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DYNAMIC ANALYSIS FOR INVESTIGATION OF CRITICAL ANGLEFOR TORSION IN R.C.C FRAME

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ABSTRACT

Torsional behaviour of asymmetric and irregular R.C.C structures are one of the most frequent source of structural failure during strong ground motions. In this paper G+ 9 stories H-shape building considered with mass, stiffness irregularity. For evaluation of critical angle of seismic incidence for torsion by using dynamic analysis response spectrum method in STAAD PRO as per IS 1893-2002. Set values from 0 to 90 degree with increment of 10 degree interval have been used for angle of excitation. Building column divided into three main categories including corner, side and middle column. The angle at which maximum torsional moment is obtain that is considered as a critical angle and results are compared in terms of axial force, bending moment and shear force for column.

Keywords: ***Mass and Stiffness Irregularity, B.I.S 1893-2002, Torsion, Angle of Excitation, Column Forces.***

I. INTRODUCTION

It has been analyse that survey conducted on modes of failure of building structures during past severe earthquakes concluded that most vulnerable building structures are those, which are asymmetric in nature. Asymmetric-plan buildings, namely buildings with in-plan asymmetric mass and strength distributions, are systems characterized by a coupled torsional-translational seismic response. Asymmetric building structures are almost unavoidable in modern construction due to various types of functional and architectural requirements. IS 1893-2002 code deal with torsion by placing restrictions on the design of buildings with irregular layouts and also through the introduction of an accidental eccentricity that must be considered in design.

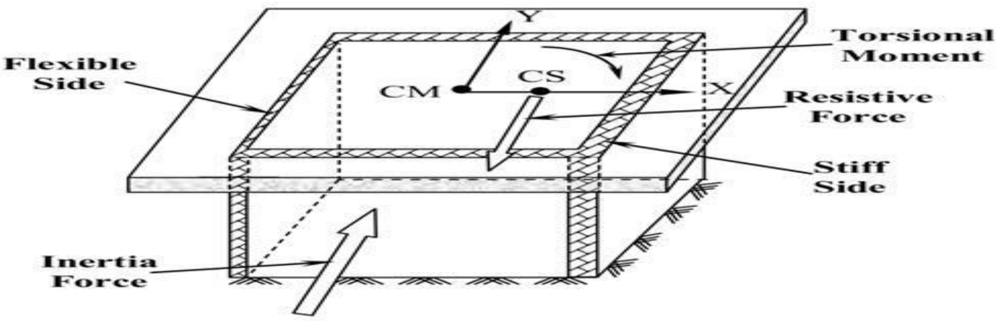

Figure No.1:- Generation of torsional moment in asymmetric structures during seismic excitation.

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The lateral-torsional coupling due to eccentricity between centre of mass (CM) and centre of rigidity (CR) in asymmetric building structures generates torsional vibration even under purely translational ground shaking. During seismic shaking of the structural systems, inertia force acts through the centre of mass while the resistive force acts through the centre of rigidity as shown in figure.1

II. FRAME STRUCTURE DETAILS

In this present study G+9 irregular building of H-shape R.C.C frame structure with mass and stiffness irregularity is taken and dynamic analysis by using response spectrum method with consideration of accidental eccentricity with the help of STAAD PRO software. The position of different type of columns i.e. corner, side, middle C1,C2,C3 respectively for model of irregular building of H-shape structure as shown in figure.2

