Planning, Analysis & Design of Hospital Building Using Staad Prov8i

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Abstract— The main aim of paper is to analyze the plan of hospital building by using software techniques. The design of hospital building should be developed with following disciplinary activities. The design was followed up by using IS (Indian standard) codes for better output of design considerations. Here the hospital building was designed and analyzed for G+3 storey structure. Nowadays, the software techniques were highly involved in a construction field for quick and better accuracy of an analysis report to execute the given project successfully. The most prominent using software for design and analysis of the respective buildings by STAAD.PRO software for accuracy and safety regards. In this paper, STAAD.PRO V8i has been used for designing and analysis purposes mainly for the reult of shear force and maximum bending moment. RCC detailing is important for clear in executing the reinforcement work on the site without any complexity

Index Terms— Bending moment, Hospital building, Limit state design, RCC detailing, Substitute frame analysis, Shear force, STAAD.PRO V8i.

1 INTRODUCTION

Structural engineering is a field of engineering dealing with the analysis and design of structures that support or resist loads which is usually considered a speciality within civil engineering. The structural engineers are the responsible for design and analysis. This field mostly depends upon a detailed knowledge of loads, physics, and materials to understand and predict how structures support and resist self-weight and imposed loads [11]. According to this paper, the structural engineer is to design the structures for a given plan of the respective buildings under safest technology in the computing field. This software process makes the structural engineers to resolve all the members in a proposed building with various loads and support conditions. All these software's are developed as the basis of advanced and requirement. Finite element analysis, which include the effect of dynamic load such as wind effect, earthquake effects etc. " Aman et al. [2].

2 METHODOLOGY

The methodology involves that the planning of hospital building should be spacious and green environment and STAAD.ProV8i analysis should be done for the planned building by giving various loads condition. Later on design the structural member by the obtained result of analysis in a method of substitute frame basis.

1. MODELLING: (G+3) Hospital building.
2. LOADS: Dead load and live load, Wind load, Combination load, 1.5 (Live Load+ Dead Load+ wind load).
3. ANALYSIS: Analysis of RCC framed structure. Shear Force and Bending Moment calculations [2].
4. DESIGN: Design of Beam, Column, slab, isolated footing, rectangular tank.
5. GEOMETRIC PARAMETRS:
   Beam = 400x300mm.
   Column = 230x450mm.
   Slab = 150mm.

2.1 Stages in Structural Design

The process of structural design involves the following stages: Structural planning, Computation of loads, Method of analysis, Member design and Detailing, drawing and preparation of schedules. " Aman et al. [2].

2.2 Introduction to STAAD.PRO V8i

STAAD.ProV8i is a structural analysis and design, computer program originally developed by Research Engineers International at Yorba Linda, CA in 1997 [12]. We use this software for the complete structural analysis and made a design by using IS [Indian standard codes] for our created plan.

2.3 Analysis of Frame

To analyze a structure a structure correctly, certain idealizations are to be made as to how the members are supported and connected. The loadings are supposed to be taken from respective design codes and local specifications, if any. The forces in the members and the displacements of the joints are found using the theory of structural analysis. "Abhishek Mehta [1].

Therefore, various types of methods are involved in the analysis of the frame such as,

1. Substitute Frame Method
2. Slope Deflection Method
3. Kani's Method
4. Portal frame method for Multi-Storey Frame
5. Cantilever Method
6. Moment distribution method
7. Matrix stiffness

2.4 Substitute Frame Method

We preferred to analyze the frame by using the substitute frame method for easy and accurate result. By considering any floor of the frame called a substitute frame, the moments can be calculated and results can be obtained in good agreement with the results from rigorous analysis. The moments carried from floor to floor through columns are very small as compared to the beam moments.
the method is very effective in analyzing any framed structure under vertical loadings. This work is focused to check its applicability and efficacy under the lateral loading conditions.

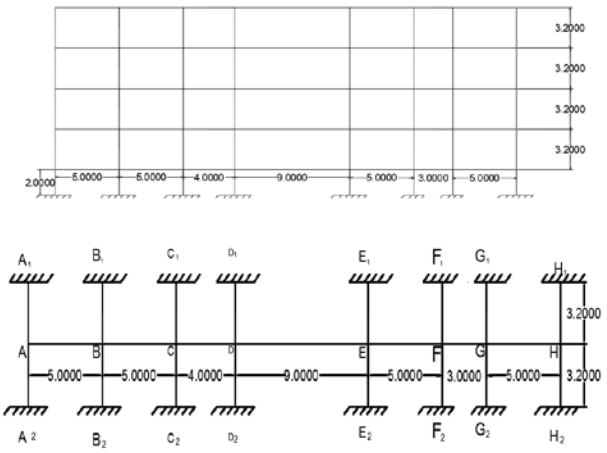

Fig 1.Substitute frame section.

