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COMPARATIVE STUDY OF UNBRACED, CROSSED AND DIAGONALLY BRACED FRAME OF MID RISE BUILDING TO BE CONSTRUCTED IN HILLY AREA

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ABSTRACT

Due to sloping land and high seismically active zones, designing and construction of multistory buildings in hilly regions is always a challenge for structural engineers. This review paper focuses to establish a review study on the Possible Types of building frame configuration in the hilly region and he behavior of Such building frames under seismic loading conditions, and (3) The recent research and developments to make such frames less vulnerable to earthquakes.

This paper concludes that the dynamics characteristics of such buildings are significantly different in both horizontal and vertical directions, resulting in the center of mass and center of stiffness having eccentricity at point of action and not vertically aligned for different floors. When such frames are subjected to lateral loads, due to eccentricity it generates torsion in the frame. Most of the studies agree that the buildings resting on slanting ground have higher displacement and base shear compared to buildings resting on plain ground and the shorter column attracts more forces and undergoes damage when subjected to earthquake. This paper conclude the computational experiment done on G+ 4 & G +7 building with different bracing patterns located in seismic zone V and in hilly area.

Keywords: Building frame configuration, Seismic behavior, Dynamic characteristics, Response spectrum analysis, time history analysis.

1. INTRODUCTION

The behavior of a building during an earthquake depends on various uncertainties. These uncertainties are due to various causes, the nature of the earthquake, the behavior of the components, and the method of analysis. Therefore, the response of the building depends on the movement of the ground and the editing of the individual responses of the structural and non-structural components in a fully stochastic framework. Past seismic experience has shown that many common buildings and typical construction methods lack basic resistance to seismic forces. This resistance can most often be achieved by the simple and inexpensive principles of good building practices. Adherence to these simple rules will not prevent all damage in moderate or large earthquakes, but life threatening collapses should be prevented, and damage limited to repairable proportions. These principles fall into several broad categories

Planning and layout of the building involving consideration of the location of rooms and walls openings such as doors and windows, the number of stories, etc. At this stage, site and foundation aspects should also be considered. Lay out and general design of the structural framing system with special attention to furnishing lateral resistance. Consideration of highly loaded and critical sections with provision of reinforcement as required. Studies has provided a good overview of structural action, mechanism of damage and modes of failure of buildings. From these studies, certain general principles have emerged: Structures should not be brittle or collapse suddenly. Rather, they should be tough, able to deflect or deform a considerable amount. Resisting elements, such as bracing or shear walls, must be provided evenly throughout the building, in both directions side to side, as well as top to bottom. All elements, such as walls and the roof, should be tied together so as to act as an integrated unit during earthquake shaking, transferring forces across connections and preventing separation. The building must be well connected to a good foundation and the earth. Wet, soft soils should be avoided, and the foundation must be well tied together, as well as tied to the wall. Care must be taken that all materials used are of good quality, and are protected from rain, sun, insects and other weakening actions, so that their strength lasts. Unreinforced earth and masonry have no reliable strength in tension and are brittle in compression. As a rule, they should be reinforced accordingly with steel or wood.

2. METHODOLOGY

The main building in the hills is a small complex with a house. Therefore, the focus of this paper is to study G + 4 and G + 7 buildings and understand their seismic response under cross-brace and diagonal brace, and compared to the last unbraded building. That is. A total of 6 models are created in STAAD pro and analyzed using the response spectrum method.

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BUILDING MODELS

Building (Floors/Bracing)	G + 4	G + 7
Unbraced	Model – 1	Model – 1
Cross-bracing	Model – 2	Model – 2
Diagonal bracing	Model – 3	Model - 3

DESIGN PARAMETERS

Site condition	Jammu and Kashmir
Seismic zone	IV
Frame	SMRF
Importance factor	1
Codes	IS:456 , IS:800 , IS-1893 (Part -1), IS 875 (Part 1 - 4)
Soil condition	Hard
Software used	STAAD pro
Loads	Dead load, Live load , Wind load, Seismic load
Analysis method	Response spectrum method

Shows the characteristics of the building frame members to be analyzed.

