

SEISMIC ANALYSIS AND DESIGN OF A APARTMENT BUILDINGS (G+10)

KAKARAPARTHY SIVA KARTHIK 1*, Mr. A.SRINIVASU 2*

1. II.M.Tech , Dept of CIVIL, AM Reddy Memorial College of Engineering & Technology, Petlurivaripalem.
2. Asst.Prof,Dept. of CIVIL, AM Reddy Memorial College of Engineering & Technology, Petlurivaripalem.

ABSTRACT

The principle objective of this project is to analyse and design a High rise building (G + 10) using STAAD Pro. The design involves load calculations manually and analyzing the whole structure by STAAD Pro. The design methods used in STAAD-Pro analysis are Limit State Design conforming to Indian Standard Code of Practice. STAAD.Pro features a state-of-the-art user interface, visualization tools, powerful analysis and design engines with advanced finite element and dynamic analysis capabilities. From model generation, analysis and design to visualization and result verification, STAAD.Pro is the professional's choice.

STAAD.Pro has a very interactive user interface which allows the users to draw the frame and input the load values and dimensions. Then according to the specified criteria assigned it analyses the structure and designs the members with reinforcement details for RCC frames. Our final work was the proper analysis and design of a G + 5 3-D RCC frame under various load combinations.

The structure was subjected to self weight, dead load, live load, seismic loads under the load case details of STAAD.Pro. Seismic load calculations were done following IS 1893-2000. The materials were specified and cross-sections of the beam and column members were assigned. The supports at the base of the structure were also specified as fixed. The codes of practise to be followed were also specified for design purpose with other important details. Then STAAD.Pro was used to analyse the structure and design the members. In the post-processing mode, after completion of the design, we can work on the structure and study the bending moment and shear force values with the generated diagrams. We may also check the deflection of various members under the given loading combinations. The design of the building is dependent upon the minimum requirements as prescribed in the Indian Standard Codes. The minimum requirements pertaining to the structural safety of buildings are being covered by way of laying down minimum design loads which have to be assumed for dead loads, imposed loads, and other external loads, the structure would be required to bear. Strict conformity to loading standards recommended in this code, it is hoped, will ensure the structural safety of the buildings which are being designed. Structure and structural elements were normally designed by Limit State Method.

INTRODUCTION

Our project involves analysis and design of multi-storeyed [G+10] using a very popular designing software STAAD Pro. We have chosen STAAD Pro because of its following advantages:

- ✚ easy to use interface,
- ✚ conformation with the Indian Standard Codes,
- ✚ versatile nature of solving any

✚ type of problem,

✚ Accuracy of the solution.

STAAD.Pro features a state-of-the-art user interface, visualization tools, powerful analysis and design engines with advanced finite element and dynamic analysis capabilities. From model generation, analysis and design to visualization and result verification,

STAAD.Pro is the professional's choice for steel, concrete, timber, aluminium and cold-formed steel design of low and high-rise buildings, culverts, petrochemical plants, tunnels, bridges, piles and much more.

STAAD.Pro consists of the following:

The STAAD.Pro Graphical User Interface: It is used to generate the model, which can then be analyzed using the STAAD engine. After analysis and design is completed, the GUI can also be used to view the results graphically.

Structural analysis comprises the set of physical laws and mathematics required to study and predicts the behaviour of structures. Structural analysis can be viewed more abstractly as a method to drive the engineering design process or prove the soundness of a design without a dependence on directly testing it.

To perform an accurate analysis a structural engineer must determine such information as structural loads, geometry, support conditions, and materials properties. The results of such an analysis typically include support reactions, stresses and displacements. This information is then compared to criteria that indicate the conditions of failure. Advanced structural analysis may examine dynamic response, stability and non-linear behaviour.

The aim of design is the achievement of an acceptable probability that structures being designed will perform satisfactorily during their intended life. With an appropriate degree of safety, they should sustain all the loads and deformations of normal construction and use and have adequate durability and adequate resistance to the effects of

The STAAD analysis and design engine: It is a general-purpose calculation engine for structural analysis and integrated Steel, Concrete, Timber and Aluminium design.

