Comparison of Multistorey Building with Regular and Irregular Shape in Different Seismic Zones

M. Seetha[1], K.E.Viswanathan[2]

[1]*PG scholar, Department of Civil Engineering, Builders College of Engineering, Kangayam-638 108, Tirupur Dt. TamilNadu, India*

[2]*Assistant Professor, Department of Civil Engineering, Builders College of Engineering, Kangayam-638 108, Tirupur Dt. TamilNadu, India*

Abstract: **-Most of the Indian lands square measure insecure owing to the vibrations caused by the earthquakes. Also, it's not possible to stop, however the damages to the buildings may be controlled by means that of effective seismic styles. during this study chiefly focuses on deciding the variation in reinforcement share for various seismic zones of Republic of India. during this gravity hundreds as per IS 456 : 2000 and once the building is intended for earthquake forces in numerous zones as per IS 1893 (Part 1) : 2002 at the side of wind hundreds as per IS 875 (Part 3) : 1987 square measure to be thought-about. For this study each regular and irregular geometric building plans square measure to be thought-about with an equivalent space of 5192sq.ft having G+5 storeys square measure analyzed and designed by exploitation structural analysis computer code tool ETABS-2015. This study conjointly includes the determination of displacement, moment, shear and base shear. the value comparison analysis conjointly to be enclosed, as a result of supported the zone alternatives it's varied. Then the results square measure compared with wind hundreds, gravity hundreds in varied seismic zones**

Key Words: **AUTO CAD, ETABS, Reinforcement, Displacement, Moment, Shear, Base Shear. Regular building, Irregular building**

I. INTRODUCTION

An earthquake may be a phenomenon that ends up in the immense devastation of built systems and facilities. within the gift state of affairs earthquake engineering attracts major attention of human as a result of this can be the event that can not be accurately foreseen it's the abrupt event that happens because of numerous reasons comparable to

A. Movement of tectonic plates.

B. Abrupt slips at the faults.

C. Volcanic earthquakes.

D. Because of explosive.

E. Because of mining etc.

Many reaches are conducted on this subject and still it's continued, as a result of a lot of we have a tendency to attempt to learn a lot of we are able to minimize the damages and save the lives. in line with studies are created on the geophysics concerning ninetieth earthquake happens because of tectonics. If we have a tendency to return to engineering Associate in Nursing engineer's job is to supply most safety within the structures designed and maintain the economy. Whenever a structure styleed is meant is intended for natural incident comparable to earthquake we have a tendency to design it to behave the subsequent limit states.

1.1. Serviceability

In this case structure can suffer less or no structural injury. Buildings that ar necessary in their nature comparable to hospital, assembly halls, and nuclear plants ar designed underneath this class as a result of even once earthquake it ought to be serviceable.

1.2. Damageability

In this kind, if Associate in Nursing earthquake happens some broken can happen and it will repaired and place to re-use. Permanents building fall in these classes.

1.3. Collapse

In this case building is unengaged to broken however the supports are remains safe in-tuned the permanents masses. In earthquake analysis the force that really acts on the structure at the time of earthquake ar abundant over the forces that ar designed. The lateral forces applied throughout unstable analysis ar extremely unpredictable. Thus, the look criteria ought to give minimum necessities to take care of safety against earthquake and major fails and loss of lives. The collapse of structure will be minimize if following points taken into thought.

- The pattern of failure will be created ductile rather than brittle, if malleability is assured dissipation of energy made can show bit of decay.
- Failure of flexure ought to precede shear failure.
- The columns shouldn't fail before beams.
- The joints ought to be onerous compare to members which can meet into them.

II. LITERATURE REVIEW

Anshuman Nimade, Niraj Soni, Mahesh Patidar and Vikas Joshi (2018), the target of study is to review the structural behaviour of shear wall – flat block interaction with

gap. In G+9 storeys, 2 differing types of mixtures area unit thought-about for the analysis. Like (i) flat block with 2 hundredth shear wall gap. (ii) flat block while not shear wall gap. the whole analysis was done by exploitation STAAD-Pro code with dynamic loading condition. In irregular structures response spectrum methodology is additional appropriate for the analysis. wholly fifteen models area unit created with the concerns of third, 2 hundredth and three hundredth vertical irregularities. They conclude that the flat block Structure with shear wall on central fringe is appropriate for the result of dynamic load on the performance of building & negligible effects of gap of size 2 hundredth of the shear wall on the stiffness of the system. and also the comparison is created between Stresses & Bending Moment on flat block, node displacement, Base shear, Story drift & the result area unit brought out.