Analysis Method The analysis is based on the following assumptions.

- The modulus of elasticity and Poisson's ratio are 25000 N / mm2 and 0.20, respectively.
- Side effects PΔ, contraction and creep are not considered.
- The soil membrane is rigid in its plane.
- Axial deformation of the column is taken into account.
- Each node in the frame has 6 degrees of freedom, 3 translations, and 3 rotations.
- Torsion is considered according to IS: 1893 (I) –2002.
- The material is homogeneous, isotropic and elastic

Response Spectrum Analysis (RSA)

Seismic analysis of all buildings is performed by the response spectrum method using IS: 1893 (I) –2002 [2]. This includes the effect of eccentricity (static + random). Other parameters used in seismic analysis are temperate seismic zone (IV), zone factor 0.24, importance factor 1.0, 5 ° mping and assuming a moment-sustaining framework common to all building configurations and heights. The response reduction factor is 3.0. Appropriate modes (at least 6) were considered for each construction case where the total modal mass of all modes is at least 99% of the total seismic mass. The bar force for each contribution mode with dynamic load was calculated and the modal response was combined using the CQC method. The following design spectra were used in the response spectrum analysis.

Load combinations -

Load Combinations are taken as per IS 1893 and are as follows:

In the limit state design of reinforced and pre-stressed concrete structures. Auto Load combination option of STAAD pro is used in this thesis.

Analysis of results

All buildings have been analyzed for seismic load with an effect of accidental eccentricity. The seismic force was applied in X direction and Z direction independently. Important results are presented in the subsequent sections.

Displacement Of G + 4 & G +7 In X And Z Direction

G + 4 CB DISPLACEMENT	G + 4 DB DISPLACEMENT	G + 4 DISPLACEMENT	G + 4 CB DISPLACEMENT	G + 4 DB DISPLACEMENT	G + 4 DISPLACEMENT
X mm	X mm	X mm	Z mm	Z mm	Z mm
0.8	0.908	2.12	1.6	2.2	2.5

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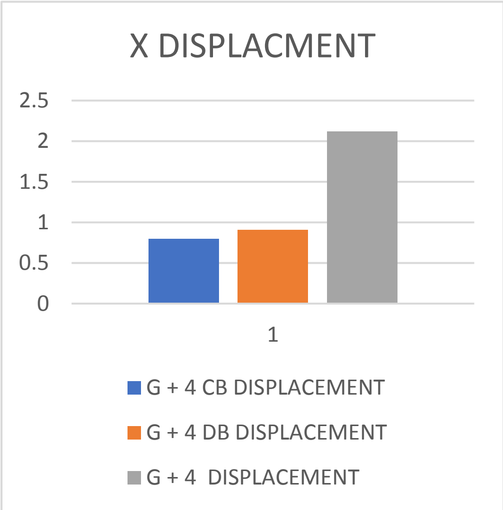
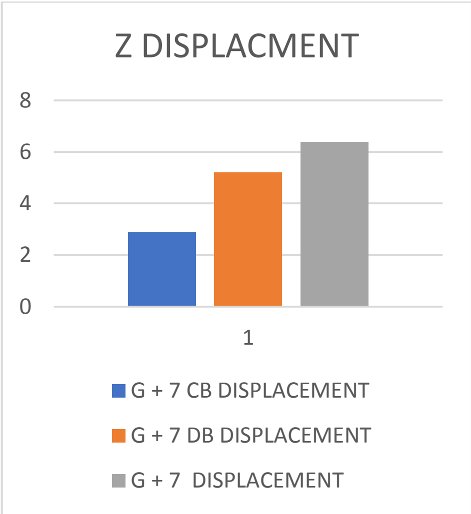
G + 7 CB DISPLACEMENT	G + 7 DB DISPLACEMENT	G + 7 DISPLACEMENT	G + 7 CB DISPLACEMENT	G + 7 DB DISPLACEMENT	G + 7 DISPLACEMENT
X mm	X mm	X mm	Z mm	Z mm	Z mm
1.729	1.956	2.116	2.9	5.19	6.383