To start with we have solved some sample problems using STAAD Pro and checked the accuracy of the results with manual calculations. The results were to satisfaction and were accurate. In the initial phase of our project we have done calculations regarding loadings on buildings and also considered seismic and wind loads.

Structure and structural elements shall normally be designed by Limit State Method. Account should be taken of accepted theories, experiment and experience and the need to design for durability. Design, including design for durability, construction and use in service should be considered as a whole. The realization of design objectives requires compliance with clearly defined standards for materials, production, workmanship and also maintenance and use of structure in service.

The design of the building is dependent upon the minimum requirements as prescribed in the Indian Standard Codes. The minimum requirements pertaining to the structural safety of buildings are being covered by way of laying down minimum design loads which have to be assumed for dead loads, imposed loads, and other external loads, the structure would be required to bear. Strict conformity to loading standards recommended in this code, it is hoped, will not only ensure the structural safety of the buildings which are being designed.

LOADS CONSIDERED

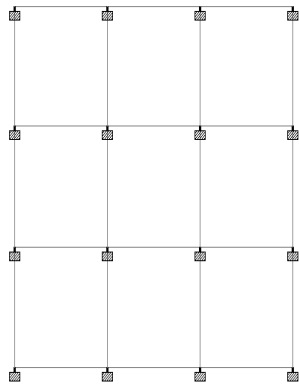
2.1 DEAD LOADS:

All permanent constructions of the structure form the dead loads. The dead load comprises of the weights of walls, partitions floor finishes, false ceilings,

false floors and the other permanent constructions in the buildings. The dead load loads may be calculated from the dimensions of various members and their unit weights. the unit weights of plain concrete and reinforced concrete made with sand and gravel or crushed natural stone aggregate may be taken as 24 kN/m³ and 25 kN/m³ respectively.

2.2 IMPOSED LOADS:

Imposed load is produced by the intended use or occupancy of a building including the weight of movable partitions, distributed and concentrated loads, load due to impact and vibration and dust loads. Imposed loads do not include loads due to wind, seismic activity, snow, and loads imposed due to temperature changes to which the structure will be



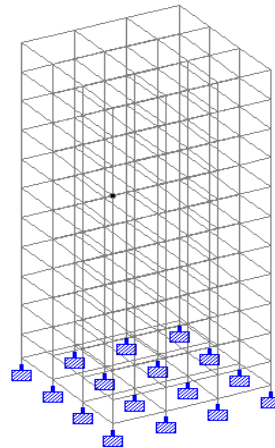
subjected to creep and shrinkage of the structure, the differential settlements to which the structure may undergo.

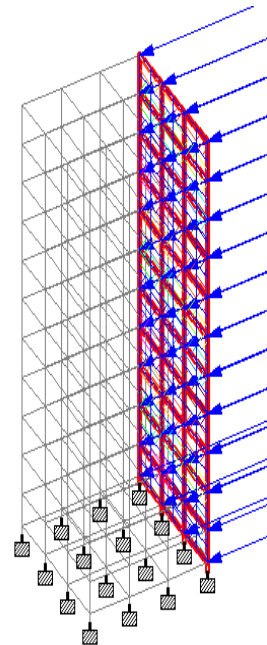
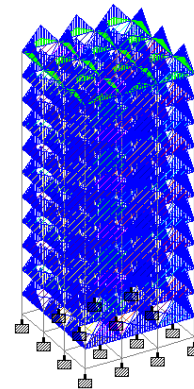
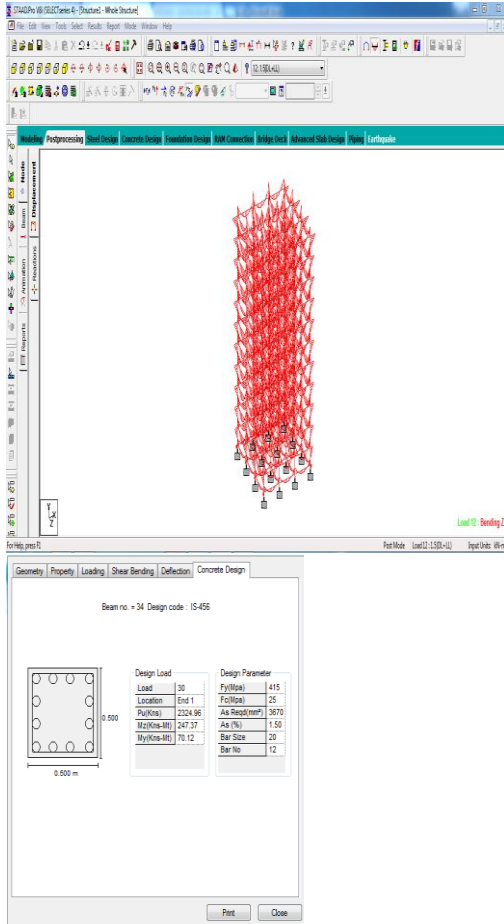
2.3 SEISMIC LOAD:

