Seismic Analysis and Design of G + 5 Commercial Complex Building

Rehan Khan [1], Pushpendra sahu [2], R R L Birali [3]

[1]*Student, Department of Civil Engineering, Shri Rawatpura Sarkar University, Raipur, India.*

[2]*Assistant Professor, Department of Civil Engineering, Shri Rawatpura Sarkar University, Raipur, India.*

[3]*Dean, Department of Civil Engineering, Shri Rawatpura Sarkar University, Raipur, India.*

Corresponding Author: rehankh1998@gmail.com

Abstract: - A multi- storied is a building that has multiple floors above ground in the building. Buildings are not particularly susceptible to vertical ground motion, but its effect should be borne in mind in the design of RCC columns, steel column connections, and pre-stressed beams. Vertical acceleration should also be considered in structures with large spans, those in which stability is a criterion for design, or for overall stability analysis of structures. Structures designed only for vertical shaking, in general, may not be able to safely sustain the effect of horizontal shaking. Hence, it is necessary to ensure that the structure is adequately resistant to horizontal earthquake shaking too. Seismic analysis of commercial complex situated in Vadodara city is done, which is located in a seismic zone –III on a site with medium soil. In analysis of loads due to different loading combinations, analysis and design of structure, study of reactions, shear forces; bending moment, seismic force etc have been done by manually as well as using STAAD-Pro V8i. Seismic weight of the entire G+5 commercial complex is = 39 286 kN, Base Shear = 1320kN, Design shear of column Vu = 390 kN.

Key Words: — ***STAAD-Pro V8i, RCC columns, Seismic analysis, Base Shear loading combinations, shear forces, bending moment.***

I. INTRODUCTION

In this project, the "Seismic Analysis and Design of G+5 commercial complex building" has been done. The project is completed with reference to the Indian standard codes in planning we have used AutoCAD, with reference to National Building Code 2005 Completed. Analysis of the structure is done in manual as well as using Staad.Pro V8i software. Designing of structural components are carried out using Indian standard code in limit state method. Structural analysis means determination of the general shape and all the specific dimensions of a particular structure so that it will perform the function for which it is created and will safely withstand the influences, which will act on it throughout its useful life.

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Our paper involves analysis and design of Multistoried complex (6-story) using a worldwide most common used designing software STAAD-Pro.STAAD-Pro features a user interface, visualization tools, powerful analysis and design appliance with advanced limited element and dynamic analysis efficiency.

From model generation, analysis and design to output visualization and result verification, STAAD-Pro is the specialist's best choice for concrete, steel, aluminum, timber and cold-formed steel design of low and high-raised multistoried buildings, culverts, petrochemical plants, tunnels, bridge, piles and much more. The main objective is to estimate and check seismic response of building and analyze & design it on that basis using STAAD-Pro software.

II. LITERATURE REVIEW

Gauri G. Kakpure.et.al. (2017): Reinforced Concrete (RC) building frames are most common types of constructions in urban India. These are subjected to several types of forces during their lifetime, such as static forces due to dead and live loads and dynamic forces due to earthquake. In the present

work, two tall buildings (a G+10 and a G+25 structure), presumed to be situated in seismic zone III, are analyzed by using two different methods viz.

B. Gireesh Babu (2017): In this study the seismic response of the structures is investigated under earthquake excitation expressed in the form of member forces, joint displacement, support reaction and story drift. The response is investigated for g+7 building structures by using STAAD PRO designing software. It's observed the response reduction of cases Ordinary moment resisting frame. In this case, we have taken earthquake zone 2, response factor 3 for Ordinary moment resisting frame and importance factor 1.

B. Rajesh.et.al., (2015): This paper aims towards the static and dynamic analysis of reinforced concrete building with plan irregularity. Four models of G+15 storey building with one regular plan and remaining irregular plan have been taken for the investigation. The analysis of R.C.C. building is carried out with the FE based software ETABS 9.5. Estimation of response such as; lateral forces, base shear, storey drift, storey shear is carried out.

E. Pavan Kumar.et.al. (2014): In this journal the parameters considered for analysis are axial force, bending moment and displacement. The plan considered was in square shape of building. To ensure safety against seismic forces of multi-storied building hence, there is need to study of seismic analysis to design earthquake resistance structures. In seismic analysis the response reduction was considered for two cases both Ordinary moments resisting frame and Special moment resisting frame.

