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EFFECT OF BRACING SYSTEMS ON STOREY HEIGHT BY USING RESPONSE SPECTRUM ANALYSIS

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Abstract- *Now a days, due to increase in population urbanization has lead to housing problems. This has been gave birth to new concept of high rise buildings and apartments and their behaviour during natural calamities such as earthquake. Earthquake leads to ground shaking and collapse of structure in all direction due to base movement of the building with the ground. In the present work an endeavour has been made to study the dynamic behaviour of regular building with different bracing system using IS 1983-2002 code recommended response spectrum method. Analysis of building has been carried out using ETABS software.*

Key Words: Bracing System, Storey Height, Base Shear, Lateral Displacement, Response spectrum method.

1.INTRODUCTION

High rise buildings are the complex systems and multiple items have to be considered during planning and designing of them. As the height of the building increases , the building are prone to effect of more loads when compared to low rise buildings. As the building grows taller there is a change in the level of response to the earthquake loads. These high rise buildings are liable for structural collapse of building under the action of dynamic loads, consequently there is a need for extensive research for achieving ultimate performance of structure even with deuced configuration**.**

1.1 EQUIVALENT STATIC ANALYSIS

The response of a structure to induced forces during the earthquake is dynamic in nature. The realistic behaviour of design forces can be obtained by dynamic analysis of building models. This method accounts for only one mode of vibration in each direction during earthquake.

1.2 RESPONSE SPECTREM ANALYSIS

A response spectrum is a plot of the peak or steady response of a series of oscillation of varying natural frequency. In this method, muitiple modes of vibrations of structures are considered. This analysis is carried out to according to IS 1893-2002(Part I) code.

2. OBJECTIVES OF STUDIES

- To analyze the structure as per IS 1893-2002(Part I) code and to study response of braced and unbraced buildings.
- To study methods of seismic analysis and to study seismic analysis of frame by ETBS version 9.7.4.

3. SELECTION OF THE STRUCTURE

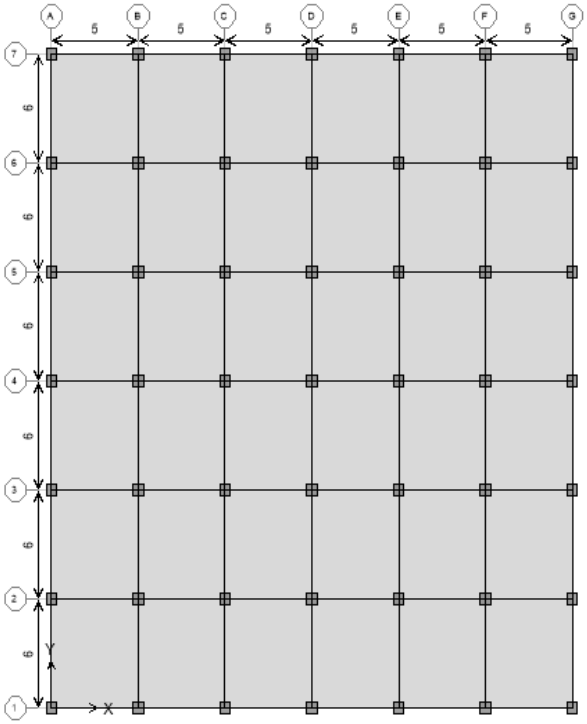
1) Grid Data	
a) Grid Spacing	Non uniform - 5 meter - X and 6 meter - Y direction.
b) Total Dimension	30m - X and 36m - Y direction
c) Grid Height	Uniform - 3 meters, At base - 2 m
d) No. Of Stories	10,20,30,40
e) Total Building Height	29,59,89,119

2) Material Properties	
a) Grade of Concrete	M_{35}
b) Grade of Steel	Fe - 500
c) Poisson's ratio	0.2

3) Frame Properties	
a) Type of frame	Special RC moment resisting frame fixed at the base
b) Size of beam	(300X600) mm
c) Size of column	(750X750) mm (From lower story to middle story)
d) Size of column	(600X600) mm (From middle story to top story)
e) Bracings	ISA (200X200X25)
f) Grade of Steel for Bracings	Fe- 345
g) Thickness of Slab	175mm
4) Static Loads	
a) Live load	3 KN/ m^2
b) Floor finish	1.5 KN/m^2
c) Wall load	11.04 KN/m^2 (Considered only for peripheral beams of the building)
5) Seismic Definition	
a) Earthquake Zone	V
b) Damping ratio	5%
c) Importance factor	1
d) Type of soil	Medium Soil
e) Respose Reduction Factor	5

4. MODELLING AND ANALYSIS OF BUILDING

For the analysis work, 32 models of high rise RC frame building (G+9),(G+19),(G+29) and (G+39) storey for medium soil of bare frame, X- bracing, V- bracing and K- bracing are made to known the practical behaviour of building during earthquake. The parameters considered are lateral displacement, storey drift, time period and base shear.



