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Behaviour of Asymmetric Building during Earthquake

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Abstract - *Asymmetric structures are more used in new architectural design due to functionality they provide. Asymmetric building comes under Irregular configuration of building in this horizontal irregularity present which makes it asymmetrical in plan shapes (e.g. L-,T-,U-,F) or discontinuties in horizantal resisting elements (diapharagms) such as cut-outs,large opening, re-entrant corners and other abrupt changes resulting torsion and stress concentration. This paper represent the behaviour of asymmetric building under seismic load. The analysis is done by equivalent static method and dynamic analysis method.*

In this paper some of data and definition taken from IS:1893-2016.

***Key Words*: asymmetric building, Irregularity, torsion, building eccentricity.**

1. INTRODUCTION

Structure has been prone to earthquake since first structure was built. Earthquake resistant building has taken a more scientific turn and still a major area of research .The higher the rise greater the fall in urban areas tall structures are build and they are more susceptible to damage during earthquake. The limitation of space in urban cities has caused many new changes in structure of building. The design having more functionality provides more utility makes structure asymmetric. Seismic surveys prove that the asymmetric structures are most vulnerable structure during earthquake hence it is important to know behaviour of earthquake under seismic load. The component of building that resist the seismic forces is known as lateral force resisting system (LFRS).

The damage in the structure generally initiates at location of structural weak planes present in the building system the weakness triggered furthur damage during earthquakke which leads to structure collapse.

1.1 structural Irregularity

Structural irregularity can be categories in two types

(1) Vertical irregularity present according to mass, strength, stiffness, setback.

(2) Horizontal irregularity present according to asymmetrical plan shapes, re-entrant corners, diaphragm discontinuity, irregular distribution of mass strength and stiffness along plan.

A story in a building said to be mass irregularity if its mass exceeds 200% than that of the adjacent story. If the stiffness of story less than 60% than the adjacent story termed as weak story..If the stiffness of story less than 70% or above as compared to adjacent then the story is termed as soft story .Many building accidentally rendered irregular due to variety of reason like non uniformity in construction practice and materials .Although irregular building are preferred due to their functionality and aesthetic consideration.

Failure of plan irregular building are due to presence of asymmetry in plan. From past earthquake it is observed that during minor and major earthquake damage occurs. The non coincident of center of mass and stiffness in structure generate plan asymmetry which causes torsional vibration resulting severe damage to structural components.

Method of analysis

As per IS: 1893(part1) 2016 method of analysis of building for design earthquake.

(1)Equivalent static method

(2) Dynamic analysis method

In equivalent static method analysis usually conservative for low to medium height of building with regular configuration. The consideration of non linear forces will not be of that significance. This method is effective where lateral torsion moments are not effective and only first mode of vibration in each direction is considered.

Dynamic analysis shall be performed to obtain design seismic force and its distribution different level along the height of resisting element. For tall buildings dynamic analysis method used. Dynamic analysis can be performed in two ways.

(1)Response spectrum method

(2)Time history method

LITERATURE REVIEW

Narayan malviya, sumit pahawa presented paper on seismic analysis of high rise building with IS code 1893-2002 and IS code 1893-2016.In this they modeled two different building as per the above two codes specification and analyzed in SAP 2000 commercial software .They concluded that new code is more efficient as compared to old code. The deflection value less as per revised code design. Shear force

and bending moment also shows less values as compared to old code .Response spectrum result concluded that acceleration against time is higher in the case of new code.

BK raghuprasad, Vinay s amarnathK represented seismic analysis of buildings symmetric and asymmetric in plan. In this paper effort to check torsional effect in asymmetric plan building. They modeled the frame in two ways fist one is spring model and second one is column model in spring model column replaced by spring. By dynamic analysis of structure they concluded that natural frequency of asymmetric spring model is greater than of symmetric spring model. Maximum displacent occurs in asymmetric spring model as compared to symmetric spring model the base shear is also more than the symmetric spring model.

Desai RM, khurd V.G, patil SP, Bavane N.U presented paper on" Behavior of symmetric and asymmetric structure in high seismic zone". In this paper they modeled three building G+3,G+6 and G+9 and effort is made to study the effect of eccentricity between centre of mass and centre of rigidity .By sap 2000 commercial software they analyzed as low rise mid rise and high rise building they concluded that symmetrical building has more time period as compared to asymmetrical building .Natural time period increases as height increases The time period of high rise is more as compared to low rise and mid rise building The time period decreases as the no of storey decreases.

Chaithra S, Anue marry Mathew presented paper on "Behaviourial analysis of asymmetric building with solid coupled and shear wall with staggered openings". In this they modeled 3 building in seismic zone V the number of storey height was 10, 20, 40 and floor height of each storey is taken as 3m, varying depth of coupling beam and staggered opening shear walls. The first building analyzed without shear wall and second one analyzed with shear wall the building modeled and analyzed in ETABS software. They concluded that the building having shear walls with regular openings brittle failure is observed where as building having shear wall with staggered opening ductile failure was analyzed. The solid shear wall is most stable form of shear wall.

Sharath Irappa kumar, Tejas D.joshi presented "Non linear static analysis of asymmetric building with and without shear wall". In this paper effort is made to study the behavior of structure with re-entrant corners under gravity and seismic loading .They modeled T shape building with and without shear wall in SAP2000 commercial software and also analyzed in this and concluded that the addition of shear wall significantly reduces displacement in structure when compared to structure without shear wall. Shear wall resist earthquake forces greater extent because base shear is less as compared to structure without shear wall. Building having re-entrant corner are more prone to earthquake damage.

K. Bindunathi, K. Rajasekhar Presented"comparision of percentage of steel quantities and cost of asymmetric commercial building under gravity loads and seismic loads" . In this paper asymmetric commercial building modeled in E-tabs software. As per IS 456:2000 gravity loads and live load estimated. Seismic analysis of the structures is carried out on the basis of lateral force assumed to act along with the gravity loads .Building is type of G+4 and main objective of analysis is to study the different forces like moments, Shear forces and axial forces acting on building. They concluded that the variation of percentage of steel of seismic loading when compare to gravity loading is 21.93%.The variation of estimated cost of structural member analyzed and design under seismic loading is 23.99% is greater.

M.D. Bensalah, M.benasaibi.A.Modaressi presented paper on"assessment of the torsion Effect in asymmetric Building under seismic Load". The main objective of the paper is to estimate the influence of torsion effects induced on the behavior of an asymmetrical structure. The dynamic analysis is done with finite element software GEFDYN by making asymmetrical and symmetrical modeled. They concluded that lateral yielding strength of the asymmetrical structure is higher than the one of the symmetrical structure. The ductility increase with increase in input motion and decrease with increasing predominant period with significant variation in asymmetrical structure than those symmetrical structures. The normalized eccentricity increase when increase in input motion. The reduction factor decreases he of earthquake

CONCLUSIONS

In present scenario asymmetrical building unavoidable due to functionality they provide but asymmetrical building more prone to earthquake.

IS 1893-2016 is more effective than IS1893-2002.

When we use spring model in case of asymmetric building the displacement is more as compared to symmetric building.

Asymmetrical building are more prone to torsional vibration. Torsional moment decreases as height increases.

Presence of shear wall with staggered openings improve the functionality of asymmetric building.

Asymmetrical structure has higher capacity of lateral yielding strength as compared to symmetrical structure.

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