JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue

JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)

An International Scholarly Open Access, Peer-reviewed, Refereed Journal

STUDY OF SEISMIC ANALYSIS OF PLAN IRREGULAR STRUCTURES BY USING ETABS SOFTWARE

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Abstract : In the event of an earthquake or wind load conditions on a building, people can be evacuated safely before the building collapses. Major causalities in the earthquakes around the world are due to the structural collapses. The major structures that collapse are mainly due to their irregularities horizontally and vertically. If we start up with a good configuration and a reasonable framing system, even a poor design cannot harm its ultimate performance too much. In these modern days, most of the structures are involved with architectural importance and is highly impossible to plan with regular shapes. Hence, extensive research is required for achieving ultimate performance even with a poor configuration. In the present work, it is focused to study "Linear Behavior of the Buildings with Plan Irregularities under Earthquake Loads". Method of analysis adopted in this work is Linear Static Analysis. 10 story and 5 Storied frames are taken into consideration for this study i.e., 6 frames with unsymmetrical plan configuration of L, C and T-shapes. From the studied results of the analysis of 8 frames, it is observed that in the regular frame, there is no torsional effect in the frame because of symmetry i.e., due to the Centre of mass coincides with the Centre of rigidity and also the lateral displacements are same in the direction of earthquake force. The same is observed in the case of wind loads. The responses for an irregular building are different for the columns which are located in the plane perpendicular to the action of force. This is due to the torsional rotation in the structure and additional lateral forces that have been added to the lateral loads due to earthquake loads. In the case of U shaped plan configuration the responses in the corner columns of two limbs are same in the earthquake loads and is not equal in the case of wind loads. Because of these variations in responses, it is healthier to study the response for each and every irregular building instead of taking a broad view.

KEY WORDS: Unsymmetrical plane configuration, structure collapses, Linear static analysis, lateral displacements, torsional rotation

I. INTRODUCTION

The Major structural collapse occurs when a building in under the building is under the action of dynamics loads which includes both earthquake and wind loads. In these modern days, most of the days most of the structure are involved with structural architectural importance and it is highly impossible to plan with regular shapes. These irregularities are responsible for structural collapse of buildings under the actions of dynamic loads. Hence, extensive research is required for achieving ultimate performance even with a poor configuration.

II. LITERATURE REVIEW:-

Ali Kadhim Sallal (2018): The main purpose of this software is to design and analysis multi-Storeyed building in a systematic process. This paper present a building where designed and analyzed under effect of earthquake and wind pressure by using ETABS software. In this case, (18m x 18m) and eight stories structure are modeled using ETABS software. Ten story is taken as (3m) height and making the total height of the structure (31m).

Pushkar Rathod and Rahul Chandrashekar (2017): With the help of seismic analysis, the structure can be designed and constructed to withstand the high lateral movement of earth's crust during an earthquake. Any type of basic or a highly advanced structure which maybe under static or dynamic conditions can be evaluated by using ETABS. ETABS is a coordinated and productive tool for analysis and designs, which range from a simple 2D frames to modern high-rises which makes it one of the best structural software for building systems.

Pardeshi Sameer and Prof. N. G. Gore (2016): This paper is concerned with the effects of various vertical irregularities on the seismic response of a structure. The objective of the project is to carry out Response spectrum analysis (RSA) of regular and irregular RC building frames and Time History Analysis (THA) of regular RC building frames and carry out the ductility based design using IS 13920 corresponding to response spectrum analysis. Comparison of the results of analysis of irregular structures with regular structure is done.

Vijaya Bhaskar reddy. S et. al. (2015): This paper presents illustration of a comparative study of static loads for 5 and 10 storey multi storeyed structures. The significance of this work is to estimate the design loads of a structure. They conclude that deflection of the members is high with an increase in no. of floors. It can be observed that axial force is high in 10-storey compared to 5-storey building.

Abhay Guleria (2014): The case study in this paper mainly emphasizes on structural behavior of multi-story building for different plan configurations like rectangular, C, L and I-shape. Modelling of 15- story's R.C.C. framed building is done on the ETABS software for analysis. Post analysis of the structure, maximum shear forces, bending moments, and maximum story displacement are computed and then compared for all the analyzed cases. The analysis of the multistoried building reflected that the story overturning moment varies inversely with story height. From dynamic analysis, mode shapes are generated and it can be concluded that asymmetrical plans undergo more deformation than symmetrical plans.

