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Seismic Behaviour of RC Structures with Lateral Resistive System

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ABSTRACT

In recent timeslateral resistive system are commonly used to increase the seismic carrying capacity of the structure.Use of bracings and shear wall are the major solutions for the laterally inadequate structures during ground motion. To know the importance of bracings, shear wall, 7 various types of models are considered for G+ 14 storeys under seismic zone v and compared with bare frame structure. This structure is analysed for linear static analysis using ETABs 16.0.2. From the results it is seen that inverted V bracings with shear wall in longitudinal directions is more efficient for seismic forces out of all other type of models.

Keywords: Bracings, Shear Wall, Infill Wall, Time Period, Base Shear, Storey Displacement

INTRODUCTION

In recent decades, developments of tall structures are become more, due to demand of infrastructure for the growth of the country. Due to growth of population and lack of space for shelter vertical development of the structure came into existences which can be known as multi storey structures. Multi storey structures can also be known as the structure whose height more than 30m. The multi storey structures should capable of withstanding structural designed loads such has dead loads, live loads and seismic forces during earthquake. To with stand the lateral forces, lateral resistive system came into occurrence without much increase in dead weight of the structure and the project cost. There are various types of lateral resistive system in which bracings and shear walls are commonly used in recent decades. Bracing can also be used to existing structures which lacks in lateral strength.

LITERATURE REFERENCES

Chadhar and Sharma [1]considered the RC moment resisting bare frame, RC moment resisting frame with steel bracing system and RC moment resisting frame with shear wall system for their study. Three different heights of buildings like low rise, medium rise and high rise and the effect of brick infill walls were also considered. Analysis was carried out using Staad Pro V8i software and the performance of the building was evaluated on the basis of bending moment, shear force, storey displacement, storey drift and base shear. They concluded that the steel bracing system provided better performance than shear wall system with variable heights of the building.

Mohammed and Nazrul [2] studied the behavior of multistory RC structure with different type of bracing system. After the analysis of the structure with different types of structural systems they concluded that the displacement of the structure, bending moments and shear forces of the column decreases after the application of bracing system. It was found that the performance of cross bracing system was better than the other specified bracing systems.

Thorat and Salunke [3] studied the seismic behavior of RC multistory building frame with shear wall and with bracing. STAAD-PRO V8i software was used for dynamic and stiffness analysis. The location of shear-wall and brace member had significant effect on the seismic response of the shear-wall frame and braced frame respectively. It was found that braced frame was very efficient in resisting seismic force than shear-wall frame and plane frame.

OBJECTIVE OF THE STUDY

I. To know behaviour of RC structure under linear static analysis.
II. To know the effect of various type of bracing systems on RC frame structure.
III. To know the effect of shear wall on the RC frame Structure.
IV. To know the effect of bracings with shear wall on the RC frame structure.
V. To know the time period, base shear, storey drift of the RC frame structure.
VI. To know the most efficient type of bracing system for RC frame structure.

METHODOLOGY

I. The building is designed as per IS 456-2000 with load consideration like dead loads, live loads and earthquake loads.
II. The building is analyzed for linear static analysis.
III. The RC frame structure of having plan dimension of 25x25m having the bay dimension of 5x5m is analyzed with various bracing system and shear wall.
IV. Result data obtained from response spectrum analysis is compared with bare frame.

Modelling and Analysis

The structure is analyzed for seven various types of models as shown below

Table 1: Various type of models

Model No.	Various type of models
1	Bare Frame
2	Bare Frame with X-Bracings at outer corners
3	Bare Frame with V-Bracings
4	Bare Frame with inverted V-Bracings
5	Bare Frame with shear wall in lateral direction
6	Bare Frame with shear wall in longitudinal direction
7	Bare Frame with X bracings and shear wall in longitudinal directions

Table 1: Structural Description

Zone	V	Column size	300x900 mm
Response Reduction Factor	3	Beam size	300X600 mm
Importance Factor	1.5	Thickness of slab	150 mm
Soil strata	Soft soil	Thickness of shear Wall	300mm
Height between two floors	3 m	Grade of Rebar Section	Fe 500
Grade of Steel Section	Fe250	Bracings	X-Bracing
Grade of Concrete	M25		V-Bracing
Bracing	200x200mm		Inverted V- Bracing
Live load	$3.5kN/m^2$	Dead load	$1.5kN/m^2$

RESULTS AND DISCUSSION

RC structure of G+14 with braced frame and shear wall for soft soil was analyzed. The variation of time period, base shear, storey displacement was studied and compared with bare frame structure. The following are the plan and 3D view of various types of models.

