Seismic Analysis and Comparative Study of Regular and Irregular Building using ETABS

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Abstract - *The current version of the IS: 1893-2016 requires that practically all multi storied buildings be analyzed as three dimensional systems. Buildings may be considered as Regular and Irregular on plain suraface, in mass and stiffness along storey of the buildings. Most of the hilly regions of India are highly seismic. Inthis study, 3D analytical model of G+15storied buildings have been generated for Regular and Irregular building models and analyzed using structural analysis tool ETABS software . Mass and stiffness are two basic parameters to evaluate the Static analysis of a structural system. Multi storied buildings are behaved differently depending upon the various parameters like mass stiffness distribution, foundation types and soil conditions. In 2001 Bhuj earthquake in Gujrat, India demonstrated the damage and collapse of the buildings due to the irregularities in structural stiffness and floor mass. This Project 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 Regular and Irregular RC building frames by Dynamic Analysis Method.*

Comparison of the results of analysis of irregular structures with regular structure is done.

Key Words: *Irregular and Asymmetric structures; Dynamic analysis, Storey Deflection, Storey Shear, Stiffness*

1. INTRODUCTION

A Regular Building is structure which performs against the earthquake. This structure must possess the simple, regular configuration, minimum lateral strength and also stiffness of the structure. Setback buildings are a subset of vertically irregular buildings where there are discontinuities with respect to geometry. The process to determine the response or behavior of a structure under some specified loads or combinations of loads is known as structural analysis

Irregularities are not avoidable in construction of Buildings. However, the behavior of structures with these irregularities during earthquake needs to be studied. By taking adequate precautions, the main objective of Earthquake Engineering is to design and build a structure in such a way that the damage to the structure and its structural components during an earthquake is minimized. Constructions can suffer diverse damages when they are put under seismic excitations. Although for a same structural configuration, region & earthquake, damages in the system are neither equal nor homogenous. So, there are several factors for these like –Structural system, Earthquake characteristics, the quality of construction, soil of location and its maintenance that define the seismic behavior of the structure. However, with the experiences in past and recent earthquakes, most of the damages are related to architectural and structural configuration in plan and elevation and site ground effects. Irregular buildings constitute a large portion of the modern urban infrastructure. Adequate precautions need to be taken. A detailed study of structural behavior of the buildings with irregularities is essential for design and behavior in earthquake. Therefore, the structural engineer needs to have a thorough understanding of the seismic response of irregular structures.Several related studies have focused on evaluating the response of 'RegularStructures".

A Irregular structure that has difference between center of mass and center of resistance. Technically all the structures are irregular. There are various types of irregularities in the buildings depending upon their location and scope, but mainly:

They are divided into two groups:

A) Plan irregularities

B) Vertical irregularities

Elements, loads, material properties, and support Analysis of a structure involves its study from the viewpoint of its strength stiffness, stability, and vibration and response of all elements.

Objectives

The Main objective is Elements are designed by using software ETABS. And consider seismic load. For load combination use code IS 1893:2016. Regular and Irregular building is compared. The designing has been carried out in ETABS software

1. To perform a comparative study of the various seismic parameters of different types of reinforced concrete moment resisting frames (MRF), configuration, and types of irregularity.
2. To analyse the implementation of SRSS Method in tall structure using ETABS.
3. Comparison between regular and irregular frame on the basis of shear force, storey drift & node displacement etc.
4. To study the change in different seismic response parameters along the increasing height and increasing bays.
5. To propose the best suitable building configuration on the existing condition.
6. To achieve better strength in Response Spectrum method.

LITRATURE REVIEW:

Pardeshi Sameer et.al (2016) : Basically They adopted 4 types of models Regular, L-Shape, T shape, Plus Shape and they analyse the Structure on the Method of Time History Analysis They found results that Plan configuration has Good Response in Seismic Analysis, Shear force was found to be max.at first Storey. Where as the Displacement will be observed large in T Shape.