Displacement of g+7 in x & z direction





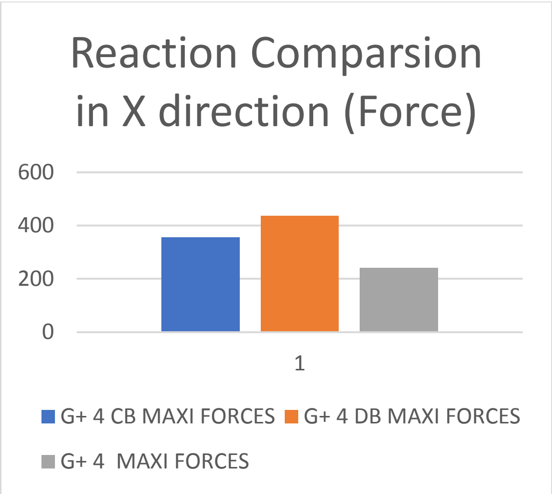
Displacement In X & Z Direction

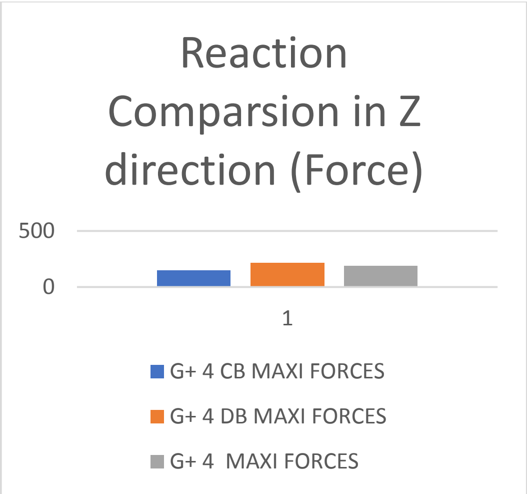
Comparison Of Reaction (Force) In X And Z Direction

G+ 7 CB MAXI FORCES	G+ 7 DB MAXI FORCES	G+ 7 MAXI FORCES	G+ 7 CB MAXI FORCES	G+ 7 DB MAXI FORCES	G+ 7 MAXI FORCES
Fx kN	Fx kN	Fx kN	Fz kN	Fz kN	Fz kN
887.425	1169.22	365.48	413.09	590.06	271.09

Reaction In G + 4 Building

Reaction In G + 7 Building





Reaction Comparison In X & Z Direction

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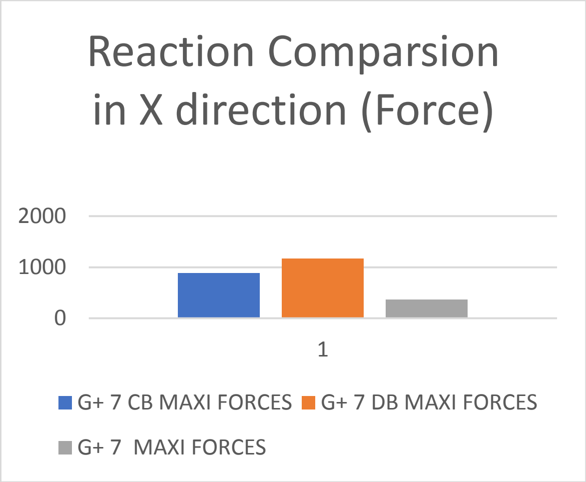
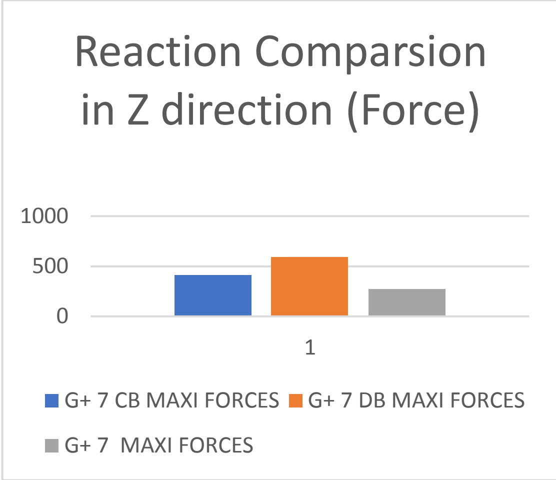


