Structural Analysis And Design of G+ 3 Apartments Building Using Staad Pro

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Abstract- *This paper attempts to understand the structural analysis and designing of G+ 3 apartments thereby depending on the suitability of plan, layout of beams and positions of columns are fixed. Dead loads are calculated based on material properties and live loads are considered according to the code IS875-part 2, footings are designed based on safe bearing capacity of soil. for the design of columns and beams frame analysis is done by limit state method to know the moments they are acted upon. Slab designing is done depending upon the type of slab (one way or two way), end condition and loading. From the slab the loads are transferred to the beams, thereafter the loads from the beams are taken up by the columns and then to the footing. The section is checked for the components manually using STAAD PRO v8i software for the post analysis of the structure maximum shear force, bending moment and maximum storey displacement are computed. The quantitative estimation has been worked out.*

Keywords- Electric Vehicles, BTMS, HEV, PHEV, FCEV

I. INTRODUCTION

Now a day large number of applications softwares are available in the civil engineering field. All these softwares are develop as the basis of advanced. Finite element analysis which includes the effect of dynamic load such as wind effect, earthquake effect bets etc. in the present work, an attempt has been made to study the efficiency of certain civil engineering application software's.

STAAD PRO v8i software is used to analyze and design the G+3 apartment. The purpose of using the software is that it is user friendly and has unique features like it designs the structural components individually along with there analysis and result. Another useful feature of this software is that shear force, bending moment, torsion diagram at each level of the building can be viewed. The autoCAD software is used to make plan along with its specification. after studying the plan and its criteria designing the structural components of building namely slabs, beams, columns and footings are carried out using STAAD PRO v8i software. This followed by manual design and comparisons of results obtained through software and then finally make it visibly realistic by using Revit software.Need for the design is to plan a structure, which meets the basic requirements of structural design are as follows:

- Serviceability
- Safety
- Strength
- Durability
- Economy
- Aesthetic appearance
- Feasibility, practicability and acceptability

All the component members are to be arranged so that they transmit their self-weight and other superimposed loads to foundation or supporting structure by cheapest means to satisfy the requirements of architecture and structural stability

II. ANALYSIS AND DESIGN OF STRUCTURAL ELEMENTS

Calculation of loads: dead loads as per IS 875-part 1 and live loads as per IS 875-part 2. Design of RCC elements: The RCC are slab, beam, column, footing and stair case etc. Design of slab: Slabs are most widely used structural elements forming floor and roof of building. Slab support mainly transverse load and transfer them to supports by bending actions more or one directions. On the basis of spanning direction: It is two type one way slabs and two way slab.One way slab: When the slab is supported on two opposite side parallel edges, it spans only in the directions perpendicular to the supporting edges. It bends in one directions and main steel is provided in the directions of the span. Such a slab is known as onewayslab.Two way slab: When the is supported on four edges and the load distribution is also on four edges of the panel. The reinforcement is provided on both the sides. Such slab is known as two way slab.

Design of beam: There are three types of reinforced concrete beams 1) Single reinforced beams 2) Double reinforced beams.

Single reinforced beams: In singly reinforced simply supported beams steel bars are placed near the bottom of the beam where they are effective in resisting in the tensile bending stress.

Double reinforced beams: It is reinforced under compression tension regions. The necessities of steel of compression region arise due to two reasons. When depth of beam is restricted. The strength availability singly reinforced beam is in adequate.

COLUMN: A column may be defined as an element used primary to support axial compressive loads and with a height of a least three times its lateral dimension. The strength of column depends upon the strength of materials, shape and size of cross section, length and degree of proportional and dedicational restrains at its ends.

FOOTING: Foundations are structural elements that transfer loads from the building or individual column to the earth. If these loads are to be properly transmitted, foundations must be designed to prevent excessive settlement or rotation, to minimize differential settlement and to provide adequate safety against sliding and overturning.

7)Design of stair case: The purpose of a stair case to provide access to pedestrian in a building. The geometrical forms of staircase may be quite different depending on the individual circumstances involved.

The shape and structural arrangement of a staircase would generally depend on two main factors.

1. Type of construction of structure around the stair case that is load bearing brick structure or reinforced concrete framed structure.

2. Availability of space. Type of staircase provided for the proposed building is Bifurcated staircase, which consists of two flights. The first flight starts from plinth level to lintel level and second flight starts from lintel level to roof level.

III. ANALYSIS AND DESIGN OF G + 3 BUILDING USING STAAD PRO V8i

Step by Step procedure for STAAD PRO Analysis The procedure carried out for Modeling and analyzing the structure involves the following steps.

Step - 1: Creation of Grid points & Generation of structure After getting opened with STAAD PRO we select a new model and a window appears where we had entered the grid dimensions and story dimensions of our building. Here itself we had generated our 3D structure by specifying the building details.

Step - 2: Defining of property Here we had first defined the material property by selecting define menu, material properties. We add new material for our structural components (beams, columns, slabs) by giving the specified details in defining. After that we define section size by selecting frame sections as shown below & added the required section for beams, columns etc.

Step - 3: Assigning of Property After defining the property we draw the structural components using command menu Draw line for beam for beams and create columns in region for columns by which property assigning is completed for beams and columns.

Step - 4: Assigning of Supports By keeping the selection at the base of the structure and selecting all the columns we assigned supports by going to assign menu, joint\frame, Restraints (supports), fixed.

Step - 5: Defining of loads The loads in STAAD PRO are defined as using static load cases command in define menu

Step - 6: Assigning of Dead loads After defining allthe loads dead loads are assigned for external walls, internal walls

Step - 7: Assigning of Live loads Live loads are assigned for the entire structure including floor finishing.