Tushar Saxena et.al(2018): The foremost objective of the present work is to analyze the behavior of the structures and to adopt the methodology to minimize the damages caused by while is result is in form of comparison and the base shear value is more in the regular configuration. Because of the structure have more symmetrical dimensions. Story drift value is more in the story 13 in the regular configuration

Prof. Vedantee Prasad Shukla et.al (2018) This Topic Based on Design of Irregular Building & Regular building at Different Earthquake Zone where as Slope is Greater than 3 Degree in the Which Regular and Irregular Building are Being Provided with Or without Shear wall, the Analysis is Performed By the Response Spectrum Method, Results in the form of storey displacement, storey drift, base shear and time period. Time period of the regular building is more than irregular. Seismic activities. They adopted Push over analysis method. While in the Results Comparison of base shear & Roof displacement can be seen, Base Shear for Regular Structure is more than that of Irregular Structure

Mr. S.Mahesh et.al (2014) : Comparison of analysis and design of regular and irregular configuration of multi-Story building in various seismic zones using STADD PRO, They were followed by Time History Analysis Method, They adopted seismic Zone 4found Drift is weak in Regular building.

Dr.S.K.Dubey&P.D.Sangamnerkar(2015)

[1] "Seismic behavior of Asymmetric R.C. buildings", they had modeled & analyzed a five storeyframed structure using STAADPRO. The building is assumed as commercial complex. Geometry of building is 'T' in shape consisting of open ground storey parking. They analyzed for ZoneIV

Abhay Guleria (2016) [4]: Presented the analysis of multi story RCC building for different plan configuration. The analysis has performed for the earthquake loads. The specification of lateral loads has been taken from IS 1893 (Part 1)2002. The modeling and analysis has done by using finite element based software ETABS In addition, this study suggests that Lshape and Ishapestructuregivesalmostsimilarresponse against overturning moment, story drift, and Story displacement.

Sanhik Kar Majumder and Priyabrata Guha(2015) [3]: Presented the comparison between wind and seismic load on different types of structures. In this study, the effect of wind and seismic both will be considered and compared them according to IS 875(Part 3)1987 and IS 1893(Part 1)2002 considering site with medium soil. They concluded that the proposed buildings with irregularities are more prone to earthquake damage & torsion is the most critical factor leading to major damage or complete collapse of building.

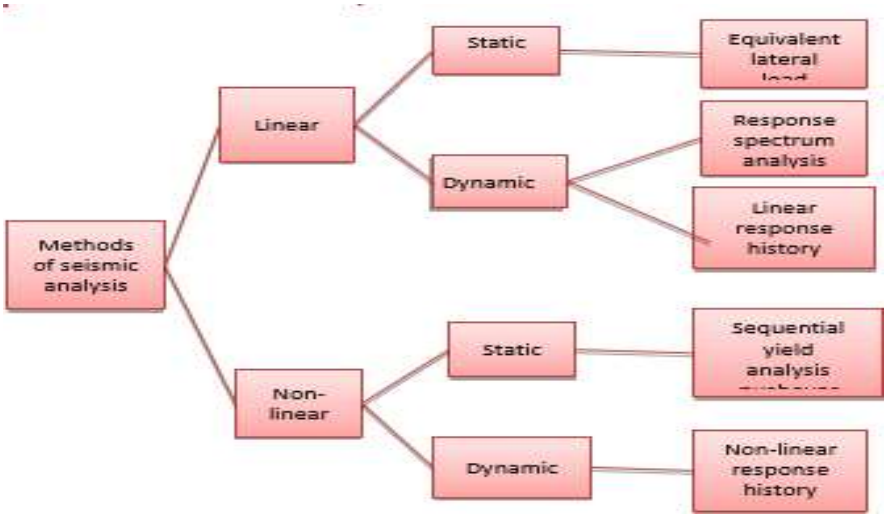
Magliulo G., Maddaloni G. & Petrone C [5] (2017):"Influence of Earthquake direction on the Seismic Response of Irregular Plan R.C. Frame buildings", they used three multi storey R.C. building, representing a very common structural topology in Italy for the evaluation. They are respectively a Rectangular Plan Shape, L-Plan Shape & a Rectangular Plan Shape with Courtyard building. The result the modeling and analysis of (G+5) structures are done by using STAAD Pro.