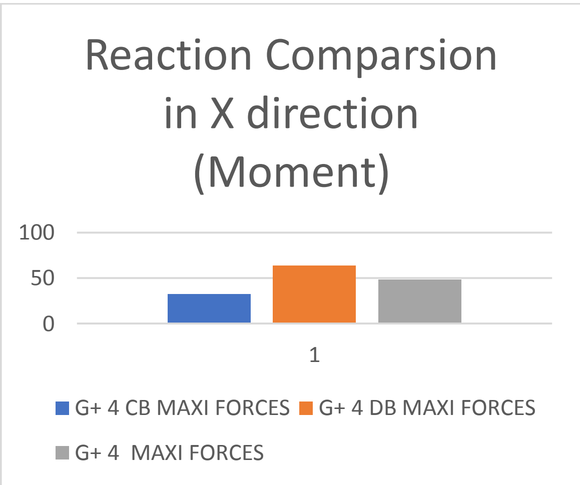


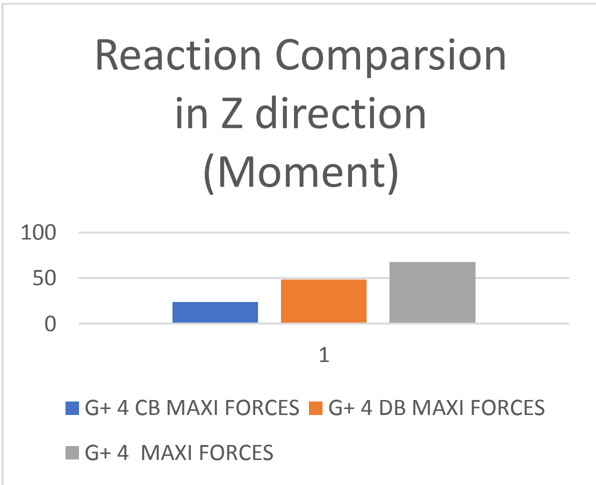
Reaction Comparison In X & Z Direction

Comparison Of Reaction Moment In X And Z Direction

Moment Table For G +4

G+ 4 CB MAXI FORCES	G+ 4 DB MAXI FORCES	G+ 4 MAXI FORCES	G+ 4 CB MAXI FORCES	G+ 4 DB MAXI FORCES	G+ 4 MAXI FORCES
Mx kN-m	Mx kN-m	Mx kN-m	Mz kN-m	Mx kN-m	Mz kN-m
32.118	63.66	48.335	23.85	48.33	67.731





Moment Comparison In X & Z Direction

Moment In G + 7 Building

G+ 7 CB MAXI FORCES	G+ 7 DB MAXI FORCES	G+ 7 MAXI FORCES	G+ 7 CB MAXI FORCES	G+ 7 DB MAXI FORCES	G+ 7 MAXI FORCES
Mx kN-m	Mx kN-m	Mx kN-m	Mz kN-m	Mx kN-m	Mz kN-m
56.82	90.236	88.93	39.78	45.161	96.696