Akhil R, Aswathy S Kumar (2017), this study comprises the modeling of standard and H-shape set up irregular building having G+10 storeys. The attainment of this framed building within the time of study earthquake motions depends on the distribution of stiffness, strength, and mass in each the horizontal and vertical planes of the building. the most aim of this work is comparative study of the stiffness of the structure by considering the 3 models in Regular Structure and 3 models in set up irregular structure with completely different Vertical irregular structure. Response spectrum methodology was adopted for the analysis of vertically irregular RC buildings. All models area unit analyzed with dynamic earthquake loading for the Zones V. Result found from the response spectroscopic analysis that in irregular formed building displacements area unit quite that of standard formed building. All building frames area unit sculpturesque in code STAAD.Pro V8i. numerous unstable responses like base shear, frequency, node displacement, etc area unit obtained. They concludes that the comparison of each geometric buildings the utmost quantity of displacement and base shear was occurred in regular building solely. particularly regular with U formed vertical irregular building having the utmost displacement compared to different shapes. And period of time is most for H-shaped set up configuration and also the Average Frequency was most for Irregular Building.

Preeti Singh (2017), this work consist each regular and irregular geometric shapes. every shapes with G+10 storied model was created by exploitation STAAD-Pro code with earthquake and wind load conditions. In regular form building static analysis was dole out within the unstable zones II and III. particularly in irregular form building T form was choosened and also the dynamic analysis was in dire straits the unstable zones IV and V. Finally calculated base shear, volume of concrete, weight of steel and also the value comparison analysis area unit compared for all unstable zones.

Inchara K P, Ashwini G (2016), the most objectives of this study were to review the performance and variation in steel proportion and quantities concrete in RC framed irregular building in gravity load and completely different unstable zones. And to grasp the comparison of steel reinforcement proportion and quantities of concrete once the building is meant as per IS 456 : 2000 for gravity masses and once the building is meant as per IS 1893 (Part 1) : 2002 for earthquake forces in numerous unstable zones. during this study 5 (G+4) models were thought-about for the analysis. All the four models were sculpturesque and analyzed for gravity masses and earthquake forces in numerous unstable zones. ETABS code was used with ESLM and RSM were adopted for the analysis of the models. in line with their analysis, it will be inferred that support reactions attended increase because the zone varied from II to V, that successively raised volume of concrete and weight of steel reinforcement in footings and just in case of beams, proportion of steel reinforcement raised through zones II to V.

Ravi Kiran, Sridhar R (2016), the most objective of this project is that the comparative study of standard and vertically irregular building having twenty storeys with RC framed structure having three differing types of sculpturesque structures area unit below earthquake forces. The structure is analyzed and designed by exploitation SAP 2000 code. The Comparison is completed on the idea of shear force, bending moment, level drifts and node displacement. The reduction in drift, deflection and elementary period of time of the regular and irregular building area unit to be supported with equivalent static and dynamic (Response Spectrum) loading cases for the zones II to V. he conclude that, among the 3 structures thought-about (Regular, set up irregularity and vertical irregularity), Regular structure shown most displacement and drift for all the zones in each static and dynamic analysis.

Abdul Khadeer Quraishi, Arshad Syed Masood Ahmed, and Md Zubair Ahmed (2015), the study was conducted on RC framed structure having G+10 storeys with unsymmetrical form. the whole model was analyzed and designed by exploitation STAAD-Pro code. to check proportion of steel quantities for buildings subjected to gravity masses, seismal forces in conjunction with wind load. once analysis and style they have to be compelled to the conclusion that proportion of reinforcement in column with most load is one.985% to 45.438%, just in case of beams it had been thirty five.112% to 95.867% for basement floors. because the concrete grade raised reinforcement space cut. Steel proportion is a lot of in exterior and edge columns whereas it's less in interior columns and just in case of beam external beam needs less proportion of reinforcement compared to internal beams.

III. OBJECTIVE AND SCOPE OF THE STUDY

The objective of the current work is to review the distinction between regular and irregular formed buildings with gravity load, wind load and seismic masses. Each sort of building having G+5 storeys with same builtup areas. The planning of wind load was calculated supported IS 875 (Part 3) : 1987 and also the earthquake load was calculated supported IS 1893 (Part 1) : 2002. The current study primarily focuses on

comparison of share of steel from zone to zone with the hundreds of wind, gravity and earthquake forces area unit to be thought-about and also the moment, shear, displacement, base shear and value comparisons area unit to be obtained. The ETABS computer code program is employed to perform the analysis and style.

