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Seismic & Torsional Instability Evaluation of Multistoried Irregular RCC Building Integrated with Special Shaped Columns

Amrutha Shaiben[1], Binu P[2]

[1]M.Tech student, Structural Engineering & Construction Management, SNGCE, Kadayiruppu, Kolenchery, Kerala
[2]Associate professor, Civil Department, SNGCE, Kadayiruppu, Kolenchery, Kerala

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Abstract - *Due to visual reasons and restricted availability of land cause for irregular shaped construction and has been increased in nowadays. Irregularly structured structures will be damaged by strong earthquakes. Structural-irregularities are an important factor which reduces the seismic performance of structure. There will be uneven dispersal flow and torsion in buildings with structural irregularities. In this study, normal columns of L-shaped buildings were replaced by columns of special dimensions and it would be in alternate ways, this would improve the seismic action of buildings. The best arrangement of column combinations will be identified for irregular L-shaped buildings.The structural responses of building are measured in terms of story displacement, story drift, and normalized base shear force and overturning moment.*

Keywords: Irregular building, strong ground motion, Structural irregularities, story drift, torsion, irregular & shaped buildings.

1. INTRODUCTION

1.1 MODELLING AND ANALYSIS OF THE BUILDING IN ETABS-2018

The buildings were modelled using ETABS. Column-replacements is considered:

Replacing the normal columns in the corners by special shaped -columns, replacing all normal columns in building by special shaped columns.

1.2 Building Geometry

To carry out the study of seismic elastic concert of different shaped structure through plan irregularities an L shaped plan asymmetric building has been modeled in ETABS 2018. ETABS is an engineering-software product that caters towards multistoried erection analysis and design. Plan and 3D view of the modeled building are shown in Fig 1.

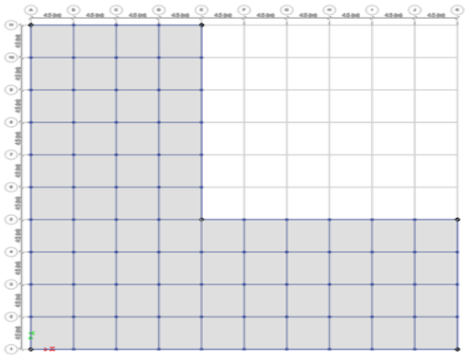

Fig -1: Plan of the building model

The buildings have nine stories with a total height of the 28 m above ground level and 1.5 m below the ground level. All stories are of 3 m height except ground floor which is 4 m. The dimensions of the regular model floors are 45 m × 45 m. The decrease in the area of the irregular model from a regular model represents the increase in the plan irregularity of the model

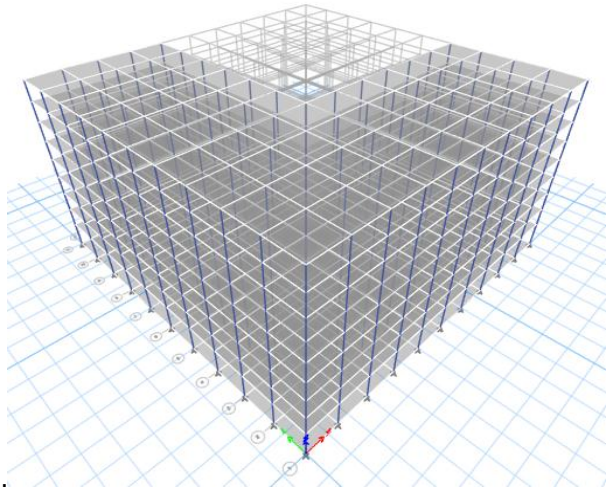

Fig -2: 3D view of the building

2. MATERIAL PROPERTIES

The concrete mix well-defined for the beam and slab is taken as M25 and M20 respectively. Fe-500 and Fe-415 grade rebar is used as a longitudinal and confinement bar. The

beams are having a specific weight density about 24.9926Kn/m³ and mass per unit volume of about 2548.538 kg/m³. The modulus of Elasticity (E) of beam is about 25000Mpa, poisons ratio (U) is about 0.2 and shear modulus (G) is about 10416.67 Mpa.

