Analytical Study on Horizontal Irregularities in Rcc Structures with Lateral Bracings under Seismic Forces

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Abstract - *Structures in high seismic prone areas may be susceptible to severe damage in a major earthquake. For the variety of structures and possible deficiencies that arise, several retrofitting techniques can be considered. The retrofitting is of two types global retrofit technique and local retrofit, global retrofit technique is further classified into conventional technique and non-conventional technique. In our study, the X type bracings are used for horizontal irregular shaped structure. A model of G+9 storeys are considered with irregular shaped structure like Square, L shape, T shape C shape, a comparison of structural behaviour in terms of base shear, storey displacement characteristics are carried out with 8 different type of models with X type of bracings. These frames are known to be efficient structural systems for buildings under high lateral loads such as seismic loadings. The fact that the lateral resistance of frame can be significantly improved by the addition of this technique has led to the idea of retrofitting seismically inadequate reinforced concrete frames. The equivalent static analyses are carried out for the evaluation of seismic forces using ETAB 16.0.3 From the results it was seen that the seismic performance of regular frame is found to be better than corresponding irregular frames in nearly all the cases.*

Key Words: **Horizontal Irregularities, Lateral resistive system, Bracings, Base Shear, Storey Displacement, Time peroid**

1. INTRODUCTION

In recent decades, India is one of the fastest developing and competing countries, which requires demand in Infrastructure facilities for the development of the country and also for growth of the population. Due to increase in population demands to fulfil basic facilities like Shelter, Water etc. These demands of land for housing and other commercial purposes, this has been result in the lack availability of land to come over this problem, Vertical development of building is being adopted, that is Multi-storey Structures.

The structures that are having height more than 30 meters are called Multi-storey Structures. Multi-storey structures are made to provide for different purposes connected with Residential and Commercial / Public Offices. The structure should sustain the loads coming on them during service life of structure by providing required strength and it should limit the deformation by possessing required stiffness. Multi-storey structures are most of the time subjected to lateral loads they are Earth quake load, Wind load or Combination of Both loads along with Gravity loads i.e. Dead Load, Live Load and Super Dead Load.

The main purpose of Framed Structures is to transfers the Gravity Loads and Lateral Loads to foundation and it pass to the earth. The Columns and Beams are used to transfer the major portion of the gravity loads and some part of lateral loads. That is not applicable to the stability of structure because due to earth quake waves, deformations will occur across the elements of the load-bearing framed structural system as it shows the effects of response of building to the earth quake motion. It can be reduced by providing following retrofitting system they are, Bracing System, Shear wall and Dampers. In this project G+9 storey building with 6x6 bays which is located at earthquake zone V for Soft soil conditions has been analysed for gravity load and earthquake load using ETABS design software

1.1 Bracings effect on structure

Steel bracing is most effective and economical way of retrofitting technique to resist lateral forces in framed structures. Bracing retrofitting technique has been adopted in majority of multi-storey buildings has it requires less space, provides obliged quality and bracing has flexibility to achieve the required strength and stiffness. The bracing system increases the stiffness of structure with less added weight to the structure, because of this it is very useful for the existing building, which building will be under lateral stiffness problem. Most of the times the braces will provided in vertical aligned spans. Bracing is efficient as they function is diagonal in axil stress and due to this function, size of member less than that are provided for stiffness against horizontal shear

1.2 Horizontal Irregularities

Buildings are described as regular or irregular in terms of their size and shape, arrangements of structural elements and mass. Regular building is almost symmetrical (in plan and elevation) about the axis and have uniform distribution of lateral force –resisting structure such that it provides a continuous load path for both gravity and lateral loads. A building that lacks symmetry having discontinuity in geometry, mass or load resisting element is called irregular building. These irregularities may cause interruption of force flow and concentration of stresses. Plan/Horizontal irregularities which refer to asymmetrical plan shape (L, T, U, C, F) or discontinuous in horizontal resisting elements (diaphragms) such as cut-outs, large openings, re-entrant corners etc. resulting in torsion, diaphragm deformation and stress concentration.

2. Description of Building

In this study RC structure of G+9 storey has been considered for model and analysis purpose. The building has been designed as per Indian standard codes is 456-2000 (plain and strengthened concrete-code of practice) and is 1893-2002(criteria for earthquake resistant design of structures).

