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Research Article

A Study of Plan Irregularity Inducing Accidental Torsional Moment of Multi Story Building using Stadd Pro

Subodh.S.Patil[#*] and Shrinivas.R.Survanshi[#]

[#]Department of Civil Engineering, ICOER, Pune, India

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Abstract

In this paper sesmic performance of multistory building is check with asymmetrical plan. It observed that during earthquake measure damage is occur at reentrant corner A g+20 and g+22 building having plan Asymmetry is modeled in finite element analysis stadd pro v8i.Accenditial torsional load is applied with reference to 1893(part-1)-2002.In this paper we provide artechtural relief and providing shear wall at re-entrant corner in the buildings.

Keywords: *Asymmetrical building, Earthquake, Torsion, Response Spectrum, Remedies on torsion &Better solution.*

1. Introduction

A building should possess four main attributes, namely simple and regular configuration, and adequate lateral strength, stiffness and ductility to perform well in earthquake. Buildings having simple regular geometry and uniformly distributed mass and stiffness in plan as well as in elevation, suffer much less damage than buildings with irregular configurations. But due to architectural consideration we have to construct buildings with irregular according is1893 clause 7.1 irregular define in two ways plan irregularities and vertical irregularity.

Torsion is caused in building during earthquake due to various reasons, mainly due to non-symmetric mass distribution and stiffness. Torsion is generated in asymmetrical building when the distance between storey's center of rigidity and storey's center of mass is greater than 20% of the width of the structure in either major plan dimension. In torsion irregularity, inertia force acts through the center of mass while the resistive force acts through the center of rigidity as shown in fig 1.

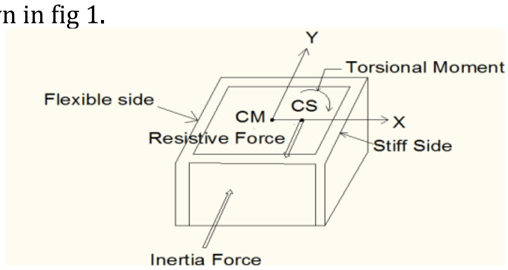

Fig.1 Generation of torsional moment in asymmetric structures

*Corresponding author **Subodh.S.Patil** is a Post Graduate Student **and Shrinivas.R.Survanshi** is working as Assistant Professor

The torsion will be developed at Re-entrant corners in L-shape and T- shape Building .the Re-entrant corner, lack of continuity corner is the common characteristic of overall building configuration that in plan .L-shape and T-shape occurs due to lack of tensile capacity and force concentration. According to IS-1893(Part1)-2002, Plan configurations of a structure and its lateral force resisting system contain re-entrant corners, where both projections of the structure beyond the re-entrant corner are greater than 15 percent of its plan dimension in the given direction. In fig 2 shows differential motion between different parts of building, resulting in local stress concentration at the notch of the re-entrant corners.

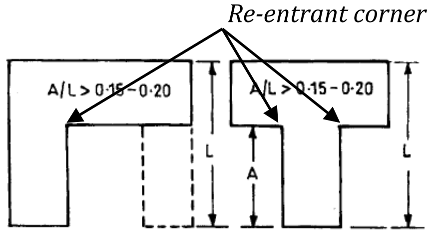

Fig.2 Examples of building with plan irregularities

To avoid the damage due to torsion irregularity provide separate wall or uniform box or artechtural relief or diagonal reinforcement is provided in T-shape and L-shape Building.

2. Methods for Seismic Analysis

The method of analysis used here is Response Spectrum method and analysis using Stadd-Pro.

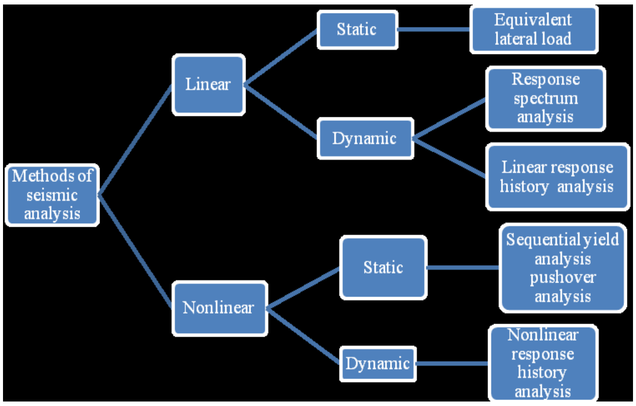

Fig.3 Methods of seismic analysis

2.1 Response Spectrum Method

In this method the load vectors are calculated corresponding to predefined number of modes. These load vectors are applied at the design centre of mass to calculate the respective modal responses. These modal responses are then combined according to SRSS or CQC rule to get the total response. From the fundamentals of dynamics it is quite clear that modal response of the structure subjected to particular ground motion, is estimated by the combination of the results of static analysis of the structures subjected to corresponding modal load vector and dynamic analysis of the corresponding single degree of freedom system subjected to same ground motion. Static response of MDOF system is then multiplied with the spectral ordinate obtained from dynamic analysis of SDOF system to get that modal response.

2.2 Using Stadd-Pro

In the analysis of the building we consider the accidental torsion in Stadd-Pro. In Stadd-Pro uses the Finite Analysis Method.

3. Building Details

In the present study the seismic load analysis and lateral load analysis as per the seismic code IS 1893 (Part 1): 2002 are carried out. For Two Buildings, one is L-Shape and other T-shape asymmetric in plan for building height G+20 and G+22 for comparison criteria is that numbers of columns are kept same for all three buildings and an effort is made to study the effect of seismic loads on them also determine torsional moments, base shear, displacement and time period by using response spectrum method.

