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DESIGN AND ANALYSIS OF MULTI-STOREYED BUILDING UNDER STATIC AND DYNAMIC LOADING CONDITIONS USING ETABS

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Abstract— **In this project a residential of G+13 multi-story building is studied for earth quake loads using ETABS. .Assuming that material property is linear static and dynamic analysis are performed. These non-linear analysis are carried out by considering severe seismic zones and the behavior is assessed by taking types II soil condition. Different response like, displacements, base shear are plotted.**

Index terms- **multistoreyed building,non-linear analysis, Etabs.**

I. INTRODUCTION

Structural response to earthquakes is a dynamic phenomenon that depends on dynamic characteristics of structures and the intensity, duration, and frequency content of the exciting ground motion. Although the seismic action is dynamic in nature, building codes often recommend equivalent static load analysis for design of earthquake-resistant buildings due to its simplicity. This is done by focusing on the predominant first mode response and developing equivalent

Static forces that produce the corresponding mode shape, with some empirical adjustments for higher mode effects. The use of static load analysis in establishing seismic design

Quantities is justified because of the complexities and difficulties associated with dynamic analysis. Dynamic analysis becomes even more complex and questionable when nonlinearity in materials and geometry is considered. Therefore, the analytical tools used in earthquake engineering have been a subject for further development and refinement, with

Significant advances achieved in recent years.

A. THE PROCEDURES FOR THE EARTHQUAKE ANALYSIS OF THE STRUCTURES:

- ✓ Linear Static Procedure
- ✓ Linear dynamic Procedure
- ✓ Response Spectrum method
- ✓ Time history method
- ✓ Nonlinear Static Procedure (Pushover analysis)
- ✓ Nonlinear dynamic procedure

As per IS-1893:2002, Methods Adopted are

- ✓ Equivalent Static Lateral Force (or) Seismic Coefficient Method
- ✓ Response Spectrum Method
- ✓ Time history method

B. LINEAR STATIC PROCEDURE:

The linear static procedure of building is modelled with their linearly elastic stiffness of the building. The equivalent viscous damps the approximate values for the lateral loads to near the yield point. Design earthquake demands for the LSP are represented by static lateral forces whose sum is equal to the pseudo lateral load. When it is applied to the linearly elastic model of the building it will result in design displacement amplitudes approximating maximum displacements that are expected during the design earthquake. To design the earth quake loads to calculate the internal forces will be reasonable approximate of expected during to design earth quake.

C. RESPONSE SPECTRUM METHOD:

I. The representation of the maximum response of idealized single degree freedom system having certain period and damping, during earthquake ground motions. The maximum response plotted against of un-damped natural period and for various damping values and can be expressed in terms of maximum absolute acceleration, maximum relative velocity or maximum relative displacement. For this purpose response spectrum case of analysis have been performed according to IS 1893

II. DEFINITIONS

Storey: when the multi-story building or the residential building is constructed in that when the floor to floor gap will be there that is the story.

Storey Shear (VI): We will calculated all the lateral loads at each floor of the building.

Story Drift: is defined as the difference in lateral deflection between two adjacent stories. During an earthquake, large lateral forces can be imposed on structures; Lateral deflection and drift have three primary effects on a structure; the movement can affect the structural elements (such as beams and columns); the movements can affect non-structural elements (such as the windows and cladding); and the movements can affect adjacent structures. Without proper consideration during the design process, large deflections and drifts can have adverse effects on structural elements, non-structural elements, and adjacent structures

A. Effect Of Drift On The Structure:

In terms of seismic design, lateral deflection and drift can affect both the structural elements that are part of the lateral force resisting system and structural elements that are not part of the lateral force resisting system. In terms of the lateral force resisting system, when the lateral forces are placed on the structure, the structure responds and moves due to those forces. Consequently, there is a relationship between the lateral force resisting system and its movement under lateral loads; this relationship can be analyzed by hand or by computer. Using the results of this analysis, estimates of other design criteria, such as rotations of joints in eccentric braced frames and rotations of joints in special moment resisting frames can be obtained. Similarly, the lateral analysis can also be used and should be used to estimate the effect of lateral movements on structural elements that are not part of the lateral force resisting system, such as beams and columns that are not explicitly considered as being part of the lateral force resisting system. Design provisions for moment frame and eccentric braced frame structures have requirements to ensure the ability of the structure to sustain inelastic rotations resulting from deformation and drift. Without proper consideration of the expected movement of the structure, the lateral force resisting system might experience premature failure and a corresponding loss of strength. In addition, if the lateral deflections of any structure become too large, P-Δ effects can cause instability of the structure and potentially result in collapse.