In this project for analysis purpose one frame in the longitudinal direction is considered, As in Fig. 1, seven bays are present. They balance moment at support and mid span moment is calculated using the substitute frame method of these moments are employed in the design part.

2.5 Analysis of Frame

The moments in one floor will vary from each other floors. Therefore, in this method, the analysis of the multi-storey frame is carried out by taking one floor at a time.

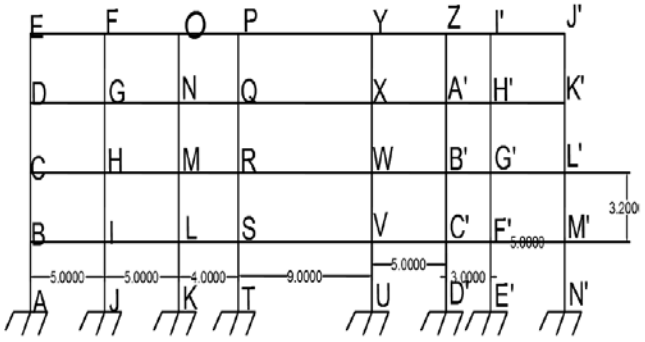

Fig 2.Analysis of frame with specification

Each floor is taken with the columns above and below a fixed at far ends, and the moments and shears are calculated in beams and columns. As in Fig. 2, which is calculated by determine the distributing factor for the preferred section of frame from the structure shows in Table. 1. Here mainly con-

TABLE 1
DISTRIBUTION FACTOR

JOINT	MEMBER	RELATIVE STIFFNESS	TOTAL	DISTRIBUTION FACTOR
A	AB	0.20		0.24
	AA_1	0.31	0.82	0.38
	AA_2	0.31		0.38
B	BC	0.2		0.196
	BA	0.2		0.196
	BB_1	0.31	1.02	0.30
	BB_2	0.31		0.30
C	CD	0.25		0.23
	CB	0.2		0.187
	CC_1	0.31	1.07	0.289
	CC_2	0.31		0.289
D	DE	0.111		0.113
	DC	0.25	0.98	0.255
	DD_1	0.31		0.316
	DD_2	0.31		0.316
E	EF	0.2		0.215
	ED	0.111	0.93	0.119
	EE_1	0.31		0.33
	EE_2	0.31		0.33
F	FG	0.33		0.287
	FE	0.2	1.15	0.174
	FF_1	0.31		0.269
	FF_2	0.31		0.269
G	GH	0.2		0.174
	GF	0.33	1.15	0.287
	GG_1	0.31		0.269
	GG_2	0.31		0.269
H	HG	0.2		0.24
	HH_1	0.31	0.82	0.38
	HH_2	0.31		0.38

TABLE 2
MAXIMUM – VE BM @ SUPPORT

A	54.43 KNm
B	73.86 KNm
C	40.30 KNm
D	213.28 KNm
E	108.5 KNm
F	33.35 KNm
G	67.84 KNm
H	54.43 KNm

KNm = kilo Newton-metre

TABLE 3
MAXIMUM + VE BM @ SUPPORT

AB	41.064 KNm
BC	272.9 KNm
CD	13.02 KNm
DE	125.91 KNm
EF	26.57 KNm
FG	42.255 KNm
GH	41.064 KNm

KNm = kilo Newton-metre

cern about the value of bending moment for both conditions of span were shows in Table. 3 and support in Table. 2.

3 DESIGN OF RCC ELEMENTS

The RCC are slab, beam, column, isolated footing and staircase and other structural members were designed by a limit sate method. The rectangular water tank was designed by a method of working stress.

3.1 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. " Aman et al. [2]. Based upon the direction of spanning, the slab has been designed into two types such as one way slab and two-way slab.

3.2 Two Way slab

When there 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. " Aman et al. [2]. Such slab is known as two way slab in Fig 3.

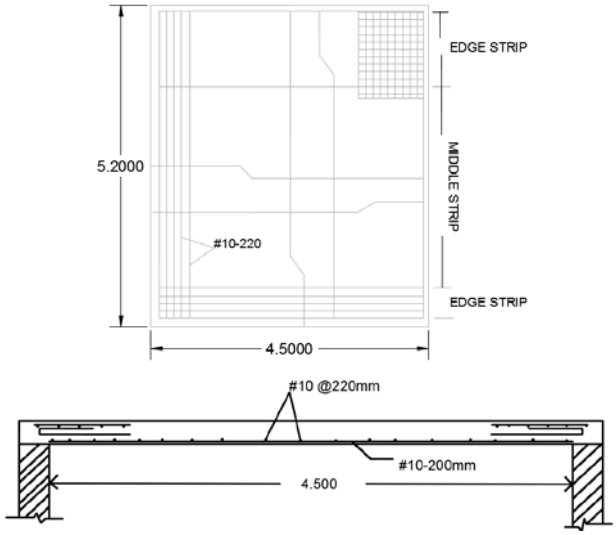

Fig. 3. Two way slab

3.3 Double reinforced beams

As in Fig. 4, the reinforced under compression tension regions. The necessities of steel of the compression region arise due to two reasons, When depth of the beam is restricted. The strength availability singly reinforced beam was inadequate**.** So, the below mentioned figure is one of the double reinforced beam samples of whole structure were designed and analyzed by STAAD. Pro.

