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Comparison between manual analysis and software analysis of a shopping complex

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***Abstract*— A good building requires adequate strength and durability. The structural design aims at guaranteed adequate safety against the external forces for all structural elements, providing stability and durability. Now a day's many software's such as STAAD Pro V8i, STRAP 2000, Tabs, NISA, and ANSIS are introduced perform various analysis.**

In this project analysis is carried out for a three storied building manually and using STRAP software. The result is compared and it is found that they are almost tallying. Use of software increases the efficiency of analysis. For a framed structure, STRAP is one of the most comprehensive, versatile, windows based and interactive structural software with many special features in earthquake analysis.

In this project a comparison is made between manual analysis and software analysis for the 3 storied building which is planned as a commercial building.

In this project studies are also carried out to construct the storied building as a framed structure with load bearing wall. It is found that load bearing wall construction is economical than framed construction in economical aspect for 3 storied one.

Keywords: STRAP, Strength, Durability.

I. INTRODUCTION

Structural analysis and design is important in civil engineering. All structures are intended to give trouble for service throughout its design life. For this analysis and design shall be done without most care. For safety, stability and serviceability. A 3 storied shopping complex to be constructed at Perumbavoor is taken up for analysis and design.

II. NECESSITY OF THE STUDY.

The main objective of the study is to ascertain its performance of the different components of the building under manual analysis and analysis using modern software. Comparison is on the shear forces, bending moments, axial forces in the elements obtained by this method. The structural design of the members is carried out by conventional methods for the framed structure and also considering it as a load bearing one.

The study aims in finding if a load bearing structure is sufficient than going for a framed one. Comparison is made to see which type is more economic.

III. NATURE OF STUDY AND METHODOLOGY.

IS 456-2000 is the basic code for reinforced cement concrete structures. The parameters for manual design bending moment, shear force, deflection etc. Are adopted from this code. In the strap analysis also IS 456-2000 used so that comparison can be made.

IS 875 (Part 1):1987

Code of practice for design loads (other than earthquake) for buildings and structures. The part 1 includes dead loads like unit weights of building materials and stored materials.

IS 875(Part 2): 1987

Code of practice for design loads (other than earthquake) for buildings and structures. The Part 2 includes imposed loads. The imposed loads, specified herein, are minimum loads which should be taken in to consideration for the purpose of structural safety of building.

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It's is mainly used as a design aids for reinforced concrete. It covers material strength and stress-strain relationship, flexural members, compression members, shear and torsion, development length and anchorage. Both charts and tables are given for flexural members. The charts can be used convenient for preliminary design and final designs were greater accuracy is needed, tables may b used. SP 16 is adopted for the design in the study.

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IS 1905: 1987

Code of practice for structural use of unreinforced masonry is referred for structural design as load bearing structures.

Fundamental requirement of a good building are that they should fulfil the physical, emotional, social and biological needs of the persons who are going to occupy it. A building must provide fresh air, sunlight, safety and it must be in healthy condition.

The spacing building with respect of geographical direction to direction of wind and altitude azimuth of sum is known as orientation of building. The knowledge of orientation is the first pre-requisite of good planning, orientation of the building is the major consideration top achieves proper placement of plan units and providing convenient access street and basic yard.

The proposed shopping complex is a three storied one. All the rooms are designed taking in to considerations the purpose for which each room will be used and also the size of the room designed by taking in to account rule KMBR.

The building is proposed as framed structure, shops, open area toilets etc, suitable stair is provided for vertical movement. A septic tank and soak pit is also provided.

For the framed building structural analysis is done by using STRAP software. STRAP is one of the most comprehensive and versatile structural analysis and design software available on the market today. So many software are available in the market such as SAP-2000, E-TABS etc.

STRAP is commonly used because it uses graphical input for that of models and loads. Every drawing on the screen can be printed, imported in to other documents or in to drawing. Complete analysis and design can be performed for any structure without ever referring to joint or beam numbers. Load combination can be created after analysis is performed. Combination can be changed instantly without saving the model again.

The manual analysis is done by moment distribution. The stiffness of various members are calculated bend on the section proportion support conditions and length. The distribution fashion of various members at a joint is found from compatibility conditions. The fixed end moments are taken out and analysis carried out.

IV. PLANNING ANALYSIS AND DESIGN

The functional planning carried out obeying the codes and moments in force. Table 1 gives the minimum requirements as per KMBR which is adopted for planning.

Soil investigation report obtained for selection of foundation is verified and a S.B.C of 250KN/m^2 is considered. Spread footing is selected to connecting the loads considered are dead loads of slab, beams, and walls. The unit weights of materials are considered as per IS 875 part 1. Live loads are considered for the roof with access provided. The live loads for floors are taken from IS 875 part 2. As the building is of ground floor + 2 floors only wind load / earthquake load are not considered. The comparison results are given in table 2. In metric view of STRAP models in fig.1 and the rendered view in fig.2. Two frames on each axis are considered for comparison manual analysis and software analysis. The sample SF, BM and axial force diagram are shown in fig.8, fig.9, fig.10.

