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Design and Analysis of Clubhouse

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Abstract: This project is based on design and analysis of structural framed clubhouse building. Planning, analysis, and design of G+1 clubhouse building structure by using software and IS-Code. Arranging of any kinds of building is finished by public construction law (NBC) in India, Hence the clubhouse building is appropriately arranged as per the national building code of India. The reinforced concrete framed design comprising of G+1 with sufficient facilities. All the structure part is design in Staad pro programming with reference of IS:456-2000, and Different loads on the part are considered by the code IS:875:1987.

I. INTRODUCTION

Design is not just process analysis, new changes should also be included, and the skill obtained as the result of knowledge and practice. Design structures as thought courses tends to accommodates estimate the dimensions of members needed in an exceedingly given structure and analysing them so as to examine the ensuing stresses and deflection against limits started in codes of apply. Structural style will be seen because the method of disposing material in 3 dimensional areas therefore on satisfy some outlined purpose within the most effective doable manner.

II. METHODOLOGY

Theoretical Description of the Designing Work

It is a G+1 storied clubhouse. The base area of the building is about $1000m^2$ and height is 9.7m. Ground floor height is 5.1m for and first floor height is 3.6m. The structural system consists of RCC frame structure arrangement.

The project having 4 main steps: -

- 1) Prepare an architectural drawing of a building.
- 2) Brief study of drawing.
- 3) Positioning of columns and floor plans.
- 4) Analysis and Modelling the structure through STAAD.pro

Layout Plan of Building

Building layout plan depend upon the requirement of the building purpose and location of site. It's a 1st step of any construction project. here a layout plan of a building.

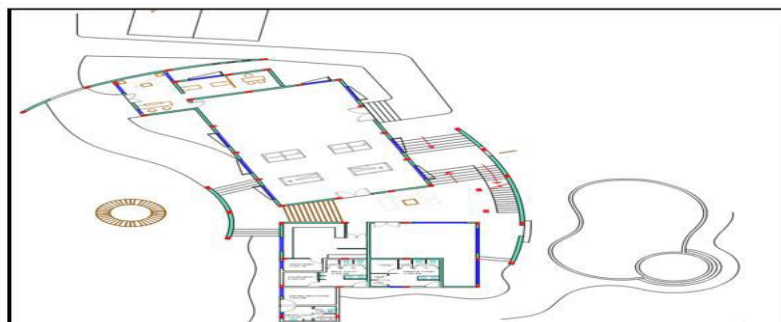


Fig.1 Layout Plan



Designing and Analysis of Clubhouse Building

General

Structural analysis is very important part of engineering project, is that the method of predicting the performance of a structure in a prescribed loading condition. The performance characteristics of structural are:

1. Stress
2. Deflections
3. Support Reactions

Thus the analysis of a structure usually involves the determination of those quantities caused by the given or the external effects. Since the building frame is 3 dimensional frames, manual analysis is difficult and time intense. Thus the structure is analysed with STAAD.Pro. so as to research in STAAD.Pro, first we've to create the model, specify properties of a member, supports and loads. Modelling includes member property specification, support status, and loading.

Initial Design

initial dimensions of beams, columns, and slabs were created in this phase. It includes the preparation of the initial design of the beam, column, and slab. After analysis, dimension of the beam and column are changed when the section was found to be failed. Initial design of all members give below.

Table 1: Dimension of Member Sections

Member	Dimensions
Slab	150mm Thickness
Beams	B1- 230mm x 350mm B2- 230mm x 400mm B3-400mm x 700mm B4-250mm x 450mm
Columns	C1-230mm x 450mm C2-300mm x 450mm C3-400mm x 700mm C4-400mm x 500mm

Design Member Property

The next step is to create a model in staad as per dimension shown in table 1. In model ZD describe the width of the member and YD describe the depth. Fig. 2 & 3, shows 3D view of structure and fig. 4 & 5, is a rendering view of structure.