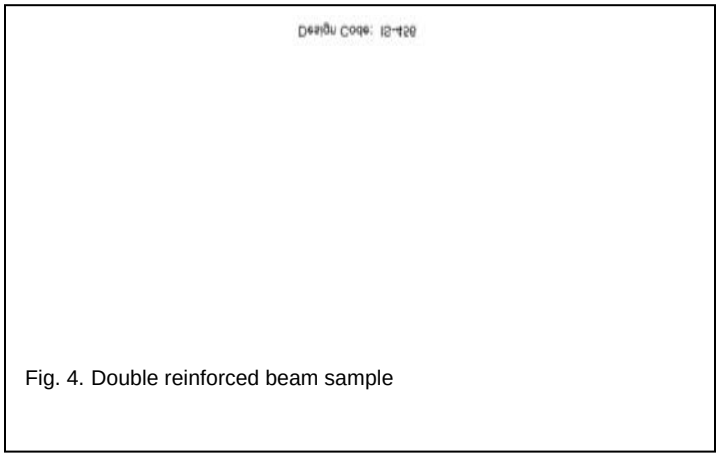

Fig. 4. Double reinforced beam sample

3.4 Column & Footing

A column may be defined as an element used primarily to support axial compressive loads and with a height of at 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. " Aman et al. [2].

A structure which is used to transfers the load of superstructure to the soil on which it rests, it shows in Fig. 5. The base of a wall or column is sufficiently enlarged to act as the

individual support. The widened base not only provides stability but is useful in distributing the load on sufficient area of the soil.

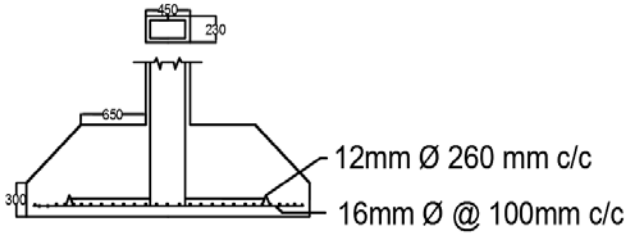

Fig. 5. Design of Isolated footing with column sample

3.5 Design of stair case

Stairs consists of step arranged in a series for the purpose of giving access to different floors of building. "S. Ramamrutham [8]. We designed a dog-legged stair i.e. the type of succeeding flights rise in opposite directions in Fig. 6. The two flights, in plan are not separated as well. A landing is provided corresponding to the level at which the direction of flight changes.

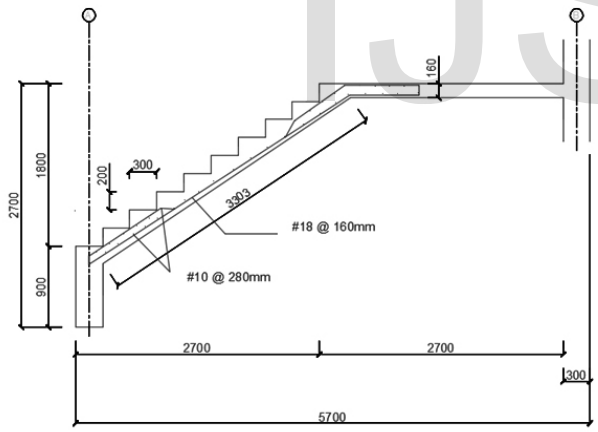

Fig. 6. Design of staircase detailing sample

3.6 Design of Rectangular Tank

A reinforced concrete tank is a useful structure which is meant for the storage of water for bathing, sewage sedimentation and other purposes. The rectangular tanks are useful for small capacities. "S. Ramamrutham [8]. As shows in Fig. 7 & 8, Here the rectangular water tank had been designed by working stress method.