Today there is a growing interest in the personality traits of a candidate by the organization to better examine and understand the candidate's response to similar circumstances and in this system, HR adds some criteria like personality required, roles and responsibilities etc. and system are examining automatically to candidates are feet to all this criterion or not for this, the system conducts a personality prediction test to determine the personality traits of the candidate. Finally, it presents the results of the candidates to the recruiter who evaluates the top candidates and shortlisted the candidate. In this project, we will register him/her with all resume details, hobbies, strengths, weakness and 15 to 16 questions for personality prediction in that HR analyzed the Candidates Openness(O), Conscientiousness(C), Extraversion(E), Agreeableness (A) means is one of the five personality traits of the Big Five personality theory.

A person with a high level of agreeableness in a personality test is usually warm, friendly, and tactful. They generally have an optimistic view of human nature and get along well with others. Neuroticism (N) Means is one of the Big Five higher-order personality traits in the study of psychology. Individuals who score high on neuroticism are more likely than average to be moody and to experience such feelings as anxiety, worry, fear, anger, frustration, envy, jealousy, guilt, depressed mood, and loneliness, which will be further, used by the system to shortlist their CV or candidates. After completing the top 10 or above shortlisted candidates, auto mail is sent.

In psychology, the theory based on the Big 5 factors is the most widely accepted model to describe the basic structure of human personality. The theory based on these factors is called the five-factor model (or the Big 5 model) and it is the most widely accepted model of personality. It provides a nomenclature and a conceptual framework that unifies much of the research findings in the psychology of individual differences and personality. It reduces the large number of personal adjectives into five main personality traits that form the acronym OCEAN. It was first studied in the 1990s when five factors or personality traits were established and has been used until the present time. According to Table, individuals in the Big 5 model vary in terms of the OCEAN, that is openness to experience, conscientiousness, extraversion, agreeableness and neuroticism. It represents a complete set of traits that could capture personality differences.

III. METHODOLOGY

The foremost basic in structural engineering is the design of simple basic components and members of a building viz., Slabs, Beams, Columns and Footings The process of structure design involves the following steps: Structural Planning, Calculation of Loads, Analysis of Structure, Member Design, Drawing and Detailing.

3.1. Preliminary data

A G+5storey RC commercial building has been designed as an RCC framed structure with a reinforced concrete slab. This building is analyzed by using STAAD.PRO Software and the analysis part is done for the zones of India and for soil types. IS code 456-2000: Plain and Reinforced Concrete, IS code 875-1987(part 2): Live Load and IS code 1893-2002: Criteria for earthquake resistant design of structures are taken into consideration.

3.2. Building Configuration

The building model has six storeys with a constant storey height of Typical floor: 5m, GF: 3.4m

3.3. Geometry of the Building

The general layout of the building is shown in Figure 1 at ground level, the floor beams FB are not provided, since the floor directly rests on ground (earth filling and 1:4:8 c.c. at plinth level) and no slab is provided. The ground beams are provided at 100 mm below ground level.

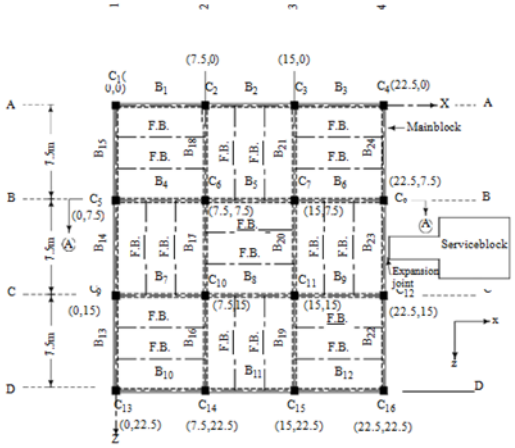

Fig.1. General lay-out of the building

3.4 Staad Pro Plan & Model

We considered a Complex building with y-axis consisted of G+5floors. The supports at the base of the structure were also specified as fixed. The structure was subjected to self-weight, dead load, live load values considering by the specifications of IS 875 part-1 and part-2. The Seismic load calculations were done following IS 1893-2002 part-1.

