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PUSHOVER ANALYSIS OF HIGH RISE BUILDING WITH AND WITHOUT BRACING

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Abstract : **India is divided into four seismic zones, and about 60% of land area under zone 3,4 and 5.Severe earthquake being destructive can causes significant structural damage or even collapse. In last decade, four devastating earthquake have been occurred in India, and low mild intensities earthquake are shaking our land frequently. Since many building suffered great damage or collapsed. To evaluate the performance of steel framed building under future expected earthquake, a non-linear static pushover analysis has been conducted. To achieve this objective G+15 story structure with and without bracings of two steel models have been analyzed using staad pro v8i software. There are n number of possibilities to arrange bracing, we are using X Type of bracing. Compare the results parameters time period, story drift, base shear, target displacement and capacity curve for this with bracing model and without bracing model. The result obtained from the study show that structure with bracing have been more strength, stiffness, stability and increase the base shear capacity of the structure, decrease the displacement of the structure, than without bracing model**

I. INTRODUCTION

1.1General

In the last few decades, steel structures have been crucial to the construction industry. It's important to build a structure to withstand seismic loads well. Steel bracings can must be added to structural system to increase the structure's stability. For retrofitting, various types of bracing can be utilized. Steel bracings can be arranged in a variety of ways, including X-braced, diagonally, alternatively, V-braced, inverted V-braced, K-braced, etc. In this instance, x type bracing is being applied, . Braced frames are classified as concentric braced frames (CBF) or eccentric braced frames (EBF). Frames of such structure should be sufficiently stable property to perform well under seismic loading. To calculate the ductility and other properties like lateral displacements time period and frequencies for with and without bracing model considered, push over analysis is performed on STAA PRO V8I.

1.2 Pushover Analysis

The analysis of the pushover improved over the previous few decades, and it is now the technique for analysis of choice for earthquake design based on performance and evaluation. It is the method that has been researched. and used in earthquake engineering and seismic design practice in order to effectively examine the ultimate strength and the limit condition after the yielding. The three fundamental components of this approach are .

Immediate occupancy: This is the state of the building after an earthquake when there have been only minor structural losses and there are very little chances of serious injuries from structural failure.

Life safety: It is a situation where there may have been earthquake-related damage to the building yet there is still some protection from a complete or partial collapse. Injury during the earthquake is possible, although there is extremely little chance of a life-threatening injury due to structural damage.

Collapse prevention: The building has severe damage and substantial persistent drifts in its current condition .If non structural parts are severely damaged, the structure may only retain a small amount of its original strength and stiffness.

WHY PUSHOVER ANALYSIS?
1.Identify the week element.
2.Better understanding of building behavior

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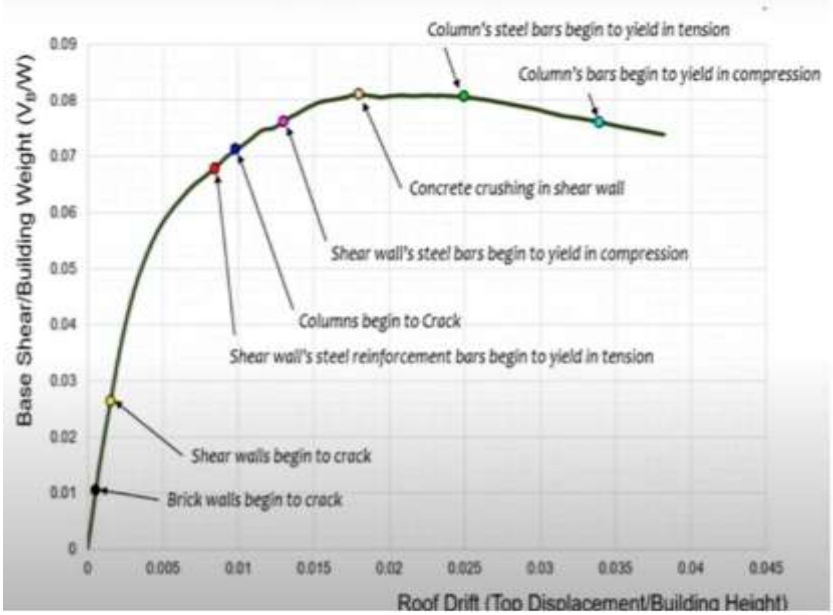


2. METHOLOGY

In order in order to comprehend how steel frame with and without bracings, a G+ 15storey structure with typical bay width of 5 m is considered in both x & z direction, total 30*30m area is considered for the present study. Plan a view from above of the frame model the study's considerations include shown in Fig.1. fig.2. and fig.3. deals with 2-different kinds of model with and without bracing model.