B. Seismic weight of building:

The seismic weight of the building means that is calculated on the entire floors weight of the building Fundamental Natural period as per IS 1893(part1):2002

1. The approximate fundamental natural period of vibration (Ta)in seconds of a moment resisting frame building without brick infill panels may be estimated by the empirical expression

Ta=0.075h^0.75 for RC framed building Ta=0.075h^0.75 for steel framed building Where h =height of building

2. The approximate fundamental natural period of vibration (Ta) in seconds, of all other buildings, including moment – resisting frame buildings with brick infill panels, may be estimated by the empirical expression:

Ta= 0.09h/√d

Where h = height of building d = Base dimensions of the building at the plinth level in m, along the considered direction of lateral force

C. Design Seismic Base Shear:

The total design lateral force or design seismic base shear (Vb) along any principal direction shall be determined by the following expression

Vb = AhXW

Where Ah = Design horizontal acceleration spectrum value as per clause 6.4.2 IS 1893(part1):2002 using the fundamental natural period Ta as per clause 7.6 IS 1893(part 1):2002 in the consider direction of vibration

W = Seismic weight of building

Here Ah = (Z/2)x(I/R)x(Sa/g)

Z = zone factor I = Importance factor Sa/g = is depending up on the Ta and type of soil

D. Load combination:

In the limit state design of reinforced and prestressed concrete structures, the following load combinations shall be accounted for as per IS1893 (part1):2002

1. 1.5(DL+IL)
2. 1.2(DL+IL±EL)
3. 1.5(DL±EL)
4. 4 0.9DL±1.5EL

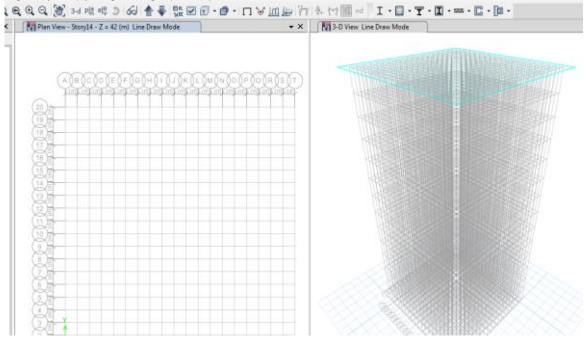
III. MATERIAL PROPERTIES OF THE STRUCTURE

Grade of Slab , Beam concrete M25
Grade of column concrete M30
Grade of steel Fe 415
Column sizes = 0.50X0.50 m
Beam sizes = 0.2X0.30 m
Slab thickness = 0.150 m
Number of stories = G+13
Height = 3 meters
Wall load = 19.2 kN/m
Live load = 2 kN/m2