SL.NO	REQUIREMENTS	AREA AS PER KMBR
1	FRONT OPEN SPACE FOR BUILDING UP TO A HEIGHT OF 3M	MINIMUM 3M (KMBR PAGE.NO:7.7R 24.3)
2	SIDE OPEN SPACE	MINIMUM -1.2 AND 1 FOR OTHER SIDE
3	REAR OPEN SPACE	MINIMUM 2M
4	CORRIDOR, VERANDHAS, PASSAGE WAY	THE CLEAR WIDTH SHALL NOT BE LESS THAN 90 CM
5	SINGLE ROOM	9M^2
6	SHOP ROOM	MINIMUM HEIGHT 3M.

TABLE 1. MINIMUM AREA FOR ROOMS AS PER KMBR.

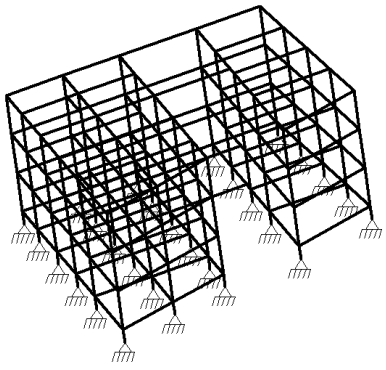

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FIG.1: STRAP MODEL

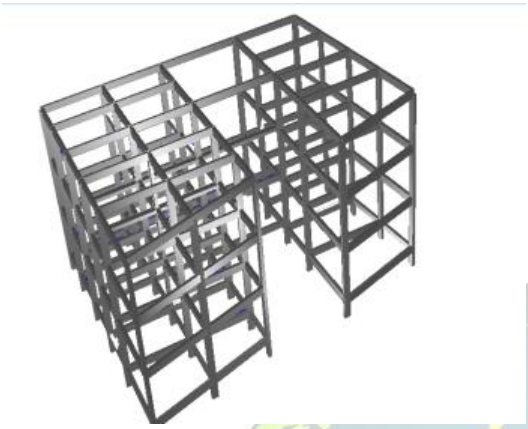

FIG.2: RENTERD VIEW

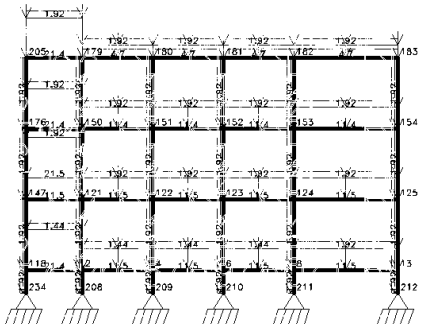

FIG.3: LOADING DIAGRAM

V. RESULT AND RESULT ANALYSIS

The summary of result of analysis in STRAP is shown in table 2. The maximum beam end forces obtained in manual design is compared for the frames considered for study.

From the comparison it is found that the maximum values different only by less than 10% which shown that the results almost tally. The difference in analysis is found due to the following reasons,

1. The manual method is based on theories and analysis is as per actual theory, and it can be considered as exact method, where as the software analysis is a numerical method. But since the numerical methods with general iteration if convergence to the result equal to actual method.
2. All the loading conditions are not considered in the manual analysis as it is laborious and tedious to do so.

For E.g.: in the case beam, the condition that maximum Support moment will occur when adjacent spans are with live loads and other spans without. Also max. Sagging moment will occur when alternate spans are loaded and all other spans unloaded with a live load. In the software all this are incorporated and as such as the minor variations are due to their reason.

The result of the analysis considering the building has given its result on to construct the bottom floor with 1*1/2 brick wall with wire cut bricks in cement mortar 1:5 and in floors using 1 brick wall wire cut bricks in c.m 1:5 and the top floor with 1:6.There is considerable savings in cost of steel in the case of load bearing construction. But the cost of brick masonry considerably increased. The cost estimation has shown that for the 3 storied building the cost of the load bearing wall is lesser and it can be recommended.

