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EFFECT OF WIND AND SEISMIC LOAD ON A COMMERCIAL BUILDING

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Abstract: Structural engineers are facing the challenge of determining the most efficient and economical design solution while ensuring that the final design of a building must be serviceable for its intended function, habitable for its occupants and safe over its design life-time. Engineers, designers and builders are trying to use different materials to their best advantage keeping in view the unique properties of each material Structurally robust and aesthetically pleasing building are being constructed by combining the best properties at individual material & at the same time meeting specific requirements of large span, building load, soil condition, time, flexibility & economy high rise buildings are best suited solution. Also, Wind & Earthquake (EQ) engineering should be extended to the design of wind & earthquake sensitive tall buildings. As our country is the growing country across the globe and need of shelter with higher land cost in major cities like Mumbai, Delhi, Ahmadabad where further horizontal expansion is not much possible due to space shortage, we are left with the solution of vertical expansion.

This paper discusses the analysis & design procedure adopted for the evaluation of multi-storey building (G+12) under effect of Wind and EQ forces. This study examines G+12 stories building analysis and design under the effect of wind and earthquake using SAAP2000. Analytical results are compared to achieve the most suitable resisting system & economic structure against the lateral forces.

Keywords- SAP2000, Finite element method, Non-Liner Static and Linear Dynamic Analysis, Reinforced Concrete Framed Structure

I. Introduction

Buildings and houses are one of the oldest construction activities of human beings. The construction skill has advanced since the beginning from ancient construction technology to the present concept of modern house buildings. In present generation construction methodology for buildings is regarded for best asthetic look, high quality and fast construction, cost effective and innovative touch.

The healthy trend in the form of growth in demand for construction works in residential, commercial, institutional, industrial and infrastructure sectors are observed over the past era. Modern structures are more multi-layered and sophisticated as compared to ancient period. one of the major changes which are being felt through all is that the present structures are taller and thinner. Modern day necessity of structures is that these should be lighter yet not compromising on functionality. Civil engineering construction has seen a repeated economic competition between steel, concrete and other construction materials.

A commercial building is a building used for profitable or marketable where investors invest their funds in-order to gain some profits in indirect manner. use. There are different Types which include office buildings, warehouses. In cities, a commercial building often combines functions, offices located on levels 2-10, with marketing is done on 1st floor. A business must be located in a commercial area partially for commerce. These zones shall be adopted by the authorities and shall be strictly followed.

II. Literature Review

"Baldev D. Prajapati (2013) discussed the analysis & design procedure that may be adopted for the evaluation of symmetric multi-storey building under effect of Wind and earthquake forces. Structures are designed to resist moderate and frequently occurring earthquakes & wind and must have sufficient stiffness and strength to control displacement and to prevent any possible damage. It is inappropriate to design a structure to remain in the elastic region, under severe earthquakes & wind lateral forces, because of the economic constraints. The inherent damping of yielding structural elements can advantageously be utilized to lower the strength requirement, leading to a more economical design. This yielding usually provides the ductility or toughness of the structure against the sudden brittle type structural failure.

"Dj. Ladjinovic et al., (2012) presented an overview of modelling methods and results of the analysis obtained for the designed model of multi-storey frame using the programme SAP2000. The paper presents different possibilities for modelling plastic hinges for the nonlinear static analysis of reinforced concrete frame. The real behaviour of a structure during an earthquake can be the best simulated using the nonlinear dynamic time-history analysis (THA). The strength and deformation capacity of ductile concrete elements of the multi-storey frame structure is determined by the analysis of moment-

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curvature based on the expected (adopted) material properties. The nonlinear behaviour of structural elements is idealized by plastic hinges set in pre-selected locations. Since, THA is still too complicated for practical application, the calculation methods based on nonlinear static pushover analysis are used.

"Mayuri D. Bhagwat et al., (2014): Dynamic analysis of multi-storeyed practiced RCC building considering for Koyna and Bhuj earthquake is carried out by time history analysis and response spectrum analysis and seismic responses of such building are comparatively studied and modelled. Two-time histories (i.e. Koyna and Bhuj) have been used to develop different acceptable criteria (base shear, storey displacement, storey drifts)."

Wakchaure M.R ***et.al:*** The effect of walls on high rise buildings. Linear analysis is done on buildings with different structural plans. Analysis on G+9 R.C.C. building is done. Time history analysis is also applied to models. equivalent strut method is used to calculate the width and Various cases. Analysis is carried out by ETABS software. Indian earthquake data is entered in order to observe that the plan can resist the slight disturbance caused in earth's crust. He describes an Earthquake Analysis of High Rise Building with and Without In filled Walls.

Kasliwal Sagar K. *et.al:* The analysis is done on multi-storey building with shear wall and difference in numbers and positions of shear wall. He has concluded that the shear walls are operative building elements which resist the lateral forces during earthquakes. The designing the model in both the software's is very difficult and it requires high skills and after modeling loads are to be applied on it. The sixteen storey buildings have wind loads and wall loads in each direction so that the design shall be safe for construction. This study gives THA of the two multi storey building both are sixteen storeys have been modeled using software ETABS and SAP2000.