IV. METHODOLOGY

The methodology of this study is scheming the unstable effects caused by AN earthquake in regular and irregular form buildings having constant buildup space. And additionally compared with totally different unstable zones as per IS 1893 (Part 1) : 2002 codal provisions. The building model is made and analyzed by ETABS package. The methodology concerned during this study is given below

AUTO CAD : Arrange & layout preparation

ETABS : Model creation

- Material specification
- Generating load and cargo mixtures
- Assigning of hundreds
- Joint or support creation
- Analysing of structures
- Compared with totally different unstable zones
- Result and discussion.

V. PLAN DETAILS

Building plans having a similar overall plot space of 5192sq.ft. However the builtup space of irregular building is 3818sq.ft. Every plots having the subsequent sq. feets.

Plot 1 = 29’ x 42’ = 1218sq.ft

Plot 3 & 4 = 29’ x 46’ = 1334sq.ft

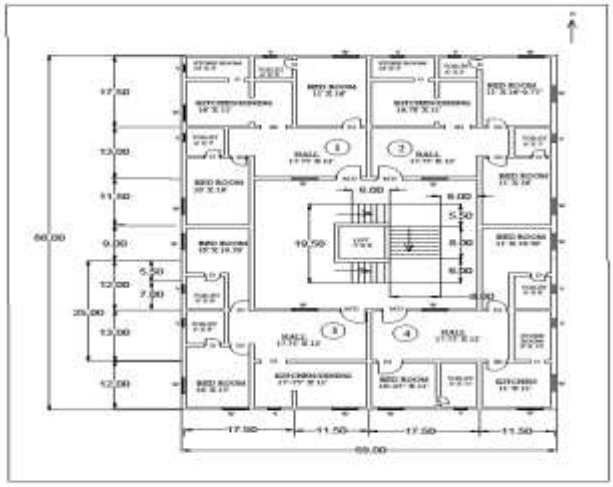

Fig - 5.1: Regular building typical floor plan by using AutoCad

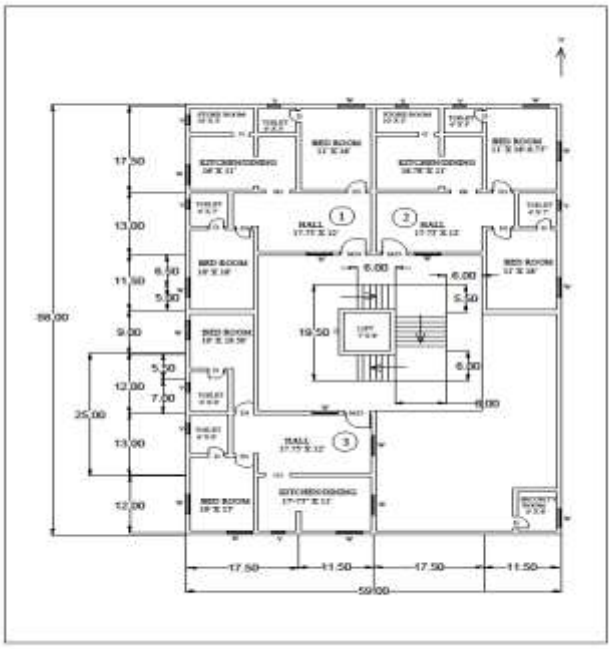

Fig - 5.2: Irregular building typical floor plan by using AutoCad

VI. BY ETBAS

6.1. Introduction to ETABS software

ETABS code is employed for the analysis of projected structural models. The equivalent static methodology is employed for analysis of symmetrical building dimensions. And dynamic analysis is completed unstable forces that square measure response spectrum methodology. it's a complete finite component based mostly structural analysis program with special purpose options for structural analysis and style of building systems. Embedded at a lower place the straightforward, intuitive programme square measure terribly powerful numerical strategies, style procedures and international style codes that permit you to be versatile and productive, whether or not you're planning a straightforward 2-dimensional frame or playacting a dynamic base isolation analysis of a fancy high-rise.

6.2. Fundamental Concept

ETABS code works off of associate degree integrated information. the essential idea is that we tend to produce only 1 model consisting of the ground systems and therefore the vertical and lateral framing systems to analysis and style the entire building. Everything we want is integrated into one versatile analysis and style system with one programme. There are not any external modules to keep up and no worries concerning knowledge transfer between modules. the consequences on one a {part of} the structure from changes in another part square measure fast and automatic.