IV. ANALYSIS AND DESIGN

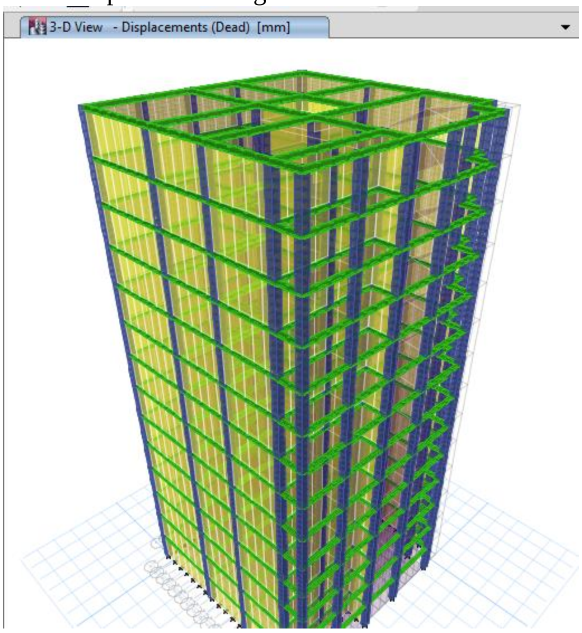
A. Plan & 3D view of structure

It is an symmetric section which comes under regular structures



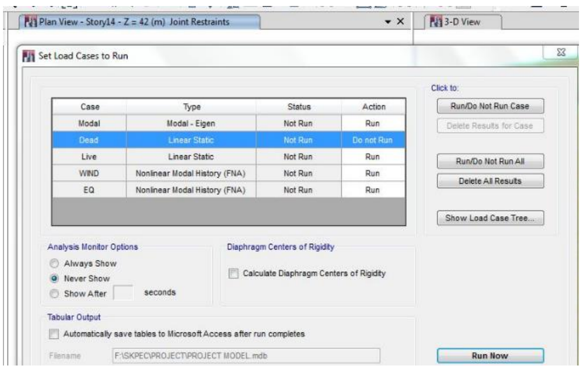
B. Plan & 3D view of irregular configuration

All the members in the framed structures are properly placed. Hence further the structure is set to analysis and the members are passed in design check.



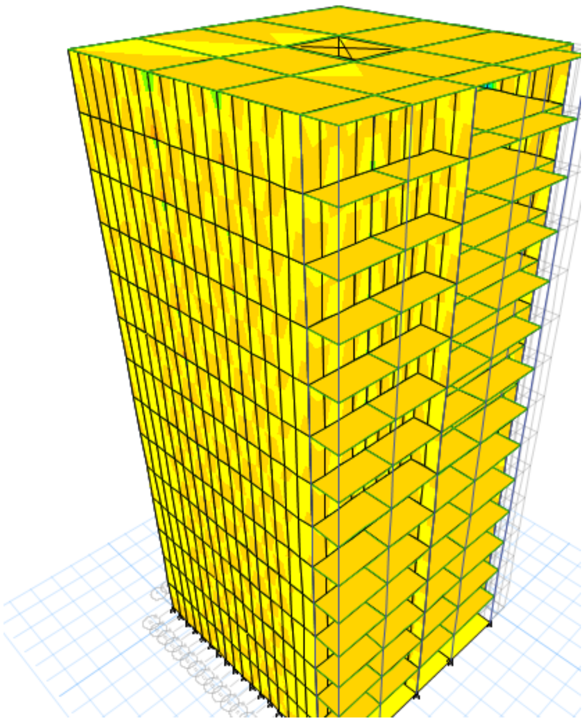
C. Running analysis for dynamic loading

The load cases for the combination seismic and live load is applied.

