Studies In Retrofitting of Typical RC Framed Building With The Help of Bracing

Monali Wagh[1], Anshul Nikhade[2], Harshal Nikhade[3]
[1,3] Professor, Civil Department, Y.C.C.E., Nagpur.
[2]Professor, Civil Department, K.D.K.C.E., Nagpur.

Abstract- *In present world many existing reinforced concrete structures are inadequate for taking seismic loads. Many existing reinforced concrete buildings needs to retrofit to overcome the deficiencies to resist seismic loads. During the late decade have indicated that Recent earthquakes which occurred, major damage occurred was not directly due to actions of earthquakes but due to poor performance of structures during earthquakes. Many existing reinforced concrete buildings need to retrofit to overcome the deficiencies to resist seismic loads. It is recognized that the most effective method of reducing the risk of damaging structure is seismic retrofitting. Steel braced frame is one of the structural systems used to retrofit multi-storeyed buildings. The use of steel bracing systems for strengthening or retrofitting seismically inadequate reinforced concrete building is abest solution for enhancing earthquake resistance. A G+6 storey building is analysed for seismic zone IV as per IS 1893(Part 1):2002 using ETABS 2017 software in the present study. The bracing is provided for peripheral columns. The building is analysed for models with X type bracing and compared with un-braced structure.*

Keywords- Seismic performance, ETABS, steel bracing, Retrofitting, Strengthening, RC building

I. INTRODUCTION

India is one of the most earthquake prone countries in the world and has experienced several major or moderate earthquakes during the last 15 years. About 50-60% of the total area of the country is vulnerable to seismic activity of varying intensities A large number of existing buildings in India are severely deficient against earthquake forces and the number of such buildings is growing very rapidly. Hence it is necessary to avoid such damages to the buildings causes due to earthquakes and these damages can be repair by retrofitting. Retrofitting can be done by various methods such as steel bracing, jacketing, adding shear wall, adding wing wall, mass reduction, base isolation, mass dampers.

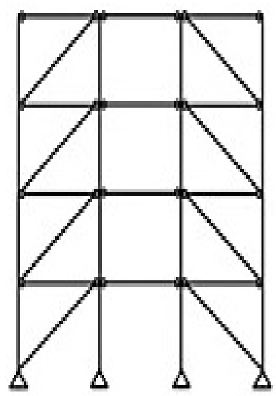
Now days steel bracing is the most common method which is used for retrofitting. Braced structures are known to be efficient structural systems for building under seismic loadings. In this paper first of all we design a building with the normal loads and calculated the results, after that we considered the seismic loads and calculated the results and due to the seismic loads, the building failed. Therefore, we used steel bracing to retrofit the building, calculated the results and compared these results with un-braced building.

Introduction To Bracing

Bracing is a very effective global upgrading strategy to enhance the global stiffness and Strength of steel and composite frames. It can increase the energy absorption of structures and/or decrease the demand imposed by earthquake loads. A braced frame is a structural system commonly used in structures subject to lateral loads such as wind and seismic pressure. The members in a braced frame are generally made of structural steel, which can work effectively both in tension and compression. The beams and columns that form the frame carry vertical loads, and the bracing system carries the lateral loads. The positioning of braces, however, can be problematic as they can interfere with the design of the façade and the position of openings. Buildings adopting high-tech or post-modernist styles have responded to this by expressing bracing as an internal or external design feature.