Design Lateral Force

The design lateral force shall first be computed for the building as a whole. This design lateral force shall then be distributed to the various floor levels. The overall design seismic force thus obtained at each floor level shall then be distributed to individual lateral load resisting elements depending on the floor diaphragm action.

DESIGN OF G + 5 RCC FRAMED BUILDING USING STAAD.Pro





CONCLUSION

STAAD PRO has the capability to calculate the reinforcement needed for any concrete section. The program contains a number of parameters which are designed as per IS: 456(2000). Beams are designed for flexure, shear and torsion.

Design for Flexure:

Maximum sagging (creating tensile stress at the bottom face of the beam) and hogging (creating tensile stress at the top face) moments are calculated for all active load cases at each of the above mentioned sections. Each of these sections are designed to resist both of these critical

sagging and hogging moments. Where ever the rectangular section is inadequate as singly reinforced section, doubly reinforced section is tried.

Design for Shear:

Shear reinforcement is calculated to resist both shear forces and torsional moments. Shear capacity calculation at different sections without the shear reinforcement is based on the actual tensile reinforcement provided by STAAD program. Two-legged stirrups are provided to take care of the balance shear forces acting on these sections.

Beam Design Output:

The default design output of the beam contains flexural and shear reinforcement

provided along the length of the beam.

Column Design:

Columns are designed for axial forces and biaxial moments at the ends. All active load cases are tested to calculate reinforcement. The loading which yield maximum reinforcement is called the critical load. Column design is done for square section. Square columns are designed with reinforcement distributed on each side equally for the sections under biaxial moments and with reinforcement distributed equally in two faces for sections under uni-axial moment. All major criteria for selecting longitudinal and transverse reinforcement as stipulated by IS: 456 have been taken care of in the column design of STAAD.

REFERENCE

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Reinforced Concrete design"

 "STAAD Pro 2004 – Getting started
& tutorials"

- Published by: R .E. I.

 "STAAD Pro 2004 – Technical
reference manual"

- Published by: R.E.I.


 **IS 875** - BUREAU OF INDIAN
STANDARDS

MANAK BHAVAN, 9 BAHADUR SHAH
ZAFAR MARG


NEW DELHI 110002

 **IS 456** - BUREAU OF INDIAN
STANDARDS

MANAK BHAVAN, 9 BAHADUR SHAH
ZAFAR MARG
NEW DELHI 110002

 **IS 1893-2000** - BUREAU OF INDIAN
STANDARDS

MANAK BHAVAN, 9 BAHADUR SHAH
ZAFAR MARG
NEW DELHI 110002

 **IS 1893-2002** - BUREAU OF INDIAN
STANDARDS

MANAK BHAVAN, 9 BAHADUR SHAH
ZAFAR MARG
NEW DELHI 110002