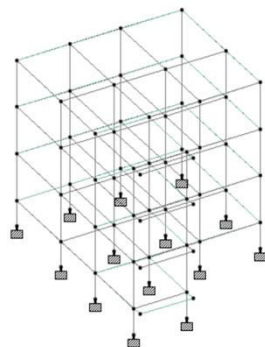


Fig.2, 3D View of 1st Structure Frame

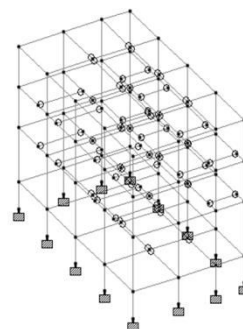


Fig.3, 3D View of 2nd Structure Frame

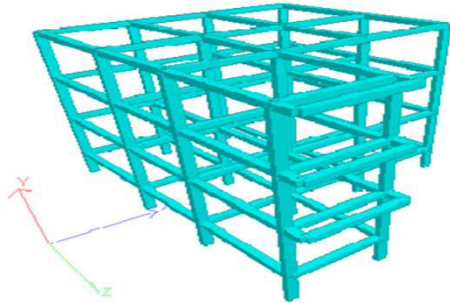


Fig.4, Rendering View of 1st Structure Frame

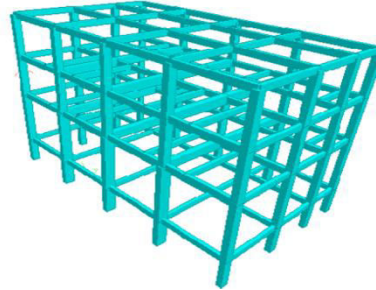


Fig.5, Rendering View of 2nd Structure Frame

Define Loads: -

The analysis is the main part of the design of the building and other construction elements. The structural load can cause stress, deformation, and displacement which will lead to structural issues or failures.

- The loads are categorized as dead load, live load, concentrated loads, distribution load, wind load, seismic load, etc.

The Loads Consider for Analysis Is: -

- Vertical Load: - It's having dead load includes self-weight of the structure and live load acting in the structure.
- Lateral Loads: - It's includes wind load and seismic load which Applying a load horizontally.

Dead Load: -It's also known as a permanent load. it should be calculated with accuracy. Gravity loads of constant magnitudes and fixed positions that act permanently on Structural Loads by the structure. Weights of permanent instrumentation, like heating and air-conditioning systems, area unit sometimes obtained from the manufacturer.

Dead load includes self-weight of the slab, beam, column, floor finish etc. the value of unit weight of a materials is available in IS 875 part-2.the dead load on the building is: -

Floor Finish Load: - Thickness of floor is= 50mm

Unit Weight of cement mortar= $20\text{KN}/\text{m}^3$

Floor load = $0.05 \times 20 = 1\text{KN}/\text{m}^2$

Self-weight of slab: - thickness of slab is 150 mm

So self-weight of slab = 0.150×25

= $3.75\text{KN}/\text{m}^3$

Partition wall: - thickness of wall =115mm

Height of wall = 3.6m

Total load = $0.115 \times 3.6 \times 20$

= $8.28\text{KN}/\text{m}$

Main wall: - thickness of wall is 230mm

Height of wall = 3.6m

Total load = $0.230 \times 3.6 \times 20$

= $16.56\text{KN}/\text{m}$

Parapet wall: - Thickness of parapet wall = 230mm

Height of wall = 1m

Total load = $0.230 \times 1 \times 20$

= $4.6\text{KN}/\text{m}$

And the load factors for RCC is 1.5.

Live Loads: -

They represent the transient forces which can be rapt through the building or act on any explicit structural part, these loads include the anticipated weight of individuals, furniture, appliances, automobiles, moveable equipment and therefore the like.

