COMPARATIVE STUDY ANALYSIS & DESIGN OF RESIDENTIAL BUILDING USING MANUAL & COMPUTER SOFTWARE

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Abstract: As we all know, food, shelter, and clothes are the basic need for people. Every person wants to make the ideal and durable house in which all facilities are available whatever they want. Our work was divided into two modules. In the first module, we had randomly chosen a building and then drawn its plan in AutoCAD software and then drawn its structural plan. After structural planning of the building, we did the structural design of the residential building by manually and by software as per Indian standards. For the designing purpose, we had used software like PLANWIN and STAAD PRO, etc.

Keywords **– Manual structural Design, Planwin, Staad Pro, Comparison of Manual Structural Design and Software Design**

I. INTRODUCTION

The structure design is an art and science of understanding the behavior of structural members subjected to loads and designing them with economy and elegance to give a safe, serviceable and durable structure.
The Basic Working principal element of an R.C. building frame consists of:

i. Slabs to cover a big portion
ii. Beams to support slabs and walls
iii. Columns to support beams
iv. Footings to distribute concentrated column loads over a large area of the supporting soil such that the bearing capacity of soil is not exceeded etc.

➢ Basic Principals Of Structural Design

i. Safety: Safety of structure is achieved by adequate strength and stability. Besides strength, ductility of structure is also nowadays considered to be an additional desired quality from a viewpoint that if at all failure occurs, it should not be sudden but should give sufficient prior warning of its probable occurrence so as to enable one to minimize the consequences of collapse and avoid loss of human life.
ii. Serviceability: The performance is rated by the fitness of the structure to maintain deflections, deformation, cracking, and vibration effects within acceptable limits. It is achieved by providing adequate stiffness and cracking resistance. Large deflection and cracking give a psychological feeling of lack of safety.
iii. Durability: The structure should perform satisfactorily in the working environment under its anticipated exposure conditions during its service life span.
iv. Economy: The economy shall be of material by optimum utilization of its strength or it may be the economy of cost which includes the cost of construction as well as the cost of maintenance and repairs.
v. Aesthetics: The structure should be so designed that it should not only be safe, serviceable, and durable but should also give an appearance without affecting the economy to a great extent.
vi. Feasibility, Practicability, and Acceptability: The structure has to be so designed that the proposed solution is feasible, practicable, and acceptable.

II. PROPERTIES OF BUILDING & METHODOLOGY

- In this research we have considered G+5 story residential building which exists in Rajkot, Gujarat named as "Sankalp Prime" plan size is (52'5" X 53'3").
- The Structural Design is made using two methods First is the manual structural design method (Kani's Method).
- The second is the software method by PLANWIN and structural analysis and design (STAAD-PRO).
- The building is subjected to horizontal and vertical loads as per Indian standard codes and load combination is applied according to IS 456-2000.

➢ Salient features of building properties

- Type Of Building: Residential Apartment Building
- No. Of Stories: G+5
- Type Of Construction: R.C.C Frame Structure
- Floor Height: 3m
- Bearing Capacity and Type of Soil: 200Kn/m^2, Medium Stiff Soil
- Concrete Grade: M20

- All Steel Grade: Fe-415
- Location: Rajkot

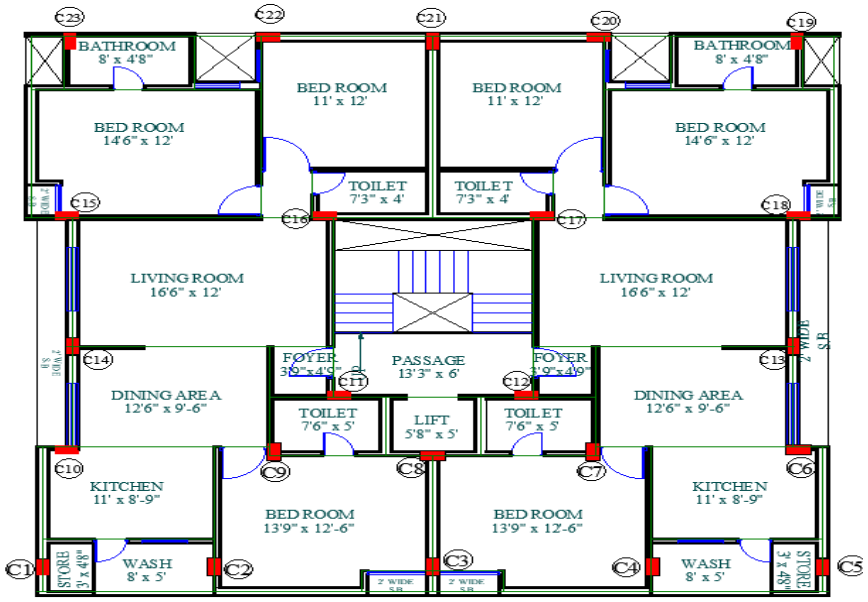

Fig. 1 Typical Floor Plan

➢ **Methodology for Manual Design**

i. Structural Planning: In this stage, the very first thing we have to do is to find a random Column Location in the plan, according to Column Location we have to set the beam grid, then we have to identify the slab.

ii. Estimation of loads: From slab size and beam grid we have to calculate the load. For the calculation Of Different types of load, we have referred IS codes like IS 1893-2002(part-1) for Seismic Load Calculation, IS 875 for Dead, Live, Wind load calculation.