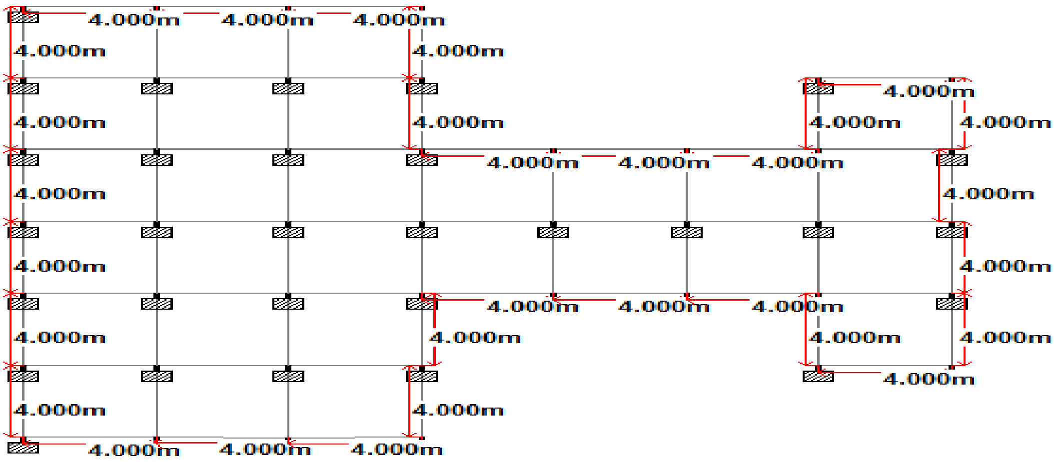
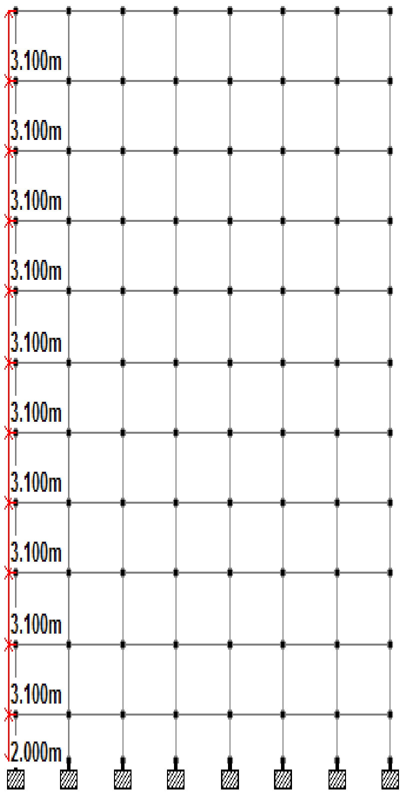


Figure No.2:- Figure shows model of irregular building of H-shape plan

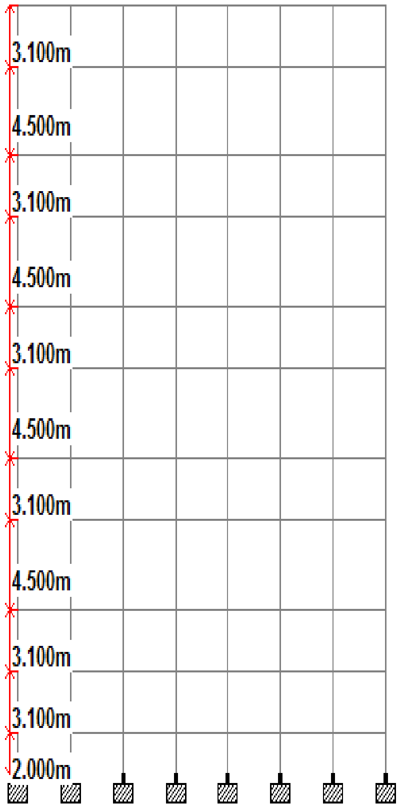
Type Of Structure	G+9 Moment Resisting Frame Structure
General Floor To Floor Height	3.1m
Stiffness Irregularity	4.5m At 2nd, 4th, 6th, And 8th Floor
Mass Irregularity (External Wall)	40kN/Sq-m At 2nd, 4th, 6th, And 8th Floor
Mass Irregularity (Internal Wall)	25kN/Sq-m At 2nd, 4th, 6th, And 8th Floor
Live Load	3 KN/Sq-m
Dead Load (External Wall)	15kN/Sq-m
Dead Load (Internal Wall)	10kN/Sq-m
Seismic Zone	V, As Per Is 1893-2002, Z=0.36
Type Soil	Medium Soil = Ii
Corner Column (C1)	230 X 300
Side Column (C2)	230 X 450
Middle Column (C3)	300 X550

Table No.1: Specification of model

Model shows the geometry in a vertical axis for mass irregular H-shape structure and stiffness irregular H-shape structure as shown in figure: 3 and figure: 4.



FigureNo.3: Front view of mass irregular H-shapeStructure.