No. of Story	G+ 15
Total area	900 m2
Dimension in X Direction	30m
Dimension in Z Direction	30m
Storey Height	3.8m

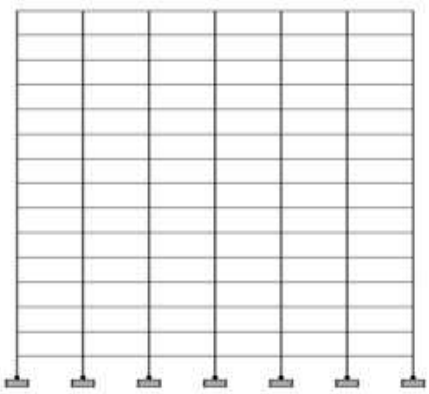


Fig. G+15 Building model elevation without bracing

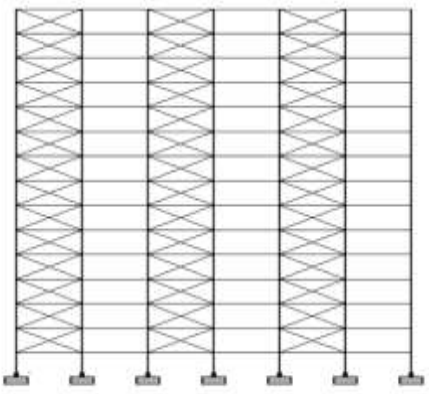
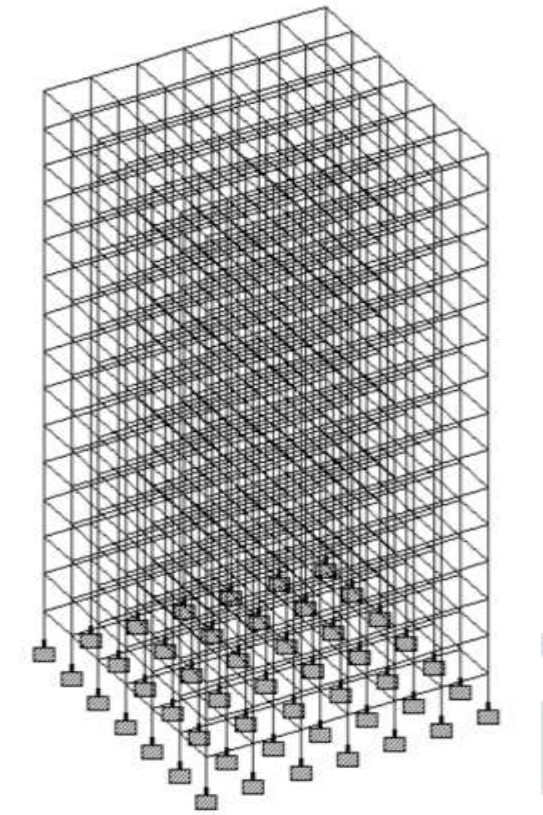
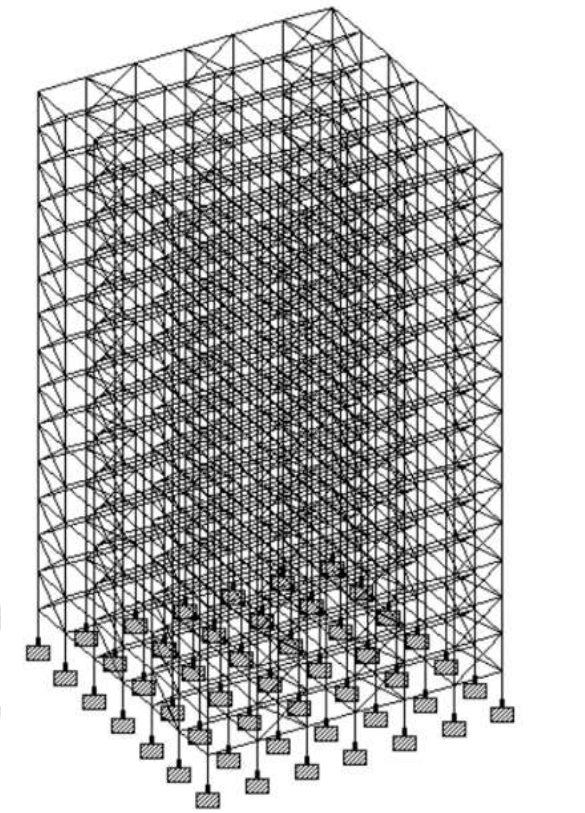