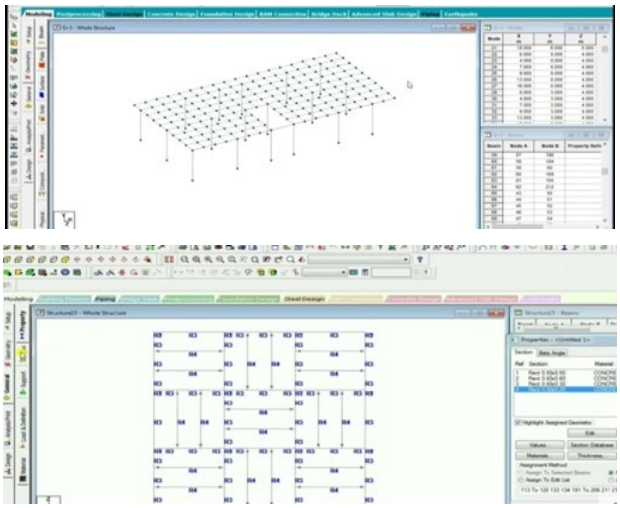

Fig.2. Property assigning in Staad.Pro

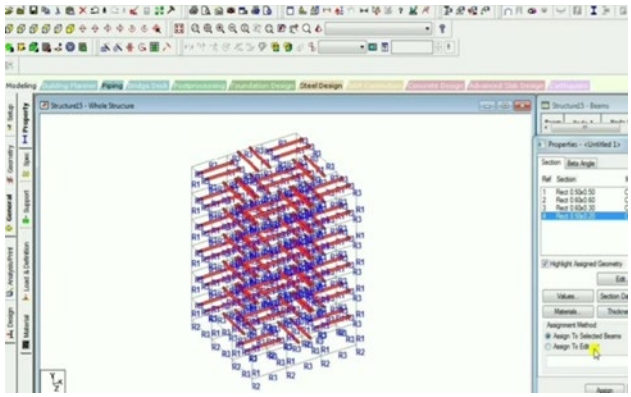

Fig.3. Property assigning in Staad.Pro

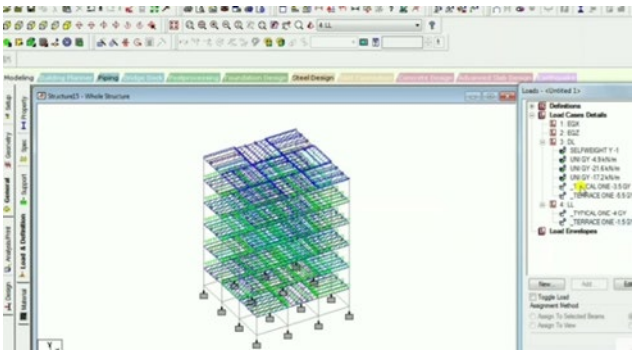

Fig.4. Assigning load in members

3.5 Seismic Weight Calculations

The seismic weights are calculated in a manner similar to gravity loads. The weight of column sand walls in any storey shall be equally distributed to the floors above and below the storey. Following reduced live loads are used for analysis: Zero on terrace, and 50% on other floors [IS: 1893 (Part 1): 2002, Clause 7.4)

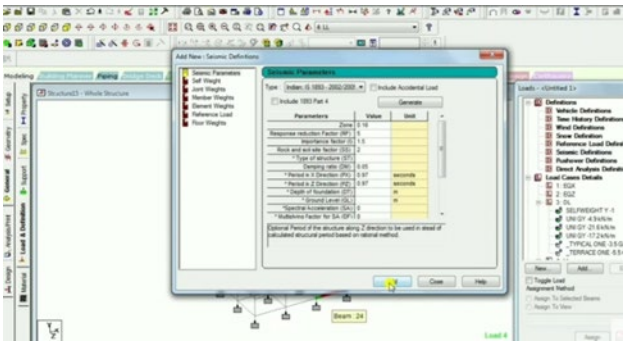

Fig.5. Assigning Seismic parameters in structure

3.6 Load Combinations

As per IS 1893 (Part 1): 2002 Clause no. 6.3.1.2, the following load cases have to be considered for analysis:

1.5(DL+IL)

1.2(DL+IL+EL)

1.5(DL +EL)

0.9DL +1.5EL

Earthquake load must be considered for +X, -X, +Z and Z directions.