- In IS-875 (Part-1) 1987 Table-1 Unit weight of different materials are given

For example

Material	Unit weight in kN/m
Reinforced Concrete	25
Brick Masonry	20

- Live load or Imposed loads include loads due to people and weight of the movable partitions, furniture, etc.
- Live load is given in IS-875 Part-2

➢ For Residential Building

Table-1 Live Load For Residential Building

Occupancy Classification	U.D.L (KN/m^2)	Concentrated Load (KN)
All Rooms & Kitchens	2	1.8
Toilet & Bath	2	--
Corridor, Passage, Stair Including Store Room	3	4.5
Balconies	3	1.5 Per concentrated at outer edge

iii. Analysis Of Structures: Method For Analysis Structures are Given Below

- Slope Deflection Method
- Moment Distribution Method

iv. Member Design: Main aim of member design to decide its size and numbers of reinforcement from which we can give an economical and safe design of members of frames. For member design, we have referred IS 456 and IS 800.

Three methods of member design generally used as given below

- Working stress method
- Ultimate load method
- Limit state method

We have designed the structure as per the Limit state method

- **Methodology For Software Design**

i. Initial Setup of No. of floor, Thickness of slab, floor finish, Live load on slab and other loads then set beam loading parameter like wall thickness, plaster thickness, density of wall, etc. Then set material properties like concrete grade and steel grade carried.

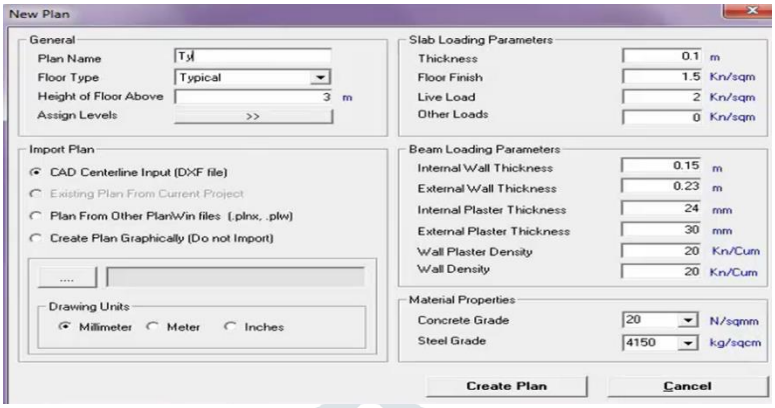

Fig. 2 Initial Setup In PLANWIN

ii. Creation of Grid in Planwin.

Fig. 3 Grid in PLANWIN

iii. We create columns as we have given in manual design and create beams as per manual design.

iv. After Creating columns and beams and slabs in all floor plans like the ground floor, typical floor, and stair cabin after that we have to set the column size and orientation and then set beam size after that give beam support condition.

v. After that, we have to set the wind parameter from IS 875 part-3, and then we have to run an analysis.

vi. After analysis std. the file generated in Planwin and this file we have to import in Staad-pro for earthquake analysis then earthquake analysis is done then we have to check analysis report.

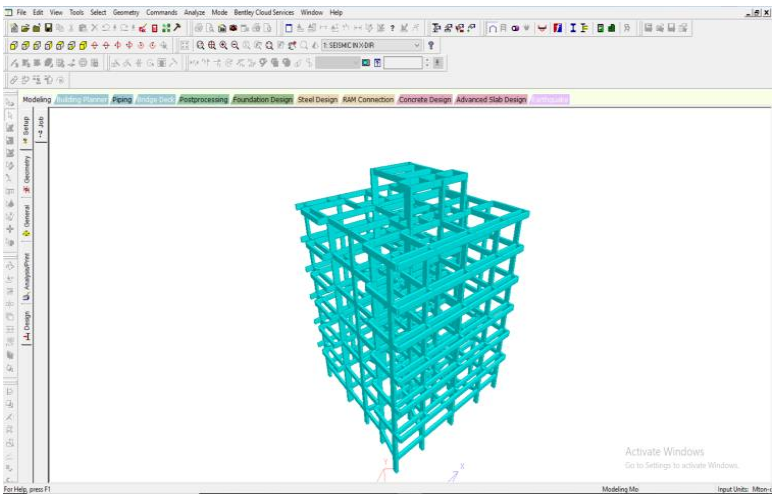

Fig.3 Staad pro model

vii. After seismic analysis in staad pro we have to set parameters for the design of footing in Planwin and generate footing design cad file and sheet then column sheet and beam design sheet and slab design sheet.

viii. From sheet, we have to calculate the no. of bar from the percentage of steel and volume of concrete.

III. Discussion And Result

As we have compared software and manual design, the manual design gives heavy design compared to Software around 6-10%

IV. Conclusion

- The structure design based on Planwin compared to manual design is easy, and it gives an economical, serviceable, and durable design.
- Software like Planwin and staad pro gives clear variation in Shear, bending moment in all members.
- If any member fails in manual design we have to redesign it and it's very lengthy process.
- Structural design using planwin and staad pro Reduces Lots of time.
- Planwin gives reinforcement percentage directly, then we can find reinforcement detailing from IS 456-1978.

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