Figue-4 .1: Plan of a structure

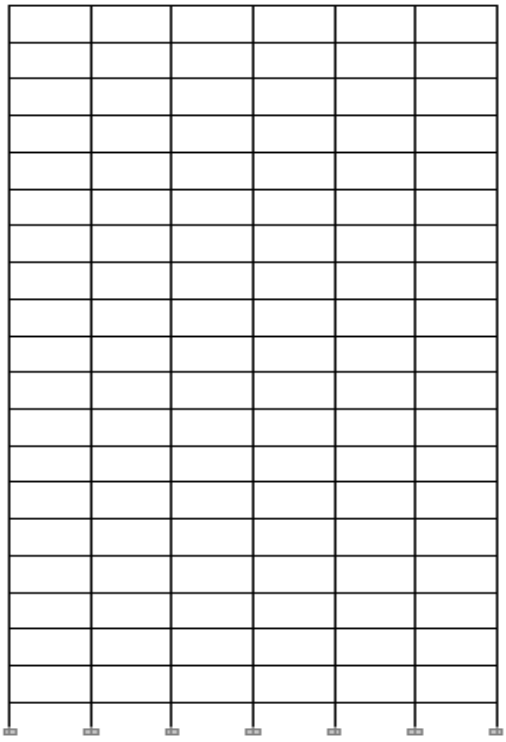


Figure-4.2: Elevation of Unbraced Structure

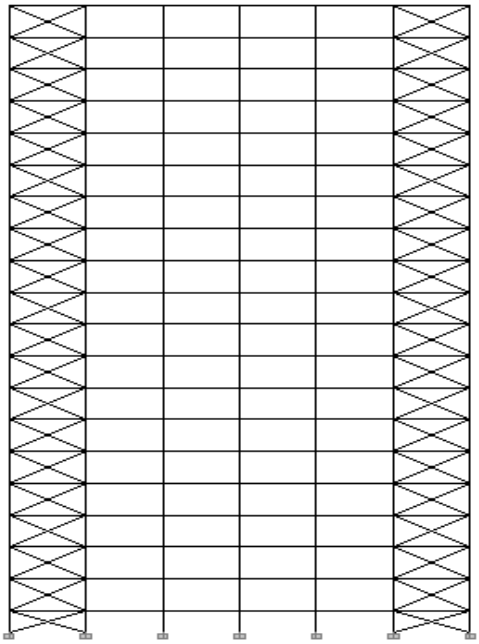


Figure-4. 3: Elevation of X- Braced Structure

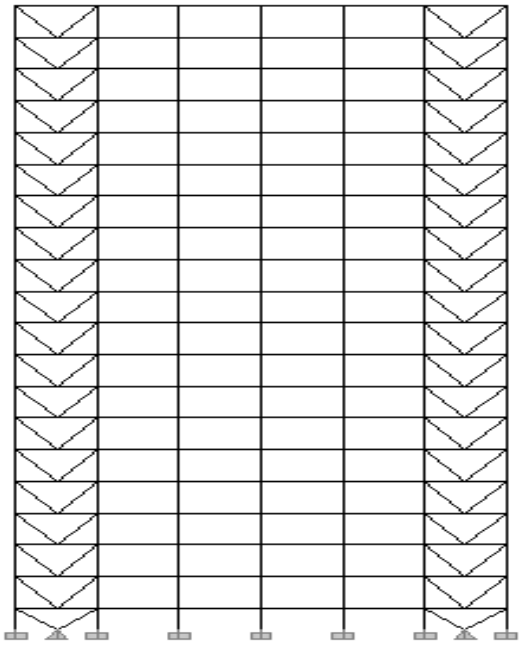


Figure-4.4: Elevation of V- Braced structure

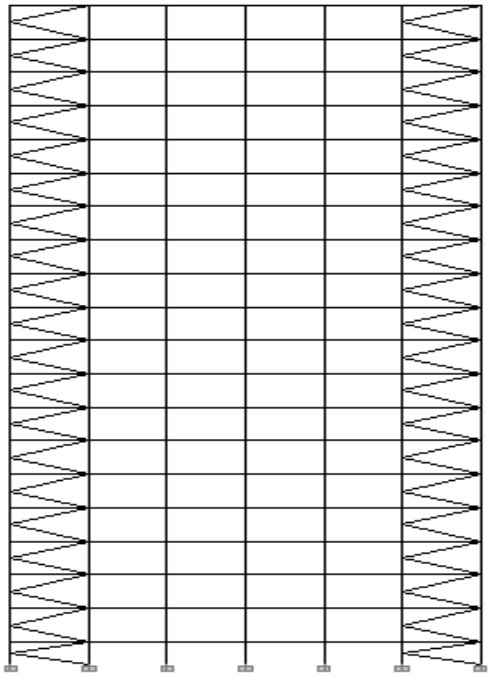


Figure-4. 5: Elevation of K- Braced structure

5. RESULTS AND DISCUSSIONS

5.1. Lateral Displacement

It is observed from the graph that the lateral displacement increases proportionally with respect to the storey height. Hence for the high rise buildings it is necessary to consider the seismic load effect while designing of building.