As per IS 875 part 2, we take value of all load

All room and kitchen = $4\text{KN}/\text{m}^2$

For toilet and bathroom = $4\text{KN}/\text{m}^2$

For corridor's passage and staircase = $4\text{KN}/\text{m}^2$

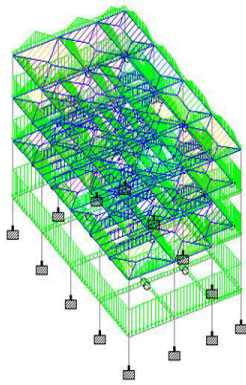


Fig.6, Dead Load Acting On the Structure

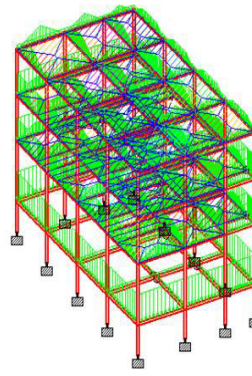
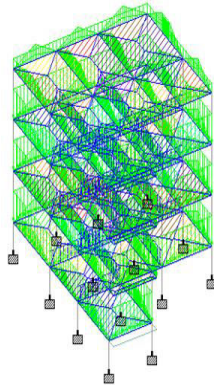
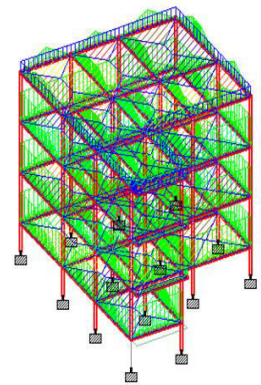


Fig.7, Live Load Acting On the Structure



Wind Load: -

They may be horizontal or inclined load. The load is depending upon the speed of the wind. winds loads are specified in IS 875 part 3.

Design wind speed, $V_z = v_b \times k_1 k_2 k_3$

Where:

k_1 = Probability factor

k_2 = structure height factor

k_3 = Topography factor

Basic wind pressure, $P_z = 0.6 v_z^2$

Value of k_2 from IS875:1987 part 3

Height	k_2
10	0.98
15	1.02
20	1.05

Earthquake Forces:

Horizontal forces act on the structure during an earthquake. It is very important to analysing the structure very carefully for the seismic load to ensure that the building is not to be failed in the earthquake. Its impact on the structure depends upon the stiffness of soil, height of the structure and the location, etc. The seismic loads are described in IS 1893:2002. The design base shear was distributed along the height of the building. Its magnitude are increases along the height of the building.

The design base shear is calculated by STAAD, accordance with the IS1893:2002.

$$V_b = A_h \times W$$

Where,

V_b = Design base shear

A_h = Horizontal Acceleration Coefficient

W = Seismic Weight of Building

The Design Horizontal Acceleration Coefficient,

$$A_h = \frac{\left(\frac{z}{2}\right) \left(\frac{S_a}{g}\right)}{\left(\frac{R}{I}\right)}$$

Where,

Z = Seismic Zone Factor

$\frac{S_a}{g}$ = Design acceleration coefficient for different types

R = Response Reduction Factors

I = Importance factor

Distribution of force

The design lateral force was distributing through the height of the building as per the following equation:

$$Q_i = v_B \frac{w_i h_i^2}{\sum_{j=1}^n w_j h_j^2}$$

Where,

Q_i - Design lateral force at floor

w_i - Seismic weight of floor

h_i - Height of floor measured from base, and

n - Number of levels at which the masses are located.

the following parameter are used for defining seismic load:

- Z = seismic zone factor
The building is design for Zone 2, so $Z = 0.10$
- Sa/g = Design acceleration coefficient for different types
This factor is depending on the type of soil, its divides in 3 type (1 for Rock or hard soil, 2 medium soil, 3 for soft soil)
- R = Response Reduction Factors,
 $RF = 5$
- I = Importance Factor
This factor depends upon the uses and type of structure and their importance.
 $I = 1$ Imposed load to be considered in calculation of seismic weight.