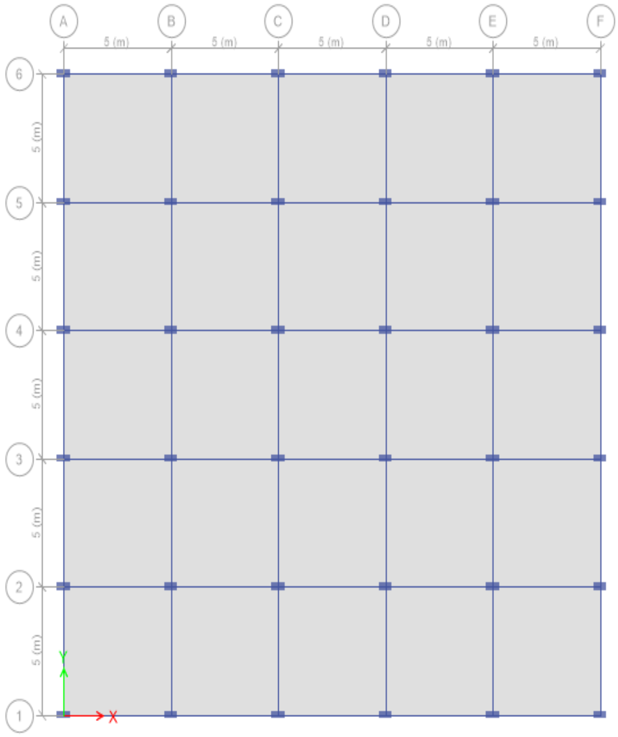

Fig 1: Plan

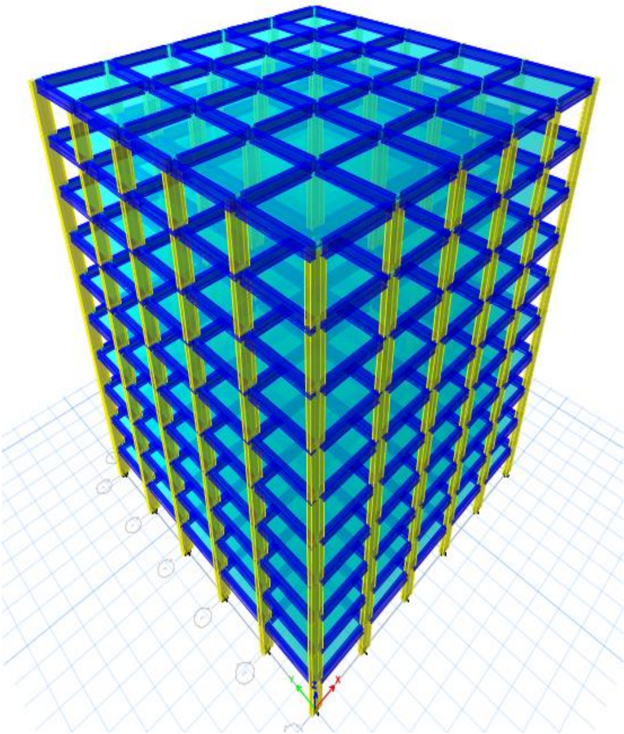

Fig 2: Model 1

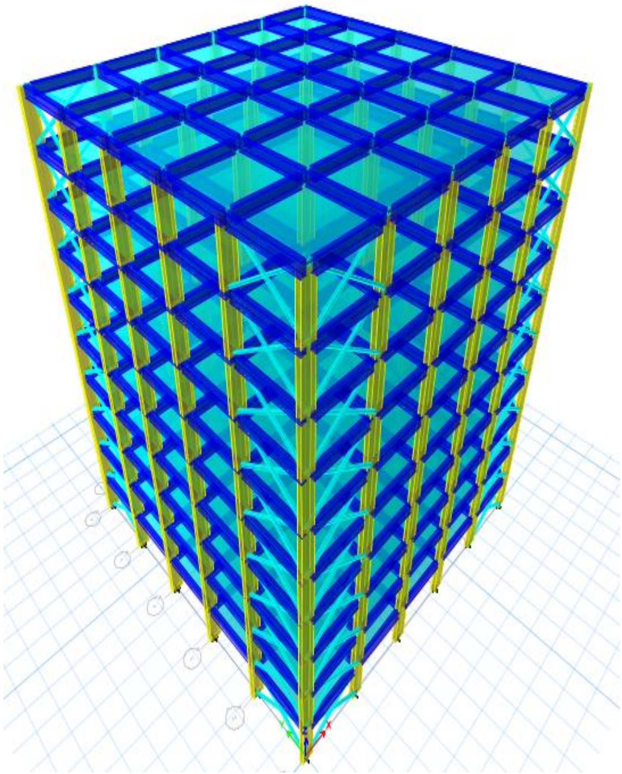

Fig 3: Model 2