6.3. Variety of Options

The analysis ways embrace a large form of Static and Dynamic Analysis choices. The integrated model will embrace, among others, advanced Composite Floor Framing Systems with Openings and Overhangs, Steel beam Systems, Moment Resisting Frames, advanced Shear Wall Systems, Rigid and versatile Floors, aslant Roofs, Ramps and Parking Structures, Mezzanine Floors, bound Systems, Multiple Tower Buildings and Stepped Diaphragm Systems

VII. ANALYSIS

7.1. Modelling data:

For Regular and Irregular Building

Beam size	- 0.3x0.3m
Column size	- 0.3x0.23m
Grade of concrete	- M25
Grade of steel	- Fe500
No of stories	- G+5
Plinth level	- 0.6m
Structure sort	- RC framed structure
Thickness of block	- 0.17m
Total floor height	- 18.6m
Typical floor height	- 3m

7.2. Material Properties

The following Table 7.1 explains the properties used in the creation of models.

Table -7.1: Material Properties

Name	Type	E	V	Unit Weight	Design Strengths
Units		MPa		kN/m^3	MPa
HYSD 500	Rebar	199947.96	0.3	76.9729	Fy=413.69 Fu=620.53
HYSD 500	Rebar	199947.96	0	76.9729	Fy=413.69 Fu=620.53
M25	concrete	24855.58	0.2	23.5631	Fc= 27.58

7.3. Load Combinations

The following load combinations are used for the analysis purpose.

1.2 (DL+LL) 1.5 (DL+EL) 1.2 (DL+LL+EL)

1.2 (DL+LL-EL) 1.5 (DL-EL) 0.9 (DL) + 1.5 (LL)

1.2 (DL+LL-WL) 1.5 (DL+WL)

7.4. Model Creation and its results

The following models area unit created by exploitation ETABS-2015 code. The higher than mentioned details area unit applied for the creation of models for each regular and irregular structures.