Step - 8: Assigning of load combinations Load combinations is based on IS 875 1987 PART 5 using load combinations command in define menu
Step - 9: Analysis After the completion of all the above steps we have performed the analysis and checked for errors.

Step - 10: Design After the completion of analysis we had performed concrete design on the structure as per IS 456:2000. For this go to Design menu, concrete design, select design combo. After this again goes to design menu, concrete frame design, start design \ check of structure then STAAD PRO performs the design for every structural element.

IV. TYPES OF LOADS USED

The loads which are considered for analysis are,

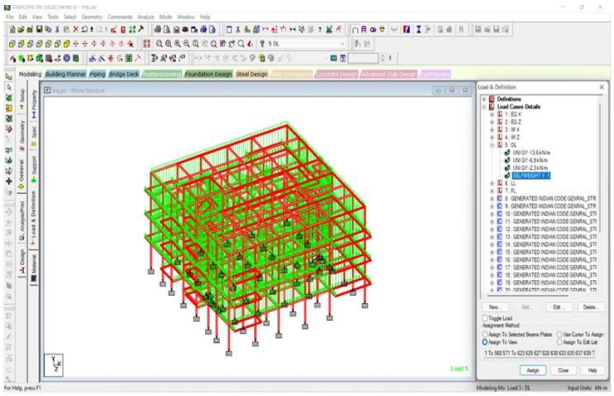
- Dead loads
- Live loads
- Earthquake load

DEAD LOAD

All permanent loads in the building are considered as dead loads. The dead loads comprise of self-weight of the building, weight of wall, weight of slab, floor finish and permanent materials placed on the building. Dead loads are specified in IS 875 (Part 1).

SELF WEIGHT

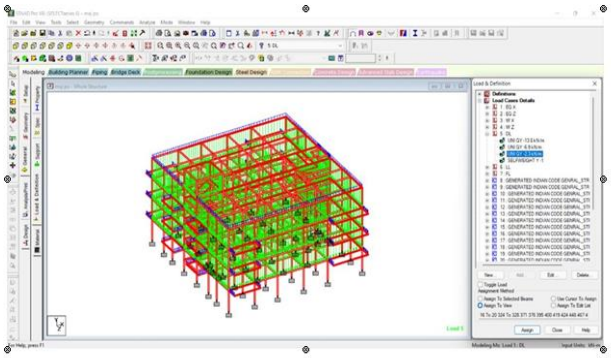
In load case we have option called self-weight which automatically calculates weights using the properties of material i.e., density and after assignment of dead load the skeletal structure looks red in color as shown in the figure.



Wall load external wall
Outer wall load = wall thickness X height X density
= 0.23 X 3 X 20 Outer wall load
= 13.8kn/m
Outer wall load shown given below figure in blue color.

Internal wall load (partition wall)
Internal wall load = 13.9/2(thickness of partition wall half of the outer wall) Internal wall load
= 6.9 kN/m
Figure showing internal wall load shown below

Parapet load
Take, thickness of parapet = 0.115 m Height of parapet = 1m
Parapet load = 0.115 X 1 X 20
Parapet load = 2.3 kN/m (parapet load shown blue color)



Live Loads:

We are taken in live load is floor load
Floor load = Thickness X density Floor load = 0.156 X 25
Floor load = 3.9 KN/m2

Floor load:

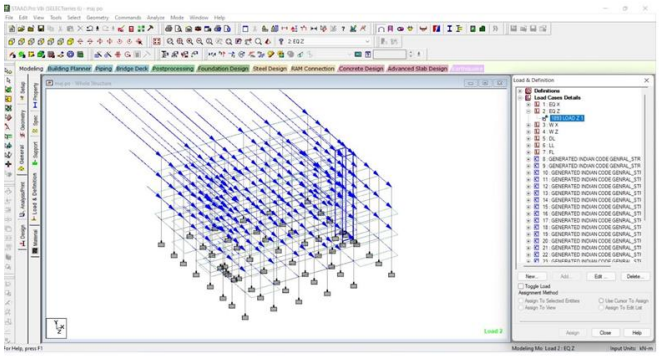
Floor load is calculated based on the load on the slabs. Assignment of floor load is done by creating a load case for floor load. After the assignment of floor load our structure looks as shown in the below figure.

The intensity of the floor load taken is: 1 KN/m2

Earthquake load

We are taken earthquake load as per IS code 1893-2000

- Earthquake load in x-direction
- Earthquake load in z-direction



VI. CONCLUSION

Planning, analysis and design of G+3 multi-storey residential building was done. It's a G+3 storied Apartment building with parking at the ground floor and the rest of the floors are occupied with apartments. Each floors are provided with 4 apartments that includes 2 numbers of 2 BHK rooms

and 2 numbers of 3 BHK rooms. All the structural components were designed manually and detailed using AutoCAD. The analysis and design were done according to standard 8 specifications using STAAD Pro for static and dynamic loads. The dimensions of structural members are specified and the loads such as dead load, live load, floor load and earthquake load are applied. Deflection and shear tests are checked for beams, columns and slabs. The tests proved to be safe. Theoretical work has been done. Hence, We conclude that todays technology upgraded much more and now we can do construction work fast as possible using the engineering softwares with less trouble and more accuracy. Today we can make the structure visualize in 3D even before constructed that is very much amazing and when we do so we can gain more knowledge in practical work when compared to theoretical work.

There are lots of people who cannot afford or satisfy after there dream homes being constructed in less space because they feel something missed so using that engineering software technology we can precisely and wisely visualize and construct structure. As the concrete structures are very much rigid, they are costly too so people/owners by preplanning there homes they can save there future renovation cost of their homes too.

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