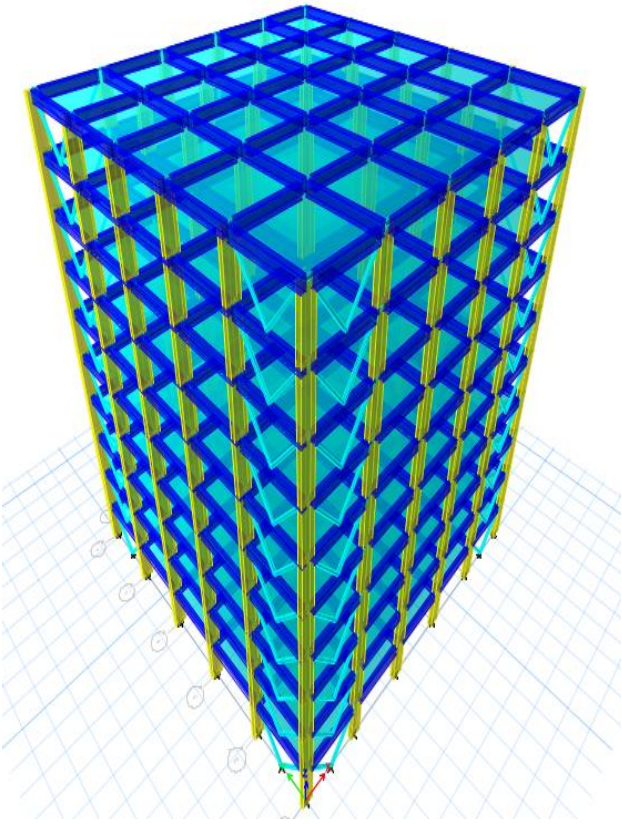

Fig 4: Model 3

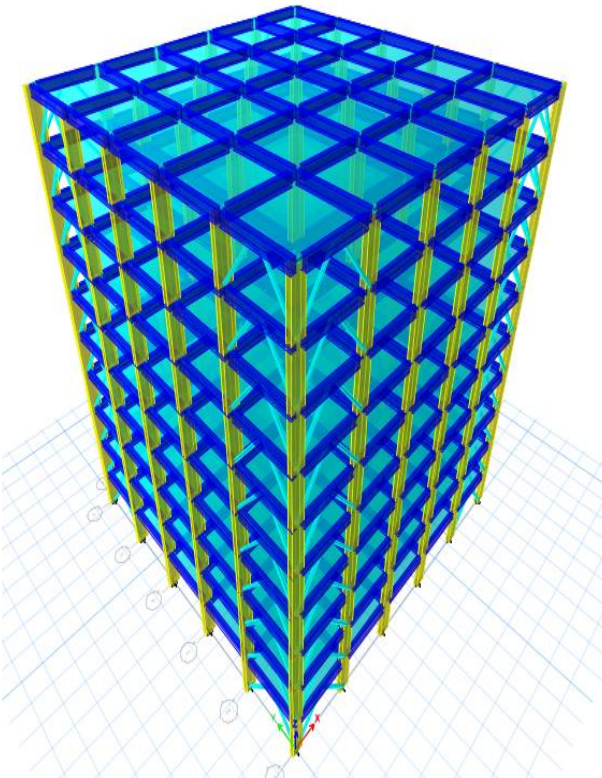

Fig 5: Model 4

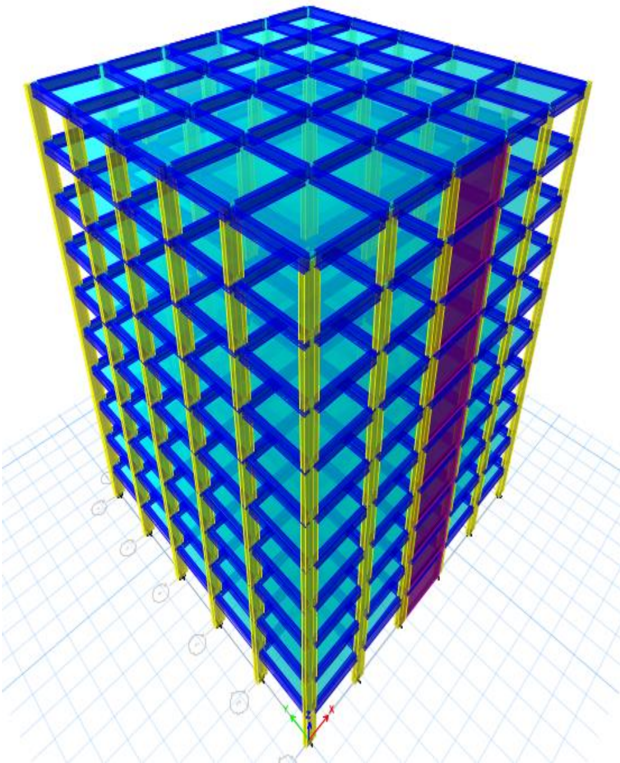

Fig 6: Model 5

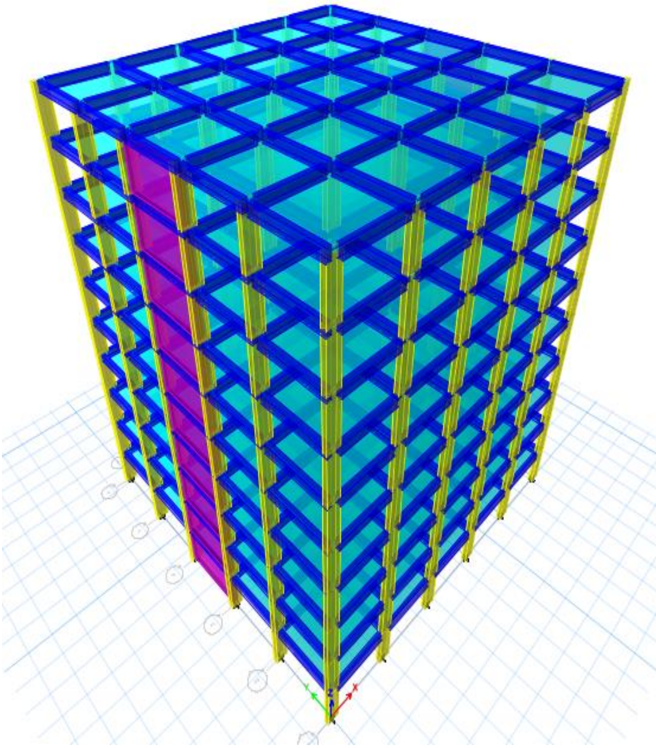