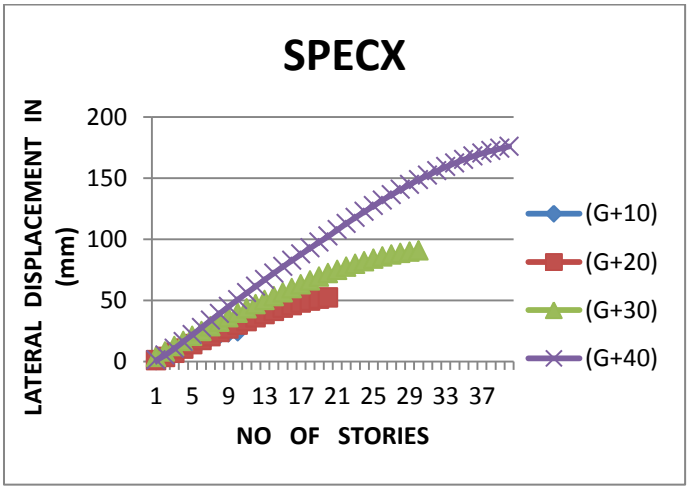


Chart-5.1: Lateral Displacement for bare frame

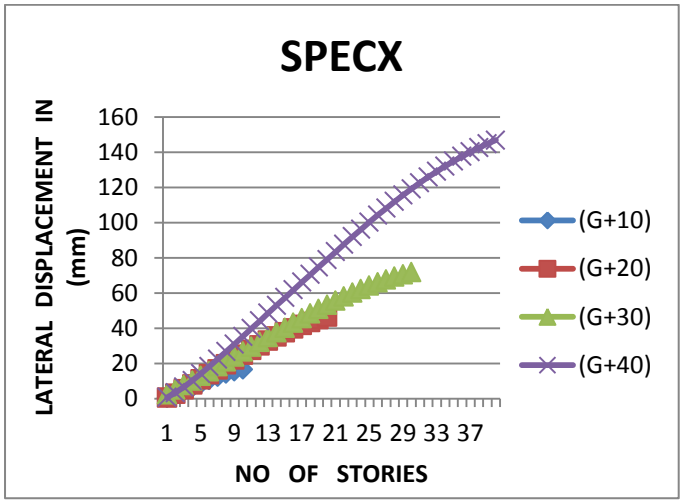


Chart-5.2: Lateral Displacement for X- Bracing

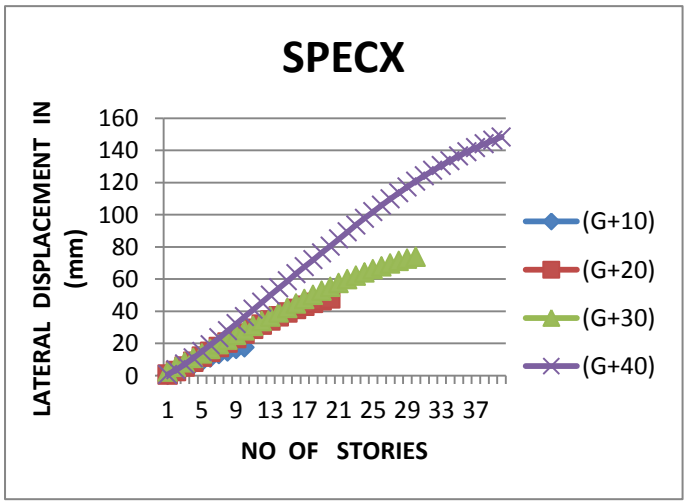


Chart-5.3: Lateral Displacement for V- Bracing

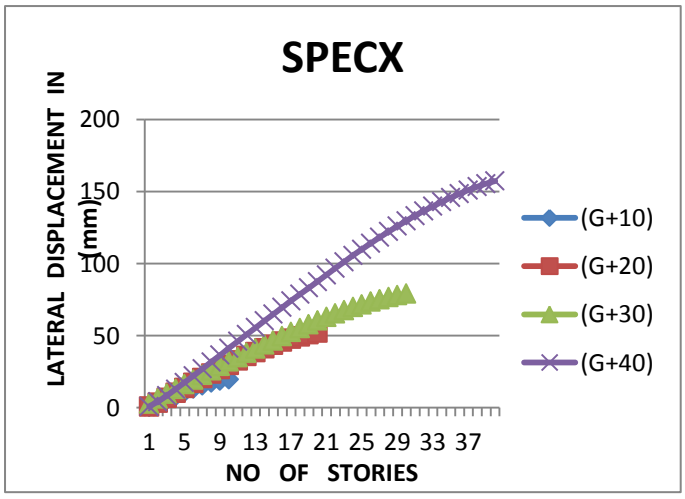


Chart - 5.4: Lateral Displacement for K- Bracing

It can be ascertained from the graph that the lateral displacement have been decreased significantly for X-type of bracing system, ,while maximum displacement is observed for bare frame (i.e. without any bracing system).The displacement are reduced sequentially for V- bracing and K- bracing. These patterns are ascertained due to increased stiffness provided by the respective bracing.

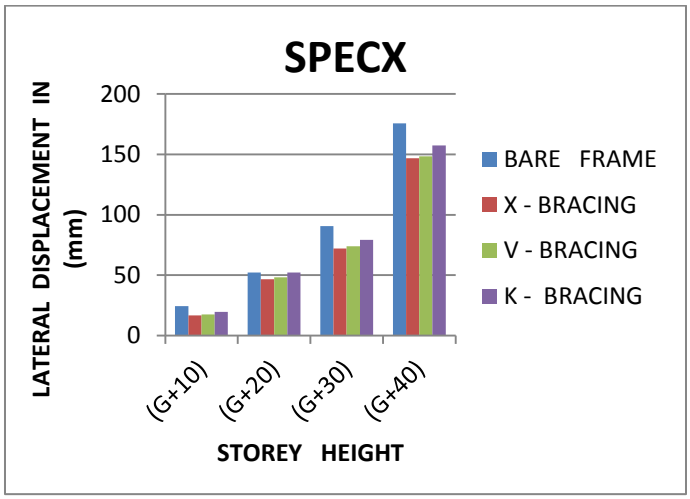


Chart-5.5: Variation of lateral displacement for various storey height with different bracings

5.2. Storey Drift:

It is noticed from the graph that the storey drift increases with respect to the storey height. It is also ascertained that, the storey drift increases suddenly at the middle storey and then decreases significantly.

