SEISMIC ANALYSIS AND DESIGN OF MULTI-STORIED RC BUILDING USING STAAD.Pro and ETABS

Taruna R Kamble[1], Dr.G.D.Awchat[2]

[1,2] Gurunanak Institute of Management and Technology, Kalmeshwar road, Nagpur (RTM Nagpur University), Maharashtra

Abstract— the principle objective of this project is to analyze the high- rise (G +20 storied) building (3-D frame) using STAAD.Pro and ETABS. Project involves dynamic analysis of RC building with shear wall to know seismic behavior of structure. In addition to that project includes the Response Spectrum Analysis for checking response of building system with long column in key plan. STAAD.Pro and ETABS features a state-of-art user interface, visualization tools, and Powerful analysis, design engines with advanced finite element and dynamic analysis capabilities. From modal generation, analysis and design to visualization and result verification, STAAD.Pro and ETABS is the professional's choice.

Test results including base shear and story drift are presented and get effective lateral load resisting system. Also gives the value of modal mass participation, design results of beam and column with shear wall. In this study, the seismic response of the structures is investigated under earthquake excitation expressed in the form of member forces, joint displacement. The response is investigated for G+20 building structures by using STAAD.Pro and ETABS designing software.

Keywords : STAAD PRO , ETABS , Commercial Building , design of columns and beams , Shear Wall, modal mass participation.

[1] INTRODUCTION

A subset of Structural analysis and one of the major analysis for the structures present in the earthquake zone is known as Seismic analysis and is used in the calculation of the response of building or other structures. It is part of the process of structural design, earthquake or structural assessment and retrofit in region where earthquakes are prevalent. So to avoid failures due to such things engineer used shear walls in their construction.

Shear walls are incorporated in buildings to resist lateral forces and support the gravity loads. Positioning of shear wall has influence on the overall behavior of the building. Shear walls are basic important structural components. These walls can be utilized for giving more strength and safety to the structure, when the structures are subjected to external loads, such as earthquake, wind, dead, live etc.

Looking to the past records of earthquake, there is increase in the demand of earthquake resisting building which can be fulfilled by providing the shear wall systems in the building. Due to the major earthquakes in the recent past the codes which were provided are revised and now more weightage is given to earthquake design of structure. The decision regarding provision of shear wall to resist lateral forces play Most important role in choosing the appropriate structural system for given project

Generally structures are subjected to two types of loads i.e. Static and Dynamic. Static loads are constant while dynamic loads are varying with time. In majority civil structure calculations are based only on static loads while dynamic loads are not calculated because the calculations are more complicated. During an earthquake due to seismic waves the type of load which acts on the structure is mostly dynamic in nature and this is more disastrous. By providing shear wall in multi-storied building we can resist seismic waves of earthquake. The loads are calculated by E-TABS software by providing shear walls at corner parts of building.

[2]PARAMETERS USED IN SOFTWARES

1.) HEIGHT - Height is the measure of vertical distance, either how "tall" something or someone is, or how "high" the position is. Height is more often called altitude to describe a higher distance. In a Cartesian coordinates, height is measured along the y axis (vertical) between a specific point and another that does not have the same y-value. If both points happen to have the same y-value, then their relative height equals to zero.

2.) LENGTH - In the International System of Quantities, length is any quantity with dimension distance. In other contexts, length is a measured dimension of an object. Length may be distinguished from height, which is vertical extent, and width or breadth, which are the distance from side to side, measuring across the object at right angles to the length. In most systems of measurement, the unit of length is a base unit, from which other units are derived. Length is a measure of one dimension.

3.) SECTION OF BEAMS AND COLUMN (Rectangular) -

BEAM - Reinforced concrete beams are structural members that support the transverse load which usually rest on supports at its end. Girder is a type of beam that supports one or more smaller beam.

Types of Concrete Beams, beams are classified as :

1. Simple Beam
2. Continuous Beam
3. Semi-Continuous Beam
4. Cantilever beam
5. T- beam

COLUMN – A structural member on which compressive load acts is called as a column. The term column applies specially to a large round support with a capital and a base and made of concrete. A small support made of metal or wood is typically called a post, and depending on the shape whether a rectangular or other than round sections are usually called piers. For the purpose of wind or earthquake engineering, columns may be designed to resist lateral forces. Other compression members are often termed "columns" because of the similar stress conditions. Mostly columns are used to support beams or arches on which the upper parts of walls or ceilings rest.