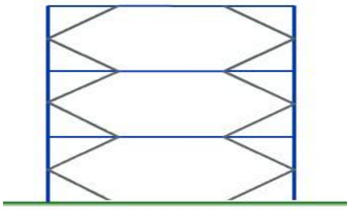
II. TYPES OF BRACING

Single diagonals

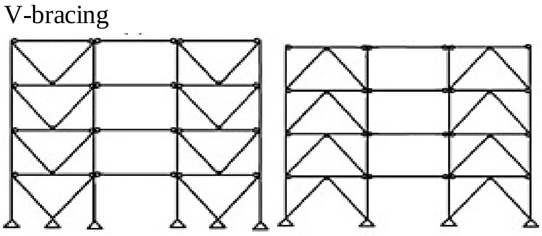


Cross-bracing

K-bracing



V-bracing

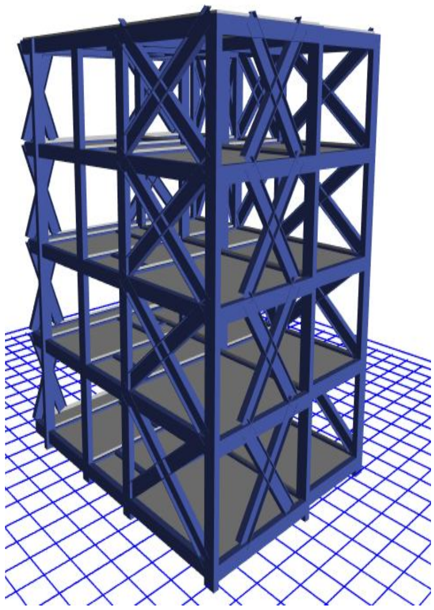


III. MODELLING IN ETABS SOFTWARE

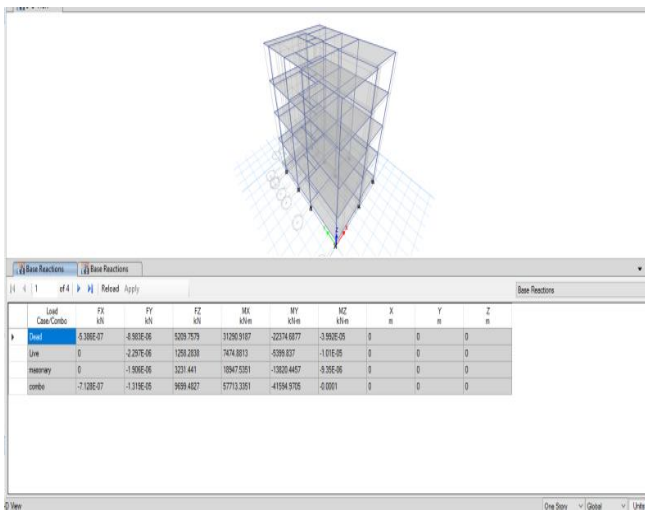
ETABS is a programme which is used for linear, nonlinear, static and dynamic analysis, and also for design of building systems. Modelling tools and templates, code-based load prescriptions, analysis methods and solution techniques, all coordinate with the grid-like geometry unique to this class of structure. Basic or advanced systems under static or dynamic conditions may be evaluated using ETABS. The innovative and revolutionary new ETABS is the ultimate integrated software package for the structural analysis and design of buildings. With the help of ETABS, analysis and design of building can be done easily in short period. ETABS provides bracing of different type of material which can be used for retrofitting of the any building.

G+4 building with steel bracing are analyzed by using ETABS 2015 with M25 and M30 grade of concrete. Building is retrofit by using X steel bracing.

Type of structure - Residential building
Number of stories - 4storey
Floor height - 12 m
Live Load - 2.5 KN/m2
Dead Load - 4 KN/m2
Masonry Load - 13.8KN/m2
Materials - M25, M30 concrete &Fe415, Fe250 steel
Size of beam - 230 mm x 400 mm
Size of column - 230 mm x 450 mm
Depth of Slab - 120mm
Seismic zone - IV
Zone factor - 0.24
Sub-soil type - Medium
Importance factor - 1
Response reduction factor – 5