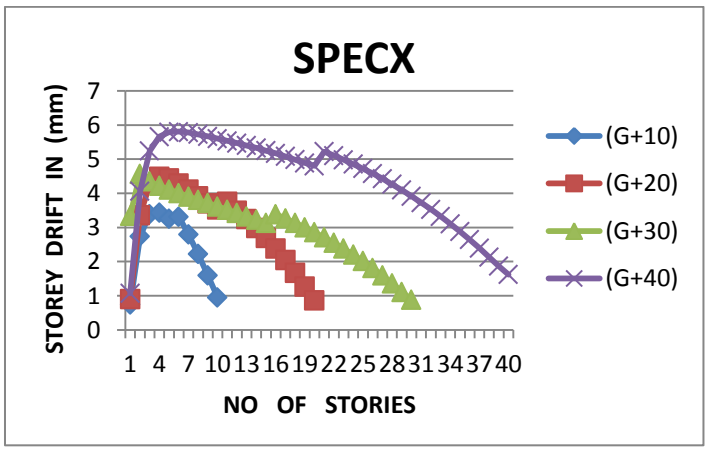


Chart-5.6: Storey Drift for bare frame

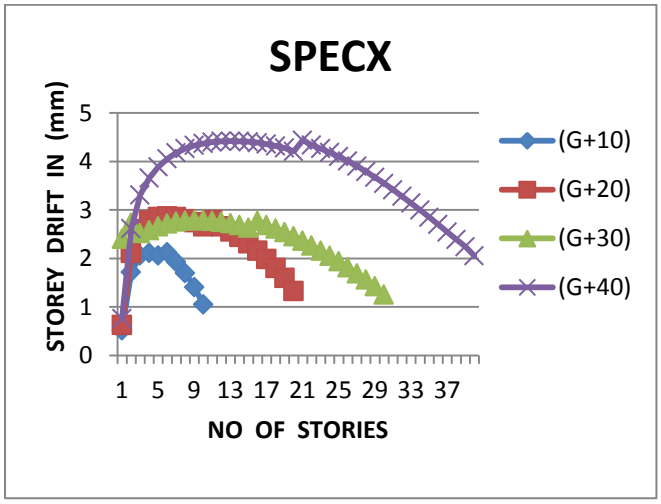


Chart-5.7 : Storey Drift for X- Bracing

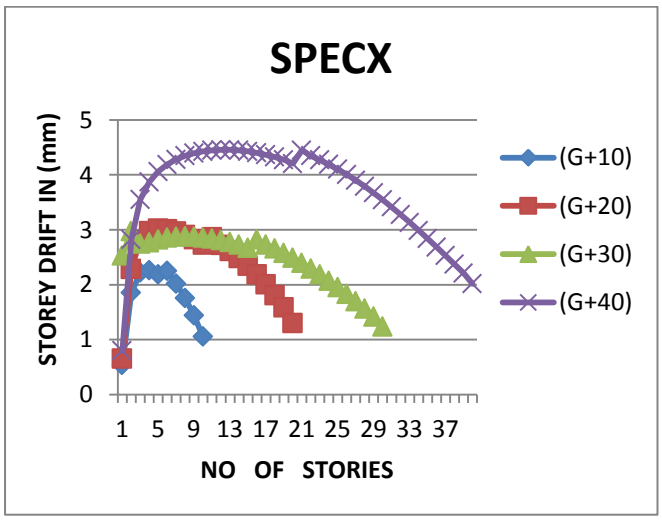


Chart-5.8: Storey Drift for V- Bracing

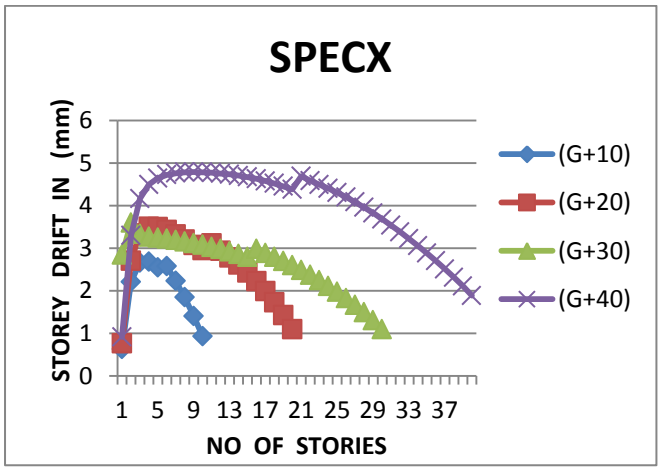


Chart-5.9 : Storey Drift for K- Bracing

It is noticed from graph that the storey drift is maximum for bare frame while by the inclusion of bracing system storey drift is reduced significantly sequentially for X- bracing, V-bracing and K –bracing system. These patterns are observed due different configuration of bracing system.

