Seismic Behaviour of Asymmetric Building

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Abstract- *Earthquake being important factor to consider nowadays. Many buildings are getting collapse due to earthquake. It has been seen that due to negligence of earthquake analysis the building cannot sustain in small earthquakes also. In modern world, structure with various shapes are being constructed which are asymmetric structure. Seismic Behavior of asymmetric building may cause break of force flow and stress awareness. Due to this, here torsion-phenomena are produced in the building which leads to amplify lateral deflection, shear force, and ultimately causes failure. Therefore it is necessary to analyze seismic behavior of asymmetric building.*

Asymmetry in the structures makes study of the seismic behavior very difficult. Seismic stipulate in peripheral fundamentals is improved. Uniformity in load distribution gets disturbed. Torsional behavior of asymmetric building is one of the most frequent causes of structural damage and failure during strong ground motions.

Considering research papers two types of asymmetric structures are selected (L and T) these are compared with one another and symmetric buildings showing the result for each considerations. Displacements (in X,Z directions), Base Shear , Moment , Time period etc. which will be used to give the remedies to resist big failures.

Keywords- Discrete event simulation, queuing system, size delay function

I. INTRODUCTION

There are two main types of structures wiz. Symmetric and asymmetric structure. Symmetric structure is those which are almost identical on either side while asymmetric structure is un-identical structures. Symmetric structure are widely used in the world from ancient, this type of structure are safe compared with the asymmetric torsion phenomenon due to the seismic forces.

Asymmetric building structures are these days' necessary in modern construction due to various types of useful and demand of architectural requirements. Earthquake harm surveys and analysis conducted on mode of malfunction of building structure during past brutal earthquakes concluded that most weak building structures are not symmetric in nature.

Asymmetry is the missing of symmetry in the buildings. It is an important to keep regularity in property of both physical and theoretical systems and it may be displayed in accurate terms or in more artistic or aesthetics terms. The absence of negligible of symmetry that are either expected or desired can have vital consequences for a scheme.

It has been seen that the cause of the major damage due to strong earthquake is torsion phenomenon, which is ranging from small destruction of the structure to the total failure or destruction. Torsion phenomenon deals with earthquake forces when the middle of mass of a structure does not match with its midpoint of rigidity. These situation may give rise to this situation in the building due to plan are positioning the stiff elements unevenly with respect to the centre of gravity of that particular story. Torsion can be caused due to the following above Reasons and which can lead to total structure failure. It is essential to avoid the torsion, the infill's walls lay important role.

The present study summarizes the work done in the past regarding different types of structural irregularities which are in Plan and vertical (height) irregularities. This work includes comparison of effect and its behaviour with the symmetric buildings or relative present building. seismic effect in different zones due can be studied and can be checked through the analysis software like STAAD-PRO. Considering and studying the work carried out in past the comparison and future scope can be evaluated which will give the better result and which will lead to conclusion.

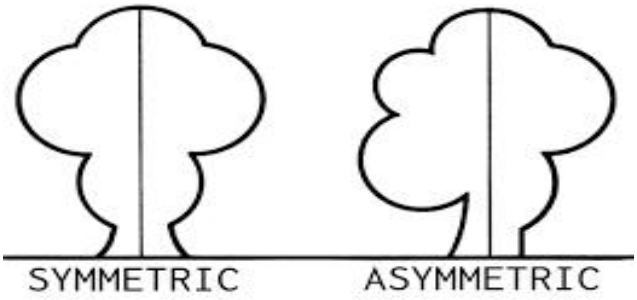

Figure 1. Concept of Symmetricity and Asymmetricity

II. OBJECTIVES

- Check behaviour due to seismic effect on asymmetric building.
- Comparison of displacement (X, Y directions) of asymmetric with symmetric building.
- Comparison of base shear
- Comparison between time period
- Checking behaviour using the zone as per IS:1893 : ZONE IV

III. LITERATURE REVIEW

1) Shantanu S. Magnum & Dr.P.S.Patil Study tell about the seismic behaviour of vertical asymmetric building Seismic behavior consisting of many stories. The asymmetric building causes disruption of strength flow and stress attention. Due to this, Torsion is produced in the building which increases shear force, lateral deflection in the building and results in failure at last. This all ultimately result in the failure of building.The author has given the studies with different irregularities which ever are possible in reference to height of the building. I.e. related vertical. Study shows that there tremendous increase in shear force of the building due to torsion which is produced in column by irregularity.

