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Influence of Discontinuous Diaphragm Characteristics on The Seismic Behaviour of Irregular RC Structure using ETABS

Phadatare Pushpa P.[1], Kadlag Vishwajeet[2]
[1, 2]*Department of Civil Engineering, University of Pune,*

Abstract: ***Researchers of past and present earthquake had damage to the R.C. structural buildings that fairly exposed to the damage and sudden breakdown of RC structure during lower and stronger ground motion. Diaphragm act as roof and roof system in concrete based reinforced building under seismic loading, these diaphragm transfers the series of lateral loads to the vertical members. In the present study, an seismic behaviour of irregular RC structures attempt is made study the behaviour of various parameters associated with diaphragm on the seismic behaviour of RC framed structure. Attempts are made to study the effect of discontinuities namely story displacement, story shears, with comparing seismic behaviour of irregular RC structures namely plus shaped with regular rectangle shaped multi storied building***
Keywords: Diaphragm discontinuity, story shear, story displacement, story drift, story stiffness, ETABS 2018

I. INTRODUCTION

In multi storied framed building, damages from earthquake generally initiates at locations structural weakness present in lateral load resisting frames. This behaviour of multi-storey framed building during strong earthquake motions depends upon distribution of mass, stiffness, strength in both the horizontal and vertical planes of building. In few cases, these weaknesses may be created by discontinuities in stiffness, strength or mass along the diaphragm. Such discontinuities between diaphragm are often associated with sudden variations in the frame geometry along the length of the building. Structural engineers have developed confidence in the design of building in which the distribution of mass, stiffness and strength are more or less uniform. There is less confidence about the design of structures having irregular.

II. SCOPE OF THE PRESENT STUDY

In present study, a typical multi story building is analysed using commercial software ETABS 2018 for nonlinear dynamic analysis in seismic region, all the analysis has been carried out considering the diaphragm discontinuity and the result so obtained have been compared. This study is done for RCC framed multi story building with fixed support conditions. The results of this report is based on one original RCC building which is planned in zone-II which I am going to analysed in zone-III.

III.METHODOLOGY

1) A thorough literature review to understand the seismic evaluation of building structures and application of ETABS analysis
2) Select an existing building with diaphragm discontinuity.
3) Design the building using dynamic analysis methods.
4) Analyse the results and arrive at conclusions.

IV.MODELLING OF BUILDING

A. Introduction

In this project we are studying a multi storey building with diaphragm discontinuity as model-1 and model-2 respectively. The building is modelled and designed in ETABS 2018 from which reinforcing details were drawn.

B. Details Of Selected Building

For study purpose, an existing building plan which is made up for Zone-II is taken for Zone-III for study purpose. Detailes are given below.

C. Details of Building

Building parameters	Details
Plan size	19.91*17.48m
Location	Pune
Usage	Residential buildimg
Floor height	2.8m
Grade of steel	Fe500
Grade of concrete	M-30
Seismic zone	III
Column dimension	300mm*750mm
Beam dimension	1. 230mm*700mm 2. 230mm*900mm
Slab thickness	1. 150mm 2. 120mm
Wall thickness	200mm
Soil type	Medium (type-2)
Importance factor	1.5
Response reduction factor	5 (specified)
Dead load	1 KN/m²
Live load	1 KN/m²

Table I: Details of the building

D. Design of the Building (Rectangle and plus (+) shaped Building Structures

In the last paper, we have studied about regular rectangular building was compared with regular C-shaped and regular L-shaped building structure. Further the building is compared with regular plus shaped with regular rectangular building shaped with same geometric details of the structure as given in table I.