4.) LOAD CALCULATIONS

4.1 DEAD LOAD - The dead load includes loads that are relatively constant over time, including the weight of the structure itself, and immovable fixtures such as walls, plasterboard or carpet. The roof is also a dead load. Dead loads are also known as permanent or static loads. Until constructed in fixed position building materials are not dead load. IS 875(part 1)-1987 gives unit weight of building materials, parts, components.

4.2 LIVE LOAD - Live loads, or imposed loads, are temporary, of short duration, or a moving load. These influential loads may involve loads such as impact, momentum, vibration, slosh dynamics of fluids and fatigue.

The forces which are variable in nature within the object's normal operation cycle and not including construction or environmental loads come under Live loads

4.3 SEISMIC LOAD - Seismic loading considers the effect of the waves due to earthquake on the structure. It acts at contact surfaces of a structure either with the ground, or with adjacent structures,[3] or with gravity waves from tsunami.

Seismic loading depends, primarily, on:

- Expected earthquake's parameters at the site - known as seismic hazard
- Geotechnical parameters of the site
- Structure's parameters
- Characteristics of the to be gravity waves from tsunami (if applicable).

Sometimes, seismic load is more than the bearing capacity of the structure and the structure does not resist it without being broken, partially or completely Due to their mutual interaction, seismic loading and seismic performance of a structure are intimately related.

Fig. 1 Rendered view of STAAD.Pro model with shear wall

5.) TIME PERIOD - Empirical expression to calculate the fundamental natural period is expressed as below:
$T=0.09h/sqrt(d)$

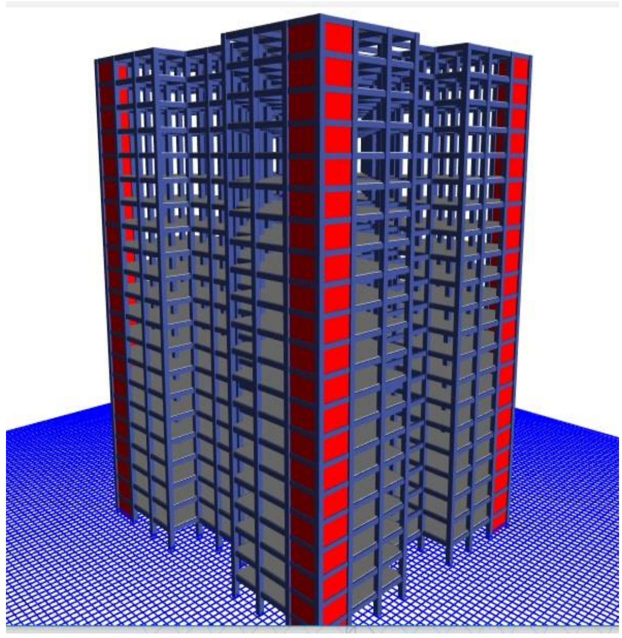

Fig.2 Rendered vie of ETABS model with shear wall

6.) BASE SHEAR - The design seismic base shear along any principal direction shall be determined by the following expression:

VB = Ah * W

9.) STOREY DRIFT - It is the displacement of one level relative to the other level above or below.

10.) LATERAL DISPLACEMENT - Lateral Displacement takes place in a R.C building due to shaking of surface.

11.) IMPORTANCE FACTOR (I) - Importance Factor is determined from Design Loads for Buildings and Other Structures (ASCE 7) based on the Occupancy Category. It is used in calculating the loads caused due to flood, wind, snow and seismic activity. The Importance Factor is a multiplier that increases or decreases the base design loads.

12.) DAMPING – The effect friction, discontinuities in the material, changes in the material properties etc in reducing the amplitude of vibration is called as Damping and is expressed as a percentage of critical damping.

13.) SHEAR WALL – It is the wall designed to resist lateral forces acting in its own plane.

14.) ZONE FACTOR (Z)-It is a factor to obtain the design spectrum depending on the perceived maximum seismic risk characterized by Maximum Considered Earthquake (MCE) in the zone in which the structure is located. The basic zone factors included in this standard are reasonable estimate of effective peak ground acceleration.

