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Comparative Study On Base Shear Of Shear Wall And Bracing Systems In RC Structure In Kabul Afghanistan

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Abstract: ***Providing strength, stability and ductility are major purposes of seismic design. It is necessary to design a structure to perform well under seismic loads. Now a day, shear wall in R.C. structure and bracings are most popular systems to resist lateral load due to earthquake, wind, blast etc. The shear wall is one of the best lateral load resisting systems which has higher base shear due to mass and stiffness but use of bracing will be the viable solution for enhancing earthquake resistance which has higher base shear compare to bare frame. The shear capacity of the structure can be increased by introducing bracings in the structural system. In this study R.C.C. building is modeled and analyzed for 16, 21, 26- storey by Response spectrum method based on Afghanistan Building Code (ABC) for one way symmetric plan, considering following cases.***

- ✓ ***Dual system(Special moment resisting frame with shear wall)***
- ✓ ***Dual system(Special moment resisting frame with concrete bracings)***
- ✓ ***Moment resisting frame***

The computer aided analysis is done by using E-TABS to find out the effective lateral load system during earthquake in third seismic zone of Afghanistan. The performance of the building is evaluated in terms of Lateral Displacement It is found that the shear wall system is the most stable, lower base shear system for all (16, 21, 26) storey models .It is also found that bracing system is also stable system due to lower displacement.

Keywords: R.C. frame, Lateral displacement, storey drift, Bracing System (BR), shear wall system (SW) Moment resisting system (MR), Afghanistan Building Code (ABC) etc.

I. INTRODUCTION

The necessary earthquake resistant capacity in a tall building can be achieved by providing adequate stiffness, strength and ductility and shear wall provides an optimum means of achieving the basic criteria of design [1].

Shear wall is an element which act as a vertical cantilever used generally in multi storied building to resist lateral forces like wind, storm, and earthquake. Those walls are in general continuous element starting from the foundation and go up to the highest point of the building. However, it may also be curtailed at intermediate height. Shear wall is able to resist combination of shear, moment and axial load induced by lateral load and gravity load transferred to it through other structural members. For buildings over 30 stories, shear wall has been an essential element to ensure economy and minimize the lateral deflection [1].

Generally, the use of bracings instead of Shear walls provides lower stiffness and resistance for a structure but it should not be forgotten that such a system has lower weight and more useful for architectural purposes. Use of braces for seismic rehabilitation of structures should not cause any torsion disorder and designers should be aware of increasing the axial loads of columns in bracing panels [5].

Shear wall may be classified into various types like short or tall wall and slender or squat wall on the basis of aspect ratio; reinforced, steel plate, plywood, mid ply or masonry shear wall on the basis of used material; deep straight walls, U shaped walls or box shaped walls on the basis of shape. Action of Shear Wall in Resisting Loads Use of shear wall provides an efficient solution to stiffen a structural system of a building as it increases the rigidity against lateral load of the building. Shear wall increases significantly the stiffness and strength of the building in the direction of its orientation.

This results in marked reduction in lateral sway of the building. Generally, the shear wall transfers the load to the next element below it in the load path. It helps in reducing the side sway of above members like roof or floor. It also prevents the floor and roof framing members from moving off their supports when they are stiffened enough and also reduces the nonstructural damages [2].

II. REVIEW OF LITERATURE

Following are the parameters that mostly affect in the analysis of brace frame RC structure, such as type of bracing, material of bracing, stiffness of bracing, etc. Mohammed Idrees Khan, Mr. Khalid Nayaz Khan (2014), concluded that the provision of bracing enhances the base shear carrying capacity of frames. The effects are more pronounced in taller structure.

OBJECTIVE AND SCOPE OF STUDY

The objective of this study is to find base shear for lateral load resisting systems (shear wall and bracing system) and compare the results.

During this investigation tried to select lateral load resisting system for RC tall structure in Afghanistan. The process Conducted for tall buildings of various heights in Kabul Afghanistan. The ETAB 2015 used to analyze these systems according to the allowable stress requirements for an objective function to know the lateral displacement, base shear and lateral drift, for maximum earthquake intensity in zone three based on Afghanistan seismic map under Afghanistan building code (ABC).