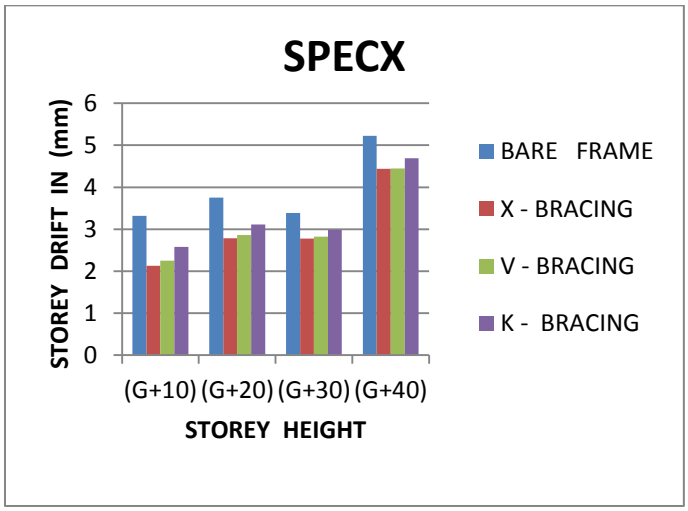


Chart-5.10:Variation of storey drift for various zones with different bracings

5.3. Base Shear:

It is observed that the base shear increases as the story height increases this is due to increased load carrying capacity of buildings when the height of the building increases.