Fig 7: Model 6

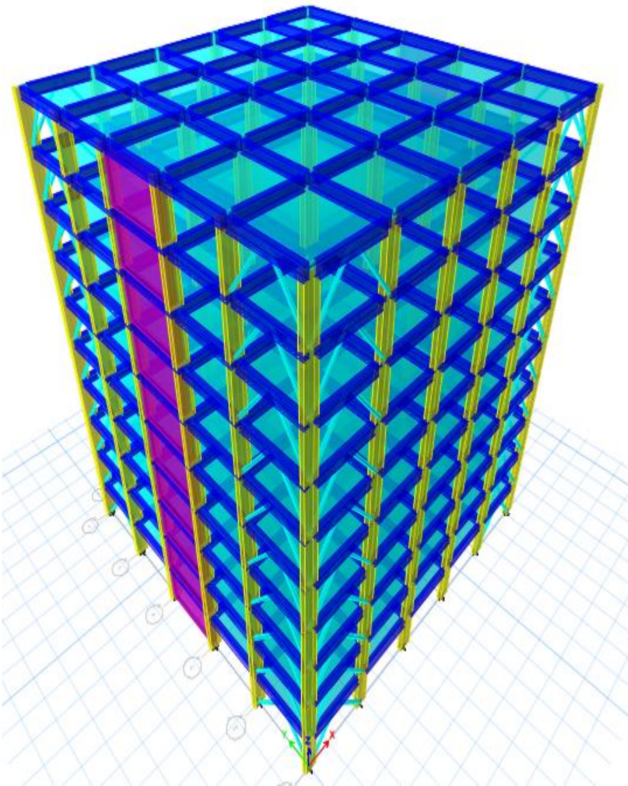

Fig 8: Model 7

Time period

Time taken for body to complete one cycle of free vibrations is known as time period.