Load Combinations:

Combination of loads occurs when more than one type of loads is applied to a structure. IS codes usually defining different loads combinations for each type of loads to ensure the safety of the structure under different conditions of expected maximum loads. We taking a combination of a loads from the IS 456:2000 and IS 1893:2002 for the designing of the structure.

The combinations loads are:

1. 1.5(DL+LL)
2. 1.2(DL+LL+EQX)
3. 1.2(DL+LL+EQZ)
4. 1.2(DL+LL-EQX)
5. 1.2(DL+LL-EQZ)
6. 1.5(DL+EQX)
7. 1.5(DL-EQX)
8. 1.5(DL+EQZ)
9. 1.5(DL-EQZ)

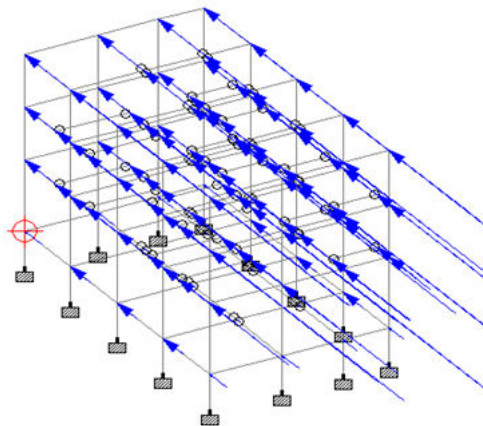


Fig.8, Seismic Forces in X- Direction

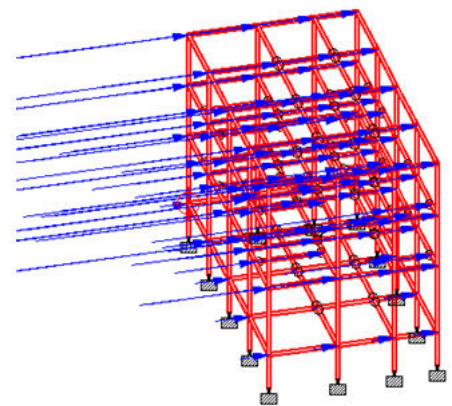


Fig.9, Seismic Forces in Z- Direction

III. EXPERIMENTAL RESULTS

Staad Analysis: -

The analysis of the structure through staad pro. Software. After applying all the loads in the structure, STAAD pro carries out the analysis of the structure by command “perform analysis” followed by “Run Analysis” command. After getting result, go for the post processing command to get bending moment, shear force, and load values and also we get design of beam and column from the properties.

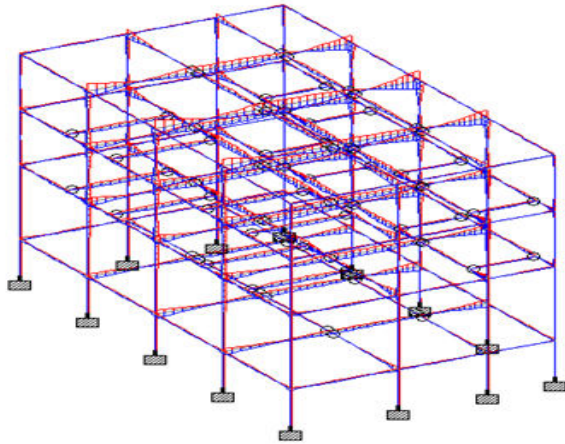
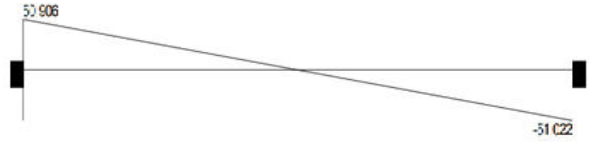


Fig.10, Shear Force Diagram



Dist.m	Fy(kN)	Mz(kNm)
0.000000	50.9065	36.6528
0.375000	42.4125	19.1555
0.750000	33.9185	4.8435
1.125000	25.4244	-6.2833
1.500000	16.9304	-14.2248
1.875000	8.4364	-18.9811
2.250000	-0.0576	-20.5522
2.625000	-8.5516	-18.9380
3.000000	-17.0456	-14.1385

Fig.11, Shear Force and B.M. Calculation.