fig G+15 Building model elevation with bracing



Fiig3 D Model view G+15 story building without bracing



Fiig 3 D Model view G+15 story building with bracing

2.2 Beam size Column size

G+15 story with and without Bracings model
Beam Size - IW500*350*10
Column size - H498*432*45
Bracing size - H294*302*12*12

Material properties of the building are like FY 250N/mm2 steel and 20000N/mm2 of modulus of elasticity of brick masonry in the buildings. Design is based on Indian Standard Codes and is analyzed for Dead, Live, and Seismic load conditions taking into relevant load combinations recommended by the code IS 456-2000, IS:875(Part5)-1987 and IS 1893 2016 (Part1).

2.3 Wall Load calculations;
External Wall Load: Height X Thickness of Wall x Density of Brick 3.25*0.3*20= 19.5 kN/m
Internal wall Load: 3.25*0.15*20= 9.75 kN/m
Parapet wall Load: 1*0.15*20 = 3 kN/ m
Live for commercial building we are considering 4 kN/m2
slab load =0.150*25+1= 4.75 kN/ m2

2.4 Load combination as per IS 1893 (part1)-2002
For Equivalent static analysis
.1.2(DL+LL+EQX)
1.2(DL+LL+EQZ)
1.5(DL±EQX)
1.5(DL±EQZ)
For Response spectrum analysis
1.2(DL+LL+DSX)
1.2(DL+LL+DSZ)
1.5(DL±SX) 1.5(DL±DSZ)

2.5 SEISMIC ANALYSIS
Seismic analysis is performed using two methods:
(1) Equivalent Static Method
(2) Dynamic analysis Method Linear Dynamic analysis (Response spectrum

Determination of base shear (VB) of the building VB = Ah × W
Ah = (Z/2) * (I/R) * (Sa/g)

W=seismic weight of the structure
seismic zone factor (Z) =Zone 5=0.36
Importance factor (I)=1
Response reduction factor (R) =5 for SMRF building
we are considering Ta=0.085h0.75 for steel MRF building Ta=0.085*56.2^0.75 = 1.74
Soil type is medium and Ta is range between 0.55s<T<4
Sa/g = 1.36/T = 1.36/1.74 = 0.80
Damping Ratio-5%.

2.6 Procedure for pushover analysis:

• In pushover analysis the magnitude is of the lateral load increased monotonically maintaining a predefined distribution pattern along the building's height.
• Building is displaced till the control node reaches the target displacement or building collapse.
• Sequence of cracking, plastic hinging and failure of the structural components throughout the procedure is observed.
In this study:
As per code fema 356 and atc 40
We are consider Method 3 for lateral load calculation refer the section (sec.3.3.3.2.3)
base shear in x direction ,number of push load steps 100
Class c is consider Site category section (1.6.1.4.1) very dense soil and soft rock
At short period Ss 0.2 as per (Table 1-4)
At one second Sa 1 as per (Table 1-5)
Push up to defined base shear

- Firstly base shear was applied by 5000 KN, the target displacement was not achieved so the base shear was again increased by 20,000 but the target displacement was not achieved.
- So the base shear was iteratively increased and when the base shear applied was 40000 the target displacement was reached in without bracing model. And in with bracing model base shear was iteratively increased and when the base shear applied was 60000 the target displacement was reached

3. RESULT AND DISSCUSION

3.1 time period

The time interval required for the mass to complete one full cycle of motion. Time period depends on factors such as mass, stiffness and strength of the structure. Time period is also affected by several factors such as storeys, number of bays, loading etc