Table-1: Dimensions of newly designed T columns

Dimension (mm)	Total depth (mm)	Total Width (mm)	Thickness(mm)
350*350	410	410	200
450*450	550	550	250
550*550	600	600	320

Table-2: Dimensions of newly designed Cross Columns

Dimension (mm)	Total Depth (mm)	Total Width(mm)	Thickness(mm)
350*350	400	400	200
450*450	500	500	280
550*550	650	650	300

Table-3: Dimensions of newly designed L Columns

Dimension (mm)	Total Depth(mm)	Total Width (mm)	Thickness(mm)
350*350	400	400	200
450*450	480	480	320
550*550	580	580	390

3. RESULTS AND DISCUSSIONS

3.1 Seismic performance of L shaped building with T- shaped columns at corners

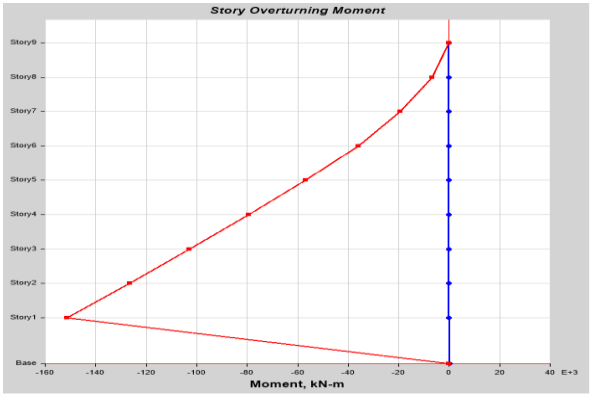

Fig -3 : Plot of Story Overturning Moment

Fig-4: Plot of Story Displacement

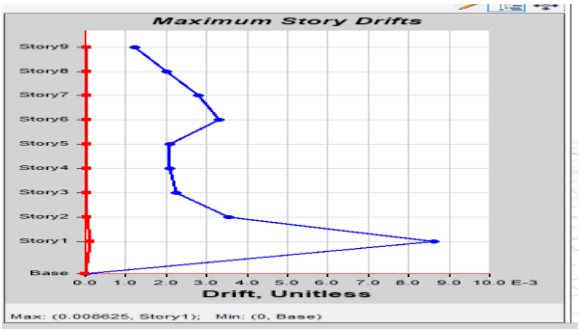

Fig- 5 : Plot of Story Drift

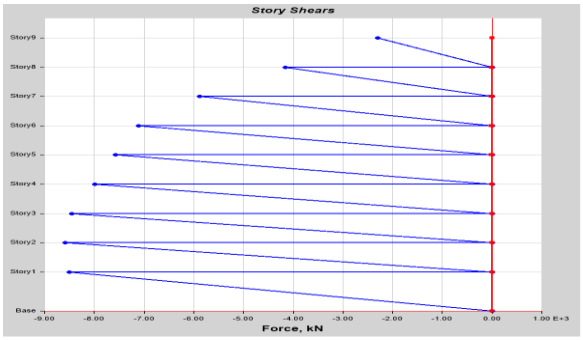

Fig -6 : Plot of Story Shear

3.2 Seismic Performance of L shaped building with Cross shaped columns at corners

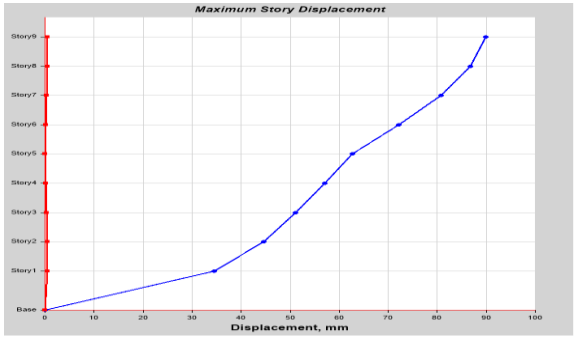

Fig-7 : Plot of Story Displacement

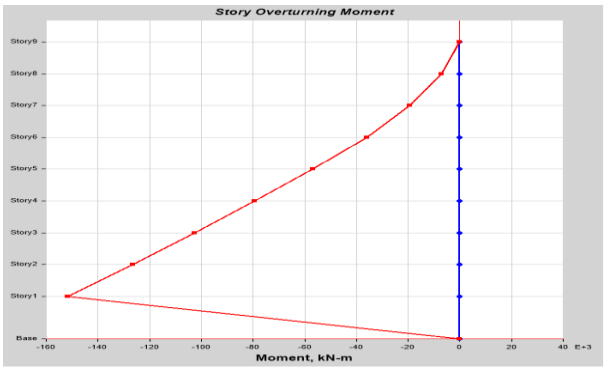

Fig-8 : Plot of Story Overturning Moment

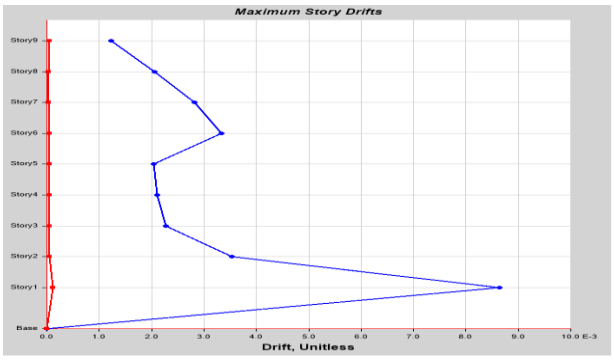

Fig -9: Plot of Story Drift

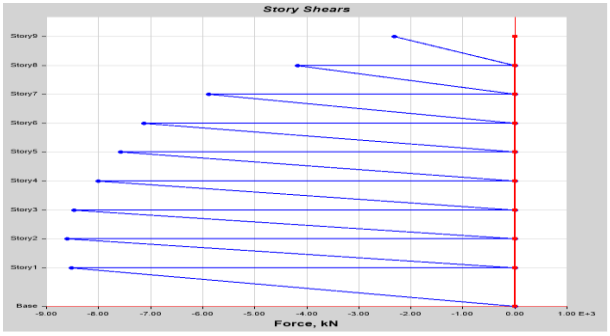

Fig -10 : Plot of Story Shear

3.3 Seismic Performance of L shaped building with L -shaped columns at corners

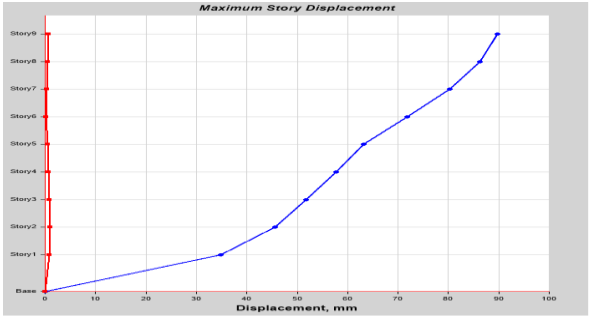