III. Methodology

A study how research is done systematically and a procedure to methodically solve the problem and by adopting various steps and there by Methodology helps to recognize products of scientific inquiry and the process aims to describe and analyze methods, clarify their assumptions relating in their potentialities.

Different methods used for methodology are as follows:

1) The Finite Difference Method
2) The Boudary Element Method

Dynamic analysis for simple structures can be carried out manually and for high rise buildings the dynamic effect on building can be analysis by software, if the building are unsymmetrical in nature the torsion will develop and it will the important parameter for the analysis , Torsional failures are seen to occur where the symmetry is not planned in the location of the lateral structural elements as for example providing the lift cores at one end of the building or at one corner of the building or unsymmetrically planned buildings in L shape at the street corners. Large torsional shears are caused in the building columns causing their torsional shear failures.

IV. Modeling and Analysis

Structural modeling is an implement step to establish three mathematical models,

1) Structural model
    a) Structural components
    b) Joints and
    c) Boundary conditions
2) A material model and
3) A load models

For designing a new structure or designing a plan, construction particulars and support conditions shall be made as close to the computational models as possible. For an existing structure estimation, structures shall be modeled as near to the actual as-built structural situations as possible. The different choice of modeling and analysis methods are

a) Reputation of the structure
b) Determination of structural analysis
c) Essential level of response accuracy

The original plan is taken and studied and the modeling is done with reference with it. The original plan is displayed below:

Fig1 .The above figure shows the original plan of the building

Model in 3D is as follow:

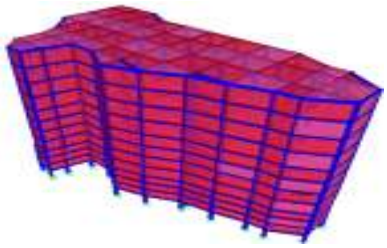

Fig2 .The above figure shows Developed 3D model in SAP2000

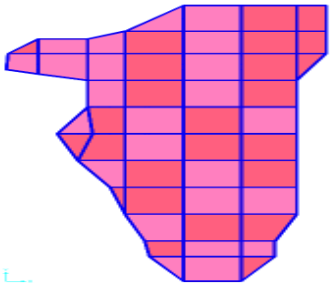

Fig3(a). The above figure shows top viewin SAP2000

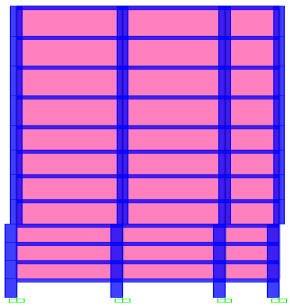

Fig3(b). The above figure shows side view in SAP2000

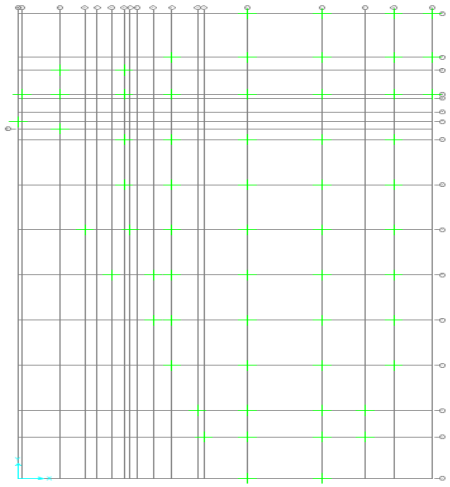

Fig 4. The above figure shows the Coloum layout in SAP2000

V. Results and Discussion

TABLE1. Different Time period and Frequencies for the structure

Mode Shape No	Time period(s)	Frequency(Hz)
Mode 1	0.5275	1.8954
Mode 2	0.3680	2.7170
Mode 3	0.3378	2.9597
Mode 4	0.1794	5.5716
Mode 5	0.1430	6.9904
Mode 6	0.1403	7.1234
Mode 7	0.1375	7.2719
Mode 8	0.1340	7.4620
Mode 9	0.1335	7.4897
Mode 10	0.1316	7.5935
Mode 11	0.1300	7.6870
Mode 12	0.1298	7.7004

A. Time History Analysis

INDIAN earthquake data has been applied for the structure and observed the destruction or the effect caused by it to the structure. In this study Uttarkashi earthquake data has been applied.

The four joints joint1434, joint1182, joint104-1, joint413-1 are taken in different heights of the structure.

The time history is applied with an Uttarkashi earthquake data in X-Direction and the graph obtained is described below:

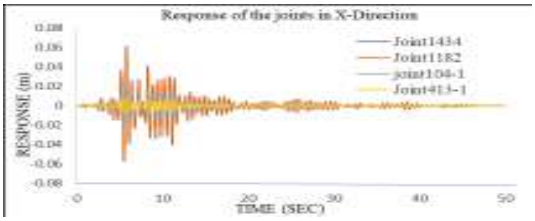

Fig 5.Response of Building suspected to Uttarkashi ground motion at the particular joints.