III. SCOPE & OBJECTIVE

To study or know the effect of plan irregularity in base share & displacement of structure.
To study plan irregular structure.
To study irregularities in structural analysis and design of G+5 and G+10 stores structure as per code (IS 1893:2002).
To study the behavior of structure without masonry infill if seismic load is applied.

IV. METHODOLOGY

Modeling of RC framed structure: Fixing the dimensions, support conditions, assigning properties and loads. Application of mass lumping methods: Different mass lumping methods were applied to the modeled structure. Analysis the model: The model was analyzed using various methods of structural analysis such as Equivalent static method, Response spectrum method and Time History method. Analysis of results: The results were analyses to get the response of each method and has to be arrived at a conclusion that the method that gives maximum floor displacement should be the most effective method of mass lumping.

V. SEISMIC ANALYSIS

Seismic analysis is a subset of structural analysis and is the calculation of the response of a building structure to earthquakes. Various methods of different complexity have been developed for the seismic analysis of structures. They can be classified as follows.

1. Equivalent Static Analysis
2. Non Linear Static Analysis
3. Response Spectrum Analysis
4. Non Linear Dynamic Analysis

Linear Dynamic or Response Spectrum Method:-

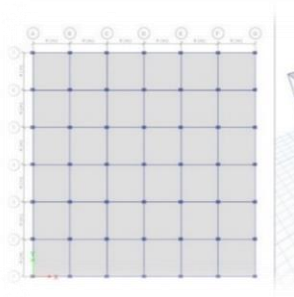
This approach permits the multiple modes of response of a building to be taken into account. This is required in many building codes for all except very simple or very complex structures. The response of a structure can be defined as a combination of many special shapes (modes) that in a vibrating string correspond to the harmonics. Computer analysis can be used to determine these modes for a structure. For each mode, a response is read from the design spectrum, based on the modal frequency and the modal mass, and they are then combined to provide an estimate of the total response of the structure. In this we have to calculate the magnitude of forces in all directions i.e. X, Y & Z and then see the effects on the building The result of a response spectrum analysis using the response spectrum from a ground motion is typically different from that which would be calculated directly from a linear dynamic analysis using that ground motion directly, since phase information is lost in the process of generating the response spectrum. In cases where structures are either too irregular, too tall or of significance to a community in disaster response, the response spectrum approach is no longer appropriate, and more complex analysis is often required, such as non-linear static analysis or dynamic analysis.

VI. RESULT

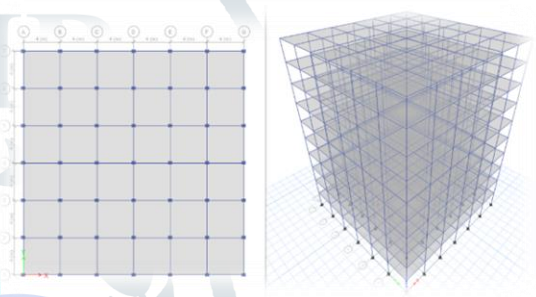
SR. NO.	TYPE OF BUILDING SHAPE OF (G+5) STORY	DISPLACEMENT	SHEAR FORCES
1	C	10.61 MM	1033.99KN
2.	T	12.27 MM	561.63 KN
3.	L	11.73 MM	678.6 KN
4.	REGULAR SHAPE	8.15 MM	757.46 KN

SR.NO.	TYPE OF BUILDING SHAPE OF (G+10) STORY	DISPLACEMENT	SHEAR FORCES
1.	C	25.47 MM	1054.70 KN
2.	T	29.91MM	552.98 KN
3.	L	27.47 MM	673.71 KN
4.	REGULAR SHAPE	16.3 MM	677.77 KN

