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Seismic Analysis of Multistoried Building with Diaphragms Discontinuity

Laxman Jadhav, Structural Engineering, Veerappa Nisty Engineering College Shorapur, Yadgir, Karnataka, India, laxmanka793@gmail.com

Abstract **At present many buildings have irregular configuration both in elevation and plan. These buildingsmay get collapse due to the devastating earthquakesin future. The seismic behaviour of the structures get decreased due to structural irregularities. The openings in the floors of buildings are provided may be due to the architectural purposes,staircases, lighting etc. The stresses are developed in buildings due to these openings. In this study a attempt is made to know the difference between a building without diaphragm discontinuity and a building with diaphragm discontinuity and also using the different stiffness modifiers like factored and unfactored stiffness modifiers. In this project a regular 15 storey RC buildings having slab opening at central, corner and peripheral opening are provided with different stiffness modifiers according to code IS 16700:2017 are modelled and are analysed by ETABS (2018). Response spectrum method is adopted for the analysis and the parameters like storey displacement, storey drift, base shear are compared and studied.**

Keywords — Regular building with factored stiffness modifiers, Regular building factored stiffness modifiers, Etabs,, Autocad,,Story displacement, Storey Drift , Base shear.

I. INTRODUCTION

Earthquakes are natural calamity which causes severe damage or collapse of buildings. Plan and elevational irregularities are common in many modern buildings. The point of structural discontinuity is particularly vulnerable to earthquake damage. Staircases, lights, architectural features, and other uses for floor openings sometimes result in tensions at discontinuities. To avoid stress computations, discontinuous diaphragms are constructed with the assumption that they will be sufficient even when gap effects are ignored. Seismic damage in multi-story buildings sometimes starts at points where lateral load-resisting frames have structural flaws. Diaphragms that alter their stiffness drastically from one level to another, have cutouts or open regions that are over 50% of gross enclosed diaphragm area, or have functional diaphragm stiffness shifts of more than half among the stories. Diaphragms are structural components that aid in the transmission of lateral loads to shear walls or frames, mostly via in-plane shear stress, according to structural engineers. Common examples of lateral loads are earthquake and wind forces.

II. OBJECTIVES

1. Studying behavior of structures with slab irregularities at different location using different stiffness modifiers.
2. To compare the behavior of different discontinuities in the diaphragm systems during earthquake loading.
3. To study comparative knowledge on various seismic parameters like base shear storey drifting and displacements at every storey utilising RSA.

III. METHODOLOGY

A. DIVERSE APPROACHES FOR SEISMIC ANALYSIS OF STRUCTURES

- Equivalent static analysis method.
- Response spectrum method.

B. Response spectrum method

This approach considers the many ways a structure might react to earthquake. Utilising modal combination techniques like, we can calculate entire response of structure by combining response of various models.

- Absolute Sum (ABS) method
- Square root of Sum of Squares (SRSS)
- Complete Quadratic Combinations (CQC)

output. Based on the output achieved further design can be performed.

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IV. Analytical Modeling

1) General Description of model

- In the present study, an effort for investigating seismic effect on reinforced cement concrete building with slab opening

- Analysis of (G+15) storied R.C.C. framed structure is performed using ETABS commercially available software.

- Lateral load analysis performed upon diverse buildings.

- Zone IV utilized for analysis.

- Type II medium soil used for analysis

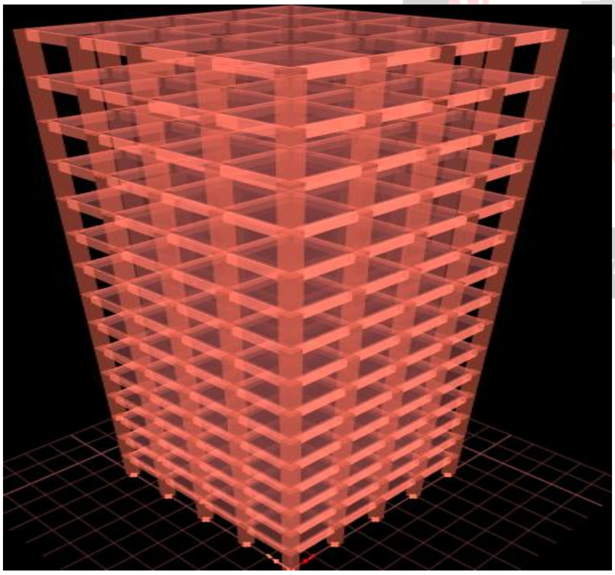
- After analyzing diverse models in ETABS software, with Maximum Storey Displacement, Base Shear, and Storey Drift are obtained.

- Finally outcomes attained are equated of all the models.