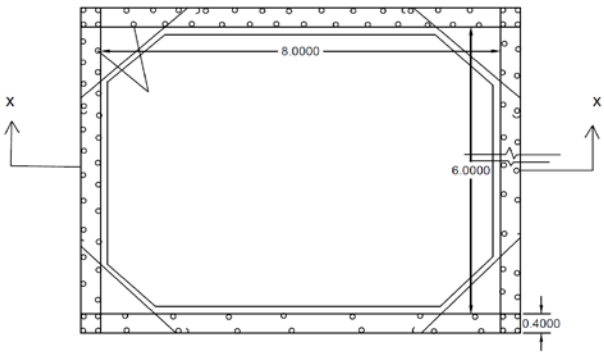

Fig. 7. Plan

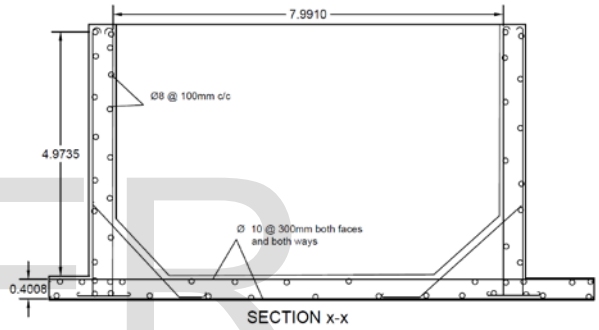

Fig. 8. Section X –X

4 Results And Discussion

The analysis and design were obtained manually and also the STAAD.PROV8i has been used for analyzing the planned structure to get a result of bending moment in Fig. 9 &10, shear force in Fig. 11 and axial force in Fig. 12 diagrams were mentioned below. Therefore, there is some minute difference between manual and software obtained results. Maximum moment and maximum shear force are the major consideration for planned structure to execute in the field.

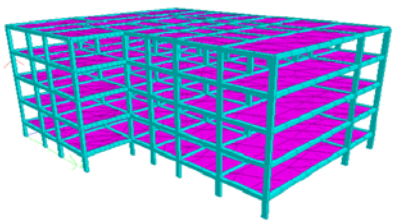

Fig. 9. 3D Modelling in STAAD.PRO V8i .

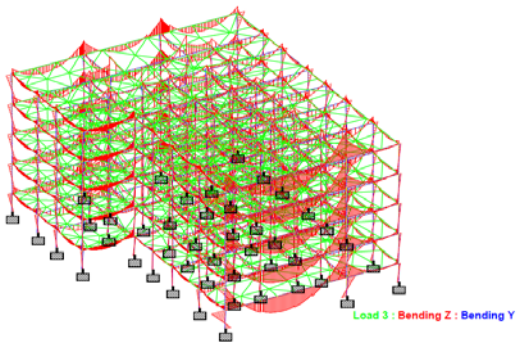

Fig. 10. Bending moment diagram

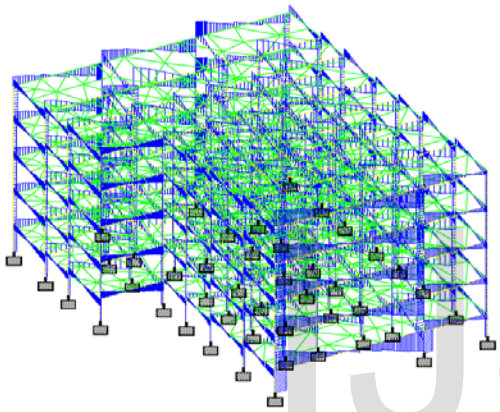

Fig. 11. Shear force diagram

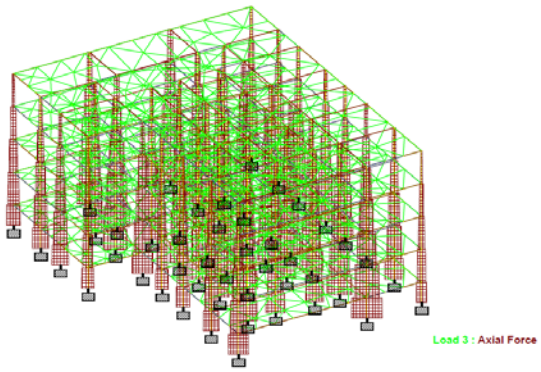

Fig. 12. Axial force diagram

5 Conclusion

The structural aspects of planning, analysis and design has been done and get an ideas for execution of structure by following appropriate rules and regulation under IS codes. By using software the project of Hospital building (G+3) were analysed for an clear execution in the field. Here the project was analysed by both manual and software for an clear idea of structural basis. Moreover, the drastic differences had been takes place between manual and software based analysis. Also some disciplinary planning has been followed for the hospital building including interior design works. Based on the requirements of public users, patients, doctors, and workers etc. in order to make sufficient and comfortable environment in the proposed area of building executed respectively. Therefore, the executing project must be clear with planning, interior and structural analysis related concepts for better result from the users.

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