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Performance of RCC Building having Shear Wall Braced with Steel Bracings

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Abstract: Due to improvement of behaviour of high rise structure, there is always a challenge for architecture and designer to select suitable structural systems. While selecting Structural systems one should have to understand the behaviour of structure in various aspects in terms of economy, resistance of structure, appearance of structure etc. So there is + to study of behaviour of various structural systems in building. The paper concentrates to study the behaviour of G+20 RCC Residential irregular building in seismic zone IV; the aim of this study to investigate the behaviour of Shear wall System braced with bracings.
Keywords: Structural systems, Shear wall, Diagonal Bracing, Cross Bracing, Chevron bracing, Irregular building.

I. INTRODUCTION

Due to advancement of Tall Building, the growth of multi-storey building in the last several decades is seen as the part of necessity for vertical extension for residence and business in leading downtown. Engineering of Tall Building requires the use of different systems for different building height range, beyond which a different system is required. The necessity of these system and their ranges of application and the premium that would result in extending their ranges is indispensable for successful solution of a tall building. For Building to be successful at a minimum the structure should employ systems and material appropriate to the building's height and configuration. To meet requirement of Tall building that is safety and least deterioration structure should sufficient ductile, stiff and have tolerable lateral strength. The Structural system which resist loads due to seismic and wind effect for RCC framed Structure is needed to analyse. For medium high rise RCC building, RCC shear wall frame or Steel braced frame could be option for designer among different structural system. In past, various researches were done on the effects of Steel Bracing and Shear Wall on seismic performance on regular and irregular building. Therefore, these structural systems engage to analysis and study the performance under seismic effect. This paper concentrates the suitability of different kind of structural system, for this purpose , a G+20 storey actual building in Gurgaon, Delhi which is in seismic zone IV is considered for study, modelled with Shear wall retrofitted with bracing such that two shear walls that are braced all through height. The behaviour of building is determined by comparing and observing analysed results for different models by Response spectrum method of analysis.

II. MODELLING AND MATERIAL SPECIFICATION

Total three models, First model is G+20 Storey having Shear Wall braced with Diagonal Steel Bracing named as MODEL 1, Second model is same building having Shear wall Braced with Cross Bracing named as MODEL 2 and third model having Shear Wall braced with Chevron Bracings named as MODEL 3. All models are drawn according to similar plan using software package , ETABS 2015:15.2.0. , total height is 77.575 m, table 2.1 shows storey height of building

Table 2.1 Storey Height

Name	Height(mm)
Tank Level	3000
Terrace To 2nd Storey	3300
1st Storey & Stilt Level	4000
Basement-1	4000
Base	0

. Building has beam of size 230mm x 450 mm, 230 mm x 600 mm and 300mm x 600 mm using M25 grade concrete, column of size 300mm x 750mm and300 mm x 750 mm using M 35 grade concrete, Shear Wall of size 230,250 and 300mm in thickness, Slab are

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130,150 and 275 mm in thickness material used is M 25 concrete. Section Shape of column and beam are rectangular.ISA 90 x 90 x 8 mm double angle connected back to back is used for Bracing. Material properties are mentioned in table 2.2. Analysis is done by Response Spectrum Method

Table 2.2 Material Properties

Name	Type	Modulus of Elasticity MPa	Unit Weight kN/m³	Design Strength MPa
Fe415	Rebar	200000	76.9729	Fy=415 (Yield Strength)
Fe500	Rebar	200000	76.9729	Fy=500 (Yield Strength)
M25	Concrete	25000	24.9926	Fc=25 (Compressive Strength)
M30	Concrete	27386.13	24.9926	Fc=30 (Compressive Strength)
M35	Concrete	29580.4	24.9926	Fc=35 (Compressive Strength)

A. Plan of Building

Plan is kept same for all storey of building and all models are drawn according to this plan