3.7. Storey Drift

As per Clause no.7.11.1 of IS 1893 (Part1):2002, the storey drift in any storey due to specified design lateral force with partial load factor of 1.0, shall not exceed 0.004 times the storey height. From the frame analysis the displacement soft he masses centers of various floors are obtained.

Maximum drift is for fourth storey=17.58mm.

Maximum drift permitted = 0.004 x 5000 = 20mm.Hence, ok.

3.8. Stability Indices

It is necessary to check the stability indices as per Annex E of IS 456:2000 for all s treys to classify the column sine given storey as non-sway or sway columns. The stability index Q_{si} of a storey is given by

$Pu\triangle_u$

Since the building configuration is same in both the directions, the displacement values are same in either direction.

IV. RESULTS AND DISCUSSION

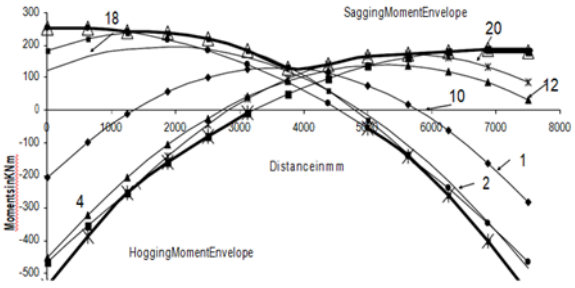

Fig.6. Moments Envelops Fop Beam 2001

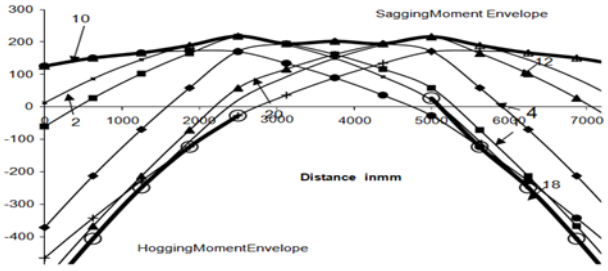

Fig.7. Moments Envelops Fop Beam 2002

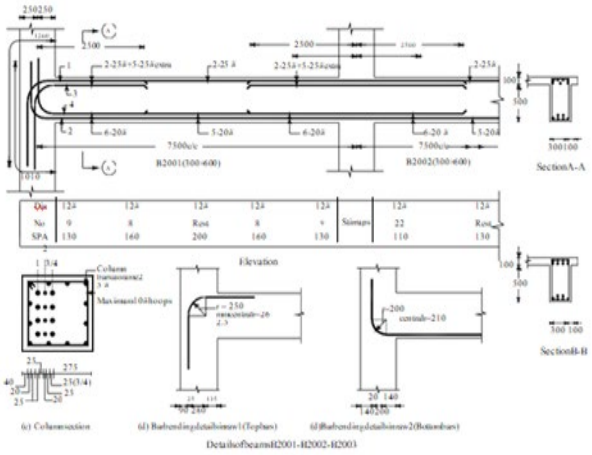

Fig.8. Details of Beams B2001 B2002 and B2003

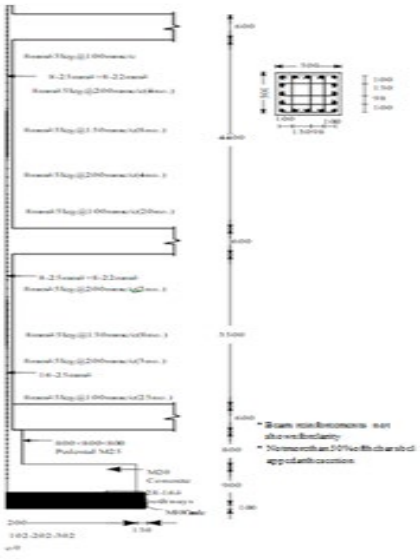

Fig.9. Reinforcement Details

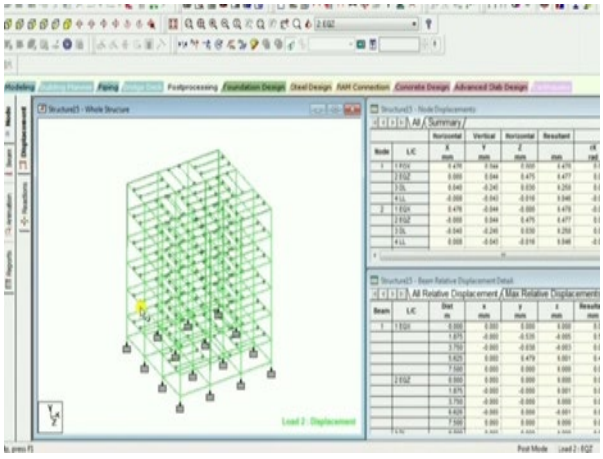

Fig.10. Displacement

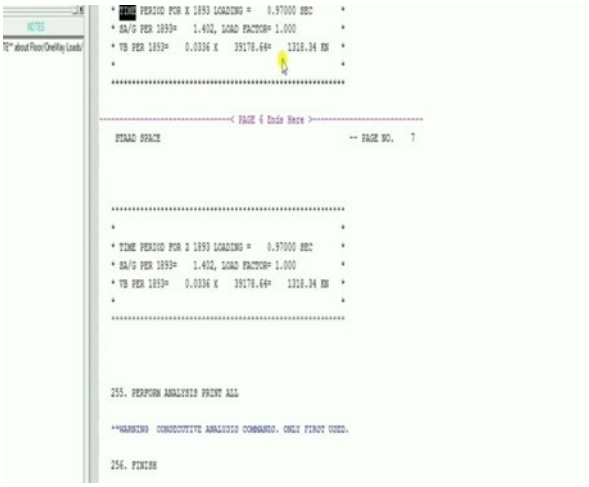

Fig.11. Base Shear

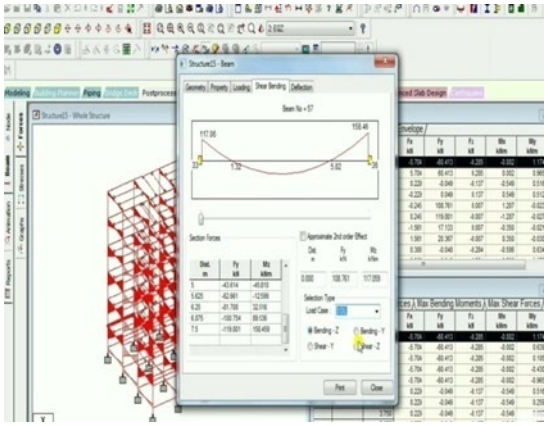

Fig.12. Bending

V. CONCLUSION

Seismic weigh to the entire building = 39 286 kN