FigureNo.4: Front view of stiffness irregular H-shapeStructure.

III. METHODOLOGY

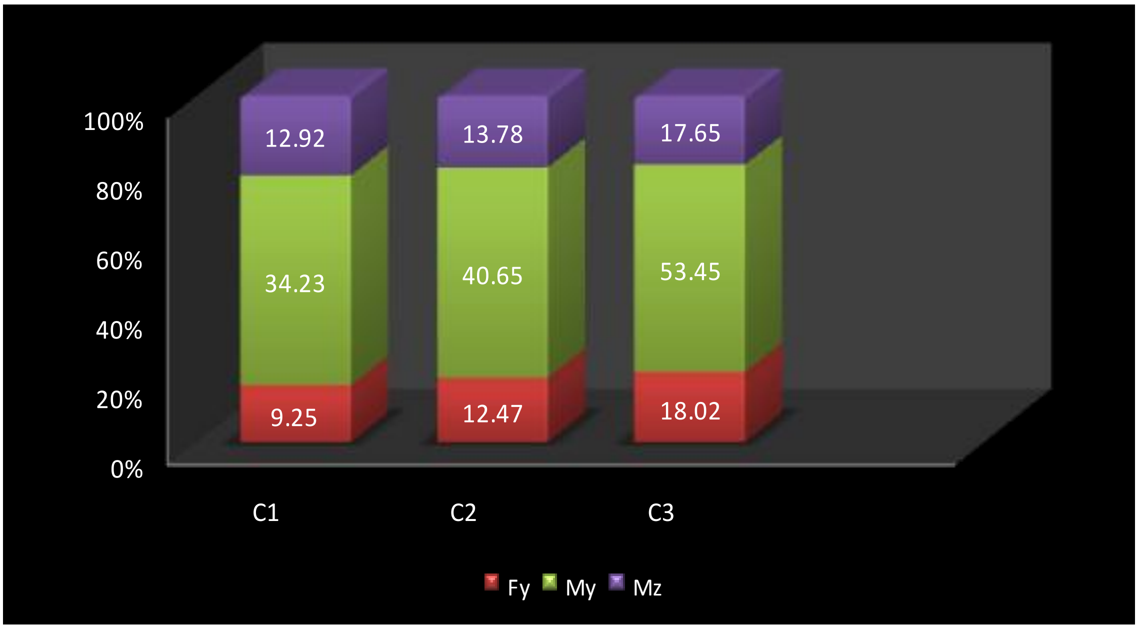
The present work deals with dynamic analysis response spectrum method considering accidental eccentricity. response spectrum method for x and z direction so in order to apply the forces at different angle structure has to be rotate with incident angle from 0 to 90 degree with increment of 10 degree interval further to find out the accurate angle the interval of one degree is used. The angle at which maximum torsional moment is obtain that is considered as a critical angle and the columns have been divided in three categories including corner, side and middle.

IV. EXPERIMENTAL RESULTS

Table No: 2 represent the percentage variation of stiffness irregular structure in terms of axial force, shear force and bending moment at critical angle where we get maximum torsional moment.

Col No.	Critical Angle (degree)	Moment and forces at 0 degree			Moment and forces at critical angle			Percentage variation in moment and forces		
		Fy	My	Mz	Fy	My	Mz	Fy	My	Mz
C1	42	38.14	83.55	63.59	34.91	112.15	56.31	9.25	34.23	12.92
C2	35	80.13	134.71	159.9	71.24	189.48	140.53	12.47	40.65	13.78
C3	37	144.6	334.17	326.45	122.57	512.81	277.46	18.02	53.45	17.65

Table No.2: Results of stiffness irregular structure



FigureNo.5: Shows percentage variation in shear force and bending moment of H-shape stiffness irregular building.

It is seen from Table No.2 and figure No.5 the maximum percentage variation in shear force for corner column 9.25% for side column 12.47% and for middle column 18.02% .percentage variation in bending moment (My) between corner and side column is 6.42% and percentage variation in side and middle column is 12.8%. If we see the results in table maximum percentage variation occur in bending moment in y-direction as compare to shear force and bending moment in z- direction.