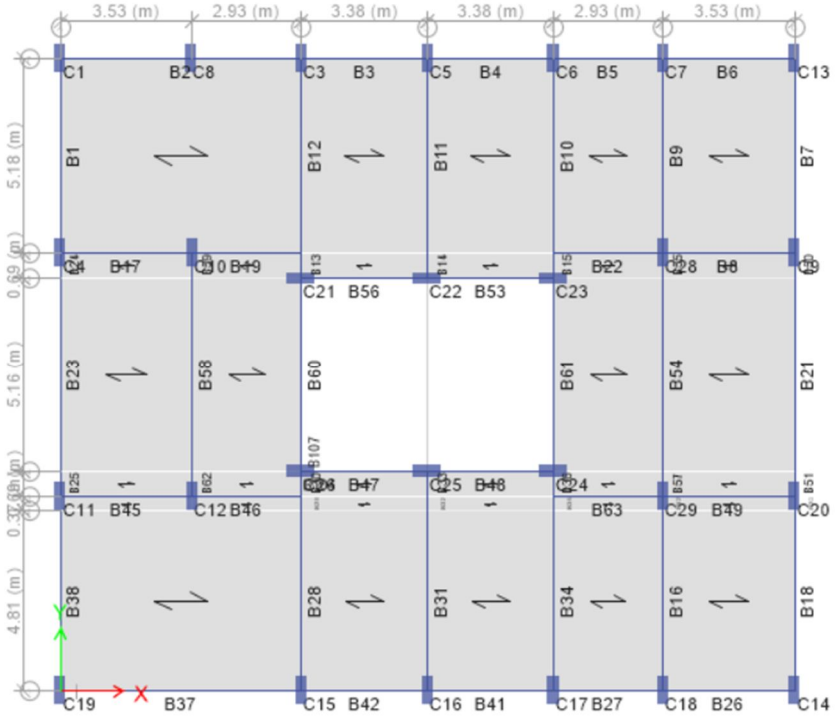

Figure I: Model-I (regular rectangular building structure with discontinuous diaphragm)

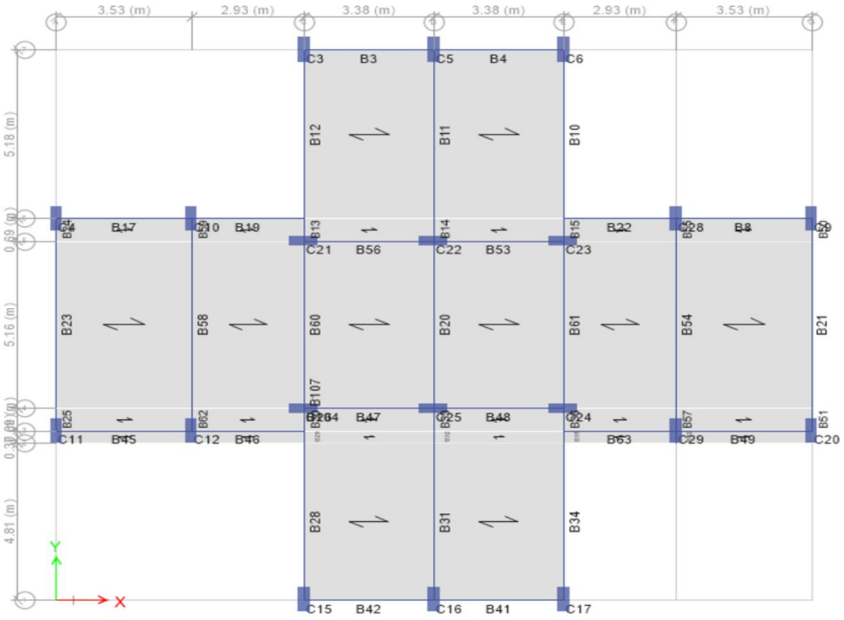

Fig. 2: Model-II (Plus shaped building structure with discontinuous diaphragm)

In fig.1 for model I and fig.2 for Model II, discontinuous diaphragm is assigned for overall building, the structure is opened at centre. Loads are assigned and building is analysed. The value for story displacement, story shear, story stiffnesses are going to compare.