[3] RESULT

Concrete Beam Design

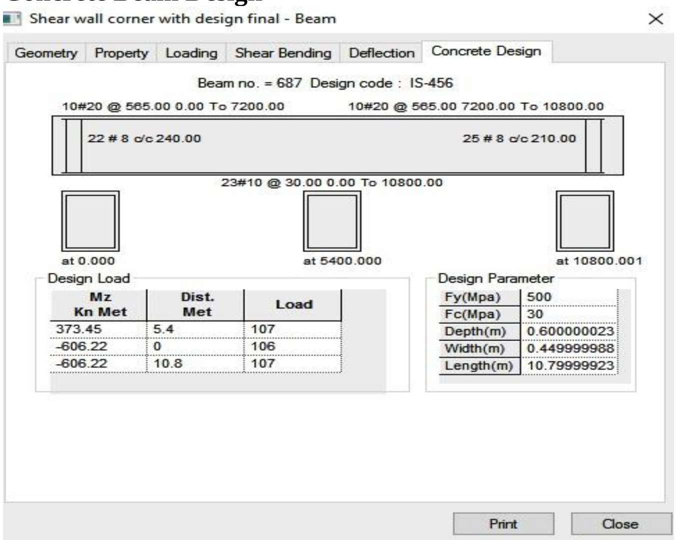

Fig. 3 Beam Reinforcement Detail

Concrete Column Design

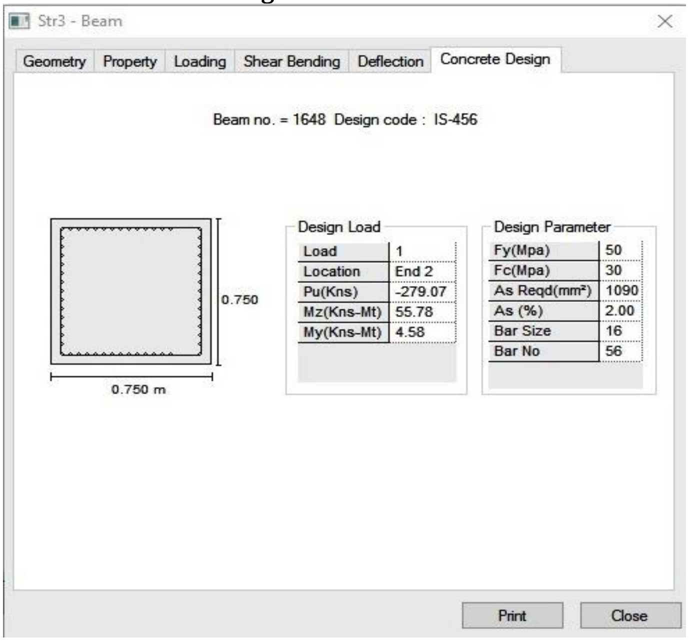

Fig.4 Column Reinforcement Details

[4] CONCLUSION

- From the analysis and design results it is conclude that STAAD-Pro and ETABS both the software's gives almost similar results, so both the softwares can be used for high rise modeling.
- Changing the shear wall will affect the attraction of forces, so that wall must be in proper position.

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AUTHOR PROFILE

Taruna .R. Kamble received the B. E. (Civil Engineering) in the year 2015 from Nagpur Institute of Technology (RTM Nagpur University), Maharashtra State, India. Now she is M.tech – student appearing (Structural Engineering) from Gurunanak Institute of Management and Technology, kalmeshwar road, Nagpur (RTM Nagpur University), Maharashtra State, India.

Dr. Ganesh D. Awchat received B.E. (Civil Engineering) from Govt. College of Engg., Amravati affiliated to Amravati University, Amravati in 1999. M. E. (Civil Structures) from Govt. College of Engg., Karad as GATE qualified candidate affiliated to Shivaji University, Kolhapur in 2003. Ph.D. (Civil Engg.), from M.I.E.T.Gondia, awarded by R.T.M. Nagpur University in March, 2013.Now he is working as Associate Professor, Department of Civil Engineering,Guru Nanak Institute of Technology (Formerly known as Guru Nanak Institute of Engineering & Management)Dahegaon, Nagpur and Dean, Research & Development,Guru Nanak Institutions,Nagpur, Maharashtra State, India.