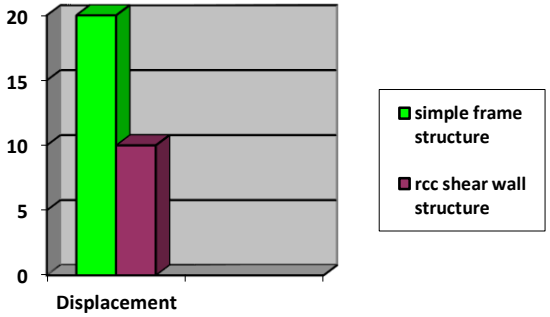

Fig. 3. Displacement comparison of simple frame & rcc shear wall structure.

VI. CONCLUSION

1. There is a continuous increment in the results of lateral forces from base floor to top floor in both manual and software analysis.
2. Variation is observed in the results of base reactions in analysis results.
3. When analysis is done story drift decreases.
4. The average drift is slightly same for different storey.
5. For good seismic performance a building should have adequate lateral stiffness.

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