Maximum drift is for fourth storey = 17.58mm.

Base Shear = 1320kN

Maximum drift permitted = 0.004 x 5000 = 20mm.Hence, ok.

Dimension of beam = b*D = 300*600

The storey drift mainly occurred at the middle of the building, in this building the middle storey I the 4th storey and it has maximum storey drift

Maximum design shear at A = 379 kN.

Design shear of column Vu = 390 kN.

Special Confining Hoops: Provide 8 mm # 5 legged confining hoops in both the directions @ 100 mm c/c.

Longitudinal reinforcement provided in beams: B2001 and B2003

Design of Transverse reinforcement:

Rectangular hoops of 8 mm diameter are used.

Total legs of stirrups (hoops) in any direction = 2 +3 = 5.

Maximum spacing of stirrups is 250 mm c/c.

Design of footing:

Size of footing 4.2 m × 4.2 m size.

Footing is to be designed for M_z for an upward pressure of 250 kN/m^2 on one edge and 167 kN/m2 on the opposite edge of the footing.

Size of pedestal:

Pedestal of size 800 mm × 800 mm is used.

Depth of pedestal = 800mm.

For the pad footing, width b = 4200 mm

Provide 28 no. 16 mm diameter bars. Of spacing 151.26 mm

A depth of 900 mm overall. Larger depth is required for shear design.

Development length = 47 × 16 = 752 mm

Anchorage length = = 1650 mm

Weight of the footing: = = 396.9 kN

Total length of dowel = = 5050 mm

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