Dr. B. G. Naresh Kumar1, Avinash Gornale2 and Abdullah Mubashir3 Presented (2018): "Seismic Performance Evaluation of RC Framed Buildings an Approach to Torsionally Asymmetric Buildings". In in this paper the effort is made to study the effect eccentricity between centre of mass (CM) and centre of stiffness (CR) and the effect of stiffness of infill walls on the performance o f the buildings. The performance of the buildings is assessed.

Methodology

Building Considered for the Analytical Study For present work seismic analysis is carried out for reinforced concrete moment resisting building frame having (PLINTH+G+15) storey situated for ground slope. Analysis & design are carried out by using ETABS.

In civil structure static analysis is perform for R.C.C frame regular and irregular building up to G+15 storey by using Dynamic Analysis method. The problems introduced due to discontinuity in stiffness, mass and geometry of Structure. Therefore, the structural engineer needs to have a thorough understanding of the seismic response of irregular structures. Several related studies have focused on evaluating the response of 'Regular Structures" However, there is lack of understanding of the seismic response of structure with irregularities.



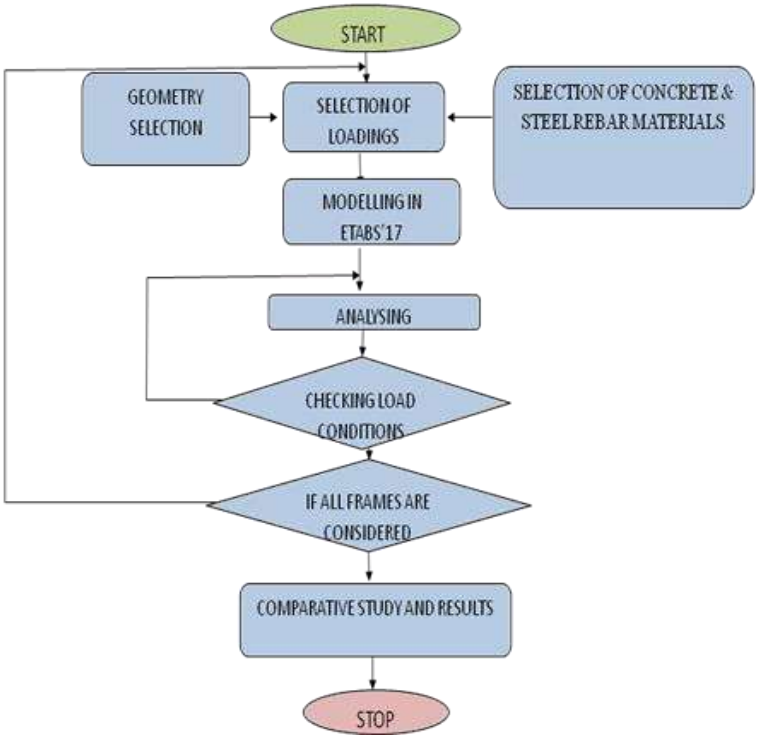


Table No.05: MODELLING & PROBLEM FORMULATION

S.NO	Description	Value
1.	Area	16 X 20 m
2.	Number of bays in X-direction	4
3.	Number of bays in Y direction	5
4.	Overall height	45m
5.	Seismic zone	V
6.	WALLS	RED BRICK
7.	SUPPORT TYPE	FIXED SUPPORT