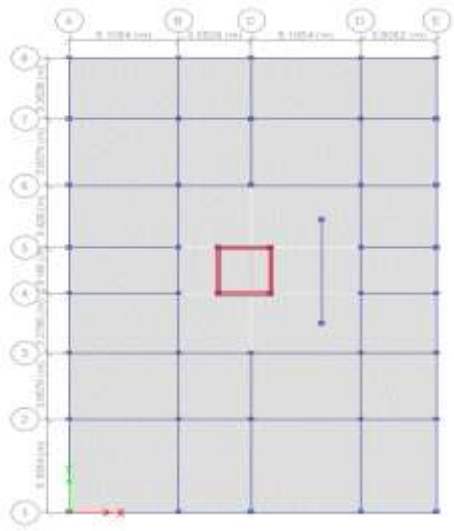

Fig - 7.1: Regular building plan view of ETABS software

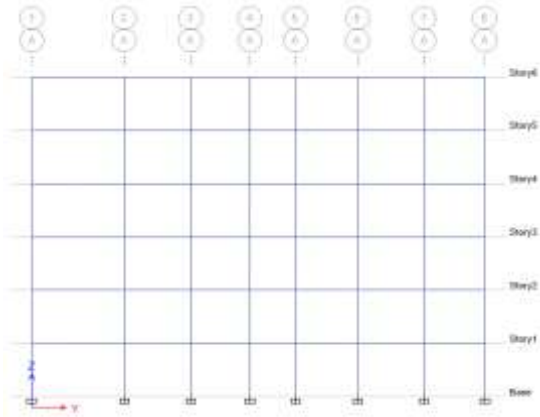

Fig - 7.2: Regular building elevation view of ETABS software

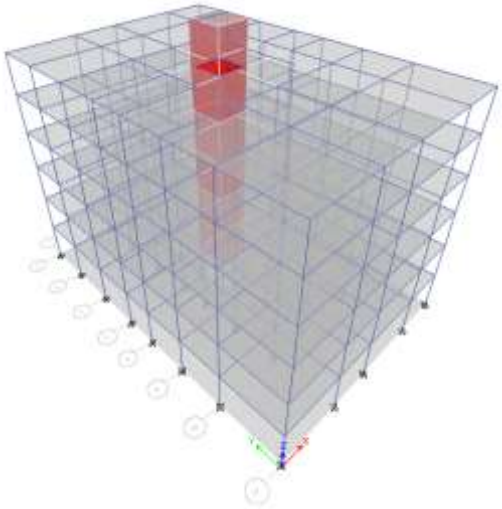

Fig - 7.3: Regular building 3D view of ETABS software

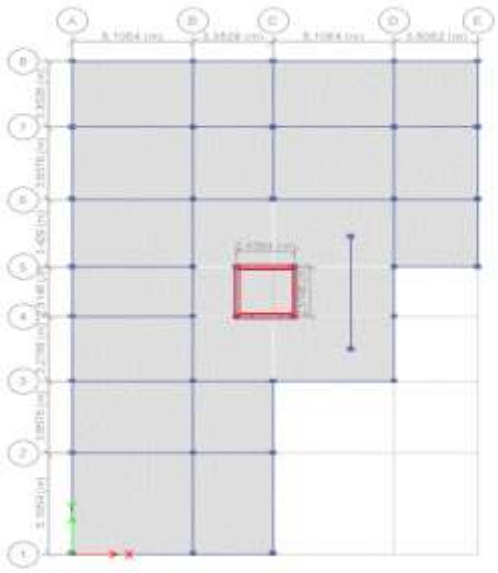

Fig - 7.4: Irregular building plan view of ETABS software

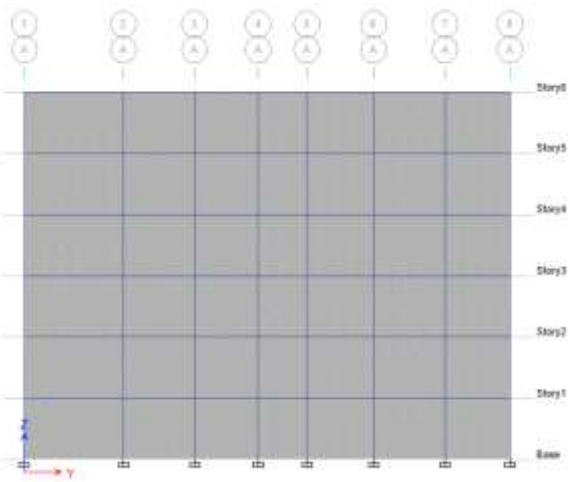

Fig - 7.5: Irregular building elevation view of ETABS software

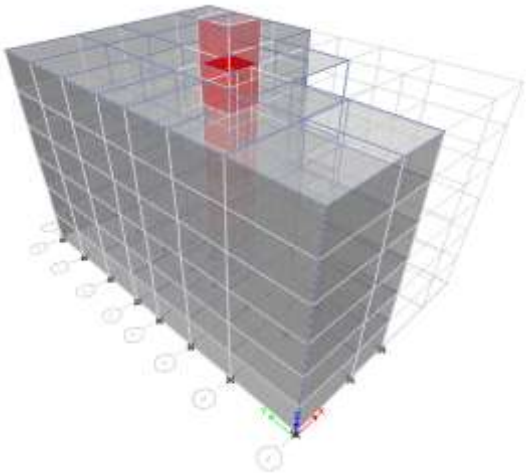

Fig - 7.6: Irregular building 3D view of ETABS software

7.4.1. Applied forces

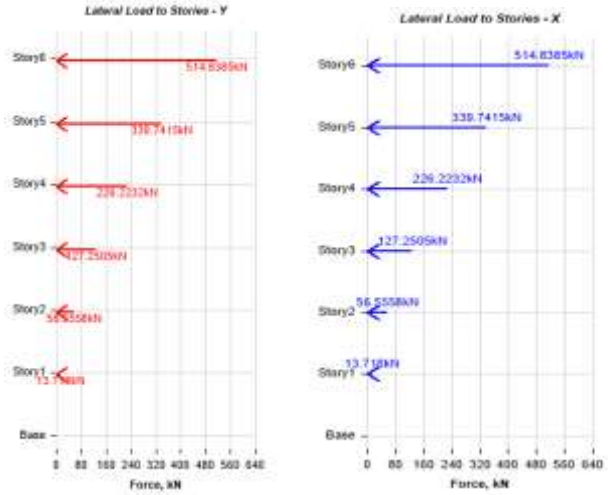

Fig - 7.7: Applied storey forces for regular building

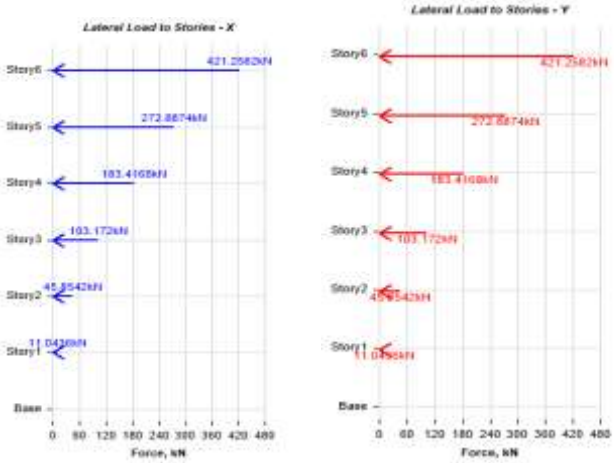

Fig - 7.8: Applied storey forces for irregular building

7.4.2. Deformation shapes

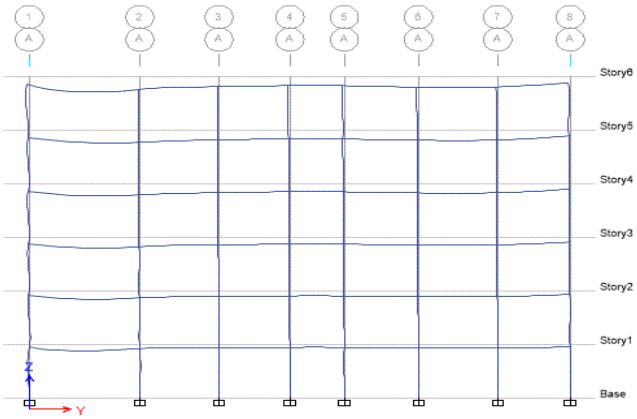