2) Mr. Sandesh N. Suryawanshi & Prof. S. B. Kadam, Dr. S. N. Tande Study tells about the Torsional Behavior of Asymmetrical Buildings related to Plan under Seismic Forces. Seismic damage survey and analysis conducted on various medium of failure of structures during past study of earthquakes concluded that most vulnerable building structures are those which were generally asymmetric in nature. The Asymmetric structures are roughly obvious in modern construction due to various types of useful and architectural demand. Torsion in buildings during earthquake shivering may be caused due to various reasons, the most ordinary of which are irregular of mass distribution and stiffness. There are new modern codes which deal with torsion restricting on the design of buildings with uneven layouts and also through the introduction of an accidental eccentricity that must be considered in design. The lateral-torsional coupling due to eccentricity between centre of rigidity & centre of mass in asymmetric building structure generate torsional vibration even under translational ground vibrations during earthquake shaking of the structural components, Moment of inertia force act through the middle of mass while the resistive force acts through the centre of rigidity.

3) Praveena E, G Narayana Studied about the Effect of foundation on the asymmetric building considering the different flexibilities. In general the seismic design of building frame structures the engineer will consider only the outcome of fixed-base condition, and will ignore the consideration of flexibility which is very important in designing. It has been seen that in the end and post earthquake research the rcc framed structure reveal that the SSI (soil structure interaction) and foundation of structure plays an vital role in damage of the buildings. In this paper the modeling is done using FEM based software which is SAP2000 (version14), they have considered the different soil conditions which are soft, medium and hard with different soil parameters. Another is consideration of the other fixed types of footing for knowing the effect or behavior of post-earthquake.

4) A.Aziminejad and A.S.Moghadam, have given the performance of asymmetric multi-storey considering the different strength condition on the shear building. Various vital responses related to the multistory buildings like drift, plastic hinge rotation of models & ductility using fragility curves. By identifying more exact configuration of the centre of mass and rigidity, adverse effect of the torsion failure can be minimized. OPENSEES software is used. By Using Fragility curve various aspect are studied of symmetric building and asymmetric building are compared and checked for the torsion phenomenon in the building and its effect. This will give the maximum eccentricity criteria and limitation which will be helpful in planning the asymmetric building which will cause minimum damage to the building during any seismic activity.

5) M.D.Bensalah, M. Bensaibi And A.Modaressi, studied that effect of torsion assessment under seismic load of irregular i.e. asymmetric building. Study on the worst effect of the torsion on the behaviour of building is completed. In this 2 types of structures are taken into account, which are defined as the symmetric and asymmetric building in terms of rigidity. Using finite element method and seismic records the analysis is done and compared with each other. Torsion effect using seismic records and comparison of response result for the maximum displacement. Irregular structures which are asymmetric are getting used more in new architectural planning. It has been seen that structures the torsion response is more in such buildings with the irregular plan and can cause many difficulties in seismic loads. In the new seismic codes, trying countering this effect and during the modelling it is not easy to know the influence or effect at the primary stage of architectural planning.

6) S.Varadharajan,V.K. Sehgal, and B.Saini, the author reviewed the different structural irregularities in the structure. This study summarize the history based on the research on different types of structural irregularities i.e. Plan and vertical (height) irregularities. Criterion and restrictions individual for these irregularities given by different codes of practice. The maximum impact is due to strength abnormality and the minimum impact is due to mass irregularity on seismic response. All other possible structural irregularities are studied and behaviour and effect of that particular building is checked. The seismic response is depended upon the structural planning and irregularity. It has been shown that the different type of irregular structure behave different in seismic.

IV. METHODOLOGY

1. By Planning different types of asymmetrical structures (L and T) having different type of asymmetricity in them, the below figure shows the asymmetric building

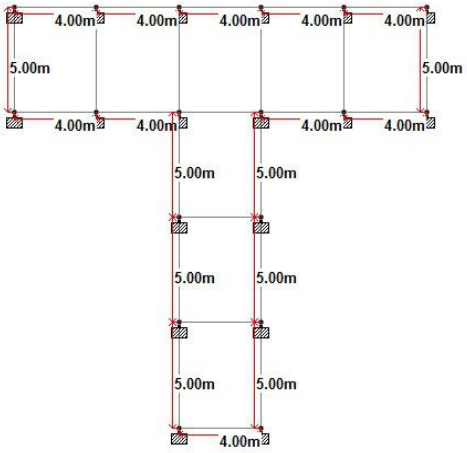

Figure 2. (T- Shaped Building)