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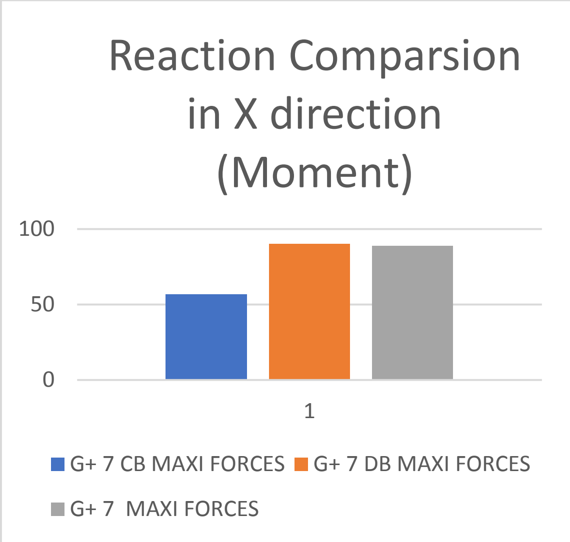
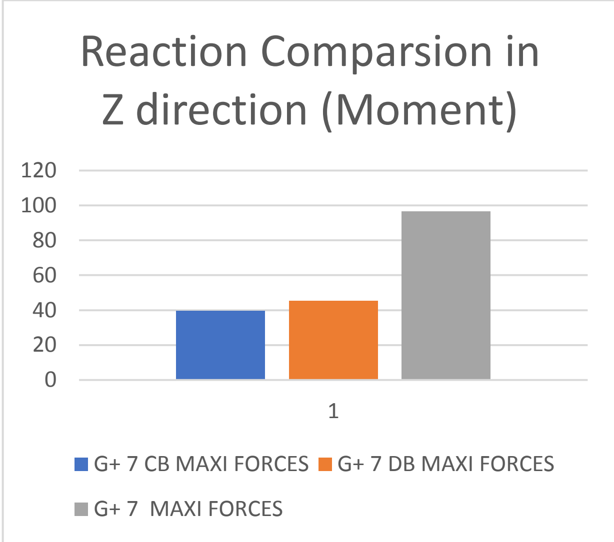




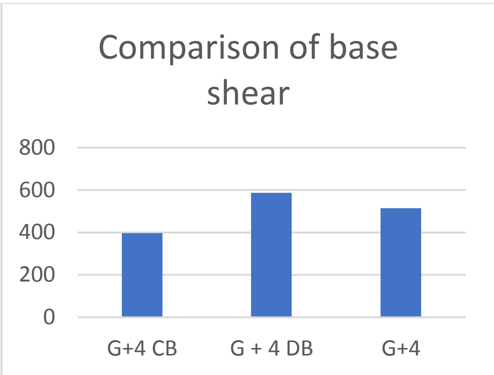
Moment Comparison In X & Z Direction

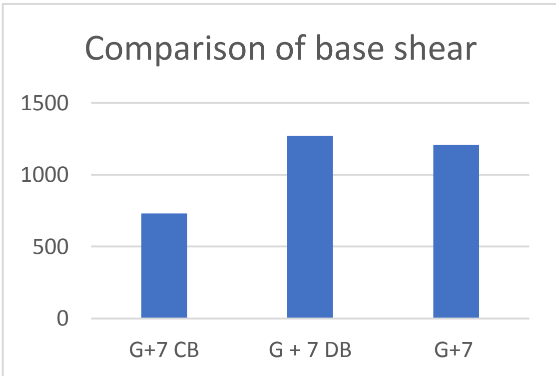
Base Shear

BASE SHEAR IN G + 4 & G+7 BUILDING

G+4 CB	395.7
G + 4 DB	586.2
G+4	513.92

G+7 CB	731.87
G + 7 DB	1269.82
G+7	1208.35





Comparison Of Base Shear In G + 4 & G+7 Building

3. CONCLUSION

After careful, computational analysis of all the different building models and bracing system it can be concluded that cross bracing system work more efficiently as it give minimum displacement, drift and member forces. Since cross bracing distribute more uniform forces through out the structure as well as provide more stiffness to the building frame hence very effective to the lateral stability of the building. Hence such bracing configuration may be very good for the Mid-rise building to be constructed in hilly area. Where as diagonal and unbraced system more or less perform very similar.

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