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Analysis And Design of a Single Core Structure

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Abstract: A building is the first structure, which pops into anyone's head as soon as one thinks of civil engineering. A building not only provides housing to its habitants but it also safeguards them from many natural adversities. Preventing all the forces causing such incidents is the need for designing the building. But designing a building requires going through a myriad of processes. The various factors have to be taken into consideration before commencing the actual work of designing a building, which is carried out before the construction work. The type of building and its design depends on the purpose for which it is built. This paper aims in designing, which is not only innovative but also endeavors to explore a new facet of civil engineering. The design process involves determining the size of the different components of the building and checking the stability of the building for various external forces to which it is subjected. The paper comprises of RCC building having G+4 floors which have been elevated from the ground floor for four floors. The proposed building is a commercial building. The shear wall will act as a single core. The shear wall will be connected to each other with a network of beams/ slabs with the slabs acting as in plane rigid diaphragms for each of the floors. . As the structure is resisting only on a single core the shear wall will be provided in such a way to control deflections and resist lateral forces. Shear wall will be provided in such a way to control deflections and resist lateral forces. Provision is done in design in such a way that services can be laid without major obstructions and maximum headroom is achieved.

Keywords: Rcc Building, Shear Wall, Floating Column, Cantilever Beam.

I. INTRODUCTION

The rapid increase in population and scarcity of land tends to the development of construction technology and high-rise commercial structures. A structure is said to be stable when it satisfies all stability requirements. Structures will be more stable when all the sides of the structure are supported and there is no eccentric loading. A normal building has a number of columns. What sets this building apart is that is consists of just one core. For aesthetic appearance we create our building supported by a single core. Modular planning of this building would also be very simple, as the interior walls have no longer any hindrances. Satisfying the requirement of the stability conditions for a single core structure will be complicated one, compared with the structures supported in all sides depending upon their configuration. Single core structure is a critical one when it is subjected to unsymmetrical and eccentric loading conditions. Eccentric loading will cause the structure to twist in any direction and may cause failure of structure. The main inspiration of this daunting paper topic is the structure of a TREE. The weight of the leaves and branches is transferred into the bark and then distributed into the soil by the root. By the paper, we want to explore a new dimension of the existing construction techniques. This paper describes planning, structural analysis and design of the single core building. The building consists of a square central core which transfers the load of the super structure to the ground surface. Since a single core is supporting the whole structure, all the other members will act as cantilevers. The structure is analysed and designed using E-TABS software which is based on finite element method and it is analysed and designed for the critical condition. The initiation of software usage in the engineering industry has remarkably reduced the complexities of different facet in the analysis and design of projects, as well as reducing the amount of time necessary to complete the designs. Concurrently, this leads to greater savings and reduction in costs. More complex projects that were almost impossible to work out several years back are now easily solved with the use of computers. In order to stay at the pinnacle of any industry, one needs to keep at par with the latest technologies advancements which accelerate work time frames and accuracy without decreasing the reliability and efficiency of the results.

II. LITERATURE REVIEW

Lekshmi Soman and Sreedevi Lekshmi (2017) studied the performance of a G+40 RC framed structure having outrigger system. This paper represents the alteration in percentage in storey drift in RC shear wall in comparision to braced framed core with an outrigger system. The Response Spectrum Analysis method had been adopted using ETABS 2015. Results showed approximately 39 percent reduction in storey drift.

Harry G Polous (2008) studied the paper and it describes the foundation design process adopted for the Burj Dubai, the world's tallest building. The paper sets out how the numerious design issues were addressed, including ultimate

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capacity, overall stability under wind and seismic loadings, and the settlement and differential settlements.This paper has outlined the processes followed in the design of the foundations for the Burj Dubai and the independent verification of the design.

E K Mohanraj, S Nisar Ahmad and A Gowri Samkar (2002) studied the STRAP (Structural Analysis Package) software by which Analysis and Design of a Monocolumn office building was to be done with the aim to achieve the goal of maximum utiliazation of space and maximum serviceability. Stiffness Matrix method has been used in STRAP also the estimation of the designed structure is done by Rate Analysis method.

III. METHODOLOGY

The steps followed while designing:

- Importing of Autocad plan on Etabs.
- Defining of material and section properties.
- Modelling of plan using various draw options.
- Defining and labeling of shear wall.
- Analysis of the structure.
- Designing of the structure.

For our project we shall be only considering the design by Limit state method. Numerous types of loads have been assigned to the structure considering IS 875 (Part 1) for dead load, IS 875 (Part 2) for live load, IS 875 (Part 3) for wind load and IS 1893 (Part 1) 2002 for seismic load.