Fig -11: Plot of Story Displacement

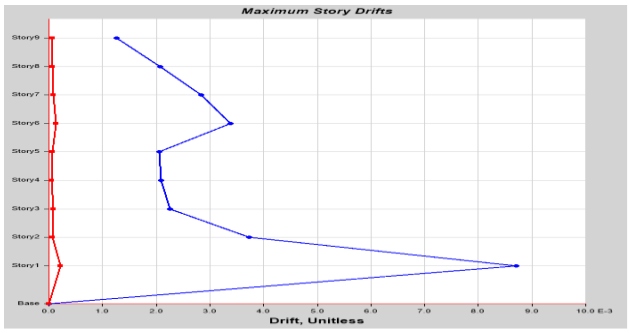

Fig -12 : Plot of Story Drift

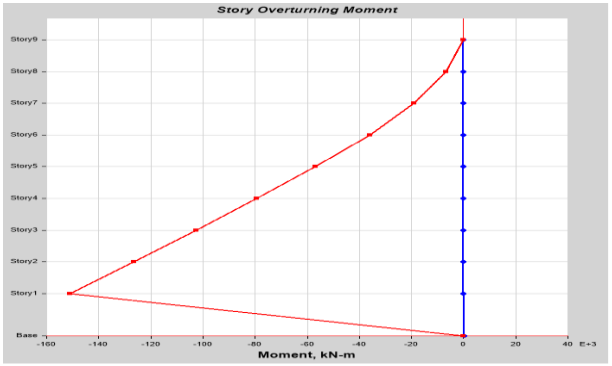

Fig -13 : Plot of Story Overturning Moment

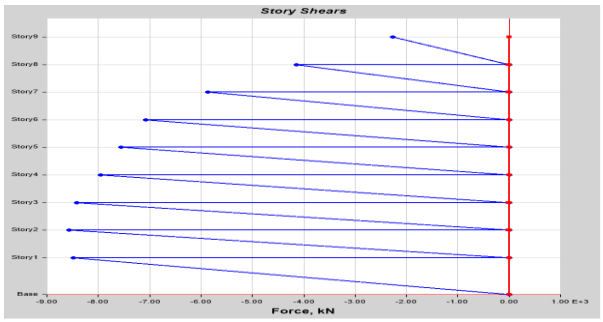

Fig -14 : Plot of Story Shear

3.4 Seismic Performance of L shaped building whose normal columns are fully replaced with special shaped columns

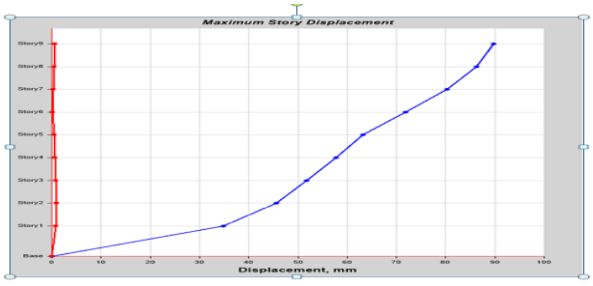

Fig -15 : Plot of Story Displacement

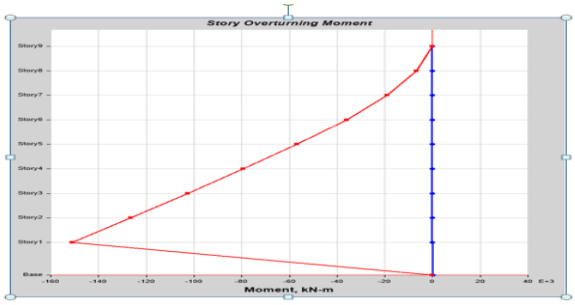

Fig -16 :Plot of Story Overturning Moment

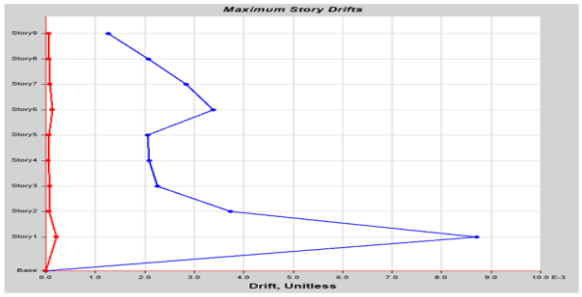

Fig -17 : Plot of Story Drift

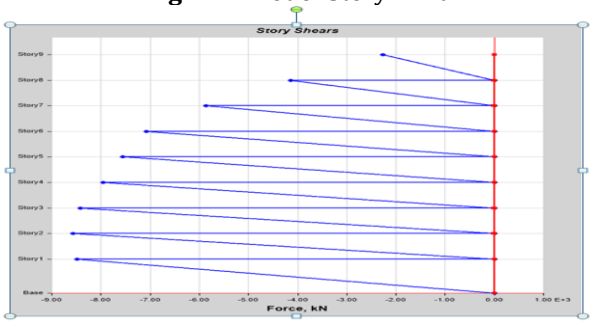

Fig -18 : Plot of Story Shear

From figure 3 to Figure 18 shows the result of different shape of the column replaced by corner Columns. From these analysis results we can see that replacing the full columns in building by different shapes consume story displacement - 89.733 mm, story displacement - 0.008, story shear -8565.8 kN and overturning moment of 55.3877 kN-m ,hence we can say that the building with special designed column performs better when exposed to seismic forces.

Table-4: Result obtained from Torsional and Buckling analysis of T columns

Location	T-shaped columns	
	Torsional Result (kN-m)	Buckling Result (kN)
A1	0.0008	0.0200
A11	0.0011	0.0191
K1	0.0026	0.0128
K5	0.3480	0.0019
E5	0.0014	0.0079
E11	0.0113	0.0925