Table -1: Building Description

Zone	V
Zone Factor	0.32
Response Reduction Factor	5
Importance Factor	1
Soil Condition	Soft soil
Building Height	45 m
Column Details	300x600 mm
Beam Details	300x450 mm
Bracing	X-Bracing System
Slab Thickness	150 mm
Floor to Floor Height	3 m
Plan	30X30 m
Each Bay in X-Direction	5 m
Each Bay in Y-Direction	5m
Grade of Steel	Fe500
Grade of Concrete	M25
Bracing	ISA 200X200X15mm

3. Structural Modelling and Analysis

In this project, RC structural building of G+9 storeys with square 6x6 bays of dimensions 5 meter in both the direction. Each floor is having common height 3 meters from floor to floor level. The building is located at seismic zone V and soil conditions are soft soil. Totally 8 modelled were analysed is this study

Table -2: Models

Model 1	Square model
Model 2	Square model with X-Bracings at outer peripheral
Model 3	L model
Model 4	L model with X-Bracings at outer peripheral
Model 5	T model
Model 6	T model with X-Bracings at outer peripheral
Model 7	C model
Model 8	C model with X-Bracings at outer peripheral

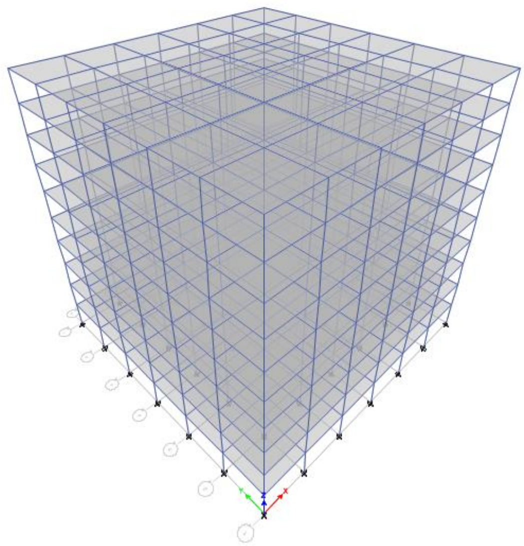

Fig 1: Model 1

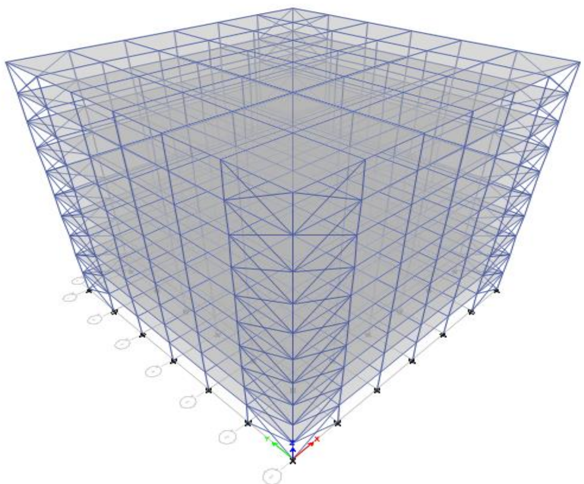

Fig 2: Model 2

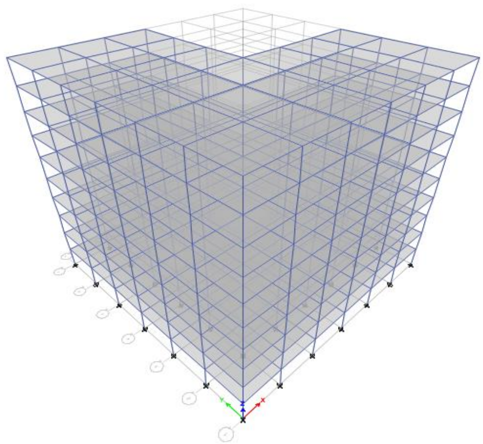

Fig 3: Model 3

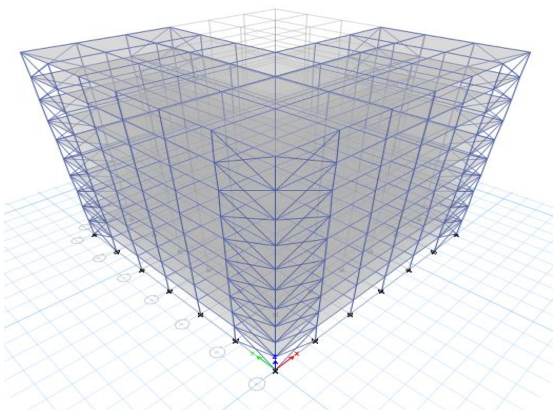

Fig 4: Model 4

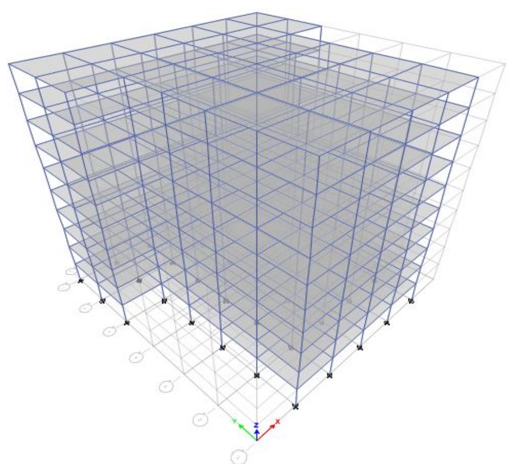

Fig 5: Model 5

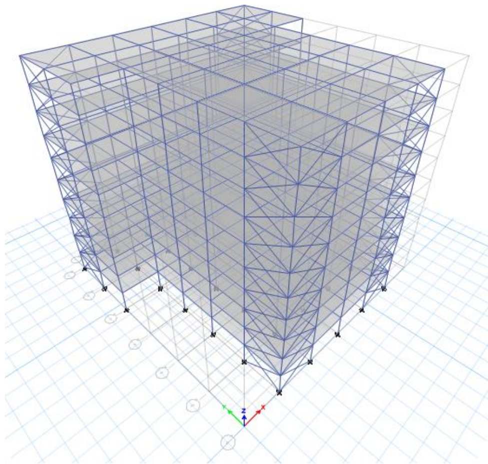

Fig 6: Model 6

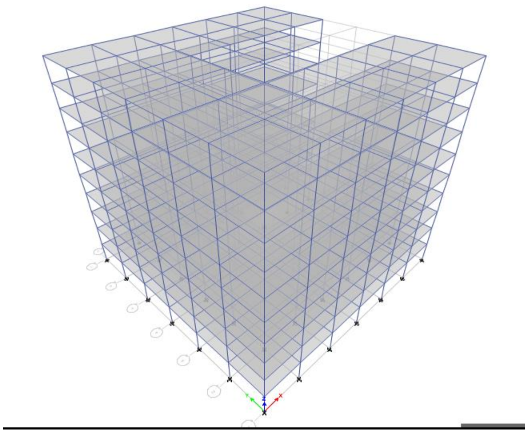

Fig 7: Model 7

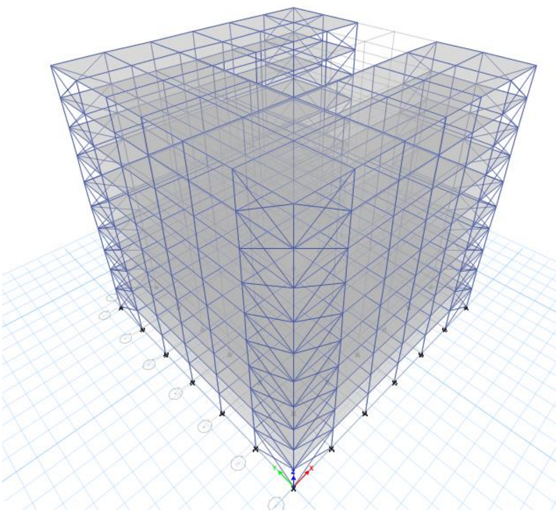

Fig 8: Model 8

3.1 Objective of Study

I. To know the behaviour of Linear static analysis of RC frame building using ETABS under seismic forces.