A. BUILDING PLAN AND DIMENSION DETAILS

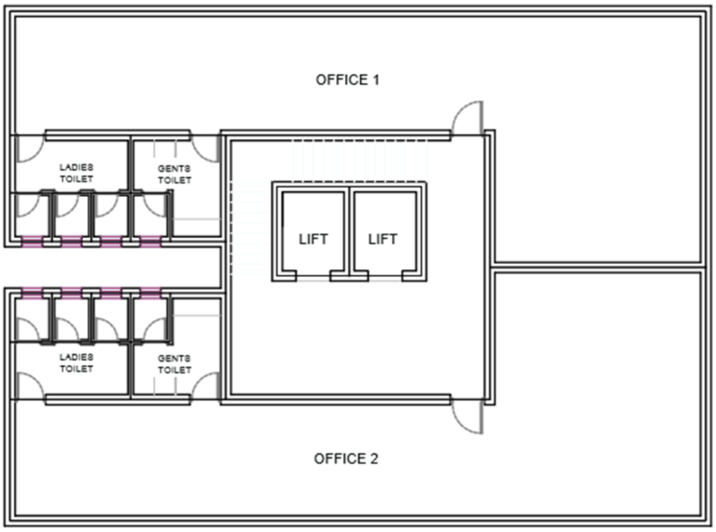

Fig. 1 Typical Floor plan.

Table I Parameters considered for Analysis

Description	Unit
No of stories	G+4
Height of each storey	4.5m
Grade of concrete	M40
Grade of steel	Fe415
Depth of slab	200mm
Size of beam (Primary)	1200mmx600mm
Size of beam (Secondary)	1000mmx500mm
Size of floating column	600mmx600mm
Shear wall thickness(outer)	600mm
Shear wall thickness (inner)	300mm
Wall thickness	230mm

B. BUILDING LOADING DETAILS

Table II Various types of loads assumed

Description	Load (kN/m^2)	Type
Beams	25*b*D	Dead load
Slabs	25*D	Dead load
Water Proofing	3	Dead load
Terrace	1	Dead load
Office rooms	5	Live load
Passage and storage	4	Live load
W/C	2	Live load

C. SEISMIC AND WIND LOAD COEFFICIENTS

Table III Parameters considered for seismic analysis

Zone	III
Importance factor	1
Response reduction factor	5
Soil type	II

Table IV Parameters considered for wind load

Zone	III
Wind speed	44m/s
Terrain category	3
Structure class	B
Risk coefficient	1
Topography	1

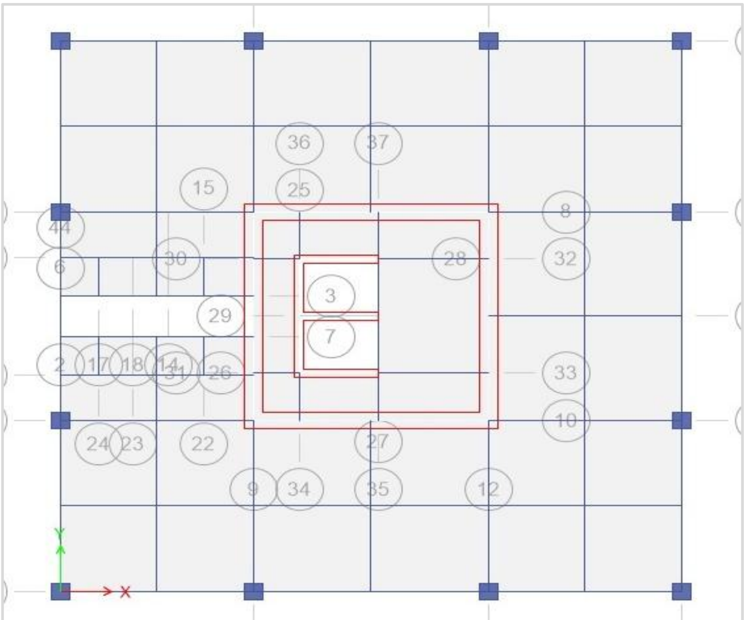

Fig. 2 Modelled plan view with members.

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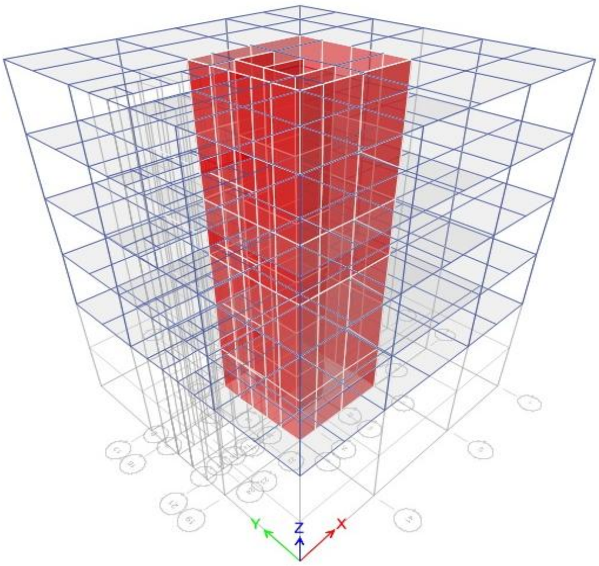

Fig. 3 3D View.