Problem statement –A G+20 and G+24 storied bare RC Ordinary Moment Resisting Frame has plan as shown in fig. is situated in seismic zone III

A) T-shape Building

In X-direction-6 Bays@30m
In Z-direction- 6Bays@30m
B) L-shape Building

In X-direction- 6Bays@30m
In Z-direction- 8Bays@40m

Beam size - 0.23m x 0.45m
Column size - 0.23m x 0.45m
Thickness of slab- 150mm
Height of storied – 3m
Plinth height above GL – 1.5m
Unit weight of concrete – 25kN/m3
Live load – 3kN/m3
Grade of concrete – M20
Grade of Steel – Fe415

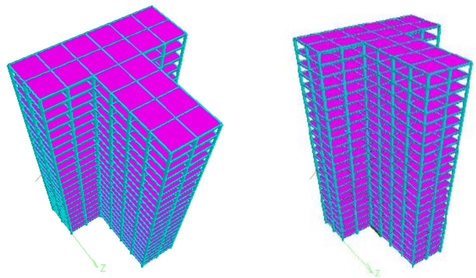

Fig.4(a) T-Shape G+20 and G+22 Building without shear wall

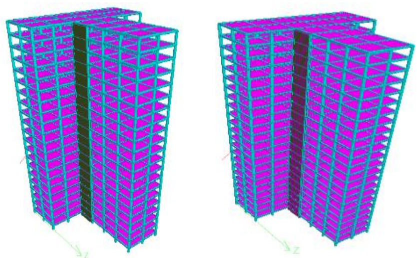

Fig.4(b) T-Shape G+20 and G+22 Building with shear wall

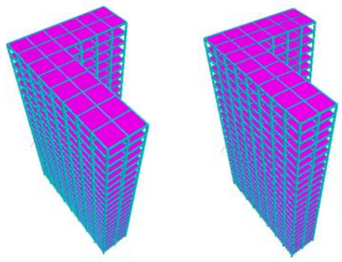

Fig.4 (c) L-Shape G+20 and G+22 Building

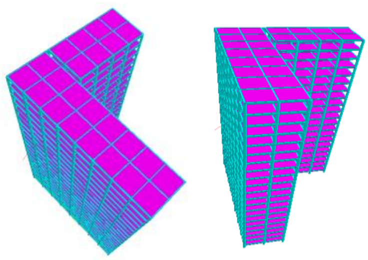

Fig.4(c) L-Shape G+20 and G+22 Building with architectural relief

4. Result and Discussion

Table 1(a) Base shear and Time period for G+20

G+20 Storied building	By using software STADDPRO Response Spectrum Method		
	Seismic weight (KN)	Time Period(Sec)	Base Shear(KN)
L-Shape	66255.94	0.87	1378.12
L-Shape with Architectural Relief	67356.25	0.875	1394.27

Table 1(b) Displacement and Maximum stress for G+20

G+20 Storied building	Displacement(mm)	Max Absolute stress(N/mm2)
L-Shape	129.091	0.143
L-Shape with Architectural Relief	128	0.106

Table 2(a) Base shear and Time period for G+22

G+22 Storied building	By using software STADDPRO		
	Seismic weight (KN)	Time Period(Sec)	Base Shear(KN)
L-Shape	72579.62	0.87	1509.65
L-Shape with Architectural Relief	73881.18	0.875	1529.34

Table 2(b) Displacement and Maximum stress for G+22

G+22 Storied building	Displacement(mm)	Max Absolute stress(N/mm2)
L-Shape	165.699	0.18
L-Shape with Architectural Relief	164.397	0.145

Table 3(a) Base shear and Time period for G+20

G+20 Storied building	By using software STADDPRO		
	Seismic weight (KN)	Time Period(Sec)	Base Shear(KN)
T-Shape	55373.61	1.01	996.72
T-Shape with Shear wall	58996.92	0.184	1964.52

Table 3(b) Displacement and Maximum stress for G+20

G+20 Storied building	Displacement(mm)	Max Absolute stress(N/mm2)
T-Shape	81.519	0.100
T-Shape with Shear wall	80.959	0.115

Table 4(a) Displacement and Maximum stress for G+22

G+22 Storied building	By using software STADDPRO		
	Seismic weight (KN)	Time Period(Sec)	Base Shear(KN)
T-Shape	60658.79	1.01	1091.85
T-Shape with Shear wall	64634.62	1.01	1163.42

Table 4(b) Displacement and Maximum stress for G+22

G+22 Storied building	Displacement(mm)	Max Absolute stress(N/mm2)
T-Shape	99.722	0.115
T-Shape with Shear wall	96.363	0.115

Conclusions

In this paper modeling of multistoried building with plan irregularity is done. In accordance with IS1893-2002 for simulation purpose finite element analysis Stadd-Pro V 8i is used following conclusions are formed after studying T-shape and L-shape Building with variation of height.

1) Increase in height of L-shape building directly increase in relative displacement & stress at re-entrant corners
2) Architectural Relief is given for L-Shape building relatively considerable decrease in displacement and also decrease in stresses at re-entrant corners.
3) Increase in height of T-shape building directly increase in relative displacement and stress will be developed at re-entrant corner.
4) A T-shape building with shear wall and without shear wall is analyzed the stress developed at re-entrant corners is uniform.
5) In T- shape building re-entrant corners are not fail due to the stress are carry by the shear wall first it will fail.
6) From above the Observation it is concluded that Architectural Relief is the better solution on the re-entrant corner on which maximum earthquake damage is done.

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