1) Case I: Maximum story displacement for rectangular and plus shaped building along X and Y direction

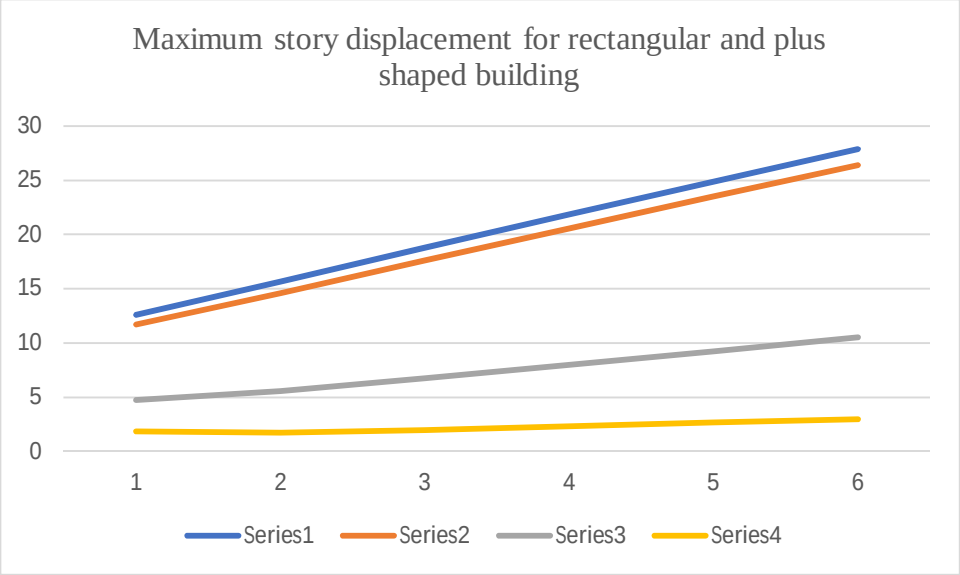

Fig.3: graphical representation of maximum story displacement for model I and model II

Fig.3 shows the graphical representation of maximum story displacement for rectangular and plus shaped building. This graph shows the value of maximum story displacment values from story 5 to story 10 for the comparison. Series 1 gives the value of displacement for model II along Y-direction, series 2 gives the value of displacment for model I along Y-direction, series 3 gives the value of displacement for model I along X-direction, series 4 gives the value of displacement for model II along X-diection..

From the above showed graph, we can see the value for model 2 building for story 5 is 1.882mm which is less than that of model I for the same story which is 4.769mm along Y-direction. Similarly, the value for model II for story 5 is 11.724mm which is less than that of model I for the same story which is 12.563mm.

Therefore, from the above said model II which is irregular (+ shaped building with discontinuous diphragm) still is effective than that of model I (regular rectangular building with discontinuous diaphragm)

For the further study about effectiveness of these model I and model II, we will discuss the other parameters like story shears and story stiffness for this 2 model

2) Case-II: Story shear for model I (rectangular) and model II (plus shaped building) along X-direction