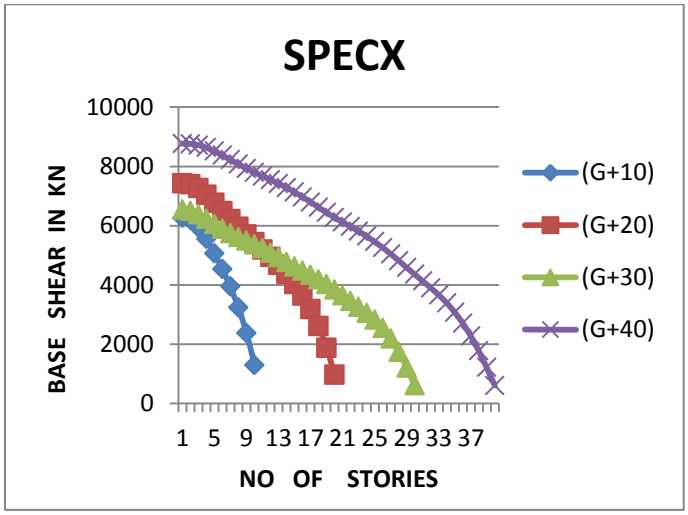


Chart -5.11 : Base shear for Bare frame

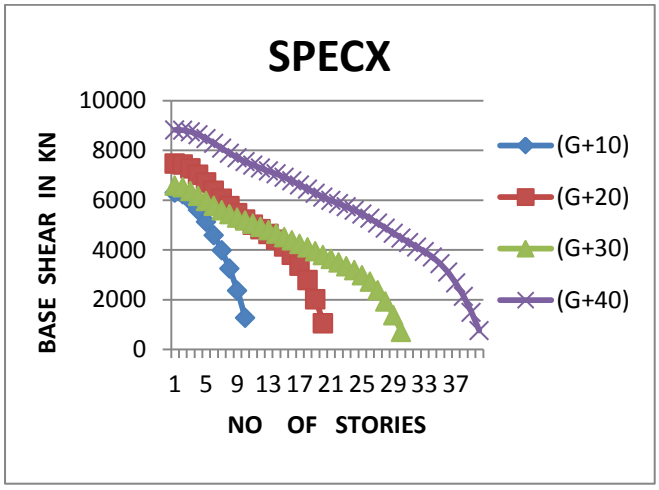


Chart-5.12: Base shear for X- Bracing

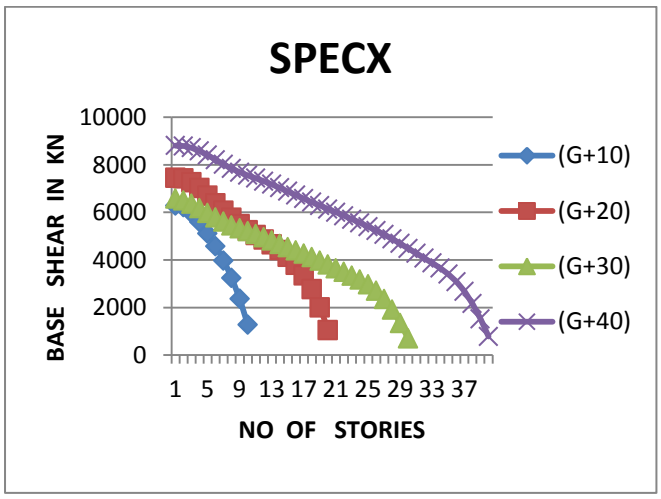


Chart-5.13: Base shear for V- Bracing

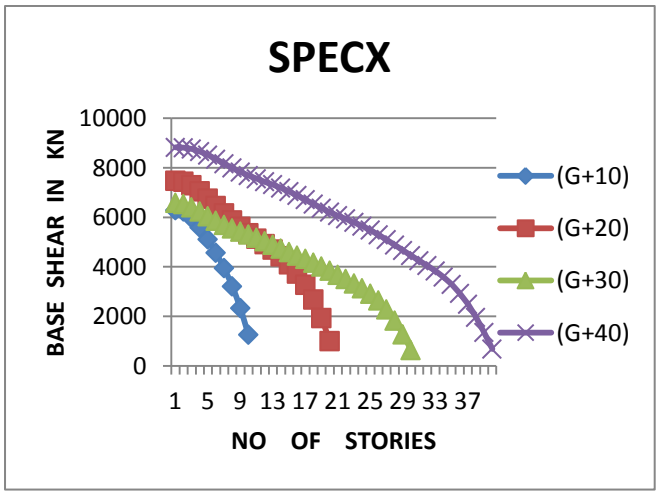


Chart -5.14 : Base shear for K- Bracing

It is observed that by the inclusion of X-bracing increases the base shear of the building significantly due configuration of X – bracing and its connection with both beam and column.

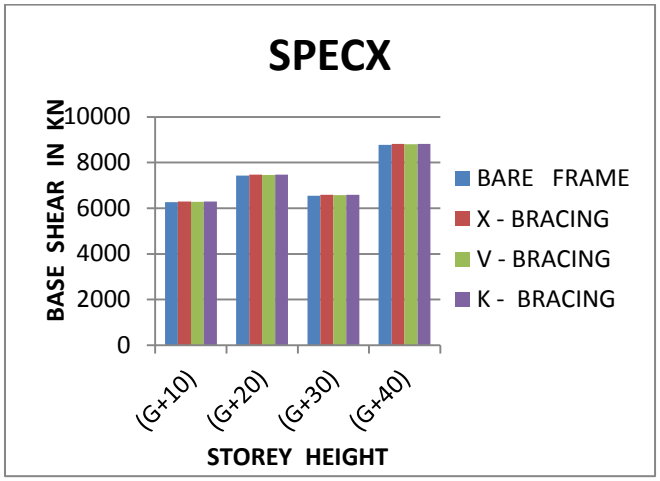


Chart-5.15: Variation of base shear for various storey height with different bracings