Fig - 7.9: Deformed shape for regular building in elevation view

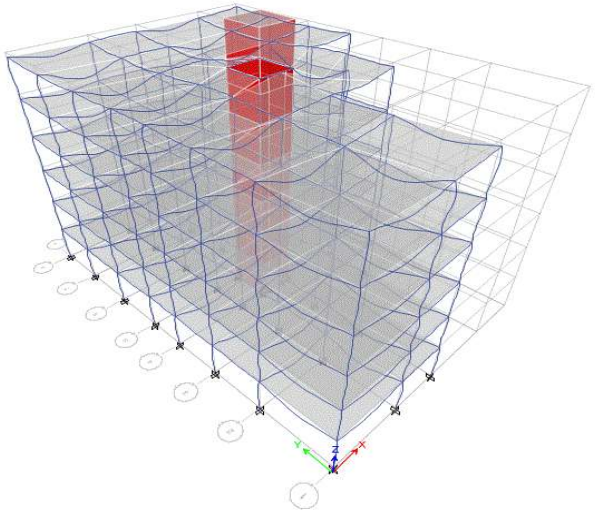

Fig - 7.10: Deformed shape for irregular building in 3d view

7.4.3. Concrete frame moment and shear

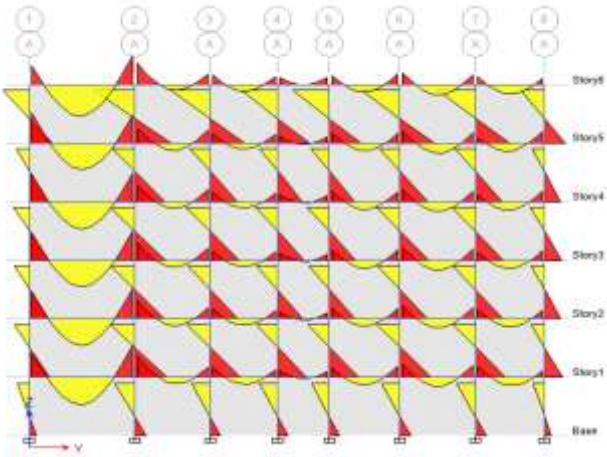

Fig - 7.11: Concrete frame moment for regular building

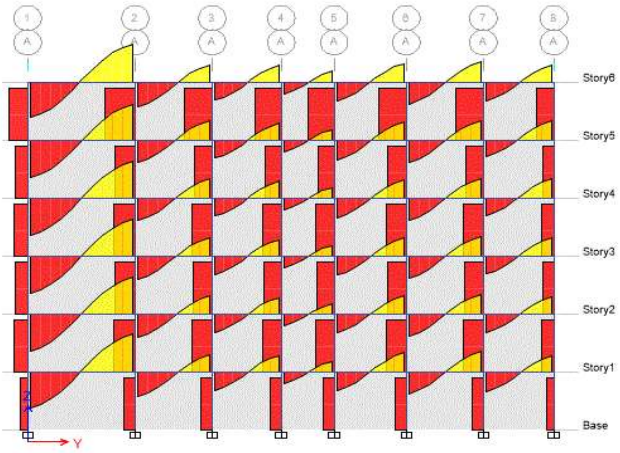

Fig - 7.12: Concrete frame shear for regular building

7.4.4. Display shell stress

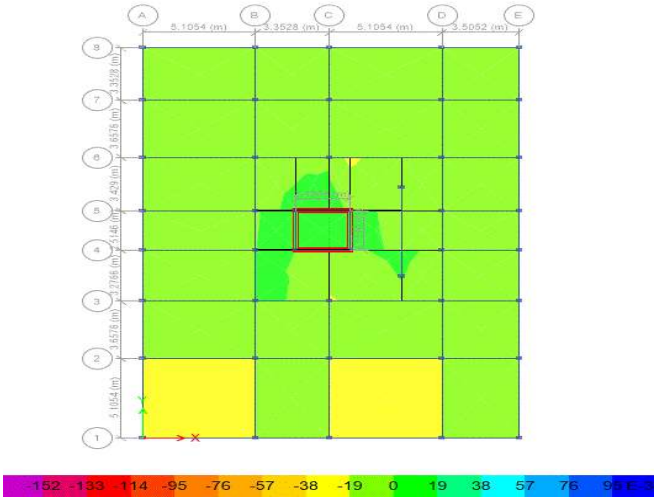

Fig -7.13: Shell stress in plan view for regular building

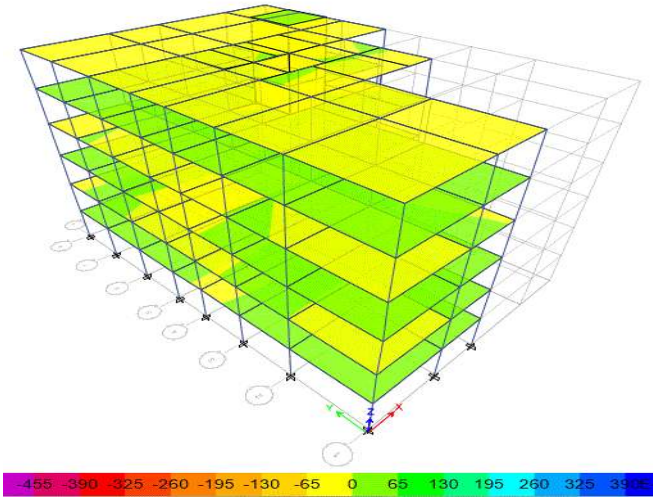

Fig - 7.14: Shell stress in 3D view irregular building

7.4.5. Design frame loads

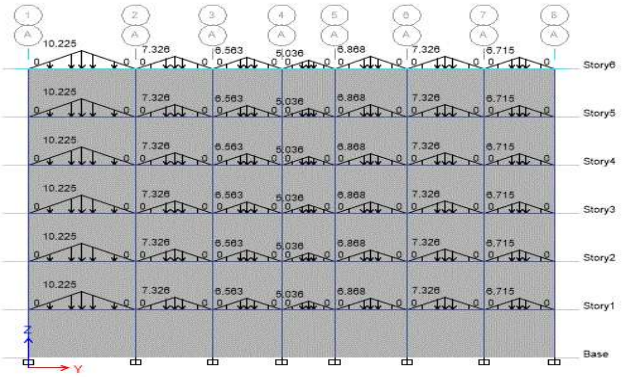

Fig - 7.15: Display frame load for regular building

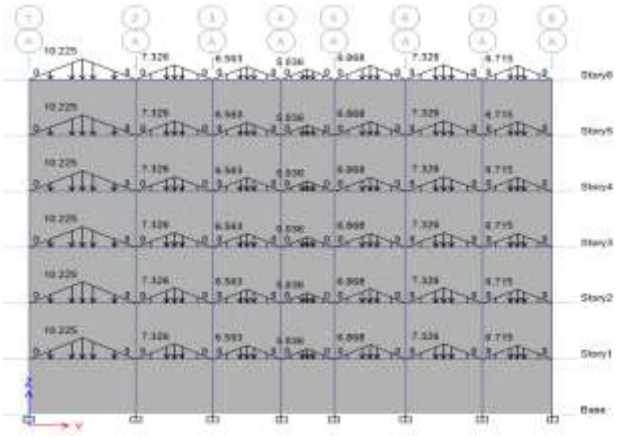

Fig - 7.16: Design frame loads for Irregular building

VIII. CONCLUSION

In this study regular and irregular geometric building plans and layouts area unit done by exploitation AutoCAD code. and also the modeling of each structures area unit created by exploitation ETABS code. and also the loadings like gravity hundreds as per IS 456 : 2000 and once the building is intended for earthquake forces in numerous zones as per IS 1893 (Part 1) : 2002 together with wind hundreds as per IS 875 (Part 3) : 1987 area unit to be taken into concerns for the planning purpose. In future analysis of each structures, planning and price comparisons area unit to be completed by exploitation ETABS code -2015.

REFERENCES

[1]. Abdul Khadeer Quraishi, Arshad Syed Masood Ahmed and Md Zubair Ahmed, "Variation of Steel Percentage in Different Seismic Zone Including Wind Effect vs Gravity Load", International Journal of Modern Engineering Research (IJMER), vol. 5, pp. 21-26, July 2015.