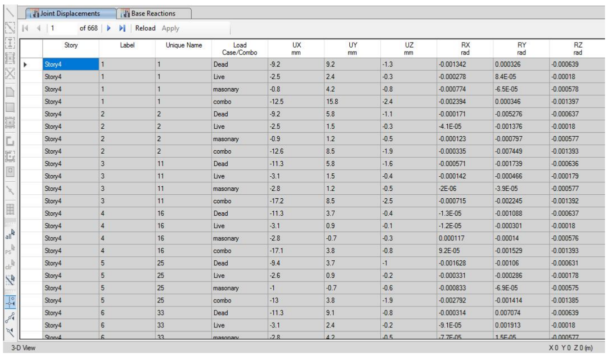


IV. RESULTS

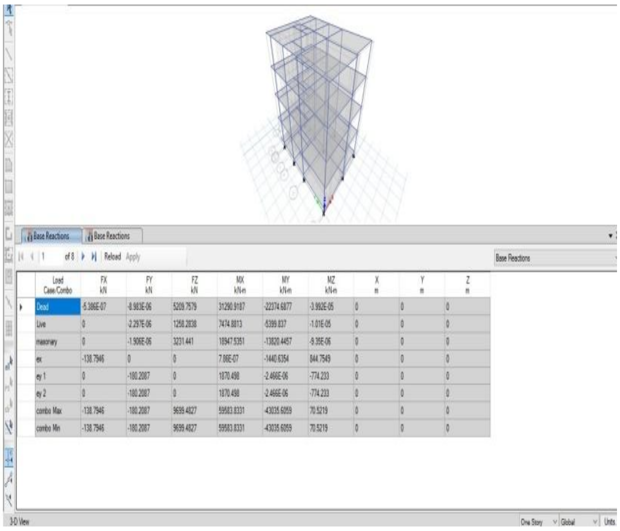


Load Case/Combo	FX kN	FY kN	FZ kN	MX kN-m	MY kN-m	MZ kN-m	X m	Y m	Z m
Dead	-5.386E-07	-8.983E-06	5209.7579	31290.9187	-22374.6877	-3.992E-05	0	0	0
Live	0	-2.297E-06	1258.2838	7474.8813	-5399.837	-1.01E-05	0	0	0
masonry	0	-1.906E-06	3231.441	18947.5351	-13820.4457	-9.35E-06	0	0	0
combo	-7.128E-07	-1.319E-05	9699.4827	57713.3351	-41594.9705	-0.0001	0	0	0

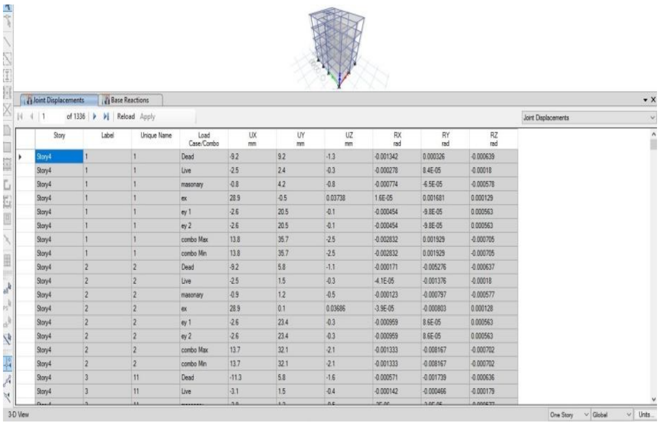
Ideal Model- Base Reaction Readings



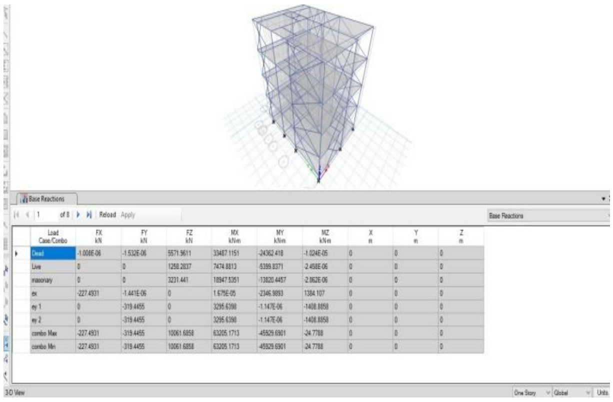
Ideal Model- Joint Displacement Readings



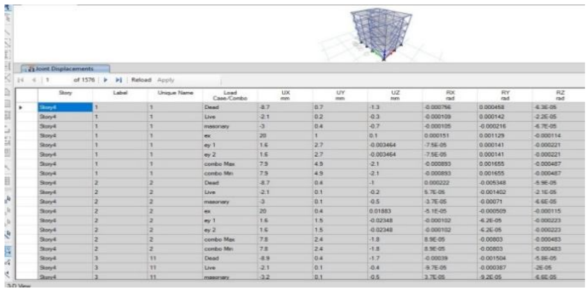
Model with Seismic Load- Base Reaction Readings.