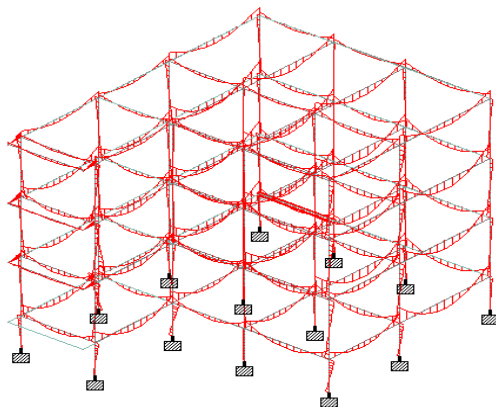
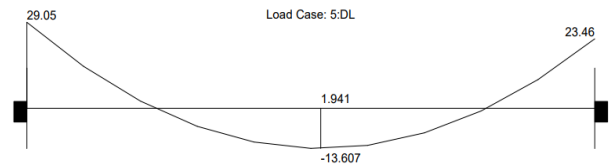


Fig.12, Bending Moment Diagram



Dist.m	Fy(kN)	Mz(kNm)
0.000000	43.9602	29.0519
0.312500	36.8819	16.4203
0.625000	29.8036	6.0007
0.937500	22.7252	-2.2069
1.250000	15.6469	-8.2025
1.562500	8.5685	-11.9862
1.875000	1.4902	-13.5579
2.187500	-5.5881	-12.9176
2.500000	-12.6665	-10.0653
2.812500	-19.7448	-5.0010

Fig.13, Shear Force and Bending Moment Calculation.