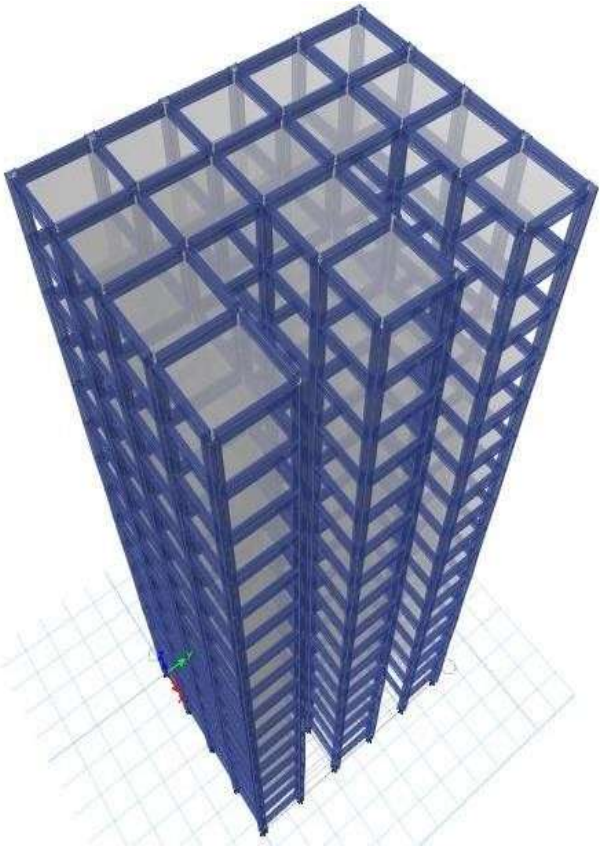
PARAMETERS FOR REGULAR AND IRREGULAR STRUCTURE:

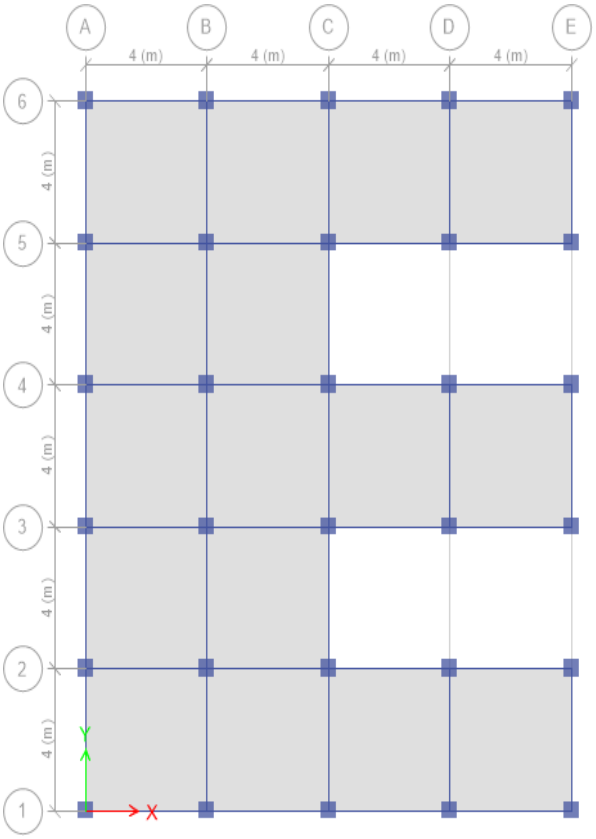
S.NO	DESCRIPTION	SIZES
1.	Type of Structure	Framed
2.	Type of Building	Residential
3.	Number of storey	16(G + 15)
4.	Height of storey	3 m
5.	Cross section of beams	300x500mm
6.	Cross section of columns	500x500mm
7.	Slab Thickness	150mm
8.	Grade of concrete	M25
9.	Grade of steel	Fe 500
10.	Dead Load	1 factor

Table no.3 Loadings….

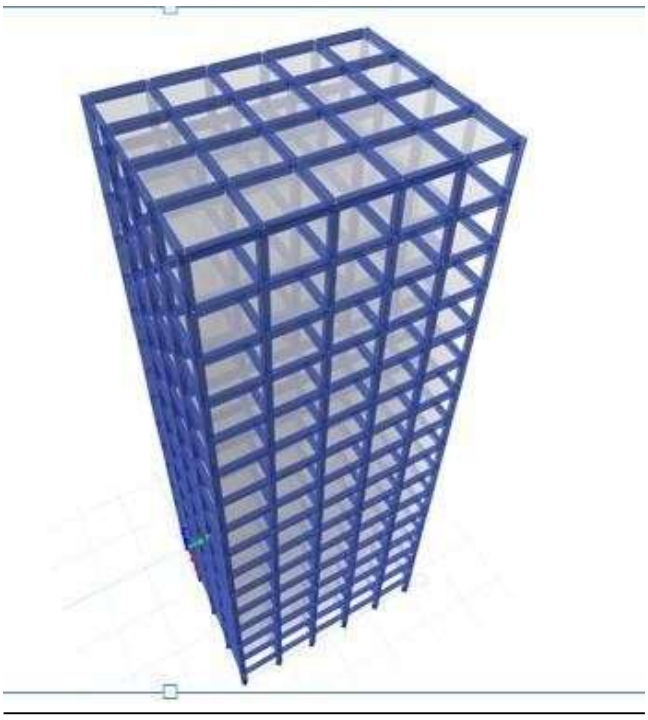
S.NO	**LOAD PARAMETERS**	**DESCRIPTION**
1.	DEAD LOAD	1). WALLLOAD-5KN/M^2 2). SLABLOAD 4.8KN/M^2
2.	LIVE LOAD	2 KN/M^2
3.	SEISMIC LOAD	AS PER IS 1893-2012
4.	SEISMIC ZONE	V
5.	SITE LOCATION	VERY SEVERE
6.	IMPORTANCE FACTOR	1.2
7.	SOIL PROPERTY	HARD SOIL