Table-5: Result obtained from Torsional and Buckling analysis of Cross columns

Location	Cross shaped columns	
	Torsional Result (kN-m)	Buckling Result (kN)
A1	0.0116	0.0447
A11	0.0083	0.1809
K1	0.0138	0.0244
K5	0.136	0.0886
E5	0.0179	0.0172
E11	0.0171	0.1111

Table-6: Result obtained from Torsional and Buckling analysis of L columns

Location	L-shaped columns	
	Torsional Result (kN-m)	Buckling Result (kN)
A1	0.0116	0.0447
A11	0.0083	0.1809
K1	0.0138	0.0244
K5	0.0.136	0.0886
E5	0.0179	0.0172
E11	0.0171	0.1111

4. CONCLUSIONS

The replacement of normal columns at corners of a structure through different shapes such as T, Cross and L shaped columns are performed with various size of 350x350, 450x450 and 550x550 mm. Similarly replacement of special column in entire building was performed. Structural responses of changed model were measured in terms of story-displacement, story-drift, torsional-irregularity, shear force, and overturning -moment. Following are the results obtained:

- From seismic analysis by replacing the corner column with special shapes, have story displacement of 89.733mm, story displacement of 0.008705, story shear of 8565.8515kN, and overturning-moment of 55.3877kN-m hence we can say that the special shaped column have better results compared to other shapes.