MANUAL ANALYSIS RESULT

FLOOR SLAB

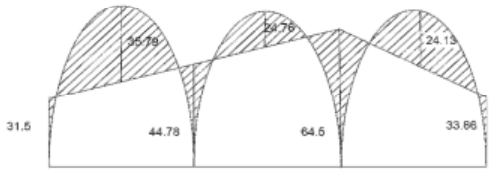

FIG.4: MAXIMUM BENDING MOMENT DIAGRAM

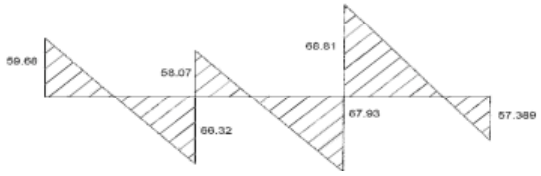

FIG.5: MAXIMUM SHEAR FORCE DIAGRAM

ROOF SLAB

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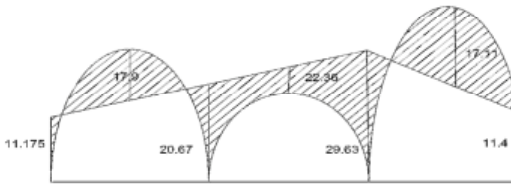

FIG.6: MAXIMUM BENDING MOMENT DIAGRAM

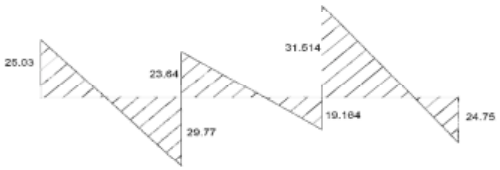

FIG.7: MAXIMUM SHEAR FORCE DIAGRAM

SOFTWARE ANALYSIS RESULT

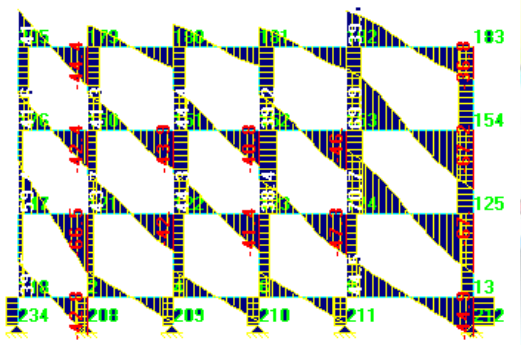

FIG. 8: SHEAR FORCE DIAGRAM

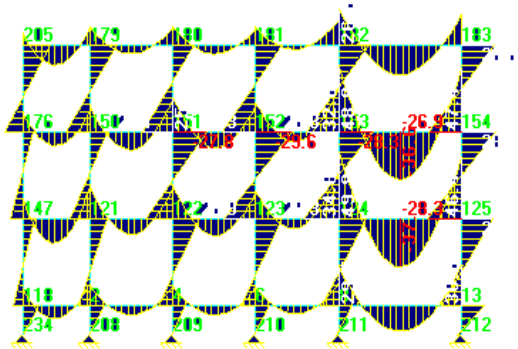

FIG. 9: BENDING MOMENT DIAGRAM

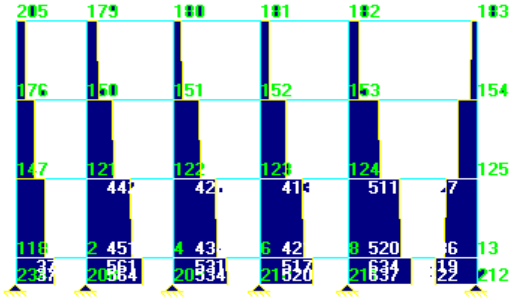

FIG. 10: AXIALFORCE DIAGRAM

DESCRIPTION	MANUAL ANALYSIS	SOFTWARE ANALYSIS
Floor slab		
Mu(+ve)	22.36KNM	26.6KNM
Mu(-ve)	29.63KNM	23.2KNM
Shear force	31.514KN	44.4KN
Roof slab		
Mu(+ve)	34.47KNM	49.9KNM
Mu(-ve)	63.51KNM	37KNM
Shear force	67.56KN	70.7KN

TABLE.2: COMPARISON

LOAD BEARING WALL

Basic compressive strength from the table8 of IS 1905-1987 for cement mortar1:6 is 0.35 N/mm^2 and the reduced strength is 0.25 N/mm^2.Compressive strength of country burnt brick is taken as 3.5 N/mm^2.

Strength of wire cut brick is 7.5 N/mm^2.basic compressive strength of cement mortar 1:5 is 0.74 N/mm^2 and the reduced

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strength is 0.621 N/mm^2 . The details of load bearing wall for each floor is shown in table.3.

	Stress (N/mm^2)	Type of brick	C.M ratio	Wall thickness
2nd floor	0.1135	Country burnt	1:6	1brick wall
1st floor	0.3675	Wire cut	1:6	1 brick wall
Ground floor	0.414	Wire cut	1:6	1.5 brickwall

TABLE.3: BEARING WALL DETAILS

VI. CONCLUSION

From the study it is observed that,

- Manual analysis and analysis using software has given comparable results.
- Using of software due to its capability can use several loading conditions where as manual design is tedious and time consuming and practically it is possible for complex structures.
- For a 3 storied building it is not necessary to structurally design it as a framed structure. The load bearing wall is sufficient unless it is warrants by any special requirements.

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