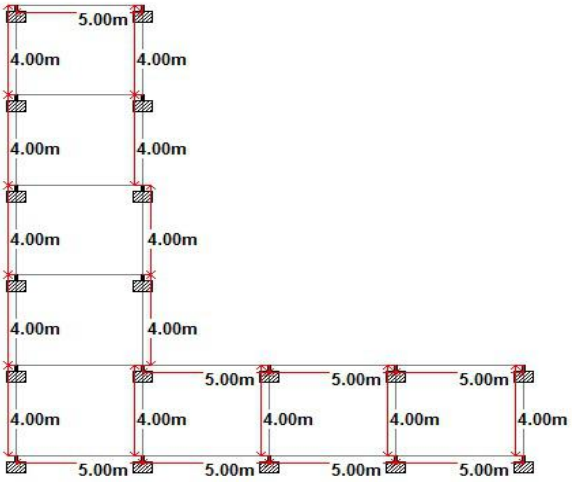

Figure 3. (L- Shaped Building)

2. All this will be done through the software named as STAAD-PRO.
3. Staad pro is the structural analysis and design program originally developed by research engineers.
4. It is famous software which is generally used in India for analysis and design of the building.
5. Steps can be followed for designing and analysing the building

Modelling

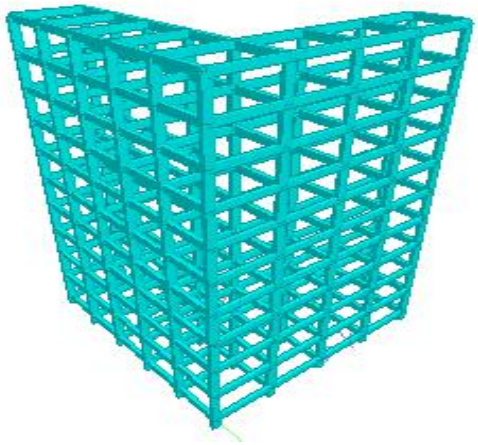

Figure 4. (3D Model in Staad Pro)

Assigning the material properties And Analysing

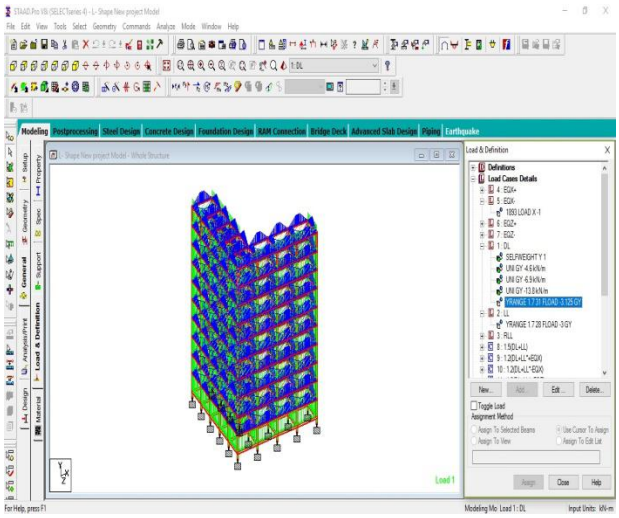

Figure 5.

6. Various option and IS Code are available inbuilt in the software.
7. The behavioural graphs are also available.
8. The behaviour can be seen clearly and result can be obtained by the STAAD PRO.

V. RESULTS

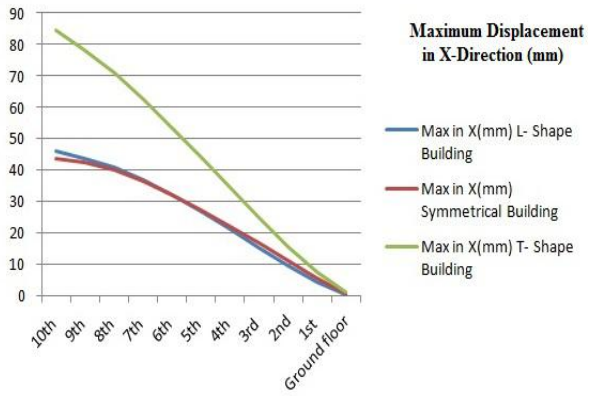

Figure 6. Maximum Displacement in X- Direction (Considering critical nodes)

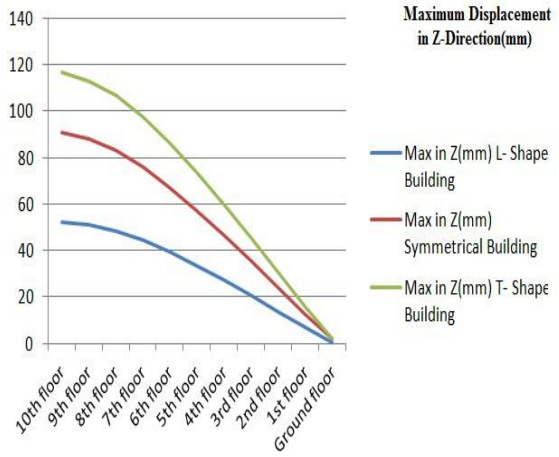

Figure 7. Maximum Displacement in Z- Direction (Considering corner point)