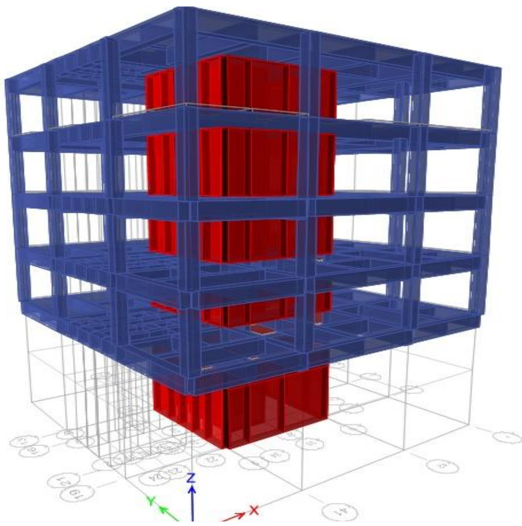

Fig.4 Extruded View.

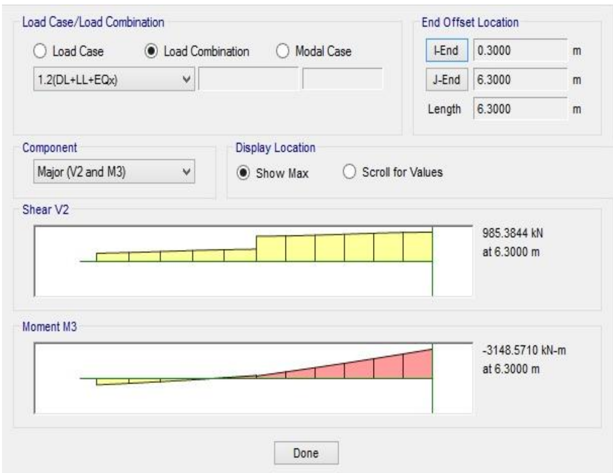

Fig. 5 SFD and BMD diagram for primary beam.

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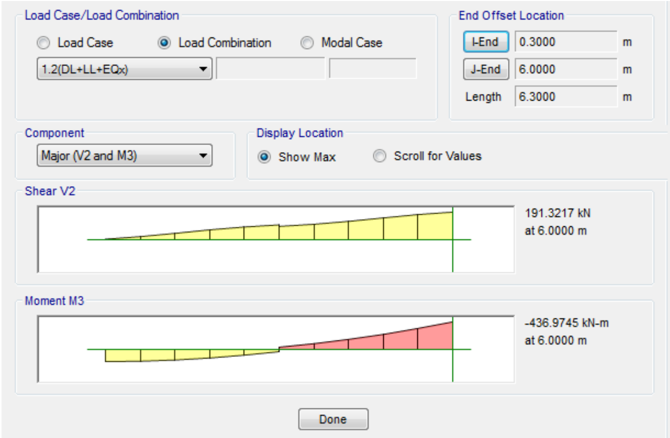

Fig. 6 SFD and BMD diagram for secondary beam.

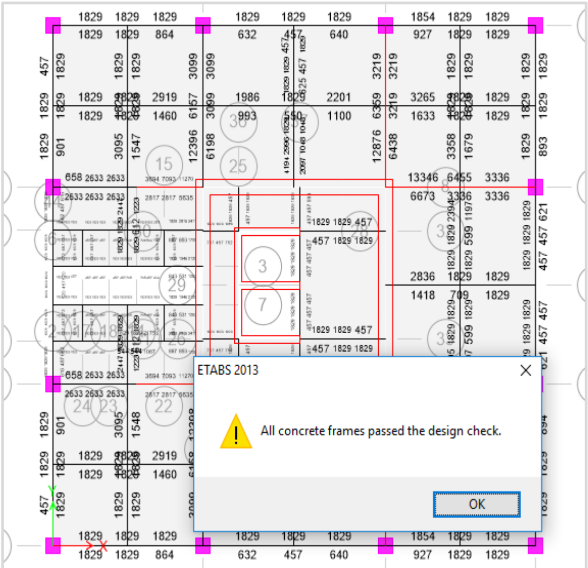

Fig. 7 Reinforcement Provided

IV. CONCLUSION

1. The building is safe for all types of loadings and is also safe for earthquake and wind.
2. The horizontal seismic co-efficient of acceleration is found to be same with the software and calculations performed manually.
3. Further the quantities of steel and concrete can be derived from the design.
4. According to IS 456 the structure is safe for permissible deflection.
5. Maximum utilization of space is achieved. Available carpet area is more.

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