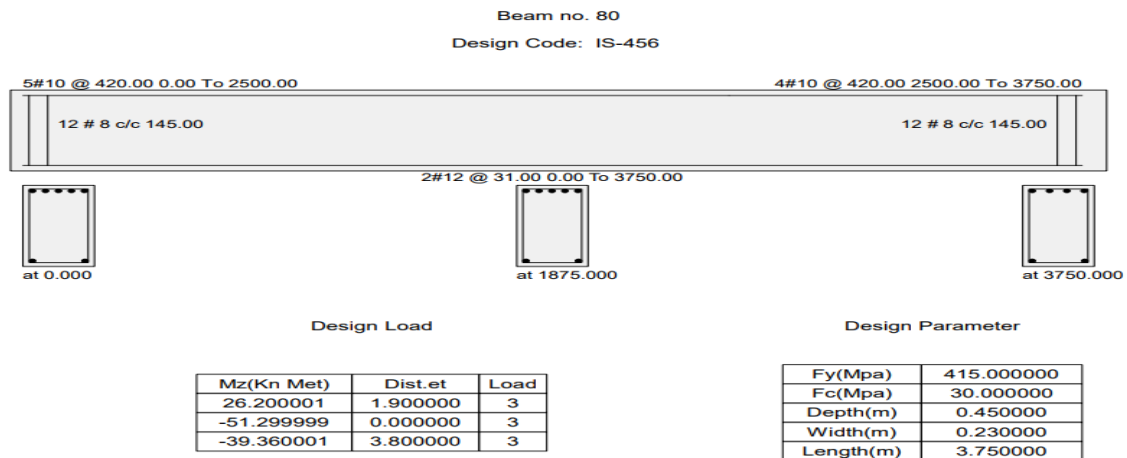


Fig.14, Beam Design

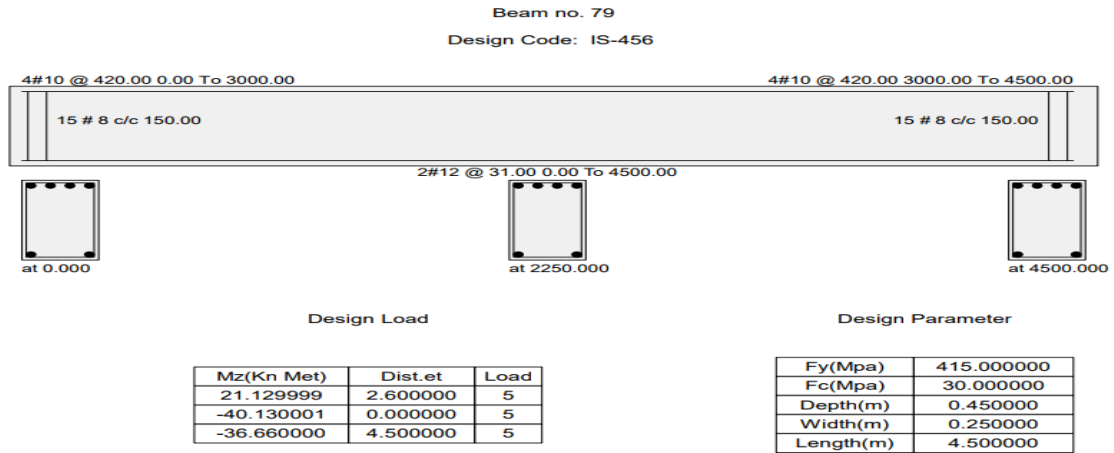
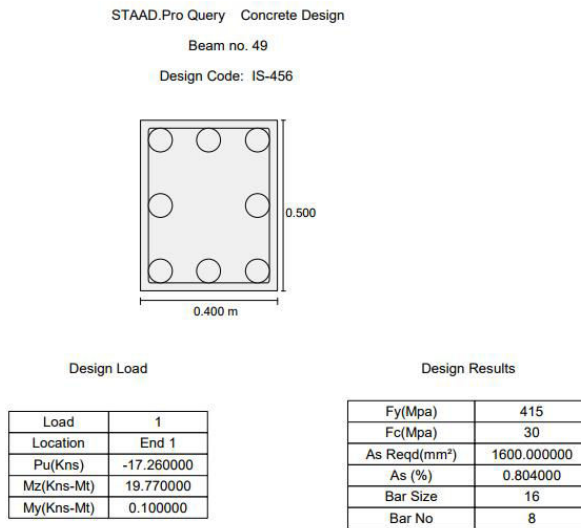


Fig.15, Beam Design



Beam no. 55
Design Code: IS-456

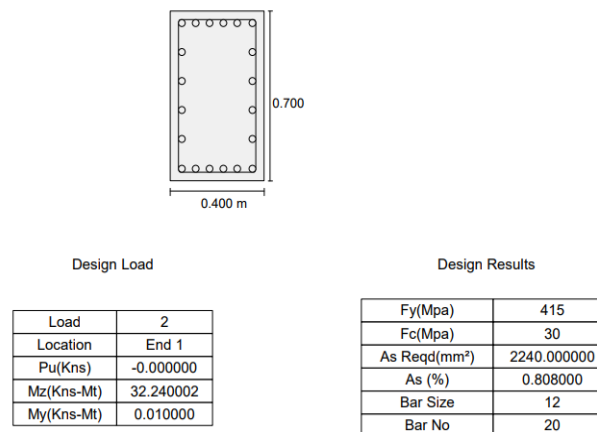


Fig.16, Column Design

Fig.17, Column Design



IV. CONCLUSION

After analysing the G+1 level building structure, ended that structure is safe in loading like load, live load, wind load and seismic load. Member dimensions (Beam, Column, Slab) area unit assigns by scheming the load sort and its amount applied on that. AutoCAD arrange provides elaborated data of the structure members length, height, depth, size & numbers etc. STAAD professional has the aptitude to calculate the reinforcement required for any concrete section. The program contains variety of parameters that area unit designed as per IS:456(2000). Beams area unit designed for flexure, shear and torsion and its provide the detail range, position, spacing of reinforcement.

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