III. TOOLS AND TESTING MODEL

A. TESTING MODEL

16, 21, 26 -Storey Models investigated during this investigation. The testing models created from a real residential building plan considered in Kabul Afghanistan, it is one side symmetric building plan with unequaled spans. The very first floor of this plan considered as basement for vehicle parking ,the second, third and fourth floors of this plans modelled for the super Markets and the remain upper storey considered for the living apartments . Width and length of the horizontal plan are determined according to code requirements for expansion joints. The maximum distance for the expansion joint should not exceed 30 m or (100 feet). Dimensions of the plan (28,65x14.72) m with Height (3 m) for each floor.

ETABE 2015 software has been used to analyze the models.

B. ANALYZED MODELS

a. MOMENT RESISTANCE FRAME MODEL :

This model has been considered as a simple bare frame without any lateral load resistance system for 16, 21 and 26 storey (Figure7-1)

b. DUAL SYSTEM MODEL (FRAME-SHEAR WALLS)

This model has been considered as a RC frame with shear walls in different locations for 16, 21and 26- Storey. (Figure 7-2).

c. BRACING SYSTEM (FRAME- RC BRACINGS)

This model has been considered as a RC frame with RC "X" shape bracings in different locations for 16, 21 and 26 Storey (Figure 7-3).

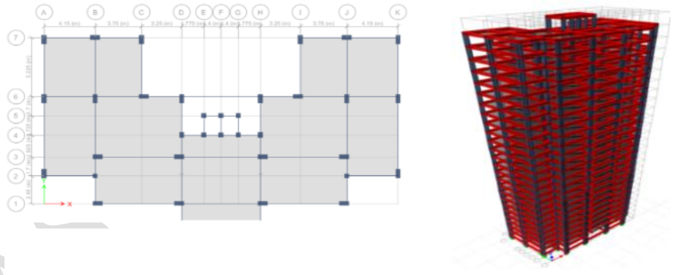

Figure 7- 1: Moment Resistance Frame structural flooring plan and model

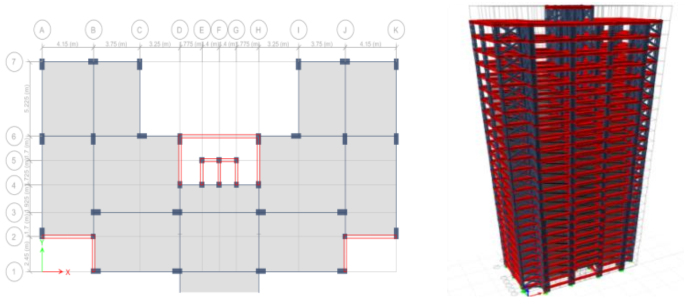

Figure 7- 3: Dual system (Frame-Bracing) plan and structural Model

IV. MODELS PARAMETERS

A. MOMENT RESISTANCE FRAME PARAMETERS

Bare frame considered without any lateral load system. Below Table shows elements Properties for (26) storey Bared RC frames. For 21 -storey, the same element sizes are there, but only (1000x400) size columns are up 5th floors. For 16 storey systems all columns considered (600x400) mm instead of (1000X400) mm.

RC Frame Structural Elements properties -26 storey Model		
No	**Structural Elements**	**Size**
1	Columns up to 10th floors	(1000x400)mm
2	Columns 10th to 25th floors	(600x400)mm

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3	Columns around the elevator	(400x400)
4	Beams	(400x500)mm
5	Floor slab	120mm
6	Cantilever beam	(400x500)mm

Table 7- 1: RC frame Model parameters

B. DUAL SYSTEM (RC FRAME-SHEAR WALL) PARAMETERS

This is the same as bared frame with the same structural elements properties. The only change is shear walls, placed in different locations in the plan as per Figure 7.2.Shear walls considered "200mm" thick RCC walls among RC frame.

C. PARAMETERS OF DUAL SYSTEM (RC FRAME-WITH RC (BRACINGS)MODEL

Frame with the same structural elements properties. The only change is bracings, placed in different locations in the plan as per Figure 7-3 bracings are considered "X" shape RC elements, size of bracing are (300x300)mm. Mark of concrete is "4000 psi" and steel has been considered "60000 psi"

V. ANALYSIS METHOD

Response spectrum analysis method has been used during this investigation.