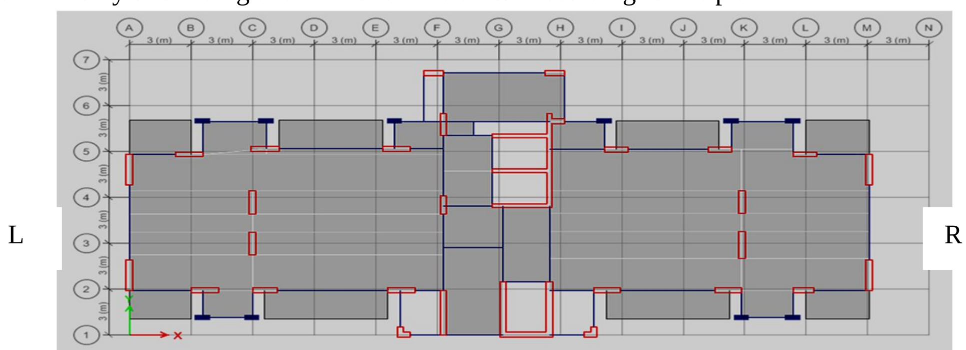
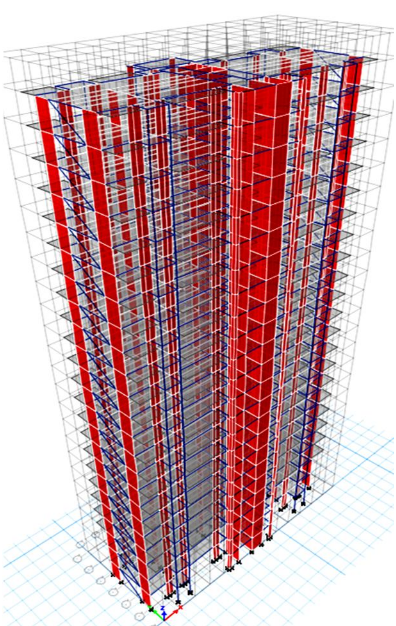
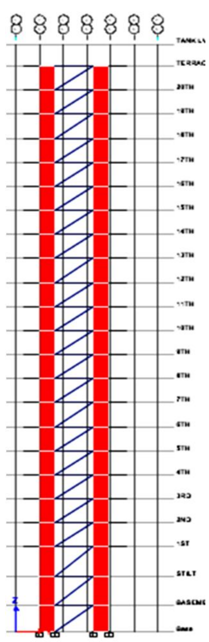


Fig 2.1 Plan View of Building

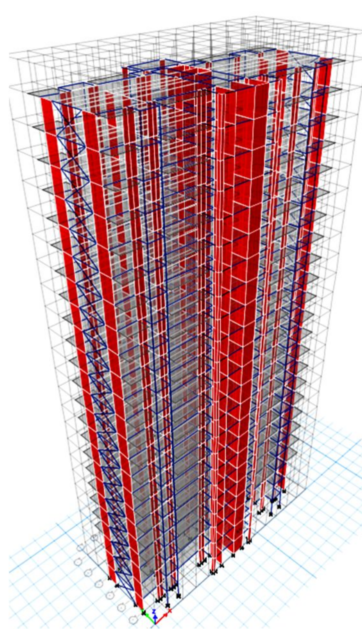
B. Model Details



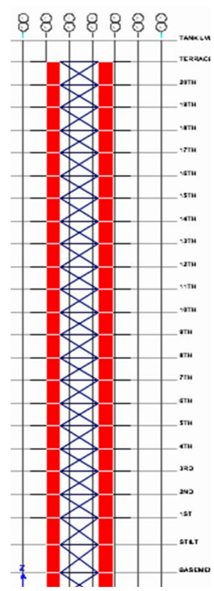
(A). 3-D View



(B) Elevation from face L and R



(C) 3-D View



(D) Elevation from face L and R

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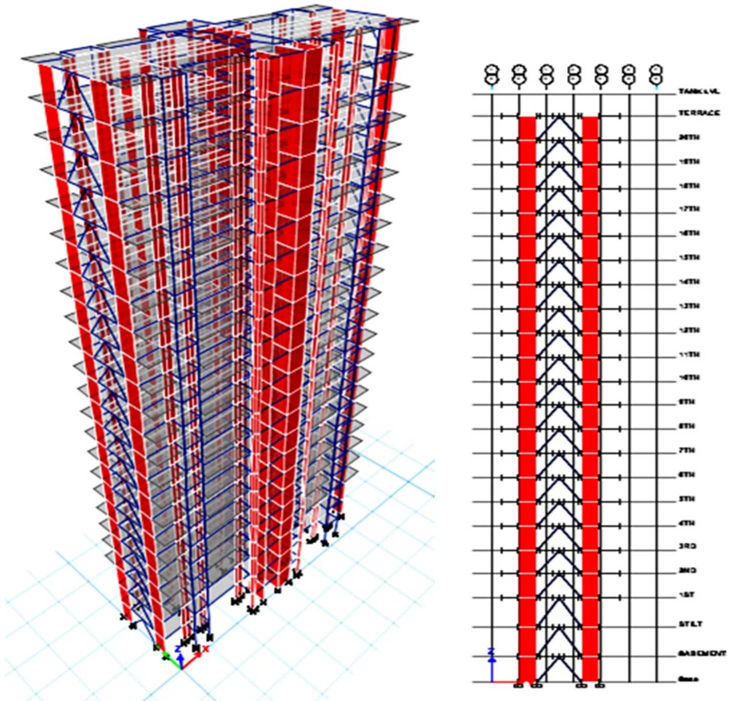