II. To know the behaviour of floors and bays of RC frame structure due to the seismic effect in the building.

III. To know the seismic behaviour of RC frame building with the improvement on property of members.

IV. To know the effect of X type bracings in RC frame structures.

V. To obtain the results as per IS 1893:2002 by using Equivalent Static Method.

VI. To find the base shear, storey displacement and time peroid with respect to each storey.

3.2 Methodology

I. In detail explanation about earthquake, frame structures and bracings and effects of bracings in buildings

II. To get clear picture of bracings elaborate literature survey has been done on bracing system in RC buildings.

III. By using IS 456-2000, 3D RC frame building design has been executed for dead load, live load and earthquake load.

IV. Linear static analysis of structures

V. located at seismic zone V as per IS 1893-2002.

4. Results and Discussions

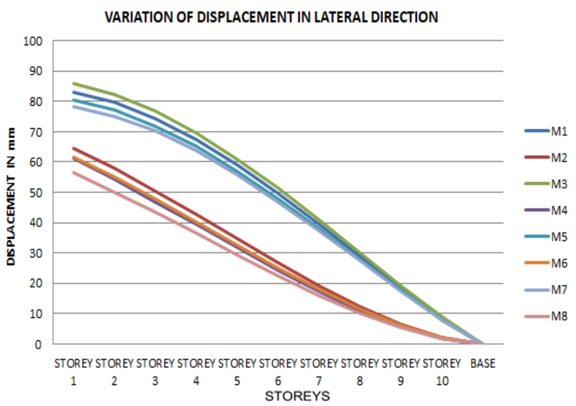

Chart -1: Displacement in Lateral Direction

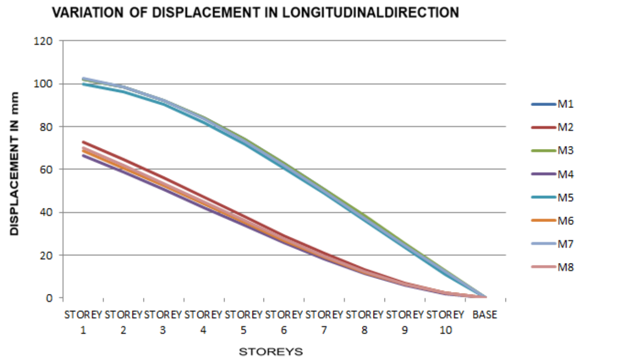

Chart -2: Displacement in Longitudinal Direction

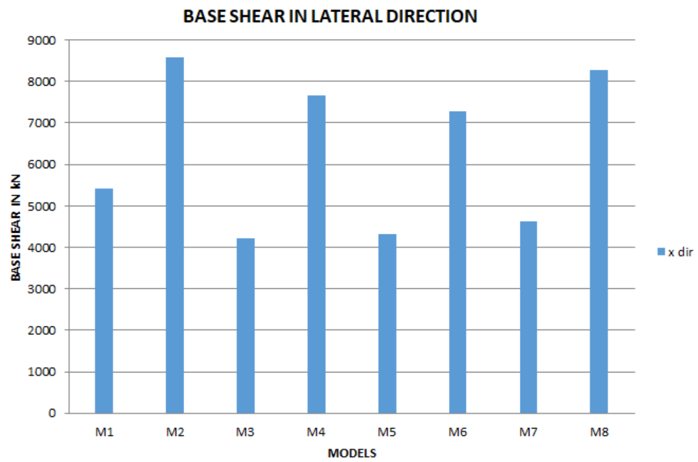

Chart -3: Base Shear in Lateral Direction

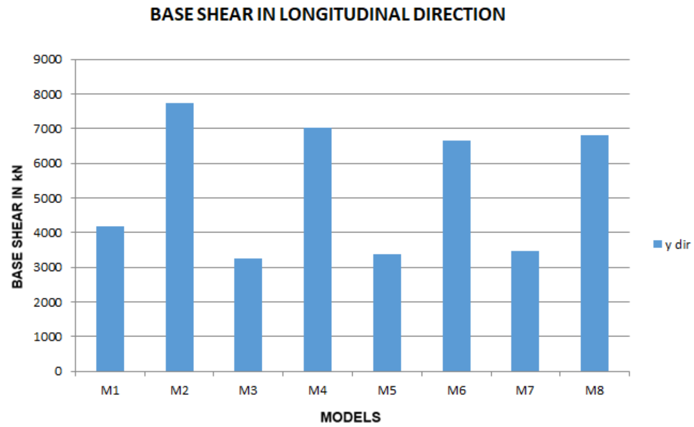

Chart -4: Base Shear in Longitudinal Direction

3. CONCLUSIONS

I. By introducing X-bracing system to RC frame time period will reduces of the structure. Due to the provision of X-bracing system on outer peripheral in RC frame it can reduce time period up to 49.73% compare RC bare frame.

II. When X-Bracing is placed in RC frame it decrease the time period for the soft soil condition. From the above points it can be concluded that the time period decreases.