[2]. Abhay Guleria, "Structural Analysis of a Multi-Storeyed Building Using ETABS for Different Plan Configurations", International Journal of Engineering Research & Technology (IJERT), vol. 3, pp. 1481-1485, May 2014.

[3]. R. Akhil, S. Aswathy and Kumar, "Seismic Analysis of Regular and Irregular Buildings with Vertical Irregularity using STAAD.Pro", International Research Journal of Engineering and Technology (IRJET), Vol. 4, pp.1863-1866, June 2017.

[4]. Anshuman Nimade, Niraj Soni, Mahesh Patidar and Vikas Joshi, "Dynamic Analysis of Flat Slab System in Vertical Irregular Building with & without Shear Wall", International Research Journal of Research and Scientific Innovation (IJRSI), vol. 5, pp.132-139, Jan 2018.

[5]. Asha, "Comparison of Seismic Behaviour of a Typical Multi-Storey Structure With Composite Columns and Steel Columns", International Journal of Civil and Structural Engineering Research (IJSER), vol. 3, pp. 360-367, Sep 2015.

[6]. K. Bindumathi and Rajasekhar K, "Comparison of Percentage of Steel Quantities and Cost of an Asymmetry Commercial Building (G+4) under Gravity Loads and Seismic Loads", International Journal of Advanced Technology in Engineering and science (IJATES), vol. 3 , pp. 145-153, Aug 2015.

[7]. K. P. Inchara. and G. Ashwini, "A Study on Comparison of Percentage Steel and Concrete Quantities of a RC Irregular Building in Different Seismic Zones", International Journal of Research in Engineering and Technology (IJRET), vol. 3, pp. 470-474, Aug 2016.

[8]. Karunakar Perla, "Earthquake Resistant Design - Impact on Cost of Reinforced Concrete Building", International Journal of Engineering Science and Innovative Technology (IJESIT), vol. 3, pp. 327-334, Nov 2014.

[9]. Lakshmi Gayathri, J.C. Wason. and V. Thiruvengadam., "Cost Modeling of Reinforced Concrete Buildings Designed for Seismic Effects", 13th World Conference on Earthquake Engineering, Vancouver, B.C, Canada, pp. 1956, Aug (1,6) 2004.

[10]. S. Mahesh and Dr.B.Panduranga Rao, "Comparison of Analysis and Design of Regular and Irregular Configuration of Multistory Building in Various Seismic Zones and Various Types of Soils using ETABS and STAAD", Journal of Mechanical and Civil Engineering (IOSR-JMCE) vol. 11, pp. 45-52, Nov – Dec 2014.

[11]. S. V. Narsa Reddy, T. Anusha. and T. Sandeep, "Earthquake Resistance Design-Impact on Cost of Reinforced Concrete Buildings", International Journal of Modern Engineering Research (IJMER), vol. 4, pp 13-25, June 2014.

[12]. G. Papa Rao and Kiran Kumar, "Comparison of Percentage Steel and Concrete Quantities of a RC Building in Different Seismic Zones", International Journal of Research in Engineering and Technology (IJRET), vol. 2, pp. 124-134, July 2013.

[13]. Preeti Singh, "Design and Comparison of Multi-Storied Building in all Seismic Zones", International Journal for Scientific Research & Development (IJSRD), vol. 5, pp. 538-539, 2017.

[14]. Ravi Kiran and R. Sridhar, "Comparative Study of Regular and Vertically Irregular Building under Seismic Loading", International Journal of Research in Engineering and Technology (IJRET), vol. 5, pp. 141-144, Sep 2016.

[15]. S. M. Salahuddin Shakeeb, Prof.S. Brij Bhushan, Prof.P. D. Maneeth, Prof. Shaik Abdulla, "Comparative Study on Percentage Variation of Steel in Different Seismic Zones of India", International Research Journal of Engineering and Technology (IRJET), vol. 02, pp. 939-949, Oct 2015.

[16]. IS 1893 (Part 1) : 2002, "Criteria for Earthquake Resistant Design of Structures", Part 1 General Provisions and Buildings, Fifth Revision, Bureau of Indian Standards, New Delhi.

[17]. IS 456 : 2000, Plain and Reinforced Concrete – Code of Practice, Fourth Revision, Bureau of Indian Standards, New Delhi.

[18]. IS 875 (Part 1) : 1987, "Code of Practice for Design Loads for Building and Structures", Part 1 Dead Loads – unit weight of building materials and stored materials, second revision, Bureau of Indian Standards, New Delhi.

[19]. IS 875 (Part 2) : 1987, "Code of Practice for Design Loads for Building and Structures", Part 2 Imposed Loads, second revision, Bureau of Indian Standards, New Delhi.