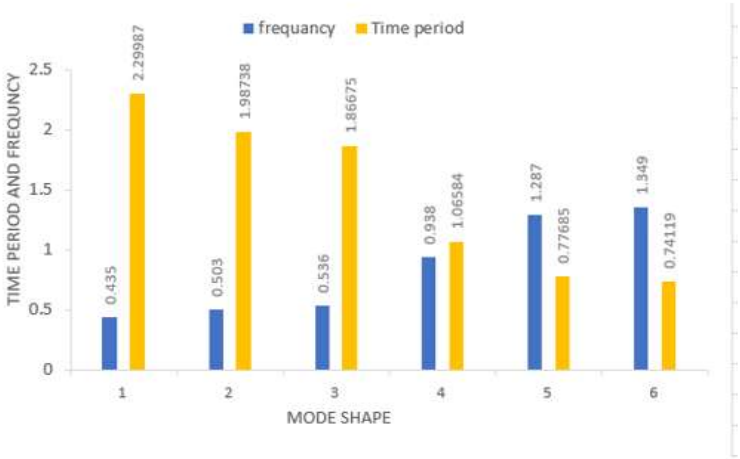


Fig. Time period and frequency for without bracing model

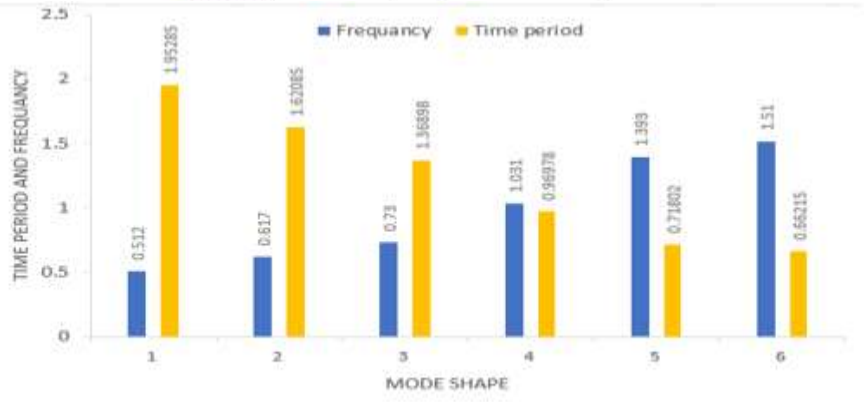
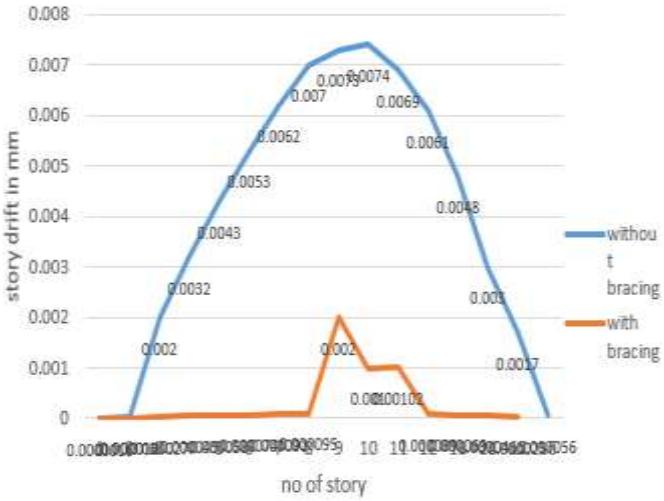


Fig Time period and frequency for without bracing model

The time period in without bracing model is higher than with bracing model. Time period is reduce with bracing model because increase the stiffness.