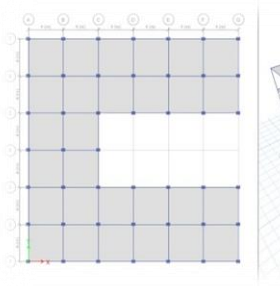
VII. PLAN AND ELEVATION OF MODELS



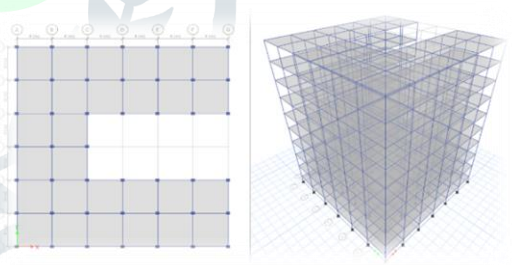
REGULAR G+5 BUILDINGS



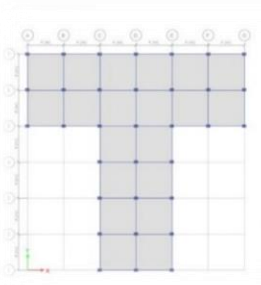
REGULAR G+10 BUILDINGS



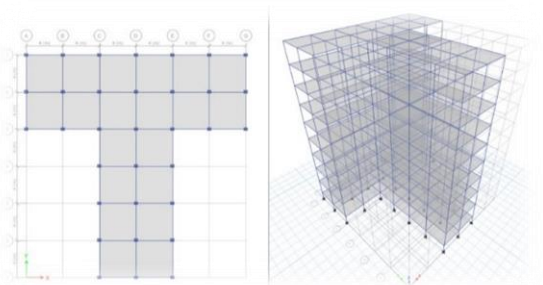
C- SHAPE G+5 BUILDINGS



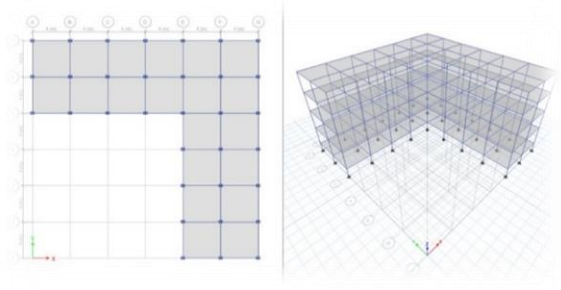
C- SHAPE G+10 BUILDINGS



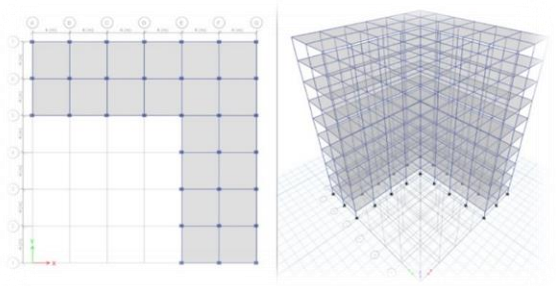
T- SHAPE G+5 BUILDINGS



T- SHAPE G+10 BUILDINGS



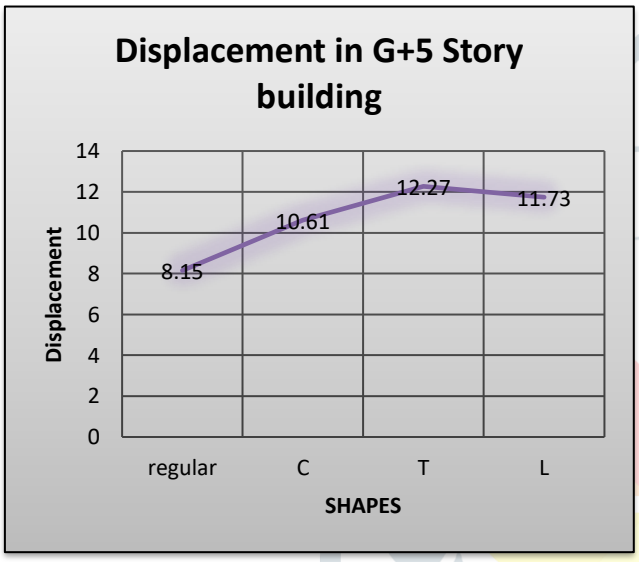
L- SHAPE G+5 BUILDINGS

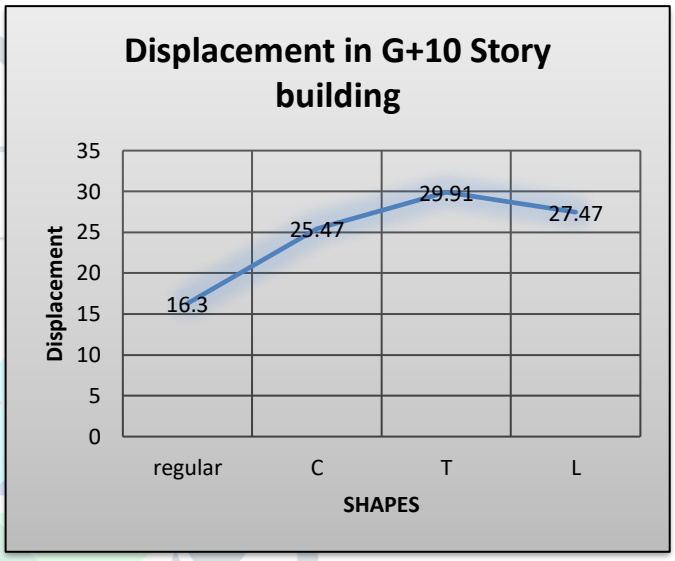


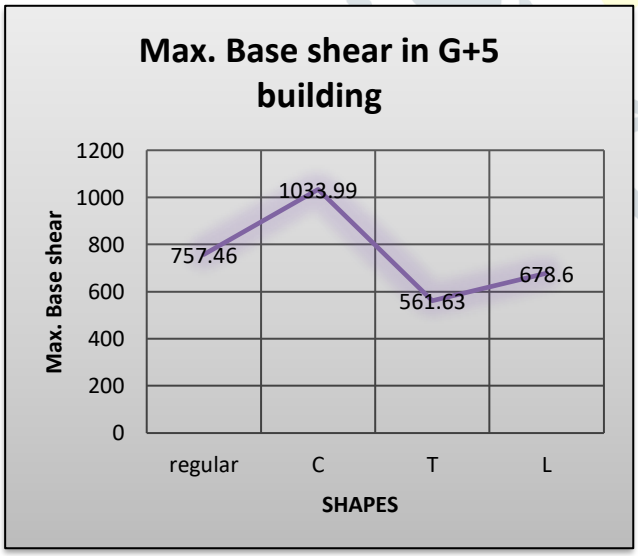
L- SHAPE G+10 BUILDINGS

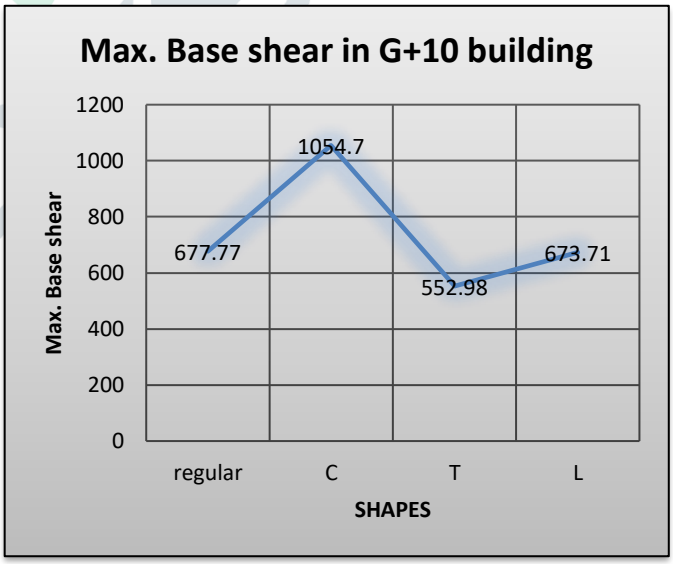
VIII. RESULTS IN GRAPH FORMAT:

COMPARSION OF IRREGULAR BUILDING WITH REGULAR BUILDING.









CONCLUSION

By analyzing the different configuration and from the results that are obtained from analysis we have concluding following:-

1. For Plan irregular structure, displacement increases as the irregularity of the structure increases.
2. For Plan irregular structure, base shear increases as the irregularity of the structure increases.
3. Amongst all the different models, T-shaped gives least displacement with more irregularity.
4. Amongst all the different models, the L-shaped model gives the largest displacement.
5. Behavior of the high rise building was shown clearly using the graphs and lateral displacements.

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