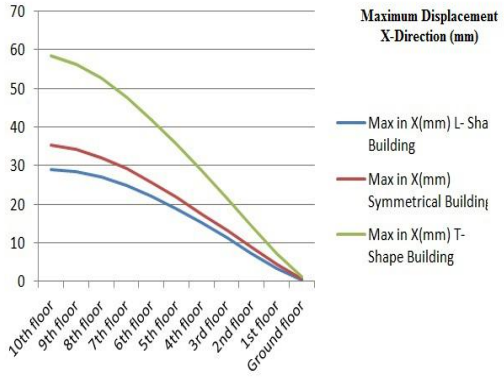

Figure 8. Maximum Displacement in X-Direction (Considering Intermediate point)

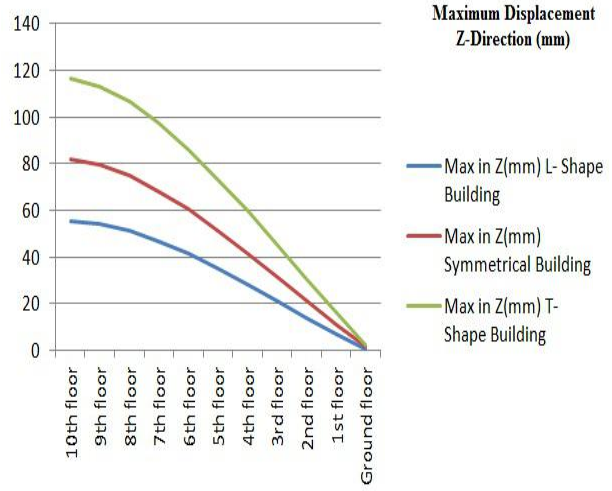

Figure 9. Maximum Displacement in Z- Direction (Considering Intermediate point)

Table 1. Base Shear and Time period and Maximum displacement:-

G+ 9 Storey Buildings	Time period (Sec)	Base shear (KN)	Maximum Displacement (mm)
T Shape Building	2.1382	2046	84.427
L Shape Building	1.9195	1656	45.85
Symmetrical Building	1.9315	1565	43.819

The above table shows , Time period, Base shear & Displacement comparison for symmetrical, L-shape building & T-shape building

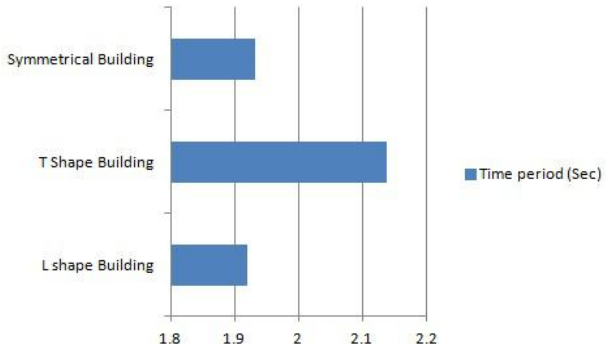

Figure 10. Time period (graph)

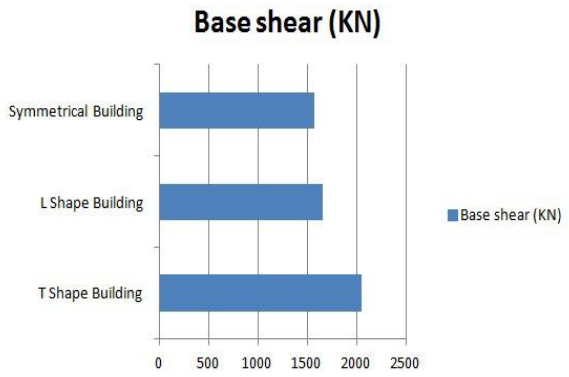

Figure 11. Base Shear (Graph)

VI. CONCLUSION

1. The Seismic behavior of asymmetric building depends upon the type of asymmetricity in plan. i.e., less symmetrical structure behaves like a symmetric building.
2. As the asymmetric geometry is increased, the check for seismic behavior is necessary.
3. Base shear is more in case of asymmetric building (T-type)
4. Displacement increases on large scale with the increase in asymmetric geometry.
5. Results for zone V may be more critical and hence one should go for symmetrical structural geometry (in plan)

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