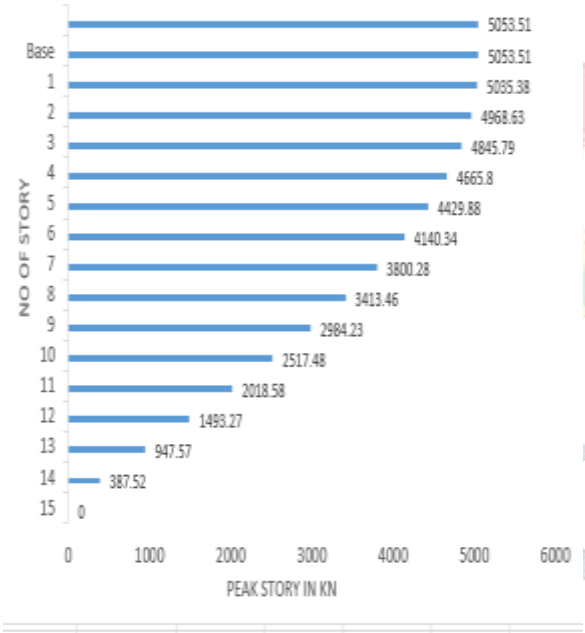
3.2 Story drift

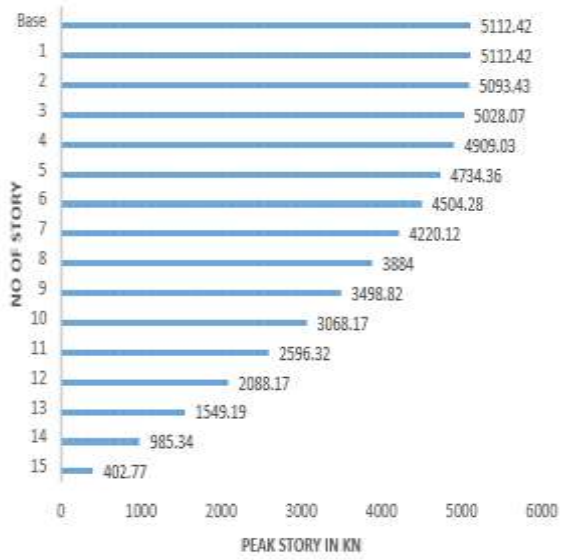
Story drift : is the displacement difference between two subsequent stories divided by the story's height. The absolute value of the displacement of the storey under the action of the lateral forces is known as the story displacement.

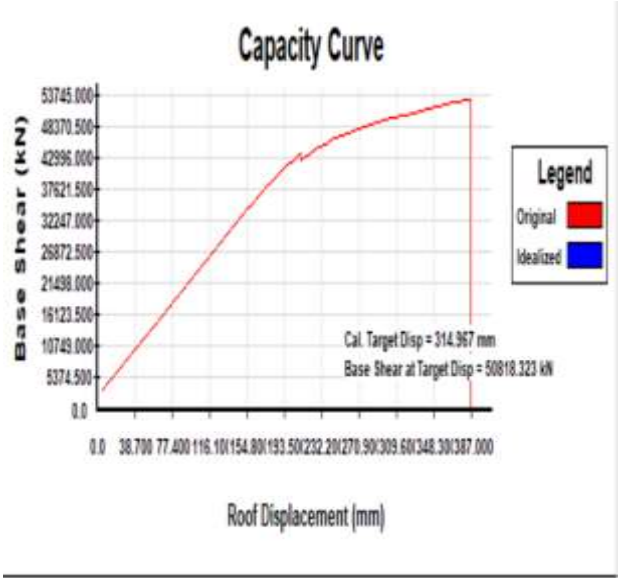


3.3 Base shear

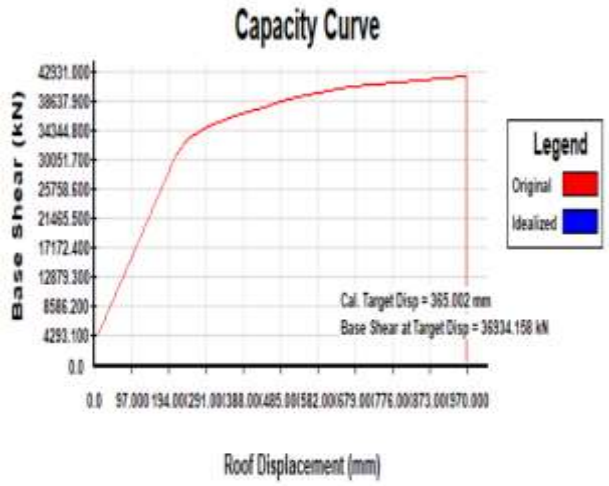
A The timing and intensity of shaking during earthquakes are unpredictable. The majority of design standards, however, indicate that the net effect of such sporadic shaking is a static lateral force, which is an earthquake-induced inertia force.