IRREGULAR BUILDING





REGULAR BUILDING



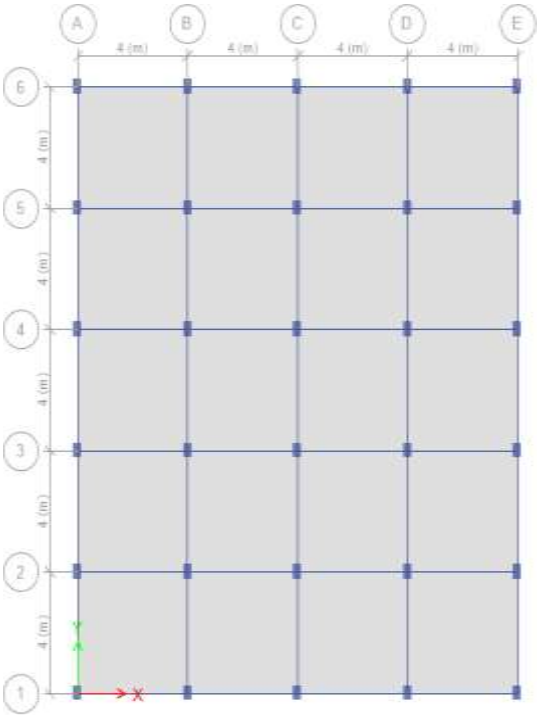


Table no.08, Storey Force (KN)