III. By the provision of X-Bracing system to the building, the weight of the building can be increased and overall stiffness of the building is increased.

IV. By the provision of X-bracing system on outer peripheral of building, storey displacement can be reduced up to 65.68% compare to RC square model.

V. The fundamental natural time period is observed to be the less for the model which is symmetrical shape as compared to asymmetry in shape.

VI. It has also been noticed that the time period increases for the models which are asymmetry in shape when subjected to irregularities in both horizontal and vertical directions.

VII. It is observed from the analysis that there is large displacement in model 7. C-shape when it is compared with the other model in Equivalent static analysis.

VIII. After carrying out the analysis and the results we came to the conclusion that the seismic performance of regular frame is found to be better than corresponding irregular frames in nearly all cases. Therefore, it is suggested to construct a regular frame to minimize the seismic effects

REFERENCES

1. Ghalimath A.G, Waghmare Y.M, Zadbuke A.A and Chaudhari A.R, " Seismic Comparative Study of Multistoried R.C.C Building with Shear Wall in Bare Frame and Masonry Infill Frame For Various Types of Soil and Seismic Zones," International Research Journal of Engineering and Technology, Volume: 02 Issue: 05 | Aug-2015

2. Viswanath K.G., Prakash K.B. and Anant Desai, "Seismic Analysis of Steel Braced Reinforced Concrete Frames."

3. IS 1893-1984 and 2002(Part I), "Criteria for Earthquake Resistant Design of Structure", Bureau of Indian Standards New Delhi.

4. IS 456-2000, "Plain and Reinforced Concrete-Code of Practice", Bureau of Indian Standards New Delhi