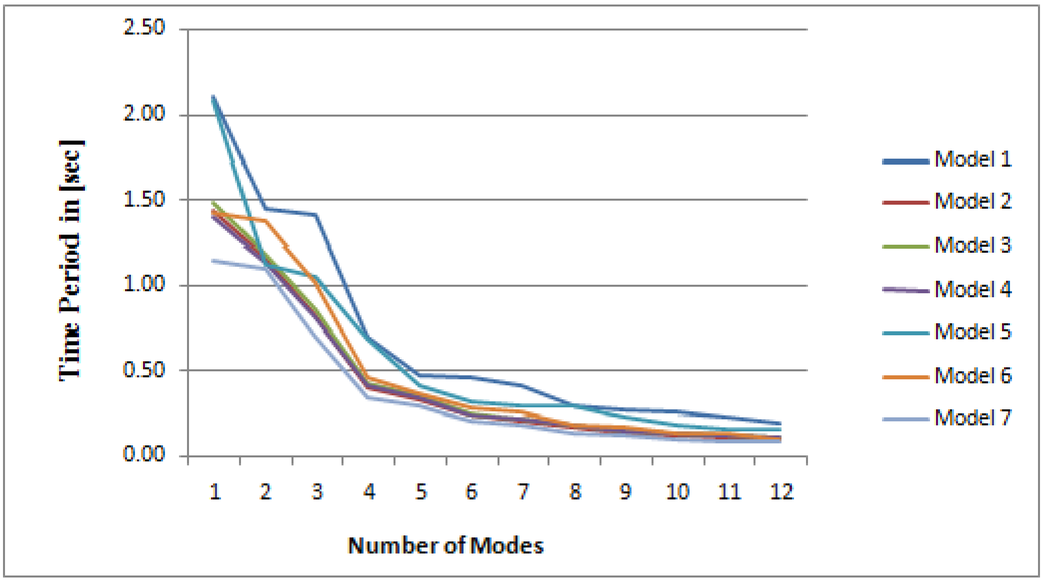

Fig 9: Variation of Time Period

OBSERVATION AND DISCUSSION

From fig 9 it is seen that the time period of structure decreases by the provision of lateral resistive system. Time period of the RC structure reduces by 51.09% in model 7, that is bare frame with inverted V bracings with shear wall in longitudinal direction.

Base Shear

Base shear can be defined as the maximum seismic force that will occur due to action at the bottom of the building.