Model With seismic load- Joint displacement reading



Model With Bracing- Base Reaction Reading.



Model with Bracing- Joint Displacement Readings.

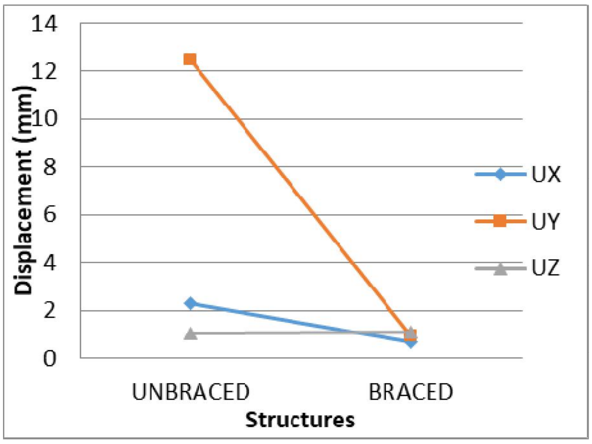
Unbraced Building (With Seismic Load)

STOREY	UX	UY	UZ
Storey4	3.45	24.65	1.975
Storey3	3.75	19.275	1.85
Storey2	2.9	12.65	1.525
Storey1	1.3	5.55	0.00161
Plinth	0.03746	0.225	0.00072
unbraced	2.287	12.47	1.0704

Braced Building (With Seismic Load)

STOREY	UX	UY	UZ
Storey4	1.625	1.95	1.8
Storey3	0.70	1.4	1.7
Storey2	0.7	0.9	0.9
Storey1	0.3	0.45	0.9
Plinth	0.035	0.15	0.2
unbraced	0.672	0.97	1.1

STRUCTURE	UX	UY	UZ
UNBRACED	2.287	12.47	1.0704
BRACED	0.672	0.97	1.1



Comparison of displacement between braced and unbraced structure

V. CONCLUSION

1. The displacement of the structure decreases after the application of bracing.
2. The concept of using steel bracing is one of the advantageous concepts which can be used to strengthen the existing structure.
3. The base reactions of the structure decrease using bracings.
4. The displacement in braced structure decreases by 82.67% with respect to unbraced structure.

REFERENCES

[1] Kalam A.L. et al. (2017), "Methods Of Seismic Retrofitting By Using Etabs Software", International Journal of Civil Engineering and Technology (IJCIET) Volume 8, Issue 5, May 2017, pp. 94–99.

[2] Aggrawal P., Shrikhande M., "Earthquake Resist Design of Structure", PHI, New Delhi.

[3] IS 456:2000, "Plain and Reinforced Concrete-Code of Practice" (Fourth Revision), Bureau of Indian Standards (BIS), New Delhi.

[4] IS 800:2007, "General Construction in Steel-Code of Practice" (Third Revision), Bureau of Indian Standards (BIS), New Delhi.

[5] IS 1893:2002, "Criteria for Earthquake Resistant Design of Structure" Part-1 General Provisions and Buildings (Fifth Revision), Bureau of Indian Standards (BIS), New Delhi

[6] Sharma R, et al. "Seismic Analysis And Retrofitting Of A Multi-Storey Rc Building" International Research Journal of Engineering and Technology(IRJET), Volume: 05 Issue: 05 | May-2018, 2395-0056.

[7] P Safvana, S Anila, "Seismic analysis of Braced RCC structures using ETABS software" International Journal of Advance Research, Ideas and Innovations in Technology Volume 4, Issue 2,1183-1185.