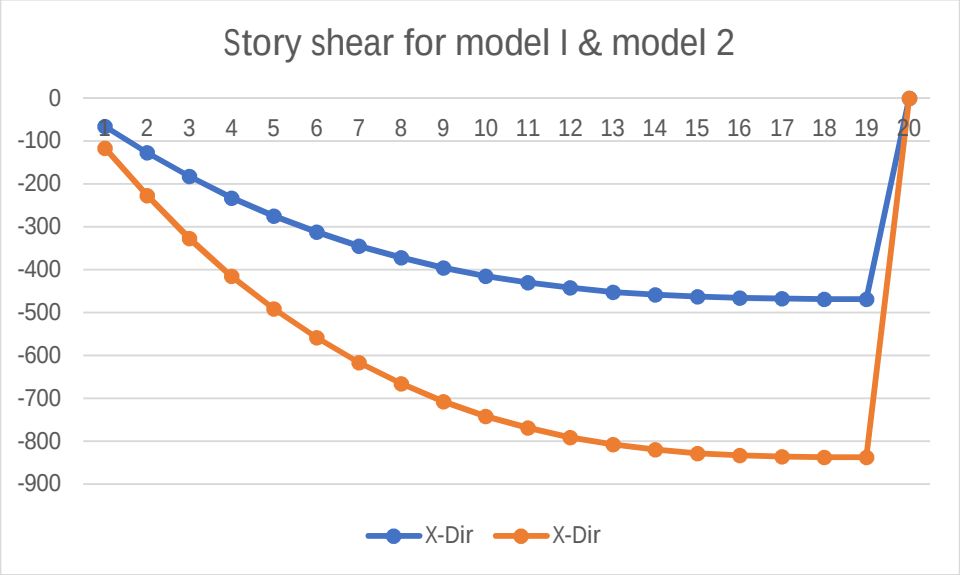

Fig. 4: graphical representation of story shear for model I and model II

Fig-4 shows the graphical representation of story shear for model I and model II. This graph shows the value of story shear values from base to story 19 for comparison. Storeys are shown along X-direction. Story shear value for model I is -468.298 KN which is less than the value for model II which is -368.924 KN. Negative shear would mean the cracks here run downwards, and if the shear would be positive, they would run upwards. As per the value of story shear for model I and Model II, model I which is regular rectangle which we can prefer at seismic region for zone III. For the better conclusion we can go for case III

Case-III: Overturning moment for model I and model II

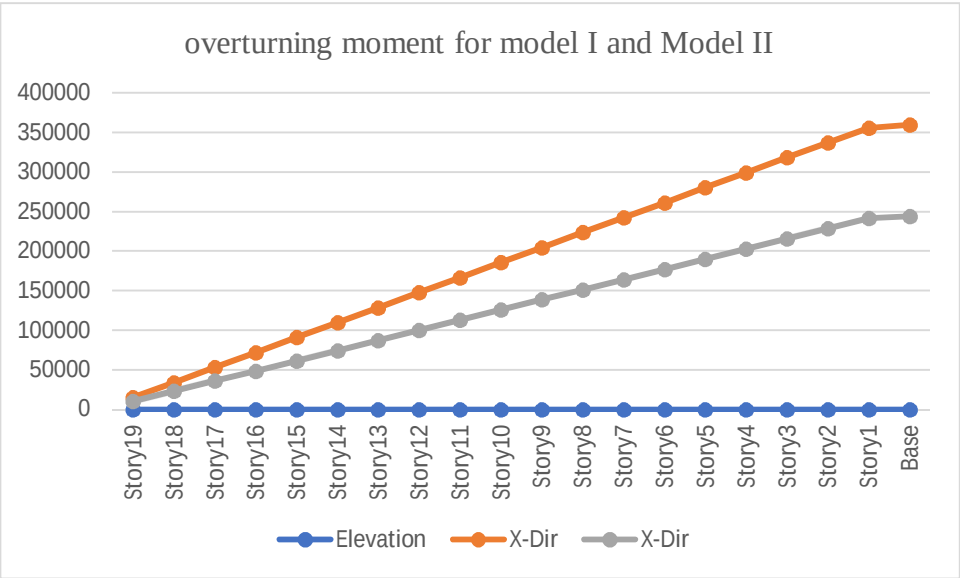

Figure 5: graphical representation of overturning moment for model I & model II

Fig. 5 shows the graphical represenatation of overturning moment for model I and Model II. The graph shows the value of overturning moment for model I and model II from base to story 19. The value for overturning moment for model I is 359584 kN.m which is more than that of model II which is 243854 kN.m. As per the IS code both the values are ok for the safe condition. But more preferably the model II gives better result.

V. CONCLUSIONS

A. From the above showed fig. 3, we can see the value for model 2 building for story 5 is 1.882mm which is less than that of model I for the same story which is 4.769mm along Y-direction. Similarly, the value for model II for story 5 is 11.724mm which is less than that of model I for the same story which is 12.563mm.

B. Story shear value for model I is -468.298 KN which is less than the value for model II which is -368.924 KN. Negative shear would mean the cracks here run downwards, and if the shear would be positive, they would run upwards. As per the value of story shear for model I and Model II, model I which is regular rectangle which we can prefer at seismic region for zone III.