(E) 3-D View (F) Elevation from face L and R

Fig 2.2- A & B – Model 1, C&D - Model 2, E &F Model 3

II. LOADING DETAILS

Static Loads and Seismic Parameters considered for analysis are mentioned in table 3.1 and table 3.2 respectively

Table 3.1 Static Loading as per IS 875 Part 2

load name	load type	details	value
dead	dead load	self weight of structural members calculate automatically using self weight multiplier in etabs	
		uniform loads on slab : floor finish loads (60 mm thick flooring) + partition load	1.5 kn/m^2
		uniform load on beams: wall load	13.5 kn/m^2
live	imposed load	balcony, lobby	3 kn/m^2
		rooms	2 kn/m^2
		parking area	5 kn/m^2

Table 3.2 Seismic Parameter

Parameter	Values
Damping	0.05
Modal Combination	CQC
Seismic Zone IV (Z)	0.24
Importance factor (I)	1
Response reduction factor	5
Time period Calculation	1.96 sec

Load Combination
1.5 D.L
1.5 D.L + 1.5 L.L
1.2 D.L + 1.2 L.L ± 1.2 EQx
1.2 D.L + 1.2 L.L ± 1.2 EQy
1.5 D.L ± 1.5 EQx
1.5 D.L ± 1.5 EQy
0.9 D.L ± 1.5 EQx
0.9 D.L ± 1.5 EQy

III.RESULTS

A. Base Shear

Base shear for models are shown in table 4.1

Table 4.1 Base Shear

Base Shear (KN)	
Model 1	3046.475
Model 2	3047.419
Model 3	3046.855

B. Time Period

Time period as per as IS 1893:2002 part 1 clause no 7.6.1 for RC frame Building ,is equal to

Ta $= 0.075\, h^{0.75}$ Where, h is height of building in metre

$= 0.075 \times (77.575)^{0.75}$

$= 1.96$ sec.

Time period from modal analysis is presented in table 4.2

Table 4.2 Modal Period

Model	Modal period from First mode shape
MODEL 1	2.37sec
MODEL 2	2.33sec
MODEL 3	2.34sec

C. Storey Forces

1) Shear Force **:** Storey wise Maximum Shear force for all models in both direction X and Y are represented by graph in Fig. 4.1 and 4.2

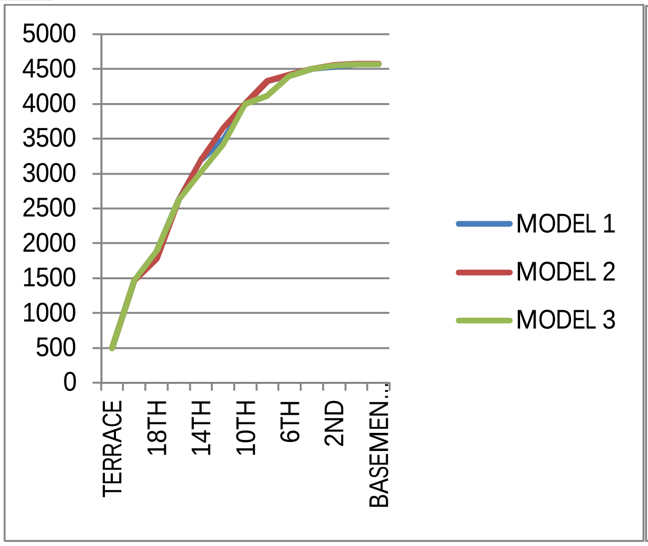

Fig.4.1 Shear force in X Direction

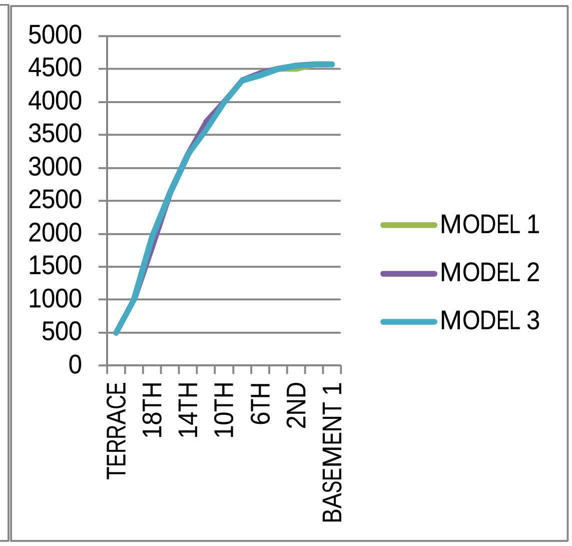

Fig 4.2 Shear Force in Y Direction

2) Torsion: Maximum Torsion from each storey for all model represented with the help of graph in Fig. 4.3