The time history is applied with an Uttarkashi earthquake data in Y-Direction and the graph obtained is described below:

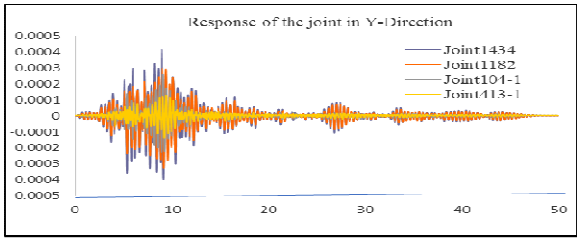

Fig6. Response of Building suspected to Uttarkashi ground motion at the particular joints.

The time history is applied with an ELCENTRO earthquake data in X-Direction and the graph obtained is described below:

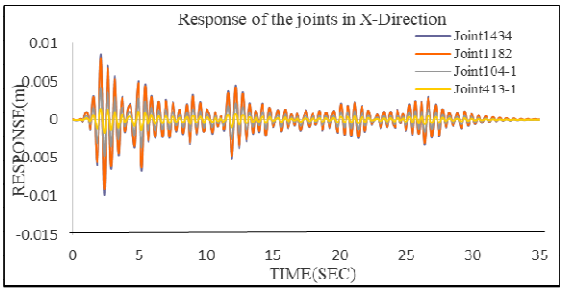

Fig7. Response of Building suspected to ELCENTRO ground motion at the particular joints

The time history is applied with an ELCENTRO earthquake data in Y-Direction and the graph obtained is described below:

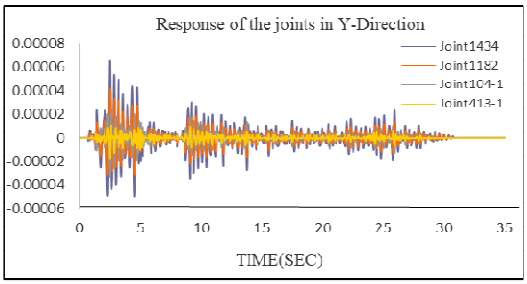

Fig8. Response of Building suspected to ELCENTRO ground motion at the particular joints

VI. Conclusions

1) The results which are obtained from the above analysis is safe for construction.

2) The structure is safe for the earthquake data i.e.; Uttarkashi and it can resist small disturbances in the earth.

3) The different coloum sizes are placed at different points and they shall not change their position in order to safety factor in the structure.

4) Designing using Software's like SAP2000 reduces the time in design work and accuracy is Improved by using software.

5) Comparison of all model shapes shows that building is more economic for all other buildings structure.

6) The maximum deflection occurred in Uttarkashi ground motion

Joint no.	Max deformation in X-Direction(m)
Joint413-1	0.00983
Joint no.	Max deformation in Y-Direction(m)
Joint1434	0.000417

7) The maximum deflection occurred in ELCENTRO earthquake data is

Joint no.	Max deformation in X-Direction (m)
Joint 1434	-0.00981
Joint no.	Max deformation in Y-Direction (m)
Joint 1434	0.00006541

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References

[1] Baldev D. Prajapati1 & D. R. Pancha (2013) study of seismic and wind effect on multi storey r.c.c., steel and composite building International Journal of Advances in Engineering & Technology, Sept. 2013.

[2] Dj. Ladjinovic, A. Raseta, A. Radujkovic & R. Folic Comparison of Structural Models for Seismic Analysis of Multi-Storey Frame Buildings 4. Aseismic Design of Multi-storied RCC Buildings A.R. Chandrasekaran + and D. S. Prakash Rao.

[3] Mayuri D. Bhagwat, Dr.P.S. Patil, Comparative Study of Performance of Rcc Multistory Building for Koyna and Bhuj Earthquakes, International Journal of Advanced Technology in Engineering and Science www.ijates.com Volume No.02, Issue No. 07, July 2014 ISSN (online): 2348 – 7550.

[4] Mayuri D. Bhagwat, Dr.P.S. Patil Comparative study of performance of rcc multistory building for koyna and bhuj earthquakes.

[5] IS: 875 (Part 1), "Indian Standard Code of Practice for design loads for building and structures, Dead Loads" Bureau of Indian Standards, New Delhi.

[6] IS: 875 (Part 2), "Indian Standard Code of Practice for design loads for building and structures, Live Loads" Bureau of Indian Standards, New Delhi.

[7] IS: 875 (Part 3), "Indian Standard Code of Practice for design loads (Other than earthquake) for building and structures, Wind Loads" Bureau of Indian Standards, New Delhi.

[8] IS 456:2000, "Indian Standard plain and reinforced concrete-Code of Practice", Bureau of Indian Standards.