- By comparing the replacement of different shape by the corner column the special shaped column have the maximum story drift and story shear as compared by the other model. By comparing the torsional and buckling values of the three models, T-shaped corner column shows better performance.

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REFERENCES

[1] Arvindreddy, R.J. Fernandis, "Seismic analysis of RC regular and irregular frame structures", IRJET, Volume 02, Issue No. 05, 2015.

[2] Basavaraju Y. K., Dr. B.S.Jayashankar Babu, "Seismic performance of multistory RC frame buildings with soft storey from pushover analysis", IJESC, Volume 06, Issue No. 7, 2016.

[3] Federal Emergency Management Agency (FEMA- 273), "The Guidelines for the Seismic Rehabilitation of Buildings", Oct-1997.

[4] IS 1893 (Part 1)," Criteria for earthquake resistant design of structures", Bureau of Indian Standards, New Delhi, India, 2002.

[5] Kancharla Srimukha, Ramesh Bantupalli, "Pushover Analysis of MultiStorey RCC Frame with and without Vertical Irregularities", International Journal of Engineering and Management Research, Volume-6, Issue-4, July-August 2016.

[6] Naresh kumar B G, T M Prakash, N. Punith, Mallamma, "Seismic analysis of multi-storied building having vertical irregularities using pushover analysis", IRJET, Volume 04, Issue No. 07, 2017.

[7] Shaikh Sameer J.,S.B. Shinde "Seismic Response of Vertically Irregular RC Frame With Stiffness Irregularity at Ground Floor ", IJARSE, Vol. 5, Issue No.09, September 2016.