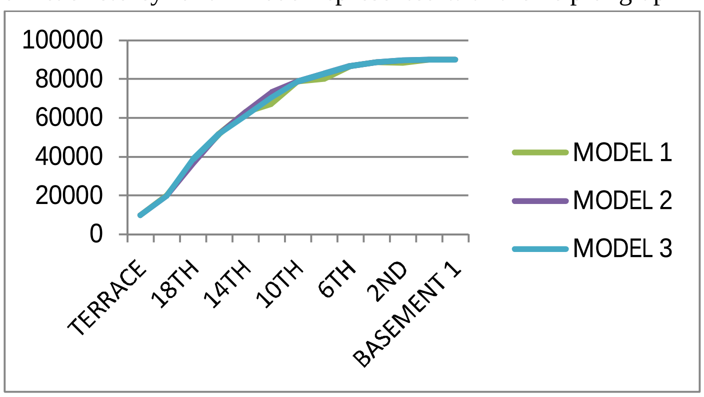

Fig. 4.3 Maximum Storey wise Torsion

3) Moments : Storeywise Maximum Moments for all Model in both direction X and Y is represented in the form of graph in Fig 4.4 and 4.5

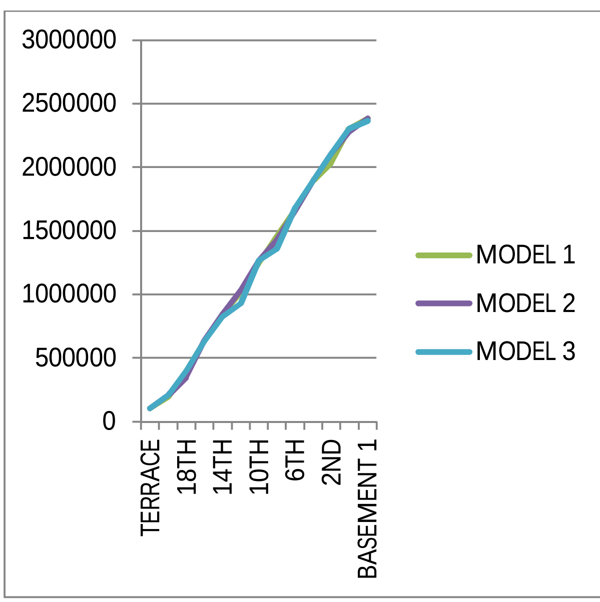

Fig 4.4 Maximum moment in X Direction

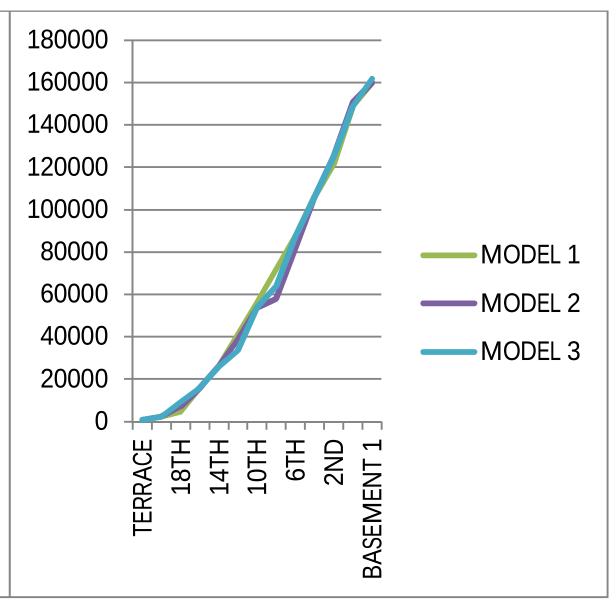

Fig 4.5 Maximum Moment in Y Direction

D. Storey Drift

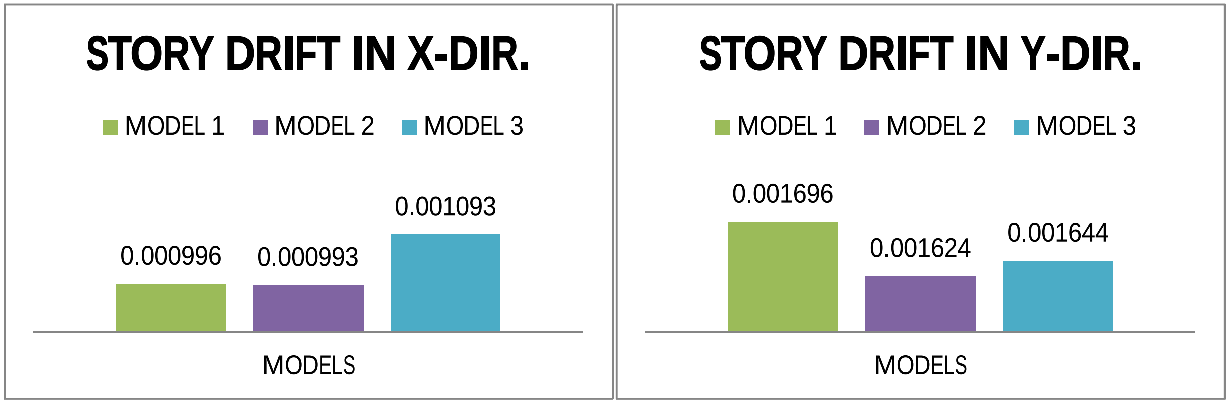

Fig 4.6 Storey Drift

E. Terrace Deflection

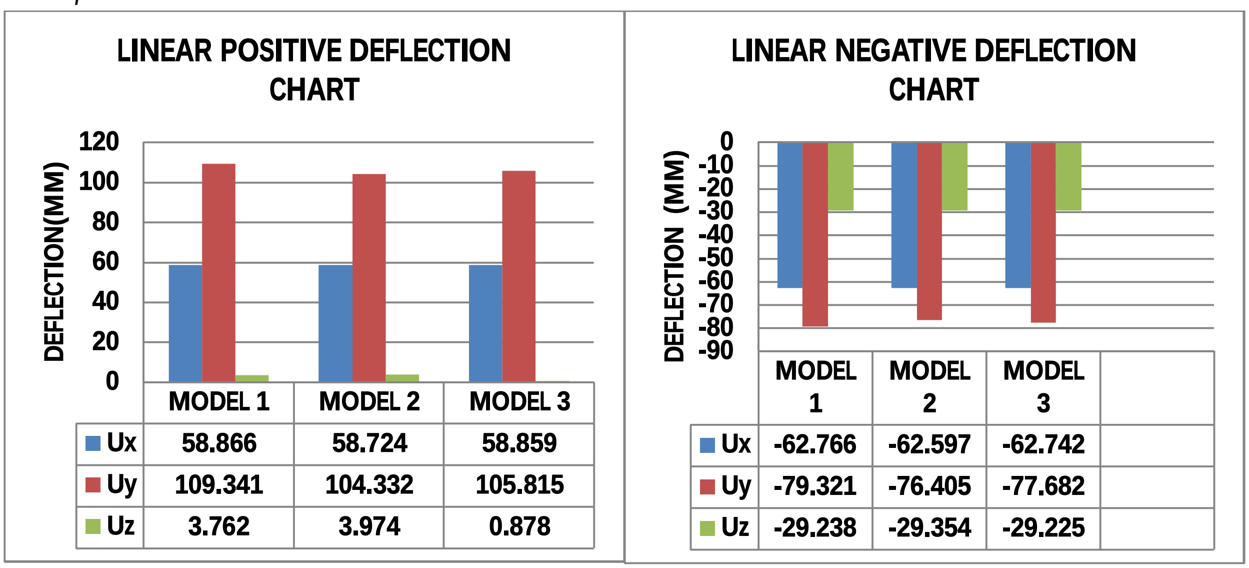

Fig 4.7 Maximum Terrace Deflection

IV. CONCLUSION

A. The idea of using steel bracing is one of the advantageous concepts which can be used to strengthen or retrofit the existing structures.

B. Steel bracings can be used as a substitute to the other strengthening or retrofitting techniques available as the total weight on the existing building will not change considerably.

C. Steel bracings decrease flexure and shear demands on beams and columns and transfer the lateral loads through axial load mechanism.

D. The lateral displacements of the building studied are reduced by employing X type of bracing systems.

E. The building frames with X bracing system will have minimum probable bending moments in comparison to other types of bracing systems.

F. Using steel bracings the total weight on the existing building will not change extensively.

G. The lateral displacement of the building is reduced by the use of X type steel bracing system, and X bracing type reduced maximum displacement.

V. ACKNOWLEDGMENT

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