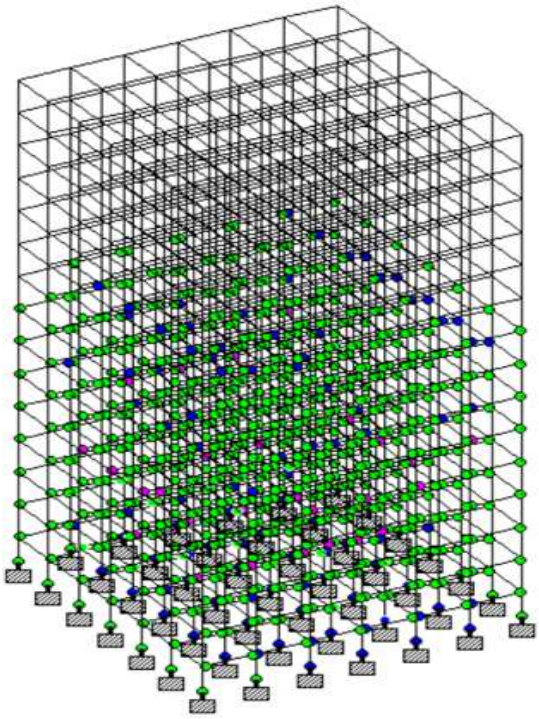
3.4 Capacity curve



The capacity curve disply base shear v/s displacement for without bracing model the base shear value are getting 36934.158KN that base shear the target displacement vaule is 365.002mm that depicted in fig.

The capacity curve shows base shear v/s displacement for with bracing model the base shear value are getting 50818.323KN that base shear value the target displacement value is 314.967mm that depicted in fig.

3.4 Hinge location and status



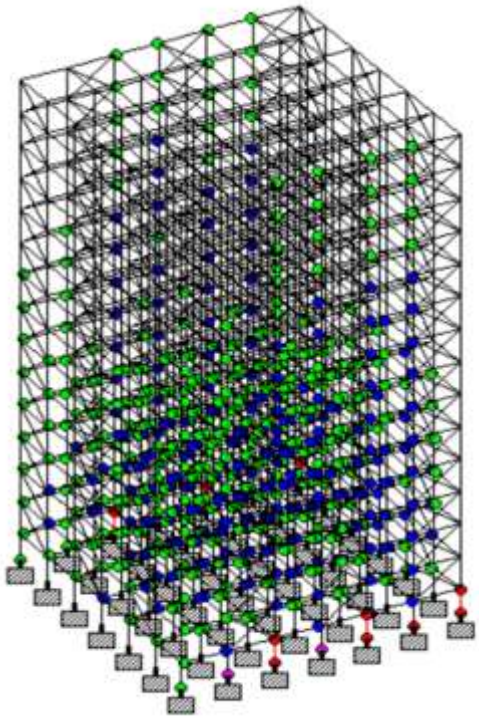


Fig location of hinges without bracing

Status of hinges;

Green color-less than immediate Occupancy.
Blue color Immediate occupancy to life safety.
Pink color -life to collapse prevention.
Red color- collapse prevention.

4. CONCLUSIONS

Analysis the G+15 steel structure with and without bracing system. Which gives the parameter like time period, story drift, base shear, displacement .The present study is focused on the seismic performance of Steel structure with and without bracings. Nonlinear static (pushover analysis) There has been analysis to understand the the actions of two model .The variation of these parameter with and without bracing model has been be studied through staad pro software.

- It's been noted that the bracing model has a shorter time frame than without bracing, from which we can conclude that the bracing model has more stiffer than the brace less model.
- The seismic analysis of the building which can give the base shear,the without bracing model has less base shear than with bracing model because increase the seismic weight of the structure in bracing model.
- The bracing model has reduce displacement increase the stiffness and stiffness is reduce in without bracing model
- The base shear v/s displacement curve the capacity curve better than without bracing model ,the bracing model has increase the lateral stability
- The structure yield highest base in bracing system model than without bracing model.

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