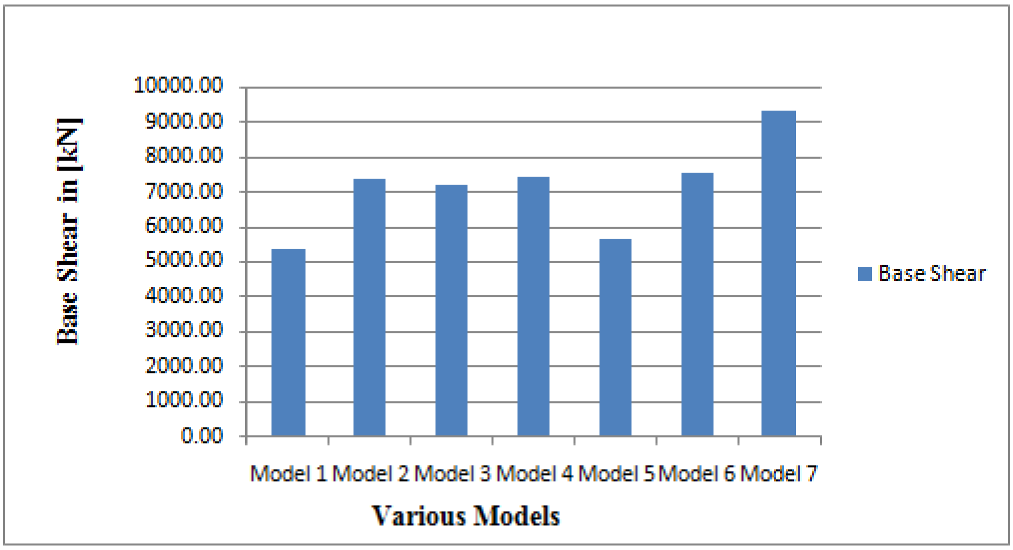

Fig 10: Base shear

OBSERVATION AND DISCUSSION

From fig 10 it is seen that base shear of the structure increases by the provision of lateral resistive system. Base shear of the RC structure increases by 73.38% in model 7, that is bare frame with inverted V bracings with shear wall in longitudinal direction.

Storey Displacement

Storey displacement can be defined as the displacement of storey initial position to final position due to seismic ground motions.

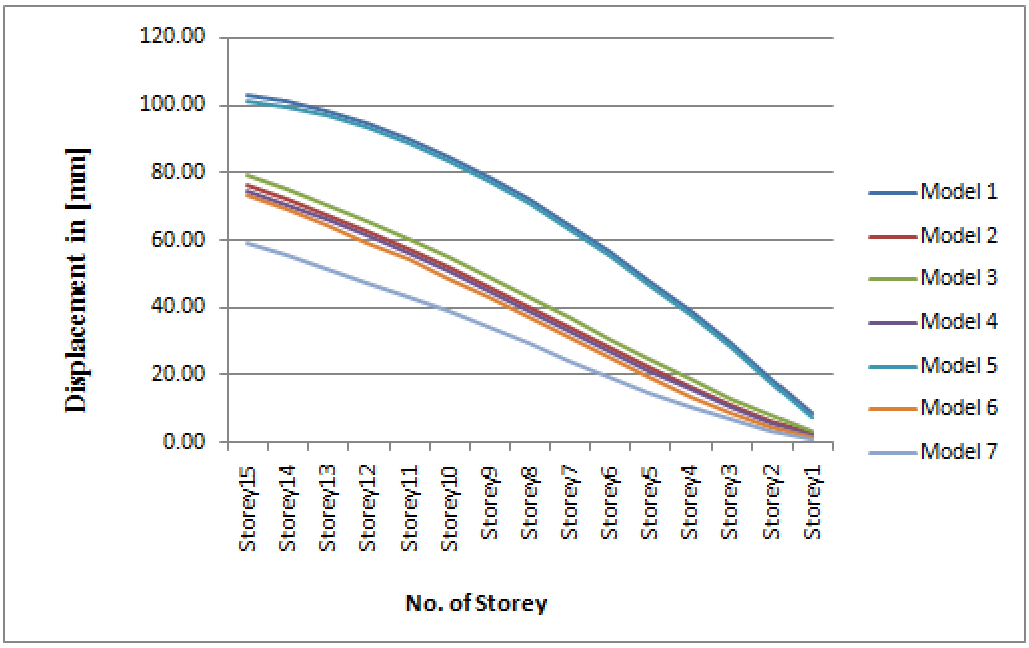

Fig 11: Storey Displacement

Observation and discussion

From fig 11 it is seen that storey displacement of structure reduces by the provision of lateral resistive system. Storey displacement of the RC structure is reduced by 61.25% in model 7, that is bare frame with inverted V bracings with shear wall in longitudinal direction.

CONCLUSION

- Provision of lateral resistive system in the RC structure decreases the time period, storey displacement and increasesthe base shear.
- Various types of bracing at outer periphery such as X, V, Inverted V bracings in the RC structures are provided.It is found that the inverted V bracings at outer periphery decreases the time period, storey displacement and increases the base shear to the maximum extent.
- Shear wall is provided in both lateral and longitudinal direction in the RC structures.It is found that the shear wall in the longitudinal direction decreases the time period, storey displacement and increases the base shear to the maximum extent.
- Provision of inverted V bracings and shear wall in longitudinal direction reduces the time period with an amount of 51.09% when compared with bare frame structure.
- Provision of inverted V bracings and shear wall in longitudinal direction reduces the storey displacement with an amount of 61.25% when compared with bare frame structure.
- Provision of inverted V bracings and shear wall in longitudinal direction increases the base shear with an amount of 73.38% when compared with bare frame structure.

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