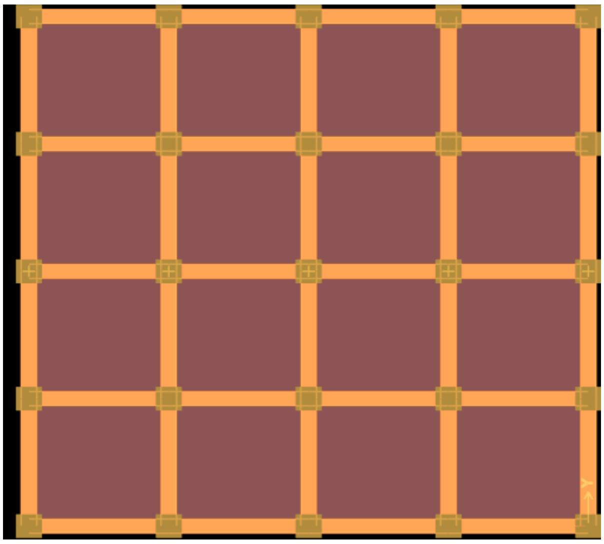
Modeling different types of models using E-TABS

Commercial Software Note: In all cases G+15 story building is considered for study

1) Regular building with factored stiffness modifiers



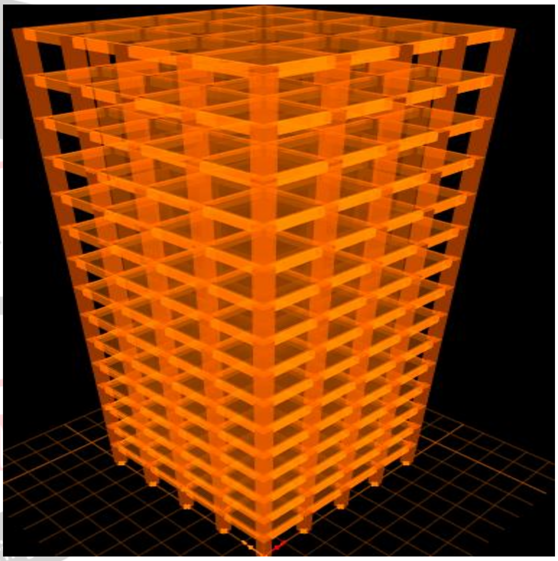
3D View

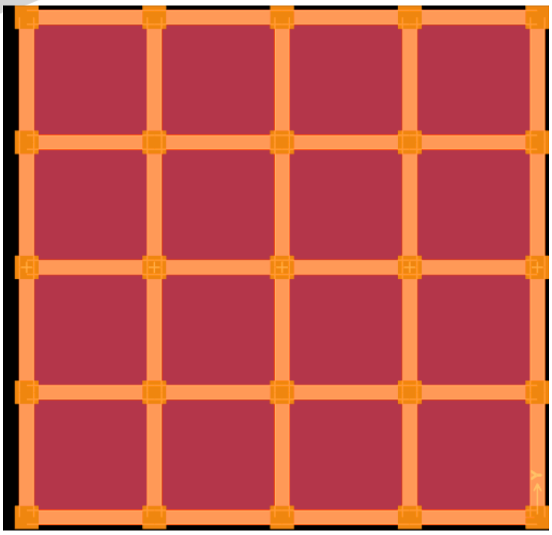


Plan

Fig.5.1. Shows regular building with factored SF

2) Regular building factored stiffness modifiers





3D View **Plan**

Fig.5.2. shows regular unfactored stiffness modifiers plan

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V. RESULT

Storey displacement

Earthquake analysis of multistory (G+15) story is carried out by response spectrum method for various type of models .The storey displacement was obtained for the various models and the results obtained are tabulated as below along with the corresponding graphs. The limiting value for the displacement is **H/500 = 45000 / 500 = 90 mm**.

Storey drift The Earthquake Analysis of Multistory (G+15 story) building (regular model) is performed utilizing RSA for the frame. The results obtained for maximum story drift are tabulated in table 6.2.1 which shows that the maximum drift is 0.000933 mm in corner opening at 6th storey. Similarly the result obtained for the regular model was found to be 0.000886 mm in X-direction. The maximum drift value for the corner opening and peripheral opening was found to be 0.000836mm and 0.000747mm respectively in x direction. the maximum storey drift value observed at at 6th storey and then the value decreased. The maximum drift value when it compares to the regular building to the central opening its value decreased up to 4% in x direction but when its compares to the corner its value increased by 4% in x direction because there is no structure to withstand the drift at the corner side and 15% value is decreased in peripheral opening.

BASE SHEAR The earthquake analysis for every model performed and result obtained is discussed below.

Maximal base shear value is observed in model no 1 regular building without slab opening factored stiffness modifiers .Maximal base shear value while it compares to central opening to regular building with using stiffness modifiers reduced about8.5% in both x and y direction.Base shear value reduced up to 18.30% in corner opening.Base shear value reduced up to 17.45% in peripheral opening.For using stiffness modifiers with factored base shear value in increased.Due to slab opening drawing lesser base shear in both x & y direction

VI. CONCLUSION

Critical observations made conclusion as.

- Its storey drift value in structure without slab opening has more drift when it compares to structure with slab opening.
- It is observed that storey displacement value in structure without slab opening has more displacement when it compares to structure with slab opening.
- Structure with more number of opening has less displacement and drift.
- Lower values for modal period (x and y), storey displacement, storey drift, and storey shear are seen in relation to percentage area of slab apertures.
- Structure with unfactored stiffness modifiers has less deflection compared factored modifiers.
- According to the Maximum Storey drift & Base shear perspective, the lateral pressures may be better resisted by slab apertures located in the middle.

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