5.4. Time Period :

It is observed that the time period has no effect on height of building. The time period decreases from 1st to 4 th mode of vibration after that it remains constant.

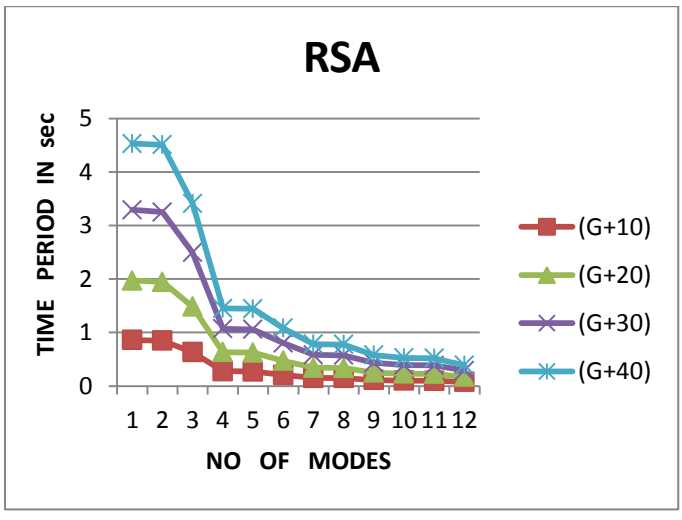


Chart-5.16: Graph of Time Period in (sec)

6. CONCLUSIONS

The following conclusions are extracted based on analysis.

- Steel bracings can be used extensively to reduce lateral loads.
- Overall performance of X-type bracing is significant when compared with K and V type bracings.

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