C. The value for overturning moment for model I is 359584 kN.m which is more than that of model II which is 243854 kN.m. As per the IS code both the values are ok for the safe condition. But more preferably the model II gives better result.

VI. ACKNOWLEDGMENT

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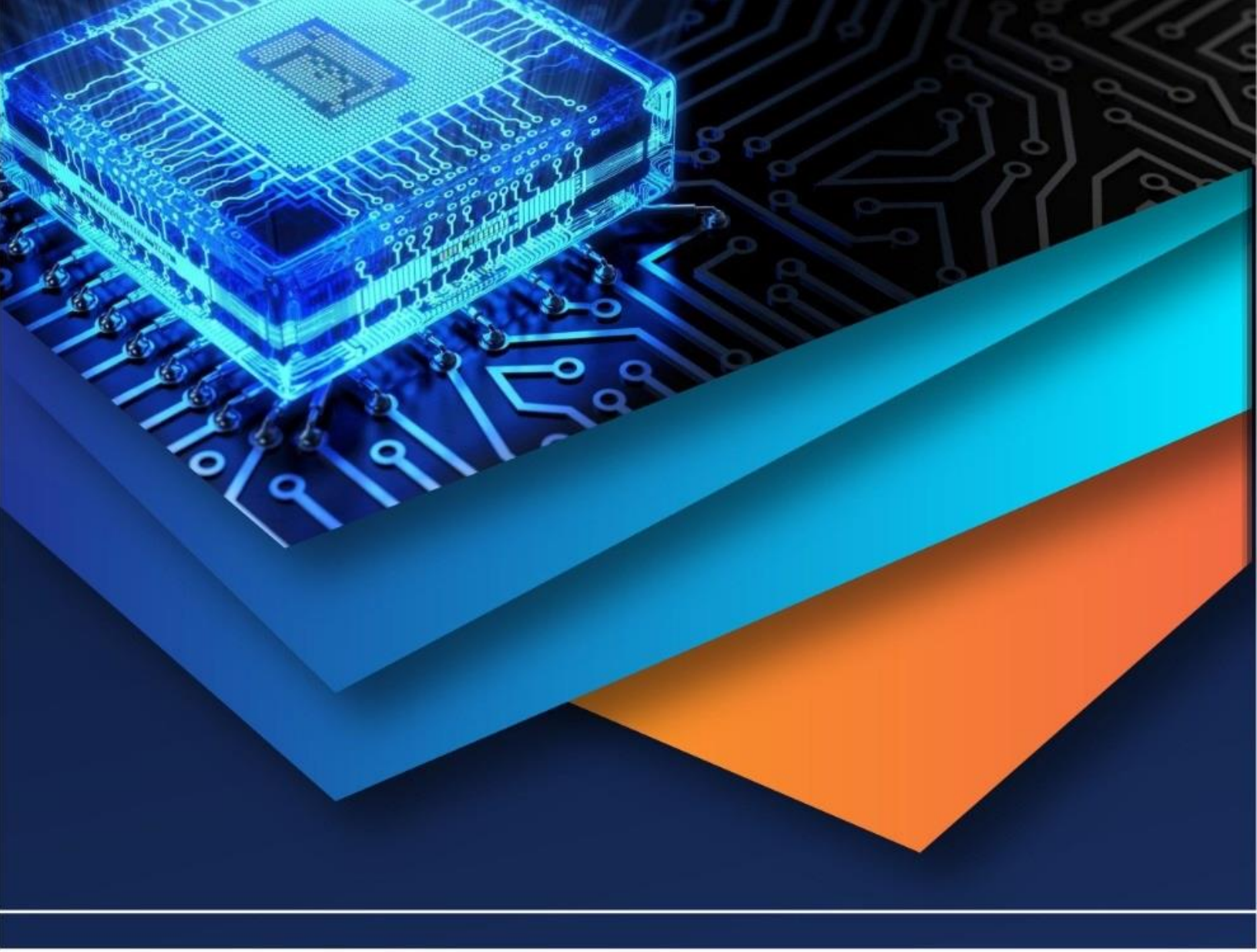

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