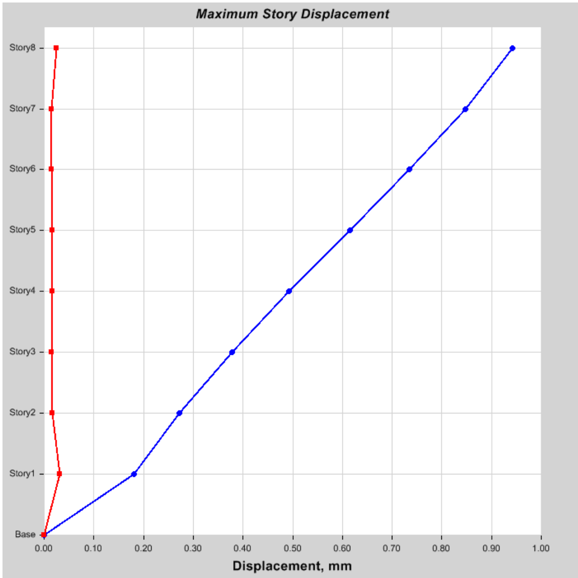


D. 3d Display of Stress in Structure

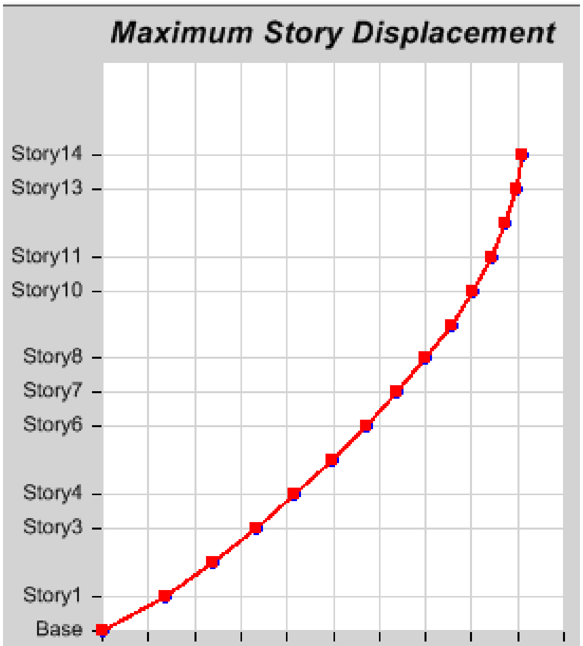
The view of Stress in the 3d quickly provides the area to be changed for even distribution of stress.



E. Displacement graph and table structure



F. Displacement graph and table structure

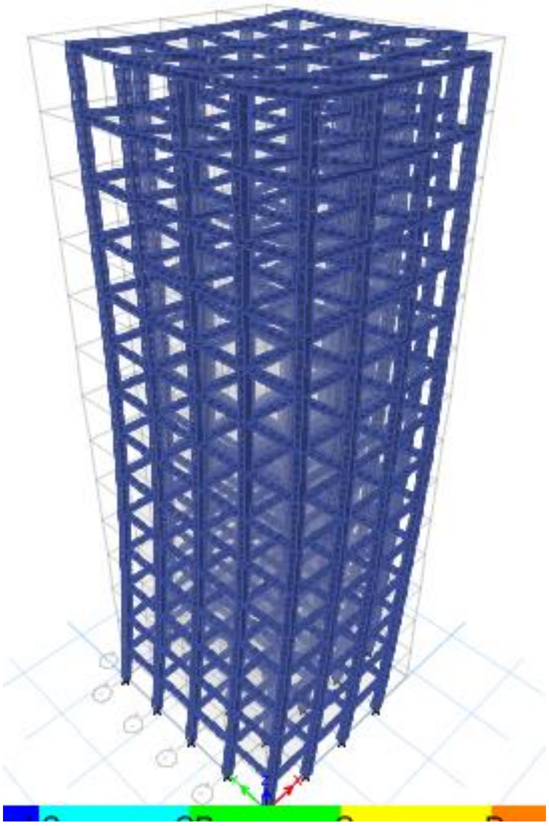


G. Base shear Vs. Displacement result

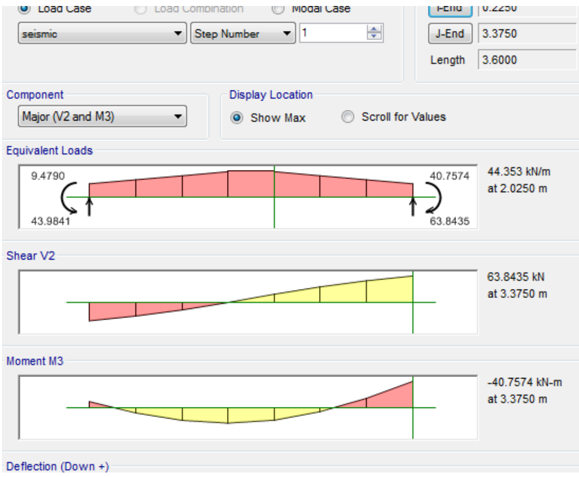
TABLE 3 : Base Shear vs. Displacement

Monitored Displ	Base Force
Mm	kN
0.9	18608.8428
0.02436	18608.8428
0.9	18608.8428
0.02436	18608.8428
0.9	18608.8428
0	0

H. Displacement of the structure is shown and it increase with the building height



I. Displacement of the structure in 3d view



J. Maximum bending moment and shear force for each beam can be viewed by right click

V. Conclusion

The maximum displacements of building in different stories in both X and Y direction for all methods of analysis have been compared and shown in figures. Also, the maximum displacement of center of mass is considered to indicate the difference between all methods; the results obtained have been shown in figures.

From the diagrams below, it is observed that, in first five stories, the difference between the results obtained with different methods is insignificant. It is observed that, the maximum displacement is increasing from first storey to last one.

However, the maximum displacement of center of mass, obtained by time history analysis for both earthquakes.

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