Table No: 3 represent the percentage variation of mass irregular structure in terms of axial force, shear force and bending moment at critical angle where we get maximum torsional moment.

Col No.	Critical Angle (degree)	Moment and forces at 0 degree			Moment and forces at critical angle			Percentage variation in moment and forces		
		Fy	My	Mz	Fy	My	Mz	Fy	My	Mz
C1	41	54.44	101.04	88.15	49.69	144.53	81.12	9.55	43.04	8.66
C2	41	113.05	150.77	182.25	94.73	253.51	149.5	19.33	68.44	21.90
C3	40	214.86	370.32	387.94	177.29	666.6	318.25	21.19	80.00	21.89

Table No.3: Results of mass irregular structure

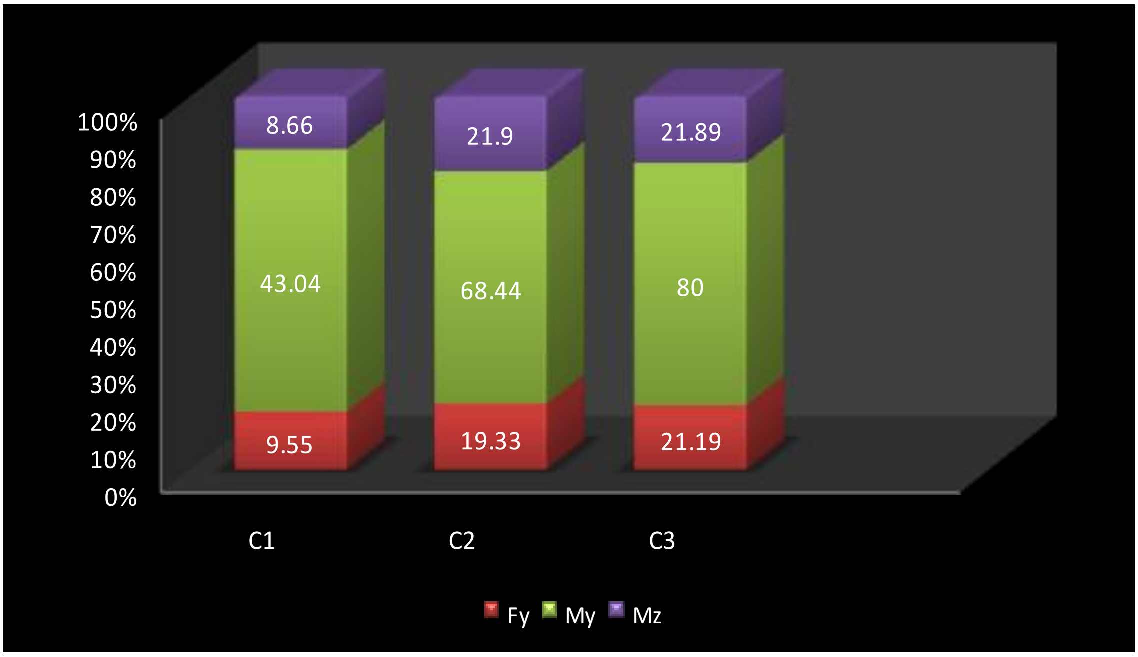


Figure No.6: Shows percentage variation in shear force and bending moment of H-shape mass irregular building.

It is seen from Table No.3 the maximum percentage variation in shear force for corner column 9.55% for side column 19.33% and for middle column 21.19% .percentage variation in bending moment (My) between corner and side column is 25.4% and percentage variation in side and middle column is 11.56%.if we see the results in table maximum percentage variation occur in bending moment in y-direction as compare to shear force and bending moment in z- direction.

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V. CONCLUSION

It is concluded that the Mass irregular structure are having more percentage variation in shear force and bending moment as compare to stiffness irregular structure and the values of critical angle are lies between 35 degree to 44 degree for both mass and stiffness irregular H-shape structure where we get the maximum torsion. Percentage variations in B.M for both structures are 13.295% and Percentage variation in S.F for both structures are 6.476%.

Thus while designing each and every component of structure shall be analysed at each particular angle and consideration of torsion is necessary because it very much affected on B.M and shear force.

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