VI. RESULTS

A. 16 STOREY SYSTEMS BASE SHEAR RESULTS

Below diagram shows base shear of all the systems under response spectrum analysis.

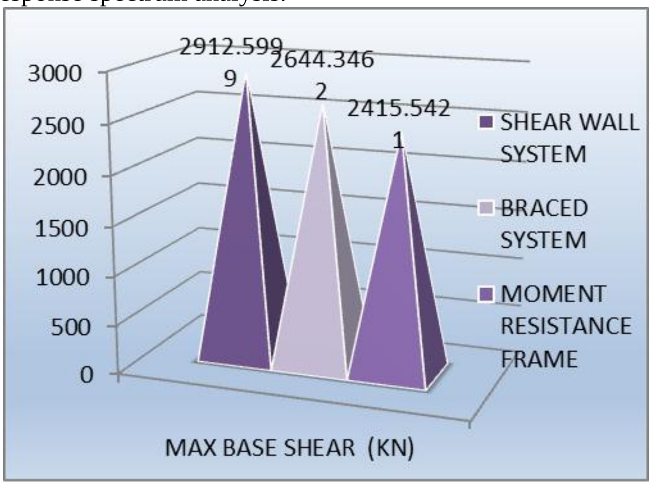

Figure 7- 4: sixteen storey Frame base shear results

B. 21 STOREY SYSTEM BASE SHEAR RESULTS

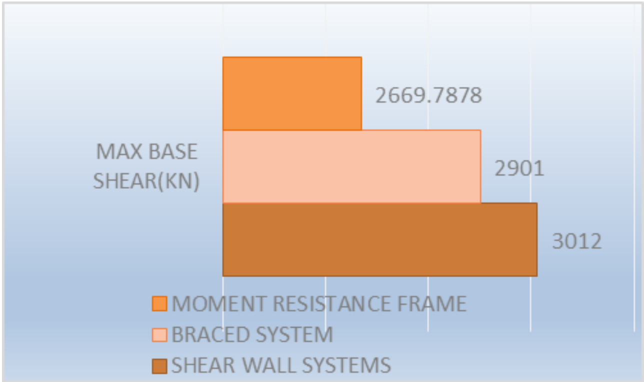

Figure 7- 5: twenty one storey Frame base shear results

C. TWENTY SIX STOREY SYSTEM BASE SHEAR RESULTS

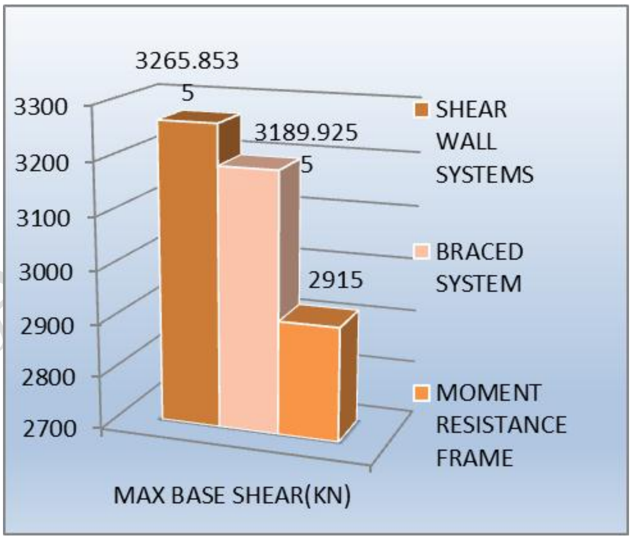

Figure 7- 6

VII. CONCLUSION

As per results above some important points have been concluded.

✓ Base shear increases when height of structure is increased. It is about 3.32% in 21 storey shear wall system and 10.81% in 26 storey compare to 16 storey shear wall system.
✓ The results conclude that shear wall system has higher base shear compare to other systems in all three models (16, 21, and 26).
✓ The results show that bracing system also increasing base shear compare to moment resisting system. It is 8.85% in 21 storey and 17.08% in 26 Storey bracing systems compare to 16 storey braced system.
✓ Finally the results show that shear wall system has high base shear value compare to bracing system. It is 9.2% in 16 storey, 3.68% in 21 Storey and 2.32% in 26 storey system.

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