MAX. STOREYFORCE		
	REGULAR	IRREGULAR
1.	4439.95	4297.17

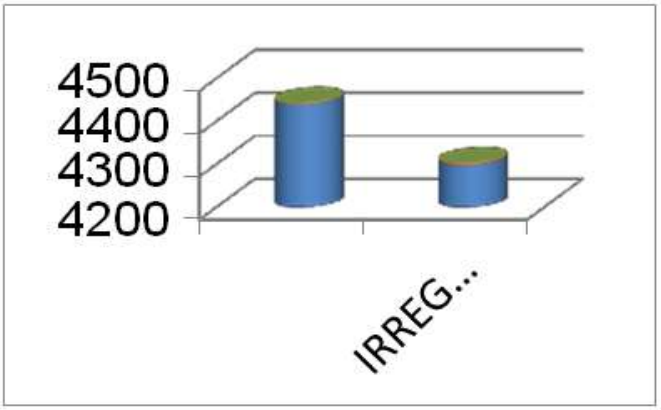


Table No. 10 STOREY DISPLACEMENT

MAX. STOREY DISPLACEMENT		
	REGULAR	IRREGULAR
1.	409.461	211.911

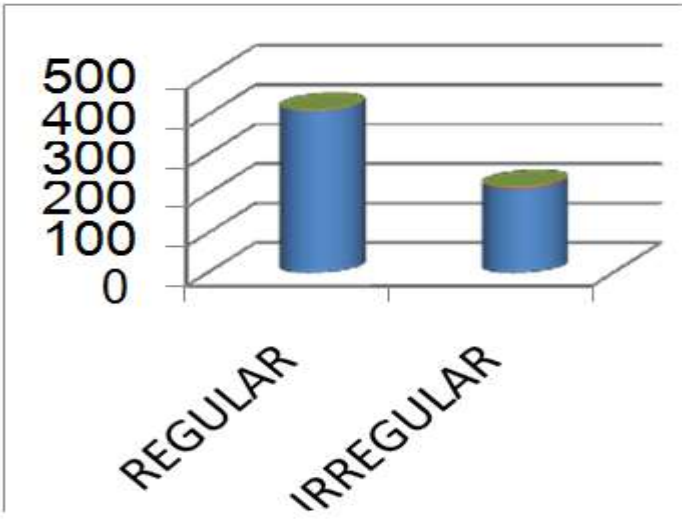


Table No. 10, STOREY DRIFT

MAX. SHEARDRIFT		
	REGULAR	IRREGULAR
1.	0.011846	17.507

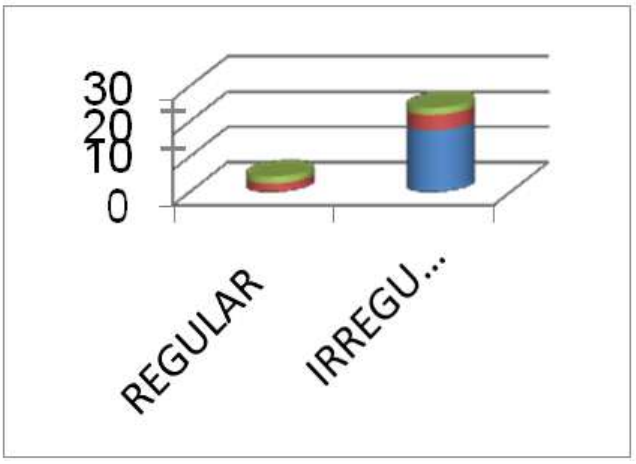
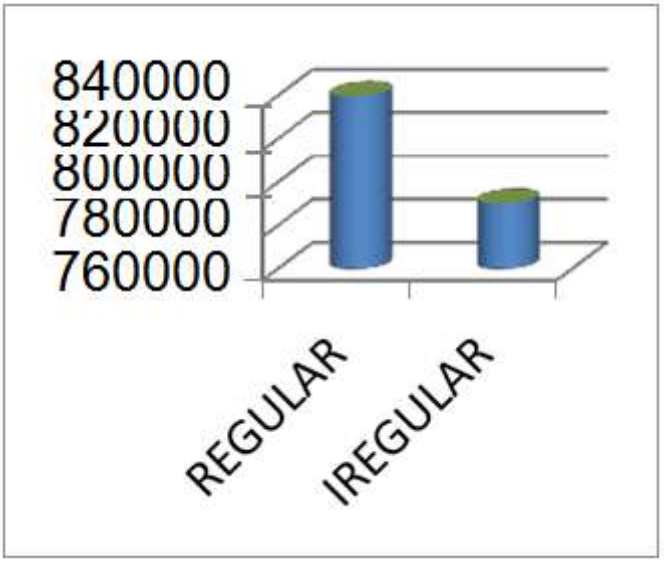


Table No. 10, BENDING MOMENT

MAX. BENDING MOMENT		
	REGULAR	IRREGULAR
1.	839787.46	790214.34



CONCLUSIONS:

Based on the work presented following conclusions can be drawn:

1. Amount of setback increases, the shear force also increases. The irregular building frames possess very low shear force compared to setback regular frames.

2. The critical bending moment of irregular frames is lesser than the regular frame for all the storey heights. This is due to decrease in stiffness of building frames due to setbacks.

3. According to results of Dynamic Response method, the stiffness irregular building experienced larger inter storey drifts as compared to regular frame and geometric irregular frames.

4. It is seen that the storey displacement of 15th storey is maximum among all the frames and the stiffness irregular structure frame has maximum joint displacements for all the floor levels. However, regular and both the vertical

geometric frames have almost variant joint displacement

5. The seismic performance of regular frame is found to be better than corresponding irregular frames in nearly all the cases.

Therefore it should be constructed to minimize the seismic effects. Among setback frames, the geometric irregular frame 1 building having setback at 3rd floor configuration is found superior than others.

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